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Addendum 9 to the Remedial Design Report/Remedial Action Work Plan for Zone 2 Soils, Slabs, and Subsurface Structures for Exposure Unit Z2-19 with Technical Memorandum at East Tennessee Technology Park, Oak Ridge, Tennessee

This document is approved for public release per review by:

Peter J. Kortman (signature on file) — 02/19/2020

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URS | CH2M Oak Ridge LLC
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ACRONYMS

Avg	average
bgs	below ground surface
COC	contaminant of concern
cpm	counts per minute
Cs-137	cesium-137
CSM	conceptual site model
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DQO	Data Quality Objective
DVS	Dynamic Verification Strategy
EPA	U.S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
EU	exposure unit
FFA	Federal Facility Agreement
GW	groundwater
GW SSL	groundwater soil screening level
Max	maximum
NFA	no further action
NNSS	Nevada National Security Site
NPDES	National Pollutant Discharge Elimination System
PCB	polychlorinated biphenyl
PCOC	potential contaminant of concern
PRG	preliminary remediation goal
RA	remedial action
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RDR/RAWP	Remedial Design Report/Remedial Action Work Plan
RL	remediation level
ROD	Record of Decision
SU	soil unit
TCE	Trichloroethylene
TCLP	toxicity characteristic leaching procedure
TDEC	Tennessee Department of Environment and Conservation
TM	Technical Memorandum
UF_6	uranium hexafluoride
VOC	volatile organic compound

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1. INTRODUCTION

The purpose of this Technical Memorandum (TM) is to document the current state of progress for an action/no further action (NFA) recommendation for Zone 2 exposure unit (EU) Z2-19 in the Poplar Creek EU Group at the East Tennessee Technology Park (ETTP) in Oak Ridge, Tennessee. The progress toward the recommendation for this EU is based on existing historical data and Dynamic Verification Strategy (DVS) soil and concrete characterization activities, which are used to determine the nature and extent of contamination and evaluate the need for an action based on the requirements of *Record of Decision for Soil, Buried Waste, and Subsurface Structures in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2161&D2; Zone 2 ROD).

EU Z2-19 is located toward the center portion of ETTP, but is in the western area of Zone 2. Historically, this EU was used as a support area for the gaseous diffusion process. This TM provides additional information for and evaluation of EU Z2-19. This TM provides supporting information to document evaluation of the entire EU, and to propose a recommendation for a remedial action (RA) or an NFA status for the EU. The recommendation for this EU is based on existing historical data, process knowledge, and characterization and sampling activities in compliance with the Zone 2 ROD. The objectives of this TM are also to document the characterization activities and RAs conducted in this area, interpret the characterization data, and make recommendations on how to reach a NFA status.

The data resulting from DVS and historical characterization activities conducted in EU Z2-19 are evaluated in this TM against the Zone 2 ROD remedial action objective (RAO) by comparing the data to certain industrial worker risk and groundwater protection criteria. The industrial worker risk criteria include remediation levels (RLs) for Zone 2 ROD primary contaminants of concern (COCs) and industrial worker preliminary remediation goals (PRGs) with which to evaluate aggregate risk from all chemicals and radionuclides. The groundwater protection criteria are a set of groundwater soil screening levels (GW SSLs) that are based on Zone 2 ROD groundwater protection requirements. The industrial worker RLs and the GW SSLs are taken from the Zone 2 ROD and are presented 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&D5; Zone 2 RDR/RAWP).

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2. EU LOCATION AND DESCRIPTION

EU Z2-19 is located in the central portion of ETTP, but is on the western edge of Zone 2. The EU is bounded by EU Z2-17 to the north, EUs Z2-20, Z2-21, and Z2-22 to the east, EU Z2-13 to the south, and Poplar Creek on the west (Figure 1). Under the DVS, EU Z2-19 was included in the *Data Quality Objective Scoping Package for the Poplar Creek Group (EUs Z2-11, Z2-12, and Z2-19) at the East Tennessee Technology Park, Oak Ridge, Tennessee* (BJC/OR-3231; DQO Scoping Package).

The Poplar Creek Group encompasses approximately 58.2 acres and includes potential sources for contamination. The land area of EU Z2-19 is approximately 23 acres. Almost all of the facilities within the EU are no longer in use. The only remaining facility, K-2527-BR Grout Shop, is still standing but is currently only used for storage of materials. The other above-grade facilities have been demolished and disposed, as identified in Table 1. Two of the remaining slabs were identified as potentially contaminated and the other remaining slabs in the EU were considered Class 3 slabs, in accordance with Appendix K of the Zone 2 RDR/RAWP. Figure 2 is a map of the EU Z2-19 and the layout of the historical and remaining structures.

The DQO Scoping Package lists two sites in EU Z2-19 that are included in Appendix C of the Federal Facility Agreement (FFA):

- K-1031 Waste Paint Accumulation Area
- K-1410 Neutralization Pits/Drain Lines

However, some of the facilities were added to the Action Memorandum via a letter from the U.S. Department of Energy (DOE) to be added to Appendix C:

- K-2527-BR Grout Shop
- K-1231-A Propane Storage
- K-1435-D4 Storage Rubb Tent

Except for K-2527-BR, all FFA sites in EU Z2-19 were buildings or facilities that were demolished during decontamination and decommissioning (D&D) activities and no longer exist. The concrete slabs associated with these buildings and other facilities not included in FFA Appendix C that remain in the EU are presented in Table 1 below.

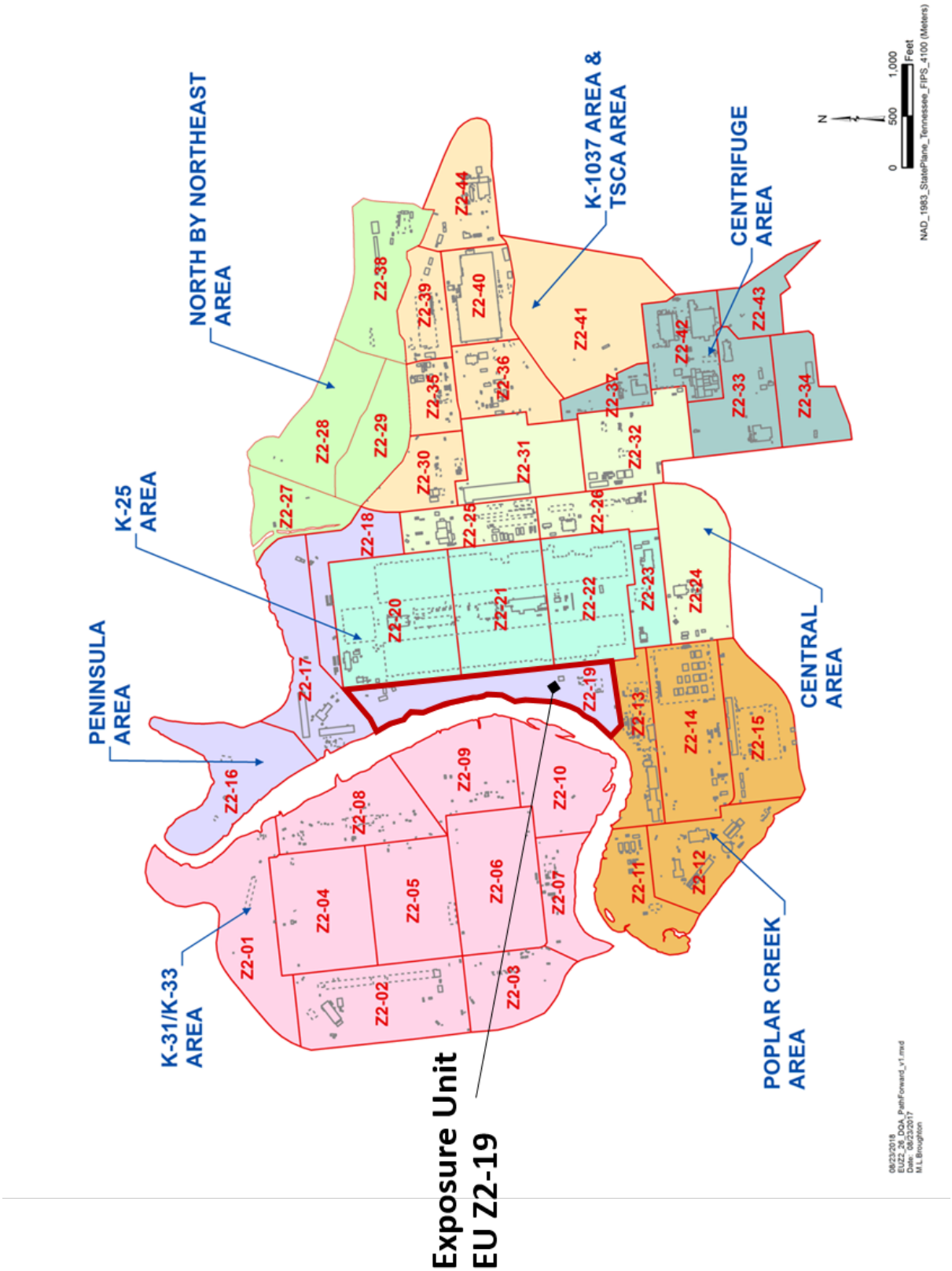


Figure 1. ETTP Zone 2 with EU Z2-19 highlighted.

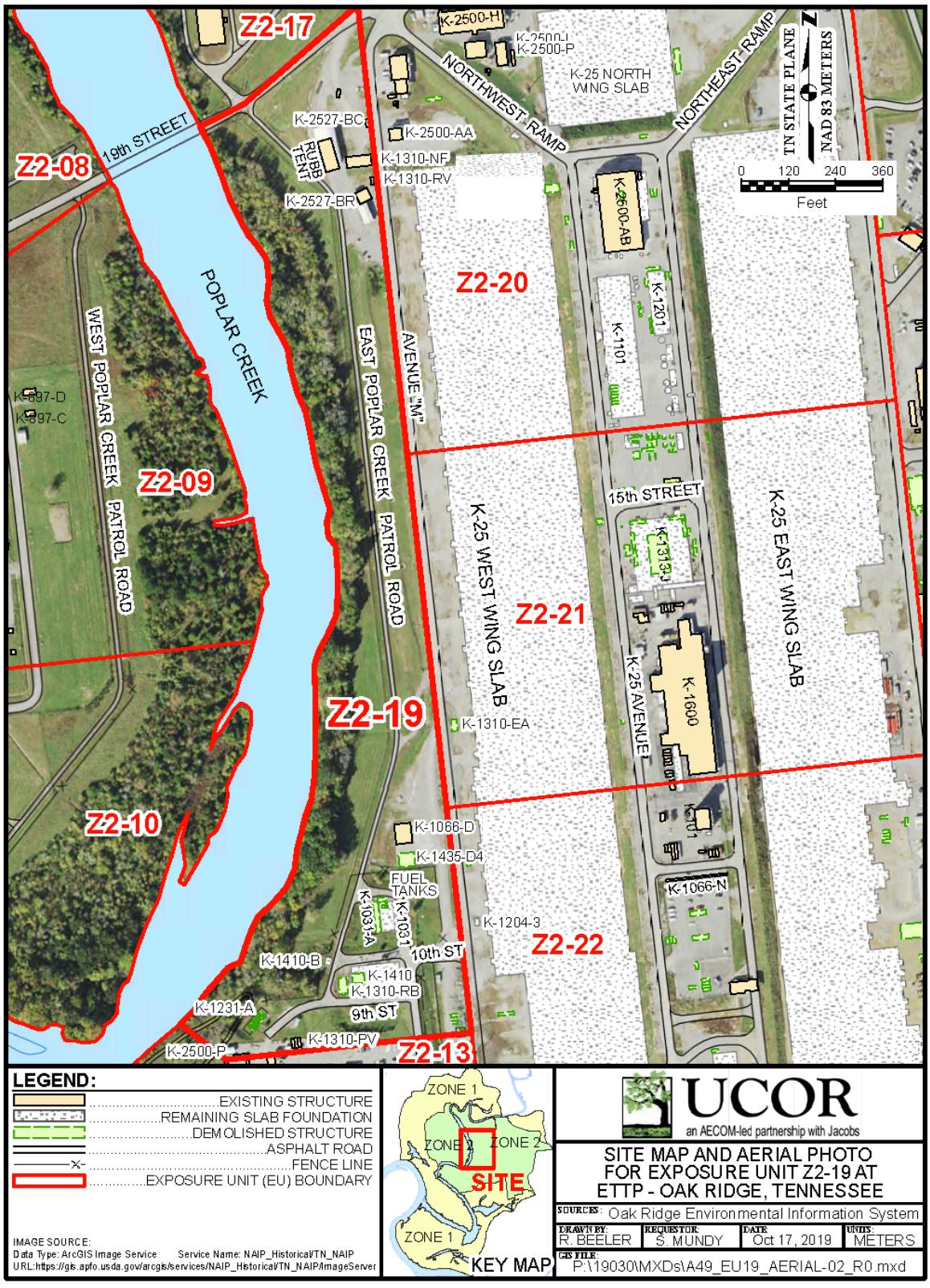


Figure 2. Location of current and historical facilities in EU Z2-19.

Table 1. Facilities within EU Z2-19.

Facility	Status	Demolition date	Potentially contaminated slab (Y/N)*
K-700-A-54 Substation	Demolished	Prior to 2006	N
K-700-A-70 Substation	Demolished	Prior to 2011	N
K-1031 Power and Utilities Storage Facility	Demolished	1999	Y
K-1066-D Tanker Storage Facility (and tanks)	Slab	Always a slab	N
K-1231-A Propane Storage	Demolished, no slab remains	Tanks were removed 1999	N
K-1410 Nickel Plating Facility	Demolished	1999	Y
K-1410-B Effluent Treatment Facility	Inactive	NA	NA
K-1435-D4 Rubb Tent	Demolished	2016	N**
K-2527-BR Trailer	Currently in place	Planned FY20	N
K-1310-NF Trailer	Currently in Place	Planned FY20	TBD
K-1031-A Support Building	Demolished	1999	N

*Based on RDR/RAWP Appendix K Table K.1.
** K-1435-D4 was on the footprint of slab K-1066-D.

TBD – to be determined, facility still active
NA – not applicable, below grade structures

3. BACKGROUND AND SITE HISTORY

Facilities located within EU Z2-19 were used to house support facilities for the gaseous diffusion process (i.e., storage areas, research and development, and waste management) and include primarily the K-1031 and K-1410 facilities. A historical photo of EU Z2-19 showing the facilities during operations is shown in Figure 3. A recent aerial is provided as Figure 4. The facilities were designed to support uranium enrichment with the larger structures housing mostly uranium hexafluoride (UF_6) handling equipment and other structures being associated with chemical and waste processing equipment.

A schematic of EU Z2-19 that displays the locations of these facilities is shown in Figure 2. The schematic is shown with storm drain lines in Figure 5. The storm drain lines and the process drain lines predominantly flow toward Poplar Creek to the west.

Portions of EU Z2-19 were sampled prior to development of the DQO Scoping Package, primarily as part of the K-25 Radiological Survey (phase 1 in 1994 and phase 2 in 1995). Additional sampling was completed to support the ETTP Remedial Investigation in 1998, *Remedial Investigation Report for the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-1778/V3&D1). Information on sampling, including dates and summaries, is included in Table 2.

Execution of the activities identified in the DQO Scoping Package began in July 2016 with a radiation walkover survey of the Class 1 Soil Unit (SU). As described, the survey results were reviewed by the Project Team on August 24, 2016 (Figure 6). The resulting revisions to the RDR/RAWP Appendix G.2 identified sampling plan was documented in concurrence form FCN-ETTP-Zone 2-194 (Attachment 5). The plan was executed beginning in March 2017. The collection of samples from 30 locations was completed the same month. Further detail regarding the sampling, including analytes and sample depths, is included in Table 3. Following preliminary evaluation of the data against Zone 2 criteria, several maximum (Max) RL exceedances were identified and delineation sampling was conducted in an additional 57 sample locations. The delineation sampling was conducted from September 26, 2017 through October 30, 2017. A listing of all sample locations is presented in Attachment 3. The locations of the characterization and delineation sampling are provided in Figure 7.

The EU Z2-19 Class 1 SU data were evaluated against the Zone 2 ROD RAO decision criteria as described in the Zone 2 RDR/RAWP and documented in concurrence FCN-ETTP-Zone 2-225 (Attachment 5). The FCN contained an EU Z2-19 technical memorandum that presented the evaluation of the data and proposed an RA for the EU. A map showing all of the sample locations is provided as Figure 7. A map showing the proposed RA is Figure 8. The data will be further discussed in Section 5.

The historical samples used to determine whether a data gap exists outside the security fence are presented in Figure 9.

Table 2. EU Z2-19 sampling events.

Sampling event	Summary	Dates	Data use
Phase 1 K-25 radiological survey	Provided an initial screening of sites at ETTP to identify areas of elevated radioactivity and collect surface soil samples.	1994	Identify areas of contamination at ETTP locations with exceedances to be re-sampled.
Phase 2 K-25 radiological survey	Provided an initial screening of sites at ETTP to identify areas of elevated radioactivity and collect surface soil samples.	1995	Identify areas of contamination at ETTP with exceedances to be re-sampled.
K-1410 Exterior Characterization	Presented and evaluated the nature and extent of contamination at ETTP.	1999 (draft)	Historical data evaluation to identify locations requiring additional sample collection.
DVS Characterization Sampling	Shallow discrete and 10 ft 3 interval composite samples were collected to support evaluation of the EU.	Mar-Apr 2017	Determine if contamination warranting an RA was present.
Delineation Sampling	Discrete 3 interval samples were collected.	Sept-Oct 2017	Delineate the identified areas of contamination warranting remediation.

DVS = Dynamic Verification Strategy
ETTP = East Tennessee Technology Park
EU = exposure unit
RA = remedial action

Table 3. Historical sampling activities.

Sampling event	Locations	RAD	Metals	PCB	SVOC	VOC	Comments
Phase 1 K-25 radiological survey	25	X					Surficial radiological investigation (0-6 in.).
Phase 2 K-25 radiological survey	12	X					Surficial radiological investigation (0-6 in.).
K-1410 Exterior Characterization	7	X	X	X		X	Various targeted discrete 2 ft intervals up to 9 ft deep.
DVS Characterization (as modified by FCN-ETTP-Zone 2-194)	30	X	X	X	X	X	Primarily shallow (0-1 ft) radiological with 3 full characterization (20%) and 5 utility corridor 10 ft 3-interval composite samples full suite.
DVS Delineation	57	X	X	X	X		Predominantly three discrete interval samples (0.5, 2, and 4 ft) to delineate the areas of contamination.

Note: Additional information, including date, intervals, and analytes, regarding individual sample locations within each sampling event can be found in Attachment 3.

DVS = Dynamic Verification Strategy
RAD = radiological
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound
VOC = volatile organic compound

Table 4. EU Z2-19 background documents.

Document Title	Date	Scope	Relevance
RCRA Facility Investigation Plan K-1410 Building Oak Ridge Gaseous Diffusion Plant Oak Ridge, Tennessee	December 1988	Contains data and information on the K-1410 building.	Provided process knowledge for K-1410 building
Remedial Site Evaluation for the K-1410 and K-1031 Facilities and Surrounding Area at the Oak Ridge K-25 Site, Oak Ridge Tennessee (DOE/OR/01-1412&D1)	October 1995	Contains data and information on the K-1410 and K-1031 buildings.	Provided process knowledge for K-1410 and K-1031 buildings
Radiological Characterization of Inactive Waste Sites at the Oak Ridge K-25 Site, Oak Ridge, Tennessee (K/ER-218)	May 1995	Provided an initial screening of sites at ETTP to identify areas of elevated radioactivity and collect surface soil samples	Provided historical radiological concentration information from surveys and sample results
Engineering Evaluation/Cost Analysis (EE/CA) for the Group 1 Auxiliary Facilities, K-25 Site, Oak Ridge, Tennessee (DOE/OR/02-1456/V2&D2)	June 1996	Support the D&D of 5 auxiliary facilities, including K-1410 and K-1031 buildings	Provided historical information on K-1410 and K-1031 buildings
Oak Ridge K-25 Site Outdoor Radiological Characterization, Phase II, Vol. 1-VI K/HS-620	September 1996	Provided an initial screening of sites at ETTP to identify areas of elevated radioactivity and collect surface soil samples	Provided historical radiological concentration information from surveys and sample results
Removal Action Work Plan for the K-25 Auxiliary Facilities Decommissioning Group I Buildings Demolition Project at the East Tennessee technology Park, Oak Ridge, Tennessee (DOE/OR/02-1657&D2)	December 1997	Support the D&D of 5 auxiliary facilities, including K-1410 and K-1031.	Provided historical information on K-1410 and K-1031
Remedial Investigation Report for the East Tennessee Technology Park, Oak Ridge, Tennessee, DOE/OR/01-1778/V3&D1, January 1999	January 1999	Document nature and extent of contamination and associated risk at ETTP.	Provides historical investigation information
Removal Action Report for the K-25 Auxiliary Facilities Decommissioning Group I Buildings Demolition Project at the East Tennessee Technology Park, Oak Ridge, Tennessee (DOE/OR/01-1829&D1)	August 1999	Support the D&D of 5 auxiliary facilities, including K-1410 and K-1031.	Provided historical information on K-1410 and K-1031.
Data Quality Objective Scoping package for the Poplar Creek Group (EUs Z2-11, Z2-12, and Z2-19) at the East Tennessee Technology Park, Oak Ridge, Tennessee (BJC/OR-3231)	April 2009	Provide background information on EU Z2-19 along with proposed characterization strategy.	Provided information on the original DVS characterization planning

Table 4. EU Z2-19 background documents (cont.)

Document Title	Date	Scope	Relevance
FCN-ETTP-Zone 2-194 - Documented the Class 1 sampling and revised the DQO Scoping Summary plan.	November 2016	Propose additional sampling in the Class 1 area of EU Z2-19.	Identifies additional sampling needed for EU characterization.
FCN-ETTP-Zone 2-225 - Documented the RA for EU Z2-19 inside the security fence.	May 2018	Evaluation of samples collected in accordance with RDR/RAWP Appendix G, as modified by FCN-ETTP-Zone 2-194.	Identified RA for EU Z2-19 inside the fence.
Appendix L Sampling and Analysis Plan for Exposure Unit Z2-19, East Tennessee Technology Park, Oak Ridge, Tennessee (DOE/OR/01-2224&D5)	January 2020	Support characterization of areas not evaluated as part of the Class 1 SU in EU Z2-19.	Provided remaining characterization data required to determine whether additional RAs are needed.

D&D = decontamination and decommissioning
DQO = Data Quality Objectie
EU = exposure unit
RCRA = Resource Conservation and Recovery Act
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan

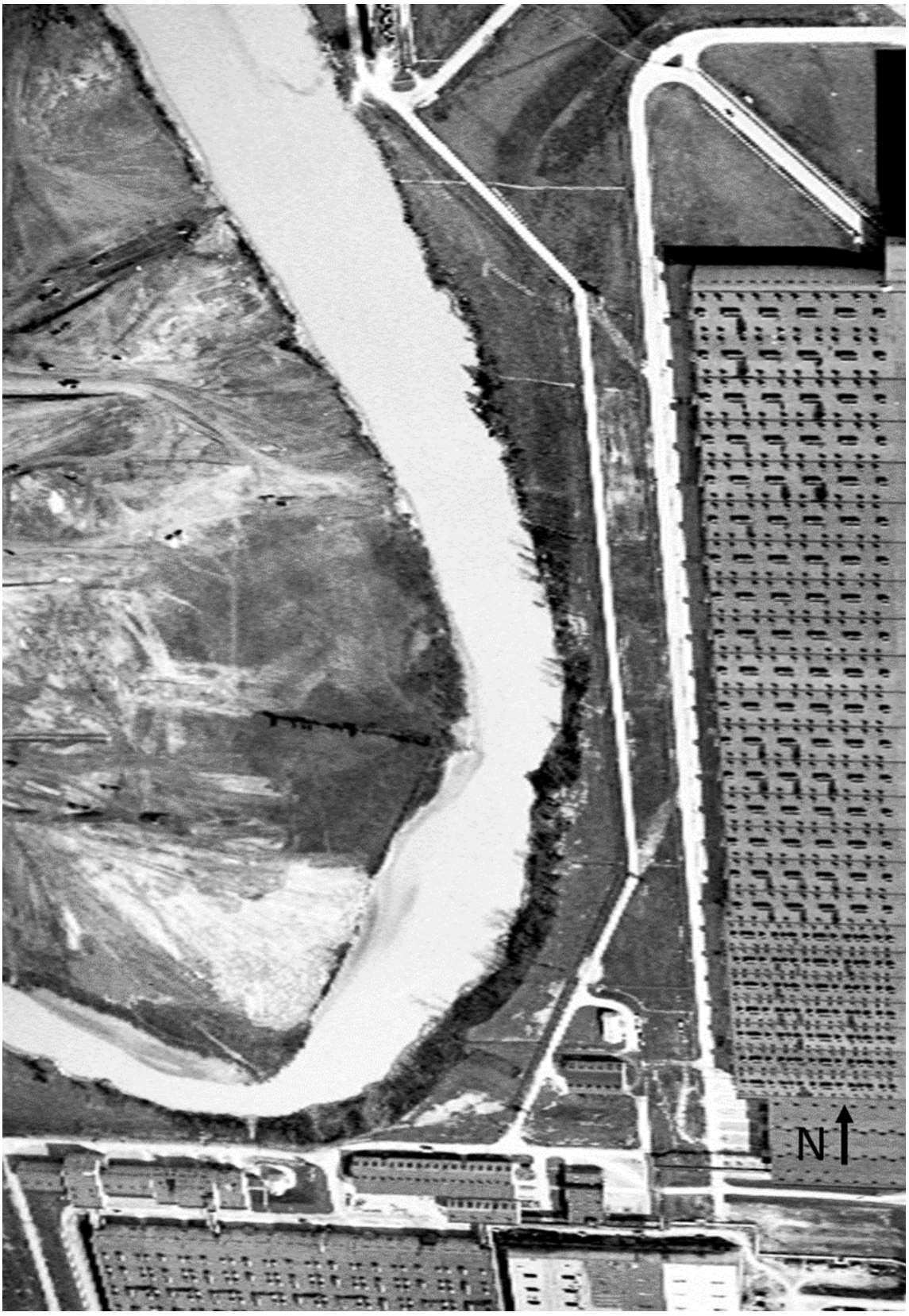


Figure 3. EU Z2-19 in 1951.

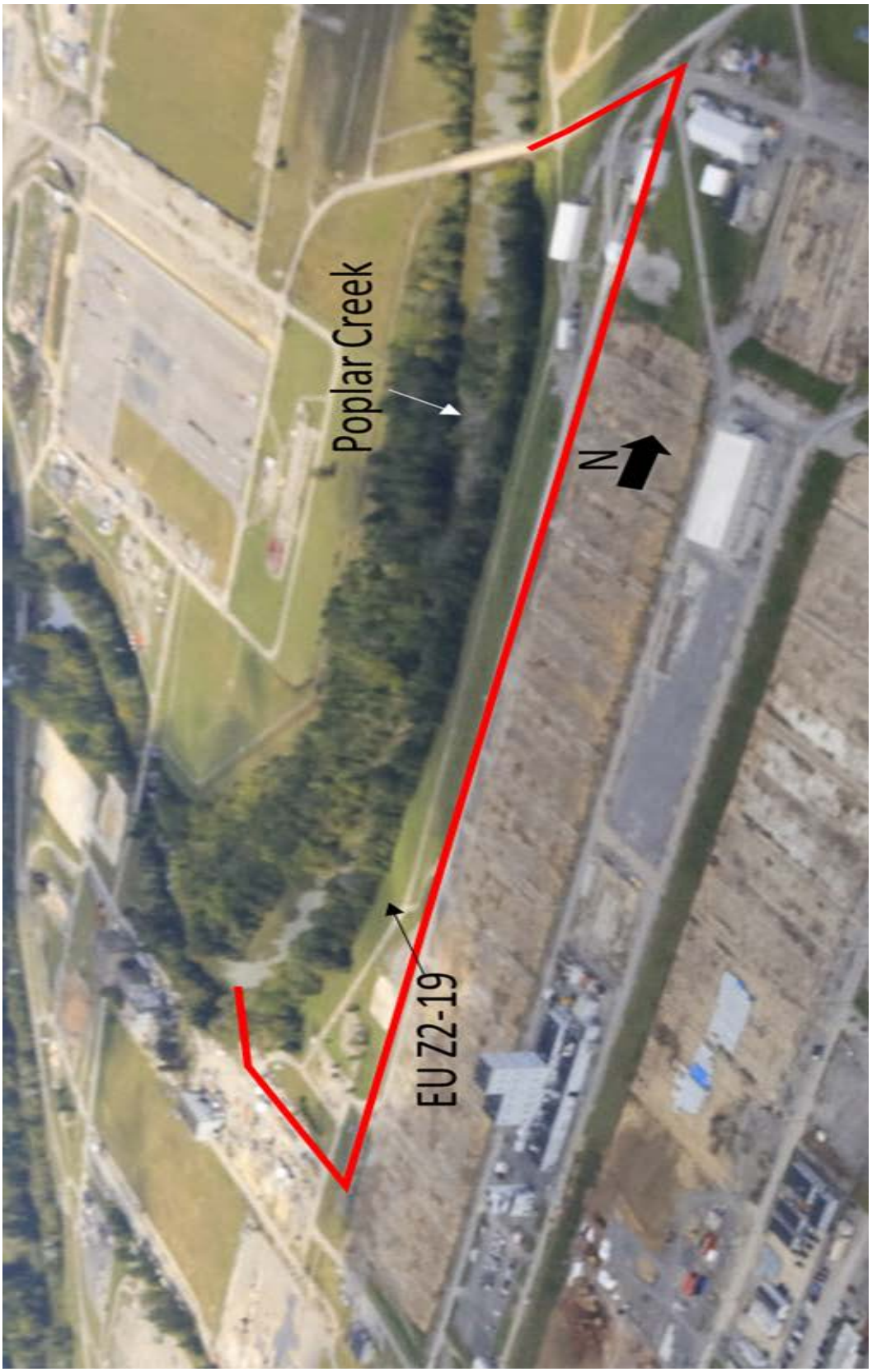


Figure 4. EU Z2-19 aerial taken in September 2018 (facing west).

