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Fiscal Year 2010 Phased Construction Completion Report for EU Z2-32 in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee

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Fiscal Year 2010 Phased Construction Completion Report for EU Z2-32 in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee

Date Issued—February 2010

Prepared for the
U.S. Department of Energy
Office of Environmental Management

BECHTEL JACOBS COMPANY LLC
managing the
Accelerated Cleanup Activities at the
East Tennessee Technology Park
under contract DE-AC05-98OR22700
for the
U.S. DEPARTMENT OF ENERGY

CONTENTS

FIGURES

TABLES

ACRONYMS

AP	assessment point
ARL	average remediation level
BAR	biased area remediation
BJC	Bechtel Jacobs Company LLC
CD	compact disc
COC	contaminant of concern
D&D	deactivation and demolition
DOE	U.S. Department of Energy
DQO	data quality objective
DVS	Dynamic Verification Strategy
DWP	Dynamic Work Plan
ELCR	excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
EU	exposure unit
FCN	Field Change Notice
FFA	Federal Facility Agreement
FY	fiscal year
FIDLER	field instrument for the detection of low energy radiation
HI	hazard index
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	maximum contaminant level
MP	mid-point
NFA	no further action
OREIS	Oak Ridge Environmental Information System
PCB	polychlorinated biphenyl
PCCR	Phased Construction Completion Report
PRG	preliminary remediation goal
QAPP	Quality Assurance Program Plan
QC	quality control
RA	remedial action
RAO	remedial action objective
RAR	Remedial Action Report
RDR/RAWP	Remedial Design Report/Remedial Action Work Plan
RL	remediation level
ROD	Record of Decision
SL	screening level
SOP	standard operating procedure
SU	soil unit
SVOC	semivolatile organic compound
TAL	target analyte list
TDEC	Tennessee Department of Environment and Conservation
TM	technical memorandum
UST	underground storage tank
VOC	volatile organic compound

EXECUTIVE SUMMARY

The *Record of Decision for Soil, Buried Waste, and Subsurface Structure Actions in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2161&D2) (Zone 2 ROD) acknowledged that most of the 800 acres in Zone 2 were contaminated, but that sufficient data to confirm the levels of contamination were lacking. The Zone 2 ROD further specified that a sampling strategy for filling the data gaps would be developed. The *Remedial Design Report/Remedial Action Work Plan for Zone 2 Soils, Slabs, and Subsurface Structures, East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2224&D3) (RDR/RAWP) defined the sampling strategy as the Dynamic Verification Strategy (DVS), generally following the approach used for characterization of the Zone 1 exposure units (EUs).

The Zone 2 ROD divided the Zone 2 area into seven geographic areas and 44 EUs. To facilitate the data quality objectives (DQOs) of the DVS process, the RDR/RAWP regrouped the 44 EUs into 12 DQO scoping EU groups. These groups facilitated the DQO process by placing similar facilities and their support facilities together, which allowed identification of data gaps. The EU groups were no longer pertinent after DQO planning was completed and characterization was conducted as areas became accessible. As the opportunity to complete characterization became available, the planned DVS program was completed for the EU addressed in this document (EU Z2-32). The purpose of this Phased Construction Completion Report (PCCR) is to address the following:

- Document DVS characterization results for EU Z2-32.
- Describe and document the risk evaluation and determine if the EU meets the Zone 2 ROD requirements for unrestricted industrial use to 10 ft bgs.
- Identify additional areas not defined in the Zone 2 ROD that require remediation based on the DVS evaluation results.
- Describe the remedial action performed in the K-1066-G Yard in EU Z2-32.

Approximately 18.4 acres are included in the EU addressed in this PCCR. Based on results of the DVS evaluation, all 18.4 acres are recommended for unrestricted industrial use to 10 ft bgs. There are no Federal Facility Agreement Sites included in Appendix A of the Zone 2 ROD in EU Z2-32.

The Zone 2 ROD requires land use controls to prevent disturbance of soils below 10 ft deep and to restrict future land use to industrial/commercial activities. In response to stakeholder comments, the U.S. Department of Energy agreed to re-evaluate the need for such land use restrictions. This document includes a screening evaluation to determine the likelihood of land use controls in EU Z2-32 being modified to: (1) eliminate the restriction on disturbance of soils below 10 ft bgs where data indicate the absence of residual contamination at any depth that would result in an unacceptable risk to the future industrial worker, and (2) permit alternative land uses that would be protective of future site occupants. Results of this screening evaluation indicate a high probability that restrictions on disturbing soil below 10 ft bgs could be safely eliminated for EU Z2-32. A qualitative screening evaluation considered the likelihood of unrestricted land use being protective of future site occupants. Based on this qualitative assessment, all 18.4 acres addressed in this PCCR were assigned a high probability for consideration of release for unrestricted land use.

This document contains the main text (Sects. 1 through 13) and one appendix. The main text addresses the purpose for this PCCR as described above. Additional supporting detail (e.g., field work and data summaries, graphics) is provided in the EU Z2-32 technical memorandum (Appendix A). Historical and DVS analytical data used in this PCCR are provided on a compact disc accompanying this document and can be accessed through the Oak Ridge Environmental Information System.

1. INTRODUCTION AND PURPOSE

The purpose of this Phased Construction Completion Report (PCCR) is to present results of Dynamic Verification Strategy (DVS) characterization activities and a remedial action (RA) performed in fiscal year (FY) 2008 and 2009 for exposure unit (EU) Z2-32 in Zone 2 at the East Tennessee Technology Park (ETTP). The ETTP is located in the northwest corner of the U.S. Department of Energy (DOE) Oak Ridge Reservation in Oak Ridge, Tennessee, and encompasses approximately 5000 acres that have been subdivided into three zones—Zone 1 (~1400 acres), Zone 2 (~800 acres), and the Boundary Area (~2800 acres).

Zone 2 comprises the highly industrialized portion of ETTP (Fig. 1) and consists of all formerly secured areas of the facility, including the large processing buildings and direct support facilities; fabrication facilities; chemical and materials handling facilities; materials storage and waste disposal facilities; and warehouses. The *Record of Decision for Soil, Buried Waste, and Subsurface Structure Actions in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2005) (Zone 2 ROD) specifies the future end use for Zone 2 acreage as uncontrolled industrial for the upper 10 ft of soils.

Characterization activities were conducted in compliance with the Zone 2 ROD and the DVS and data quality objectives (DQOs) presented in the *Main Plant Group DQO Scoping Package* (July 2006) and the *Remedial Design Report/Remedial Action Work Plan for Zone 2 Soils, Slabs, and Subsurface Structures, East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2007a) (RDR/RAWP). The purpose of this PCCR is to address the following:

- Document EU Z2-32 DVS characterization results;.
- Describe and document the risk evaluation and determine if the EU meets the Zone 2 ROD requirements for unrestricted industrial use to 10 ft bgs.
- Identify additional areas not defined in the Zone 2 ROD that require remediation based on DVS evaluation results.
- Describe the remedial action (RA) performed in the K-1066-G Yard in EU Z2-32.

The Zone 2 ROD divided the area into 7 geographic areas and 44 EUs. To facilitate DQOs of the DVS process, the RDR/RAWP regrouped the 44 EUs into 12 DQO scoping EU groups. These groups facilitated the DQO process by placing similar facilities and their support facilities together and allowing identification of data gaps. The EU groups were no longer pertinent after DQO planning was completed, and characterization was conducted as EUs became accessible. As the opportunity to complete characterization became available, the planned DVS program was completed in FY 2008 and 2009. The K-1066-G Yard soils RA was performed in FY 2009.

The main body of this report describes the DVS process and the scope of work performed. The scope and approach for performing DVS activities that lead to action/no further action decisions are presented in Sects. 2 through 4. The RA is described in Sects. 5 through 10. Future land use and the status of all Zone 2 EUs as of this PCCR is presented in Sect. 11.

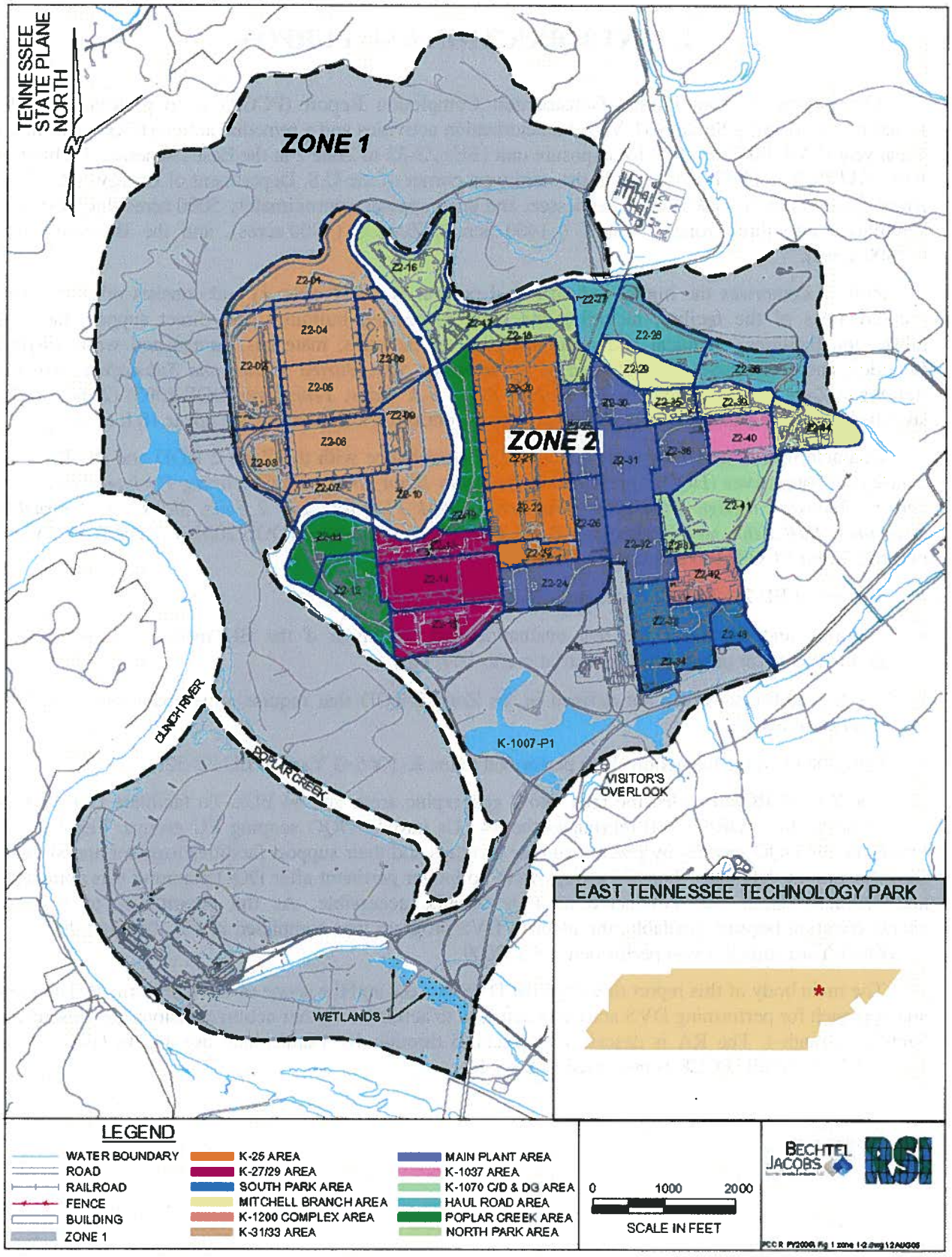


Fig. 1. ETTP site map with Zone 2 DQO scoping EU groups and EUs.

2. PROJECT DESCRIPTION

2.1 SCOPE

2.1.1 Exposure Unit Groups

The Zone 2 ROD specifies the division of Zone 2 into 44 EUs that range in size from 5.9 acres (EU Z2-37) to 38 acres (EU Z2-41). The location of EU Z2-32 in the Main Plant Area is shown in Fig. 2. An EU represents a hypothetical area over which an industrial worker could be exposed to contaminated soil in the interval 0-10 ft bgs. The acreage of each EU was calculated based on the estimated EU boundaries defined in the Zone 2 ROD. For the Zone 2 DVS characterization program, EU boundaries and acreage calculations were refined. Acreages presented in this document have been rounded to one decimal place.

To facilitate DQO development and planning, the 44 EUs within Zone 2 were divided into 12 EU Groups (DOE 2007a). Field activities were conducted as the opportunity for access to the various areas arose. Coordination between deactivation and demolition (D&D) activities and assets utilization priorities were the primary drivers in executing the Zone 2 DVS characterization program and RA. Therefore, EU groups were not completed in their entirety. Evaluation and discussion of the DVS program completed in EU Z2-32 is provided in the technical memorandum (TM) (see Appendix A). The Zone 2 EU groups, EUs, and associated total EU group acreages are shown in Table 1.

Table 1. Zone 2 EU groups and acreages

EU Group	EUs	Acreage
K-31/K-33 Area	Z2-01, Z2-02, Z2-03, Z2-04, Z2-05, Z2-06, Z2-07, Z2-08, Z2-09, Z2-10	223.6
Poplar Creek Area	Z2-11, Z2-12, Z2-19	58.5
K-27/K-29 Area	Z2-13, Z2-14, Z2-15	60.5
North Park Area	Z2-16, Z2-17, Z2-18	62.9
K-25 Area	Z2-20, Z2-21, Z2-22, Z2-23	87.6
Main Plant Area	Z2-24, Z2-25, Z2-26, Z2-31, Z2-32, Z2-31	100.9
Haul Road Area	Z2-27, Z2-28, Z2-38	52.3
Mitchell Branch Area	Z2-29, Z2-30, Z2-35, Z2-39, Z2-44	59.7
K-1037 Area	Z2-40	13.8
K-1070-C/D and Downgradient Area	Z2-37, Z2-41	44.0
K-1200 Complex Area	Z2-42	15.5
South Park Area	Z2-33, Z2-34, Z2-43	39.7
	Total acreage	**819.0**

EU = exposure unit

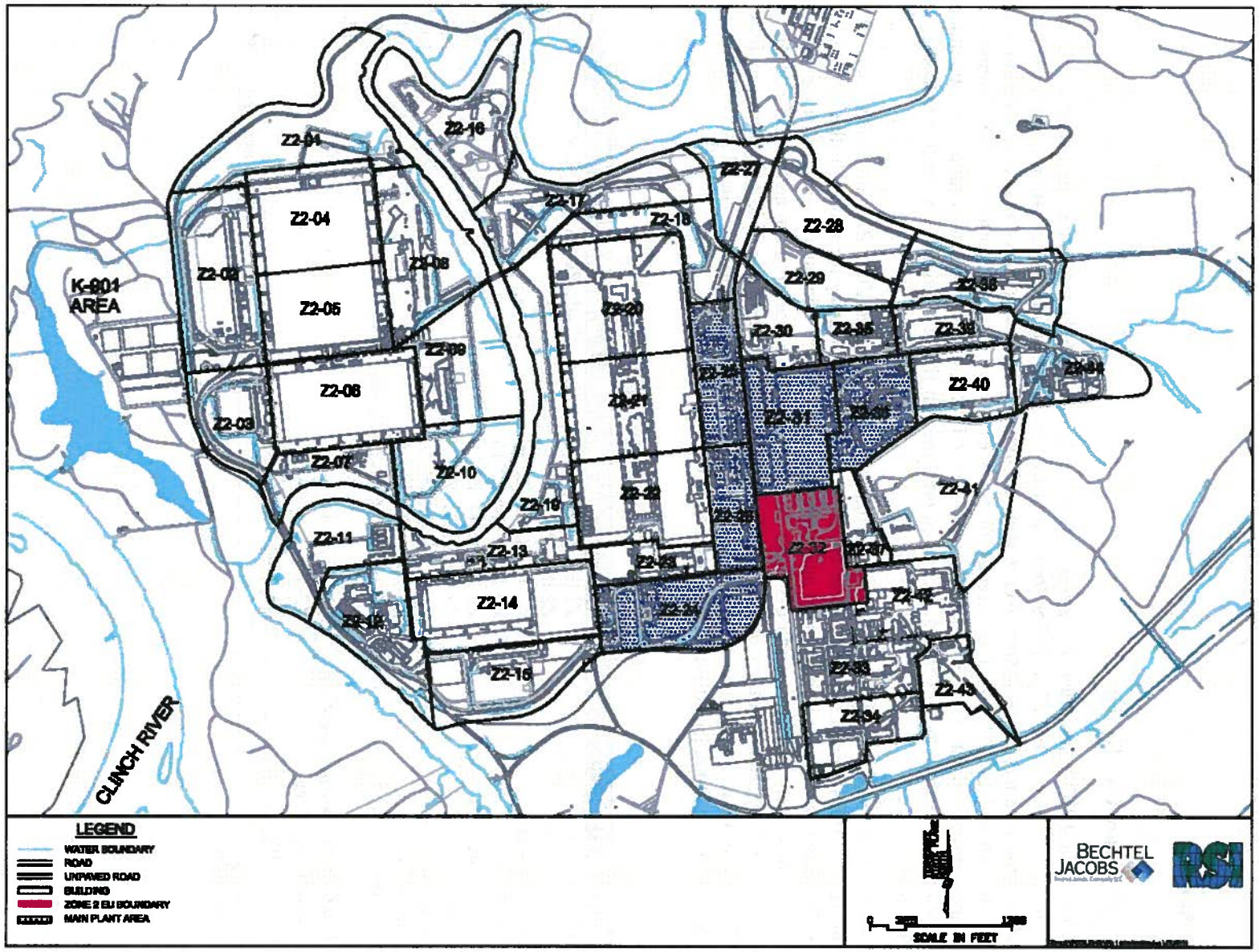


Fig. 2. EU Z2-32 location map.

2.1.2 Excluded Acreage

No EU Z2-32 acreage is excluded. All acreage in EU Z2-32 discussed in this document is included in its entirety.

2.1.3 Data Quality Objectives and Soil Unit Classifications

The first action taken under the DVS characterization program was to assemble the DQO scoping packages, which are Core Team documents that give a compilation and evaluation of facility records and present the results of previous sampling that provided the bases for soil unit (SU) classification and determination of additional sampling needs. The Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), which describes the probability that an area has been impacted and the extent to which the impact forms the basis for classification, was generally followed for SU classification. The SU classification was used to develop a graded approach to the level of scrutiny so that soils with the highest probability of contamination received the highest level of scrutiny and those with the lowest probability of contamination received the lowest level of scrutiny. The SUs were classified as follows:

- Class 1—high to moderate probability that contaminants exceed remedial action objectives (RAOs).
- Class 2—moderate to low probability that contaminants exceed RAOs.
- Class 3—impacted areas with low probability of contamination above RAOs.
- Class 4—no impact from anthropogenic activities (no Class 4 SU areas were identified in Zone 2).

The soil classification breakdown for acreage in EU Z2-32 included the following:

- 0 acres in Class 1 SUs
- 3.7 acres in Class 2 SUs
- 14.7 acres in Class 3 SUs
- 0 acres in Class 4 SUs

In each case, the probability of contamination was based on a thorough review of historical data, aerial photographs, records, and personnel interviews. Soil sampling activities under DVS included both the Class 2 and Class 3 SUs. The SUs were evaluated by walkover assessments, which included historic photograph analysis, records research, visual inspection, limited radiological survey, and selected biased sampling based on walkover assessment observations and measurements.

2.1.4 Federal Facility Agreement Sites

There are no Federal Facility Agreement (FFA) Sites (DOE 1992) in EU Z2-32.

2.2 DVS CHARACTERIZATION APPROACH

The DVS approach to soils characterization and the rationale to support conclusions drawn from the characterization results are presented in this section. Through characterization activities, DVS provides the necessary information to support decisions on whether an action is required. Additionally, DVS supports decisions on the extent of an action and, through confirmation sampling, whether the action is complete. In this section, the characterization approach and communications necessary to make key decisions throughout the DVS process are discussed. Decisions and communications required during remediation also are discussed. The DVS process was further defined in the RDR/RAWP (DOE 2007b).

The DVS process was designed to provide sufficient data to determine if a RA is needed. To meet this goal, a sampling strategy was developed based on the likelihood of RA being required. The DVS characterization approach has six key components, which include the following:

- Planning (Sect. 2.2.1), including acreage classification (Sect. 2.2.1.1) and DQO scoping (Sect. 2.2.1.2)
- Class 1 and Class 2 SU characterization approach (Sect. 2.2.2)
- Class 3 and Class 4 SU characterization approach (Sect. 2.2.3)
- Program execution (Sect. 2.2.4)
- Action/no further action (NFA) decision/communication (Sect. 2.2.5)
- Documentation and records (Sect. 2.2.6)

During the planning stage (first component), the acres of interest were classified into SUs according to their potential level of contamination as described in Sect. 2.1.3, and the DQOs were applied to develop a sampling plan. Because of different probabilities for the presence of contamination, SU classifications had different characterization strategies (second and third component). However, a base survey and sampling program was developed for all SU classifications and presented during DQO scoping. This base program was modified during field implementation as work was conducted and additional characterization needs were identified. The Class 1 and Class 2 SU base program consisted of radiological walkover and geophysical surveys, where appropriate, and systematic sampling supplemented by biased sampling. The Class 3 and Class 4 SU base program primarily consisted of visual inspections and radiological screening surveys, with biased sampling conducted based on inspection and survey observations. Execution techniques to accomplish SU characterization were carried out in the field (fourth component). The final stage included RA Core Team decision making and communication, which occurred with all sampling programs (fifth component).

The RA Core Team was created to streamline planning and accelerate the completion of all actions at ETTP to accelerate site closure. The RA Core Team approach is a formalized, consensus-based process where members reach agreement on key closure issues and strategies. This Team consists of representatives from parties to the FFA—DOE, U.S. Environmental Protection Agency (EPA), and Tennessee Department of Environment and Conservation (TDEC) as well as DOE's accelerated closure contractor. The primary function of the RA Core Team is to make programmatic decisions that facilitate and guide specific projects as ETTP progresses toward closure.

The following subsections provide an overview of the first four DVS characterization process components.

2.2.1 Planning

Two key parts of the planning component included soil unit classification and DQO scoping for sampling plan development, both of which required RA Core Team concurrence.

2.2.1.1 SU classification

To begin planning, the land area within each EU Group was classified as either impacted or non-impacted by ETTP plant activities. This initial classification included compilation and review of existing information from historic aerial photographs, maps, drawings, and other facility records. After classification as impacted/non-impacted, land areas were assigned SU classifications as defined in Sect. 2.1.3 (FFA sites were typically designated as Class 1 or Class 2 SUs).

2.2.1.2 DQO scoping

Once the area under consideration was classified into a SU, the quantity and quality of existing data and other information was evaluated against the DQO requirements for sufficiency and quality, and a DQO scoping plan for base program surveying, sampling, and analysis was developed. Some of the work described below (e.g., field survey results) was used to design the DQO scoping plan and was considered part of the planning process. A DQO scoping plan, including SU classifications, was presented to the RA Core Team for concurrence and documented in the Dynamic Work Plan (DWP), which identified sample locations and analysis requirements, and included the use of real-time field measurements where applicable. Any additional sampling and analysis was added to the program with RA Core Team concurrence. The DQO scoping meeting for work described in this PCCR was conducted on January 19, 2005, and the applicable DWP is the *Zone 2 Dynamic Work Plan, East Tennessee Technology Park, Oak Ridge, Tennessee* (BJC 2007).

Per the DVS process, a portion of characterization samples were analyzed for an extensive list of potential contaminants. Fixed laboratory analyses were performed for a suite of analytes [volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), target analyte list (TAL) metals, polychlorinated biphenyls (PCBs), and a radiological analytical suite that included gamma spectroscopy, alpha spectroscopy, thorium isotopic, uranium isotopic, technetium-99, and radium-specific analyses].

All identified contamination was evaluated to determine if action was needed for the EU, including the following:

- Primary and secondary contaminants of concern (COCs) that are identified in the Zone 2 ROD.
- Contaminants of potential concern that are identified during the risk evaluation process.
- EU-specific COCs, which are contaminants identified during characterization that result in an unacceptable EU risk.

The documentation included a summary of existing data, assessment of data gaps in DQO scoping packages, and records of the base survey and sampling program in the Zone 2 DWP. Concurrence on the base program was reached by the Core Team and documented on concurrence forms.

2.2.2 Class 2 SU Characterization Approach

Implementation of the Class 2 SU characterization program included the steps listed below. Details on each step are provided in Sect. A.8 of the *Quality Assurance Project Plan for Soil Characterization Activities under the Dynamic Verification Strategy at the East Tennessee Technology Park, Oak Ridge, Tennessee* (QAPP), which is included as Appendix A in the RDR/RAWP (DOE 2007a).

- Step 1 (not applicable in Zone 2)—Complete an ecological impact assessment prior to significant disturbance.
- Step 2 (not applicable in Zone 2)—Clear to provide access (as required).
- Step 3—Perform radiological walkover surveys (where historic surveys are unavailable) and geophysical surveys [burial sites and underground storage tank (UST) sites].
- Step 4—Select systematic sampling locations and additional biased sampling locations based on the survey results.
- Step 5—Perform base program and initial biased sampling.
- Step 6—Evaluate field and laboratory data.
- Step 7—Select additional biased sampling locations based on field measurements and laboratory results.

A flow diagram outlining the details of this characterization approach and associated decisions made for Class 2 SUs is shown in Fig. 3. Along with the planning component (acreage classification and DQOs) defined in Sects. 2.2.1.1 and 2.2.1.2, Steps 1 through 4 above constitute the base program for characterizing Class 2 SUs.

Field radiological and geophysical surveys (Step 3) were performed prior to the actual sampling activity. A lead time of several weeks to months allowed for the evaluation of survey data and supported selection of a set of biased sampling locations to evaluate the results. Geophysical surveys were used to define the boundaries of buried waste at landfill disposal sites or the presence of other buried objects (USTs) and materials.

Radiological walkover surveys were used to define the limits of radiological contamination in surface soils. The decision to have biased sampling locations where elevated radiological readings or geophysical anomalies were encountered (Step 4) was made after reviewing results of the radiological walkover and geophysical surveys. (These survey results were used later during the confirmation sampling phase to assist in identifying potential excavation boundaries.) After concurrence from the RA Core Team, any biased sampling locations identified from these survey results were included in the base sampling program.

Characterization field work began (Step 5) after the base program was defined and agreed to by the RA Core Team. Each EU Group was characterized according to the specific details presented during DQO scoping and finalized in the DWP. Soil sampling was performed using standard field methods and following EPA Region IV standard operating procedures (SOPs).

Geoprobe® sampling was the predominant method of sample acquisition for subsurface soil to depths up to 30 ft. Surface and shallow interval soil sampling was performed predominantly using hand augers. The standard DVS sampling methodology calls for composite samples to be taken from the 0- to 6-in. interval, 6-in. to 2-ft interval, and 2- to 10-ft interval. The sample composite protocol is presented in Attachment C to the QAPP [Appendix A in the RDR/RAWP (DOE 2007a)]. Discrete interval samples were collected based on the following two criteria (Steps 5, 6, and 7):

- Field screening method showed an elevated level for a COC in a segment of a core.
- Initial analytical results from samples submitted to a laboratory showed an action level [25% of an average remediation level (ARL)] for one or more COCs was exceeded in the composited sample (Steps 6 and 7).

For the first criterion, field screening methods were used as part of the field characterization activity (Step 5). Two field screening methods used on soil cores included (1) VOC screening using hand-held meters, and (2) radiological screening using core-scanning devices developed specifically for the DVS program. Field screening allowed sample collection for laboratory analysis of the core intervals most likely to have contamination in addition to collection of the composited sample. Collection of the most-likely contaminated segment of the core ensured existing contamination was represented in the analytical results. Recognition of potential VOC contamination also allowed the segment of the core to be collected for VOC analysis prior to compositing, but VOCs were not analyzed for in composite samples.

The second criterion was based on analysis of laboratory results. The base program required all samples to be analyzed for TAL metals and PCBs. To support the risk assessment, a randomly selected 20% of all samples also were analyzed for VOC (discrete interval), SVOC, and radiological analyses (Step 5). If laboratory-reported results indicated action levels were exceeded in any of the randomly selected samples, the location with elevated results was resampled for the specific parameters of concern and three discrete intervals [0-6 in., 6 in.-2 ft, and a selected interval in the 2-10 ft interval (Steps 6 and 7)] were sent for analysis.