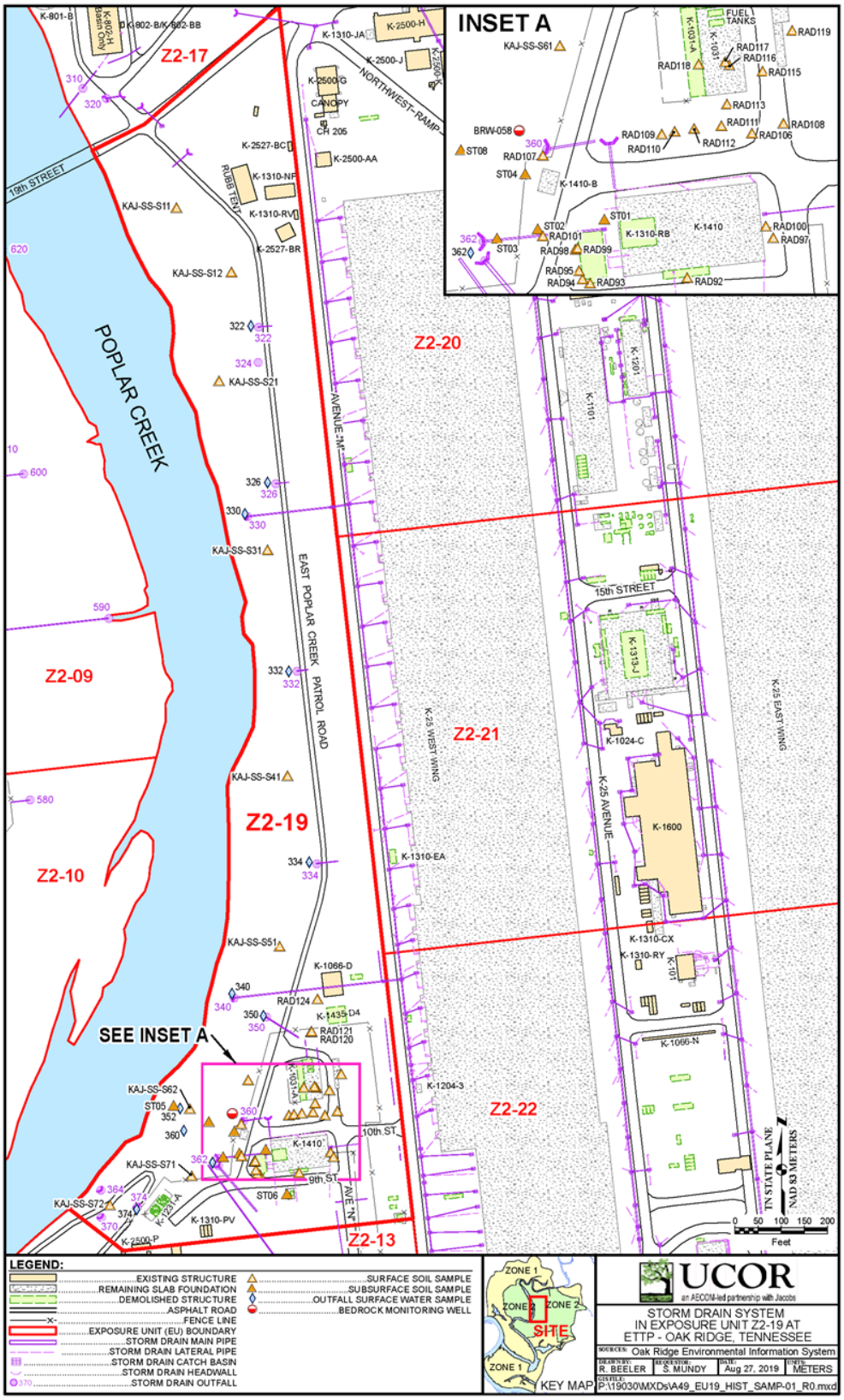


Figure 5. Historical sampling locations and storm drain lines in EU Z2-19.

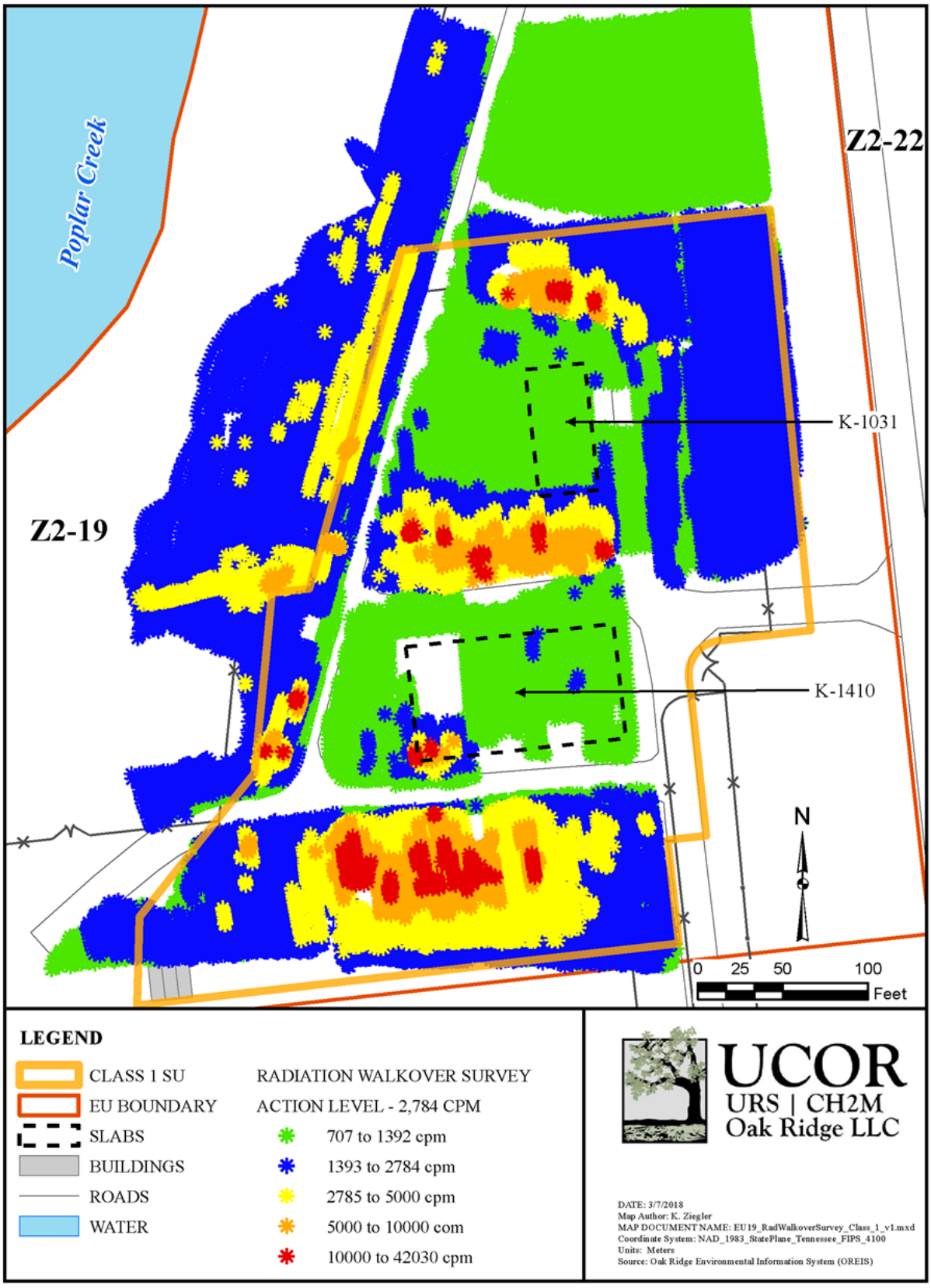


Figure 6. Results for the Class 1 SU radiation walkover survey performed July 2016 in EU Z2-19.

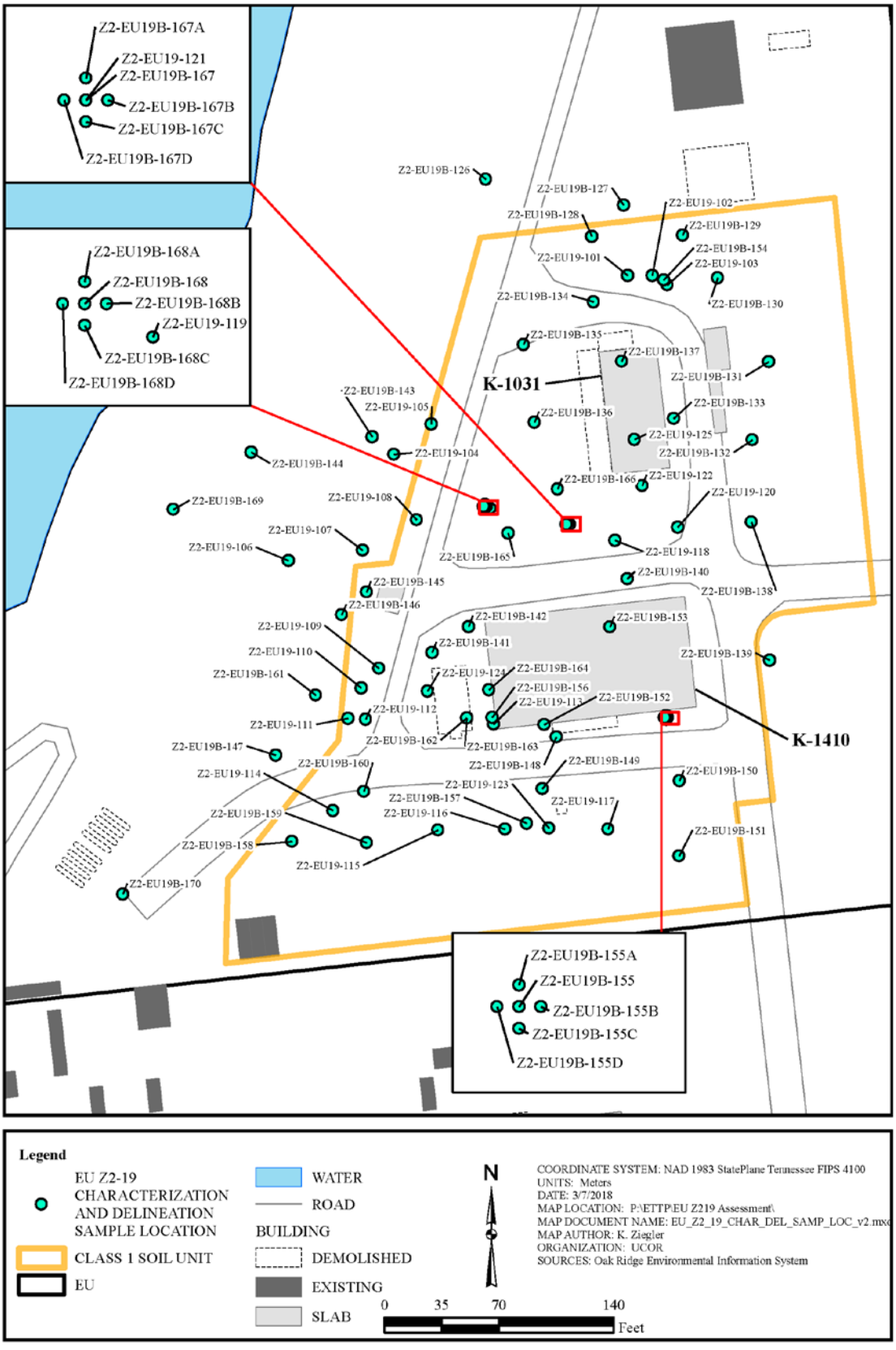


Figure 7. Soil sample locations in the Class 1 SU (dates are provided in Attachment 3).

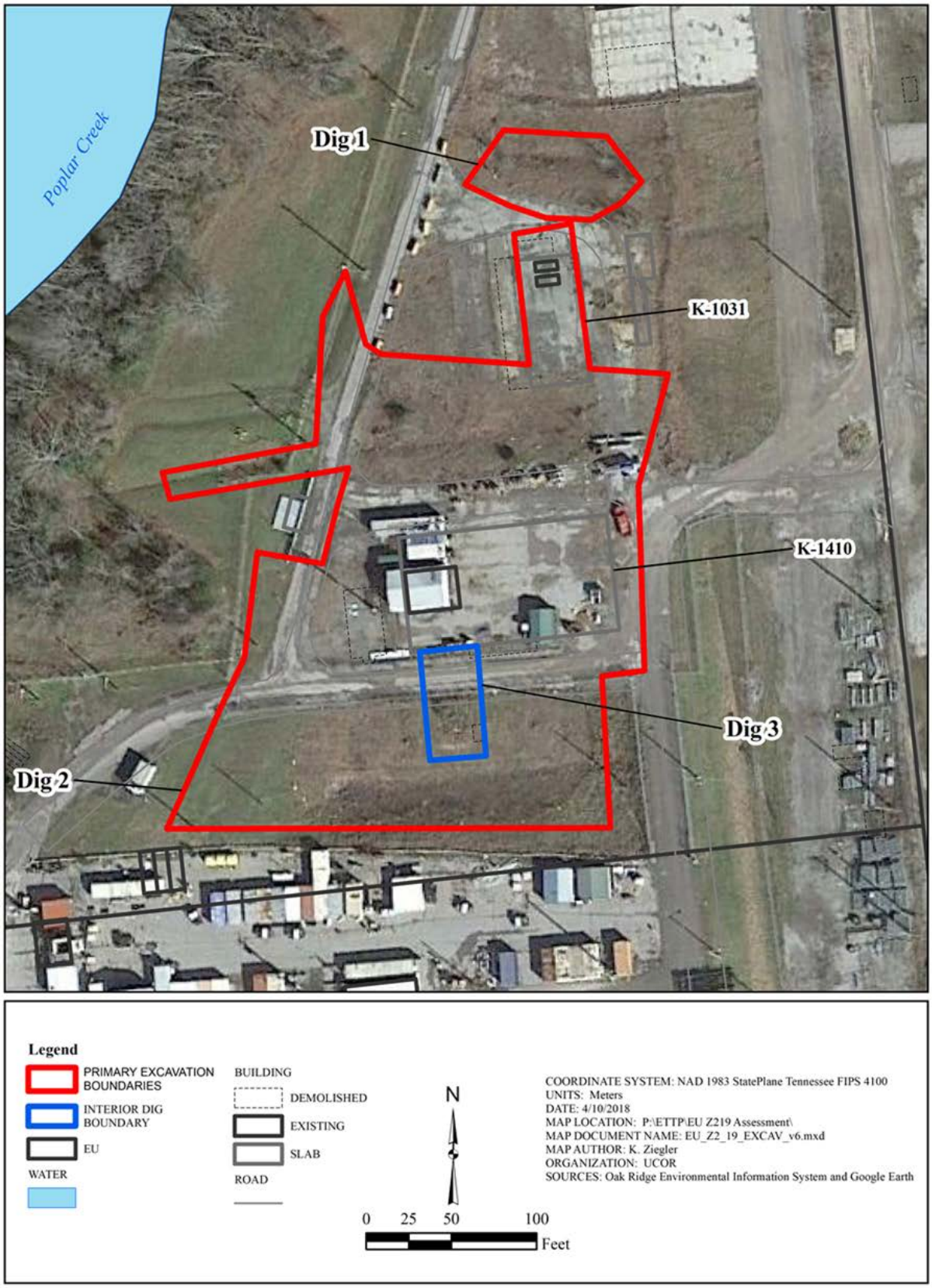


Figure 8. EU Z2-19 RAs.

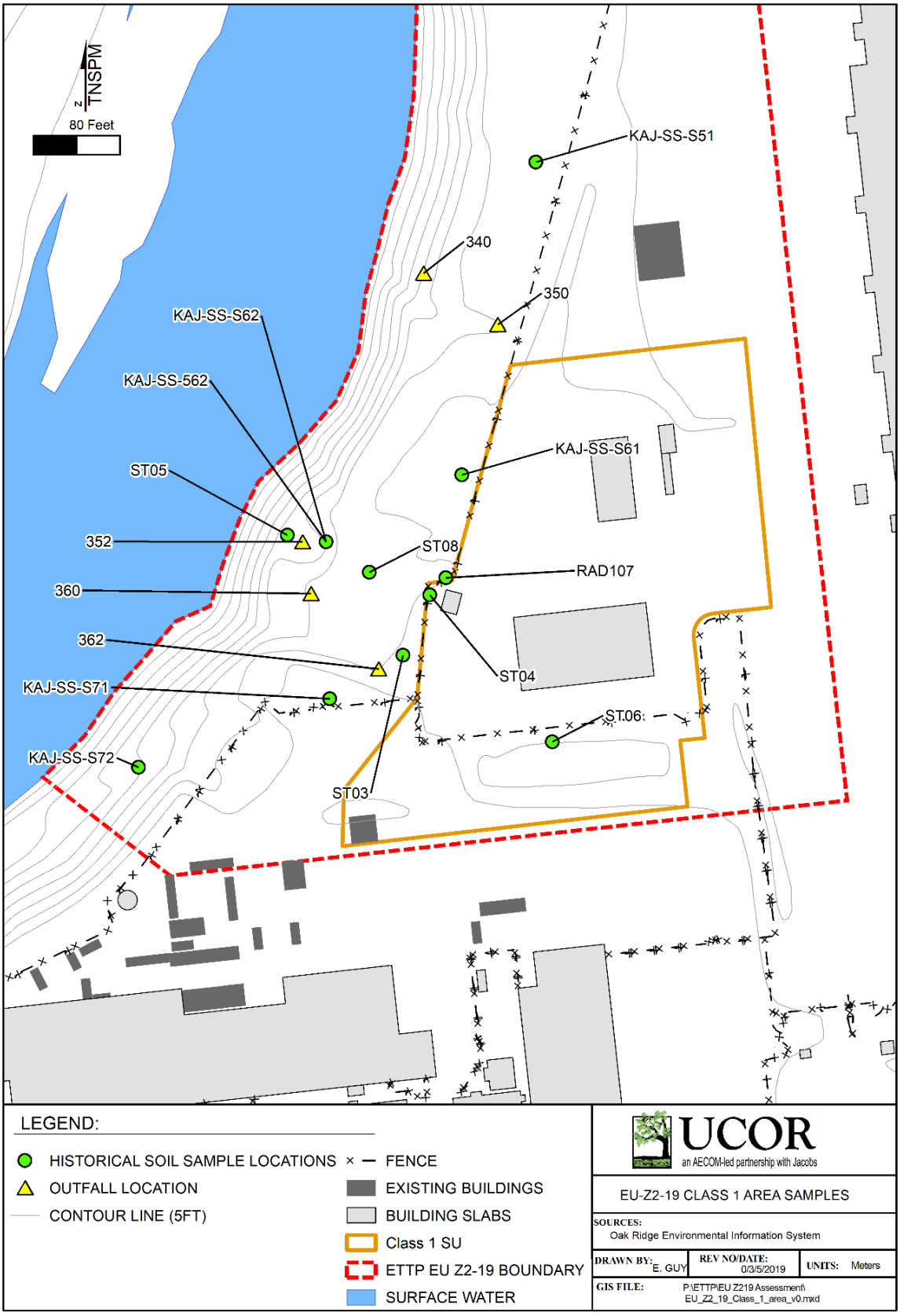


Figure 9. Historical sampling locations used for the Creek Bank DQO (dates are provided in Attachment 3).

3.1 OPERATIONAL HISTORY

Following is a brief discussion of the historical use and existing conditions of the facilities located in EU Z2-19.

3.1.1 Building K-1410

The K-1410 Building was used to mix media from the spent cascade traps for use in the K-25 Gaseous Diffusion Plant. Subsequently, it was used for decontamination and recovery of uranium from large pieces of process equipment. The building included two spray facilities to solubilize and remove uranium with nitric acid and to degrease pumps with Trichloroethylene (TCE). Finally, the facility was converted to an electroplating facility by removing the decontamination tanks and filling the degreasing pits with concrete. Only a concrete slab remains. The slab was covered with asphalt following the building demolition in 1994. The slab is within the Class 1 SU of EU Z2-19.

The operational use of the facility transitioned through time. A description of the facility use through time is provided below:

- 1945 – Facility constructed, original operations involved storage of clean trapping materials (alumina, carbon, and sodium fluoride), mixing carbon and cadmium-coated alumina for use in carbon traps.
- 1947 – Began operations to separate carbon from the alumina in spent trapping media for uranium recovery.
- 1948 – Building converted to a cleaning and decontamination facility when use of carbon in cascade traps was discontinued. Conversion included installation of two spray facilities in the west end of the building for decontaminating large pieces of equipment. The spray facilities included two 8x2x25 stainless steel spray tanks in pits with floor pans to collect spray. A degreaser that used tetrachloroethene, carbon tetrachloride, and TCE was installed between the two pits.
    - A contaminated material incinerator was constructed near the SW corner of the building (no information on what was burned is available).
- 1953 1954 — The facility was dedicated to decontamination of equipment from the K-1131 Feed Manufacturing Plant (FMP), which processed spent reactor fuel from other DOE sites.
    - During this period, and likely at other times, contaminated process equipment was stored periodically in outdoor areas adjacent to K-1410 (and K-1031).
    - One documented episode involved outdoor storage of ash receivers associated with the FMP fluorination towers. The ash receivers were staged to allow time for short-lived isotopes to decay. The receivers were opened daily for stirring and off-gassing.
- 1963/1964 – The facility was converted to an electroplating facility. The conversion entailed filling in the spray pits, installing plating equipment, and adding a new degreasing station. A limestone neutralization pile was constructed near Poplar Creek to neutralize acid discharges from plating operations. The plating process used hydrochloric acid dips, alkali dips, sulfuric acid dips, and solvents for degreasing. The electroplating solution contained nickel sulfate, nickel chloride, boric acid, etc., in support of nickel electroplating.
- 1975 – Installed a concrete pit (K-1410-B) with equipment to allow for neutralization prior to discharge (discharge from the new pit went into the original limestone pile).
- 1979 – Facility was deactivated.

- 1999 – Facility demolition completed; the slab and three pits remain. These pits will be removed when the building slab is demolished.

3.1.1.1 K-1410 Drain Lines Leading to Outfall 360

The drain lines emanating from the K-1410 building are a primary source for the contamination found in the drainage ditch associated with Outfall 360 (Figure 12 below shows the outfalls in relation to K-1410). The contaminants of concern associated with the drain line include radionuclides, metals, and polychlorinated biphenyls (PCBs) due to the processes in the facility. The drain lines received various wastewater streams throughout the life of the facility. The lines ran from various floor drains in the facility, as shown in Figure 10, through a common cleanout box (Figure 11.) to the open ditch that is now Outfall 360.

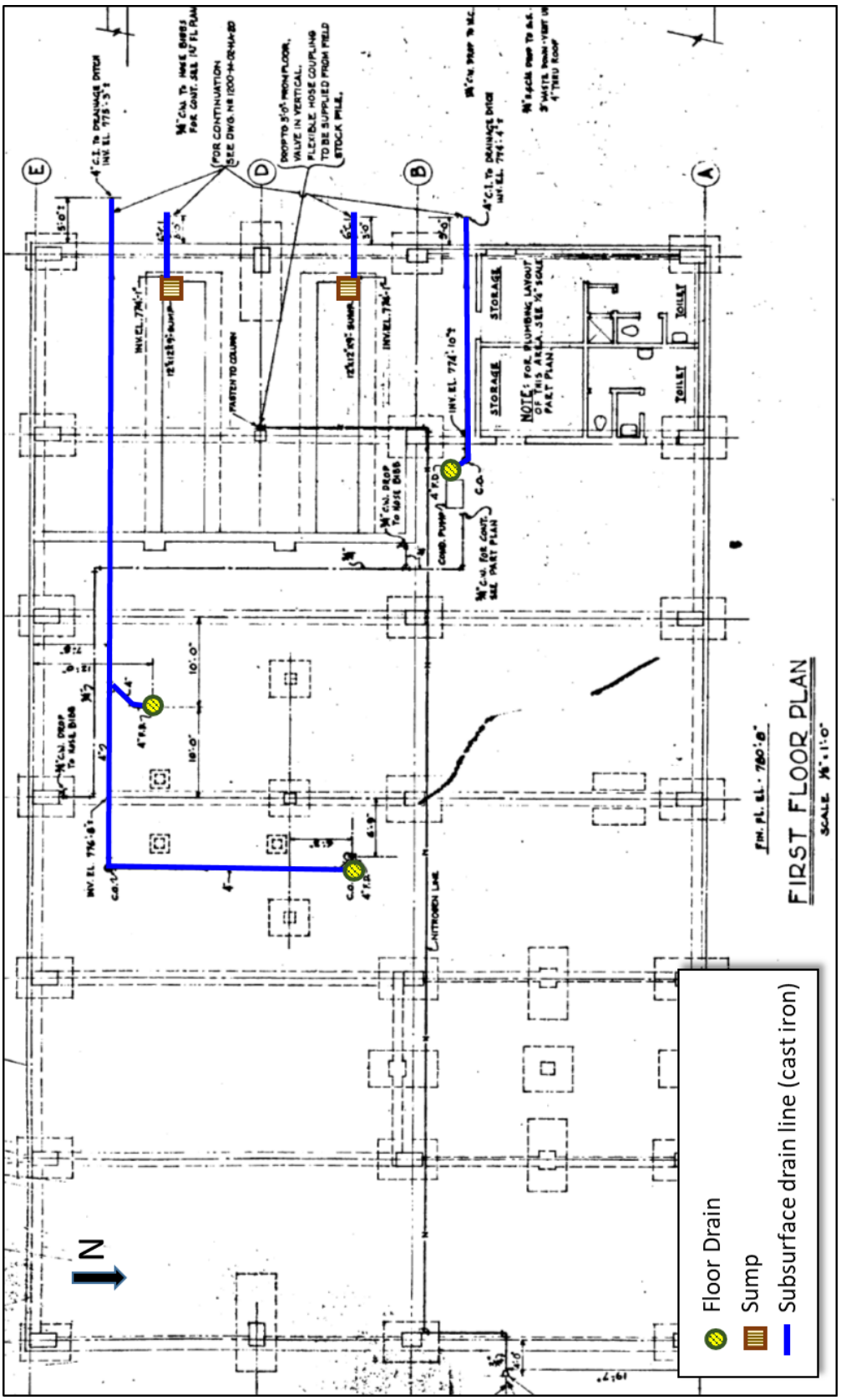
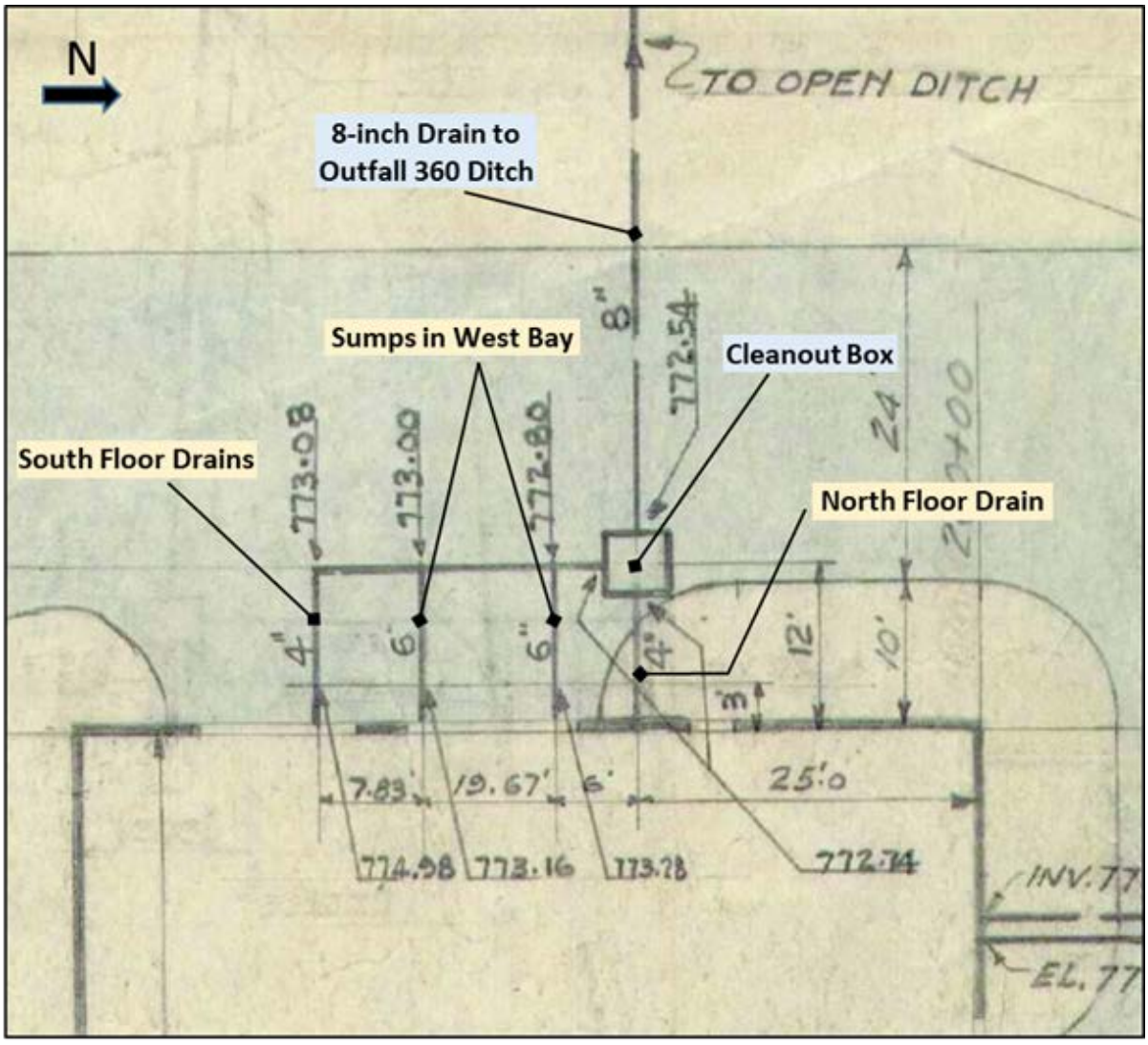


Figure 10. Floor drains identified in K-1410 inside building.



Source: Kellex Dwg 1200-M-02-HA-20 Rev.5, Dec 1945 (As-Built)

Figure 11. Floor drains identified in 1945 drawing of K-1410 outside building.

3.1.2 Building K-1031

Constructed in 1945 as a maintenance support facility for the K-25 building, the K-1031 building was used to store and dispense trapping media for spent cascade traps and was later used as a cutting and size reduction area for process equipment from the Fercleve Thermal Diffusion Plan. Prior to demolition, the building was used for paint storage and mixing, equipment and material storage. Only the concrete slab remains. Walkover surveys performed in 1999 indicated low levels of contamination exist throughout the slab, with small areas of higher activity to the north and south of the building. The slab was covered with asphalt following the building demolition in 1999. Demolition of the K-1031 Building can be found in the *Removal Action Report for the K-25 Auxiliary Facilities Decommissioning Group I Buildings Demolition Project* (DOE/OR/01-1829&D1). The slab is within the Class 1 SU of EU Z2-19.

3.1.3 Ancillary Buildings

In the northern portion of the EU, temporary structures, including trailers and grouped Sealand containers/Rubb tents were brought in to support the grouting process at the K-25 demolition project. The structures were used to house personnel and to store containers of grouted material prior to shipment. All of the facilities except for the K-2527-BR Grout Shop have been removed from the area. The K-2527-BR Grout Shop is scheduled to be demolished in FY20.

3.1.4 Creek Bank Area

EU Z2-19 extends from the industrial area to Poplar Creek. The area west of the predominantly industrial area has also been potentially impacted by the operations of the facilities. There are four areas of potential contamination including the National Pollutant Discharge Elimination System (NPDES) and process drain outfalls, the K-1410-B Neutralization Pile, historical hotspots, and runoff from the industrial area.

3.1.4.1 NPDES and process drain outfalls

Past practices in the industrial area included disposal of wastes and potential contaminants into process drains and storm drains with outfalls along the banks of Poplar Creek. Historically, storm water runoff from ETTP was another potential source of contamination due to contact with contaminated facilities and soils. Demolition and removal of contaminated facilities and remediation of contaminated soil areas has resulted in significant improvements in water quality in the storm drain discharges from ETTP. Discharges from ETTP are regulated under an NPDES permit issued by the State of Tennessee. Currently, Outfalls 360 and 362 are authorized to discharge storm water runoff under NPDES Permit TN0002950. (In the DQO, Outfall 360 was chosen to represent this ditch, when OF 362 should have been referenced. This document corrects the discrepancy.) Outfalls 360 and 362 receive runoff from the K-1031 and K-1410 buildings. Even with recent improvements, residual contamination is known to be present in soils downstream of these outfalls. Figure 12 shows the storm water flow direction in the southern portion of the EU.

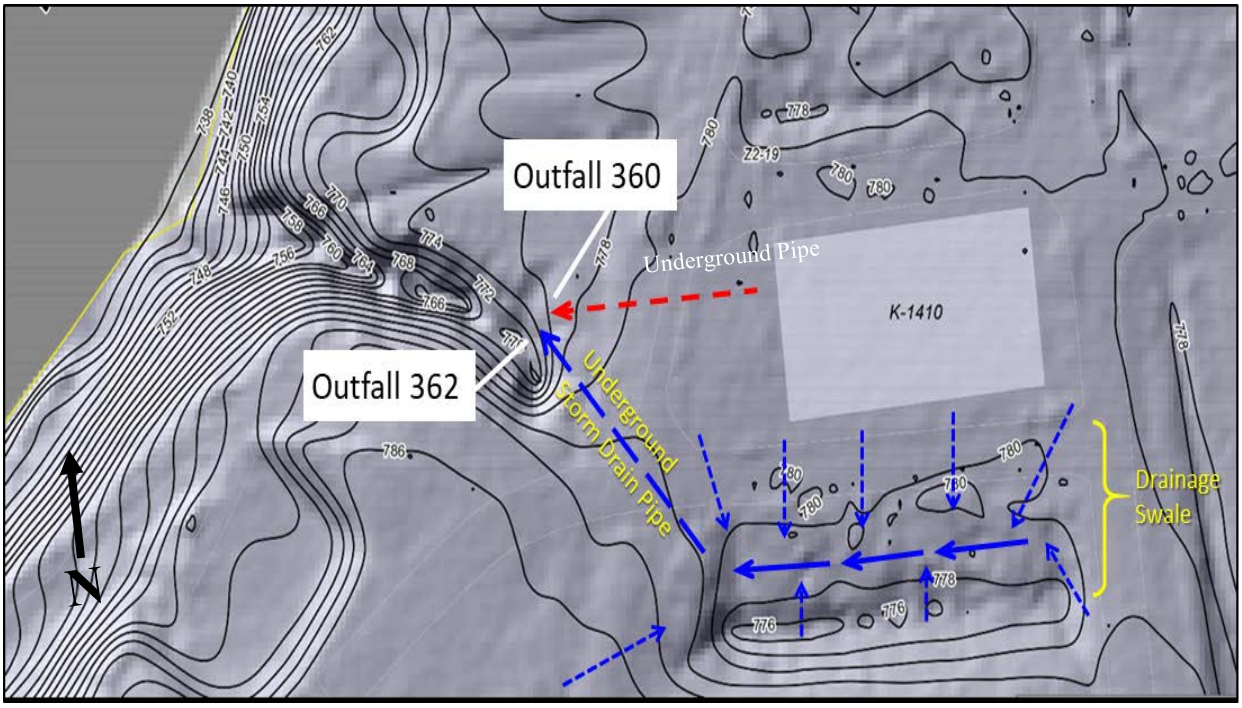


Figure 12. Storm water flow direction.

3.1.4.2 K-1131 Neutralization Pit

The K-1131 Neutralization Pile (Figure 13) was constructed in 1964 with limestone gravel, approximately 26 ft by 26 ft and connected to process lines running to the northwest from K-1410. A 4 in. vitrified clay drain line runs approximately 200 ft from K-1410 to the limestone acid disposal pit. The pipe was previously identified as Outfall 352, but was plugged in the late 1990's and was identified in the 1997 permit renewal as "sealed and no longer requiring permitting".

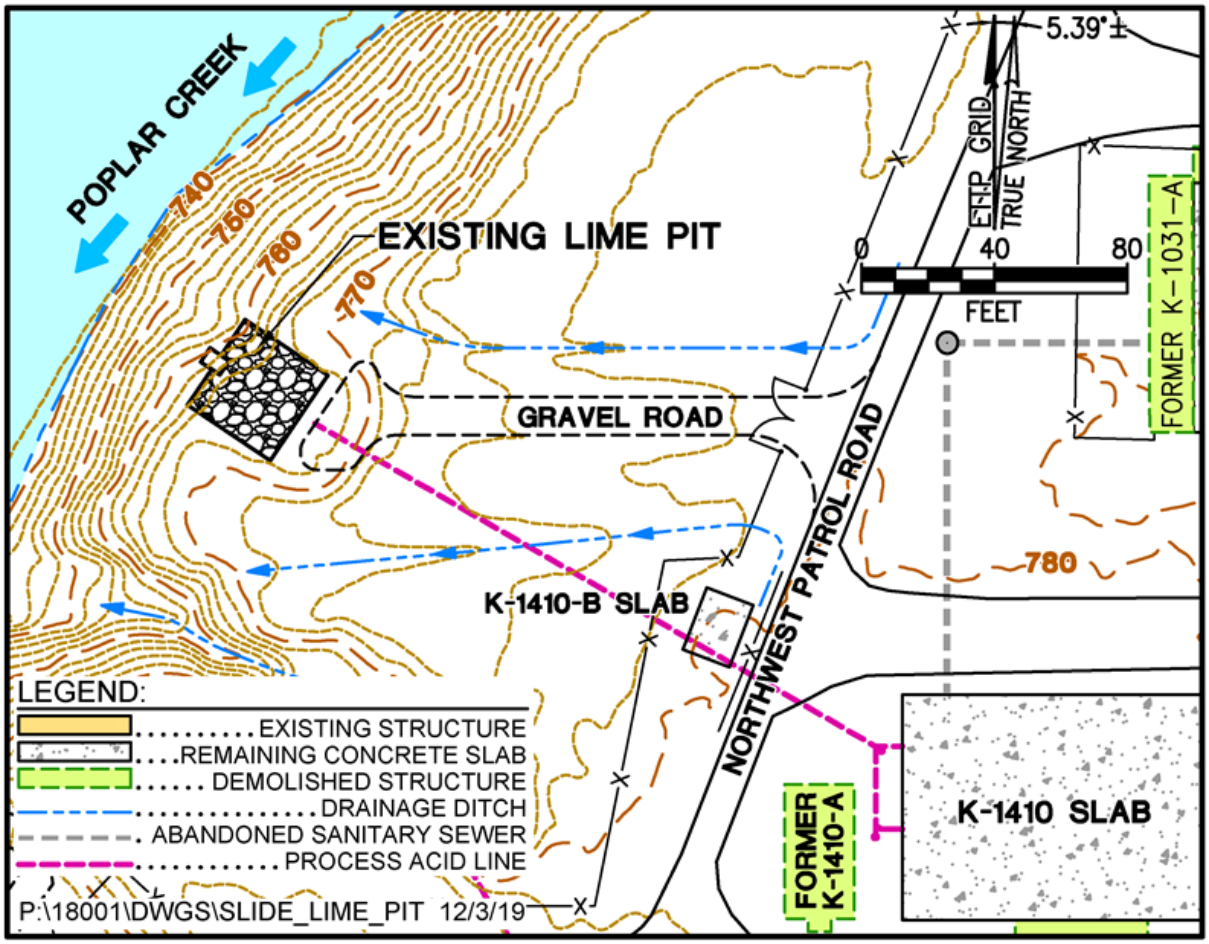


Figure 13. K-1410 Limestone Pit

3.1.4.3 Creek Bank Area

The area west of the EU Z2-19 industrial area is bounded by Poplar Creek, approximately 60-250 ft west of the industrial area fence. The topography drops, at its steepest, approximately 46 ft between the industrial area and Poplar Creek. Overland releases of contamination have occurred west of the industrial facilities, carrying contamination to the area between Poplar Creek and the industrial area. One portion of the creek bank is incised by a storm water outfall drainage ditch (Outfall 362) pictured in Figure 14.

Figure 14. Area west of EU Z2-19 (looking east) showing the slope to Poplar Creek.

3.2 HISTORICAL SAMPLING RESULTS

3.2.1 Pre-DQO Scoping Summary Sampling

Historical sampling was conducted in EU Z2-19 from 1994 through 1998, as part of the K-25 Radiological Survey Phase 1 (1994), Phase 2 (1995), and in support of the *Remedial Investigation Report for the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-1778/V3&D1). A listing of all sample locations are presented in Attachment 3. Samples exceeding the Zone 2 ROD criteria have been identified and discussed previously in FCN-ETTP-Zone 2-225 (Attachment 5), which identified an RA in the southern portion of the EU.

Surface and near surface soil samples were collected as part of a K-25 Radiological survey in 1994, documented in *Radiological Characterization of Inactive Waste Sites at the Oak Ridge K-25 Site, Oak Ridge, Tennessee* (K/ER-218). The 1995 radiological assessment, *Oak Ridge K-25 Site Outdoor Radiological Characterization, Phase II,* (Vol. I-VI K/HS-620), included further evaluation of the EU Z2-19 area. In 1998, soil borings were collected to support the *Remedial Investigation Report for the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-1778/V3&D1). A table containing sample locations, intervals, and an analyte list is found in Attachment 3.

In the historical sampling campaigns, numerous sample locations were identified as having Zone 2 ROD criteria exceedances for radiological constituents. As prescribed by the 2009 DQO Scoping Package, a radiological survey of the Class 1 SU was conducted to define contamination boundaries. During evaluation of the survey information, an apparent redistribution of contamination was identified and the characterization plan was revised by FCN-ETTP-Zone 2-194 (Attachment 5).

3.2.2 DVS Sampling

The investigation activities identified in FCN-ETTP-Zone 2-194 (Attachment 5) began in March 2017. The collection of samples from 30 locations was completed in March 2017. Following preliminary evaluation of the data against Zone 2 ROD criteria, several Max RL exceedances were identified (primarily radiological), and delineation sampling was conducted in an additional 57 sample locations, collected in September and October 2017. A listing of all sample locations are presented in Attachment 3.

The EU Z2-19 Class 1 SU data were evaluated against the Zone 2 ROD RAO decision criteria, as described in the Zone 2 RDR/RAWP, Section 3.2 and documented in FCN-ETTP-Zone 2-225 (Attachment 5). The FCN contained an EU Z2-19 technical memorandum that presented the evaluation of the data and proposed an RA for the EU, as presented in the following sections. A map showing all of the sample locations is provided as Figure 7. The primary focus of this characterization event was the Class 1 SU of EU Z2-19; however, samples were also collected in areas impacted by the operation of the K-1410 facility and in drainage pathways identified as being impacted by the Class 1 Area walkover survey, Figure 6.

3.2.2.1 Maximum RL Screening

There are 19 sample locations in the EU Z2-19 Class 1 SU with maximum RL exceedances, with 18 locations in the 0-1 ft depth and 1 location within the 0-2 ft depth. Table 5 indicates the analytes and the number of exceedances observed. There are no maximum exceedances at depths greater than 2 ft (Attachment 4). The distribution of sample locations is shown on Figure 7 and information regarding specific sample locations are presented in Attachment 3. According to the Zone 2 ROD, the area represented by these 19 sample locations requires an RA.

Table 5. Class 1 SU analytes with maximum detected concentrations exceeding maximum RLs.

Analyte with maximum RL exceedance(s)	Number of exceedances	SU maximum detected concentration	Maximum RL (pCi/g)
Ra/Th decay series	15/70	6,254 pCi/g	15
Cesium-137	6/70	4,060 pCi/g	20
Uranium-234	2/70	57,300 pCi/g	7000
Uranium-235	7/70	4,250 pCi/g	80
Uranium-238	8/70	17,300	500

Ra=radium
RL=remediation level
SU=soil unit
Th=thorium

3.2.2.2 Average RL Screening

The process presented in Section 3.2 of the Zone 2 RDR/RAWP for conducting an average RL screen arrives at a conclusion about whether the EU average concentration of a primary COC exceeds the average RL. Typically, the average RL screen is conducted across the EU, however, since EU-wide characterization was not complete at the time, the average RL exceedances within SU 1 were used to help define the excavation boundaries for the Class 1 SU.

There are 36 sample locations with maximum detected concentrations exceeding average RLs, excluding locations with maximum RL exceedances. Of the 36 locations, 33 have constituents in the 0-4-ft depth

interval and three have constituents up to 10 ft in depth. Table 6 indicates the analytes and the number of exceedances observed. The distribution of the sample locations are shown on Figure 7.

Table 6. Class 1 SU analytes with maximum detected concentrations exceeding average RLs.

Analyte with maximum RL exceedance(s)	Number of exceedances	SU maximum detected concentration	Average RL
Total PCBs	1/70	26,300 µg/kg	10,000
Ra/Th decay series	8/70	11.7 pCi/g	5 pCi/g
Cesium-137	8/70	13.8 pCi/g	2 pCi/g
Uranium-234	4/70	6,690 pCi/g	700 pCi/g
Uranium-235	33/70	75.3 pCi/g	8 pCi/g
Uranium-238	34/70	362 pCi/g	50 pCi/g

PCB = polychlorinated biphenyl
Ra = radium
RL=remediation level
SU=soil unit
Th = thorium

Historical radiological surveys of the slabs demonstrated the presence of elevated radioactivity, which resulted in the slabs being designated as a Contamination Area (K-1031) and a High Contamination Area (K-1410), as documented in the *Removal Action Report for the K-25 Auxiliary Facilities Decommissioning Group I Buildings Demolition Project at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-1829&D1). Based on their location within the area of EU Z2-19, which has been demonstrated to pose a threat to the industrial worker and a probable threat to groundwater (i.e., Class 1 SU) as a result of the presence of radiological contamination, it is concluded that the slabs themselves pose similar risks. Removal of the K-1031 and K-1410 slabs will eliminate the risks associated with them.

3.2.2.3 Threat to Groundwater

This evaluation is performed to ensure constituent concentrations in soil do not exceed modeled concentrations (GW SSLs) such that leaching would lead to groundwater concentrations in excess of drinking water standards. Should constituents exceed GW SSLs, an RA is required to protect groundwater. There are 31 sample locations with maximum detected concentrations exceeding GW SSLs, 31 have constituents within the 0-4-ft depth and 3 have constituents up to 10 ft deep. Table 7 indicates the analytes and the number of exceedances observed.

Table 7. Class 1 SU analytes with maximum detected concentrations exceeding GW SSLs.

Analyte with Maximum RL exceedance(s)	Number of exceedances	SU maximum detected concentration	Industrial RSL
Chromium	1/70	530 µg/kg	172 µg/kg
Uranium-234	41/70	57,300 pCi/g	61.1 pCi/g
Uranium-235	8/70	4,250 pCi/g	61.1 pCi/g
Uranium-238	34/70	17,300 pCi/g	61.1 pCi/g
Technetium-99	1/70	154 pCi/g	128 pCi/g

GW = groundwater
RL = remediation level
RSL = risk screening level
SSL = soil screening level
SU = soil unit

One step in evaluating possible threats to groundwater is to estimate the volumetric extent and mass of analytes with GW SSL exceedances to determine whether the analytes pose a threat to groundwater (Zone 2 RDR/RAWP, Section 3.2). The distribution of residual GW SSL exceedance locations forms a cluster near the interior of the Class 1 SU (Figure 15) to the point where there is probably sufficient volume of contaminated soil so that the mass of the detected constituents pose a threat to groundwater. As such, the area represented by these sample locations indicates that an RA is required, which was previously agreed upon in concurrence form FCN-ETTP-Zone 2-225).

3.2.2.4 Evaluation Summary

The evaluation of the Class 1 SU in EU Z2-19 identified a broad area of contaminants in exceedance of the various Zone 2 ROD criteria as discussed in the previous sections. A simple depiction of the contaminant distribution is provided as Figure 15. The figure shows that a large number of the Zone 2 ROD criteria exceedances are of the Max RL, with a prescribed RA of excavation. A figure containing sample identification numbers is provided as Figure 7. All DVS and early characterization activities were carried out according to the procedures and protocols of the Zone 2 RDR/RAWP including Appendix A: Quality Assurance Project Plan for Characterization Activities under the Dynamic Verification Strategy at the East Tennessee Technology Park, Oak Ridge, Tennessee. Attachment 3 presents the details of sampling and analysis at each characterization sample location in EU Z2-19. The information includes date, analyte groups, and sample intervals.

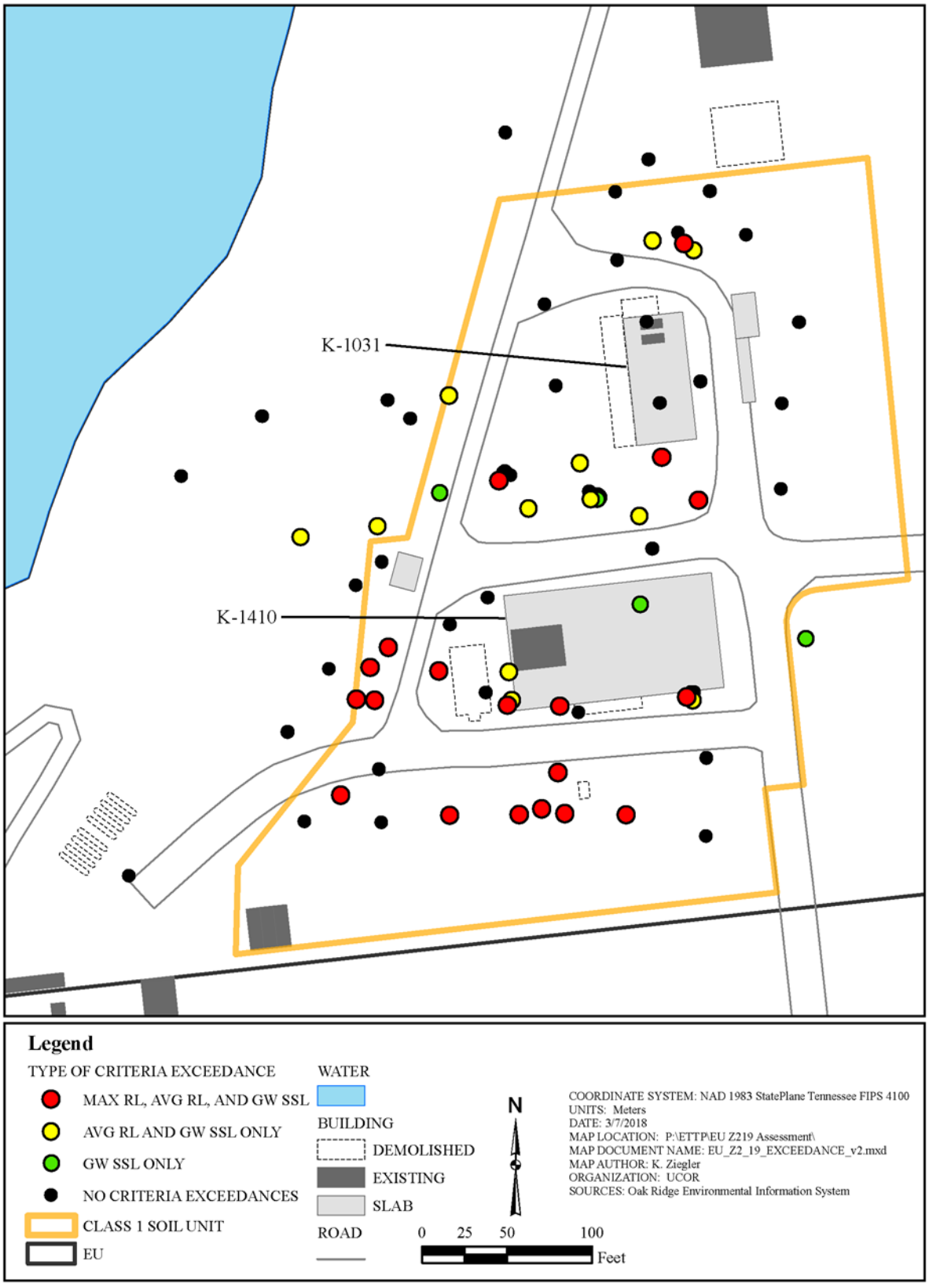


Figure 15. Historical sample locations (2017) with exceedances identified in EU Z2-19 (FCN-ETTP-Zone 2-225).

3.2.2.5 Additional data collection

Following preparation of FCN-ETTP-Zone 2-225, included in this TM as Attachment 5, additional data was required to support remedial action planning and waste disposal. Additional samples were collected in 2017 to determine the appropriate receiving facility for the waste material (soil, concrete, and sub-slab piping). Samples were also collected to support preparation of project execution support documents with analysis for additional radionuclides, to support toxicity characteristic leaching procedure (TCLP) with analysis for metals and volatile organic compounds (VOCs), and additional targeted VOC analysis to determine which materials might be subject to listing as F001 waste. The F001 listing was possible due to the facility process knowledge identifying degreasing operations in the western portion of the K-1410 building. Additional sampling was also required to support the waste stream characterization for the K-1410 and K-1031 concrete slabs.

The samples have been categorized as waste disposition, waste disposition/TCLP, delineated Nevada National Security Site (NNSS) excavations, gridded VOC, biased VOC subsurface structures, and groundwater (GW) source investigation.

- Waste disposition – predominantly concrete samples, the data supports waste disposal planning.
- Waste disposition – predominantly collection of samples at locations with results greater than 20 times the Resource Conservation and Recovery Act (RCRA) limit, to obtain TCLP results.
- Delineate NNSS excavations – some radionuclide concentrations in the soil exceed the limits allowed for Environmental Management Waste Management Facility disposal, thus causing the soil to be shipped to NNSS for disposal. These samples delineate the volumes of soil identified for NNSS disposal.
- Gridded VOC samples – the western portion of the K-1410 facility was historically used for degreasing operations, resulting in a potential F001 RCRA waste code for the waste material. These samples were planned to determine how much, if any, of the material in the general area would be impacted.
- Biased VOC samples – to further evaluate the impact of the degreasing operations, some samples were biased near the sub-slab drains and process drain lines.
- Subsurface structures – there are several subsurface structures in the EU. These samples were coupled with facility assessments, with water and/or sediment sample collection where media was available. The structures included electrical, transformer vaults, and the K-1410-B neutralization pit.
- GW source investigation – a GW plume has been identified in association with GW well BRW-058. Samples were collected to depths of bedrock or refusal to use in determining if the contamination is from an up-gradient source, or from within the EU.

Figure 16 shows the sample locations by sample type. More detailed information for each location is provided in Attachment 3. The detailed information includes category, sample identifier, sample description, date, analyte groups, and sample intervals. The pink dashed line in the western portion Figure 16 portrays an extension of the dig (Dig 2 Expansion), which was noted in a letter sent to the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC). Similar RL exceedances were found outside of the original dig areas (discussed in more detail in Section 5), so in accordance with the Zone 2 ROD, the RA area was extended to include all contaminated soil. The “dig areas” labeled on the Figure are RA areas that are approved via concurrence form FCN-ETTP-Zone 2-225.