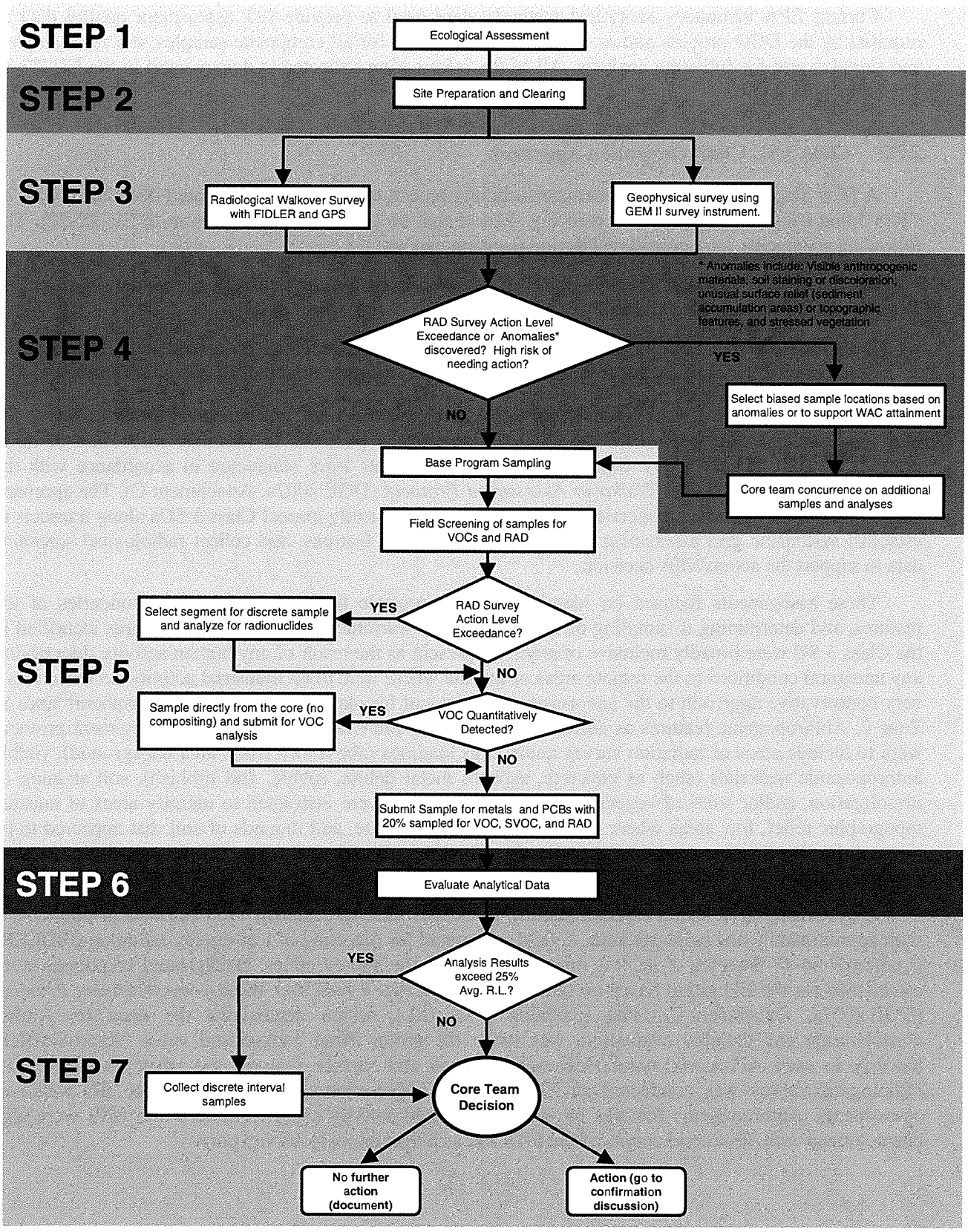


Fig. 3. Zone 2 DVS Class 1 and Class 2 SU sampling and analysis decision process flow.

Current EPA laboratory analytical methods were used to provide risk assessment quality data as required by the DQO process and as stipulated in the DWP for all composite samples, discrete samples, and samples sent for full-suite analysis. All of the information collected is documented in the EU Z2-32 TM (Appendix A).

2.2.3 Class 3 SU Characterization Approach

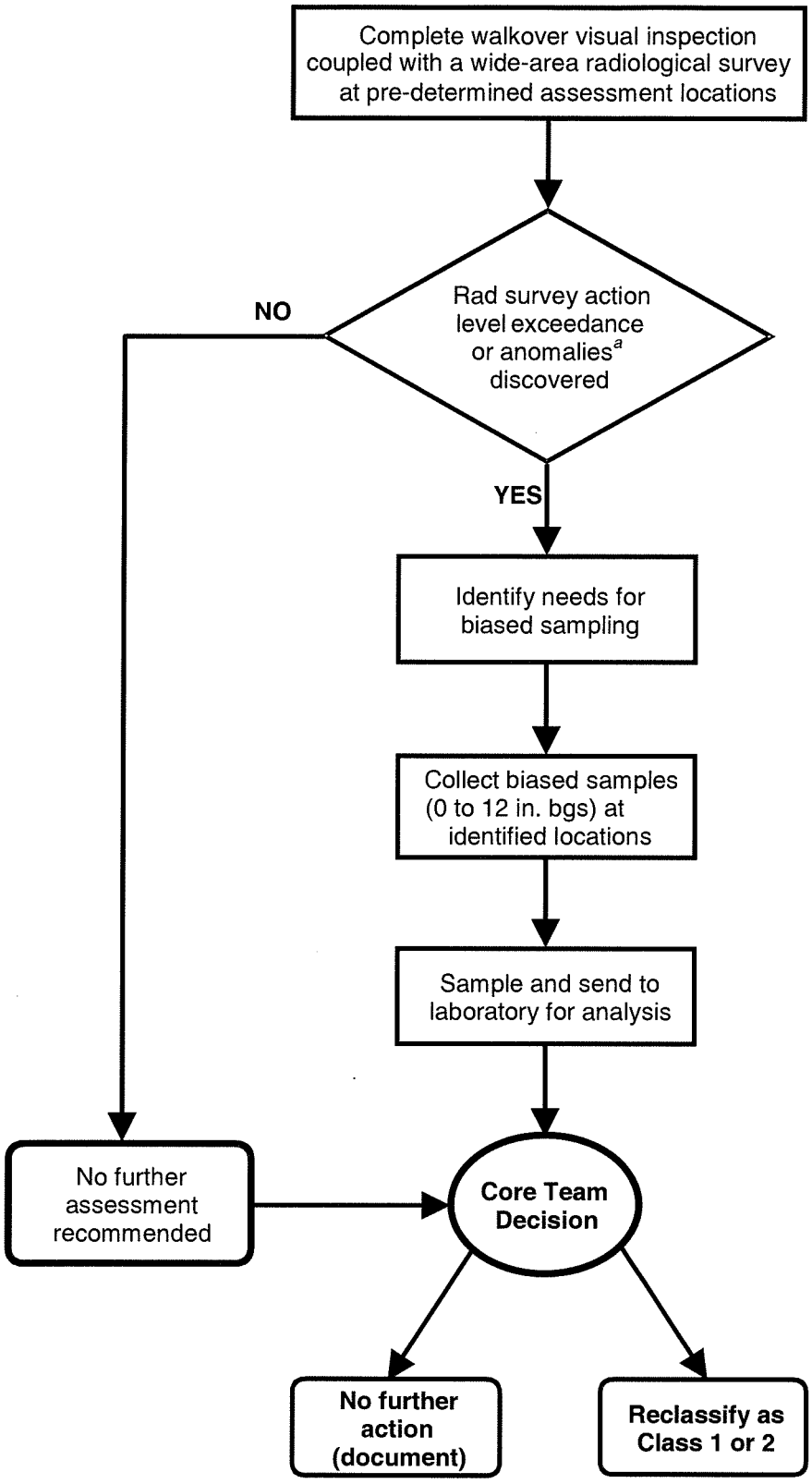
A flow diagram outlining the characterization approach taken and the associated decisions made for Class 3 and Class 4 SUs is presented in Fig. 4 (note that no Class 4 SUs are present in EU Z2-32). The following statements were considered during decision making:

- Are there anthropogenic features, areas of elevated radiation, or sediment accumulation areas that require biased sampling and analysis?
- Does the EU exceed RAOs stated in the Zone 2 ROD and, therefore, require action? (Results from Class 1 and 2 SU evaluations, if applicable, are needed to make this final EU-level assessment.)

Assessment of the Class 3 and Class 4 SU acreage proceeded independently of the Class 2 SU investigations and were performed during the winter, when possible, to facilitate inspection of those portions of Zone 2 with heavy vegetation. These assessments were conducted in accordance with the *Class 3 and Class 4 Soil Unit Walkover Assessment Protocol* (DOE 2007a, Attachment C). The approach began with visual walkover inspections conducted to systematically inspect Class 3 SUs along transects to establish systematic grid assessment locations, map observed features, and collect radiological screening data to support the action/NFA decision.

These assessments focused on identifying anthropogenic features, delineating boundaries of the features, and determining if sampling of the features was warranted. Anthropogenic features identified in the Class 3 SU were broadly inclusive of anything present as the result of any human activity. Identifying any unnatural conditions in the remote areas of the site where little to no industrial activity occurred was a very conservative approach to the site assessment protocol for clearing large tracts of peripheral lands in Zone 2. Anthropogenic features as defined in the Class 3 and Class 4 SU walkover assessment protocol were to include areas of radiation survey anomalous readings (above two times area background), visible anthropogenic materials (such as concrete, asphalt, metal debris, rubble, and rubbish), soil staining or discoloration, and/or stressed vegetation. In addition, crews were instructed to identify areas of unusual topographic relief, low areas where sediment would accumulate, and mounds of soil that appeared to be unusual for the local topographic conditions. This very broad definition of anthropogenic features provided a thorough assessment of the Class 3 SU in EU Z2-32.

A systematic grid with a random starting point was used to establish each assessment point (AP), with approximately one point per acre. A field instrument for detection of low-energy radiation (FIDLER) (Ludlum® 44-17 detector, 2 in. × 2 mm) was used by the survey crews. Background conditions were established for the EU group based on the *Class 3 and Class 4 Soil Unit Walkover Assessment Protocol* (DOE 2007a, Attachment C). The screening level (SL), which determined the need for further consideration and detailed evaluation, was twice the group mean background value. Approximately halfway to each AP, a mid-point (MP) was counted and surface features described. A Class 3 SU radiological survey was conducted at APs, MPs, and discretionary points during the SU walkover assessments. Anthropogenic features or areas of elevated activity away from APs and MPs were also characterized with 30-second counts of the FIDLER as a discretionary survey point.



[a]Anomalies include visible anthropogenic materials, soil staining or discoloration, unusual surface relief (sediment accumulation areas) or topographic features, and stressed vegetation (sediment accumulation areas also require sampling and analysis).

Fig. 4. Zone 2 DVS Class 3 and Class 4 SU sampling and analysis decision process flow.

Biased soil samples from identified anomalies are typically collected and analyzed for metals, radionuclides, and PCBs. Approximately 20% of the biased samples are typically analyzed for a larger suite of analytes to aid in identifying potentially unrecognized, site-related soil contaminants. In EU Z2-32, biased samples were obtained from one location as a RA confirmation sample.

Biased sampling locations also are typically identified in sediment accumulation areas, which are defined as areas where runoff from large portions of the SU and surrounding areas converge and have the potential for sediment deposition. The chemical and radiological composition of sediment accumulation area soils or sediments is representative of the upstream conditions, and elevated levels of contamination are indicative of an upgradient source. Biased samples collected from sediment accumulation areas typically are sent to a laboratory for radionuclide, metal, VOC, SVOC, and PCB analysis to identify previously unrecognized site-related soil contaminants. One biased sample was obtained in EU Z2-32 as a RA confirmation sample.

2.2.4 Program Execution

Soil sample collection was performed following EPA Region 4 standard sampling methods and SOPs. The DVS base program sampling was tailored to site-specific conditions and samples were collected in the 0- to 10-ft depth in all Class 1 and Class 2 SUs. There were several conceptual site models in Zone 2 that included surface and subsurface models describing the potential contaminant source and potential release to the environment.

The DVS program for the Class 1 and 2 SUs required at least 20% of all sample locations be drilled and sampled to a depth of 10 ft bgs. Sample borings were completed using Geoprobe® direct-push equipment (Models 54DT and 54LT) and were collected in acetate liners and capped upon recovery. All boreholes were logged and described according to EPA Region 4 guidance (EPA 2002), and all soil cores were scanned in the field for the presence of radioactive contaminants using the Model T Radiological Soil Core Screening System. The core screening action level was set to correspond with approximately 80% of the ARL for U-238 (40 pCi/g). The SL for the core scanner was based on a background soil core for which a daily baseline value was determined. The SL varied slightly from day to day in response to local ambient radiological conditions and natural activity of the background soils specific for the EU Group. Screening levels were set at the observed daily baseline (commonly in the range of 135-150 cpm), plus 65 cpm, and were in the range of 200 cpm (±20 cpm), which provided 100% accuracy for identifying gamma-emitting radioactive contamination in soils in excess of 40 pCi/g.

Results of field activities completed in this PCCR indicate the SLs of baseline plus 65 cpm were consistently identifying radiological constituents at 10 pCi/g or greater in soil cores. When the SL was exceeded, a discrete interval soil sample was collected for radiological analysis.

The acetate liners were split in the field and the core was screened for the presence of VOCs. If VOCs were detected > 5 ppm using a hand-held photoionization detector, a discrete interval soil sample was collected for VOC analyses using EnCore® samplers. Approved sample containers were used at these sites and managed according to EPA Region 4 protocols (EPA 2002).

At base program sampling locations, three intervals of the soil core were composited according to the protocol described in the QAPP (DOE 2007a, Appendix C). The compositing procedure stipulates that equal volumes of soil from the surface to 0.5-ft interval, 0.5- to 2-ft interval, and a selected section of core in the 2- to 10-ft interval be collected and thoroughly mixed to form a composite soil sample. The interval selected for inclusion in the soil composite was based on visual observation of the sample and targeted to select the most contaminated portion of the soil core. Selection was made based on visual observations such as staining, odor, soil contacts, obvious waste, or the presence of unnatural materials. This compositing methodology provided a physical composite that represented the average contaminant profile for the entire 0- to 10-ft interval. All base program composite samples were analyzed for PCBs and TAL metals and screened in the field for the presence of VOCs (> 5 ppm) and radioactivity (in excess of two

times background). Discrete interval samples were collected for VOC and radiological analyses if field SLs were exceeded [refer to the Zone 2 QAPP (DOE 2007a) for specific procedures].

The DVS program requires 20% of all sample locations be drilled and sampled to 10 ft bgs. At surface contamination sites, the base program focused on the 0- to 2-ft interval where contaminant releases would have occurred. However, 20% of the locations were drilled and sampled to 10 ft bgs. At the UST sites and buried utilities and infrastructure sites, all borings were drilled and sampled to 10 ft bgs or to native material, whichever was deeper. The program also requires at least 20% of all samples be analyzed for a full suite of COCs, including VOCs, SVOCs, metals, PCBs, and radioisotopes. Locations to be drilled to depth and samples for full suite analyses are randomly selected. This selection process results in full suite analyses being performed on both surface and shallow interval samples as well as on some deep soil samples.

Changes to the base program plan included dropping inaccessible sample locations (e.g., areas of steep slopes or obstructions such as roads or heavy dead fall areas) and moving locations due to shallow refusal (e.g., buried concrete and metallic debris and rubble). These changes were documented on concurrence forms and presented to the RA Core Team for concurrence. Drops and moves occurred at < 5% of the planned locations. Locations moved more than 5 ft from the planned grid node were identified by the inclusion of an "M" character in the location identification.

At surface contamination sites, the base program plan stipulated sampling the 0- to 2-ft interval to focus in the interval where contamination levels were assumed to be the highest. Sampling in these areas was performed using the Geoprobe® equipment and 0- to 2-ft, two-interval composite samples using the standard sampling method. In these areas, 20% of the base program sample locations were drilled to 10 ft at randomly selected locations and 20% of all locations (0 to 2 ft and to depth) were analyzed for a full suite of constituents. Soil cores at these sites also were screened in the field for VOC and radiological contamination.

Biased sampling was performed in addition to base program sampling. These locations were selected based on the results of geophysical surveys, radiological walkover surveys, and "step-out" locations to base program samples that indicated significant concentrations of contamination occurred. Biased samples drilled to 10 ft were collected in three discrete intervals (0.5-ft interval, 0.5- to 2-ft interval, and a selected section of core in the 2- to 10-ft interval). Surface soil samples were generally collected as five-point composite samples to provide area coverage of radiological surface anomalies, surface-distributed mounds of soils, or small waste piles. The intent of surface compositing was to provide an average contaminant profile for a localized surface area.

Sampling procedures and methods were complied using EPA Region 4 guidance. Sampling equipment, shipping containers, and quality assurance/quality control (QC) requirements also followed EPA Region 4 guidance. Standard laboratory analytical methods were used, and data management and QC procedures were complied with EPA criteria. Detailed discussion of field and laboratory requirements is included in the RDR/RAWP (DOE 2007a).

2.2.5 Action/No Further Action Decision/Communication

Once results of field and analytical work were received, the RA Core Team evaluated the data and decided on an appropriate action. The action/NFA decision was based on one or more of the following criteria:

- Exceedance of a maximum remediation level (RL) at any location.
- Exceedance of an average RL across the EU.
- Unacceptable future threat to groundwater.

- Unacceptable cumulative excess lifetime cancer risk (ELCR) of $> 1 \times 10^{-4}$ and hazard index (HI) of > 1 across the EU.

Sample results were evaluated for the 0- to 10-ft soil interval and were not depth dependent. Contamination anywhere within the 0- to 10-ft interval had equal weighting in the risk assessment and was presumed equally accessible to an industrial worker. Soil sample compositing provided data representative of the 0- to 10-ft interval. Discrete interval sampling was selected based on the field screening for VOCs and radioactivity identified by soil core screening. This approach provided a very conservative evaluation of soil conditions and had an equivalent consideration in the risk assessment methodology. Selection of intervals for inclusion in soil core composite samples was based on visual observation and included the portion of the soil core with the highest probability of contamination. Visual cues included but were not limited to bedding contacts, porous and permeable intervals, staining, and odor. Discrete sample interval depth information is included in the data set on the compact disc (CD) provided with this document. Major stratigraphic differences (i.e., 2 ft of cover material over fill) are referenced in the text where appropriate.

An area-weighted mean of the data in each EU was used to compare the average composition of the EU to the average RLs. Risk was evaluated by area-weighting the results. Because data within an EU was unevenly distributed across the SUs (i.e., SUs with greater probability of contamination had a higher density of samples), weighting was based on the areal extent of the SUs. For SUs with little probability of contamination and, therefore, few, if any, sample results (i.e., Class 3 SUs), background concentrations of COCs as defined in the *Soil Background Supplemental Data Set for the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2003) were used in the weighted average calculations for the EU risk assessments and comparison to average RLs.

Data collected for the original background data set for ETTP (DOE 1993a) was not representative of ETTP site soils, nor were the associated statistical calculations performed in accordance with then current EPA guidance. To resolve the issues, additional samples were collected and statistics were recalculated to comply with EPA guidance. Samples were collected from the B soil horizon of the Rome and Upper Knox formations to supplement the original data set. These samples were collected from approximately 12-24 in. bgs and analyzed only for radiological constituents and inorganic elements. The comparison of site data versus background data was made using methods from the *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (EPA 2002). Soil background data used in this report was presented in the document *Soil Background Supplemental Data Set for the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2003) and not from the earlier report.

If elevated concentrations (i.e., above background) were found, sample results were used (even if sparse) after the SU was reclassified as a Class 1 or Class 2 SU. Results of the action/NFA evaluation are documented in the EU Z2-32 TM, which was provided to the RA Core Team for early review but formally submitted for approval as an appendix to this PCCR.

The risk RAO was developed in the Zone 2 ROD to identify new COCs because of the uncertainty that all COCs had been identified in the historical data sets. If the risk assessment identified contaminants requiring remediation that did not have associated RLs, remediation was recommended if the risk was found to be unacceptable.

2.2.6 Documentation and Records

All information, data, documents, and records necessary to support the decisions presented in this PCCR will be transferred to the post-decision document file upon approval of the PCCR. A list of referenced documents that becomes part of the file is provided in Sect. 12. Additional records contained within the file but not listed in Sect. 12 include but are not limited to Field Change Notices (FCNs), Core Team concurrence forms, and analytical data packages. The FCNs and Core Team concurrences pertinent to EU Z2-32 are listed in Sect. 6. The post-decision document file is available to the public through the

DOE Oak Ridge Office Information Center. Analytical data, field data, and sample location maps are archived in and made available to the public through the Oak Ridge Environmental Information System (OREIS).

3. PROJECT REQUIREMENTS

Requirements for the characterization activities, final status assessments, and RAs originated in the Zone 2 ROD, which presents specific soil RAs required in Zone 2 and provides general guidelines for addressing the remainder of the soils. In response to the guidelines for addressing Zone 2 soils, DVS was developed to present specific requirements for addressing soils and making action/NFA decisions. It is further stated in Sect. 1.5 of the Zone 2 ROD that additional contaminants could be identified during remedy implementation or confirmation.

3.1 ZONE 2 RECORD OF DECISION

The Zone 2 ROD presents the selected remedy for environmental remediation of contaminated areas within Zone 2 at ETTP. An evaluation of existing data presented in the Zone 2 ROD determined the following sites either had sufficient characterization data to demonstrate unacceptable risk, warrant additional characterization, and/or select an action for the soil:

- K-1070-B Old Burial Ground
- K-1420 Facility Area
- K-1004-J Lab Complex Area
- K-1401 Facility Area
- K-1070-C/D Area
- Zone 2 miscellaneous soils

In addition, the ROD specifies that DVS should be developed to address the characterization of soils in other areas in the Zone with insufficient data to determine if an action is required. As discussed in the ROD, the key criterion for an action/NFA decision and a successful RA is the RAO, which is presented in Table 2.

Table 2. RAO and protection goals for Zone 2

Remediation issue	Protection goal
Future land use	Protect human health under an unrestricted industrial land use to a risk level not to exceed 1×10^{-4}
Groundwater resources	Control leaching and migration from contaminated soil to help minimize further impacts to groundwater

RAO = remedial action objective

Other key parts of the ROD include determining future land use as unrestricted industrial to 10 ft bgs, protecting the industrial worker from soil exposure identified as the primary risk driver, developing a risk assessment methodology based on EUs, and defining soil COCs with corresponding soil RLs (two RLs were established for each COC in the ROD). The maximum RL is the concentration that a COC may not exceed at any location within an EU. The average RL is the average COC concentration within an EU that, when exceeded, means the RAO risk protection goal has not been met. The Zone 2 ROD COCs, chemicals, and radionuclides required for analysis and associated RLs are presented in Table 3.

Table 3. Chemicals and radionuclides required for analysis in Zone 2 DVS samples and their evaluation criteria[a]

Chemicals and radionuclides	Maximum RL	Average RL	Industrial PRG (10^{-5})	Background	Groundwater SL[b]	Residential PRG (10^{-6})
Metals (mg/kg) (mg/L for groundwater)						
Aluminum			100,000	40,300		7,614
Antimony			410	1.52	144	3.1
Arsenic[c]	900	300	16	14.95	66.3	0.39
Barium			67,000	124.93	9,150	537
Beryllium	6,000	2,000	1,900	2.20		15
Boron			100,000			1,600
Cadmium			450	0.22U		3.7
Calcium				2400		
Chromium			640	44.88	172	22
Cobalt			130,000	42.00		138
Copper			41,000	22.48		313
Iron			100,000	58,600		2,346
Lead			800	37.91	3,370	400
Lithium			20,000	48.94		156
Magnesium				3,300		
Manganese			19,000	2,200		176
Mercury[c]	1,800	600	310	0.17		2.35
Molybdenum			5,100			39
Nickel			20,000	26.07		156
Potassium				5,074.69		
Selenium			5,100	1.47		39
Silver			5,100	0.6U		39
Sodium				497		
Thallium			67	0.4U	10.8	0.52
Uranium			200			1.56
Vanadium			1,000	65.47		7.8
Zinc			100,000	89.70		2,346
Radionuclides (pCi/g) (ug/L for groundwater)						
Cesium-137[c]	20	2	1.1			0.06
Cobalt-60			0.6			0.04
Gross alpha activity						
Gross beta activity						
Neptunium-237[c]	50	5	2.7			0.13
Potassium-40			2.7	32.12		0.11
Radium-226[c,d]	15	5	0.26	1.25		0.01
Technetium-99			9,000			0.25
Thorium-230[c,d]	15	5	210	1.20		3.5
Thorium-232[c,d]	15	5	0.176	1.95		0.01
Uranium-234[c,d]	7,000	700	330	1.47	61.1	4.02
Uranium-235[c,d]	80	8	4.0		61.1	0.2
Uranium-238[c,d]	500	50	18	1.47	61.1	0.74
Pesticides and PCBs (ug/kg)						
PCB-1016[c]	100,000	10,000	37,000			393
PCB-1221[c]	100,000	10,000	7,436			112
PCB-1232[c]	100,000	10,000	7,436			112
PCB-1242[c]	100,000	10,000	7,436			112
PCB-1248[c]	100,000	10,000	7,436			112
PCB-1254[c]	100,000	10,000	7,436			112
PCB-1260[c]	100,000	10,000	7,436			112
Polychlorinated biphenyl[c]	100,000	10,000	7,436			112

Table 3. Chemicals and radionuclides required for analysis in Zone 2 DVS samples and their evaluation criteria[a] (continued)

Chemicals and radionuclides	Maximum RL	Average RL	Industrial PRG (10^{-5})	Background	Groundwater SL[b]	Residential PRG (10^{-6})
Semivolatile Organic Compounds (ug/kg) (ug/L for groundwater)						
1,2,4-Trichlorobenzene			220,000			6,216
1,2-Dichlorobenzene			600,000			110,330
1,3-Dichlorobenzene			600,000			53,135
1,4-Dichlorobenzene			79,000			3,447
2,3,4,6-Tetrachlorophenol			18,000,000			183,309
2,4,5-Trichlorophenol			62,000,000			611,031
2,4,6-Trichlorophenol			62,000			611
2,4-Dichlorophenol			1,800,000			18,331
2,4-Dimethylphenol			12,000,000			122,206
2,4-Dinitrophenol			1,200,000			12,221
2,4-Dinitrotoluene			25,000			715
2,6-Dinitrotoluene			25,000			715
2-Chloronaphthalene			23,000,000			493,664
2-Chlorophenol			240,000			6,340
2-Methyl-4,6-dinitrophenol			62,000			611
2-Methylnaphthalene			190,000			5,592
2-Methylphenol			31,000,000			305,515
2-Nitrobenzenamine			1,800,000			18,277
2-Nitrophenol						
3,3'-Dichlorobenzidine			38,000			1,081
3-Nitrobenzenamine			18,000			1,833
4-Bromophenyl phenyl ether						
4-Chloro-3-methylphenol						
4-Chlorobenzenamine			2,500,000			24,441
4-Chlorophenyl phenyl ether						
4-Methylphenol			3,100,000			310,000
4-Nitrobenzenamine			180,000			18,330
4-Nitrophenol						
Acenaphthene			29,000,000			370,000
Acenaphthylene			29,000,000			370,000
Aniline			3,000,000			42,742
Anthracene			100,000,000			2,200,000
Benz(a)anthracene			21,000			621
Benzenemethanol			100,000,000			1,833
Benzo(a)pyrene			2,100			62
Benzo(b)fluoranthene			21,000			621
Benzo(ghi)perylene			29,000,000			231,595
Benzo(k)fluoranthene			210,000			6,215
Benzoic acid			100,000,000			24,000,000
Bis(2-chloroethoxy) methane						
Bis(2-chloroethyl) ether			5,800			218
Bis(2-chloroisopropyl) ether			74,000			2,884
Bis(2-ethylhexyl)phthalate			1,200,000		2,350,000	34,741
Butyl benzyl phthalate			100,000,000			1,200,000
Carbazole			860,000			24,319
Chrysene			2,100,000			62,146
Di-n-butyl phthalate			62,000,000			611,000

Table 3. Chemicals and radionuclides required for analysis in Zone 2 DVS samples and their evaluation criteria[a] (continued)

Chemicals and radionuclides	Maximum RL	Average RL	Industrial PRG (10^{-5})	Background	Groundwater SL[b]	Residential PRG (10^{-6})
Di-n-octylphthalate			25,000,000			244,000
Dibenz(a,h)anthracene			2,100			62
Dibenzofuran			1,600,000			14,526
Diethyl phthalate			100,000,000			4,900,000
Dimethyl phthalate			100,000,000			61,000,000
Diphenyldiazene			160,000			4,422
Fluoranthene			22,000,000			230,000
Fluorene			26,000,000			275,000
Hexachlorobenzene			11,000			304
Hexachlorobutadiene			180,000			1,833
Hexachloro-cyclopentadiene			3,700,000			36,550
Hexachloroethane			620,000			6,110
Indeno(1,2,3-cd)pyrene			21,000			621
Isophorone			5,100,000			512,000
N-Nitroso-di-n-propylamine			2,500			69.5
N-Nitrosodimethylamine			340			9.54
N-Nitrosodiphenylamine			3,500,000			99,261
Naphthalene			190,000			5,592
Nitrobenzene			100,000			1,964
Pentachlorophenol			90,000			2,979
Phenanthrene			29,000,000			23,160
Phenol			100,000,000			1,800,000
Pyrene			29,000,000			231,600
Pyridine			620,000			6,110
Volatile Organic Compounds (ug/kg) (ug/L for groundwater)						
1,1,1-Trichloroethane			1,200,000		97,900	198,200
1,1,2,2-Tetrachloroethane			9,300			408
1,1,2-Trichloroethane			16,000		1,370	729
1,1-Dichloroethane			1,700,000			50,640
1,1-Dichloroethene			410,000		1,750	12,350
1,2-Dichloroethane			6,000		729	278
1,2-Dichloropropane			7,000			342
2-Butanone			110,000,000			2,230,000
2-Hexanone						
4-Methyl-2-pentanone			47,000,000			528,100
Acetone			54,000,000			1,413,000
Benzene			14,000		1,150	643
Bromodichloromethane			18,000			824
Bromoform			2,200,000			61,570
Bromomethane			13,000			390
Carbon disulfide			720,000			35,530
Carbon tetrachloride			5,500		2,770	217
Chlorobenzene			530,000			15,070
Chloroethane			65,000			3,026
Chloroform			4,700		1230	221
Chloromethane			160,000			4,685
Dibromochloromethane			26,000			1,109
Ethylbenzene			400,000			186,400
Methylene chloride			210,000		241	9,107
Styrene			1,700,000			438,210

Table 3. Chemicals and radionuclides required for analysis in Zone 2 DVS samples and their evaluation criteria[a] (continued)

Chemicals and radionuclides	Maximum RL	Average RL	Industrial PRG (10^{-5})	Background	Groundwater SL[b]	Residential PRG (10^{-6})
Tetrachloroethene			13,000		4,720	484
Toluene			520,000		502,000	65,600
Total Xylene			420,000			27,000
Trichloroethene			1,100		1,720	53
Vinyl chloride			7,500		176	79
cis-1,2-Dichloroethene			150,000			4,294
cis-1,3-Dichloropropene			18,000			777
trans-1,2-Dichloroethene			230,000			6,949
trans-1,3-Dichloropropene			18,000			777
Diesel Range Organics[e]					100 mg/kg	
Gasoline Range Organics[e]					100 mg/kg	

[a]Chemicals and radionuclides listed include all of the Zone 2 soils COCs and other chemical and radionuclides considered to be potential contaminants at ETTP. Analytical laboratories for DVS samples often report the results for chemicals and radionuclides not listed here and historical data may include analyses for chemicals and radionuclides not reported in DVS samples. When there is a detection in either a DVS or historical sample of a chemical or radionuclide not listed here, the concentration is compared to its 1×10^{-5} industrial PRG and 1×10^{-6} residential PRG, which can be found in the *Remedial Design Report/Remedial Action Work Plan for Zone 2 Soils, Slabs, and Subsurface Structures, East Tennessee Technology Park, Oak Ridge, Tennessee*, DOE/OR/01-2224&D3, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.
[b]Referred to as soil exposure concentrations in the Zone 2 ROD.
[c]Zone 2 ROD contaminant of concern.
[d]Radium-226, Thorium-230, and Thorium-232 are evaluated by a computational method that determines the primary RAD constituent and the daughters of the primary radionuclide; the total activity of the primary plus daughters is then compared to established Zone 2 RLs that are listed in the *Remedial Design Report/Remedial Action Work Plan for Zone 2 Soils, Slabs, and Subsurface Structures, East Tennessee Technology Park, Oak Ridge, Tennessee*, DOE/OR/01-2224&D3, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN..
[e]Diesel-range organics and gasoline-range organics apply when there is an UST under investigation. The 100-mg/kg limit for protection of groundwater is based on State of Tennessee UST regulations.