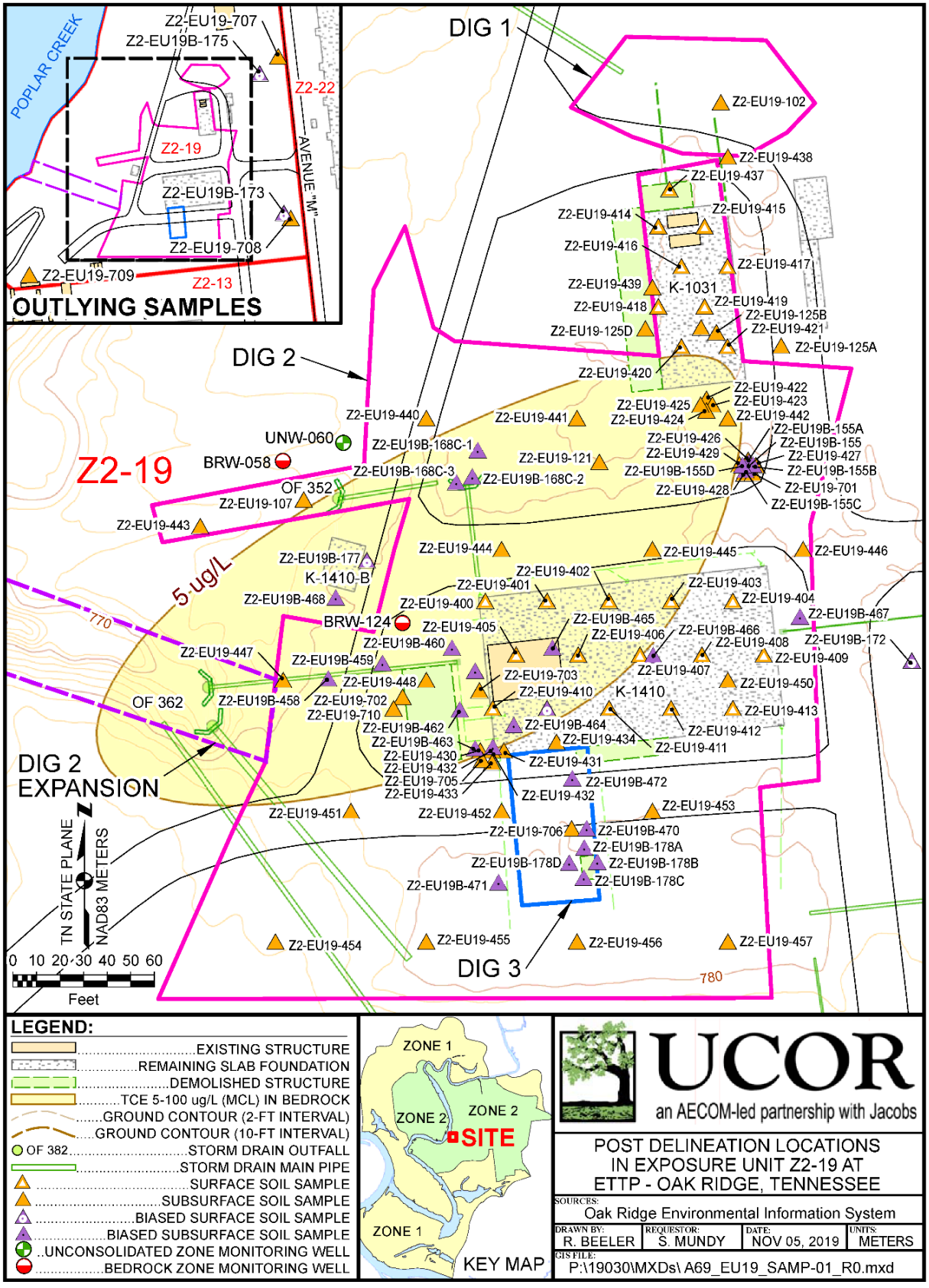


Figure 16. Samples collected in 2018 with TCE plume shown (sample dates are included in Attachment 3).

4. CONCEPTUAL SITE MODEL

The conceptual site model (CSM) is a representation of how EU-associated contaminants within a given source may be released, transported, and made available for uptake by a receptor. The CSM serves to conceptualize the relationship between contaminant sources and receptors through the consideration of potential and actual release mechanisms, migration pathways, and exposure points. Understanding these relationships allows actions to be taken to disrupt (i.e., break) or eliminate pathways to reduce or eliminate risk to human health at the exposure points. The CSM for EU Z2-19 is shown in Table 8 and Figure 17. The following sections summarize the major elements of the CSM.

4.1 PRIMARY SOURCE

Primary sources are locations or entities from which the potential contaminants of concern (PCOCs) within the local environment arise. There are three primary sources located within EU Z2-19 that include the following:

1. Historical operations: decontamination and degreasing, plating and UF_6 processing,
2. Outdoor storage of process equipment, and
3. Acid neutralization piles.

The primary sources are discussed in Section 2 EU and Description. Design, mode of operations, and the types of materials handled within these primary sources potentially affect the exposure pathways as depicted in the CSM. Within this EU, all current and former facility locations are known, therefore, specific footprints may be targeted for sampling.

4.2 PRIMARY RELEASE MECHANISM

The primary release mechanism for process facilities includes either planned or unplanned spills and direct releases to area surface soils and facility concrete slabs.

The primary release mechanism for subsurface structures includes leaks and unplanned discharges as a result of structural failures or containment breaches. Such releases would have contributed to subsurface soil contamination since these structures are several feet below grade.

4.3 SECONDARY SOURCE

Secondary sources consist of process and storm drains including catch basins, environmental and anthropogenic media that contain contaminants or a defined material that acts as a reservoir for contaminants that in turn contribute PCOCs to the environment. These media include surface soil, subsurface soil, and the concrete slabs of buildings that hold significant quantities of constituents, which may continue to be released to the environment over time. Delineating secondary sources allows actions to be taken that reduce or eliminate associated exposure pathways.

Table 8. Conceptual Site Model for EU Z2-19.

Primary Sources	Facilities	Primary COCs	Secondary sources	Release mechanism	Migration pathways
Historical operations: Decontamination & degreasing, plating, UF_6 processing	K-1410	U-234, -235, -238 Tc-99 & other fission products TCE & other VOCs	Process drains Storm drains & catch basins Contaminated soil	Discharge onto creek bank Ventilation hoods Spills, Leaks Demolition & downsizing	Surface run-off Erosion Air dispersion Downward percolation to GW
Outdoor storage of process equipment	K-1410 K-1031	U-234, -235, -238 Tc-99 & other fission products Transuranics Fluoride	Contaminated soil Accumulation areas Storm drains & catch basins	Spills, Leaks Contact with rain Routine discharges	Surface run-off Erosion Air dispersion
Acid neutralization pit	K-1410	Uranium Metals Acid residues Fluorides	Contaminated soil Accumulation areas	Routine discharges Leaching from rainfall	Surface run-off Erosion Downward percolation to GW

COC = contaminant of concern
GW = groundwater
VOC = volatile organic compound

4.4 SECONDARY RELEASE MECHANISM

Secondary release mechanisms for concrete slabs include runoff in accumulated precipitation into adjacent surface soils. While intact buildings eliminate accumulation of precipitation, once the structure is removed, constituents present in the concrete are available for runoff.

The release mechanisms for surface soil include suspension and entrainment in air as particulate matter and percolation and vertical migration into deeper soils via water infiltrating the soil column, which leads to contamination of subsurface soil. In addition, VOCs present in surface soil and subsurface soil may volatilize and migrate by vapor intrusion into future structures.

Secondary release mechanisms for subsurface soil include dissolution with percolation of water and vertical migration potentially to the water table.

4.5 MIGRATION PATHWAY

The migration pathway for the EU Z2-19 area consists of both surface spills/releases (contamination in soil) and liquid leaks/discharges (contamination from releases from pipes/conduits or pits). The contaminant migration will take the contaminants to deeper intervals of the soil and, eventually, to the groundwater.

4.6 IMPACTED MEDIA

The impacted media in this area could be soil, groundwater, and surface water/sediments. Based on sampling of the area, the impacted media have been identified as soil in the southern portion of the EU and along the bank of Poplar Creek, which is discussed in more detail in Section 5.

4.7 ANTICIPATED CONTAMINANT DISTRIBUTION

An industrial worker is the potential receptor for EU Z2-19 consistent with the future end use of industrial for ETTP Zone 2 as documented in the Zone 2 ROD. The exposure routes (i.e., mode of internalization of contaminants from environmental media into a receptors' body) for both surface soil and subsurface soil include incidental ingestion, inhalation (particulates and vapors), dermal contact, and external exposure (for radionuclides). Because groundwater is to be addressed in a separate decision document for ETTP, this exposure medium is evaluated in terms of concentrations of constituents left in the soil that could lead to concentrations in groundwater via vertical migration that exceed maximum concentration limits or, if not available, risk-based concentrations based on domestic use.

4.8 DATA GAPS

The data gaps for making the action/NFA determination for EU Z2-19 were addressed by the characterization activities presented in the DQO Scoping Package and Project Team Concurrences FCN-ETTP-Zone 2-194 and FCN-ETTP-Zone 2-225 (Attachment 5).

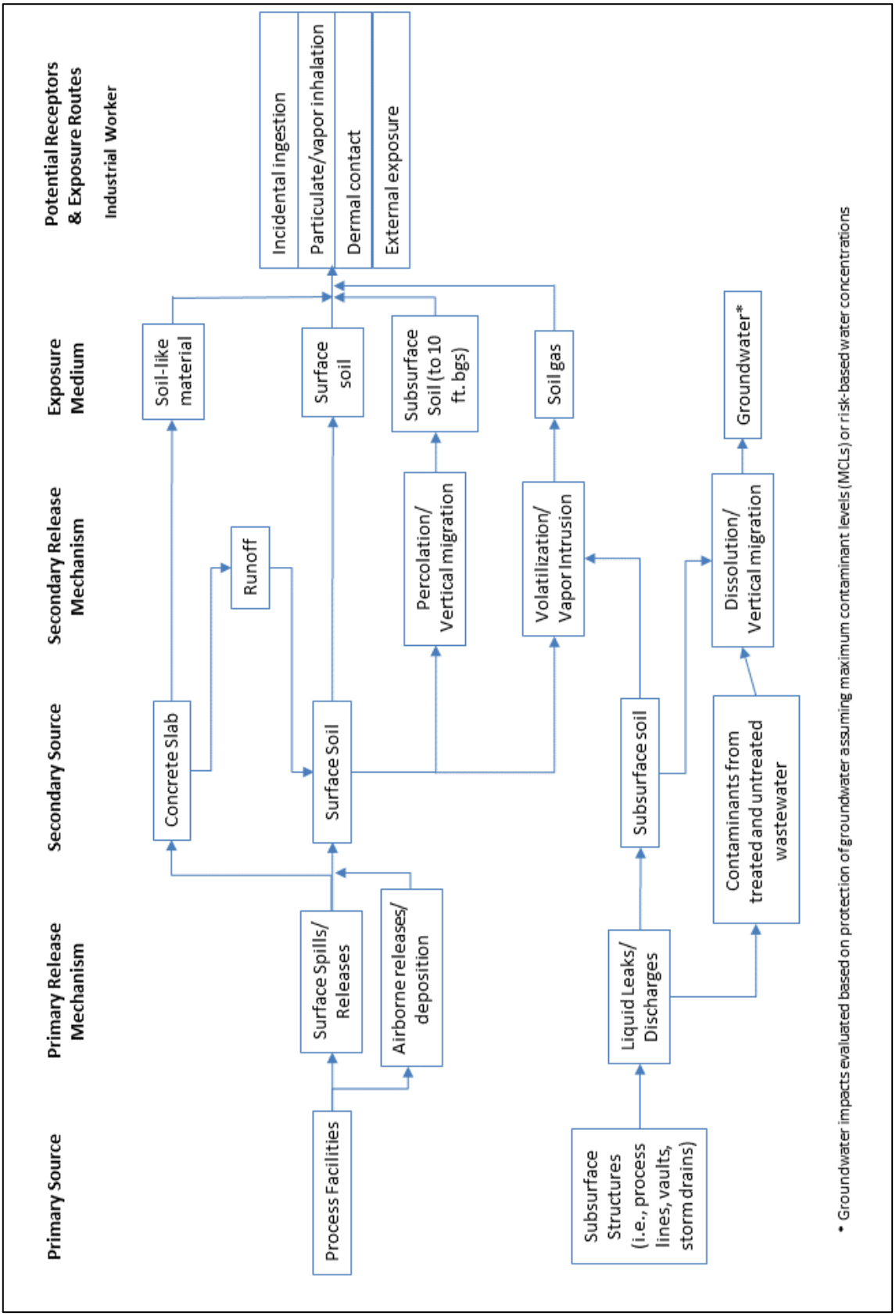


Figure 17. Conceptual Site Model for EU Z2-19.

5. TECHNICAL BASIS FOR RA DECISION

Several sampling events have been conducted across EU Z2-19 since the first samples were collected in 1994. Only limited sampling had occurred in the EU prior to the DQO Scoping Package, so a large amount of sampling was conducted beginning in 2016 in order to characterize the EU. A majority of the EU was sampled in 2017 in accordance with concurrence form FCN-ETTP-Zone 2-194, which is discussed in detail in the technical memorandum in Attachment 5. The following sections discuss the characterization activities completed in 2019 to complete characterization of the EU.

5.1 SAMPLING ACTIVITIES

In this Section, the EU Z2-19 data are evaluated against the Zone 2 ROD RAO decision criteria in the manner described in Section 3.2 of the Zone 2 RDR/RAWP to make the action/NFA decision for the EU. The risk decision criteria include for both the industrial worker and maintenance worker scenarios the soils Max RL, average (Avg) RL, and 1×10^{-5} excess lifetime cancer risk or hazard index = 1 PRGs, as well as the non-scenario specific GW SSLs. The sources for and assumptions behind the Max RL, Avg RL, PRG, and GW SSL criteria values for both the industrial worker and maintenance worker scenarios are presented in Section 3 of the Zone 2 RDR/RAWP.

Initial DVS characterization results and process knowledge identified three soil excavation RAs needed to take place within the EU Z2-19 Class 1 SU to remove threats to the industrial worker and underlying groundwater (Figure 18). The proposed RA aerial boundaries are shown in the Technical Memorandum that is included in Attachment 5 (Figure 18). Following removal of contaminate soil and other materials within the excavation, confirmation samples will be collected to demonstrate that the RAs have achieved the RAOs presented in the Zone 2 ROD. Results from the confirmation sampling will be presented in the EU Z2-19 Phased Construction Completion Report once the RAs are complete.

However, to reach an NFA/RA decision for the entire EU, additional sampling was deemed necessary. Characterization objectives were identified in the DQO Scoping Summary to complete remaining characterization of EU Z2-19. The four objectives are associated with historical waste discharge and are identified in Figure 19:

- Outfall 360 drainage channel
  - Received runoff from K-1031 and K-1410 areas.
- Outfall 362 drainage channel
  - Received runoff and process drain discharges from K-1410 building.
  - Received storm water runoff from drainage swale south of K-1410.
    - Storm drainage from EU Z2-13
    - Surface runoff from K-1410
  - Received process drain discharges from K-413 sludge disposal pit.
- Outfall 350 drainage channel
  - Received surface runoff from the K-1031 Maintenance Support Building.
    - Used for storage and dispensing of trapping media for spent cascade traps.
    - Used as cutting and size reduction of process equipment from Fercleve Thermal Diffusion Plant.
      - Received storm water runoff from drainage swale north of K-1031.
- K-1410 Neutralization Pile
      - Designed to treat corrosive plating waste from the K-1410 building.

Evaluation of EU Z2-19 data to arrive at RA decisions begins with evaluating characterization data to identify specific sample locations with criteria exceedances that require sampling to delineate extent. Characterization data are evaluated in the following sections.

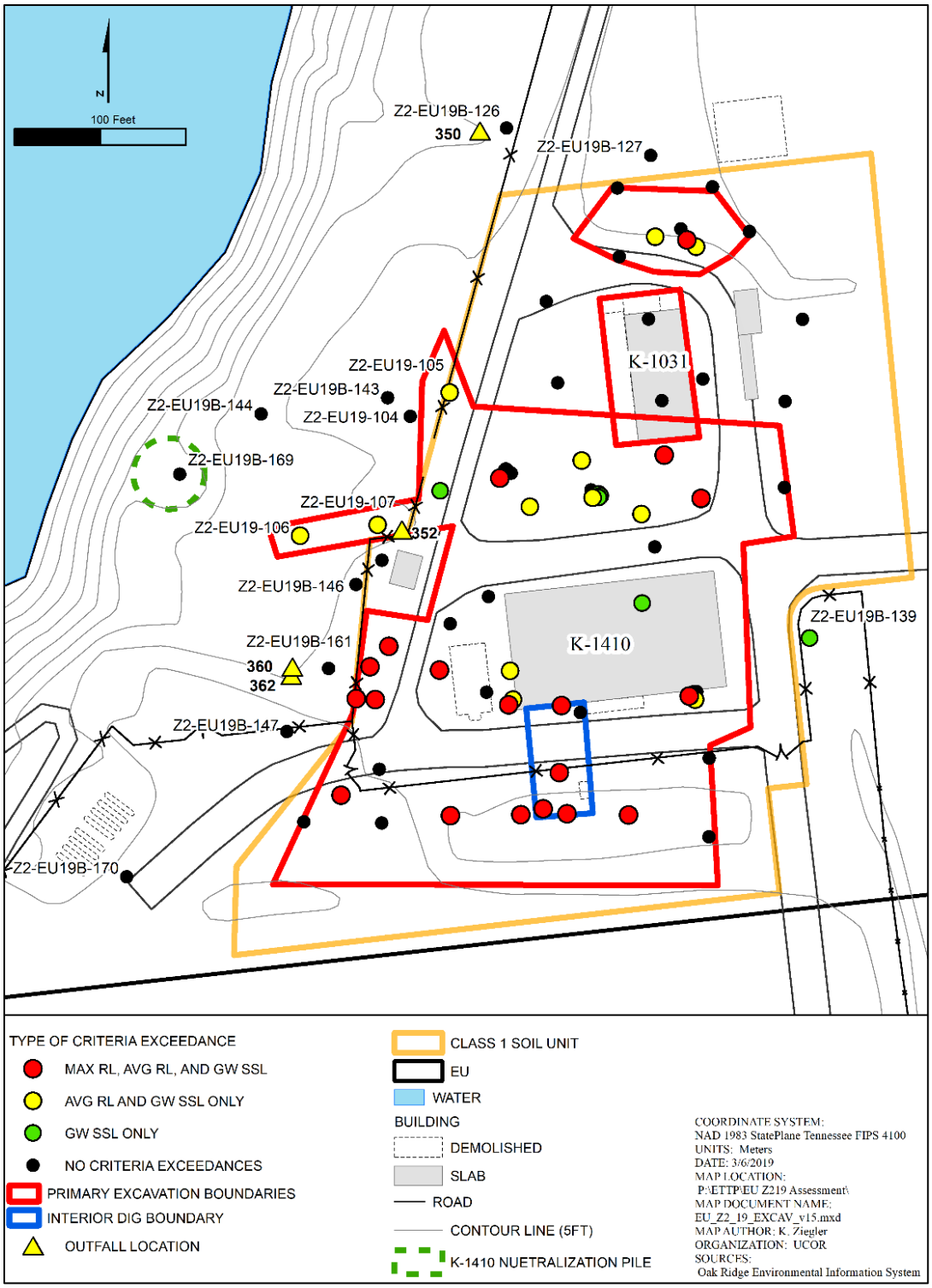


Figure 18. EU Z2-19 Class 1 Soil RA Areas

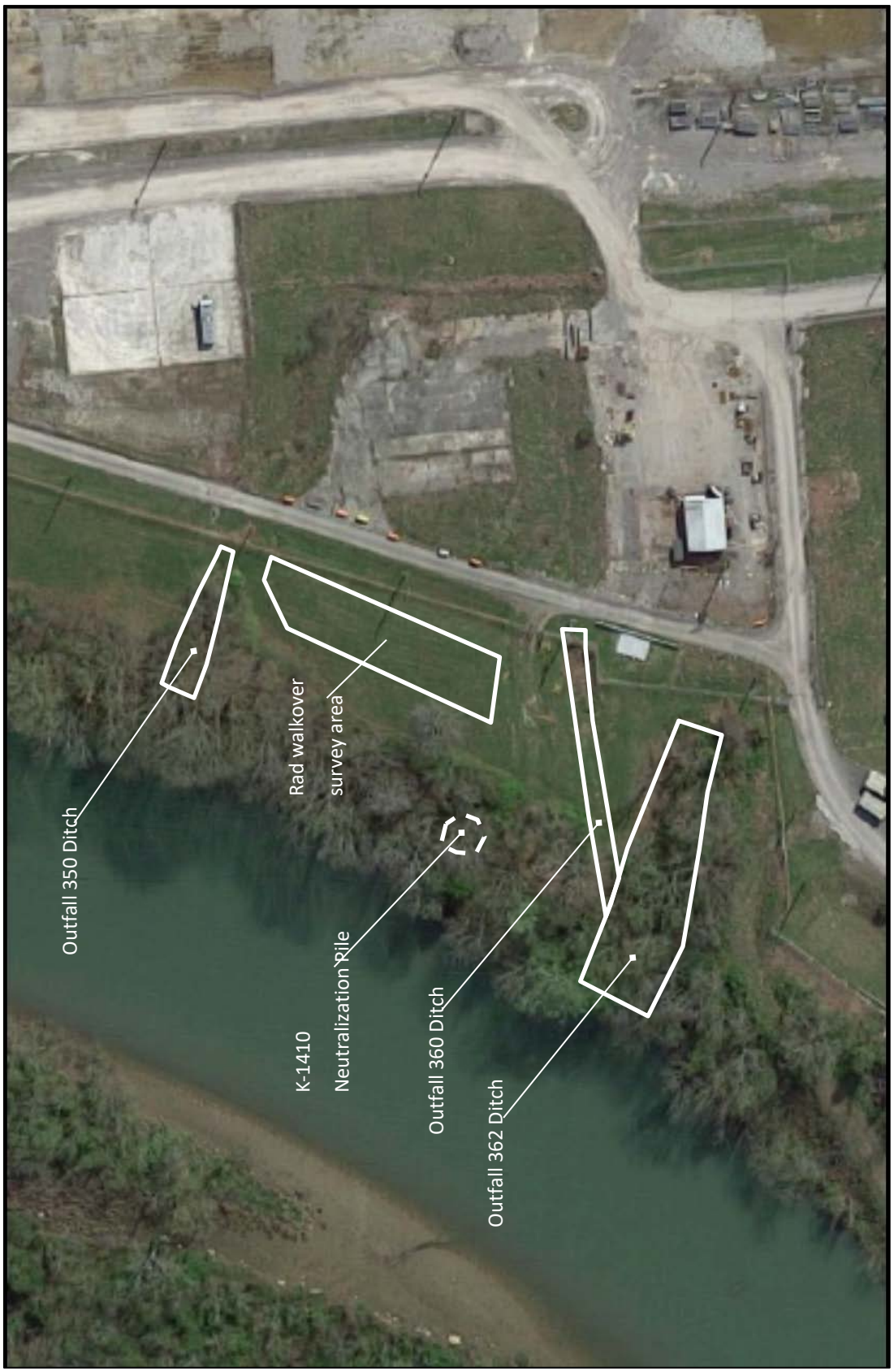


Figure 19. EU Z2-19 creek bank sampling location summary.

5.2 K-1410 NEUTRALIZATION PILE

A radiation walkover survey was performed in the K-1410 Neutralization Pile area and no readings within the area exceeded two times background levels (Figure 20).

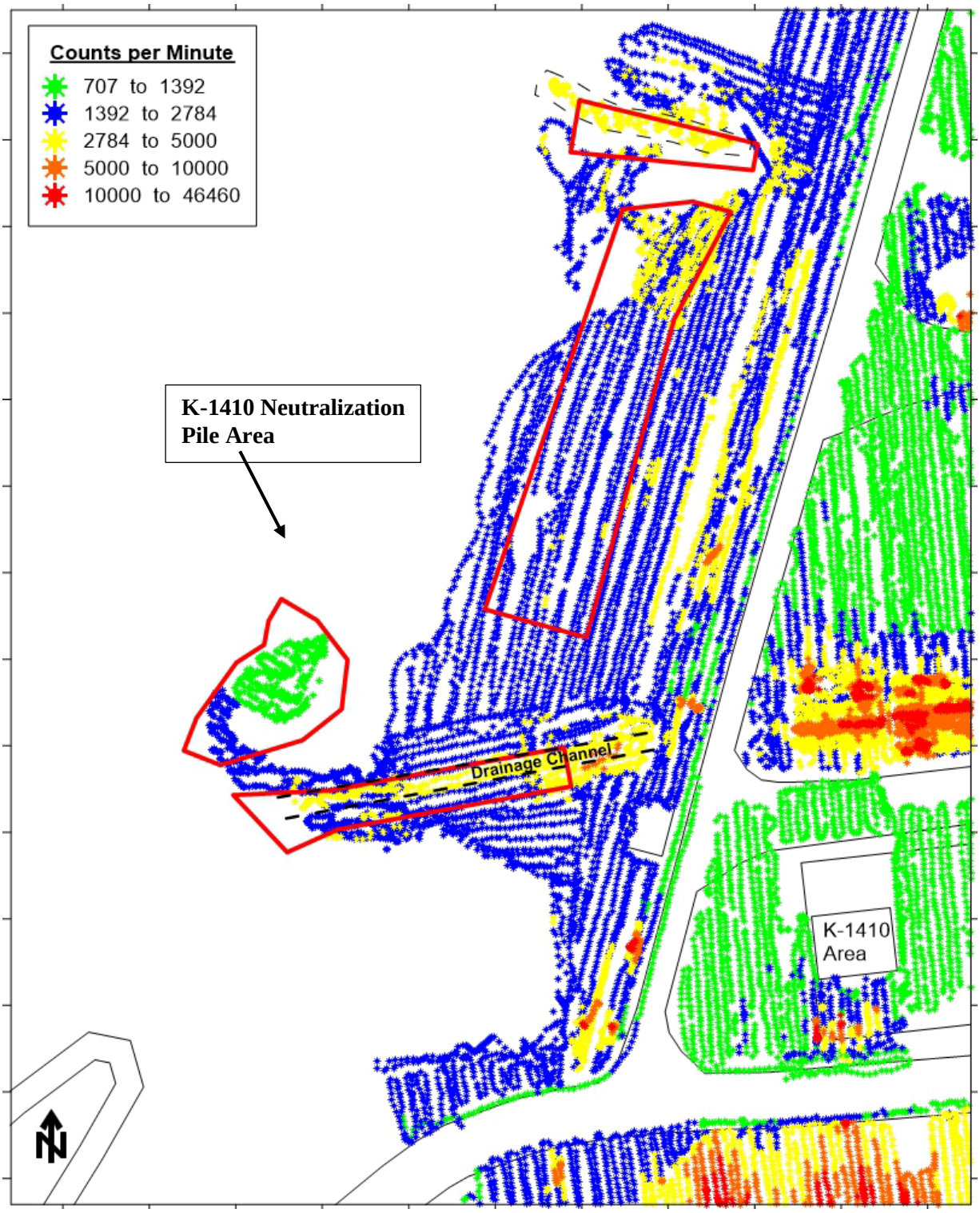


Figure 20. Radiation walkover survey in the K-1410 Neutralization Pile area.

Four sample locations were collected in the K-1410 Neutralization Pile area (Figure 23). Two of the locations (Z2-EU19B-713 and Z2-EU19B-714) were collected 0-1 ft and analyzed for rad, metals, and PCBs.

Location Z2-EU19B-723 was drilled to 15 ft below ground surface (bgs), and location Z2-EU19B-724 was drilled to 18.5 ft bgs. Four feet of gravel was found at both locations, so soil sampling started at soil/gravel interface. The 0-1 and 1-2 ft samples were analyzed for rad, metals, and PCBs. Location Z2-EU19B-723 had 5-6 and 10 11 ft samples analyzed for metals and rad. Refusal was found at 11 ft below the soil/gravel interface. A map of the sample locations is located in Figure 23.

Location Z2-EU19B-724 had 5-6, 10-11, and 13.5-14.5 ft samples analyzed for metals and rads. Refusal was found at 14.5 ft below soil/gravel interface.

No exceedances were identified in any samples in the K-1410 Neutralization Pile area; therefore, an NFA is recommended for this area.

5.3 OUTFALLS 350 AND 360 DRAINAGE DITCHES

A radiation walkover survey was performed in the Outfalls 350 and 360 drainage areas and several readings within both ditches exceeded two times background levels (Figure 21).

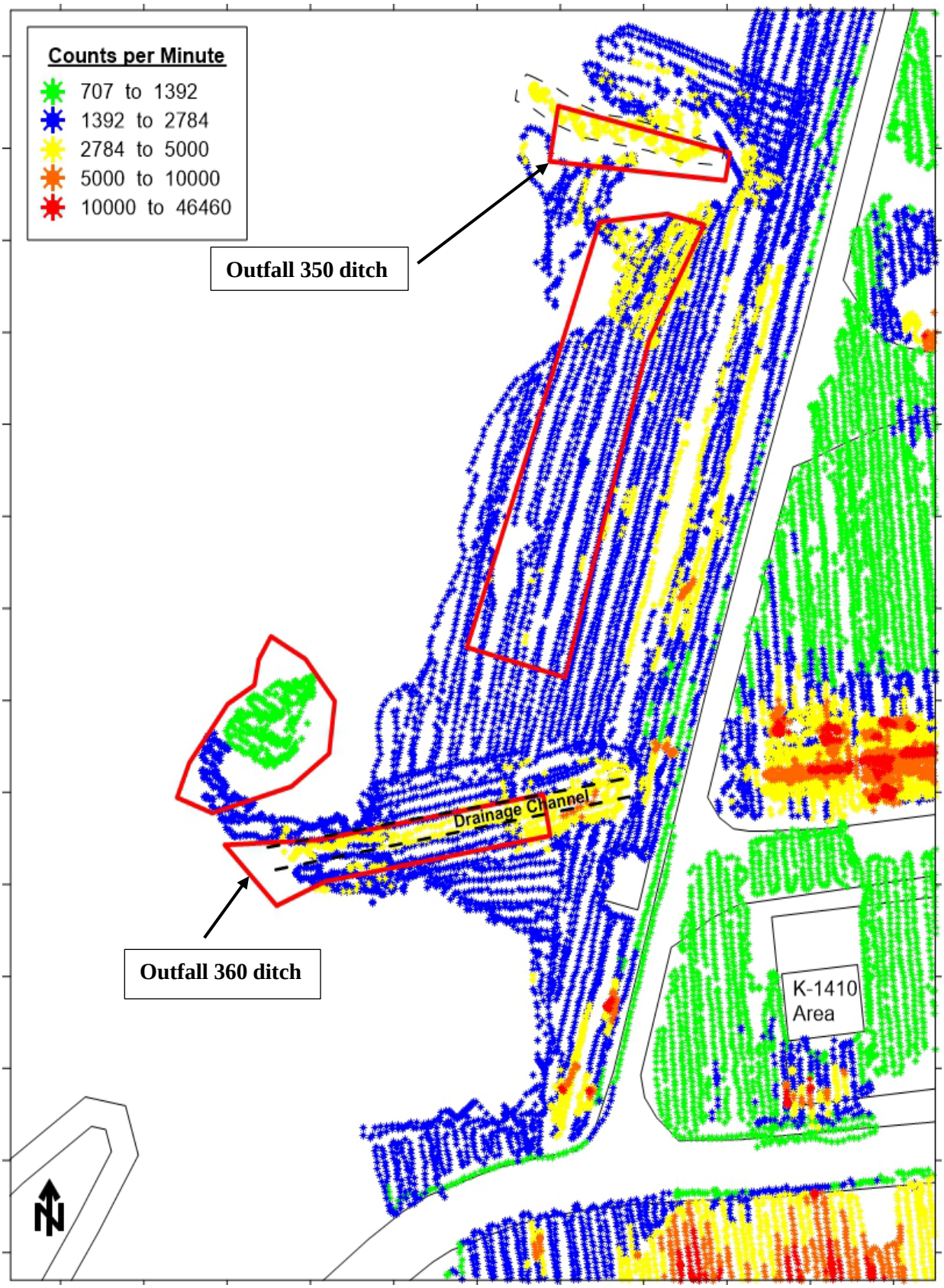


Figure 21. Radiation walkover survey in the Outfalls 350 and 360 surface drainage areas.

Outfall 360 ditch. Two locations were collected in the Outfall 360 ditch (Figure 23). Locations Z2-EU19B-715 and Z2-EU19B-716 were collected 0-1 ft and analyzed for rads, metals, and PCBs. These locations were biased towards the highest readings found during the radiological walkover survey. Location Z2-EU19B-715 did not exceed Zone 2 ROD criteria.

Location Z2-EU19B-716 exceeded the GW SSL for U-234 at 70.4 pCi/g (GW SSL is 61.1 pCi/g). The location falls within the current footprint of the Class 1 SU RA dig extension into the Outfall 360 ditch. This location will be remediated with the Class 1 SU discussed above.

Outfall 350 ditch. Three locations were collected in the Outfall 250 ditch area (Figure 22). All locations were collected 0-1 ft and analyzed for rads, metals, and PCBs. Sample locations were biased towards the highest readings from the radiological walkover survey. Location Z2-EU19B-719 was added due to finding higher readings outside of the ditch area. The location was sampled to access surface runoff into the ditch.

Locations Z2-EU19B-718 and Z2-EU19B-719 did not exceed Zone 2 criteria. Location Z2-EU19B-717 exceeded the GW SSL for U-234 (73.5 pCi/g) and the Avg RL for cesium-137 (Cs-137) (3.14 pCi/g) (Attachment 4). This location does not currently fall within the Class 1 SU RA boundaries.

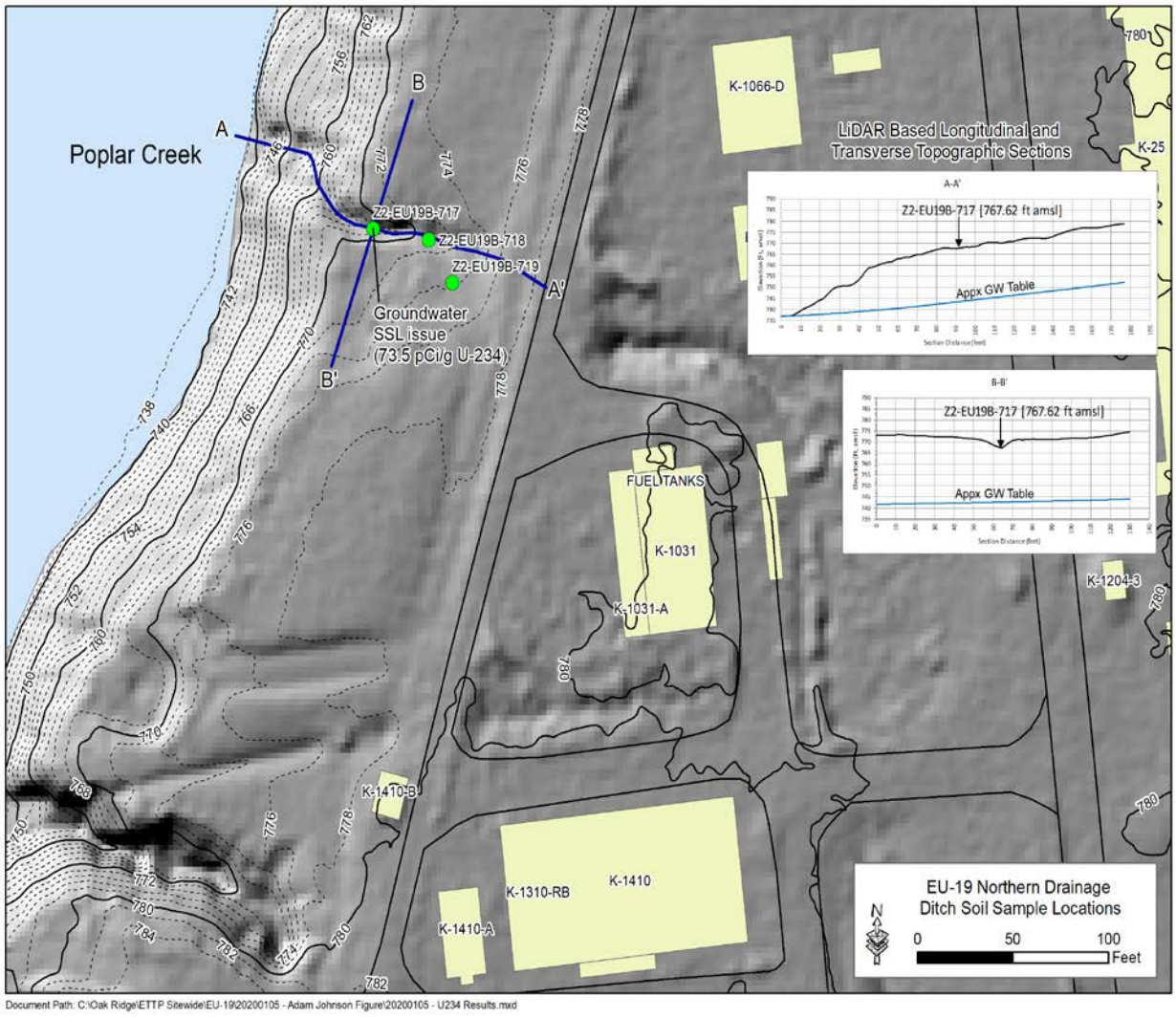


Figure 22. Outfall 350 ditch sampling results.

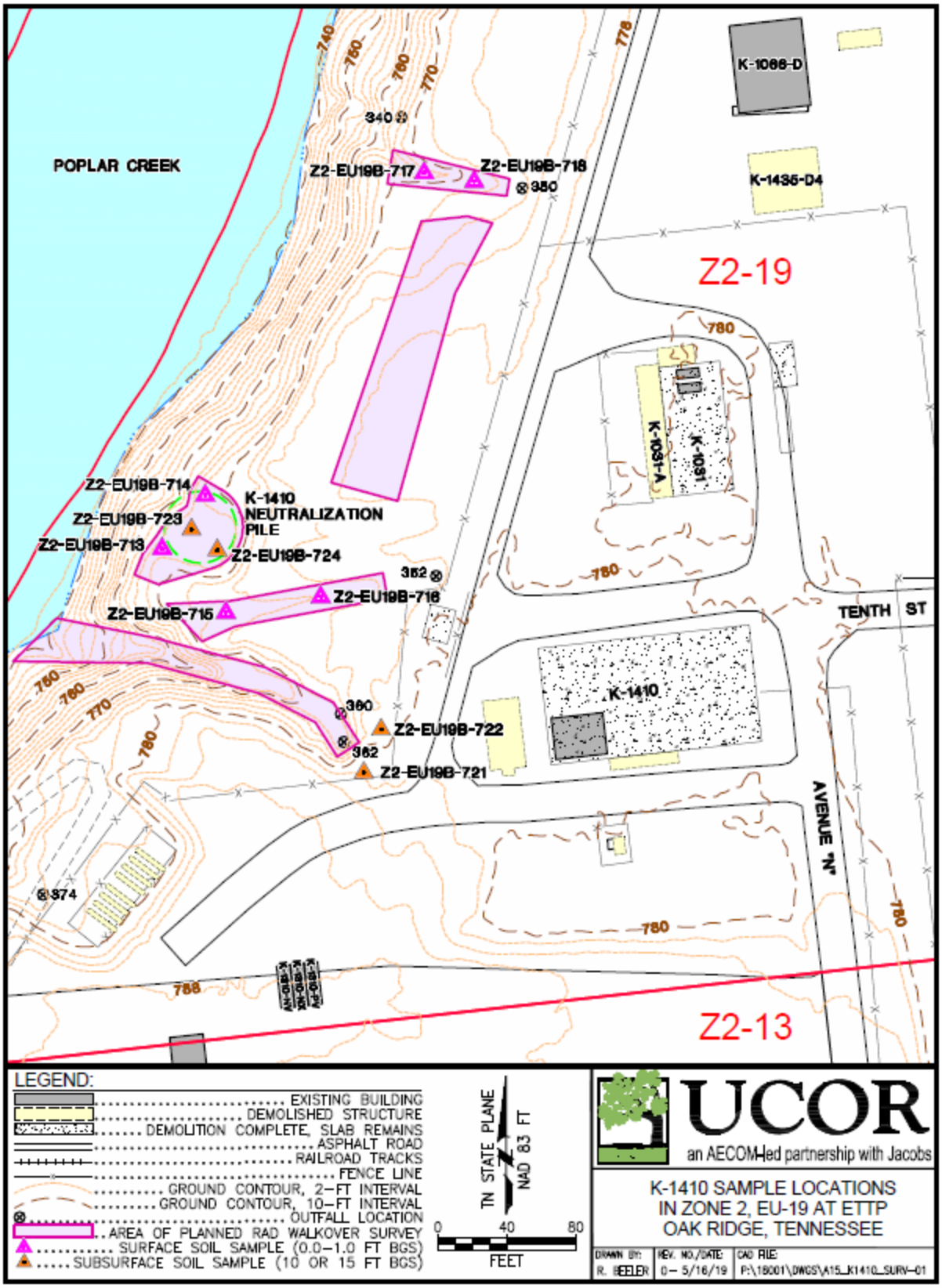


Figure 23. EU Z2-19 additional sampling activities.

Location Z2-EU19B-717 exceeded the GW SSL for U-234 (73.5 pCi/g) and the Avg RL for Cs-137 (3.14 pCi/g). This location does not currently fall within the Class 1 SU RA boundaries, so further delineation was required in order to bound the contamination area. Three step-out locations (-717A, -717B, and -717C) were collected around the original location Z2-EU19B-717 (Figure 24). These samples were collected at a 0-1 ft depth and analyzed for rads.

There were no Zone 2 ROD criteria exceedances detected in the step-out samples. Due to the GW SSL exceedance being a single-point hot spot and minimal in volume, it is not considered a source to groundwater and no further action is appropriate for this location.

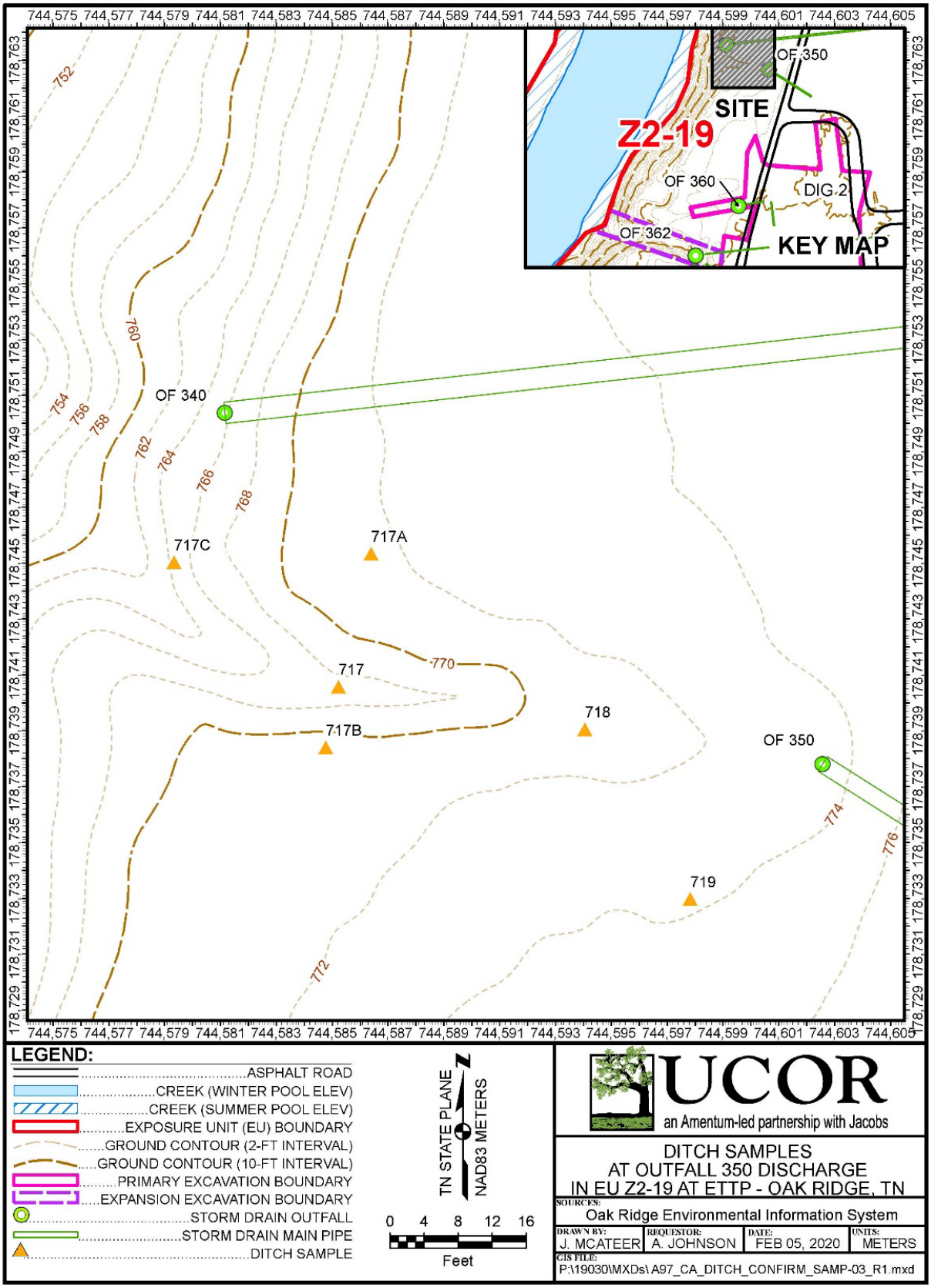


Figure 24. Delineation sample locations collected around location Z2-EU19B-717.

5.4 OUTFALL 362 DRAINAGE DITCH

A radiological walkover survey was performed in the Outfall 362 drainage ditch area and several readings exceeded two times background levels (Figure 25). Readings within the ditch area exceeded two times background throughout the entire drainage channel. The highest reading encountered (over 500,000 counts per minute [cpm]) was in the vicinity of the drainage pipes (background was 1600 cpm). Contamination was attributed to discharges from both the 8-inch process drain line from K-1410 and the storm water discharges from the drainage swale immediately south of K-1410. The drainage swale is a posted radiological area with both surface and subsurface soil contamination.

A radiological walkover survey was also performed at the bottom of the Outfall 362 ditch, in the soils that are exposed when TVA lowers the water levels in Watts Bar Lake, which lower water levels in Poplar Creek. Multiple locations from this area exceeded two times background. The highest reading encountered (19,157 cpm) was at the bottom of the ditch, near the upstream edge of the soils exposed during low water levels (Figure 26).

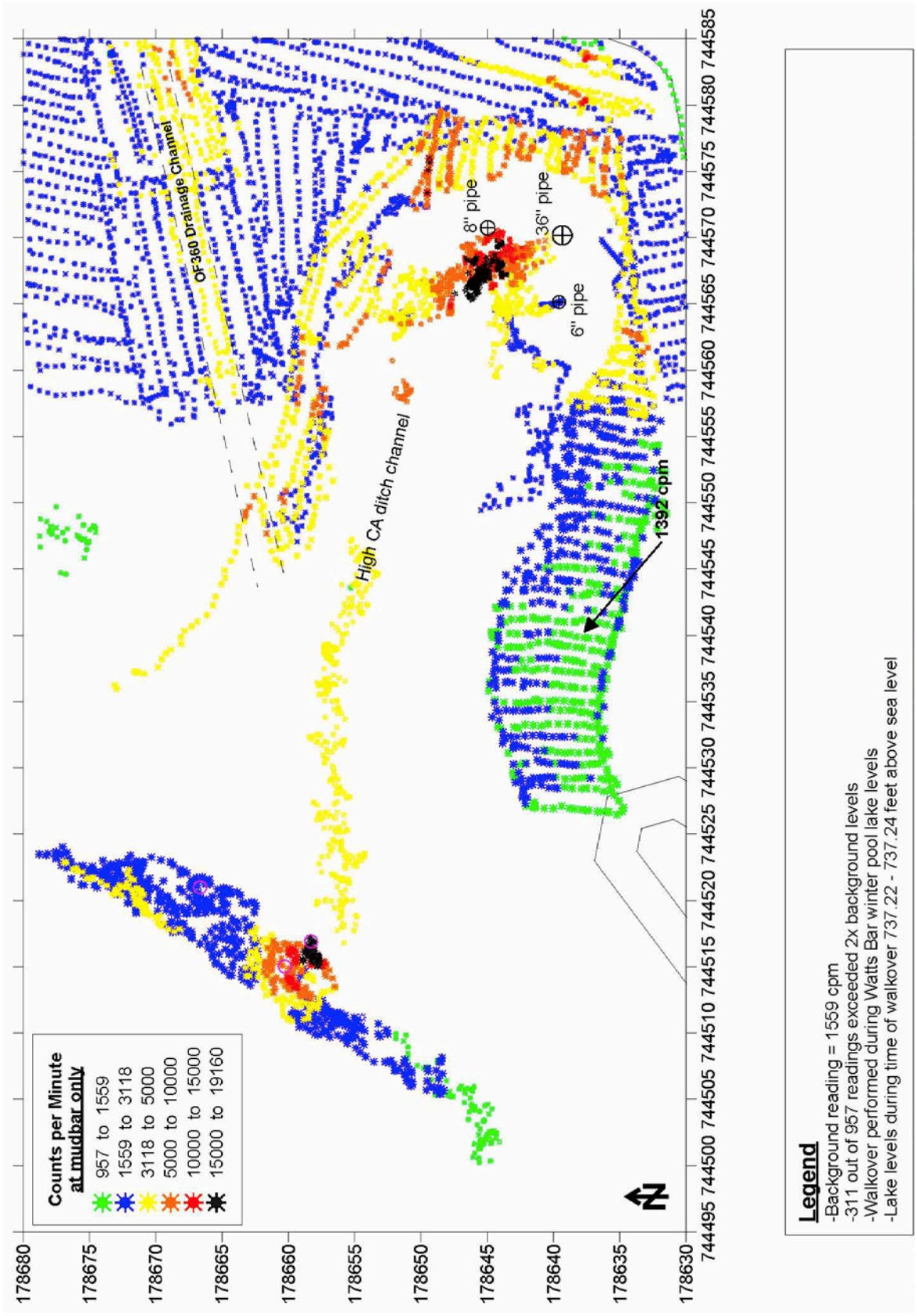


Figure 25. EU Z2-19 Outfall 362 drainage ditch radiological walkover survey (January 2020).

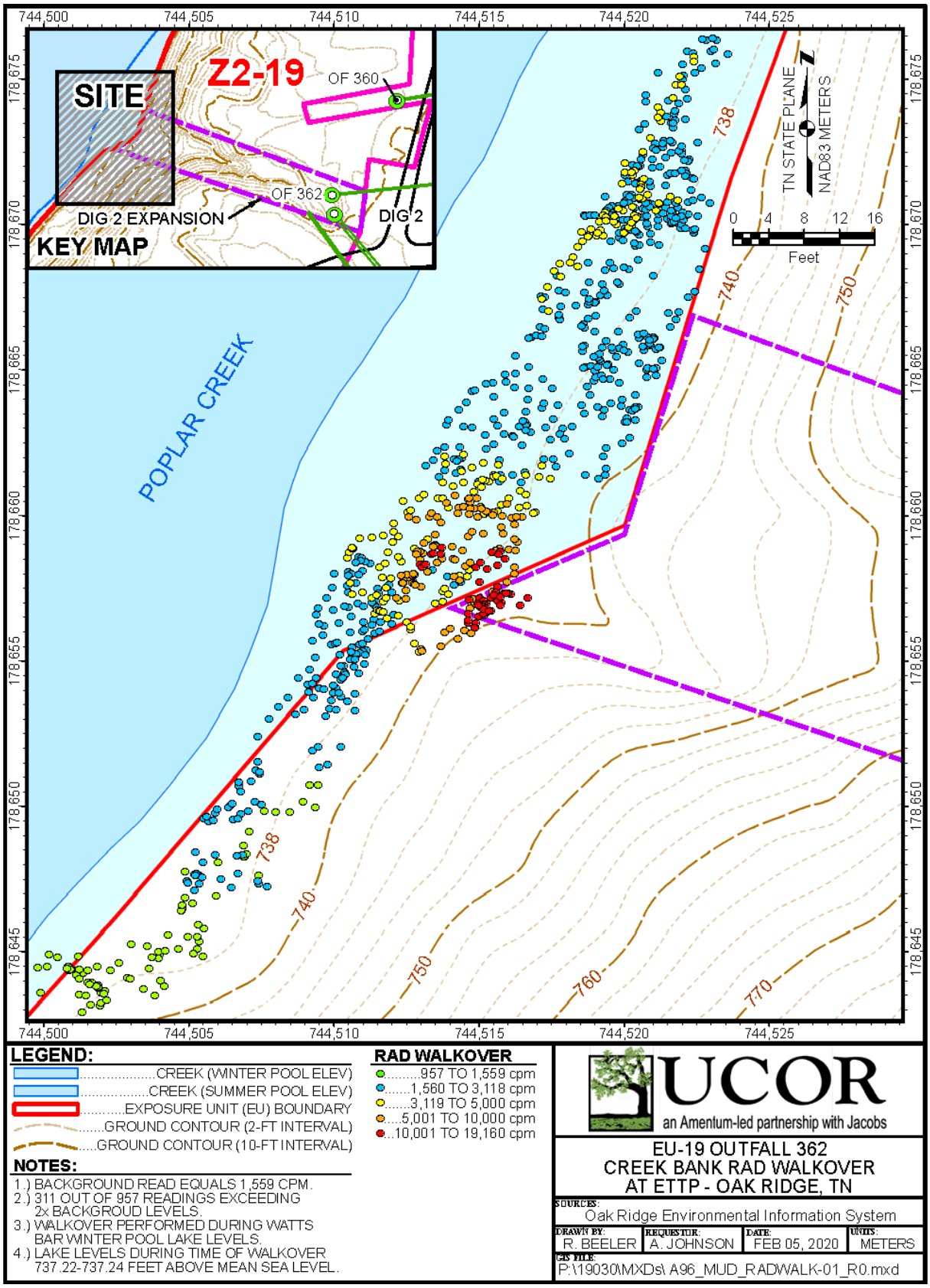


Figure 26. EU Z2-19 Poplar Creek radiological walkover survey at bottom of ditch (January 2020).

Sampling locations in the upper portion of the ditch were biased towards high rad readings, located adjacent to drainage pipes and within sediment accumulation areas. Nine sampling locations with discrete samples from 0-0.5 ft and 0.5-1 ft were completed in the ditch and in the transition area at the bottom of the ditch (Figure 27). Multiple sample locations exceeded Zone 2 ROD criteria (Attachment 4) and required further delineation.

The delineation sampling included the collection of deeper samples from eight locations in the uppermost portion of the ditch, near the outfalls for the storm water and process drainpipes. Analytical results from these samples confirmed that the contamination was generally confined to the defined channel in the middle of the ditch. The delineation samples also confirmed that the contamination was limited primarily to surface and near surface soils, less than 2 ft in depth. A localized area associated with sampling locations Z2-EU19-605 and Z2-EU19-620 had deeper contamination, extending to depths of 5 ft. Delineation sampling results supported the development of excavation limits for the upper portion of the ditch, as detailed in the following section.

Table 9. Delineation sampling in upper portion of Dig 2 Expansion in Outfall 362 Ditch.

Location	Sample Depths (ft bgs)
Z2-EU19-605 (*deeper samples from original 605 location*)	1 - 2 3.5 - 4
Z2-EU19-618	0 - 1 1.5 - 2
Z2-EU19-619	1.1 - 2.1 2.2 - 2.7
Z2-EU19-620	1 - 2 3.5 - 4
Z2-EU19-621	2.5 - 3.5 3.5 - 4
Z2-EU19-622	1 - 2
Z2-EU19-623	1 - 2 3.5 - 4
Z2-EU19-624	1 - 2 3.5 - 4
Z2-EU19-625	3 - 4

bgs = below ground surface
ft = feet

Five geoprobe boring locations (Z2-EU19-613, -614, -615, -616, and -617) were completed around the perimeter of the ditch to determine whether contamination extended beyond the topographically defined ditch limits (Figure 28). These borings were completed to various depths in order to collect samples from elevations corresponding to the maximum depth of the ditch near the boring location. None of the samples from these geoprobe boring locations exceeded Zone 2 ROD criteria. No remedial action is required outside the boundaries of the upper portion of the ditch.

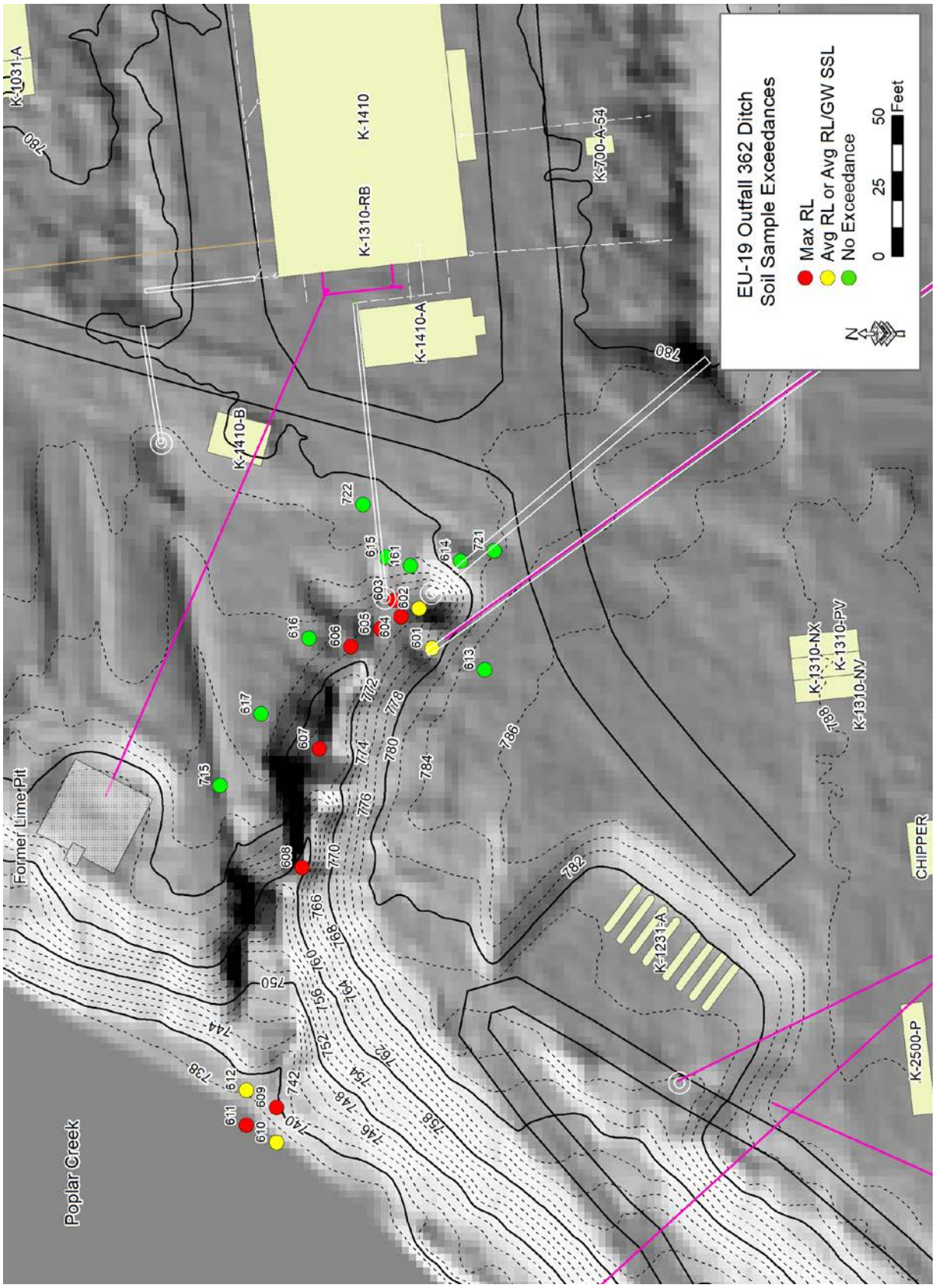


Figure 27. Outfall 362 ditch soil sample locations.