COC = contaminant of concern
DVS = Dynamic Verification Strategy
ETTP = East Tennessee Technology Park
PRG = preliminary remediation goal
RAD = radiological
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RL = remediation level
ROD = Record of Decision
UST = underground storage tank

As specified in the Zone 2 ROD, all of Zone 2 should be evaluated for unrestricted use with data from the industrial use scenario. In areas where information indicates there is little chance for unacceptable contamination, restrictions will not be imposed (see Sect. 11).

3.2 DYNAMIC VERIFICATION STRATEGY

The DVS was developed as required by the Zone 2 ROD and designed to provide sufficient data to fill data gaps, conduct final status assessments for all of Zone 2, and facilitate real-time decision making. This strategy focused on the soil characterization portion of the Zone 2 ROD to determine where action was needed. Acreage classification was used to progressively focus the investigation efforts in areas with a moderate to high probability of soil contamination (see Sect. 2.1.3). The DVS also helped verify information from previous investigations to incorporate flexibility to facilitate rapid collection of additional data based on data results. The strategy was to gather adequate data with minimal iterations of site investigation planning and mobilization.

The DVS addressed requirements of the Zone 2 ROD RAO with the DQO process. Step 5 of the DVS DQOs presented four decision rules whereby any particular land area in Zone 2 was deemed to have met the RAO requirements (see Table 4).

Table 4. DVS decision rules for Zone 2 soils

Decision Rule	If	Then	Otherwise
1	Concentration of any COC in a localized area ("hot spot" nominally 50-ft radius) within an EU to a depth of 10 ft exceeds the maximum RL	Remediate localized area of elevated contamination until the COC concentration is less than the maximum RL	NFA for protection of industrial worker
2	Mean concentration value of any soil COC to a depth of 10 ft exceeds the average RL within an EU	Remediate elevated areas of contamination until the mean COC concentration over the EU is less than the respective RL	NFA for protection of industrial worker
3	Industrial risk across the EU to a depth of 10 ft is > 1×10^{-4} ELCR or target organ HIs exceed 1	Remediate elevated areas of contamination until residual risk over the EU is below the risk levels. Evaluate the need for action if target HIs exceed 1	NFA for protection of industrial worker
4	Site-specific contaminants in groundwater exceed MCL or site-specific, mass-based soil SLs[a] calculated for a site for the protection of groundwater are exceeded above the water table or bedrock surface (whichever is shallower)	Evaluate the impacts of remediating the site	NFA for the protection of groundwater

[a]Soil SLs for the protection of groundwater are presented in the *Record of Decision for Soil, Buried Waste, and Subsurface Structure Actions in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee*, DOE/OR/01-2161&D2, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

COC = contaminant of concern
DVS = Dynamic Verification Strategy
ELCR = excess lifetime cancer risk
EU = exposure unit
HI = hazard index
MCL = maximum contaminant level
NFA = no further action
RL = remediation level
SL = screening level

3.3 FINAL STATUS EVALUATION PROCESS

The final status recommendation for action/NFA of EU Z2-32 was determined by evaluating the EU in terms of the four decision rules. Descriptions of the action/NFA evaluation processes for each decision rule are presented in Sect. 3.3.1. A discussion of special data uses and considerations in the action/NFA evaluations is included in Sect. 3.3.2. As defined in the Zone 2 ROD, a risk screening was performed to evaluate the industrial land use of each EU. A qualitative risk screening also was conducted against 1×10^{-6} residential preliminary remediation goals (PRGs) to evaluate the unrestricted use of the EU. A description of this evaluation is presented in Sect. 3.3.3.

3.3.1 Action/No Further Action Decision

The process whereby EUs are evaluated against the four DVS decision rules (see Sect. 3.2) is described in the following text and presented graphically in Fig. 5 as Steps 1 through 4.

Decision Rule 1—Maximum RL Evaluation. Zone 2 soil chemical and radionuclide COC concentrations are screened against their maximum (not to exceed) RLs as defined in the Zone 2 ROD. If any compound is detected at a concentration above its maximum RL, an action is required. Maximum RLs and COCs they are applied to are presented in Table 3.

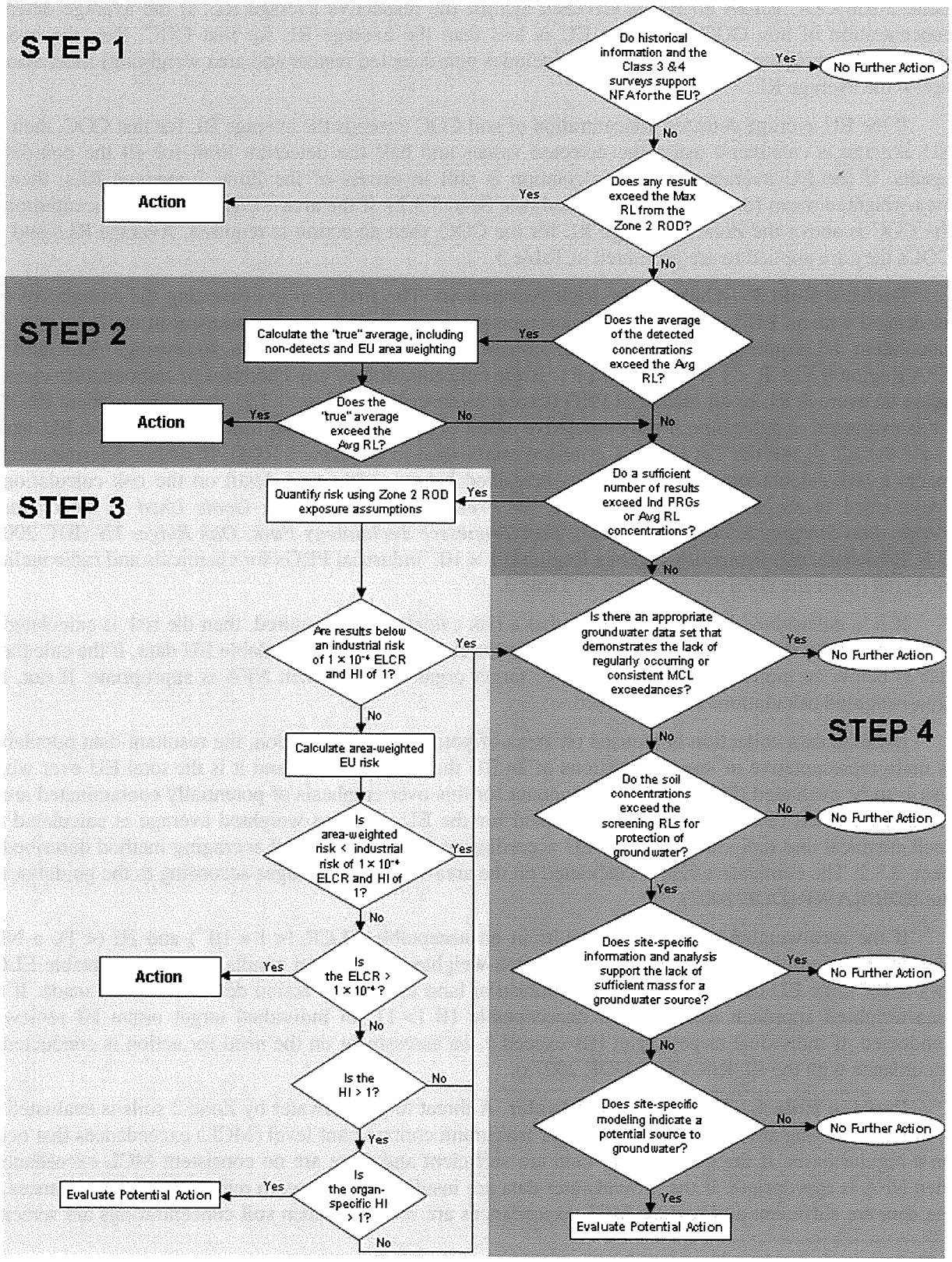


Fig. 5. Risk evaluation process.

Decision Rule 2—Average RL Evaluation. The mean value of the detected concentrations for each Zone 2 soil COC across an EU is screened against the respective average RL. If the average detected concentration of any COC across an EU is less than the average RL for that COC, then the overall average concentration of the COC (which includes non-detected results and area weighting) must also be below the average RL.

If the EU average detected concentration of soil COC exceeds the average RL for that COC, then the EU average is calculated using the detected values and half the detection limit for all the non-detect results. If the EU average for this calculation is still in excess of the Zone 2 average RLs, then an area-weighted mean for the EU is calculated (see Sect. 3.3.2). If the area-weighted mean concentration of the COC is above the Zone 2 average RL for the COC, then an action is required. Average RLs and the COCs they are applied to are presented in Table 3.

Decision Rule 3[a]—Cumulative Risk Assessment. The first step in evaluating the cumulative risk associated with an EU is to perform a risk screen to determine if further assessment in the form of a risk calculation is required. The risk screen consists of comparing the data to average RLs and an EPA Region 9 ELCR $< 1 \times 10^{-5}$ or HI of 1. If the concentration of any chemical or radionuclide exceeds either an average RL or an industrial PRG (except as described in Sect. 3.3.2), then the complete EU data set is evaluated to determine if the cumulative effect of all chemicals and radionuclides in the EU would cause the EU to fail the 1×10^{-4} risk criterion established in the Zone 2 ROD. If such a determination is made, a risk calculation[b] is conducted as described below. Additional detail on the risk calculation is documented in *Supporting Documentation for Preliminary Remediation Goals Used in the Dynamic Verification Strategy Sampling Program, East Tennessee Technology Park, Oak Ridge, TN* (BJC 2006). U.S. Environmental Protection Agency Region 9 1×10^{-5} industrial PRGs for chemicals and radionuclides analyzed under the DVS are presented in Table 3.

If it is determined by the risk screen that a risk calculation is required, then the risk is calculated in accordance with the Zone 2 ROD by calculating the risk based on the available EU data. If the calculated risk is below an industrial 1×10^{-4} ELCR or target organ HI of 1, then NFA is appropriate. If not, EU area-weighted calculations are performed.

Because data collection is focused on areas of potential contamination, the resultant data population is more representative of specific portions of an EU than the total EU, and it is the total EU over which risk is to be evaluated (DOE 2005)). To account for this over emphasis of potentially contaminated areas, an area-weighted risk calculation is performed for the EU. An area-weighted average is calculated for each chemical and radionuclide in the EU according to the area-weighted averaging method described in Sect. 3.3.2. The cumulative risk is calculated on the area-weighted averages according to the guidelines in the RDR/RAWP (DOE 2007).

If the area-weighted calculation results in an acceptable ELCR ($< 1 \times 10^{-4}$) and HI (< 1), a NFA determination can be made. However, if the area-weighted calculation results in an unacceptable ELCR ($> 1 \times 10^{-4}$), the EU cannot be cleared for industrial land use and an action determination is made. If the area-weighted approach results in an unacceptable HI (> 1), an individual target organ HI review is conducted. If individual target organ HIs exceed 1, an assessment on the need for action is conducted in accordance with the RDR/RAWP (DOE 2007a).

Decision Rule 4—Threat to groundwater. A threat to groundwater by Zone 2 soils is evaluated by reviewing existing area groundwater data for maximum contaminant level (MCL) exceedances that occur on a regular basis. If the groundwater data are sufficient and there are no consistent MCL exceedances, then NFA is appropriate. If the groundwater data are insufficient to discern regular MCL exceedances, or the data are sufficient and regular MCL exceedances are observed, then soil concentrations are screened

[a]Radium and thorium isotopes are excluded from the risk evaluation (see Sect. 3.3.2 for further discussion).

[b]Number of samples to adequately characterize the EU and evaluate risk is determined in the DQO scoping process with the RA Core Team. Available DVS and historical data are used when risk calculations are performed.

against the SLs for the protection of groundwater as defined in the Zone 2 ROD (DOE 2005). Based on the screening, site-specific modeling may be conducted if additional evaluation is required. Consideration of an action is required if modeling results indicate a site may be a potential source of contamination to groundwater. The sitewide ROD evaluates available site data for threats to groundwater. Data generated from the DVS process will be included in this ROD. Groundwater SLs for chemicals and radionuclides analyzed under the DVS are presented in Table 3.

The Zone 2 ROD specifically addresses USTs at ETTP, including those in Zones 1 and 2. State UST regulations are applicable or relevant and appropriate regulations for all ETTP tanks according to the Zone 2 ROD. Therefore, closure will be performed according to State of Tennessee regulations. Tanks that are demonstrated to be clean (i.e., containing no fluids that could adversely effect groundwater) and have no soil contamination present to indicate a leak will be closed in place by filling. Tanks that contain residual fluid and/or where soil contamination indicates a leak will be removed according to state UST regulations.

3.3.2 Special Data Uses and Considerations

Circumstances requiring special data uses and considerations during EU action/NFA evaluations fall into three categories: (1) evaluation of Class 3 and Class 4 SUs that may not have any analytical data, (2) area-weighted averages, and (3) chemicals and radionuclides with regulatory limit concentrations less than or similar in value to background concentrations.

Class 3 and Class 4 SU Evaluations—The Class 3 and Class 4 SU walkover assessments provide sufficient information to support the NFA determination on EUs that have historical information. Class 3 and Class 4 SU walkover assessments include visual observation of the SU acreage, collection of radiological survey data, and selected biased sampling where survey results or observations indicate the presence of impacted soils.

Area-weighted Averages—Area-weighted averaging is accomplished by calculating the fraction of the total area of the EU that contains contaminated soil (called a contaminant area fraction). The remaining area of the EU constitutes a remaining acreage area fraction. The average concentration of soil constituents in the area of contamination is calculated and then multiplied by the contaminant area fraction. Average soil concentrations are calculated for the remaining acreage area of the EU using all available sample results or, if no sample data are available, background concentrations. These average concentrations are multiplied by the remaining acreage area fraction. The area-weighted EU average then is calculated as the sum-of-fractions.

Regulatory Limit versus Background Concentrations—The industrial PRGs for arsenic, Cs-137, K-40, Ra-226, Th-228, and Th-232 are less than or similar in value to their respective background concentrations, which results in the industrial PRGs exceeding all or most instances where the chemical or radionuclide is detected. It was concluded in the Zone 2 ROD that data for Ra-226, Th-228, and Th-232 will not be used for risk calculations. Instead, health hazards associated with the presence of these radionuclides in Zone 2 soils will be evaluated by comparison to the RLs for Ra-226 and Th-232 (which contain Th-228 in its decay chain).

When a risk screen is conducted as part of the Decision Rule 3 evaluation (Sect. 3.3.1), secondary concentration comparisons are made in response to PRG exceedances by arsenic, Cs-137, and K-40 before proceeding with the cumulative effects evaluation, which may lead to performing risk calculations for the EU. The industrial PRG for arsenic (15.9 mg/kg) was very close in value to the arsenic background concentration (14.95 mg/kg). Although no local background value exists, the industrial PRG for Cs-137 (1.13 pCi/g) was low enough that this ubiquitous nuclear fallout radionuclide exceeded its PRG in most instances where detected, and the industrial PRG for K-40 (2.73 pCi/g) was less than the background concentration for K-40 (32.12 pCi/g). Secondary concentration comparisons that were

performed included arsenic concentrations to the arsenic Zone 2 soils average RL, Cs-137 concentrations to the Cs-137 Zone 2 soils average RL, and K-40 concentrations to the K-40 background value. If any of these secondary concentration comparisons resulted in an exceedance, then the complete EU dataset was evaluated for cumulative effects as described in Sect. 3.3.1.

Ra/Th Decay Series Calculation. Because the carcinogenic risk associated with the concentrations of radium and thorium isotopes in the natural background at ETTP exceed the cumulative risk goal of 1×10^{-4}, RL values for these radionuclides were based on alternative concentration levels rather than risk. The alternative concentration levels of 5 pCi/g above background (average RL) and 15 pCi/g above background (maximum RL) were set as low as reasonably achievable under the site-specific conditions. Concentrations of these radionuclides and their decay series were not considered in the risk estimates because site-specific background concentrations of the radionuclides exceeded the target risk range.

The Zone 2 ROD states that average RL and maximum RL exceedances by Ra-226, Th-230, and Th-232 are to be evaluated by summing above-background concentrations of the greater of Ra-226 or Th-230 with the above-background concentrations of Th-232, and comparing the results to 5 pCi/g (average RL) and 15 pCi/g (maximum RL). These calculations were performed by subtracting the background values of Ra-226, Th-230, and Th-232 from the analytical result. A Ra/Th decay series value then was calculated for each sample by selecting the larger of the Ra-226 or Th-230 value and summing the selected value with the Th-232 value.

The Ra/Th decay series was considered to be analyzed in a sample if one or more of the three radionuclides it comprised were analyzed for in the sample. Also, this decay series was considered to be detected in a sample if one or more of the three radionuclides it comprised were detected in a sample. It is possible that a Ra/Th decay series detected value could equal zero.

3.3.3 Qualitative Risk Screening for Unrestricted Use

While not required by the Zone 2 ROD, a qualitative risk screening for unrestricted use was conducted to determine the possibility of releasing the EUs without institutional controls. These results are provided for information only and do not form the basis for action (see Sect. 11). For this screening, average concentrations were compared to 1×10^{-6} residential PRGs and ETTP soils background values from Table 4 in *Soil Background Supplemental Data Set for the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2003). EPA Region 9 residential PRGs 1×10^{-6} and ETTP soil background values for the chemicals and radionuclides analyzed for under the DVS are presented in Table 3.

4. FINAL STATUS ASSESSMENTS

This section presents the DVS evaluation results for EU Z2-32 and the final status assessment based on that evaluation. Guidelines for the evaluation are presented in Sect. 2 and for preparing the final status assessment are presented in Sect. 3. A high-level summary of the DVS evaluation is presented in Table 5.

The final status assessment conclusions for EU Z2-32 are presented in Table 6, which is followed by a summary of the evaluation and conclusions. The EU acreage, Class 1 and Class 2 SU acreage, Class 3 and Class 4 SU acreage, and FFA sites in EU Z2-32 are shown in Table 6.

Because all samples within the 0- to 10-ft soil interval were considered equally in the risk assessment, there was no differentiation in the contamination information by depth. Any contamination in the 0- to 10-ft interval was considered to be equally accessible to an industrial worker. Depth information for discrete interval samples, including all VOC samples and the majority of the radiological samples, is provided in the accompanying CD. Because there is no depth differentiation of the potential impact of contamination, details regarding sample intervals were not included in the EU evaluation presented in the following text.

Details of the material presented in Tables 6 and the associated summaries are presented in the EU Z2-32 TM (see Appendix A). Analytical data summary tables also are presented in the TM. The complete set of analytical data used to generate the summary data tables is provided in the CD attached to this PCCR. Data are also available in the OREIS database, which can be accessed by contacting DOE.

Table 5. DVS evaluation summary for EU Z2-32

Bulk acreage summary		
Total acreage in Zone 2	819	
Acreage included in this PCCR	18.4	
Acreage for NFA – no RA	18.4	
Acreage for NFA – post RA[a]	< 1	
Acreage of RAs conducted	< 1	
Acreage of RAs to be conducted	0	
SU classification summary for acreage in the PCCR		
Class 1 SU acreage	0	
Class 2 SU acreage	3.7	
Class 3 SU acreage	14.7	
Class 4 SU acreage	0	
EU summary		
Number of EUs in Zone 2	44	
Number of EUs addressed in this PCCR	1	
Number of EUs for NFA	1	
Number of EUs for NFA – post RA	0	
Characterization summary		
Sample analyses DVS and historical	Metal: 23	VOC: 11
	PCB: 24	Other: 1
	Radionuclide: 12	TCLP SVOC: 0
	SVOC: 6	TCLP Metals: 0
Radiological walkover survey acreage	Approximately 3.5	
Geophysical survey acreage	0	
Linear feet of soil core obtained	Approximately 96 ft	

Table 5. DVS evaluation summary for EU Z2-32 (continued)

Characterization summary (continued)	
Class 3 and Class 4 SU walkover assessments	Assessment point locations: 13 Mid-point locations: 12 Discretionary point locations: 5 Total locations assessed: 30
FFA Sites Addressed – NFA	
None	
FFA Sites – Additional Action	
None	

[a]The need for RA anywhere in an EU indicated the NFA decision could not be made for the whole EU until the action was complete. Final status of FFA sites within an EU where an action was planned was contingent on completion of the RA. "Acreage for NFA-post RA" indicates the sum of acreages in which a RA was to be conducted. "Acreages of RAs to be conducted" indicates the sum of acreages of the actions themselves.

DVS = Dynamic Verification Strategy
EU = exposure unit
FFA = Federal Facility Agreement
NFA = no further action
PCB = polychlorinated biphenyl
PCCR = Phased Construction Completion Report
RA = remedial action
SU = soil unit
SVOC = semivolatile organic compound
TCLP = toxicity characteristic leaching procedure
VOC = volatile organic compound

Table 6. EU Z2-32 Final status assessment summary

EU size (acres)	EU Group	Zone 2 ROD Appendix A FFA Sites	Class 1 and 2 SU area (acres)	Class 3 and 4 SU area (acres)	Risk evaluation	Decision rule evaluation	Final status decision
18.4	Main Plant	None	3.7	14.7	Passes risk screen	Max RL: NFA Avg RL: NFA Risk: NFA GW: NFA	NFA for soils

Avg = average
EU = exposure unit
FFA = Federal Facility Agreement
GW = groundwater
Max = maximum
NFA = no further action
RL = remediation level
ROD = Record of Decision
SU = soil unit

4.1 EXPOSURE UNIT EVALUATION

The following section summarizes the evaluation and conclusions for EU Z2-32. Details of the material presented in Tables 5 and 6 and the following section are presented in Appendix A. The evaluation is performed and presented from a post-RA perspective by removing from the analysis data where RA was performed.

4.1.1 Exposure Unit Z2-32

Exposure unit Z2-32 is located in the east central portion of Zone 2 in the Main Plant EU Group. This EU is bounded on the north by EU Z2-31, on the east by EUs Z2-37 and Z2-42, on the south by EU Z2-33, and on the west by EU Z2-26. All of the land area in this EU has been impacted by site operations, including the construction of buildings, roads, parking lots, and sidewalks.

Exposure unit Z2-32 has no FFA sites that are listed in Appendix A of the Zone 2 ROD.

One conceptual site model, a surface release model related to material storage in the K-1066-G Yard, applies to this EU.

Only Class 2 and Class 3 SUs are contained in this EU. The 3.7-acre K-1066-G Class 2 SU is located in the southeast corner of the EU (Fig. 2). The boundaries of this Class 2 SU were defined to encompass the boundaries of the K-1066-G Cylinder Storage Yard, which was used for the storage of UF_6 cylinders and, more recently, for storage of contaminated and uncontaminated equipment, vehicles, and wastes. The remainder of this EU is a Class 3 SU where walkover assessments were performed.

Data evaluation for EU Z2-32 is summarized in the following table.

EU #	Max RL exceeded?	Average RL over EU exceeded?	Industrial risk above 1×10^{-4}?	Potential source to groundwater?	Action required?
Z2-32	No	No	No	No	No

EU = exposure unit
RL = remediation level

- There were no maximum RL exceedances in EU Z2-32.
- No average COC concentration across EU Z2-32 exceeded its average RL.
- Industrial risk for EU Z2-32 was calculated to be $< 1 \times 10^{-4}$ ELCR, with a target organ HI of 1.
- Despite the presence of VOC groundwater contaminant plumes beneath EU Z2-32, the source areas are located to the south in EU Z2-41, and EU Z2-32 soils did not contribute to those plumes and do not pose a threat to groundwater.
- No further action is necessary to meet industrial land use.

There is a low probability that EU Z2-32 acreage could be released with no land use restrictions because of contaminated groundwater at depth. As described above, there is no potential for industrial risk in the 0- to 10-ft-depth interval. However, an appropriate evaluation of residential risk should be conducted to make a definitive conclusion.

5. REMEDIATION ACTIVITIES

The only RA performed in EU Z2-32 was on a small volume of contaminated soil and gravel in the K-1066-G Yard. This action is described below and constitutes the final report for the soil RA described here and in Sects. 6, 7, and 8. In addition to the RA, Bldgs. K-1008-A through F and K-1020 slabs were removed so sufficient concrete was available to complete the backfill of the K-1401 basement in EU Z2-31.

5.1 K-1066-G YARD DESCRIPTION, HISTORY, CHARACTERIZATION, AND RA

The K-1066-G Yard is an approximately 3.5-acre fenced and graveled area that was originally used as a parking lot for the K-25 Gaseous Diffusion Plant in the 1950s and later for the storage of UF_6 cylinders. After removal of the UF_6 cylinders, the area was used for the storage of both contaminated and uncontaminated equipment, vehicles, and waste.

Removal of the equipment and materials was performed in 2008 and 2009 and DVS sampling and a radiological walkover survey was performed in accordance with the Main Plant DQO scoping package. The bulk of the sampling was performed in the upper 2 ft of soil because the conceptual model for the area included surface contamination resulting from equipment and material storage.

None of the soil sample analytical results exceeded DVS criteria. Details of the radiological walkover survey are reported in the FY 2009 report on walkover assessments and radiological surveys for Zones 1 and 2 (BJC 2009). Radiological contamination levels over the vast majority of the area were below the action level, but the results (Fig 6) show one small area (< 1 m^2) with surface contamination of 5410 cpm, which exceeds the action level of 3000 cpm.

Rather than perform biased sampling to evaluate if an RA was required, the RA Core Team agreed to proceed with a small soil RA (concurrence form FCN-ETTP-Zone 2-115). The RA of mixed soil and gravel was performed in October 2009 to a depth of approximately 3.5 ft. Confirmation sampling results demonstrated the RA was complete (highest radiological COC concentration of 5.6 pCi/g for ^{234}Th), and the excavation was filled with clean gravel (Fig. 7).

5.2 END STATE

The K-1066-G Yard remains a fenced and graveled area that may require periodic mowing or herbicide application. The locations of former Bldgs. K-1008-A through F and K-1020 slabs were planted with domestic grass that will require mowing.