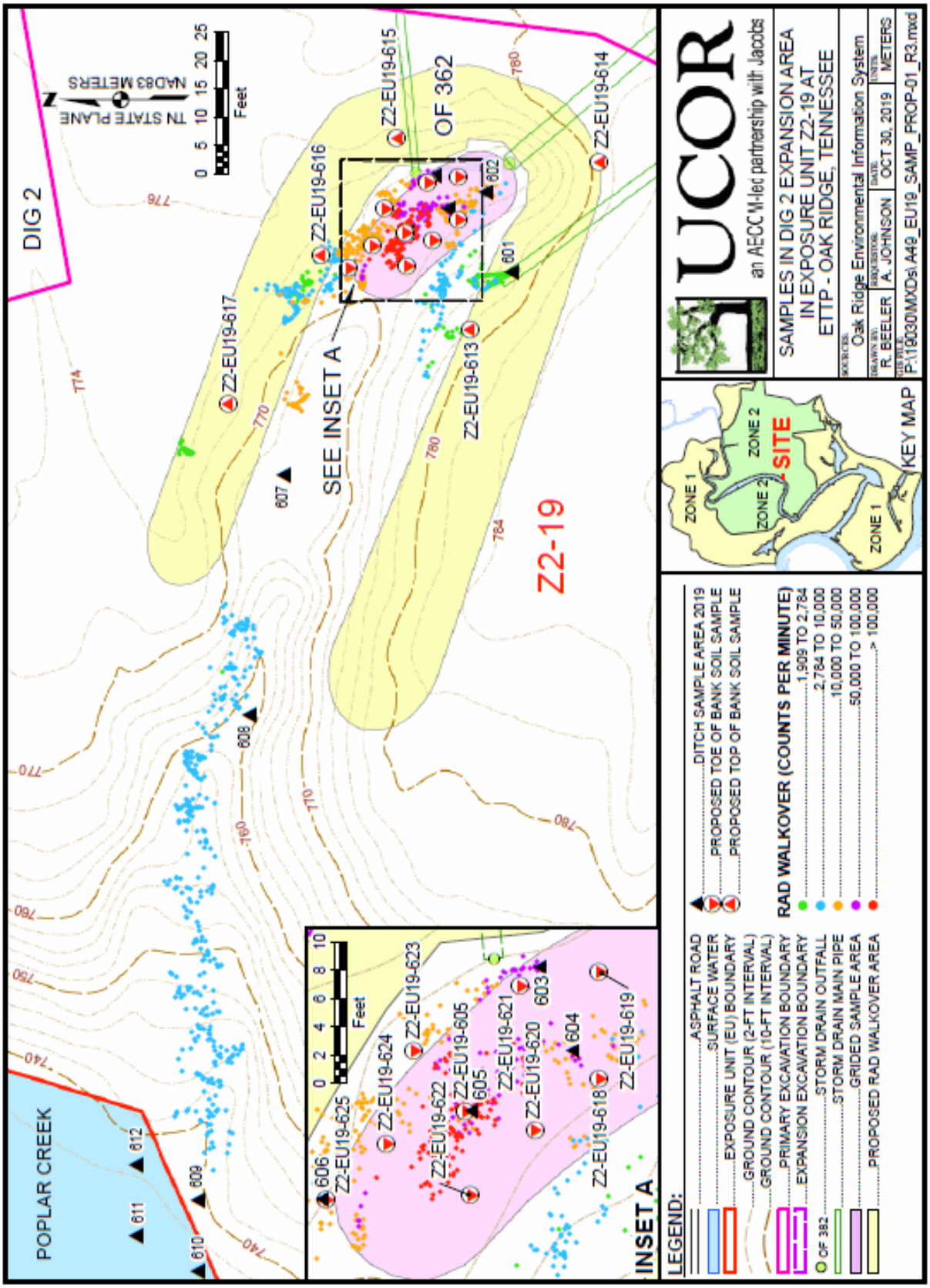


Figure 28. Delineation sampling areas in EU Z2-19 Outfall 362 ditch.

Three of the four sample locations at the bottom of the ditch exceeded Zone 2 ROD criteria (Z2-EU19-609, -611, and -612). Locations Z2-EU19-609 and Z2-EU19-611 had Max RL exceedances for Cs-137. Location Z2-EU19-612 had average RL exceedances for uranium and thorium (Attachment 4).

In order to delineate the extent of contamination at the bottom of the ditch, 22 additional samples were collected (Figure 29). These samples were collected to depths of 1-3 ft (Table 10). Deeper sampling was attempted at most of the locations but was not successful due to the presence of saturated, granular soils and gravel. The presence of shallow groundwater was not unexpected given the proximity of the sampling locations to Poplar Creek. Locations Z2-EU19B-634, -641, and -645 were analyzed for rads, metals/Hg, PCBs, VOCs, and SVOCs. All of the other samples were analyzed for rads only.

The delineation sampling at the bottom of the ditch identified additional locations with Max RL exceedances. Similar to results from the upper portion of the ditch, the contamination exceeding RL criteria was limited to near surface soils less than 2 feet in depth. The bottom of the ditch lies within Poplar Creek as this area is submerged during higher water levels in the summer. A decision for this area — which should be considered sediment rather than soil — is outside the scope of the Zone 2 ROD.

The middle portion of the ditch has a steep slope with exposed bedrock along the sides and bottom. No appreciable soil remains in the middle portion due to erosion driven by the steep slope. The walkover survey identified radiation levels greater than background but much lower than levels in the upper portion of the ditch. Given the lack of soil, and that the Zone 2 ROD limits remedial actions to soils above the top of bedrock, no remedial action will be conducted in the steep, rocky portions of the ditch.

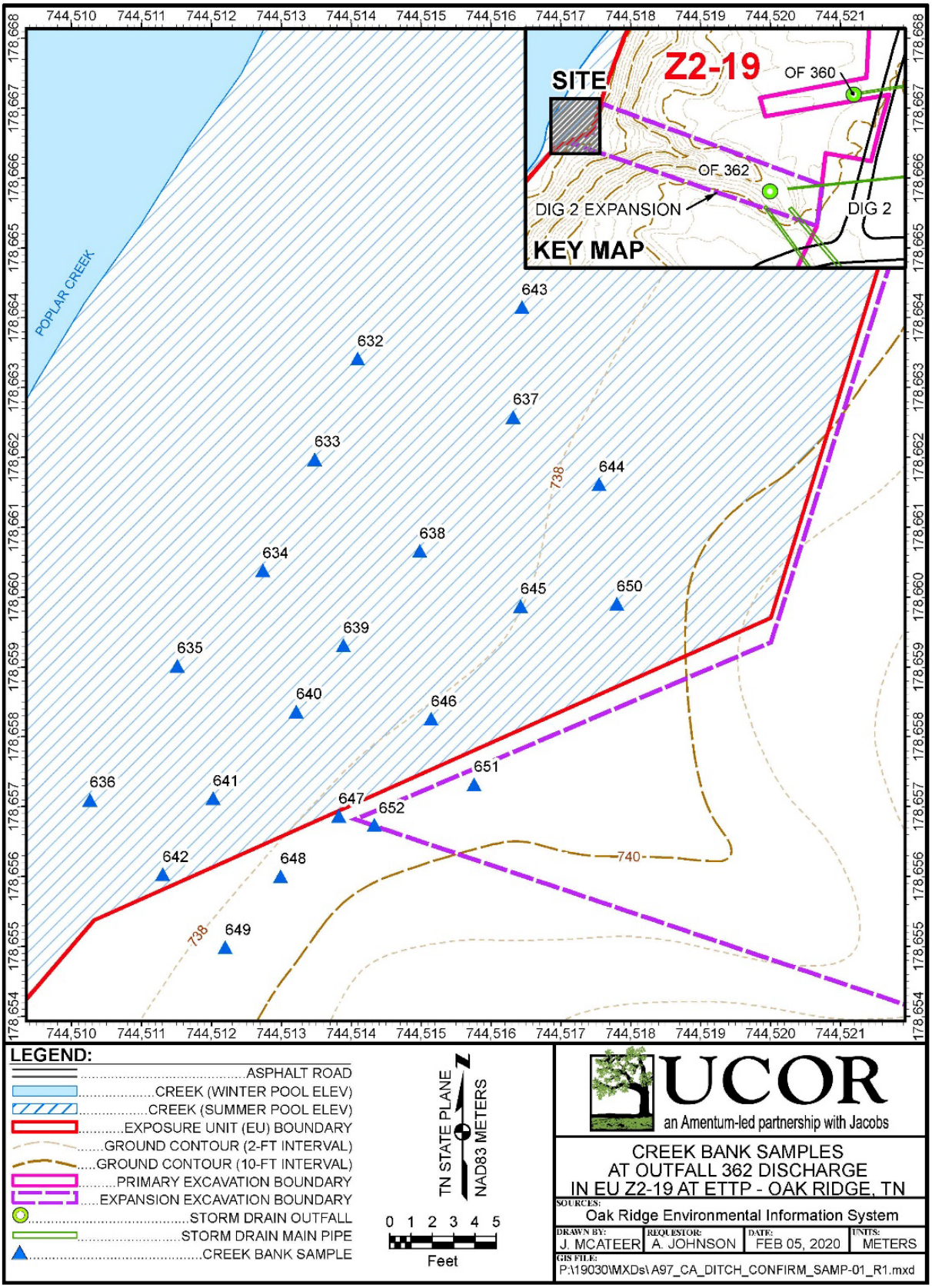


Figure 29. Delineation sample locations at the bottom of the ditch.

Table 10. Bottom of ditch delineation sampling depths.

Sample Location	Sample Depth (ft)
Z2-EU19B-632	0-1
Z2-EU19B-633	0-1
Z2-EU19B-634	0-1
Z2-EU19B-635	0-1
Z2-EU19B-636	0-1
Z2-EU19B-637	0-1
Z2-EU19B-638	0-1
Z2-EU19B-639	0-1
Z2-EU19B-640	1-2
Z2-EU19B-641	0-1, 1-2
Z2-EU19B-642	0-1, 1-2
Z2-EU19B-643	0-1, 1-2
Z2-EU19B-644	0-1, 1-2
Z2-EU19B-645	0-1, 1-2
Z2-EU19B-646	0-1, 1-2
Z2-EU19B-647	0-1, 1-2, 2-3
Z2-EU19B-648	0-1, 1-2
Z2-EU19B-649	0-1, 1-2
Z2-EU19B-650	0-1, 1-2
Z2-EU19B-651	1-2, 2-3
Z2-EU19B-652	0-1, 1-2

ft = feet

5.5 K-2527-BR GROUT SHOP

The K-2527-BR Grout Shop was constructed in 2008 2009 and created by combining a number of structures under a common roof. To the north, three 8 ft x 8 ft x 20 ft storage containers are oriented side-by-side north to south. The interior and south walls of the containers were removed to make part of the space for a grout shop. A woodshed on the east side previously housed the high-efficiency particulate air ventilation unit. Two carports attached on the south side of the shop provided storage space, housed the equipment for mixing, and supply of the grout. The Grout Shop was used for stabilization of mined materials. Drums were placed on a conveyer and transported to a vent hood for addition of grout and mixing with the waste. The primary contaminants of concern are uranium isotopes (U-234, U-235, and U-238) and technetium-99.

A Facility Assessment was conducted for the K-2527-BR Grout Shop, and a radiological walkover survey was performed around and inside the building (Figure 30). No levels exceeded two times background and the area is considered Class 3.

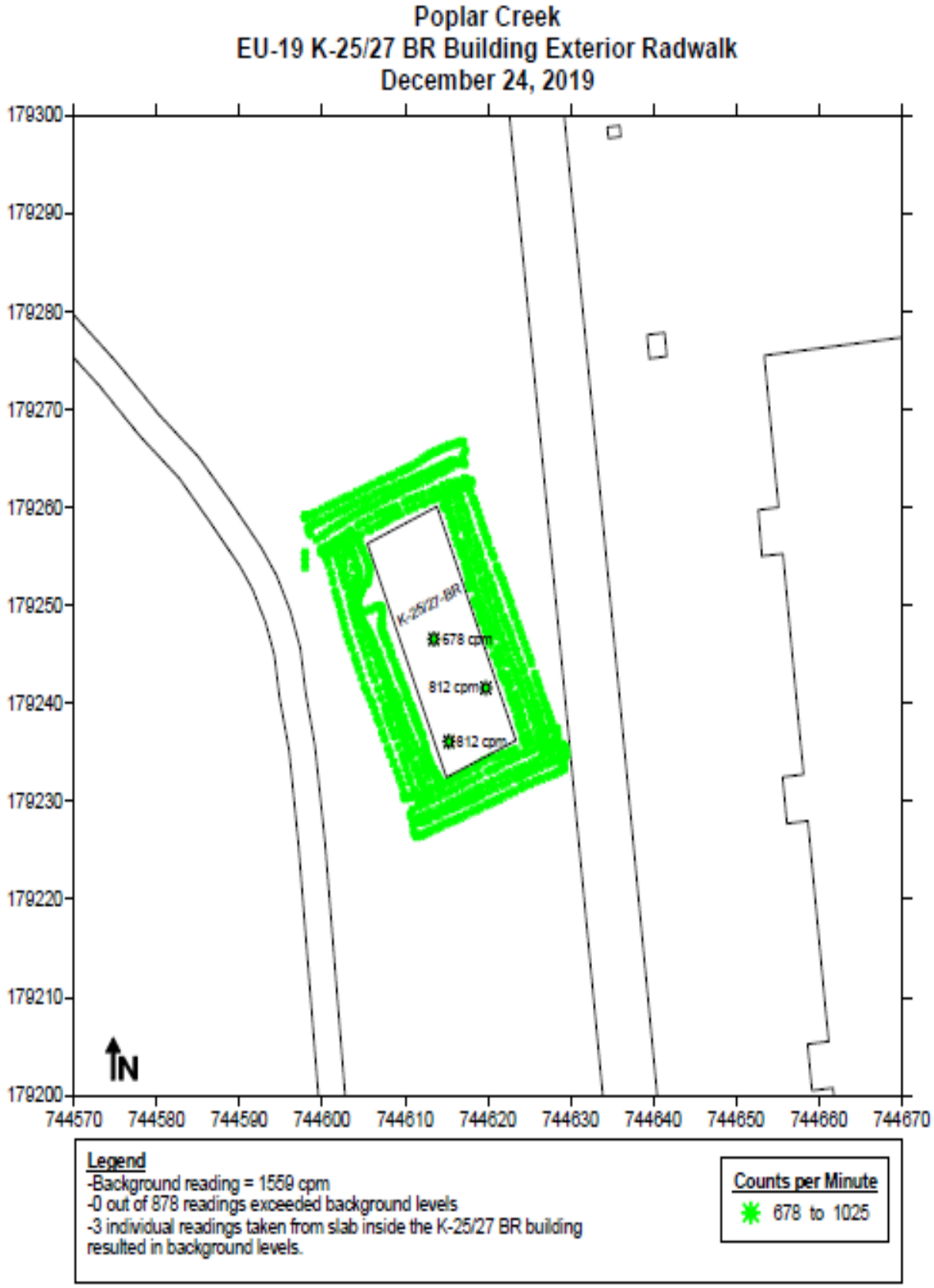


Figure 30. Radiological walkover assessment of K-2527-BR Grout Shop (December 2019).

5.6 RA DECISION

An RA has already been recommended in the Class 1 SU per concurrence FCN-ETTP-Zone 2-225 (Attachment 5). The additional characterization and delineation work outside the Class 1 SU identified multiple Zone 2 ROD criteria exceedances in the Outfall 362 drainage ditch. This contamination was attributed to storm water and process drain discharges from areas within the Class 1 SU. The types and distribution of contamination detected in the ditch were nearly identical to those detected in samples from the upgradient Class 1 SU. An extension of the Class 1 SU RA defined in FCN-ETTP-Zone 2-225 is justified based on the ditch sampling results, as stated in correspondence dated September 17, 2019 from DOE to TDEC and EPA (Attachment 7).

The RA extension consists of the upper portion associated with the storm water runoff. No further action is required for the lower portion characterized by a steep slope with exposed bedrock and insignificant quantities of soil. A decision on remediation of the contaminated sediment exposed when TVA lowers water levels in Poplar Creek is outside the scope of the Zone 2 ROD.

No further action is required for all other EU Z2-19 areas that lie outside the Class 1 SU and previously defined remedial action boundaries.

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6. RA QUANTITIES

Remedial action was recommended for multiple areas in EU Z2-19 (Section 5). Figures 31, 32, and 33 show the location of the recommended remedial action areas.

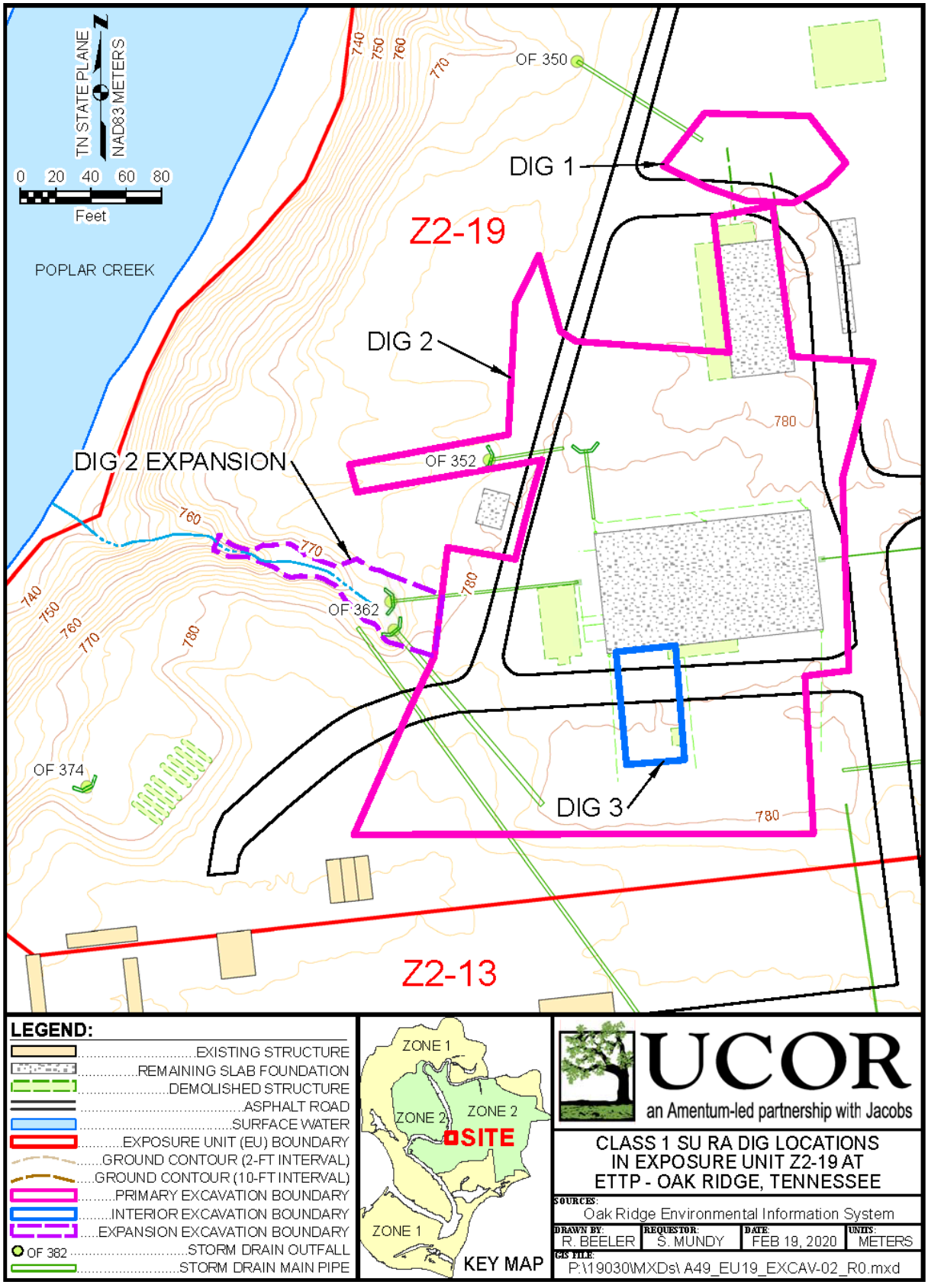

Figure 31. Remedial actions recommended for the Class 1 SU area in EU Z2-19.

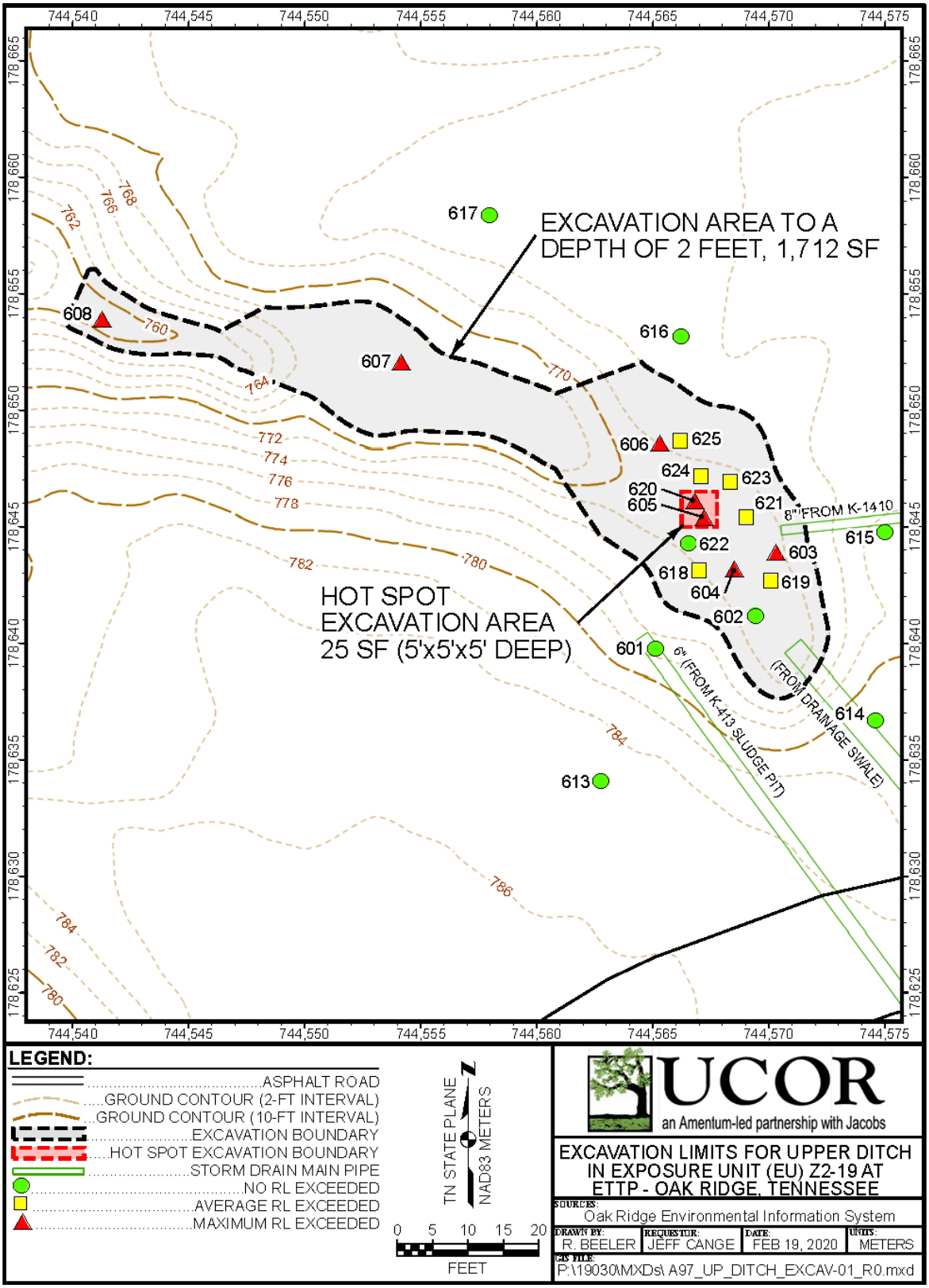

Figure 32. Excavation proposed in the upper ditch area of the Dig 2 Expansion.

Dig 1. Dig 1 is located on the north end of the EU Z2-19 Class 1 SU. The area of Dig 1 is approximately 3800 sq. ft and excavation will be conducted to a depth of 3 ft.

Dig 2. Dig 2 is the largest of the EU Z2-19 RA digs. The area of Dig 2 is approximately 62,400 sq. ft and excavation will be conducted to a depth of 4 ft except in Dig 3 (below). The approximately 8700 sq. ft K-1410 concrete slab will be excavated during excavation of Dig 2 and therefore the depth of excavation at the K-1410 footprint will be 4 ft.

Dig 3. Dig 3 encompasses an area of approximately 2150 sq. ft and the depth of excavation will be 6 ft. The purpose for Dig 3 is to excavate the GW SSL exceedances at sample locations Z2-EU19B-152 and Z2-EU19B-157, which occur at depths between 5 and 6 ft.

K-1031 slab. The demolition of the K-1031 building left approximately a 4400 sq. ft concrete slab in place. A radiological survey of the slab was conducted in 1999 and showed elevated radioactivity over the slab. The slab was then covered with 2 in. of asphalt, which is its current state. Based on the inability to resurvey the slab, the entire slab will be removed as an RA. This will be approximately 154 yd^3 (4163 sq. ft by 1 ft deep).

Dig 2 expansion into Outfall 362 ditch. Delineation sampling at the Outfall 362 drainage ditch defined an area for remediation under the Zone 2 ROD. The RA for the upper portion of the ditch includes an area of 1712 ft^2 to be excavated to a depth of 2 ft and a smaller hot spot area of 25 ft^2 that will be excavated to 5 ft.

Table 11 presents the estimated depths and area of excavations for the EU Z2-19 RAs. The areas referred to by Table 10 are shown on Figures 31, 32, and 33. Confirmation sampling for this RA is discussed in Section 7.

Table 11. Approximate depths, areas, and volumes of material to be excavated during recommended RAs to be performed in EU Z2-19.

Excavation area	Excavation depth (ft)	Excavation area (sq. ft)	Estimate Volume (in-place yd^3)
Dig 1	3	3800	422
Dig 2	4	62,400	9,244
Dig 3	6	2150	477
K-1031 slab	1	4400	163
Dig 2 expansion—upper portion of ditch	2	1712	127
Dig 2 expansion—hot spot in upper portion	5	25	4.7

EU = exposure unit
ft = feet
sq. = square
yd = yard

7. CONFIRMATION SAMPLING

The approaches for confirmation sampling at four of the five RA areas have been reviewed by the Zone 2 Project Team and approved in concurrence FCN-ETTP-Zone 2-225, which is included in Attachment 5. The process of confirmation sampling for the Outfall 362 ditch has not been previously discussed with the Project Team in a concurrence form, but is provided here for review.

Confirmation sampling at the five RA areas described in Section 6 will be conducted as follows.

7.1 CLASS 1 SOIL UNIT CONFIRMATION SAMPLING

The following is a description of how sampling will be conducted to confirm that the RA in the EU Z2-19 Class 1 SU has successfully removed threats to the industrial worker and groundwater. Figure 33 is a map of the proposed confirmation sampling locations in the Class 1 SU. The conclusion from confirmation sampling that the RA was successful will apply only to the Class 1 SU:

- At the end of every day, when an approximately 30 ft x 50 ft excavation grid consisting of one or more walls along the excavation perimeter boundaries of Digs 1, 2, and 3 (Figure 31) has been completed, a radiological survey of the wall(s) will be conducted. Excavation into the wall(s) will continue wherever the radiological survey results exceed two times background. When the survey results are consistently less than two times background, samples will be collected at the five locations with highest radiological survey results and the five discrete samples will be sent to a laboratory for analysis.
- At the end of every day, when an approximately 30 ft x 50 ft excavation grid has reached its maximum depth in Digs 1, 2, and 3, a radiological survey of the excavation floor will be conducted if possible based on excavation depth and safety considerations. Excavation into the floor will continue wherever the radiological survey results exceed two times background. When the survey results are consistently less than two times background, samples will be collected at the five locations with highest radiological survey results and the five discrete samples will be sent to a laboratory for analysis.
- Confirmation soil samples will be sent to a laboratory for radionuclide analysis with a three-day turnaround time. Beginning the day after a sample has been sent to the laboratory and while waiting for the laboratory results, the excavation crew will continue by opening another 30 ft x 50 ft excavation area.
- If an analytical result exceeds an RL or GW SSL in a wall or floor confirmation sample, then an additional 1 ft of soil will be excavated from the area represented by the confirmation sample. A radiological survey will be conducted on the newly excavated area and excavation will continue until the radiological survey results are less than two times background. At that time, a confirmation sample of the newly excavated area will be collected and sent to the laboratory for analysis.
- When confirmation sampling shows that there are no RL or GW SSL exceedances in an excavation grid, then the excavation grid area that the confirmation sample(s) represents will be backfilled.
- Following excavation of the K-1031 concrete slab, a systematic grid of eight sample locations will be laid down on the exposed sub-slab soil footprint of the former slab. Discrete samples will be collected at each sample location from 0-1 ft and 1-2 ft each sample will be analyzed for metals, radionuclides, PCBs, semivolatile organic compounds, and VOCs.
- Upon receipt of the K-1031 concrete slab confirmation sample data from the laboratory, the data will be evaluated against the Zone 2 ROD criteria for protection of the industrial worker and groundwater. If the data indicate that the newly exposed soil is a threat to the industrial worker or groundwater, then

the exposed soil at the locations identified as possible threats will be excavated to 2 ft and a discrete confirmation sample from each newly excavated area.

- When the K-1031 confirmation samples demonstrate that the K-1031 footprint does not pose a threat to the industrial worker or groundwater, then the RA at K-1031 will be complete and, if soil excavation has been conducted, the excavation will be backfilled with clean soil.

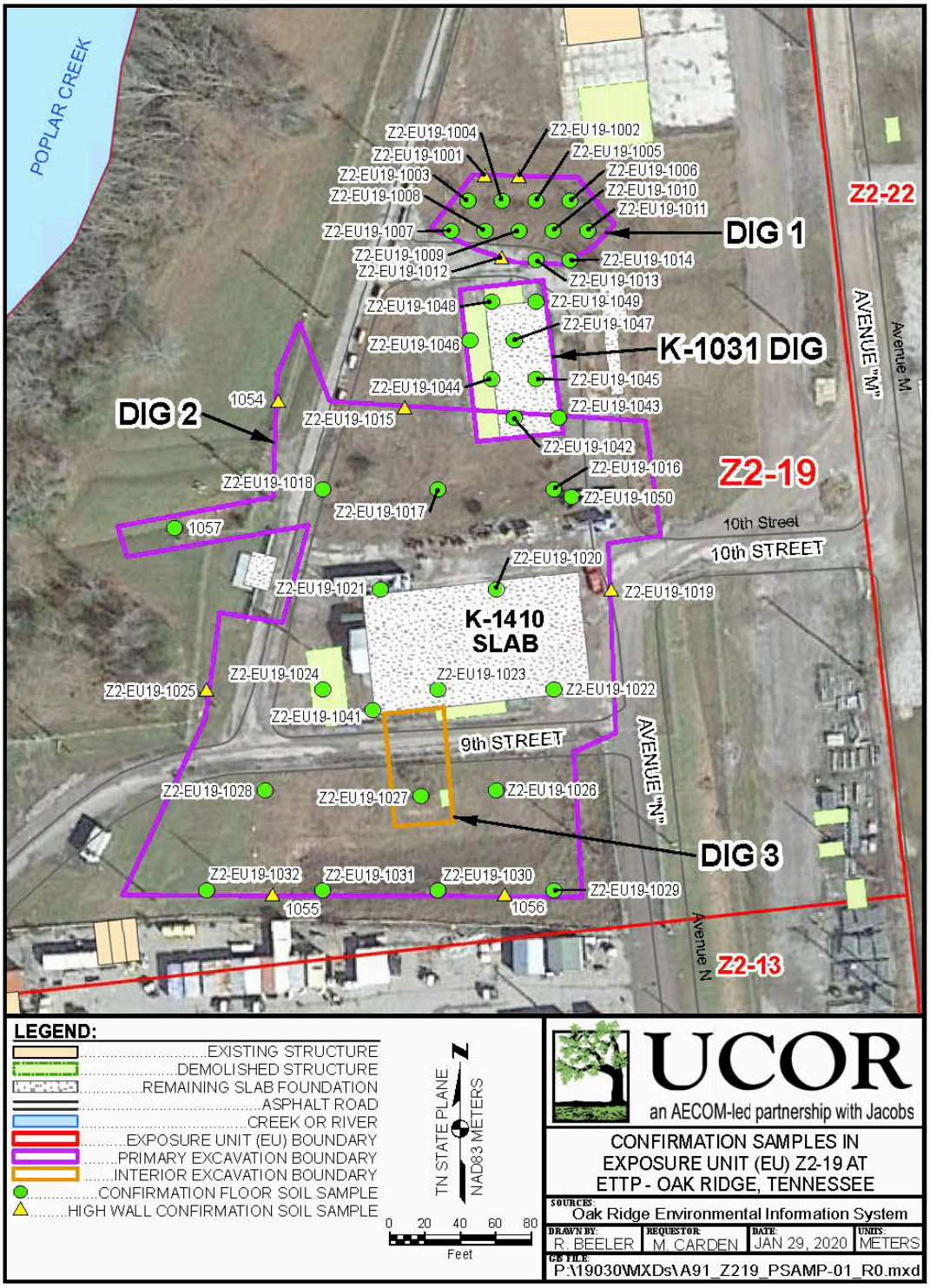

Figure 33. Confirmation sample locations in Class 1 SU.

7.2 CONFIRMATION SAMPLING IN THE OUTFALL 362 DITCH (DIG 2 EXPANSION)

The following confirmation sampling approach will be used to determine the effectiveness of the RA at the High CA ditch and to fill data gaps remaining from delineation sampling (Figure 34):

- After the dig area has been excavated in the upper portion of the ditch, 13 discrete soil samples will be collected from the base of the soil excavation.
- Confirmation soil samples will be sent to a laboratory for radionuclide analysis with a three-day turnaround time.
- If an analytical result exceeds an RL or GW SSL in a wall or floor confirmation sample, then an additional 1 ft of soil will be excavated from the area represented by the confirmation sample. A radiological survey will be conducted on the newly excavated area and excavation will continue until the radiological survey results are less than two times background. At that time, a confirmation sample of the newly excavated area will be collected and sent to the laboratory for analysis.
- When confirmation sampling shows that there are no RL or GW SSL exceedances in an excavation grid, then the excavation grid area that the confirmation sample(s) represents will be backfilled.

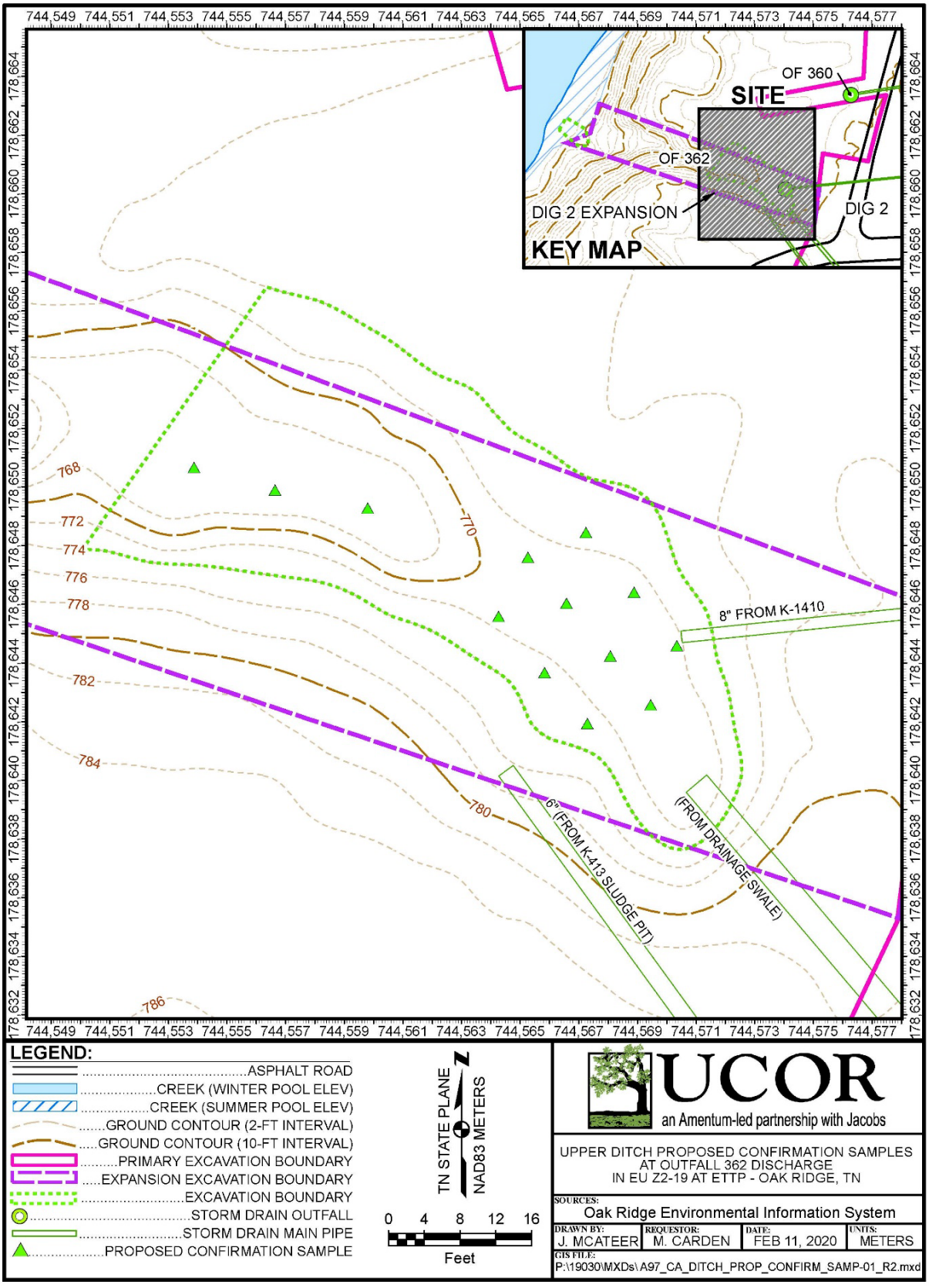

Figure 34. Confirmation sample locations for upper portion of the Outfall 362 ditch.

8. GROUNDWATER CONDITIONS

Depth to groundwater in the area of EU Z2-19 ranges between 20 and 30 ft below ground surface. There are two existing groundwater monitoring wells (BRW-058 and UNW-060) in EU Z2-19 (Figure 35). Well BRW-058 is a bedrock well and UNW-060 is an unconsolidated zone well. Well construction information is provided in Table 12. Figure 35 identifies the location of the wells in the EU and provides site topography, a potentiometric surface, and groundwater flow direction based on available wells in the area. These wells lie between the operational area of EU Z2-19 where subsurface contamination has been identified and Poplar Creek, and are down gradient of the potential contaminant mass.

The most recent results in Oak Ridge Environmental Information System are from the October 2018 sampling event. The results from the 2017 sampling event are discussed in *2017 Remediation Effectiveness Report for the U.S. Department of Energy Oak Ridge Reservation Oak Ridge, Tennessee Data and Evaluation* (DOE/OR/01-2731&D1), as "[t]he source of the VOC contamination in well BRW-058 is not suspected to be from the K-27/K-29 area operations but is more likely associated with groundwater contamination that originates in the K-25 area." Well UNW-060 has been dry since initial installation. BRW-058 is part of the routine well monitoring program with samples collected twice each year. The groundwater samples are currently analyzed for Tc-99 and total VOCs.

Table 12. EU Z2-19 monitoring well information.

Well	Ground surface elevation (ft amsl)	Average Groundwater elevation (ft amsl)	Total Depth (ft bgs)	Top of Screened interval (ft bgs)	Bottom of Screened interval (ft bgs)
BRW-058	778.58	751.38	70.0	54.3	64.3
UNW-060	778.78	<763.18 (dry)	21.4	20.8	15.6
BRW-124	787.3	755.92	66.0	55	65

amsl = above mean sea level
bgs = below ground surface
ft = feet

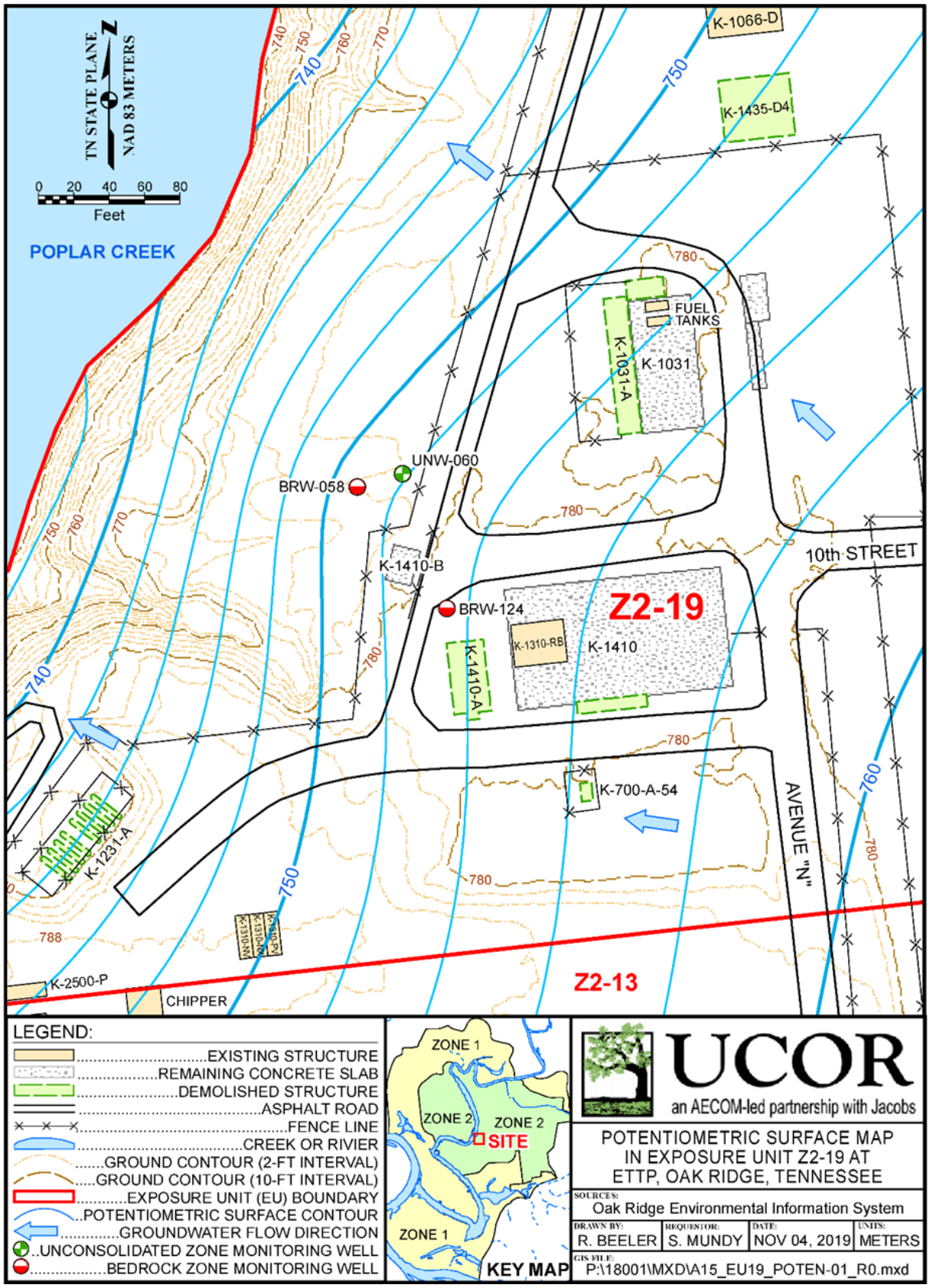

Figure 35. Location of groundwater monitoring wells.

9. EU STATUS

With the demolition of all of the buildings in EU Z2-19 excluding the K-2527-BR Grout Shop that will be demolished in FY20, there will be no remaining above-grade structures within the EU post-FY20. Various slabs have been evaluated and the contaminated slabs will be demolished as RAs (the K-1031 and K-1410 slabs). The K-1066-D slab was sampled in 2019 and determined to be uncontaminated, so the slab will remain in place.

All RAs that have been defined throughout the EU are documented in this TM or in the attachments to this TM. All completed RAs will be documented in the final Phased Construction Completion Report for the EU Z2-19. The RA status for the EU is discussed in Table 13.

Figure 36 is an aerial view of the EU Z2-19 taken in 2019.

Table 13. RA status for EU Z2-19

Action	Status
RA for removal of contaminated soil in Class 1 SU	Planned FY20
RA for removal of contaminated soil in the Outfall 362 ditch	Planned FY20

EU = exposure unit
FY = fiscal year
RA = remedial action
SU = soil unit

Figure 36. 2019 aerial view of EU Z2-19 facing east.

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10. REFERENCES

BJC/OR-3231, *Data Quality Objective Scoping Package for the Poplar Creek Group (EUs Z2-11, Z2-12, and Z2-19) at the East Tennessee Technology Park, Oak Ridge, Tennessee*, 2009, Bechtel Jacobs Company LLC, Oak Ridge, TN.

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Vol. I-VI K/HS-620. *Oak Ridge K-25 Site Outdoor Radiological Characterization, Phase II*, 1996, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

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ATTACHMENT 1:
EU Z2-19 DATA QUALITY ASSESSMENT AND PATH FORWARD

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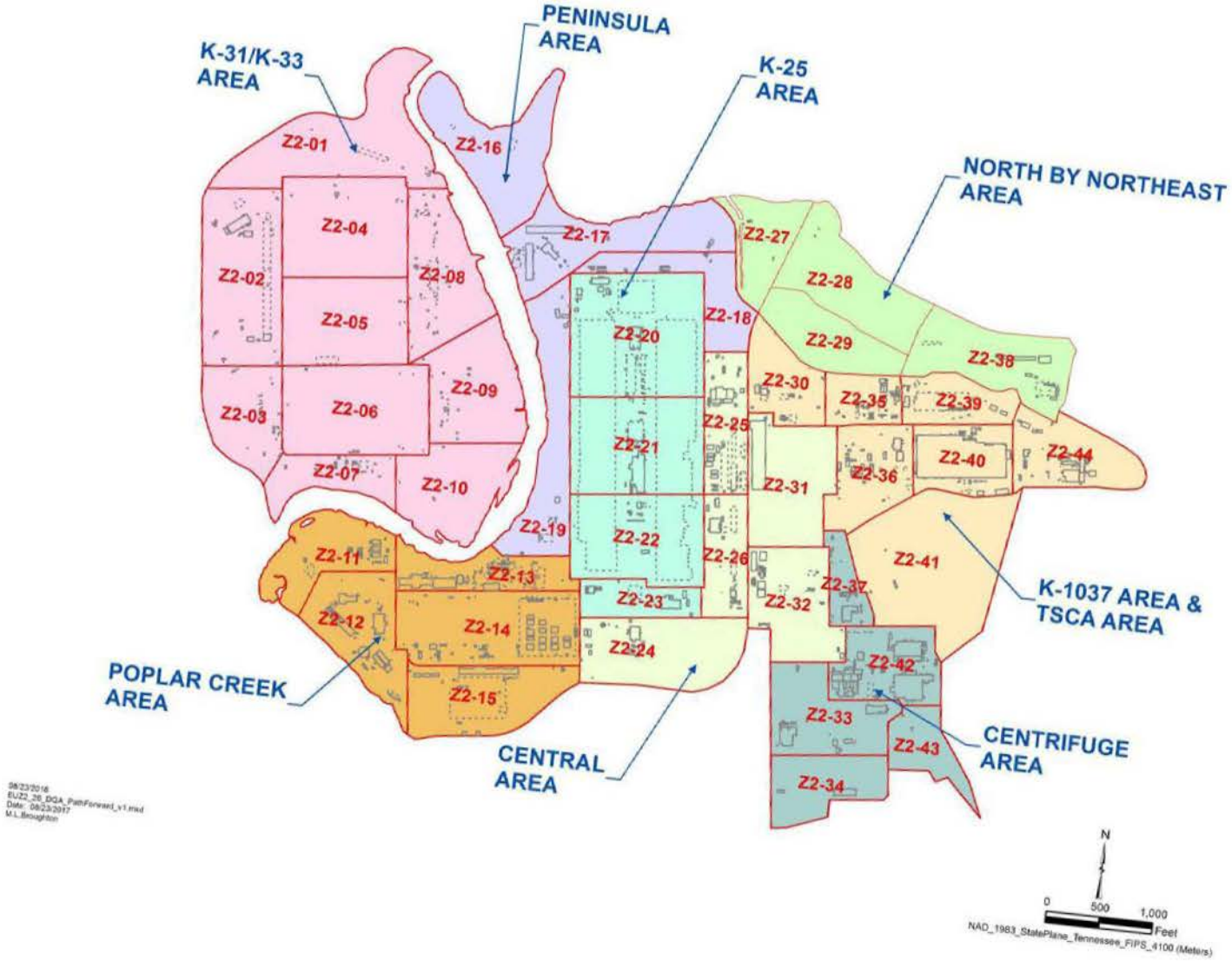
EU Z2-19 Data Quality Assessment

And Path Forward


K-31/K-33 AREA
PENINSULA AREA
K-25 AREA
NORTH BY NORTHEAST AREA
K-1037 AREA & TSCA AREA
POPLAR CREEK AREA
CENTRAL AREA
CENTRIFUGE AREA
Z2-01
Z2-02
Z2-03
Z2-04
Z2-05
Z2-06
Z2-07
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Z2-09
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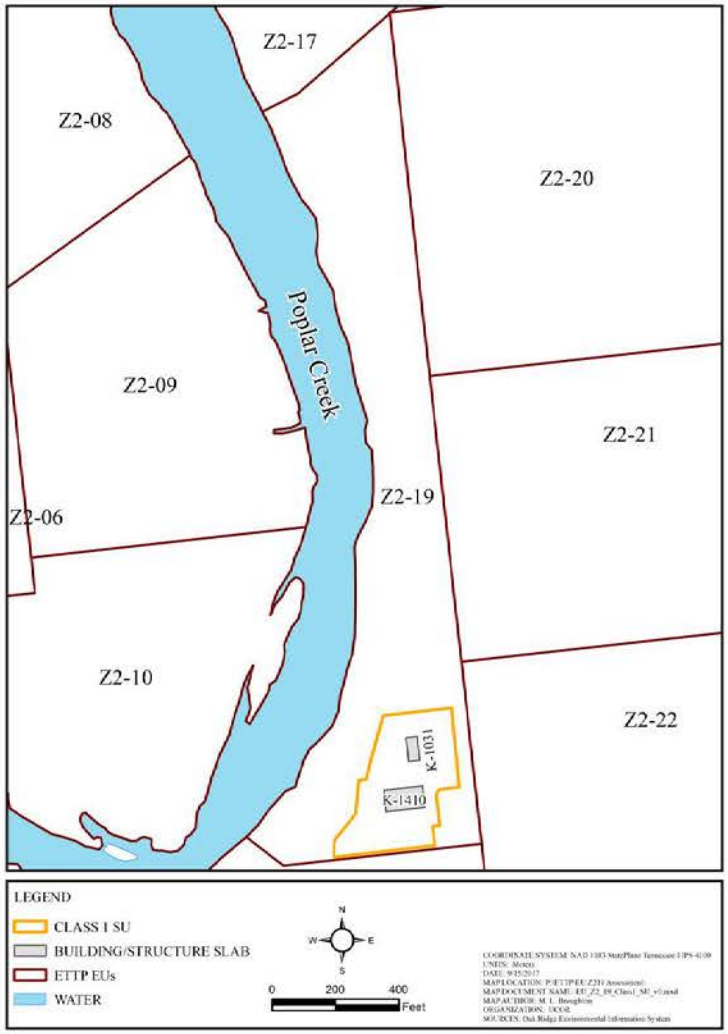
EU Z2-19 Soil Units



EU Z2-19 Characterization Requirements*

*Initially, *Data Quality Objective Scoping Package for the Poplar Creek Group (EUs Z2-11, Z2-12, and Z2-19) at the East Tennessee Technology Park, Oak Ridge, Tennessee* (BJC/OR-3231); modified in concurrence form FCN-ETTP-Zone 2-194. Modifications based upon completed radiation walkover survey.

Class 1 SU

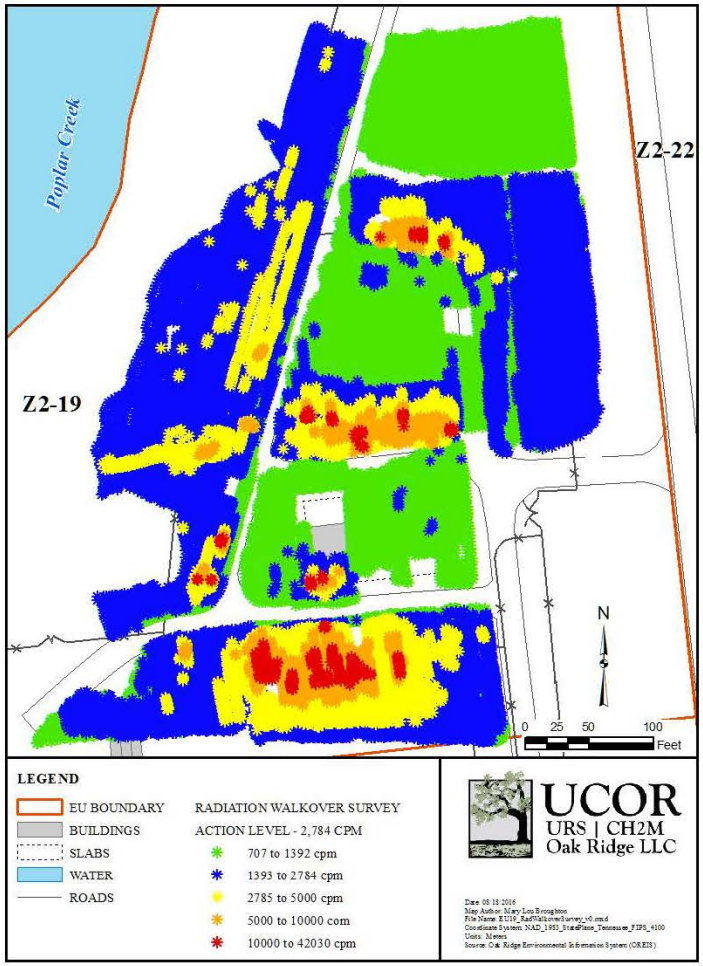
1. Radiation walkover survey of Class 1 SU
2. 20 sample locations in rad walkover survey above-action level areas (0-1 ft.; M, P, R, S, cV)**
3. 3 sample locations in rad walkover survey above-action level areas (0-10 ft., 3 discrete intervals; M, P, R, S, cV)**
4. One 3-point composite sample at area of historical Max RL exceedance but unconfirmed by rad walkover survey (0-1 ft.; M, P, R, S, cV)**
5. One 4-point composite sample at area of historical Max RL exceedance but unconfirmed by rad walkover survey (0-1 ft.; M, P, R, S, cV)**
6. Extent of RAs to be determined with delineation sampling around sample locations identified as requiring RAs

Class 3 SU

1. Conduct Class 3 SU walkover assessment
2. 4 biased locations near utility corridors (0-10 ft.; M, P, cR, S, cV)**
3. Sample storm drains where sufficient sediment exists (M, P, cR, S, cV)**

** M = metals, P = PCBs, R = radionuclides, S = SVOCs, V = VOCs, c = conditional

Class 1 SU Characterization Requirement 1
Radiation Walkover Survey



Class 1 SU Characterization Requirement 2
20 Sample Locations in Radiation Walkover Survey Above-AL Areas

Samples collected from 0 to 1 ft.; all samples analyzed for metals, PCBs, radionuclides, SVOCs

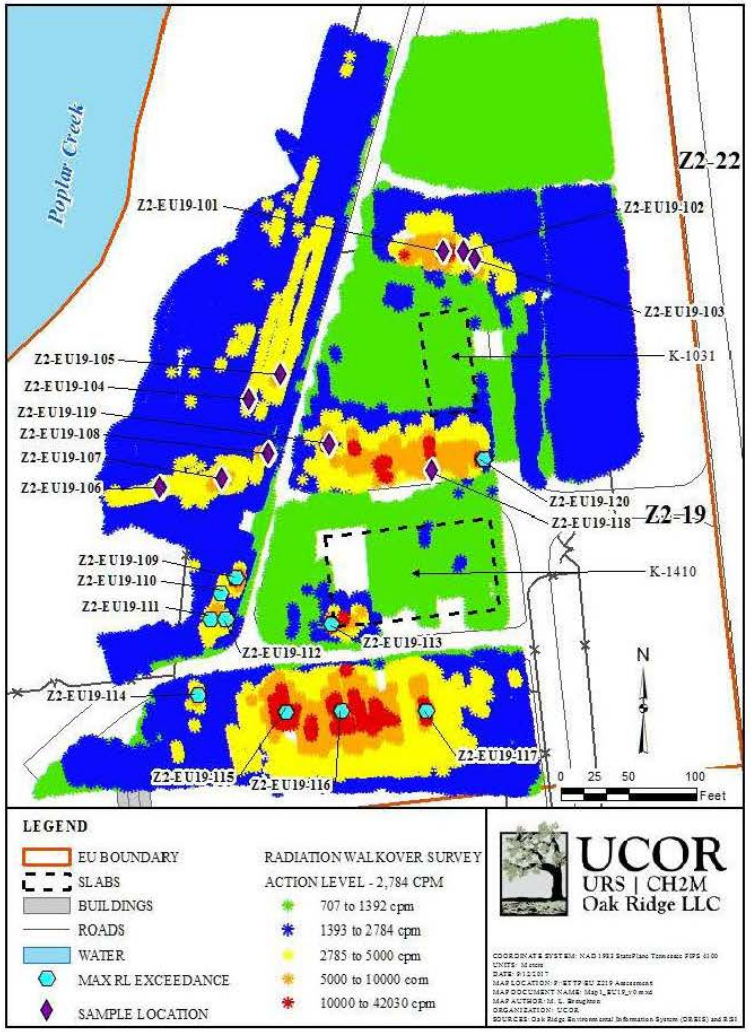
Sample Location	Sample Location
Z2-EU19-101	Z2-EU19-111
Z2-EU19-102	Z2-EU19-112
Z2-EU19-103	Z2-EU19-113
Z2-EU19-104	Z2-EU19-114
Z2-EU19-105	Z2-EU19-115
Z2-EU19-106	Z2-EU19-116
Z2-EU19-107	Z2-EU19-117
Z2-EU19-108	Z2-EU19-118
Z2-EU19-109	Z2-EU19-119
Z2-EU19-110	Z2-EU19-120

Class 1 SU Characterization Requirement 2

Sample Locations in Rad Walkover Survey
Above-AL Areas, 0-1 ft.