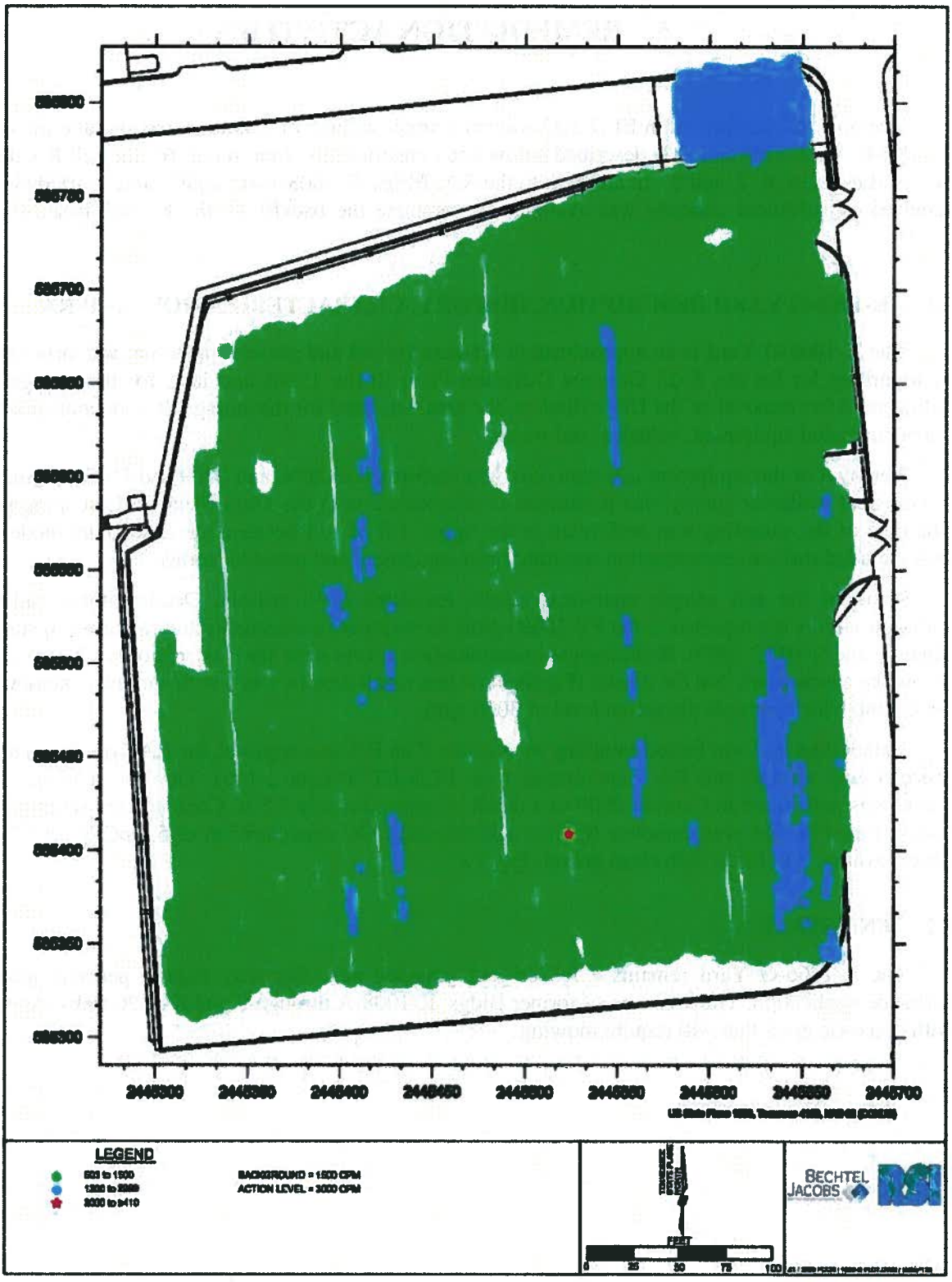


Fig. 6. K-1066-G Yard radiological walkover survey results.

Fig. 7. K-1066-G Yard RA location after excavation backfilling.

6. DEVIATIONS FROM GOVERNING DOCUMENTS

Zone 2 was divided into 7 geographic areas and 44 EUs in the ROD (DOE 2005). To facilitate the DQOs, the RDR/RAWP (DOE 2007a) regrouped the 44 EUs into 12 DQO scoping EU groups, which facilitated the DQO process by placing similar facilities and their support facilities together and allowing identification of data gaps.

It is not uncommon for EU acreages reported in PCCRs to differ from that reported in the ROD because of boundary refinement and an increased level of accuracy. In the case of EU Z2-32, however, the 18.4 acres used in this PCCR is essentially the same as that reported in the ROD.

The RA Core Team concurrence process is an integral part of DVS implementation, which allows actions such as revising sampling locations or RA implementation based on field conditions encountered. The FCNs and concurrences submitted to and reached by the RA Core Team pertaining to the DVS characterization and RA presented in this PCCR are listed in Table 7.

Table 7. EU Z2-32 FCNs and concurrences

Log number	FCN number	Title or description	Date issued	Date approved
219	FCN-ETTP-Zone 2-084	K-1008 concrete slab CAC (EU Z2-32)	6/12/2008	6/17/2008
226	FCN-ETTP-Zone 2-090	Add tankers to WHP (EUs Z2-19, Z2-32, and Z2-44)	7/10/2008	7/17/2008
234	FCN-ETTP-Zone 2-093	Delete samples in EUs Z2-12, Z2-32, and Z2-36	8/21/2008; resubmitted 9/29/2008	10/14/2008
245	FCN-ETTP-Zone 2-103	Main Plant EU Z2-32 SAP to add K-1066-G yard debris to WHP	12/18/2008; resubmitted 1/7/2009; Rev. 1 submitted 2/12/2009	Rev. 1 approved 3/3/2009
258	FCN-ETTP-Zone 2-109	Main Plant SAP K-1066-G yard SAP debris deviations (EU Z2-32)	4/30/2009	5/07/2009
268	FCN-ETTP-Zone 2-115	Perform soil RA in K-1066-G Yard (EU Z2-32)	9/29/2009	10/1/2009

CAC = Concrete Acceptance Criteria
ETTP = East Tennessee Technology Park
EU = exposure unit
FCN = Field Change Notice
RA = remedial action
SAP = Sampling and Analysis Plan
WHP = Waste Handling Plan

7. PROJECT ORGANIZATION, COSTS, AND SCHEDULE FOR REMEDIAL ACTION

The EU Z2-32 RA project characterization was performed by Bechtel Jacobs Company LLC (BJC) and its subcontractors for DOE, and DOE performed the program and project oversight. Overall program and project management; project execution; project controls; waste management; laboratory oversight; data management; and environment, safety, and health services were provided by BJC. Remedial action characterization and documentation support was provided by Restoration Services, Inc., and radiological control services were provided by Safety and Ecology Corporation. Analytical laboratory services were provided by DOE contract laboratories.

Remedial action performed by BJC at the K-1066-G Yard started on October 12, 2009, and was completed on October 13, 2009. Total project costs were approximately $6560.

The Zone 2 ROD determined that all Zone 2 RAs would be complete by the end of FY 2008. Changing priorities and the emergence of additional programs at ETTP extended the planned completion date.

8. WASTE MANAGEMENT ACTIVITIES FOR REMEDIAL ACTION

The waste type, volume, and disposal location for waste generated from the K-1066-G Yard RA are shown in Table 8.

Table 8. RA waste disposal

Waste type	Waste volume (yd^3)	Disposal location
Soil and gravel	3	EMWMF Waste Lot 14.21

EMWMF = Environmental Management Waste Management Facility
RA = Remedial action

9. OPERATIONS AND MAINTENANCE

There are no active systems in EU Z2-32 that require ongoing operations and maintenance.

10. MONITORING SCHEDULE AND/OR EXPECTATIONS

There are no monitoring requirements for the RA performed in EU Z2-32.

11. LAND USE CONTROLS

This section discusses general land use controls for the EUs in Zone 2 at ETTP. Details of the controls will be presented in the Remedial Action Report. An assessment for possible unrestricted use of EU Z2-32 is presented in Sect. 11.4.

Dynamic Verification Strategy characterization of EU Z2-32 was conducted in accordance with the requirements of the Zone 2 ROD and RDR/RAWP. The goal of characterization was to gather sufficient information to evaluate the EU against the four decision rules developed in the DVS DQOs (Table 5) and arrive at an action/NFA decision. The decision rule evaluation process used in this PCCR is described in Sect. 3. Consistent with the Zone 2 ROD, a NFA decision means an EU is available for unrestricted industrial use to a depth of 10 ft bgs.

11.1 POSSIBLE LIFTING OF LAND USE CONTROLS

As required by the Zone 2 ROD, this section presents an evaluation of EU Z2-32 for possible lifting of the following two land use controls:

- Industrial land use controls below 10 ft bgs.
- Making the EU available for unrestricted land use.

The DVS process and EU status assessment presented in this PCCR for EU Z2-32 can assign a high, medium, or low qualitative probability of lifting land use controls.

11.2 DEFINITIONS

High probability—This designation indicates there are no identified areas of contaminated soils and no significant disposal or landfill operations observed in the EU. Dynamic Verification Strategy evaluations indicate no identified impact within the EU and a high probability the acreage could be released with no land use controls following appropriate evaluation.

Medium probability—This designation indicates an identifiable impact from facility operations to some portion of acreage in the EU. This impact may be visible rubbish and debris, concentrations of several metals and/or radionuclides above background levels, and/or the detection of organic compounds in a few samples within the EU. Based on the observations and sample results, the impact appears to be minor and limited in extent. There is a moderate probability the acreage could be released following appropriate evaluation.

Low Probability—This designation indicates a clearly identified impact to substantial portions of acreage within the EU. Metals and radionuclides are commonly above background levels and organic compounds may be present in several samples within the EU at levels above 1×10^{-6} residential PRGs. The probability of unrestricted use of the acreage is low.

11.3 INDUSTRIAL CONTROLS AT DEPTH

An evaluation was performed to determine if EU Z2-32 would require industrial controls below 10 ft bgs. The DVS program was designed to assure the top 10 ft of soil meet industrial criteria. However, sufficient information exists to make reasonable conclusions regarding the need for land use controls below 10 ft of soil. Waste has not been buried in EU Z2-32, contamination has not been identified on the

surface or shallow subsurface, and there is no mechanism to transport contaminants to depth below 10 ft, therefore, EU Z2-32 is considered to be a good candidate for lifting industrial controls below 10 ft.

11.4 POTENTIAL UNRESTRICTED USE

To conduct the evaluation and determine the probability of lifting land use controls, EU Z2-32 analytical data were compared to background concentrations and 1×10^{-6} residential PRGs. A qualitative assessment of the comparison results applicability to the whole EU was prepared. DVS sampling is biased to areas with relatively high probabilities of contamination being present (i.e., DVS systematic sampling is focused on Class 1 and Class 2 SUs and DVS biased sampling is conducted in all SUs based on a determination from visual and screening assessments that there is a likelihood of contamination). As a result, the presence of background or 1×10^{-6} residential-use PRG concentration exceedances in the data set does not automatically preclude the possibility of lifting industrial land use controls. The probability of lifting land use controls for acreage in Zone 2 is generally low because it has been extensively impacted by the construction of ETTP facilities, infrastructure, and heavy industrial activities. Sample results consistently indicate impact to area soils above background levels and commonly above industrial use PRGs. Also, unrestricted use of Zone 2 acreage is an unlikely alternative because there are many small structures and abandoned infrastructures in the area.

Further evaluation is recommended before a final conclusion can be made concerning lifting industrial land use controls because the DVS process is designed around requirements of the Zone 2 ROD, which specifies an unrestricted industrial land use.

To evaluate for unrestricted use, appropriate DQOs were developed that considered but were not limited to the following:

- Calculated RLs consistent with the risk management requirements of an unrestricted land use scenario.
- Remediation levels for chemicals and radionuclides where background concentrations are greater than residential PRGs (i.e., aluminum, arsenic, iron, manganese, K-40, Ra-226, Th-228, and Th-232).
- Remediation levels for Cs-137, a ubiquitous fallout radionuclide that does not have a determined background concentration but typically exceeds its residential PRG when detected.
- EU size.

It is probable that EU Z2-32 acreage could be released with no land use restrictions. There is no potential for industrial risk in the 0- to 10-ft-depth interval and the data demonstrate that industrial risk is unlikely in the depth interval > 10 ft. However, an appropriate evaluation of residential risk should be conducted to make a definitive conclusion.

11.5 REMAINING ACTIVITIES

This section summarizes activities remaining to be completed in Zone 2. The rationale for these activities falls into the following four categories:

- Remaining activity is an action to be performed.
- Remaining activity awaits a risk management decision.
- Remaining activity is part of a larger infrastructure investigation to be conducted at a later date.
- Remaining activity awaits D&D to make soils accessible.

The status of each EU in Zone 2 is presented in Table 9. The status of Zone 2 RA characterization as of this PCCR is shown in Fig. 6. Characterization has been completed in 26 of the 44 Zone 2 EUs [455 of 800 acres (57%)].

Table 9. Status of Zone 2 EUs

EU	Characterization complete?	NFA on soil appropriate?	NFA on infrastructure appropriate?[a]	Action required?	Closure documentation?	Comment/ explanation
Z2-01	✓	✓	✓		FY 2007 PCCR	
Z2-02	✓	✓	✓		FY 2006 PCCR	
Z2-03	✓	✓	✓		FY 2007 PCCR	
Z2-04					PCCR or Zone 2 RAR	
Z2-05					PCCR or Zone 2 RAR	
Z2-06					PCCR or Zone 2 RAR	
Z2-07	✓	✓	✓		FY 2006 PCCR	
Z2-08	✓	✓	✓		FY 2007 PCCR	
Z2-09	✓	✓	✓		FY 2006 PCCR	
Z2-10	✓	✓	✓		FY 2006 PCCR	
Z2-11	✓		✓	✓	FY 2009 Zone 2 six EUs PCCR	Cs-137 soil RA at the K-1134-A former HF storage tank
Z2-12	✓		✓	✓	FY 2009 Zone 2 six EUs PCCR	Two small soil RAs southeast of the K-1203 area
Z2-13					PCCR or Zone 2 RAR	
Z2-14					PCCR or Zone 2 RAR	
Z2-15					PCCR or Zone 2 RAR	
Z2-16					PCCR or Zone 2 RAR	
Z2-17	✓			✓	FY 2009 Zone 2 six EUs PCCR	Sludge RA at the K-801-H cooling tower basin and asphalt from the K-1006-F cylinder yard
Z2-18	✓	✓	✓		FY 2009 Zone 2 six EUs PCCR	
Z2-19					PCCR or Zone 2 RAR	
Z2-20					PCCR or Zone 2 RAR	
Z2-21					PCCR or Zone 2 RAR	
Z2-22					PCCR or Zone 2 RAR	
Z2-23	✓	✓	✓		FY 2007 PCCR	
Z2-24	✓	✓	✓		FY 2007 PCCR	
Z2-25					PCCR or Zone 2 RAR	

Table 9. Status of Zone 2 EUs (continued)

EU	Characterization complete?	NFA on soil appropriate?	NFA on infrastructure appropriate?[a]	Action required?	Closure documentation?	Comment/ Explanation
Z2-26					PCCR or Zone 2 RAR	
Z2-27	✓	✓	✓		FY 2006 PCCR	
Z2-28	✓	✓	✓	✓	FY 2007 PCCR	Rusty's Mountain soil RA
Z2-29	✓			✓	FY 2009 Zone 2 six EUs PCCR	Soil RA at the K-1407-C Retention Pond and K-1407-C Pond Pipeline FFA Site
Z2-30					PCCR or Zone 2 RAR	
Z2-31					PCCR or Zone 2 RAR	
Z2-32	✓	✓	✓		FY 2010 EU Z2-32 PCCR	
Z2-33	✓	✓	✓		FY 2008 EU Z2-33 PCCR	
Z2-34	✓	✓	✓		FY 2007 PCCR	
Z2-35					PCCR or Zone 2 RAR	
Z2-36	✓	✓	✓		FY 2009 EU Z2-36 PCCR	
Z2-37	✓	✓	✓		FY 2007 PCCR	
Z2-38	✓		✓	✓	FY 2009 Zone 2 six EUs PCCR	Small soil RA at the K-1417-B FFA Site
Z2-39					PCCR or Zone 2 RAR	
Z2-40					PCCR or Zone 2 RAR	
Z2-41	✓	✓	✓	✓	FY 2007 PCCR	
Z2-42	✓	✓	✓	✓	PCCR or Zone 2 RAR	Soil RA complete; K-1004-J Vaults FFA Site requires RA
Z2-43	✓	✓	✓		FY 2007 PCCR	
Z2-44	✓	✓	✓		FY 2007 PCCR	

[a]The check mark in this column indicates either the infrastructure has been evaluated or there is no infrastructure requiring evaluation.

EU = exposure unit
FFA = Federal Facility Agreement
FY = fiscal year
NFA = no further action
PCCR = Phased Construction Completion Report
RA = remedial action
RAR = Remedial Action Report

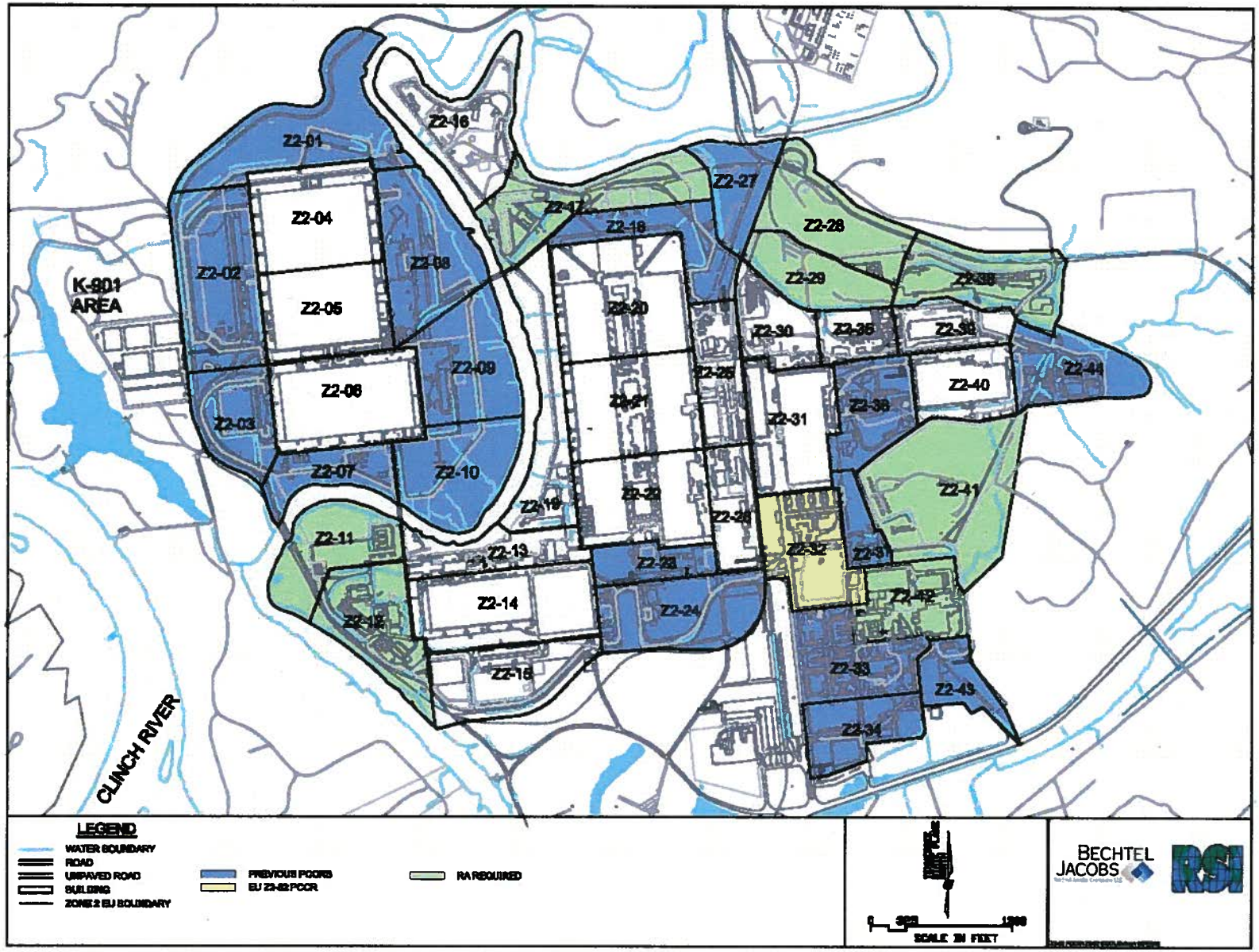


Fig. 8. Status of Zone 2 DVS characterization as of this PCCR.

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APPENDIX A.
MAIN PLANT EXPOSURE UNIT GROUP
ZONE 2 EU 32 TECHNICAL MEMORANDUM

FIGURES

TABLES

EXPOSURE UNIT (EU) GROUP: Zone 2 Main Plant Group EU 32	
	INTRODUCTION
The purpose of this Technical Memorandum (TM) is to document the recommendation for an action/no further action (NFA) decision for Zone 2 EU 32 (EU Z2-32) in the Main Plant EU Group. The recommendation for this EU is based on existing historical data and Dynamic Verification Strategy (DVS) soil characterization activities. These data are used to determine the nature and extent of contamination in the EU and to evaluate the need for an action. When it is determined that an action is necessary, the data also are used to calculate soil volumes for the proposed remedial alternative as identified in the *Record of Decision for Soil, Buried Waste, and Subsurface Structure Actions in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2161&D2) (Zone 2 ROD).	
1.0	**BACKGROUND AND EU SUMMARY**
1.1	**LOCATION AT EAST TENNESSEE TECHNOLOGY PARK (ETTP)**
Exposure Unit Z2-32 is located in the southeast quadrant of Zone 2 in the Main Plant EU Group (Fig. A.1). The EU is bounded on the north by EUs Z2-31 and Z2-37, on the east by EUs Z2-37 and Z2-42, on the south by EU Z2-33 and Zone 1, and on the west by EUs Z2-24 and Z2-26.	
1.2	**EU ACREAGE**
The area of EU Z2-32 is approximately 18.4 acres (Fig. A.2).	
1.3	**SUMMARY DESCRIPTION**
All of the land area in EU Z2-32 has been impacted by site operations, including the construction of buildings, roads, parking lots, sidewalks, and the K-1066-G Cylinder Storage Yard. The Data Quality Objective (DQO) Scoping Package for the Main Plant EU Group lists 32 facilities in the EU. An accounting of facilities in the EU is presented in Table A.1.	
1.4	**SOIL UNITS (SUs)**
Class 1 SU: None **Class 2 SU**: 3.7 acres **Class 3 SU**: 14.7 acres **Class 4 SU**: None The EU Z2-32 soil unit boundaries are shown on Fig. A.2.	
1.5	**ZONE 2 ROD APPENDIX A FEDERAL FACILITY AGREEMENT (FFA) SITES**
There are no FFA sites in EU Z2-32 that are listed in Appendix A of the Zone 2 ROD.	
2.0	**DVS INVESTIGATIONS AND RESULTS**
2.1	**DVS FIELD ACTIVITIES**
The DVS activities were conducted in accordance with the *Remedial Design Report/Remedial Action Work Plan for Zone 2 Soils, Slabs, and Infrastructure, East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2224&D3) (Zone 2 RDR/RAWP).	
2.1.1	**CLASS 1 SUs**
None	

2.1.1.1	**CLASS 1 SU RADIOLOGICAL WALKOVER SURVEY**
None	
2.1.1.2	**CLASS 1 SU GEOPHYSICAL SURVEY**
None	
2.1.1.3	**CLASS 1 SU SOIL SAMPLING**
None	
2.1.2	**CLASS 2 SU**

There is one Class 2 SU in EU Z2-32.

K-1066-G Class 2 SU: The 3.7-acre K-1066-G Class 2 SU is located in the southeast corner of the EU (Fig. A.2). The boundaries of this SU were defined to encompass the boundaries of the K-1066-G Cylinder Storage Yard that was used for storage of UF_6 cylinders and, more recently, for storage of contaminated and uncontaminated equipment, vehicles, and wastes.

2.1.2.1	**CLASS 2 SU RADIOLOGICAL WALKOVER SURVEY**

A radiation walkover survey was conducted over the entire K-1066-G Class 2 SU between August 31 and September 3, 2009. The survey and results are described in the *FY 2009 Walkover Assessments and Radiological Surveys for Exposure Units in Zones 1 and 2, East Tennessee Technology Park, Oak Ridge, Tennessee* (BJC/OR-3157) (Assessment Report). In summary, one location, a small depression that had been marked as a contamination area, exceeded the radiation walkover survey action level (AL) [2880 counts per minute (cpm)] with a radiation reading of 3475 cpm. The depression was filled with water during the radiation walkover survey. A resurvey of the location when it was dry resulted in a radiation reading of 5410 cpm.

With Remedial Action (RA) Core Team concurrence, the location of the AL exceedance in the K-1066-G Class 2 SU was addressed by a RA. The area of elevated radioactivity was excavated and a confirmation sample was collected and analyzed for radionuclides (see Sect. 2.2.5 for the analytical results).

2.1.2.2	**CLASS 2 SU GEOPHYSICAL SURVEY**
None	
2.1.2.3	**CLASS 2 SU SOIL SAMPLING**

K-1066-G Class 2 SU: Twenty DVS systematic grid sample locations were identified in the K-1066-G Class 2 SU during DQO scoping. Actual DVS sampling in the K-1066-G Class 2 SU included the following:

- 20 systematic grid sample locations
- A confirmation sample location at the area excavated because of a radiation walkover survey AL exceedance

Details of the actual sampling and analysis in the Class 2 SU, including sample depths, analytes, and deviations from the planned sampling, are presented in Table A.2.

2.1.3	**CLASS 3 AND CLASS 4 SU WALKOVER ASSESSMENT**

The protocol used for addressing the Class 3 and Class 4 SUs in EU Z2-32 is the *Class 3 and Class 4 Soil Unit Walkover Inspection Protocol*, Revision 1 (found in Appendix A of the Zone 2 RDR/RAWP). The purpose of the Class 3 SU walkover assessments is to systematically inspect Class 3 SUs by visual observation along transects to established grid assessment locations, map observed features, and collect radiological screening data at grid and discretionary locations. Details of the walkover assessment results for this EU are presented in the Assessment Report. A summary of the report results is presented below in Sects. 2.1.3.1 and 2.1.3.2. Class 3 SU boundaries are

shown on Fig. A.2. The assessment point (AP), mid-point (MP), and discretionary point (DP) locations are shown on Fig. A.3.

Thirteen APs were identified in this EU prior to the start of fieldwork and are documented in the DQO Scoping Package. The actual number of APs evaluated in the EU is presented in the following table.

	Number of APs	Number of MPs	Number of DPs
EU Z2-32	13	12	5

AP = assessment point EU = exposure unit
DP = discretionary point MP = mid-point

In addition to the APs, the field team made an assessment at 12 MP locations, which are selected in the field and located approximately half way between APs, and conducted discretionary surveys at 5 locations (see below). Mid-point and DP locations were not specified in planning documents.

2.1.3.1 CLASS 3 AND CLASS 4 SU RADIOLOGICAL SURVEY SUMMARY

Screening level (SL): 4278 cpm

SL exceedances: None

2.1.3.2 CLASS 3 AND CLASS 4 SU ANTHROPOGENIC FEATURES

Number of identified anthropogenic features: 6

Exposure unit Z2-32 is located in an industrialized portion of ETTP where there are numerous anthropogenic features, including facilities and associated constructed features such as roads, sidewalks, and paved areas. Plant facilities and their associated constructed features are assessed as part of the Class 3 and Class 4 SU Walkover Assessment protocol (Sect. 2.1.3.3). Other than plant facilities and associated constructed features, six anthropogenic features identified in EU Z2-32 during the Class 3 SU walkover assessment include the following:

- Plastic storage shed
- Contamination area inside of the K-1066-G Class 2 SU
- Diesel spill area
- Temporary field office
- Ten mini-mobile storage units
- Six mini-mobile storage units

2.1.3.3 CLASS 3 SU FACILITIES ASSESSMENTS

Thirty-two facilities are listed in the DQO scoping package as being located in EU Z2-32 and 41 facilities were assessed during the Class 3 SU walkover assessment (Table A.1). The facility assessments are reported in the Assessment Report. In summary, no facility was identified during the assessment as a possible source for either chemical or radiological contamination. The K-1066-G Cylinder Storage Yard is identified as a facility in the DQO Scoping Package and was addressed as a Class 2 SU.

2.1.3.4 CLASS 3 SU BIASED SAMPLING

Based on visual assessment of each anthropogenic feature for evidence of possible contamination and radiation survey results, no biased sample locations were selected during the Class 3 SU walkover assessment.

One DVS Class 3 SU biased sample location was identified in EU Z2-32 during DQO scoping. The sample location was specified to be an available access point to the K-1204-01 Sewage Ejector Station. However, inspection of the sewage ejection station showed that no sediment was available for sampling, and the RA Core Team concurred to delete that sample.

2.2 DVS AND HISTORICAL SAMPLE RESULTS

Sample data for DVS and historical sampling in EU Z2-32 are summarized in Table A.3. The total number of samples referred to in the table is a combination of all sample results. The presentation of sample results in Sect. 2.2.5 summarizes the subsets of Table A.3 by presenting pertinent results for focused characterization within the EU. Sample locations are shown on Fig. A.4. A compact disc (CD) containing electronic files for the historical and DVS analytical data used to generate the data tables is provided with this Phased Construction Completion Report (PCCR).

2.2.1 CLASS 1 SUS

None

2.2.2 CLASS 2 SUS

There are 25 DVS and historical sample locations in the Class 2 SU in EU Z2-32. Historical sampling was conducted during the 1995 K-25 Radiological Walkover Survey. The Class 2 SU sample locations are shown on Fig. A.4 and are summarized below. All samples from the Class 2 SU sample locations were collected from the 0- to 10-ft-depth interval.

DVS sample locations	Historical sample locations
K-1066-G Class 2 SU Systematic Grid Locations: Z2-EU32-200, Z2-EU32-201, Z2-EU32-202, Z2-EU32-203, Z2-EU32-204, Z2-EU32-205, Z2-EU32-206, Z2-EU32-207, Z2-EU32-208, Z2-EU32-209, Z2-EU32-210, Z2-EU32-211, Z2-EU32-212, Z2-EU32-213, Z2-EU32-214, Z2-EU32-215, Z2-EU32-216, Z2-EU32-217, Z2-EU32-218, Z2-EU32-219 **Confirmation Location At Excavation:** Z2-EU32B-301[a]	**K-1066-G Class 2 SU Historical Locations:** KAD-SS-S11, KAD-SS-S21, KAD-SS-S31, KAD-SS-S41, KAD-SS-S51

[a]This is a Class 2 SU sample location even though the location identifier indicates a Class 3 SU origin.

DVS = Dynamic Verification Strategy
SU = soil unit

Sampling and analytical details for each sample location are presented in Table A.2. The analytical data are summarized in Table A.3 and the analytical results for samples collected from the 0- to 10-ft-depth interval are evaluated in Sect. 2.2.5. The number of analyses conducted in the Class 2 SU is presented below by analyte group.

Metals	PPCBs	Radionuclides	SVOCs	VOCs
20	20	10	4	4

PPCB = pesticide and polychlorinated biphenyl
SVOC = semivolatile organic compound
VOC = volatile organic compound

2.2.3 CLASS 3 SUS

There are 17 historical sample locations in the EU Z2-32 Class 3 SU. Historical sampling was conducted for the Reindustrialization Program, Sitewide Residual Contamination RI, and the K-1070-C/D RI. The Class 3 SU sample locations are shown on Fig. A.4 and are summarized below. Samples were collected from the 0- to 10-ft-depth interval unless indicated otherwise.

DVS sample locations	Historical sample locations
None	020-RAD-01N, 020-RAD-01W, 4J-MET-01N[a], 4J-P-01N[a], 4J-P-01W[a], 4J-VOC-01N[a], 4J-VOC-01W[a], BH009[b], BH010, K1035-DPT-001[c], K1070CD-DPT-01[c], K1070CD-DPT-03[c], K1200-09, K1200-10, RR-S01, RR-SS01, SB-100[b]

[a]These are listed as separate sample locations in OREIS but actually represent designations for different analyses of the same sample from the same sample location.
[b]Samples were collected from the 0- to 10-ft and > 10-ft-depth intervals at these locations.
[c]Samples were collected from the > 10-ft-depth interval at these locations.

DVS = Dynamic Verification Strategy

Numbers of samples collected and sampling intervals at each location varied as did the chemicals and radionuclides that were analyzed. The sampling and analytical details for each sample location are presented in Table A.2, the analytical data are summarized in Tables A.3 and A.4, and the analytical results for the 0- to 10-ft-depth interval are evaluated in Sect. 2.2.5. The number of analyses conducted in the Class 3 SU, including samples collected at > 10 ft, is presented below by analyte group.

Metals	Other organics[a]	PPCBs[b]	Radionuclides	SVOCs	VOCs
3	1	4	2	2	7

[a]Includes Diesel Range Organics and Gasoline Range Organics.
[b]Includes two pesticide analyses.

PPCB = pesticide and polychlorinated biphenyl
SVOC = semivolatile organic compound
VOC = volatile organic compound

2.2.4 INFRASTRUCTURE

No infrastructure sampling was conducted in EU Z2-32.

2.2.5 EU EVALUATION

In this section, characterization data are evaluated for EU Z2-32. Analytical data presented in the following summaries are presented by analyte group and results for a particular analyte group are summarized only if that group was analyzed in the samples from the unit being summarized. Within each summary, the data are evaluated by comparing to certain criteria, including the Zone 2 soils maximum remediation level (Max RL), Zone 2 soils average remediation level (Avg RL), 1×10^{-5} industrial preliminary remediation goal (Ind PRG), ETTP soils background composition (Bkg), Zone 2 groundwater screening levels (GW SL), and 1×10^{-6} residential preliminary remediation goal (Res PRG). If a particular criterion does not apply to any member of an analyte group, it is not tabulated for that analyte group; if a particular criterion does not apply to all analytes within an analyte group, those analytes to which it does not apply are notated with NA (not applicable). Individual metals and radionuclides, which are naturally occurring, are reported in the summaries only if one or more criterion is exceeded. Organic chemicals, which are not naturally occurring, are reported if they are detected even if no criteria are exceeded. The Max RL, Avg RL, Ind PRG, Bkg, GW SL, and Res PRG criteria values as they pertain to the analytes listed in Appendix A of the RDR/RAWP [i.e., Quality Assurance Program Plan (QAPP)] are presented in Sect. 3.1 of this PCCR.

Because the carcinogenic risk associated with the concentrations of radium and thorium isotopes in the natural background at ETTP exceeds the cumulative risk goal of 1×10^{-4}, RL values for these radionuclides are based on alternative concentration levels rather than risk. The alternative concentration levels of 5 pCi/g above background (Avg RL) and 15 pCi/g above background (Max RL) were set as low as reasonably achievable under the site-specific conditions. Because site-specific background concentrations of these radionuclides exceed the target risk range, residual concentrations of these radionuclides and their decay series are not considered in the estimates of residual risk following any remedial action.

The Zone 2 ROD states that Avg RL and Max RL exceedances by Ra-226, Th-230, and Th-232 will be evaluated by summing above-background concentrations of the greater of Ra-226 or Th-230 with the above-background

concentrations of Th-232 and comparing the results to 5 pCi/g (Avg RL) and 15 pCi/g (Max RL). These required calculations have been performed. Average and Max RL exceedances for these radionuclides, if any, are reported in the TM data summaries below and in Table A.2 as "Ra/Th decay series", and individual RL exceedances by Ra-226, Th-230, and Th-232 are reported as NA. The Ra/Th decay series data are summarized in the sections that follow only if an Avg or Max RL has been exceeded, consistent with the description in the preceding paragraph for reporting radionuclides. Discussion of the Ra/Th decay series calculation, including the manner in which the calculation is performed, is presented in Sect. 3.3 of this PCCR.

EU Z2-32 Conceptual Site Model (CSM)

The Main Plant EU Group DQO Scoping Package identified one Class 2 SU (K-1066-G Cylinder Storage Yard in the southern portion of the EU) in the EU and classified the remaining land area as a Class 3 SU. The CSM for the EU is dominated by the K-1066-G Cylinder Storage Yard, which has a surface release model where possible contaminants may include radioactive contamination from equipment and metallic debris stored in the yard and fuels and other organic compounds that may have been released to surface soils.

The K-1066-G Cylinder Storage Yard has most recently been used as a laydown yard for storing and staging machinery, equipment, supplies, and excess metallic debris. The yard is a centrally located open area on a small hill south of the K-1401 building and across from the vehicle maintenance facility and fuel station. Possible releases may have occurred in the yard over the period of operation because of weathering of surface contamination from the stored equipment and debris. Releases would have been low-concentration and low-volume releases to surface soils. Suspected contaminants include metals, radionuclides, polychlorinated biphenyls (PCBs) associated with paint, and fluids and fuels associated with equipment and machinery.

The impact of contaminant releases to surface soils is expected to have affected isolated spots or areas in proximity to the release points. There are no surface-receiving water drainage features in proximity to the site.

The potential impact to groundwater is considered unlikely due to the limited total contaminant mass of potential releases from this site. The potential for airborne transport is considered unlikely due to the limited total contaminant mass of potential releases from this site.

EU Z2-32 Groundwater Evaluation

The topography across the site is defined by high ground in the south and a lower broad flat area across the northern portion of the EU that merges with the general elevation of the north portion of Zone 2. The higher ground in the southern portion of the EU is a flat topped small hill that extends from the high point further to the east and slopes toward the southwest across the EU.

There are six groundwater monitoring wells and six temporary drive point piezometers in the EU. All of the groundwater monitoring locations are in the low flat area in the north portion of the EU. A local groundwater divide corresponds to the crest of the small hill in the south portion of the EU. Groundwater flow is from the divide toward the north, groundwater gradients are low, and flow rates are low. Ultimate discharge is into Mitchell Branch.

There are no sources of groundwater contamination within the EU. Contamination is present in the groundwater across the northern portion of the EU. The source of the contaminant plume is associated with the K-1070-G Pit that was located in EU Z2-41 to the east of EU Z2-32. High levels of organic compounds are present in the plume, predominantly tetrachloroethene and trichloroethene and their degradation products dichloroethene and vinyl chloride.

EU Z2-32 Sampling Results

The land area in EU Z2-32 (18.4 acres) was classified into one Class 2 and one Class 3 SU. The K-1066-G Class 2 SU corresponds to the K-1066-G Cylinder Storage Yard and the remainder of the EU is a Class 3 SU. There are no FFA sites in EU Z2-32.

The Class 3 SU area in this EU was evaluated using a DVS Class 3 SU walkover assessment and historical sampling. There are 17 historical sample locations from the Reindustrialization Program, the Sitewide Residual Contamination RI, and the K-1070-C/D RI.

Summaries of sampling results for the EU in the 0- to 10-ft-depth interval are provided in the following sections. Data summarized are for samples collected at the locations presented in Sects. 2.2.2 and 2.2.3. The summaries begin with presentations of analytical results for the focused investigation areas in the EU, which are discussed below and include the K-1066-G Class 2 SU and the area in the Class 2 SU that was excavated in response to a radiation walkover survey AL exceedance. Analytical results from the remaining sample locations, although not strictly focused investigations, also are summarized below. Following the focused investigation summaries is an EU summary with data summary tables and a written description of the current nature and extent of chemicals and radionuclides observed in the EU. Sample locations are shown on Fig. A.3 and details of sampling at each location, including sample depths and analytes, are presented in Table A.2. The data presented below are evaluated against the Zone 2 ROD decision criteria in Sect. 3.

K-1066-G Class 2 SU: The 0- to 10-ft-depth interval of the K-1066-G Class 2 SU was addressed using 20 DVS systematic grid sample locations, one DVS biased sample location at the point of a radiation walkover survey AL exceedance, and five historical sample locations (Sect. 2.2.2). Analytical results for DVS and historical sampling in the 0- to 10-ft-depth interval at the K-1066-G Class 2 SU are summarized below and show radionuclide Ind PRG and Bkg exceedances, metal Bkg exceedances, and detections of PCBs, semivolatile organic compounds (SVOCs), and volatile organic compounds (VOCs).

EU Z2-32 K-1066-G CLASS 2 SU METALS WITH BACKGROUND, PRG, GW SL, AND/OR RL EXCEEDANCES (mg/kg) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria					
						Max RL	Avg RL	Ind PRG	Bkg	GW SL	Res PRG
Aluminum	20/20	6,000	22,000	Z2-EU32-212	12,580	NA	NA	0	0	NA	17
Arsenic	20/20	1.2	8.8	Z2-EU32-212	3.92	0	0	0	0	0	20
Barium	20/20	41	490J	Z2-EU32-207	87.8	NA	NA	0	1	0	0
Cadmium	20/20	0.3	0.66	Z2-EU32-215	0.442	NA	NA	0	20	NA	0
Calcium	20/20	2,800J	160,000J	Z2-EU32-215	45,370	NA	NA	NA	20	NA	NA
Chromium	20/20	8.9	41J	Z2-EU32-217	19.5	NA	NA	0	0	0	6
Copper	20/20	11J	49	Z2-EU32-212	24.3	NA	NA	0	11	NA	0
Iron	20/20	17,000	57,000	Z2-EU32-212	32,800	NA	NA	0	0	NA	20
Lead	20/20	8.4	53	Z2-EU32-207	20.5	NA	NA	0	2	0	0
Magnesium	20/20	870J	45,000J	Z2-EU32-215	13,849	NA	NA	NA	14	NA	NA
Manganese	20/20	280	2,400J	Z2-EU32-217	740	NA	NA	0	1	NA	20
Nickel	20/20	6J	39J	Z2-EU32-215	18.7	NA	NA	0	3	NA	0
Selenium	8/20	0.71	2.1	Z2-EU32-201	1.35	NA	NA	0	2	NA	0
Uranium	20/20	0.68	2	Z2-EU32-211 Z2-EU32-212	1.42	NA	NA	0	NA	NA	9
Vanadium	20/20	15	55	Z2-EU32-212	30.2	NA	NA	0	0	NA	20

Avg = average
Bkg = background
EU = exposure unit
GW = groundwater
Ind = industrial
J = analyte was identified and result is approximate concentration
Max = maximum
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level
SU = soil unit

EU Z2-32 K-1066-G CLASS 2 SU PPCB DETECTS (ug/kg) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria			
						Max RL	Avg RL	Ind PRG	Res PRG
PCB-1254	4/20	220	430	Z2-EU32-201	305	0	0	0	4
Polychlorinated biphenyl	4/20	220	430	Z2-EU32-201	305	0	0	0	4

Avg = average
EU = exposure unit
Ind = industrial
Max = maximum
PRG = preliminary remediation goal
PPCB = pesticide and polychlorinated biphenyl
Res = residential
RL = remediation level
SU = soil unit

EU Z2-32 K-1066-G CLASS 2 SU RADIONUCLIDES WITH BACKGROUND, PRG, AND/OR RL EXCEEDANCES (pCi/g) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria					
						Max RL	Avg RL	Ind PRG	Bkg	GW SL	Res PRG
Potassium-40	4/4	10.1	28.5	Z2-EU32-208	22.9	NA	NA	4	0	NA	4
Thorium-228	8/9	0.39	1.4	KAD-SS-S41	0.939	NA	NA	8	0	NA	8
Thorium-230	9/9	0.27	1.9	KAD-SS-S11	1.02	NA	NA	0	2	NA	0
Thorium-232	9/9	0.26	2.1	KAD-SS-S41	0.983	NA	NA	9	1	NA	9
Uranium-238	8/9	0.5	1.59	Z2-EU32-219	0.984	0	0	0	1	0	6

Avg = average
Bkg = background
EU = exposure unit
GW = groundwater
Ind = industrial
Max = maximum
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level
SU = soil unit

EU Z2-32 K-1066-G CLASS 2 SU SVOC DETECTS (ug/kg) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria		
						Ind PRG	GW SL	Res PRG
Benz(a)anthracene	1/4	190J	190J	Z2-EU32-202	190	0	NA	0
Benzo(a)pyrene	1/4	200J	200J	Z2-EU32-202	200	0	NA	1
Benzo(b)fluoranthene	1/4	260J	260J	Z2-EU32-202	260	0	NA	0
Benzo(ghi)perylene	1/4	180J	180J	Z2-EU32-202	180	0	NA	0
Benzo(k)fluoranthene	1/4	110J	110J	Z2-EU32-202	110	0	NA	0
Chrysene	1/4	200J	200J	Z2-EU32-202	200	0	NA	0
Fluoranthene	2/4	98J	290J	Z2-EU32-202	194	0	NA	0
Indeno(1,2,3-cd)pyrene	1/4	140J	140J	Z2-EU32-202	140	0	NA	0
Pyrene	1/4	870J	870J	Z2-EU32-202	870	0	NA	0

EU = exposure unit
GW = groundwater
Ind = industrial
J = analyte was identified and result is approximate concentration
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level
SVOC = semivolatile organic compound
SU = soil unit

EU Z2-32 K-1066-G CLASS 2 SU VOC DETECTS (ug/kg) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria		
						Ind PRG	GW SL	Res PRG
Acetone	1/4	8.4J	8.4J	Z2-EU32-202	8.4	0	NA	0

EU = exposure unit
GW = groundwater
Ind = industrial
J = analyte was identified and result is approximate concentration
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level
VOC = volatile organic compound

K-1066-G Class 2 SU Excavated Area Confirmation Sampling: One sample location in the K-1066-G Class 2 SU (Sect. 2.2.2) was selected to confirm that the excavation of the soil area with the radiation walkover survey AL exceedance (Sect. 2.1.2.1) successfully removed potential radionuclide contamination. Analytical results from this sample location summarized below show potassium-40, thorium-228, and thorium-232 Ind PRG exceedances and a thorium-230 Bkg exceedance. In summary, the Ind PRG and Bkg exceedances are for radionuclides that require special handling for risk evaluation. Based on the data evaluation in Sect. 3.3, it is concluded the RA removed any possible radiological contaminants from the area of excavation.

EU Z2-32 K-1066-G CLASS 2 SU EXCAVATION CONFIRMATION SAMPLING RADIONUCLIDES WITH BACKGROUND, PRG, AND/OR RL EXCEEDANCES (pCi/g) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria					
						Max RL	Avg RL	Ind PRG	Bkg	GW SL	Res PRG
Potassium-40	1/1	32	32	Z2-EU32-301	32	NA	NA	1	0	NA	1
Thorium-228	1/1	1.42J	1.42J	Z2-EU32-301	1.42	NA	NA	1	0	NA	1
Thorium-230	1/1	1.64J	1.64J	Z2-EU32-301	1.64	NA	NA	0	1	NA	0
Thorium-232	1/1	1.64J	1.64J	Z2-EU32-301	1.64	NA	NA	1	0	NA	1
Uranium-235	1/2	0.277J	0.277J	Z2-EU32-301	0.277	0	0	0	NA	0	1

Avg = average
Bkg = background
EU = exposure unit
GW = groundwater
Ind = industrial
J = analyte was identified and result is approximate concentration
Max = maximum
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level
SU = soil unit

Other Class 3 SU Historical Sampling: There are 17 historical sample locations in EU Z2-32 that do not address a specific focused investigation area (Sect. 2.2.3). Analytical results summarized below for samples collected at the 17 locations indicate one metal (arsenic) and several radionuclide Ind PRG exceedances, metal and radionuclide Bkg exceedances, and detections of PCBs, SVOCs, and VOCs.

EU Z2-32 OTHER CLASS 3 SU METALS WITH BACKGROUND, PRG, GW SL, AND/OR RL EXCEEDANCES (mg/kg) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria					
						Max RL	Avg RL	Ind PRG	Bkg	GW SL	Res PRG
Aluminum	6/6	1,830J	36,500	RR-S01	16,510	NA	NA	0	0	NA	4
Antimony	2/6	0.47J	9.33J	RR-S01	4.9	NA	NA	0	1	0	1
Arsenic	3/6	4.47J	22.9J	RR-S01	11	0	0	1	1	0	3
Barium	6/6	49.5	173	RR-S01	86.3	NA	NA	0	1	0	0
Cadmium	3/6	0.348J	1.69J	RR-S01	1.15	NA	NA	0	3	NA	0
Calcium	6/6	289	2,920	K1200-09	1795	NA	NA	NA	2	NA	NA
Chromium	6/6	4.55J	39.3	K1200-09	20.5	NA	NA	0	0	0	2
Copper	6/6	23.2J	56.7	4J-MET-01N	38.9	NA	NA	0	6	NA	0

EU Z2-32 OTHER CLASS 3 SU METALS WITH BACKGROUND, PRG, GW SL, AND/OR RL EXCEEDANCES (mg/kg) 0-10 ft (continued)

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria					
						Max RL	Avg RL	Ind PRG	Bkg	GW SL	Res PRG
Iron	6/6	3,890	38,500J	RR-SS01	23,482	NA	NA	0	0	NA	6
Manganese	6/6	418	3,130	RR-S01	1,192	NA	NA	0	1	NA	6
Nickel	6/6	16.7J	116J	4J-MET-01N	52.6	NA	NA	0	4	NA	0
Potassium	6/6	393	5,580	RR-S01	2,381	NA	NA	NA	1	NA	NA
Selenium	3/5	0.437J	13.5J	RR-SS01	6.39	NA	NA	0	2	NA	0
Silver	2/5	0.88	1.1	SB100	0.99	NA	NA	0	2	NA	0
Vanadium	5/5	7.02J	64.8	RR-S01	31.3	NA	NA	0	0	NA	4
Zinc	6/6	30.9J	132J	4J-MET-01N	81.8	NA	NA	0	3	NA	0

Avg = average
Bkg = background
EU = exposure unit
GW = groundwater
Ind = industrial
J = analyte was identified and result is approximate concentration
Max = maximum
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level
SU = soil unit

Diesel range organics (DRO) and gasoline range organics (GRO) were analyzed for in two samples but were not detected.

EU Z2-32 OTHER CLASS 3 SU PPCB DETECTS (ug/kg) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria			
						Max RL	Avg RL	Ind PRG	Res PRG
PCB-1254	4/7	0.028J	0.45	RR-SS01	0.138	0	0	0	0
PCB-1260	1/7	180	180	K1200-09	180	0	0	0	1

Avg = average
EU = exposure unit
Ind = industrial
J = analyte was identified and result is approximate concentration
Max = maximum
PRG = preliminary remediation goal
PPCB = pesticide and polychlorinated biphenyl
Res = residential
RL = remediation level
SU = soil unit

EU Z2-32 OTHER CLASS 3 SU RADIONUCLIDES WITH BACKGROUND, PRG, AND/OR RL EXCEEDANCES (pCi/g) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria					
						Max RL	Avg RL	Ind PRG	Bkg	GW SL	Res PRG
Cesium-137	5/7	0.12J	0.54	020-RAD-01W	0.279	0	0	0	NA	NA	5
Cobalt-60	3/7	0.01J	0.04	020-RAD-01N 020-RAD-01W	0.03	NA	NA	0	NA	NA	2
Potassium-40	1/1	32.85	32.85	BH009	32.8	NA	NA	1	1	NA	1
Technetium-99	4/8	0.75J	1.67J	RR-SS01	1.27	NA	NA	0	NA	NA	4
Thorium-228	4/5	0.09J	1.15	BH009	0.382	NA	NA	2	0	NA	4
Thorium-230	5/5	0.08J	3.09J	BH009	0.742	NA	NA	0	1	NA	0
Thorium-232	4/5	0.08	1.58J	BH009	0.483	NA	NA	1	0	NA	4
Uranium-235	6/7	0.0713J	0.579	K1200-10	0.177	0	0	0	NA	0	1
Uranium-238	7/7	1.13J	3.52	BH009	1.67	0	0	0	3	0	7

Avg = average
Bkg = background
EU = exposure unit
GW = groundwater
Ind = industrial
J = analyte was identified and result is approximate concentration
Max = maximum
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level
SU = soil unit

EU Z2-32 OTHER CLASS 3 SU SVOC DETECTS (ug/kg) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria		
						Ind PRG	GW SL	Res PRG
2-Methylnaphthalene	1/6	310J	310J	K1200-10	310	0	NA	0
Anthracene	1/6	0.053J	0.053J	RR-S01	0.053	0	NA	0
Benz(a)anthracene	2/6	0.58	86J	K1200-10	43.3	0	NA	0
Benzo(a)pyrene	4/6	0.094J	100J	K1200-10	39	0	NA	1
Benzo(b)fluoranthene	4/6	0.13J	120J	K1200-10	42.8	0	NA	0
Benzo(ghi)perylene	4/6	0.34J	88J	K1200-10	33.9	0	NA	0
Benzo(k)fluoranthene	4/6	0.088J	85J	K1200-10	34.5	0	NA	0
Butyl benzyl phthalate	1/6	110J	110J	K1200-10	110	0	NA	0
Chrysene	5/6	0.053J	120J	K1200-10	34	0	NA	0
Dibenz(a,h)anthracene	1/6	0.1J	0.1J	BH010	0.1	0	NA	0
Dibenzofuran	1/6	78J	78J	K1200-10	78	0	NA	0
Dimethyl phthalate	1/6	0.081J	0.081J	BH010	0.081	0	NA	0
Di-n-butyl phthalate	1/6	2,400	2400	K1200-10	2,400	0	NA	0
Fluoranthene	5/6	0.045J	150J	K1200-10	46.3	0	NA	0
Indeno(1,2,3-cd)pyrene	3/6	0.3J	73J	K1200-10	24.6	0	NA	0

EU Z2-32 OTHER CLASS 3 SU SVOC DETECTS (ug/kg) 0-10 ft (continued)

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria		
						Ind PRG	GW SL	Res PRG
Naphthalene	1/6	210J	210J	K1200-10	210	0	NA	0
Phenanthrene	2/6	0.049J	200J	K1200-10	100	0	NA	0
Pyrene	5/6	0.064J	150J	K1200-10	45.8	0	NA	0

EU = exposure unit
GW = groundwater
Ind = industrial
J = analyte was identified and result is approximate concentration
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level
SVOC = semivolatile organic compound

EU Z2-32 OTHER CLASS 3 SU VOC DETECTS (ug/kg) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria		
						Ind PRG	GW SL	Res PRG
1,1,2-Trichloro-1,2,2-trifluoroethane	1/3	0.001J	0.001J	BH010	0.001	0	NA	0
Methylene chloride	3/8	0.0026J	8	SB100	2.67	0	0	0

EU = exposure unit
GW = groundwater
Ind = industrial
J = analyte was identified and result is approximate concentration
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level
VOC = volatile organic compound

EU Z2-32 Summary: This section presents a summary of the current nature and extent of contamination in the 0- to 10-ft-depth interval by combining all analytical data presented above for this EU. Details of the sampling and analysis are presented in Table A.2 and the sample locations are shown on Fig. A.4. There are 21 DVS and 2 historical sample locations with samples in the 0- to 10-ft-depth interval in the EU. Analytical data from the 43 sample locations are included in the focused investigation summaries above. All the data are combined in this section and summarized below. In addition, samples collected in the 0- to 10-ft-depth interval are summarized in Table A.3 and samples collected from the > 10-ft-depth interval are summarized in Table A.4. Analytical data for the 43 locations with samples in the 0- to 10-ft-depth interval show one metal (arsenic) and several radionuclide Ind PRG exceedances, metal and radionuclide Bkg exceedances, and detections of PCBs, SVOCs, and VOCs.

EU Z2-32 METALS WITH BACKGROUND, PRG, GW SL, AND/OR RL EXCEEDANCES (mg/kg) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria					
						Max RL	Avg RL	Ind PRG	Bkg	GW SL	Res PRG
Aluminum	26/26	1,830J	36,500	RR-S01	13,487	NA	NA	0	0	NA	21
Antimony	22/26	0.16J	9.33J	RR-S01	0.72	NA	NA	0	1	0	1
Arsenic	23/26	1.2	22.9J	RR-S01	4.84	0	0	1	1	0	23
Barium	26/26	41	490J	Z2-EU32-207	87.4	NA	NA	0	2	0	0
Cadmium	23/26	0.3	1.69J	RR-S01	0.534	NA	NA	0	23	NA	0
Calcium	26/26	289	160,000J	Z2-EU32-215	35,314	NA	NA	NA	22	NA	NA
Chromium	26/26	4.55J	41J	Z2-EU32-217	19.8	NA	NA	0	0	0	8
Copper	26/26	11J	56.7	4J-MET-01N	27.7	NA	NA	0	17	NA	0
Iron	26/26	3,890	57,000	Z2-EU32-212	30,650	NA	NA	0	0	NA	26
Lead	25/26	7.6	53	Z2-EU32-207	21	NA	NA	0	2	0	0
Magnesium	26/26	387	45,000J	Z2-EU32-215	11,071	NA	NA	NA	14	NA	NA
Manganese	26/26	280	3,130	RR-S01	844	NA	NA	0	2	NA	26
Nickel	26/26	6J	116J	4J-MET-01N	26.6	NA	NA	0	7	NA	0
Potassium	26/26	393	5,580	RR-S01	1,878	NA	NA	NA	1	NA	NA
Selenium	11/25	0.437J	13.5J	RR-SS01	2.73	NA	NA	0	4	NA	0
Silver	4/25	0.12J	1.1	SB100	0.558	NA	NA	0	2	NA	0

EU Z2-32 METALS WITH BACKGROUND, PRG, GW SL, AND/OR RL EXCEEDANCES (mg/kg) 0-10 ft (continued)

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria					
						Max RL	Avg RL	Ind PRG	Bkg	GW SL	Res PRG
Uranium	20/20	0.68	2	Z2-EU32-212	1.42	NA	NA	0	NA	NA	9
Vanadium	25/25	7.02J	64.8	RR-S01	30.4	NA	NA	0	0	NA	24
Zinc	26/26	23	132J	4J-MET-01N	55.1	NA	NA	0	3	NA	0

Avg = average
Bkg = background
EU = exposure unit
GW = groundwater
Ind = industrial
J = analyte was identified and result is approximate concentration
Max = maximum
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level

DRO and GRO were analyzed for in two samples but were not detected.

EU Z2-32 PPCB DETECTS (ug/kg) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria			
						Max RL	Avg RL	Ind PRG	Res PRG
PCB-1254	8/27	0.028J	430	Z2-EU32-201	153	0	0	0	4
PCB-1260	1/27	180	180	K1200-09	180	0	0	0	1
Polychlorinated biphenyl	4/20	220	430	Z2-EU32-201	305	0	0	0	4

Avg = average
EU = exposure unit
Ind = industrial
J = analyte was identified and result is approximate concentration
Max = maximum
PRG = preliminary remediation goal
PPCB = pesticide and polychlorinated biphenyl
Res = residential
RL = remediation level

EU Z2-32 RADIONUCLIDES WITH BACKGROUND, PRG, AND/OR RL EXCEEDANCES (pCi/g) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria					
						Max RL	Avg RL	Ind PRG	Bkg	GW SL	Res PRG
Cesium-137	5/17	0.12J	0.54	020-RAD-01W	0.279	0	0	0	NA	NA	5
Cobalt-60	3/17	0.01J	0.04	020-RAD-01N 020-RAD-01W	0.03	NA	NA	0	NA	NA	2
Potassium-40	6/6	10.1	32.85	BH009	26.1	NA	NA	6	1	NA	6
Technetium-99	4/18	0.75J	1.67J	RR-SS01	1.27	NA	NA	0	NA	NA	4
Thorium-228	13/15	0.09J	1.42J	Z2-EU32-301	0.804	NA	NA	11	0	NA	13
Thorium-230	15/15	0.08J	3.09J	BH009	0.968	NA	NA	0	4	NA	0
Thorium-232	14/15	0.08	2.1	KAD-SS-S41	0.887	NA	NA	11	1	NA	14
Uranium-235	6/17	0.0713J	0.579	K1200-10	0.177	0	0	0	NA	0	1
Uranium-238	16/17	0.5	3.52	BH009	1.42	0	0	0	5	0	14

Avg = average
Bkg = background
EU = exposure unit
GW = groundwater
Ind = industrial
J = analyte was identified and result is approximate concentration
Max = maximum
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level

EU Z2-32 SVOC DETECTS (ug/kg) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria		
						Ind PRG	GW SL	Res PRG
2-Methylnaphthalene	1/10	310J	310J	K1200-10	310	0	NA	0
Anthracene	1/10	0.053J	0.053J	RR-S01	0.053	0	NA	0
Benz(a)anthracene	3/10	0.58	190J	Z2-EU32-202	92.2	0	NA	0
Benzo(a)pyrene	5/10	0.094J	200J	Z2-EU32-202	71.2	0	NA	2
Benzo(b)fluoranthene	5/10	0.13J	260J	Z2-EU32-202	86.2	0	NA	0
Benzo(ghi)perylene	5/10	0.34J	180J	Z2-EU32-202	63.1	0	NA	0
Benzo(k)fluoranthene	5/10	0.088J	110J	Z2-EU32-202	49.6	0	NA	0
Butyl benzyl phthalate	1/10	110J	110J	K1200-10	110	0	NA	0
Chrysene	6/10	0.053J	200J	Z2-EU32-202	61.7	0	NA	0
Dibenz(a,h)anthracene	1/10	0.1J	0.1J	BH010	0.1	0	NA	0
Dibenzofuran	1/10	78J	78J	K1200-10	78	0	NA	0
Dimethyl phthalate	1/10	0.081J	0.081J	BH010	0.081	0	NA	0
Di-n-butyl phthalate	1/10	2,400	2,400	K1200-10	2,400	0	NA	0
Fluoranthene	7/10	0.045J	290J	Z2-EU32-202	88.5	0	NA	0
Indeno(1,2,3-cd)pyrene	4/10	0.3J	140J	Z2-EU32-202	53.4	0	NA	0
Naphthalene	1/14	210J	210J	K1200-10	210	0	NA	0
Phenanthrene	2/10	0.049J	200J	K1200-10	100	0	NA	0
Pyrene	6/10	0.064J	870J	Z2-EU32-202	183	0	NA	0

EU = exposure unit
GW = groundwater
Ind = industrial
J = analyte was identified and result is approximate concentration
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level
SVOC = semivolatile organic compound

EU Z2-32 VOC DETECTS (ug/kg) 0-10 ft

Analyte	Detect frequency	Minimum detect	Maximum detect	Location(s) of maximum detect	Average detected result	Number of analyses exceeding criteria		
						Ind PRG	GW SL	Res PRG
1,1,2-Trichloro-1,2,2-trifluoroethane	1/7	0.001J	0.001J	BH010	0.001	0	NA	0
Acetone	1/11	8.4J	8.4J	Z2-EU32-202	8.4	0	NA	0
Methylene chloride	3/12	0.0026J	8	SB100	2.67	0	0	0

EU = exposure unit
GW = groundwater
Ind = industrial
J = analyte was identified and result is approximate concentration
NA = not applicable
PRG = preliminary remediation goal
Res = residential
RL = remediation level
SL = screening level
VOC = volatile organic compound

2.2.6 ZONE 2 ROD APPENDIX A FFA SITES EVALUATION

There are no FFA sites in EU Z2-32.

3.0 RISK EVALUATION AND ACTION/NO FURTHER ACTION DECISION

3.1 INTRODUCTION

In this section, data are evaluated in terms of the four decision rules presented in the Zone 2 RAWP, which include the following:

- Does the concentration of any Zone 2 contaminant of concern (COC) exceed its maximum RL?
- Does the mean concentration of any Zone 2 COC exceed its average RL across the EU?
- Does the EU pose a risk exceeding an industrial 1×10^{-4} excess lifetime cancer risk (ELCR) or target organ hazard index (HI) of 1?
- Does the site pose a threat to groundwater based on MCL exceedances or soil RLs for protection of groundwater?

Results from comparison of the data to the Zone 2 soils RLs, Ind PRGs (set at an ELCR of 1×10^{-5} or a HI of 1), and background levels are presented in Table A.3. In addition, the EU summary in Sect. 2.2.5 presents an evaluation of the EU data by analyte group. The following table summarizes the conclusions for current conditions in EU Z2-32.

EU #	Max RL exceeded?	Avg RL over EU exceeded?	Industrial risk above 1×10^{-4}?	Potential source to groundwater?	Action required?
Z2-32	No	No	No	No	No

Avg = average
EU = exposure unit
Max = maximum
RL = remediation level

3.2 DATA EVALUATION FOR THE ACTION /NO FURTHER ACTION DECISION

The requirements for determining NFA in the Zone 2 EUs are stated in the protection goals of the Zone 2 ROD remedial action objective. Four decision rules developed in the DVS DQOs state the specific criteria against which each EU must be compared to make the NFA decision. These four decision rules are presented in Sect. 3.2 of this PCCR and the how the decision rule evaluations are conducted and special data handling requirements are discussed in Sect. 3.3. In summary, the decision rule criteria for NFA are that each EU must meet each of the following compositional constraints:

- Zone 2 soils Max RLs—maximum allowable concentrations of Zone 2 soils COCs. Zone 2 soils Max RLs are presented in the Zone 1 ROD and Sect. 3.2 of this PCCR.
- Zone 2 soils Avg RLs—limit on the allowable average concentrations of Zone 2 soils COCs across an EU. Zone 2 soils Avg RLs are presented in the Zone 1 ROD and Sect. 3.2 of this PCCR.

- Cumulative risk across the EU—cumulative risk across an EU cannot exceed 1×10^{-4} ELCR or HI of 1. A stepwise evaluation of cumulative risk is performed by comparing EU data to 1×10^{-5} Ind PRGs. The 1×10^{-5} Ind PRGs for the analytes required by the RDR/RAWP are presented in Sect. 3.2 of this PCCR.

- Groundwater protection goals—composition of Zone 2 soils cannot pose a threat to groundwater. This evaluation is conducted by assessing local groundwater monitoring results and comparing soils composition to calculated SLs. Groundwater SLs are presented in Sect. 3.2 of this PCCR.

3.3 SUMMARY AND CONCLUSIONS

EU Z2-32

In this section, soils compositions from the 0- to 10-ft-depth interval in the EU are evaluated in terms of the decision rule criteria discussed in Sect. 3.2 of this PCCR.

Maximum RL screening. There were no Max RL exceedances in the EU Z2-32 data.

Average RL screening. The Avg RL screening process includes the Zone 2 ROD requirement that the weighted average concentrations of Zone 2 COCs across the EU may not exceed their respective Avg RLs. The screening process begins by documenting the individual locations of Avg RL exceedances in the EU. Next, the average detected concentration of any COC with an Avg RL exceedance is compared to the Avg RL. If the detected average concentration is less than the Avg RL, the COC is dropped from further screening. If an average detected concentration of a COC exceeds the average RL, then a new average concentration is calculated where one-half the value of the detection limit is used for non-detects. If the new average exceeds the Avg RL, then a weighted average concentration for the COC is calculated and compared to the Avg RL.

There were no Avg RL exceedances in EU Z2-32 data.

Risk evaluation. The 1×10^{-5} Ind PRGs are used as an initial screen to test for the possibility that a 1×10^{-4} industrial risk would be exceeded. The first step in the risk screen is to document all of the chemicals and radionuclides with 1×10^{-5} Ind PRG exceedances. The 1×10^{-5} Ind PRGs for Ra-226, Th-228, Th-230, and Th-232 are not considered in the risk evaluation because risk for those radionuclides is evaluated with the Ra/Th decay series RLs, and K-40 is considered in the risk evaluation only if its average detected concentration exceeds its background concentration. The second step in the risk screen is to compare the average detected concentrations of chemicals and radionuclides with individual Ind PRG exceedances to the 1×10^{-5} Ind PRGs. If the average detected concentration of a chemical or radionuclide is $< 1 \times 10^{-5}$ Ind PRG, that chemical or radionuclide is no longer evaluated for risk. If the average detected concentration of a chemical or radionuclide exceeds the 1×10^{-5} Ind PRG, then the average concentration is recalculated using one-half the detection limit for nondetects. If the recalculated average concentration exceeds the 1×10^{-4} Ind PRG (i.e., 10 times the 1×10^{-5} Ind PRG), then a weighted average calculation is performed (weighted average is explained in this PCCR). If the weighted average exceeds the 1×10^{-4} Ind PRG, then a quantitative risk assessment is performed. Lastly, all chemicals and radionuclides with individual 1×10^{-5} Ind PRG exceedances are evaluated for their combined impact on cumulative risk. An estimate of cumulative risk is made by calculating the fraction each average concentration is of its 1×10^{-5} Ind PRG, then summing those fractions. If the sum is > 7.5 (i.e., approximately 75% of the 1×10^{-4} Ind PRGs), then the need for quantitative risk assessment is evaluated.

In EU Z2-32 there is one discrete 1×10^{-5} Ind PRG exceedance. This tally does not include radium-226, thorium-228, thorium-230, thorium-232, or potassium-40 whose average detected concentration (26.1 pCi/g) does not exceed its 1×10^{-5} Ind PRG (32.12 pCi/g). The analyte with the 1×10^{-5} Ind PRG exceedance, the number of exceedances for the analyte, the 1×10^{-5} Ind PRG for the analyte with the exceedance, the average detected concentration for the analyte with an exceedance, and an assessment of whether the average detected concentration exceeds the 1×10^{-5} Ind PRG is presented in the following.

Average detected concentrations of analytes with Ind PRG exceedances compared to 1×10^{-5} Ind PRGs

Analyte with 1×10^{-5} Ind PRG exceedance(s)	Number of exceedances	1×10^{-5} Ind PRG (mg/kg)	Average detected concentration (mg/kg)	Exceeds 1×10^{-5} Ind PRG?
Arsenic	1	15.9	4.84	No

Ind = industrial
PRG = preliminary remediation goal

Based on the foregoing analysis, no individual chemical or radionuclide in EU Z2-32 exceeds its 1×10^{-5} Ind PRG, thereby it is concluded there are no chemicals or radionuclides that cause a risk > 1×10^{-4}.

The fraction of each average detected concentration relative to the respective 1×10^{-5} Ind PRG was calculated for all chemicals and radionuclides with 1×10^{-5} Ind PRG exceedances, except for K-40, Ra-226, Th-228, Th-230, and Th-232. The chemicals and radionuclides with individual 1×10^{-5} Ind PRG exceedances, the fraction of their average concentrations relative to their respective 1×10^{-5} Ind PRGs, and the sum of fractions is shown in the following table.

Chemicals and radionuclides with individual Ind PRG exceedances, their average results, and the fraction of the average results relative to Ind PRGs

Analyte	1×10^{-5} Ind PRG (mg/kg)	Average concentration (mg/kg)	Result/Ind PRG fraction
Arsenic	15.9	4.84	0.30
		Sum of fractions	0.30

Ind = industrial
PRG = preliminary remediation goal

The sum of fractions calculation result of 0.30 is less than the benchmark of 7.5. Thus, it is concluded that the 1×10^{-5} Ind PRG exceedances observed in EU Z2-32 will not cause the EU to exceed the risk limits of the Zone 2 ROD.

Threat to groundwater. The threat to groundwater from an EU is evaluated by looking at MCL exceedances in local groundwater wells and comparing the chemicals and radionuclides with MCL exceedances to chemicals and radionuclides with GW SL exceedances. If there are matches between the two sets of analytes, then the mobilities of the matching analytes are evaluated, the volumetric extent of their GW SL exceedances are estimated, and a conclusion is made regarding whether any of the matching analytes is a source of groundwater contamination.

As described in Sect. 2.2.5, EU Z2-32 Groundwater Evaluation, there are no sources for groundwater contamination in the EU. Contaminated groundwater in the EU is sourced in the adjacent EU Z2-41. Furthermore, as demonstrated in the data evaluations in Sect. 2.2.5, there were no GW SL exceedances in the EU Z2-32 data. Therefore, it is concluded that soils in the EU do not pose a threat to groundwater.

Qualitative risk screening for unrestricted use. There is a low probability that EU Z2-32 acreage could be released with no land use restrictions because of contaminated groundwater at depth. As described above, there is no potential for industrial risk in the 0- to 10-ft-depth interval. However, an appropriate evaluation of residential risk should be conducted to make a definitive conclusion.

Zone 2 ROD Appendix A FFA Sites

There are no FFA sites in EU Z2-32.

4.0	RECOMMENDATION FOR ACTION/NO FURTHER ACTION

4.1	DECISION AND REMEDIATION ACTIVITIES

EU Z2-32: Based on the analytical results of DVS and historical samples collected in the EU and the Class 3 SU walkover assessment in the EU, the U.S. Department of Energy (DOE) recommends that NFA is appropriate for the entire 18.4 acres of the EU.

FFA Sites: There are no FFA sites in EU Z2-32.

4.2	EXCAVATION ACTIVITIES/CONFIRMATION SAMPLING

None.

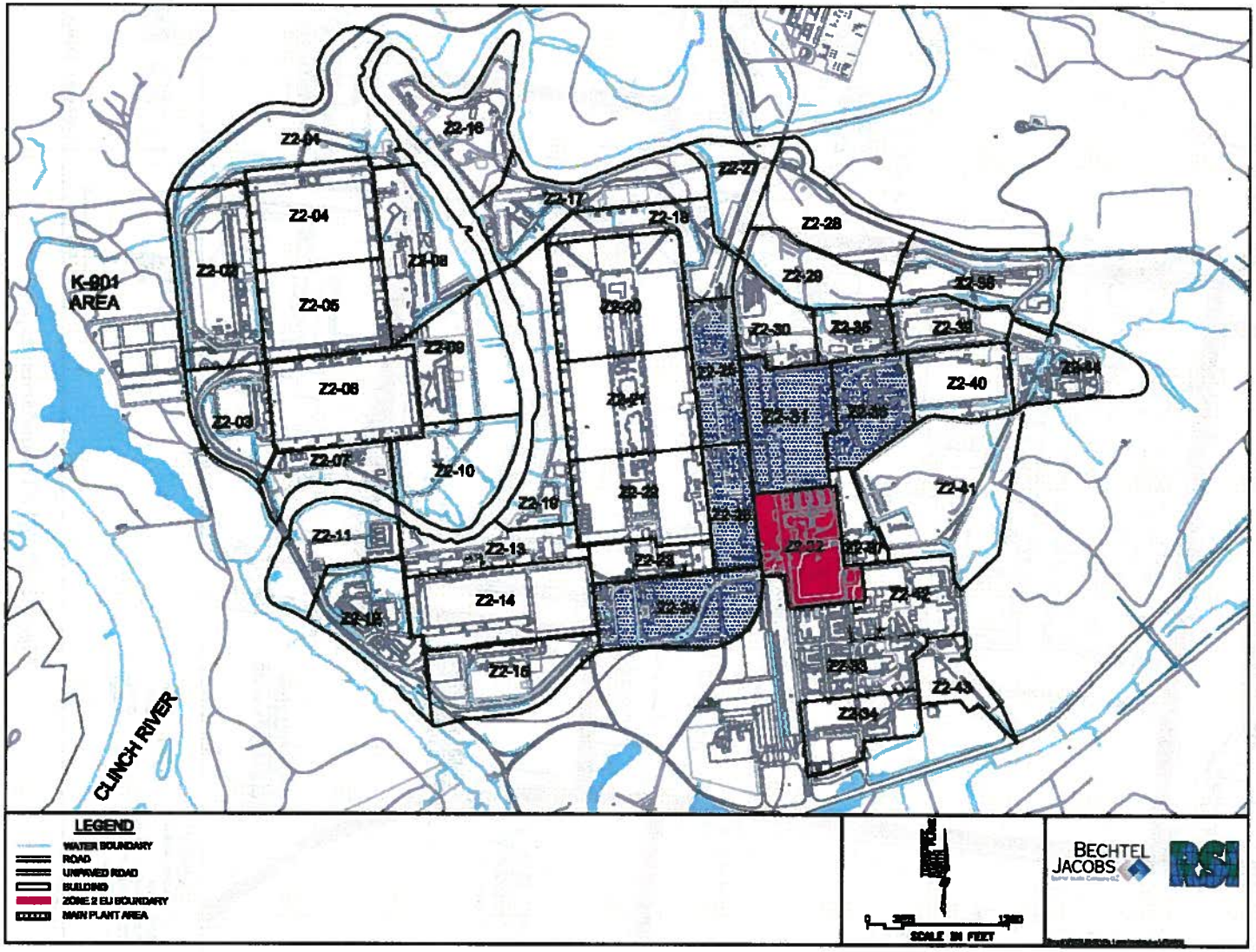

Fig. A.1. EU Z2-32 location map.

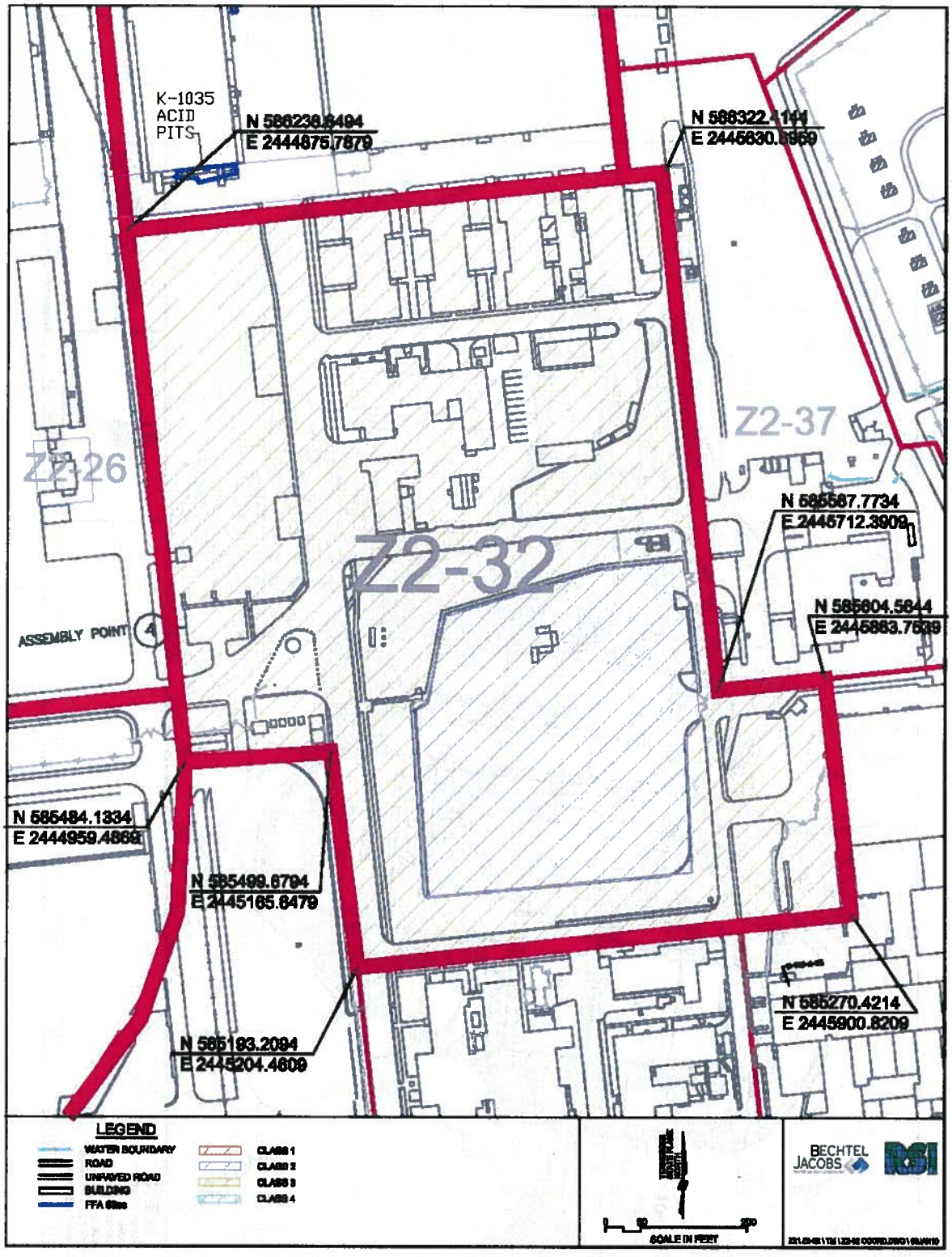

Fig. A.2. EU Z2-32 boundaries map.

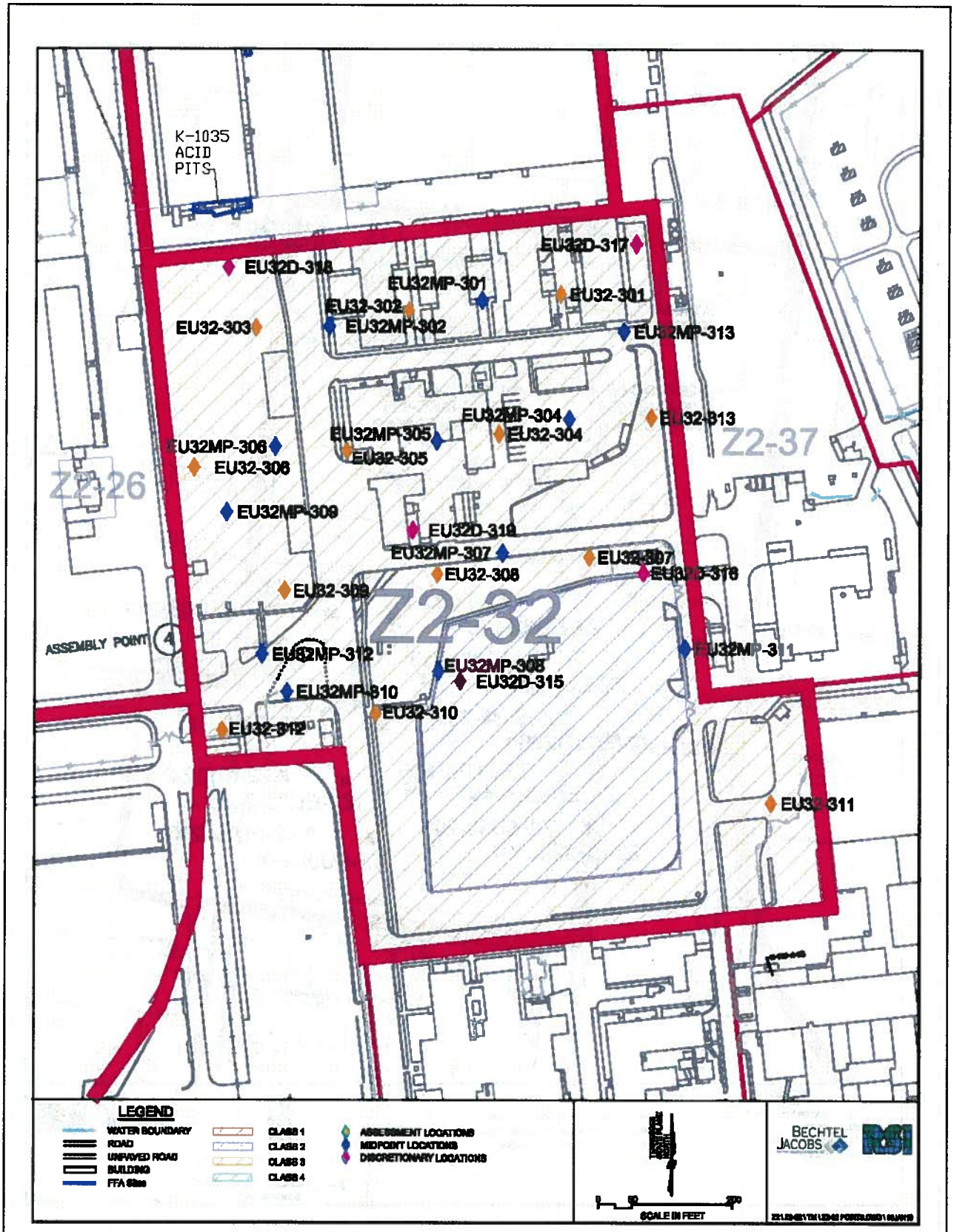

Fig. A.3. EU Z2-32 assessment points, mid-point, and discretionary points map.

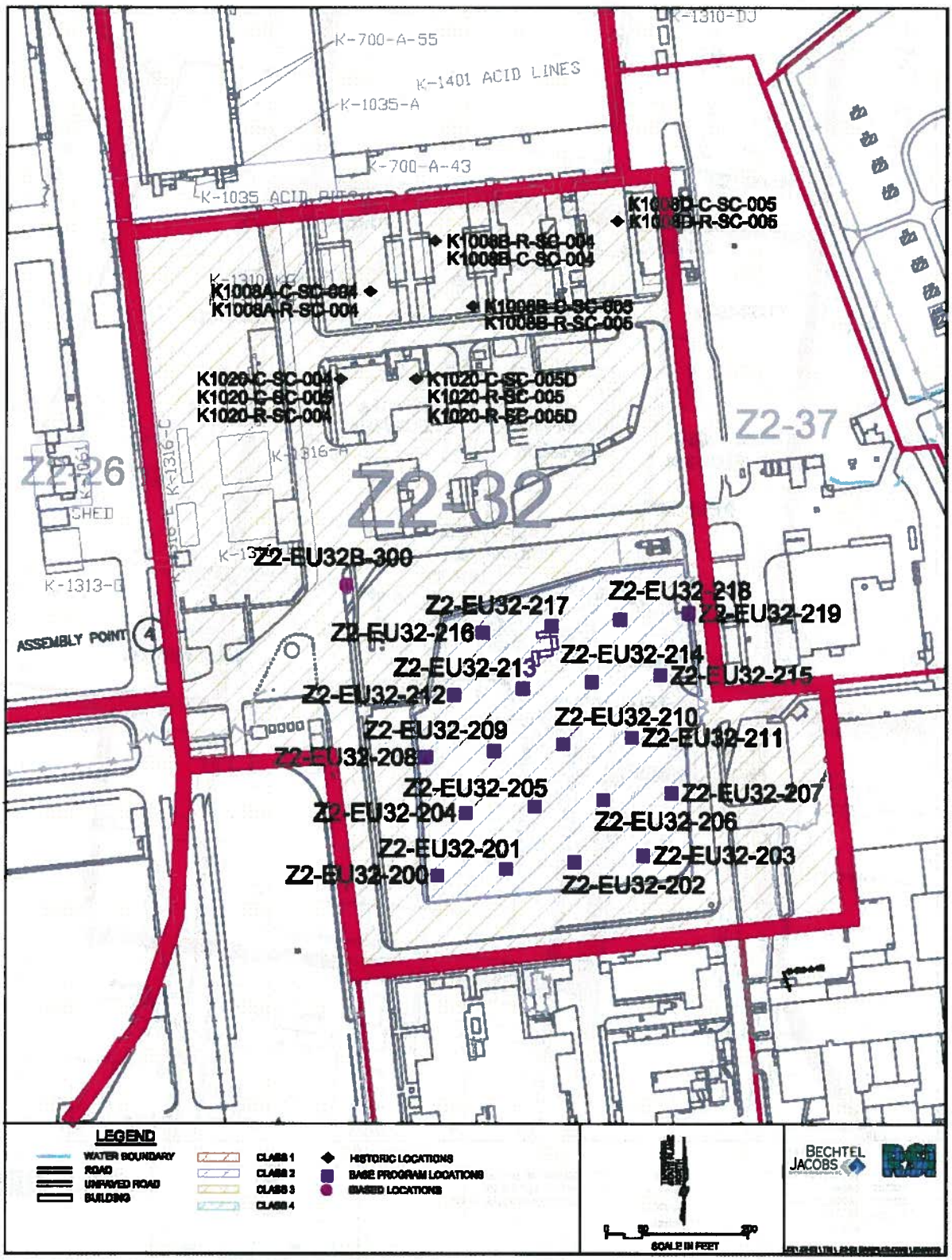

Fig. A.4. EU Z2-32 sample locations map.

Table A.1. EU Z2-32 facility list

Facility name	Facility assessed? Yes	No	Comments
Named in DQO scoping			
K-700-A-65 Substation	X		
K-1008-A Changehouse	X		
K-1008-B Changehouse	X		
K-1008-C HP Offices/Respirator Cleaning and Testing	X		
K-1008-D Medical Therapy Building	X		
K-1020 Environment Division Building	X		
K-1020-A Valve House		X	
K-1021 Old Firehouse		X	
K-1021-A Old Tower		X	
K-1028-40 Gatehouse	X		
K-1028-45 Gatehouse	X		
K-1066-G Cylinder Storage Yard	X		Investigated as a Class 2 SU
K-1098-D Maintenance Offices	X		
K-1098-G Heavy Equipment Storage Shed	X		
K-1204-01 Sewage Ejector Station	X		
K-1205-B Condensate Station	X		
K-1310-BN Trailer		X	
K-1310-BP Trailer		X	
K-1310-BZ Trailer	X		
K-1310-CA Trailer	X		
K-1310-CH Trailer		X	
K-1310-KG Trailer	X		
K-1310-KH Trailer	X		
K-1310-T Trailer		X	
K-1310-U Trailer		X	
K-1316-A Trailer	X		
K-1316-B Trailer	X		
K-1316-C Trailer	X		
K-1316-E Trailer	X		
K-1414 Unleaded, Underground Storage Tank	X		
K-1414 Diesel, Underground Storage Tank	X		
K-1435-G Trailer	X		
Not named in DQO scoping			
K-1310-FB Trailer	X		
K-1310-FLTrailer	X		
K-1310-JA Trailer	X		
K-1310-MF Trailer	X		
K-1316-D Trailer	X		
K-1316-G Trailer	X		
K-1316-H Trailer	X		
K-1316-J Trailer	X		
K-1316-K Trailer	X		
K-1316-L Trailer	X		
K-1316-M Trailer	X		
K-1316-N Trailer	X		
K-1316-P Trailer	X		
K-1316-Q Trailer	X		
K-1316-R Trailer	X		
K-1316-S Trailer	X		
Rubbermaid Building	X		No facility number

DQO = data quality objective SU = soiol unit
EU = exposure unit

Table A.2. EU Z2-32 sample summary

SU class	Date sampled	EU	Location ID	Location		Sample interval	Screening		Off-site laboratory							Comments and notes
				Easting	Northing		RAD	VOC	Metals	PCB	RAD	SVOC	VOC	Other	Splits/ duplicates	
DVS samples																
2	06/23/08	Z2-32	Z2-EU32-200	2445317	585332	0-3.5 ft, 1 interval composite sample; gravel surface	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/23/08	Z2-32	Z2-EU32-201	2445413	585342	0-3.5 ft, 1 interval composite sample; gravel surface	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/23/08	Z2-32	Z2-EU32-202	2445509	585351	0-10 ft, 2 interval composite sample; gravel surface	1	1	1	1	1	1	1		S	K-1066-G Class 2 SU; systematic grid location
2	06/23/08	Z2-32	Z2-EU32-203	2445606	585361	0-3.5 ft, 1 interval composite sample; gravel surface	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/25/08	Z2-32	Z2-EU32-204	2445357	585420	0-3.5 ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/25/08	Z2-32	Z2-EU32-205	2445453	585430	0-3.5 ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/25/08	Z2-32	Z2-EU32-206	2445549	585439	0-3.5 ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/25/08	Z2-32	Z2-EU32-207	2445645	585449	0-3.5ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/25/08	Z2-32	Z2-EU32-208	2445301	585499	0-10 ft, 2 interval composite sample; gravel surface	1	1	1	1	1	1	1			K-1066-G Class 2 SU; systematic grid location
2	06/27/08	Z2-32	Z2-EU32-209	2445397	585508	0-3.5 ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/27/08	Z2-32	Z2-EU32-210	2445493	585518	0-3.5 ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/27/08	Z2-32	Z2-EU32-211	2445589	585527	0-3.5 ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/27/08	Z2-32	Z2-EU32-212	2445341	585587	0-3.5 ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/27/08	Z2-32	Z2-EU32-213	2445437	585596	0-3.5 ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/30/08	Z2-32	Z2-EU32-214	2445533	585606	0-10 ft, 2 interval composite sample; gravel surface	1	1	1	1	1	1	1			K-1066-G Class 2 SU; systematic grid location
2	06/30/08	Z2-32	Z2-EU32-215	2445629	585615	0-3.5 ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	06/30/08	Z2-32	Z2-EU32-216	2445381	585675	0-3.5 ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	07/01/08	Z2-32	Z2-EU32-217	2445477	585684	0-3.5 ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	07/01/08	Z2-32	Z2-EU32-218	2445573	585694	0-3.5 ft, 1 interval composite sample	1	1	1	1						K-1066-G Class 2 SU; systematic grid location
2	07/01/08	Z2-32	Z2-EU32-219	2445669	585703	0-10 ft, 2 interval composite sample; gravel surface	1	1	1	1	1	1	1		D	K-1066-G Class 2 SU; systematic grid location
2	10/13/09	Z2-32	Z2-EU32B-301	2445520	585409	5 point composite surface sample					1					K-1066-G Class 2 SU excavation confirmation
						DVS sampling total	**20**	**20**	**20**	**20**	**5**	**4**	**4**			
Historical samples																
3	12/1/1999	Z2-32	020-RAD-01N	2445309	586053	0-0.5-ft surface sample					1					
3	12/1/1999	Z2-32	020-RAD-01W	2445175	586022	0-0.5-ft surface sample					1					
3	12/1/1999	Z2-32	4J-MET-01N	2445309	586053	0-0.5-ft surface sample			1							
3	12/1/1999	Z2-32	4J-P-01N	2445309	586053	0-0.5-ft surface sample				1						

Table A.2. EU Z2-32 sample summary (continued)

SU class	Date sampled	EU	Location ID	Location		Sample interval	Screening		Off-site laboratory							Comments and notes
				Easting	Northing		RAD	VOC	Metals	PCB	RAD	SVOC	VOC	Other	Splits/ duplicates	
3	12/1/1999	Z2-32	4J-P-01W	2445175	586022	0-0.5-ft surface sample				1						
3	12/1/1999	Z2-32	4J-VOC-01N	2445309	586053	0-0.5-ft surface sample							1			
3	12/1/1999	Z2-32	4J-VOC-01W	2445175	586022	0-0.5-ft surface sample							1			
3	10/1/1993	Z2-32	BH009	2445570	585977	7 to 9 ft			1	1	1	1	1	1		Includes diesel range and gasoline range organics
3	10/7/1993	Z2-32	BH010	2445663	585810	0-2 ft and I6-18 ft			1	1	1	2	2	2		Includes diesel range and gasoline range organics
3	2/24/2005	Z2-32	K1035-DPT-001	2445056	586256	25-26 ft							1			
3	2/10/2005	Z2-32	K1070CD-DPT-01	2445605	586241	15-15.8 ft							1			
3	2/10/2005	Z2-32	K1070CD-DPT-03	2445617	586017	13-15 ft						1				
3	1/19/2000	Z2-32	K1200-09	2445789	585285	0-0.5-ft surface sample			1	1	1					
3	1/19/2000	Z2-32	K1200-10	2445800	585505	0-0.5-ft surface sample					1	1	1			
2	10/24/1995	Z2-32	KAD-SS-S11	2445421	585545	0-0.5-ft surface sample					1					K-1066-G Class 2 SU
2	10/24/1995	Z2-32	KAD-SS-S21	2445323	585398	0-0.5-ft surface sample					1					K-1066-G Class 2 SU
2	10/24/1995	Z2-32	KAD-SS-S31	2445439	585391	0-0.5-ft surface sample					1					K-1066-G Class 2 SU
2	10/24/1995	Z2-32	KAD-SS-S41	2445551	585558	0-0.5-ft surface sample					1					K-1066-G Class 2 SU
2	10/24/1995	Z2-32	KAD-SS-S51	2445570	585408	0-0.5-ft surface sample					1					K-1066-G Class 2 SU
3	11/23/1999	Z2-32	RR-S01	2444956	585915	0-0.5-ft surface sample			1	1	1	1	1			
3	1/17/2000	Z2-32	RR-SS01	2444956	585915	0.5-2 ft			1	1	1	1	1			
3	11/18/1993	Z2-32	SB100	2445639	585900	0-5 ft and 15-16 ft			2	2	2	2	2			
						Historical sampling total			**8**	**9**	**15**	**9**	**12**	**3**		

DVS = Dynamic Verification Strategy
EU = exposure unit
D = duplicate
ID = identification
MS/MDS = matrix spike/matrix spike duplicate
PCB = polychlorinated biphenyl
RAD = radiological
S = split
SU = soil unit
SVOC = semivolatile organic compound
VOC = volatile organic compound

Table A.3. EU Z2-32 data summary for soil samples collected from 0 to 10 ft below ground surface[a]

Analyte	Frequency of detect	Minimum detect[b,c]	Maximum detect[b,c]	Location(s) of maximum detected result	Average detected result	Maximum RL	Frequency of detects exceeding maximum RL	Average RL	Frequency of detects exceeding average RL	PRG limit (10^{-5} or 1)	Frequency of detects exceeding PRG limit	Background concentration	Frequency of detects exceeding background
Inorganics (mg/kg)													
Aluminum	26/26	1,830J	36,500	RR-S01	13,487		NA		NA	100,000	0/26	40,300	0/26
Antimony	22/26	0.16J	9.33J	RR-S01	0.72		NA		NA	408.8	0/26	1.52	1/26
Arsenic	23/26	1.2	22.9J	RR-S01	4.84	900	0/26	300	0/26	15.9	1/26	14.95	1/26
Barium	26/26	41	490J	Z2-EU32-207	87.4		NA		NA	66,577	0/26	124.93	2/26
Beryllium	25/26	0.44	2.03	RR-SS01	1.15	6,000	0/26	2,000	0/26	1,941	0/26	2.2	0/26
Boron	20/20	0.75J	13J	Z2-EU32-214	3.57		NA		NA	100,000	0/20		NA
Cadmium	23/26	0.3	1.69J	RR-S01	0.534		NA		NA	451	0/26	0.22	23/26
Calcium	26/26	289	160,000J	Z2-EU32-215	35,314		NA		NA		NA	2,400	22/26
Chromium	26/26	4.55J	41J	Z2-EU32-217	19.8		NA		NA	640	0/26	44.88	0/26
Cobalt	26/26	3.7	33	Z2-EU32-219	13.9		NA		NA	133,310	0/26	42	0/26
Copper	26/26	11J	56.7	4J-MET-01N	27.7		NA		NA	40,877	0/26	22.48	17/26
Cyanide	0/1	ND	ND		ND		NA		NA	12,000	0/1	0.6	0/1
Iron	26/26	3,890	57,000	Z2-EU32-212	30,650		NA		NA	100,000	0/26	58,600	0/26
Lead	25/26	7.6	53	Z2-EU32-207	21		NA		NA	800	0/26	37.91	2/26
Lithium	20/20	4.1	29	Z2-EU32-202	15.1		NA		NA	20,439	0/20	48.94	0/20
Magnesium	26/26	387	45,000J	Z2-EU32-215	11,071		NA		NA		NA	3,300	14/26
Manganese	26/26	280	3,130	RR-S01	844		NA		NA	19,458	0/26	2,200	2/26
Mercury	25/26	0.019J	0.158J	4J-MET-01N	0.064	1,800	0/26	600	0/26	307	0/26	0.17	0/26
Molybdenum	21/22	0.57J	1.2	Z2-EU32-217	0.872		NA		NA	5,110	0/22		NA
Nickel	26/26	6J	116J	4J-MET-01N	26.6		NA		NA	20,439	0/26	26.07	7/26
Potassium	26/26	393	5,580	RR-S01	1,878		NA		NA		NA	5,074.69	1/26
Selenium	11/25	0.437J	13.5J	RR-SS01	2.73		NA		NA	5,110	0/25	1.47	4/25
Silver	4/25	0.12J	1.1	SB100	0.558		NA		NA	5,110	0/25	0.6	2/25
Sodium	14/26	26	170	Z2-EU32-215	104		NA		NA		NA	497	0/26
Thallium	22/26	0.14J	0.39J	Z2-EU32-211	0.233		NA		NA	67.5	0/26	0.4	0/26
Tin	2/2	1.6	1.9J	SB100	1.75		NA		NA	100,000	0/2		NA
Uranium	20/20	0.68	2	Z2-EU32-212	1.42		NA		NA	204	0/20		NA
Vanadium	25/25	7.02J	64.8	RR-S01	30.4		NA		NA	1,022	0/25	65.47	0/25
Zinc	26/26	23	132J	4J-MET-01N	55.1		NA		NA	100,000	0/26	89.7	3/26
Other Organics (mg/kg)													
Diesel Range Organics	0/2	ND	ND		ND		NA		NA		NA		NA
Gasoline Range Organics	0/2	ND	ND		ND		NA		NA		NA		NA
Organics, pesticides, and PCBs (ug/kg)													
4,4'-DDD	0/2	ND	ND		ND		NA		NA	100,000	0/2		NA
4,4'-DDE	0/2	ND	ND		ND		NA		NA	70,000	0/2		NA
4,4'-DDT	0/2	ND	ND		ND		NA		NA	70,000	0/2		NA
Aldrin	0/2	ND	ND		ND		NA		NA	1,000	0/2		NA
alpha-BHC	0/2	ND	ND		ND		NA		NA	3,600	0/2		NA
alpha-Chlordane	0/2	ND	ND		ND		NA		NA	65,000	0/2		NA
beta-BHC	0/2	ND	ND		ND		NA		NA	13,000	0/2		NA
delta-BHC	0/2	ND	ND		ND		NA		NA		NA		NA
Dieldrin	0/2	ND	ND		ND		NA		NA	1,100	0/2		NA
Endosulfan I	0/2	ND	ND		ND		NA		NA	3,700,000	0/2		NA
Endosulfan II	0/2	ND	ND		ND		NA		NA	3,70,0000	0/2		NA
Endosulfan sulfate	0/2	ND	ND		ND		NA		NA	3,700,000	0/2		NA
Endrin	0/2	ND	ND		ND		NA		NA	180,000	0/2		NA
Endrin aldehyde	0/2	ND	ND		ND		NA		NA	180,000	0/2		NA
Endrin ketone	0/2	ND	ND		ND		NA		NA	180,000	0/2		NA
gamma-Chlordane	0/2	ND	ND		ND		NA		NA	65,000	0/2		NA

Table A.3. EU Z2-32 data summary for soil samples collected from 0 to 10 ft below ground surface[a] (continued)

Analyte	Frequency of detect	Minimum detect[b,c]	Maximum detect[b,c]	Location(s) of maximum detected result	Average detected result	Maximum RL	Frequency of detects exceeding maximum RL	Average RL	Frequency of detects exceeding average RL	PRG limit (10^{-5} or 1)	Frequency of detects exceeding PRG limit	Background concentration	Frequency of detects exceeding background
Heptachlor	0/2	ND	ND		ND		NA		NA	3,800	0/2		NA
Heptachlor epoxide	0/2	ND	ND		ND		NA		NA	1,900	0/2		NA
Lindane	0/2	ND	ND		ND		NA		NA	17,000	0/2		NA
Methoxychlor	0/2	ND	ND		ND		NA		NA	3,100,000	0/2		NA
PCB-1016	0/27	ND	ND		ND	100,000	0/27	10,000	0/27	37,000	0/27		NA
PCB-1221	0/27	ND	ND		ND	100,000	0/27	10,000	0/27	7,436	0/27		NA
PCB-1232	0/27	ND	ND		ND	100,000	0/27	10,000	0/27	7,436	0/27		NA
PCB-1242	0/27	ND	ND		ND	100,000	0/27	10,000	0/27	7,436	0/27		NA
PCB-1248	0/27	ND	ND		ND	100,000	0/27	10,000	0/27	7,436	0/27		NA
PCB-1254	8/27	0.028J	430	Z2-EU32-201	153	100,000	0/27	10,000	0/27	7,436	0/27		NA
PCB-1260	1/27	180	180	K1200-09	180	100,000	0/27	10,000	0/27	7,436	0/27		NA
Polychlorinated biphenyl	4/20	220	430	Z2-EU32-201	305	100,000	0/20	10,000	0/20	7,436	0/20		NA
Toxaphene	0/2	ND	ND		ND		NA		NA	16,000	0/2		NA
Radionuclides (pCi/g)													
Actinium-228	3/3	1.31J	1.48J	Z2-EU32-214	1.38		NA		NA	11,900	0/3		NA
Alpha activity	7/7	3.43	10.03	BH009	6.83		NA		NA		NA		NA
Aluminum-26	0/1	ND	ND		ND		NA		NA	0.16	0/1		NA
Americium-241	0/1	ND	ND		ND		NA		NA	57	0/1		NA
Beta activity	6/7	4.39J	23.68	SB100	8.92		NA		NA		NA		NA
Bismuth-214	6/6	0.75J	2.64	BH009	1.23		NA		NA	134,000	0/6		NA
Cesium-137	5/17	0.12J	0.54	020-RAD-01W	0.279	20	0/17	2	0/17	1.13	0/17		NA
Cobalt-60	3/17	0.01J	0.04	020-RAD-01N 020-RAD-01W	0.03		NA		NA	0.6	0/17		NA
Lead-212	6/6	1.04	1.55	Z2-EU32-208	1.3		NA		NA	61,300	0/6		NA
Lead-214	6/6	0.745J	2.83	BH009	1.29		NA		NA	756,000	0/6		NA
Neptunium-237	0/11	ND	ND		ND	50	0/11	5	0/11	2.72	0/11		NA
Plutonium-238	0/6	ND	ND		ND		NA		NA	160	0/6		NA
Plutonium-239	0/6	ND	ND		ND		NA		NA	144	0/1		NA
Potassium-40	6/6	10.1	32.85	BH009	26.1		NA		NA	2.73	6/6	32.12	1/6
Protactinium-234m	2/3	6.89	7.8	K1200-10	7.34		NA		NA	250,000000	0/3		NA
Ra/Th decay series[d]	15/15	0	1.52	BH009	0.152	15	0/15	5	0/15		NA		NA
Strontium-90	0/1	ND	ND		ND		NA		NA	110	0/1		NA
Technetium-99	4/18	0.75J	1.67J	RR-SS01	1.27		NA		NA	8,960	0/18		NA
Thallium-208	4/4	0.313	0.398	Z2-EU32-202	0.36		NA		NA	368,000	0/4		NA
Thorium-228[e]	13/15	0.09J	1.42J	Z2-EU32-301	0.804		NA		NA	0.18	11/15	1.86	0/15
Thorium-230[e]	15/15	0.08J	3.09J	BH009	0.968		NA		NA	202	0/15	1.2	4/15
Thorium-232[e]	14/15	0.08	2.1	KAD-SS-S41	0.887		NA		NA	0.18	11/15	1.95	1/15
Thorium-234	4/8	1.55J	5.64	Z2-EU32-301	3.31		NA		NA	32,800	0/8		NA
Total Activity	3/3	9.92J	17J	K1200-09	14.6		NA		NA		NA		NA
Uranium-234	13/17	0.963	3.62	Z2-EU32-301	2.01	7,000	0/17	700	0/17	332	0/17		NA
Uranium-235	9/22	0.0713J	0.579	K1200-10	0.182	80	0/22	8	0/22	3.98	0/22		NA
Uranium-238	16/17	0.5	3.52	BH009	1.42	500	0/17	50	0/17	18	0/17	1.47	5/17
Semivolatile organics (ug/kg)													
1,2,4-Trichlorobenzene	0/14	ND	ND		ND		NA		NA	215,925	0/14		NA
1,2-Dichlorobenzene	0/14	ND	ND		ND		NA		NA	600,000	0/14		NA
1,3-Dichlorobenzene	0/14	ND	ND		ND		NA		NA	600,000	0/14		NA
1,4-Dichlorobenzene	0/14	ND	ND		ND		NA		NA	78,665	0/14		NA
2,2'-Dichlorodiisopropyl ether	0/2	ND	ND		ND		NA		NA		NA		NA
2,3,4,6-Tetrachlorophenol	0/4	ND	ND		ND		NA		NA	18,468,189	0/4		NA
2,4,5-Trichlorophenol	0/10	ND	ND		ND		NA		NA	61,560,629	0/10		NA
2,4,6-Trichlorophenol	0/10	ND	ND		ND		NA		NA	61,561	0/10		NA

Table A.3. EU Z2-32 data summary for soil samples collected from 0 to 10 ft below ground surface[a] (continued)

Analyte	Frequency of detect	Minimum detect[b,c]	Maximum detect[b,c]	Location(s) of maximum detected result	Average detected result	Maximum RL	Frequency of detects exceeding maximum RL	Average RL	Frequency of detects exceeding average RL	PRG limit (10^{-5} or 1)	Frequency of detects exceeding PRG limit	Background concentration	Frequency of detects exceeding background
2,4-Dichlorophenol	0/10	ND	ND		ND		NA		NA	1,846,819	0/10		NA
2,4-Dimethylphenol	0/10	ND	ND		ND		NA		NA	12,312,126	0/10		NA
2,4-Dinitrophenol	0/10	ND	ND		ND		NA		NA	1,231,213	0/10		NA
2,4-Dinitrotoluene	0/10	ND	ND		ND		NA		NA	25,348	0/10		NA
2,6-Dinitrotoluene	0/10	ND	ND		ND		NA		NA	25,348	0/10		NA
2-Chloronaphthalene	0/10	ND	ND		ND		NA		NA	23,382,732	0/10		NA
2-Chlorophenol	0/10	ND	ND		ND		NA		NA	235,768	0/10		NA
2-Methyl-4,6-dinitrophenol	0/10	ND	ND		ND		NA		NA	61,561	0/10		NA
2-Methylnaphthalene	1/10	310J	310J	K1200-10	310		NA		NA	187,691	0/10		NA
2-Methylphenol	0/10	ND	ND		ND		NA		NA	30,780,315	0/10		NA
2-Nitrobenzenamine	0/10	ND	ND		ND		NA		NA	1,830,232	0/10		NA
2-Nitrophenol	0/10	ND	ND		ND		NA		NA		NA		NA
3,3'-Dichlorobenzidine	0/10	ND	ND		ND		NA		NA	38,304	0/10		NA
3-Methylphenol	0/4	ND	ND		ND		NA		NA	30,780,315	0/4		NA
3-Nitrobenzenamine	0/10	ND	ND		ND		NA		NA	18,468	0/10		NA
4-Bromophenyl phenyl ether	0/10	ND	ND		ND		NA		NA		NA		NA
4-Chloro-3-methylphenol	0/9	ND	ND		ND		NA		NA		NA		NA
4-Chlorobenzenamine	0/10	ND	ND		ND		NA		NA	2,462,425	0/10		NA
4-Chlorophenyl phenyl ether	0/10	ND	ND		ND		NA		NA		NA		NA
4-Methylphenol	0/6	ND	ND		ND		NA		NA	3,100,000	0/6		NA
4-Nitrobenzenamine	0/10	ND	ND		ND		NA		NA	184,648	0/10		NA
4-Nitrophenol	0/10	ND	ND		ND		NA		NA		NA		NA
Acenaphthene	0/10	ND	ND		ND		NA		NA	29,219,327	0/10		NA
Acenaphthylene	0/10	ND	ND		ND		NA		NA	29,219,327	0/10		NA
Aniline	0/4	ND	ND		ND		NA		NA	3,024,031	0/4		NA
Anthracene	1/10	0.053J	0.053J	RR-S01	0.053		NA		NA	100,000,000	0/10		NA
Benz(a)anthracene	3/10	0.58	190J	Z2-EU32-202	92.2		NA		NA	21,096	0/10		NA
Benzenemethanol	0/4	ND	ND		ND		NA		NA	100,000,000	0/4		NA
Benzo(a)pyrene	5/10	0.094J	200J	Z2-EU32-202	71.2		NA		NA	2,110	0/10		NA
Benzo(b)fluoranthene	5/10	0.13J	260J	Z2-EU32-202	86.2		NA		NA	21,096	0/10		NA
Benzo(ghi)perylene	5/10	0.34J	180J	Z2-EU32-202	63.1		NA		NA	29,126,201	0/10		NA
Benzo(k)fluoranthene	5/10	0.088J	110J	Z2-EU32-202	49.6		NA		NA	210,962	0/10		NA
Benzoic acid	0/4	ND	ND		ND		NA		NA	100,000,000	0/4		NA
Bis(2-chloroethoxy)methane	0/10	ND	ND		ND		NA		NA		NA		NA
Bis(2-chloroethyl) ether	0/10	ND	ND		ND		NA		NA	5,755	0/10		NA
Bis(2-chloroisopropyl) ether	0/8	ND	ND		ND		NA		NA	73,518	0/8		NA
Bis(2-ethylhexyl)phthalate	0/10	ND	ND		ND		NA		NA	1,231,213	0/10		NA
Butyl benzyl phthalate	1/10	110J	110J	K1200-10	110		NA		NA	100,000,000	0/10		NA
Carbazole	0/10	ND	ND		ND		NA		NA	861,849	0/10		NA
Chrysene	6/10	0.053J	200J	Z2-EU32-202	61.7		NA		NA	2,109,623	0/10		NA
Dibenz(a,h)anthracene	1/10	0.1J	0.1J	BH010	0.1		NA		NA	2,110	0/10		NA
Dibenzofuran	1/10	78J	78J	K1200-10	78		NA		NA	1,563,342	0/10		NA
Diethyl phthalate	0/10	ND	ND		ND		NA		NA	100,000,000	0/10		NA
Dimethyl phthalate	1/10	0.081J	0.081J	BH010	0.081		NA		NA	100,000,000	0/10		NA
Di-n-butyl phthalate	1/10	2,400	2,400	K1200-10	2,400		NA		NA	61,560,629	0/10		NA
Di-n-octylphthalate	0/10	ND	ND		ND		NA		NA	24,624,252	0/10		NA
Diphenylamine	0/3	ND	ND		ND		NA		NA	15,000,000	0/3		NA
Diphenyldiazene	0/4	ND	ND		ND		NA		NA	156,700	0/4		NA
Fluoranthene	7/10	0.045J	290J	Z2-EU32-202	88.5		NA		NA	22,000,353	0/10		NA
Fluorene	0/10	ND	ND		ND		NA		NA	26,281,433	0/10		NA
Hexachlorobenzene	0/10	ND	ND		ND		NA		NA	10,773	0/10		NA

Table A.3. EU Z2-32 data summary for soil samples collected from 0 to 10 ft below ground surface[a] (continued)

Analyte	Frequency of detect	Minimum detect[b,c]	Maximum detect[b,c]	Location(s) of maximum detected result	Average detected result	Maximum RL	Frequency of detects exceeding maximum RL	Average RL	Frequency of detects exceeding average RL	PRG limit (10^{-5} or 1)	Frequency of detects exceeding PRG limit	Background concentration	Frequency of detects exceeding background
Hexachlorobutadiene	0/14	ND	ND		ND		NA		NA	184,682	0/14		NA
Hexachlorocyclopentadiene	0/10	ND	ND		ND		NA		NA	3,658,717	0/10		NA
Hexachloroethane	0/10	ND	ND		ND		NA		NA	61,5606	0/10		NA
Indeno(1,2,3-cd)pyrene	4/10	0.3J	140J	Z2-EU32-202	53.4		NA		NA	21,096	0/10		NA
Isophorone	0/10	ND	ND		ND		NA		NA	5,119,795	0/10		NA
Naphthalene	1/14	210J	210J	K1200-10	210		NA		NA	187,691	0/14		NA
Nitrobenzene	0/10	ND	ND		ND		NA		NA	102,935	0/10		NA
N-Nitrosodimethylamine	0/4	ND	ND		ND		NA		NA	338	0/4		NA
N-Nitroso-di-n-propylamine	0/10	ND	ND		ND		NA		NA	2,462	0/10		NA
N-Nitrosodiphenylamine	0/7	ND	ND		ND		NA		NA	3,517,750	0/7		NA
Pentachlorophenol	0/10	ND	ND		ND		NA		NA	89,982	0/10		NA
Phenanthrene	2/10	0.049J	200J	K1200-10	100		NA		NA	29,126,201	0/10		NA
Phenol	0/10	ND	ND		ND		NA		NA	100,000,000	0/10		NA
Pyrene	6/10	0.064J	870J	Z2-EU32-202	183		NA		NA	29,126,201	0/10		NA
Pyridine	0/4	ND	ND		ND		NA		NA	615,606	0/4		NA
Volatile organics (ug/kg)													
(1,1-Dimethylethyl)benzene	0/4	ND	ND		ND		NA		NA	390,000	0/4		NA
(1-Methylpropyl)benzene	0/4	ND	ND		ND		NA		NA	220,000	0/4		NA
1,1,1,2-Tetrachloroethane	0/4	ND	ND		ND		NA		NA	72,755	0/4		NA
1,1,1-Trichloroethane	0/12	ND	ND		ND		NA		NA	1,200,000	0/12		NA
1,1,2,2-Tetrachloroethane	0/12	ND	ND		ND		NA		NA	9,294	0/12		NA
1,1,2-Trichloro-1,2,2-trifluoroethane	1/7	0.001J	0.001J	BH010	0.001		NA		NA	5,600,000	0/7		NA
1,1,2-Trichloroethane	0/12	ND	ND		ND		NA		NA	16,050	0/12		NA
1,1-Dichloroethane	0/12	ND	ND		ND		NA		NA	1,738,654	0/12		NA
1,1-Dichloroethene	0/12	ND	ND		ND		NA		NA	413,325	0/12		NA
1,1-Dichloropropene	0/4	ND	ND		ND		NA		NA		NA		NA
1,2,3-Trichlorobenzene	0/4	ND	ND		ND		NA		NA		NA		NA
1,2,3-Trichloropropane	0/4	ND	ND		ND		NA		NA	760	0/4		NA
1,2,4-Trimethylbenzene	0/4	ND	ND		ND		NA		NA	170,272	0/4		NA
1,2-Dibromo-3-chloropropane	0/4	ND	ND		ND		NA		NA	11,000	0/4		NA
1,2-Dibromoethane	0/4	ND	ND		ND		NA		NA	630	0/4		NA
1,2-Dichloroethane	0/12	ND	ND		ND		NA		NA	6,035	0/12		NA
1,2-Dichloroethene	0/3	ND	ND		ND		NA		NA	150,000	0/3		NA
1,2-Dichloropropane	0/12	ND	ND		ND		NA		NA	7,422	0/12		NA
1,2-Dimethylbenzene	0/9	ND	ND		ND		NA		NA	420,000	0/9		NA
1,3,5-Trimethylbenzene	0/4	ND	ND		ND		NA		NA	69,712	0/4		NA
1,3-Dichloropropane	0/4	ND	ND		ND		NA		NA	360,521	0/4		NA
1-Chloro-4-methylbenzene	0/4	ND	ND		ND		NA		NA		NA		NA
1-chlorohexane	0/4	ND	ND		ND		NA		NA		NA		NA
1-Methyl-4-(1-methylethyl)benzene	0/4	ND	ND		ND		NA		NA		NA		NA
2,2-Dichloropropane	0/4	ND	ND		ND		NA		NA		NA		NA
2-Butanone	0/11	ND	ND		ND		NA		NA	113,264,388	0/11		NA
2-Hexanone	0/11	ND	ND		ND		NA		NA		NA		NA
2-Methoxy-2-methylpropane	0/4	ND	ND		ND		NA		NA	700,000	0/4		NA
4-Methyl-2-pentanone	0/12	ND	ND		ND		NA		NA	47,001,434	0/12		NA
Acetone	1/11	8.4J	8.4J	Z2-EU32-202	8.4		NA		NA	54,320,986	0/11		NA
Benzene	0/12	ND	ND		ND		NA		NA	14,094	0/12		NA
Bromobenzene	0/4	ND	ND		ND		NA		NA	92,152	0/4		NA
Bromochloromethane	0/8	ND	ND		ND		NA		NA		NA		NA

Table A.3. EU Z2-32 data summary for soil samples collected from 0 to 10 ft below ground surface[a] (continued)

Analyte	Frequency of detect	Minimum detect[b,c]	Maximum detect[b,c]	Location(s) of maximum detected result	Average detected result	Maximum RL	Frequency of detects exceeding maximum RL	Average RL	Frequency of detects exceeding average RL	PRG limit (10^{-5} or 1)	Frequency of detects exceeding PRG limit	Background concentration	Frequency of detects exceeding background
Bromodichloromethane	0/12	ND	ND		ND		NA		NA	18,306	0/12		NA
Bromoform	0/12	ND	ND		ND		NA		NA	2,181,998	0/12		NA
Bromomethane	0/12	ND	ND		ND		NA		NA	13,078	0/12		NA
Butylbenzene	0/4	ND	ND		ND		NA		NA	240,000	0/4		NA
Carbon disulfide	0/12	ND	ND		ND		NA		NA	720,000	0/12		NA
Carbon tetrachloride	0/12	ND	ND		ND		NA		NA	5,493	0/12		NA
Chlorobenzene	0/12	ND	ND		ND		NA		NA	530,466	0/12		NA
Chloroethane	0/12	ND	ND		ND		NA		NA	64,855	0/12		NA
Chloroform	0/12	ND	ND		ND		NA		NA	4,698	0/12		NA
Chloromethane	0/12	ND	ND		ND		NA		NA	155,746	0/12		NA
cis-1,2-Dichloroethene	0/9	ND	ND		ND		NA		NA	146,301	0/9		NA
cis-1,3-Dichloropropene	0/12	ND	ND		ND		NA		NA	17,645	0/12		NA
Cumene	0/4	ND	ND		ND		NA		NA	520,000	0/4		NA
Dibromochloromethane	0/12	ND	ND		ND		NA		NA	25,543	0/12		NA
Dibromomethane	0/4	ND	ND		ND		NA		NA	233,550	0/4		NA
Dichlorodifluoromethane	0/4	ND	ND		ND		NA		NA	308,058	0/4		NA
Ethylbenzene	0/12	ND	ND		ND		NA		NA	395,000	0/12		NA
Iodomethane	0/4	ND	ND		ND		NA		NA		NA		NA
M + P Xylene	0/7	ND	ND		ND		NA		NA	420,000	0/7		NA
Methylene chloride	3/12	0.0026J	8	SB100	2.67		NA		NA	205,265	0/12		NA
o-Chlorotoluene	0/4	ND	ND		ND		NA		NA	560,010	0/4		NA
Propylbenzene	0/4	ND	ND		ND		NA		NA	240,000	0/4		NA
Styrene	0/12	ND	ND		ND		NA		NA	1,700,000	0/12		NA
Tetrachloroethene	0/12	ND	ND		ND		NA		NA	13,086	0/12		NA
Toluene	0/12	ND	ND		ND		NA		NA	520,000	0/12		NA
Total Xylene	0/5	ND	ND		ND		NA		NA	420,000	0/5		NA
trans-1,2-Dichloroethene	0/9	ND	ND		ND		NA		NA	234,823	0/9		NA
trans-1,3-Dichloropropene	0/12	ND	ND		ND		NA		NA	17,645	0/12		NA
Trichloroethene	0/12	ND	ND		ND		NA		NA	1,147	0/12		NA
Trichlorofluoromethane	0/4	ND	ND		ND		NA		NA	1,276,074	0/4		NA
Vinyl acetate	0/4	ND	ND		ND		NA		NA	1,396,422	0/4		NA
Vinyl chloride	0/12	ND	ND		ND		NA		NA	7,461	0/12		NA

[a]Stations in summary include 020-RAD-01N, 020-RAD-01W, 4J-MET-01N, 4J-P-01N, 4J-P-01W, 4J-VOC-01N, 4J-VOC-01W, BH009, BH010, K1200-09, K1200-10, KAD-SS-S11, KAD-SS-S21, KAD-SS-S31, KAD-SS-S41, KAD-SS-S51, RR-S01, RR-SS01, SB100, Z2-EU32-200, Z2-EU32-201, Z2-EU32-202, Z2-EU32-203, Z2-EU32-204, Z2-EU32-205, Z2-EU32-206, Z2-EU32-207, Z2-EU32-208, Z2-EU32-209, Z2-EU32-210, Z2-EU32-211, Z2-EU32-212, Z2-EU32-213, Z2-EU32-214, Z2-EU32-215, Z2-EU32-216, Z2-EU32-217, Z2-EU32-218, Z2-EU32-219, and Z2-EU32-301.

[b]Values in these columns are for detected results; non-detects are not included.

[c]"J" validation qualifier means the analyte was positively identified and the result is the approximate concentration in the sample.

[d]Ra/Th (radium/thorium) decay series results are calculated values for each sample based on detections of radium-226, thorium-230, and thorium-232 as discussed in the Zone 2 ROD.

[e]These radionuclides are not included in aggregate risk calculations for the EU. Instead, human health risk effects of these radionuclides (thorium-228 is included in the thorium-232 decay series) are evaluated with the Ra/Th decay series RLs as discussed in the Zone 2 ROD.

EU = exposure unit
NA = not applicable
ND = not detected
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RL = remediation level

Table A.4. EU Z2-32 data summary for soil samples collected from greater than 10 ft below ground surface[a]

Analyte	Frequency of detect	Minimum detect[b,c]	Maximum detect[b,c]	Location(s) of maximum detected result	Average detected result	Maximum RL	Frequency of detects exceeding maximum RL	Average RL	Frequency of detects exceeding average RL	PRG limit (10^{-5} or 1)	Frequency of detects exceeding PRG limit	Background concentration	Frequency of detects exceeding background
Inorganics (mg/kg)													
Aluminum	2/2	19,200	52,000	SB100	35,600		NA		NA	100,000	0/2	40,300	1/2
Antimony	1/2	1.3J	1.3J	SB100	1.3		NA		NA	408.8	0/2	1.52	0/2
Arsenic	2/2	11.1	15.6J	SB100	13.4	900	0/2	300	0/2	15.9	0/2	14.95	1/2
Barium	2/2	125	131	BH010	128		NA		NA	66,577	0/2	124.93	2/2
Beryllium	2/2	3.2	3.8	SB100	3.5	6,000	0/2	2,000	0/2	1,941	0/2	2.2	2/2
Cadmium	2/2	0.42J	0.85	SB100	0.635		NA		NA	451	0/2	0.22	2/2
Calcium	2/2	1,260	20,400J	SB100	10,830		NA		NA		NA	2,400	1/2
Chromium	2/2	18	53.1	SB100	35.6		NA		NA	640	0/2	44.88	1/2
Cobalt	2/2	15.2J	23.2	BH010	19.2		NA		NA	133,310	0/2	42	0/2
Copper	2/2	50.3	50.5J	SB100	50.4		NA		NA	40,877	0/2	22.48	2/2
Cyanide	0/1	ND	ND		ND		NA		NA	12,000	0/1	0.6	0/1
Iron	2/2	28,600	35,900	SB100	32,250		NA		NA	100,000	0/2	58,600	0/2
Lead	2/2	42.7	57.9	BH010	50.3		NA		NA	800	0/2	37.91	2/2
Magnesium	2/2	4,270	79,400	SB100	41,835		NA		NA		NA	3,300	2/2
Manganese	2/2	585	2,520	BH010	1,552		NA		NA	19,458	0/2	2,200	1/2
Mercury	0/2	ND	ND		ND	1,800	0/2	600	0/2	307	0/2	0.17	0/2
Molybdenum	1/2	1.1	1.1	BH010	1.1		NA		NA	5,110	0/2		NA
Nickel	2/2	78.7	184J	SB100	131		NA		NA	20,439	0/2	26.07	2/2
Potassium	2/2	1,720	2,940	SB100	2,330		NA		NA		NA	5,074.69	0/2
Selenium	0/1	ND	ND		ND		NA		NA	5,110	0/1	1.47	0/1
Silver	1/2	1.1	1.1	BH010	1.1		NA		NA	5,110	0/2	0.6	1/2
Sodium	1/2	155	155	SB100	155		NA		NA		NA	497	0/2
Thallium	0/2	ND	ND		ND		NA		NA	67.5	0/2	0.4	0/2
Tin	2/2	4.7	4.8J	SB100	4.75		NA		NA	100,000	0/2		NA
Vanadium	2/2	20.5	48.9	SB100	34.7		NA		NA	1,022	0/2	65.47	0/2
Zinc	2/2	279	389J	BH010	334		NA		NA	100,000	0/2	89.7	2/2
Other Organics (mg/kg)													
Diesel Range Organics	0/1	ND	ND		ND		NA		NA		NA		NA
Gasoline Range Organics	0/1	ND	ND		ND		NA		NA		NA		NA
Organics, pesticides, and PCBs (ug/kg)													
4,4'-DDD	0/2	ND	ND		ND		NA		NA	100,000	0/2		NA
4,4'-DDE	0/2	ND	ND		ND		NA		NA	70,000	0/2		NA
4,4'-DDT	0/2	ND	ND		ND		NA		NA	70,000	0/2		NA
Aldrin	0/2	ND	ND		ND		NA		NA	1,000	0/2		NA
alpha-BHC	0/2	ND	ND		ND		NA		NA	3,600	0/2		NA
alpha-Chlordane	0/2	ND	ND		ND		NA		NA	65,000	0/2		NA
beta-BHC	0/2	ND	ND		ND		NA		NA	13,000	0/2		NA
delta-BHC	0/2	ND	ND		ND		NA		NA		NA		NA
Dieldrin	0/2	ND	ND		ND		NA		NA	1,100	0/2		NA
Endosulfan I	0/2	ND	ND		ND		NA		NA	3,700,000	0/2		NA
Endosulfan II	0/2	ND	ND		ND		NA		NA	3,700,000	0/2		NA
Endosulfan sulfate	0/2	ND	ND		ND		NA		NA	3,700,000	0/2		NA
Endrin	0/2	ND	ND		ND		NA		NA	180,000	0/2		NA
Endrin aldehyde	0/2	ND	ND		ND		NA		NA	180,000	0/2		NA
Endrin ketone	0/2	ND	ND		ND		NA		NA	180,000	0/2		NA
gamma-Chlordane	0/2	ND	ND		ND		NA		NA	65,000	0/2		NA
Heptachlor	0/2	ND	ND		ND		NA		NA	3,800	0/2		NA
Heptachlor epoxide	0/2	ND	ND		ND		NA		NA	1,900	0/2		NA
Lindane	0/2	ND	ND		ND		NA		NA	17,000	0/2		NA

Table A.4. EU Z2-32 data summary for soil samples collected from greater than 10 ft below ground surface[a] (continued)

Analyte	Frequency of detect	Minimum detect[b,c]	Maximum detect[b,c]	Location(s) of maximum detected result	Average detected result	Maximum RL	Frequency of detects exceeding maximum RL	Average RL	Frequency of detects exceeding average RL	PRG limit (10^{-5} or 1)	Frequency of detects exceeding PRG limit	Background concentration	Frequency of detects exceeding background
Methoxychlor	0/2	ND	ND		ND		NA		NA	3,100,000	0/2		NA
PCB-1016	0/2	ND	ND		ND	100,000	0/2	10,000	0/2	37,000	0/2		NA
PCB-1221	0/2	ND	ND		ND	100,000	0/2	10,000	0/2	7,436	0/2		NA
PCB-1232	0/2	ND	ND		ND	100,000	0/2	10,000	0/2	7,436	0/2		NA
PCB-1242	0/2	ND	ND		ND	100,000	0/2	10,000	0/2	7,436	0/2		NA
PCB-1248	0/2	ND	ND		ND	100,000	0/2	10,000	0/2	7,436	0/2		NA
PCB-1254	0/2	ND	ND		ND	100,000	0/2	10,000	0/2	7,436	0/2		NA
PCB-1260	0/2	ND	ND		ND	100,000	0/2	10,000	0/2	7,436	0/2		NA
Toxaphene	0/2	ND	ND		ND		NA		NA	16,000	0/2		NA
Radionuclides (pCi/g)													
Alpha activity	2/2	8.39J	32.38	SB100	20.4		NA		NA		NA		NA
Americium-241	0/1	ND	ND		ND		NA		NA	57	0/1		NA
Beta activity	2/2	4.84	83.51	SB100	44.2		NA		NA		NA		NA
Cesium-137	0/1	ND	ND		ND	20	0/1	2	0/1	1.13	0/1		NA
Cobalt-60	0/1	ND	ND		ND		NA		NA	0.6	0/1		NA
Lead-212	1/1	1.5	1.5	BH010	1.5		NA		NA	61,300	0/1		NA
Neptunium-237	0/1	ND	ND		ND	50	0/1	5	0/1	2.72	0/1		NA
Plutonium-238	0/1	ND	ND		ND		NA		NA	160	0/1		NA
Plutonium-239	0/1	ND	ND		ND		NA		NA	144	0/1		NA
Potassium-40	1/1	44.78	44.78	BH010	44.8		NA		NA	2.73	1/1	32.12	1/1
Ra/Th decay series[d]	1/1	0	0		0	15	0/1	5	0/1		NA		NA
Strontium-90	1/1	1.19J	1.19J	BH010	1.19		NA		NA	110	0/1		NA
Technetium-99	1/2	1.63J	1.63J	SB100	1.63		NA		NA	8,960	0/2		NA
Thorium-228[e]	1/1	1.87J	1.87J	BH010	1.87		NA		NA	0.18	1/1	1.86	1/1
Thorium-230[e]	1/1	0.99J	0.99J	BH010	0.99		NA		NA	202	0/1	1.2	0/1
Thorium-232[e]	1/1	1.51J	1.51J	BH010	1.51		NA		NA	0.18	1/1	1.95	0/1
Uranium-234	0/1	ND	ND		ND	7,000	0/1	700	0/1	332	0/1		NA
Uranium-235	0/1	ND	ND		ND	80	0/1	8	0/1	3.98	0/1		NA
Uranium-238	0/1	ND	ND		ND	500	0/1	50	0/1	18	0/1	1.47	0/1
Semivolatile organics (ug/kg)													
1,2,4-Trichlorobenzene	0/5	ND	ND		ND		NA		NA	215,925	0/5		NA
1,2-Dichlorobenzene	0/5	ND	ND		ND		NA		NA	600,000	0/5		NA
1,3-Dichlorobenzene	0/5	ND	ND		ND		NA		NA	600,000	0/5		NA
1,4-Dichlorobenzene	0/5	ND	ND		ND		NA		NA	78,665	0/5		NA
2,4,5-Trichlorophenol	0/2	ND	ND		ND		NA		NA	61,560,629	0/2		NA
2,4,6-Trichlorophenol	0/2	ND	ND		ND		NA		NA	61,561	0/2		NA
2,4-Dichlorophenol	0/2	ND	ND		ND		NA		NA	1,846,819	0/2		NA
2,4-Dimethylphenol	0/2	ND	ND		ND		NA		NA	12,312,126	0/2		NA
2,4-Dinitrophenol	0/2	ND	ND		ND		NA		NA	1,231,213	0/2		NA
2,4-Dinitrotoluene	0/2	ND	ND		ND		NA		NA	25,348	0/2		NA
2,6-Dinitrotoluene	0/2	ND	ND		ND		NA		NA	25,348	0/2		NA
2-Chloronaphthalene	0/2	ND	ND		ND		NA		NA	23,382,732	0/2		NA
2-Chlorophenol	0/2	ND	ND		ND		NA		NA	235,768	0/2		NA
2-Methyl-4,6-dinitrophenol	0/2	ND	ND		ND		NA		NA	61,561	0/2		NA
2-Methylnaphthalene	0/2	ND	ND		ND		NA		NA	187,691	0/2		NA
2-Methylphenol	0/2	ND	ND		ND		NA		NA	30,780,315	0/2		NA
2-Nitrobenzenamine	0/2	ND	ND		ND		NA		NA	1,830,232	0/2		NA
2-Nitrophenol	0/2	ND	ND		ND		NA		NA		NA		NA
3,3'-Dichlorobenzidine	0/2	ND	ND		ND		NA		NA	38,304	0/2		NA
3-Nitrobenzenamine	0/2	ND	ND		ND		NA		NA	18,468	0/2		NA
4-Bromophenyl phenyl ether	0/2	ND	ND		ND		NA		NA		NA		NA

Table A.4. EU Z2-32 data summary for soil samples collected from greater than 10 ft below ground surface[a] (continued)

Analyte	Frequency of detect	Minimum detect[b,c]	Maximum detect[b,c]	Location(s) of maximum detected result	Average detected result	Maximum RL	Frequency of detects exceeding maximum RL	Average RL	Frequency of detects exceeding average RL	PRG limit (10^{-5} or 1)	Frequency of detects exceeding PRG limit	Background concentration	Frequency of detects exceeding background
4-Chloro-3-methylphenol	0/2	ND	ND		ND		NA		NA		NA		NA
4-Chlorobenzenamine	0/2	ND	ND		ND		NA		NA	2,462,425	0/2		NA
4-Chlorophenyl phenyl ether	0/2	ND	ND		ND		NA		NA		NA		NA
4-Methylphenol	0/2	ND	ND		ND		NA		NA	3,100,000	0/2		NA
4-Nitrobenzenamine	0/2	ND	ND		ND		NA		NA	184,648	0/2		NA
4-Nitrophenol	0/2	ND	ND		ND		NA		NA		NA		NA
Acenaphthene	0/2	ND	ND		ND		NA		NA	29,219,327	0/2		NA
Acenaphthylene	0/2	ND	ND		ND		NA		NA	29,219,327	0/2		NA
Anthracene	0/2	ND	ND		ND		NA		NA	100,000,000	0/2		NA
Benz(a)anthracene	0/2	ND	ND		ND		NA		NA	21,096	0/2		NA
Benzo(a)pyrene	0/2	ND	ND		ND		NA		NA	2,110	0/2		NA
Benzo(b)fluoranthene	0/2	ND	ND		ND		NA		NA	21,096	0/2		NA
Benzo(ghi)perylene	0/2	ND	ND		ND		NA		NA	29,126,201	0/2		NA
Benzo(k)fluoranthene	0/2	ND	ND		ND		NA		NA	210,962	0/2		NA
Bis(2-chloroethoxy)methane	0/2	ND	ND		ND		NA		NA		NA		NA
Bis(2-chloroethyl) ether	0/2	ND	ND		ND		NA		NA	5,755	0/2		NA
Bis(2-chloroisopropyl) ether	0/2	ND	ND		ND		NA		NA	73,518	0/2		NA
Bis(2-ethylhexyl)phthalate	0/2	ND	ND		ND		NA		NA	1,231,213	0/2		NA
Butyl benzyl phthalate	0/2	ND	ND		ND		NA		NA	100,000,000	0/2		NA
Carbazole	0/2	ND	ND		ND		NA		NA	861,849	0/2		NA
Chrysene	0/2	ND	ND		ND		NA		NA	2,109,623	0/2		NA
Dibenz(a,h)anthracene	0/2	ND	ND		ND		NA		NA	2,110	0/2		NA
Dibenzofuran	0/2	ND	ND		ND		NA		NA	1,563,342	0/2		NA
Diethyl phthalate	0/2	ND	ND		ND		NA		NA	100,000,000	0/2		NA
Dimethyl phthalate	0/2	ND	ND		ND		NA		NA	100,000,000	0/2		NA
Di-n-butyl phthalate	0/2	ND	ND		ND		NA		NA	61,560,629	0/2		NA
Di-n-octylphthalate	0/2	ND	ND		ND		NA		NA	24,624,252	0/2		NA
Fluoranthene	0/2	ND	ND		ND		NA		NA	22,000,353	0/2		NA
Fluorene	0/2	ND	ND		ND		NA		NA	26,281,433	0/2		NA
Hexachlorobenzene	0/2	ND	ND		ND		NA		NA	10,773	0/2		NA
Hexachlorobutadiene	0/5	ND	ND		ND		NA		NA	184,682	0/5		NA
Hexachlorocyclopentadiene	0/2	ND	ND		ND		NA		NA	3,658,717	0/2		NA
Hexachloroethane	0/2	ND	ND		ND		NA		NA	615,606	0/2		NA
Indeno(1,2,3-cd)pyrene	0/2	ND	ND		ND		NA		NA	21,096	0/2		NA
Isophorone	0/2	ND	ND		ND		NA		NA	5,119,795	0/2		NA
Naphthalene	0/2	ND	ND		ND		NA		NA	187,691	0/2		NA
Nitrobenzene	0/2	ND	ND		ND		NA		NA	102,935	0/2		NA
N-Nitroso-di-n-propylamine	0/2	ND	ND		ND		NA		NA	2,462	0/2		NA
N-Nitrosodiphenylamine	0/2	ND	ND		ND		NA		NA	3,517,750	0/2		NA
Pentachlorophenol	0/2	ND	ND		ND		NA		NA	89,982	0/2		NA
Phenanthrene	0/2	ND	ND		ND		NA		NA	29,126,201	0/2		NA
Phenol	0/2	ND	ND		ND		NA		NA	100,000,000	0/2		NA
Pyrene	0/2	ND	ND		ND		NA		NA	29,126,201	0/2		NA
Volatile organics (ug/kg)													
1,1,1-Trichloroethane	2/5	0.001J	120	K1070CD-DPT-01	60		NA		NA	1,200,000	0/5		NA
1,1,2,2-Tetrachloroethane	0/5	ND	ND		ND		NA		NA	9,294	0/5		NA
1,1,2-Trichloro-1,2,2-trifluoroethane	1/2	0.003J	0.003J	BH010	0.003		NA		NA	5,600,000	0/2		NA
1,1,2-Trichloroethane	0/5	ND	ND		ND		NA		NA	16,050	0/5		NA
1,1-Dichloroethane	3/5	3J	15	K1070CD-DPT-01	10.3		NA		NA	1,738,654	0/5		NA
1,1-Dichloroethene	1/5	47	47	K1070CD-DPT-01	47		NA		NA	413,325	0/5		NA

Table A.4. EU Z2-32 data summary for soil samples collected from greater than 10 ft below ground surface[a] (continued)

Analyte	Frequency of detect	Minimum detect[b,c]	Maximum detect[b,c]	Location(s) of maximum detected result	Average detected result	Maximum RL	Frequency of detects exceeding maximum RL	Average RL	Frequency of detects exceeding average RL	PRG limit (10^{-5} or 1)	Frequency of detects exceeding PRG limit	Background concentration	Frequency of detects exceeding background
1,2-Dibromoethane	0/3	ND	ND		ND		NA		NA	630	0/3		NA
1,2-Dichloroethane	0/5	ND	ND		ND		NA		NA	6,035	0/5		NA
1,2-Dichloroethene	0/2	ND	ND		ND		NA		NA	150,000	0/2		NA
1,2-Dichloropropane	0/5	ND	ND		ND		NA		NA	7,422	0/5		NA
1,2-Dimethylbenzene	0/3	ND	ND		ND		NA		NA	420,000	0/3		NA
2-Butanone	0/5	ND	ND		ND		NA		NA	113,264,388	0/5		NA
2-Hexanone	0/5	ND	ND		ND		NA		NA		NA		NA
4-Methyl-2-pentanone	1/5	5J	5J	SB100	5		NA		NA	47,001,434	0/5		NA
Acetone	0/5	ND	ND		ND		NA		NA	54,320,986	0/5		NA
Benzene	1/5	3J	3J	SB100	3		NA		NA	14,094	0/5		NA
Bromochloromethane	0/3	ND	ND		ND		NA		NA		NA		NA
Bromodichloromethane	0/5	ND	ND		ND		NA		NA	18,306	0/5		NA
Bromoform	0/5	ND	ND		ND		NA		NA	2,181,998	0/5		NA
Bromomethane	0/5	ND	ND		ND		NA		NA	13,078	0/5		NA
Carbon disulfide	0/5	ND	ND		ND		NA		NA	720,000	0/5		NA
Carbon tetrachloride	0/5	ND	ND		ND		NA		NA	5,493	0/5		NA
Chlorobenzene	0/5	ND	ND		ND		NA		NA	530,466	0/5		NA
Chloroethane	0/5	ND	ND		ND		NA		NA	64,855	0/5		NA
Chloroform	0/5	ND	ND		ND		NA		NA	4,698	0/5		NA
Chloromethane	0/5	ND	ND		ND		NA		NA	155,746	0/5		NA
cis-1,2-Dichloroethene	2/3	6.2	13	K1070CD-DPT-01	9.6		NA		NA	146,301	0/3		NA
cis-1,3-Dichloropropene	0/5	ND	ND		ND		NA		NA	17,645	0/5		NA
Dibromochloromethane	0/5	ND	ND		ND		NA		NA	25,543	0/5		NA
Ethylbenzene	1/5	2J	2J	SB100	2		NA		NA	395,000	0/5		NA
M + P Xylene	0/3	ND	ND		ND		NA		NA	420,000	0/3		NA
Methylene chloride	2/5	0.13J	9	SB100	4.57		NA		NA	205,265	0/5		NA
Styrene	0/5	ND	ND		ND		NA		NA	1,700,000	0/5		NA
Tetrachloroethene	0/5	ND	ND		ND		NA		NA	13,086	0/5		NA
Toluene	0/5	ND	ND		ND		NA		NA	520,000	0/5		NA
Total Xylene	1/2	9	9	SB100	9		NA		NA	420,000	0/2		NA
trans-1,2-Dichloroethene	0/3	ND	ND		ND		NA		NA	234,823	0/3		NA
trans-1,3-Dichloropropene	0/5	ND	ND		ND		NA		NA	17,645	0/5		NA
Trichloroethene	2/5	8.3	39	K1035-DPT-001	23.6		NA		NA	1,147	0/5		NA
Vinyl chloride	0/5	ND	ND		ND		NA		NA	7,461	0/5		NA

[a]Stations in summary include BH010, K1035-DPT-001, K1070CD-DPT-01, K1070CD-DPT-03, and SB100.
[b]Values in these columns are for detected results; non-detects are not included.
[c]"J" validation qualifier means the analyte was positively identified and the result is the approximate concentration in the sample.
[d]Ra/Th (radium/thorium) decay series results are calculated values for each sample based on detections of radium-226, thorium-230, and thorium-232 as discussed in the Zone 2 ROD.
[e]These radionuclides are not included in aggregate risk calculations for the EU. Instead, human health risk effects of these radionuclides (thorium-228 is included in the thorium-232 decay series) are evaluated with the Ra/Th decay series RLs as discussed in the Zone 2 ROD.

EU = exposure unit
NA = not applicable
ND = not detected
PCB = polychlorinated biphenyl
PRG = preliminary remediation goal
RL = remediation level