Max RL Exceedances

Location	Analyte
Z2-EU19-109	Ra/Th decay series
Z2-EU19-110	Ra/Th decay series
Z2-EU19-111	Cesium-137
	Ra/Th decay series
Z2-EU19-112	Cesium-137
	Ra/Th decay series
Z2-EU19-113	Cesium-137
	Ra/Th decay series
	Uranium-234
	Uranium-235
	Uranium-238
Z2-EU19-114	Cesium-137
	Ra/Th decay series
	Uranium-238
Z2-EU19-115	Uranium-235
	Uranium-238
Z2-EU19-116	Ra/Th decay series
Z2-EU19-117	Ra/Th decay series
Z2-EU19-120	Ra/Th decay series
	Uranium-234
	Uranium-235
	Uranium-238

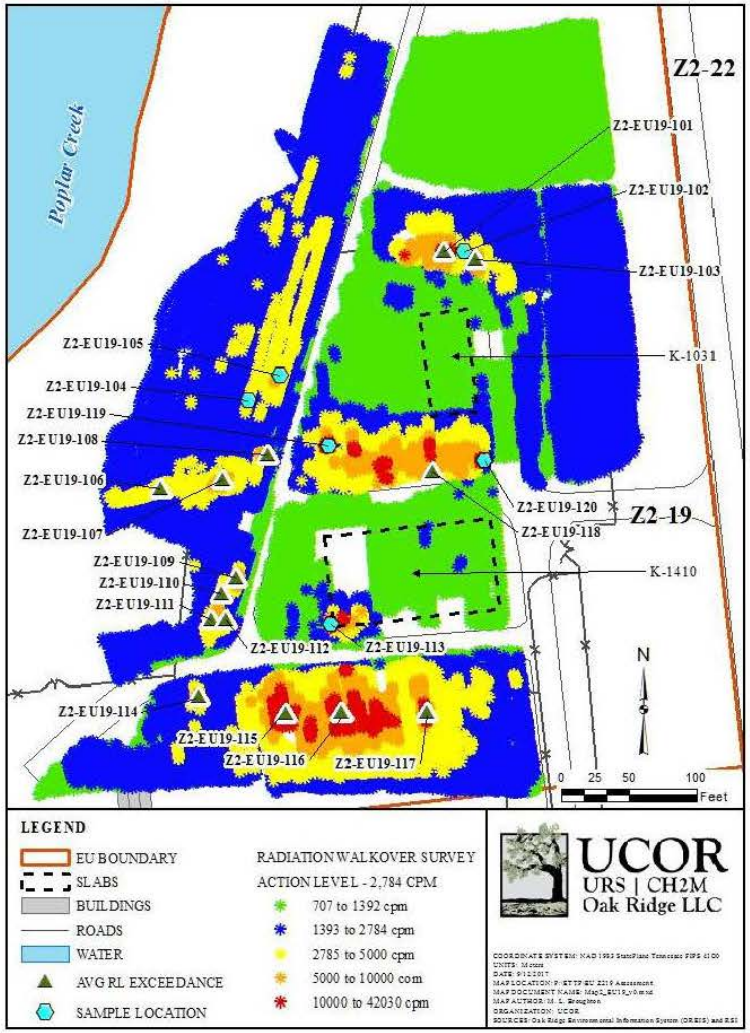


Class 1 SU Characterization Requirement 2

Sample Locations in Rad Walkover Survey Above-AL Areas, 0-1 ft.

Avg RL Exceedances not Captured by Max RLs

Z2-EU19-101	Uranium-238
Z2-EU19-103	Uranium-235
	Uranium-238
Z2-EU19-105	Uranium-235
	Uranium-238
Z2-EU19-106	Uranium-238
Z2-EU19-107	Cesium-137
	Ra/Th decay series
	Uranium-235
	Uranium-238
Z2-EU19-108	Ra/Th decay series
Z2-EU19-109	Cesium-137
	Uranium-235
	Uranium-238
Z2-EU19-110	Uranium-238
Z2-EU19-111	Uranium-235
	Uranium-238
Z2-EU19-112	Uranium-235
	Uranium-238
Z2-EU19-114	Uranium-235
Z2-EU19-115	Uranium-234
Z2-EU19-116	Cesium-137
	Uranium-235
	Uranium-238
Z2-EU19-117	Cesium-137
	Uranium-235
	Uranium-238
Z2-EU19-118	Uranium-235
	Uranium-238

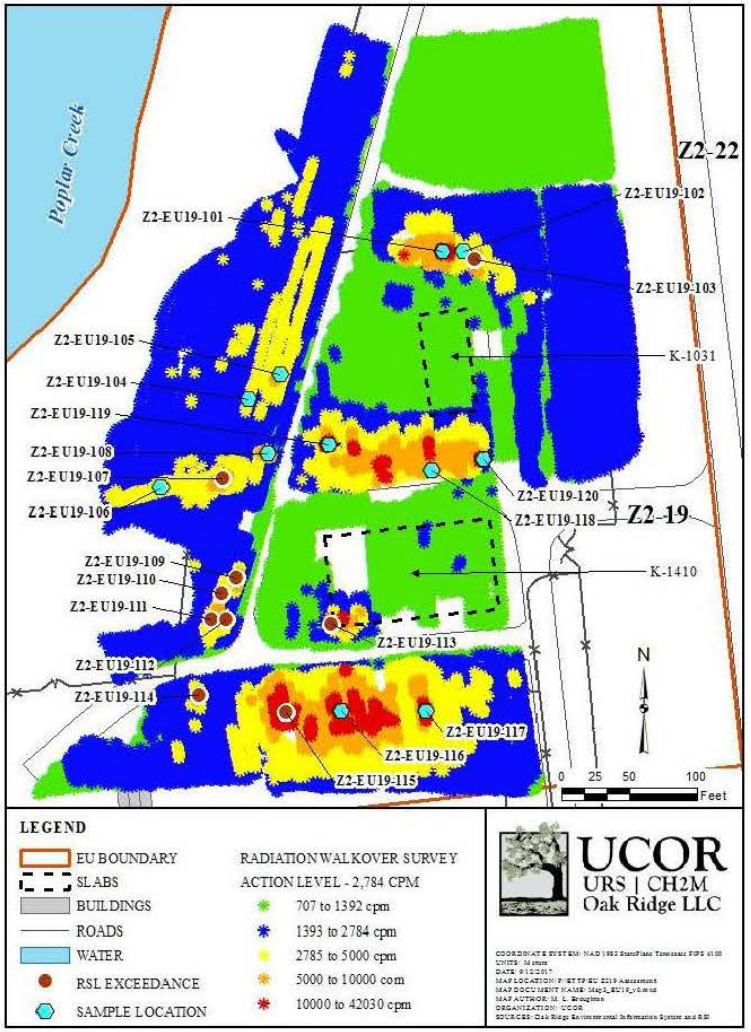


Class 1 SU Characterization Requirement 2

Sample Locations in Rad Walkover Survey Above-AL Areas, 0-1 ft.

RSL Exceedances not Captured by Avg and Max RLs and Excluding K-40

Z2-EU19-103	Uranium
Z2-EU19-107	Uranium
Z2-EU19-109	Uranium
Z2-EU19-110	Uranium
Z2-EU19-111	Uranium
Z2-EU19-112	Plutonium-239
	Uranium
Z2-EU19-113	Uranium
Z2-EU19-114	Uranium
Z2-EU19-115	Uranium

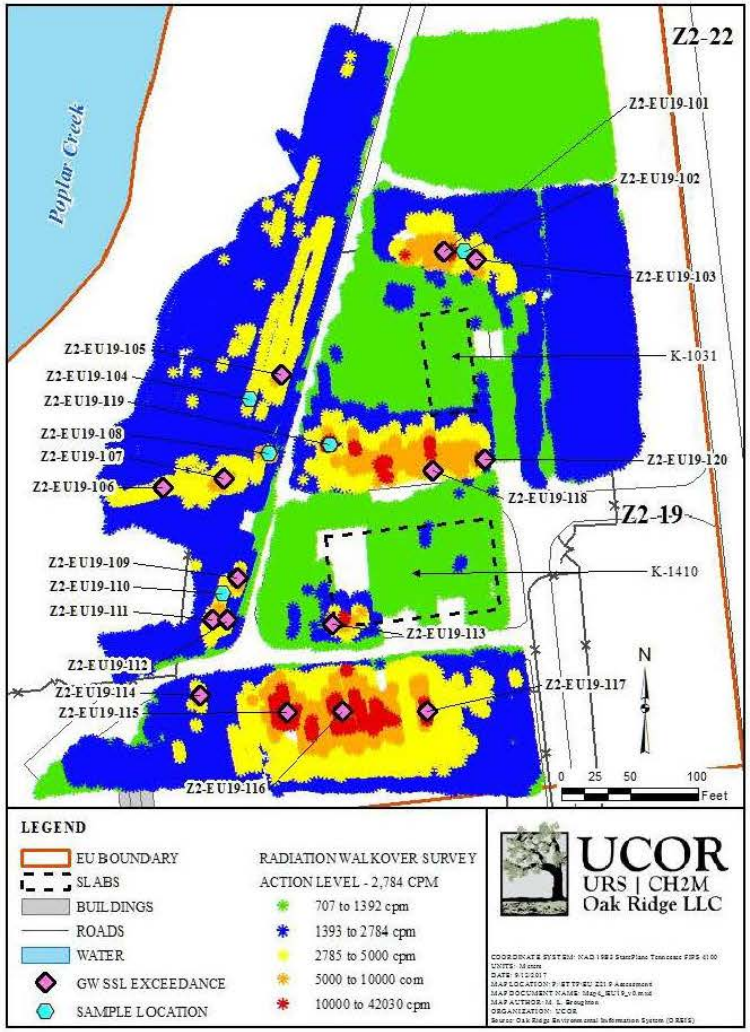


Class 1 SU Characterization Requirement 2

Sample Locations in Rad Walkover Survey Above-AL Areas, 0-1 ft.

GW SSL Exceedances

Z2-EU19-101	Uranium-234
	Uranium-238
Z2-EU19-103	Uranium-234
	Uranium-238
Z2-EU19-105	Uranium-234
	Uranium-238
Z2-EU19-106	Uranium-234
Z2-EU19-107	Uranium-234
	Uranium-238
Z2-EU19-109	Uranium-234
	Uranium-238
Z2-EU19-111	Uranium-234
	Uranium-238
Z2-EU19-112	Uranium-234
	Uranium-238
Z2-EU19-113	Chromium
	Technetium-99
	Uranium-234
	Uranium-235
	Uranium-238
Z2-EU19-114	Uranium-234
	Uranium-238
Z2-EU19-115	Uranium-234
	Uranium-235
	Uranium-238
Z2-EU19-116	Uranium-234
	Uranium-238
Z2-EU19-117	Uranium-234
	Uranium-238
Z2-EU19-118	Uranium-234
	Uranium-238
Z2-EU19-120	Uranium-234
	Uranium-235
	Uranium-238



Class 1 SU Characterization Requirement 3
3 Sample Locations in Radiation Walkover Survey Above-AL Areas

0 to 10 ft., 3 discrete interval samples; all samples analyzed for metals, PCBs, radionuclides, SVOCs

Sample Location	Sample Depth Intervals (ft.)
Z2-EU19-121	0-0.5, 0.5-2, 2-10
Z2-EU19-122	0-0.5, 0.5-2, 2-10
Z2-EU19-123	0-0.5, 0.5-2, 2-10

Class 1 SU Characterization Requirement 3

Three Sample Locations in Above-Action Level Areas

Max RL Exceedances

Z2-EU19-122	Uranium-235 (0-0.5 ft.)
	Uranium-234 (0-0.5 ft.)*
	Uranium-238 (0-0.5 ft.)
Z2-EU19-123	Ra/Th decay series (0-0.5 ft.)
	Uranium-235 (0-0.5 ft.)
	Uranium-238 (0-0.5 ft.)

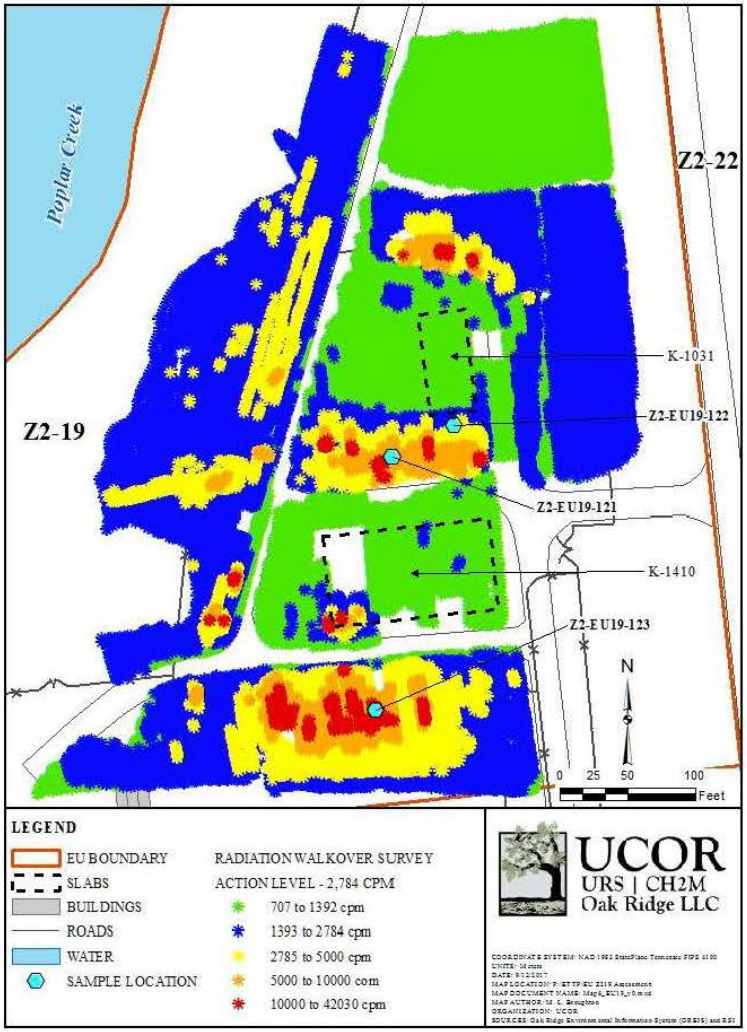
Avg RL Exceedances**

Z2-EU19-121	Ra/Th decay series (0-0.5 ft.)
	Uranium-234 (0-0.5 ft.)
	Uranium-235 (0-0.5 ft.)
	Uranium-238 (0-0.5 ft.)
Z2-EU19-122	Ra/Th decay series (0-0.5 ft.)
Z2-EU19-123	Cesium-137 (0-0.5 ft.)
	Uranium-234 (0-0.5 ft.)
	Uranium-235 (0.5-2 ft.)
	Uranium-238 (0.5-2 ft.)

RSL Exceedances***

Z2-EU19-121	Uranium (0-0.5 ft.)
Z2-EU19-122	Uranium (0-0.5 ft.)
Z2-EU19-123	Uranium (0-0.5 ft.)
	Uranium (0.5-2 ft.)

*6960 pCi/g; Max RL = 7000 pCi/g
**Not captured by Max RL exceedances
***Not captured by Max or Avg RL exceedances and not including K-40

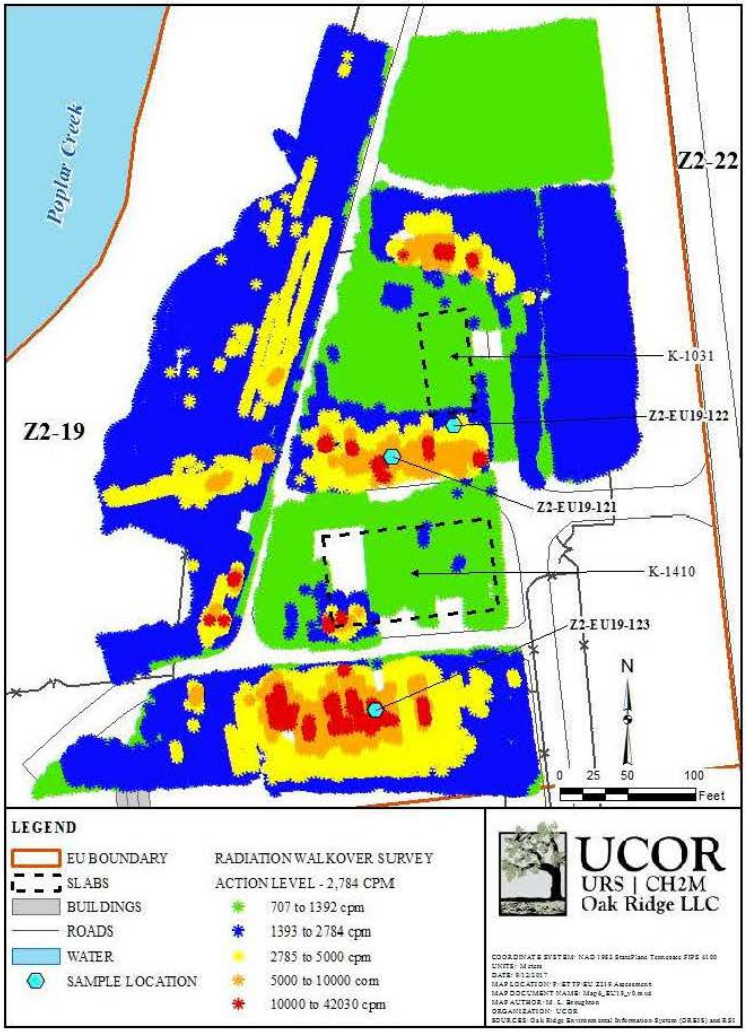


Class 1 SU Characterization Requirement 3

Three Sample Locations in Above-Action Level Areas

GW SSL Exceedances

Z2-EU19-121	Uranium-234 (0-0.5 ft.)
	Uranium-238 (0-0.5 ft.)
Z2-EU19-122	Uranium-234 (0-0.5 ft.)
	Uranium-234 (2-10 ft.)
	Uranium-235 (0-0.5 ft.)
	Uranium-238 (0-0.5 ft.)
Z2-EU19-123	Uranium-234 (0-0.5 ft.)
	Uranium-234 (0.5-2 ft.)
	Uranium-235 (0-0.5 ft.)
	Uranium-238 (0-0.5 ft.)
	Uranium-238 (0.5-2 ft.)



Class 1 SU Characterization Requirement 4

One 3-pt. Composite in Unconfirmed Historical Max RL Exceedance Area; 0-1 ft.

Max RL Exceedances

Z2-EU19-124	Ra/Th decay series

Avg RL Exceedances*

Z2-EU19-124	Cesium-137
	Uranium-238

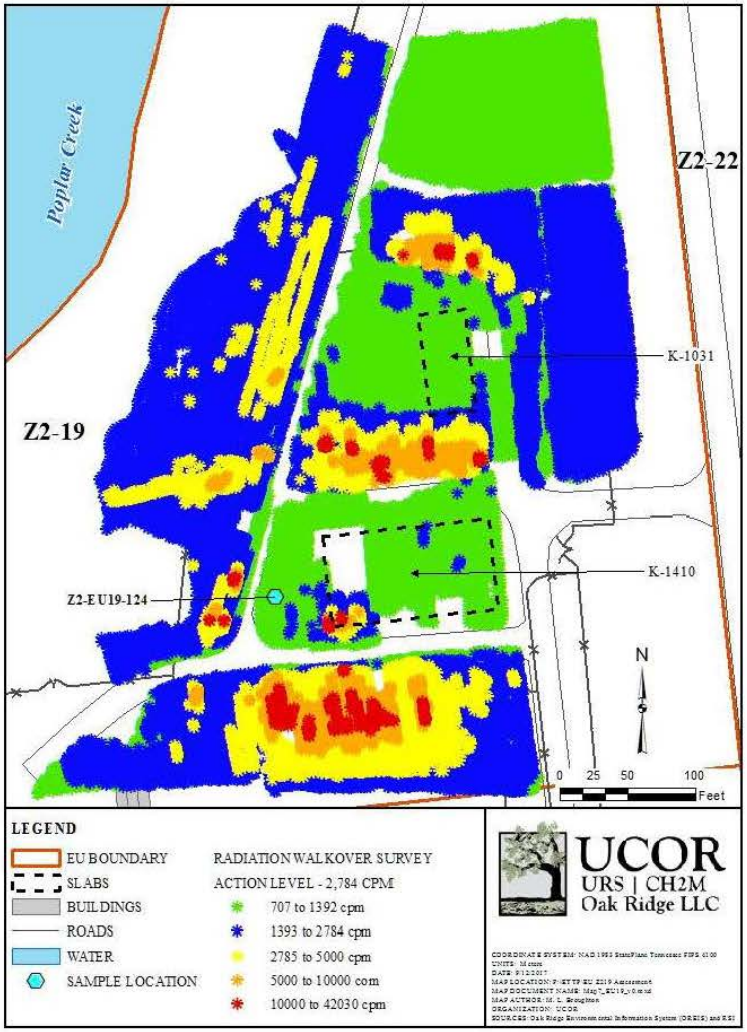
RSL Exceedances**

Z2-EU19-124	Uranium

GW SSL Exceedances

Z2-EU19-124	Uranium-234
	Uranium-238

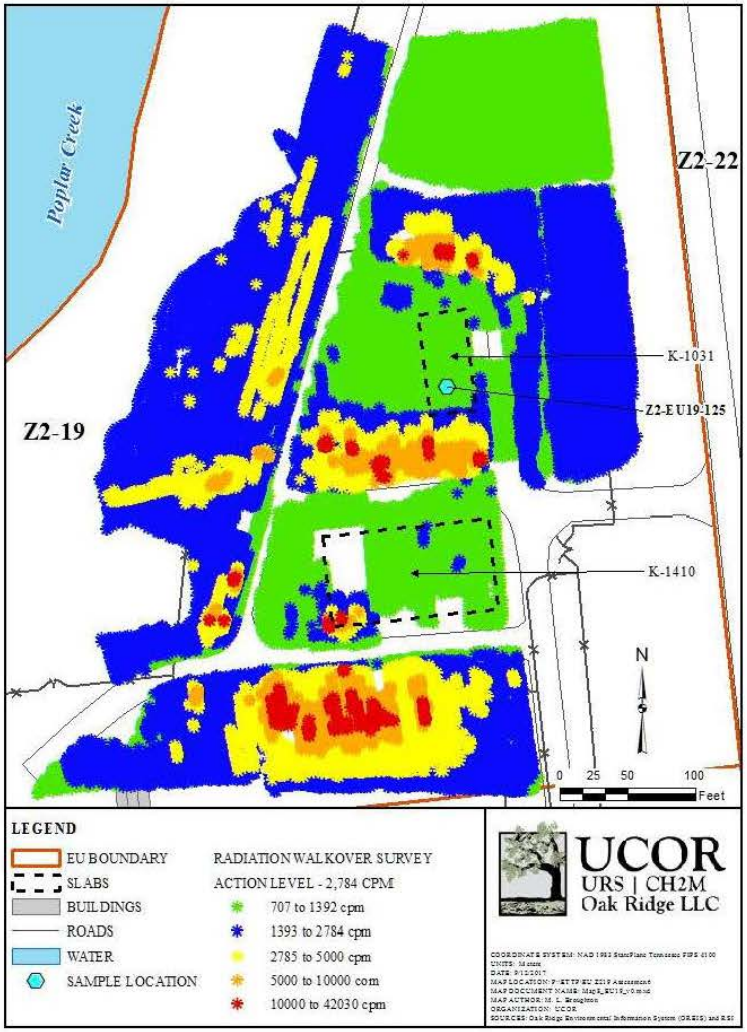
*Not captured by Max RL exceedances
**Not captured by Max or Avg RL exceedances and not including K-40



Class 1 SU Characterization Requirement 5

One 4-pt. Composite in Unconfirmed Historical Max RL Exceedance Area; 0-1 ft.

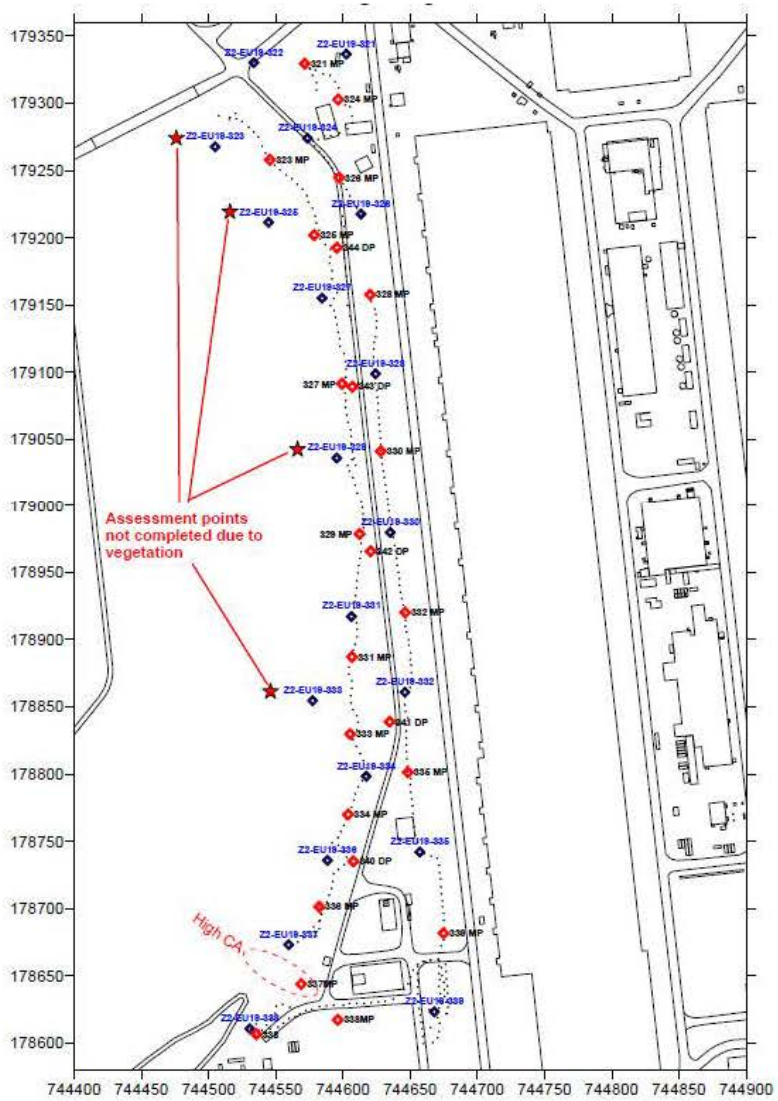
No criteria exceedances



Class 3 SU Characterization Requirement 1

Walkover assessment

- 19 assessment points
- 17 mid-points
- 5 discretionary points
- 1 biased sample based on walkover assessment

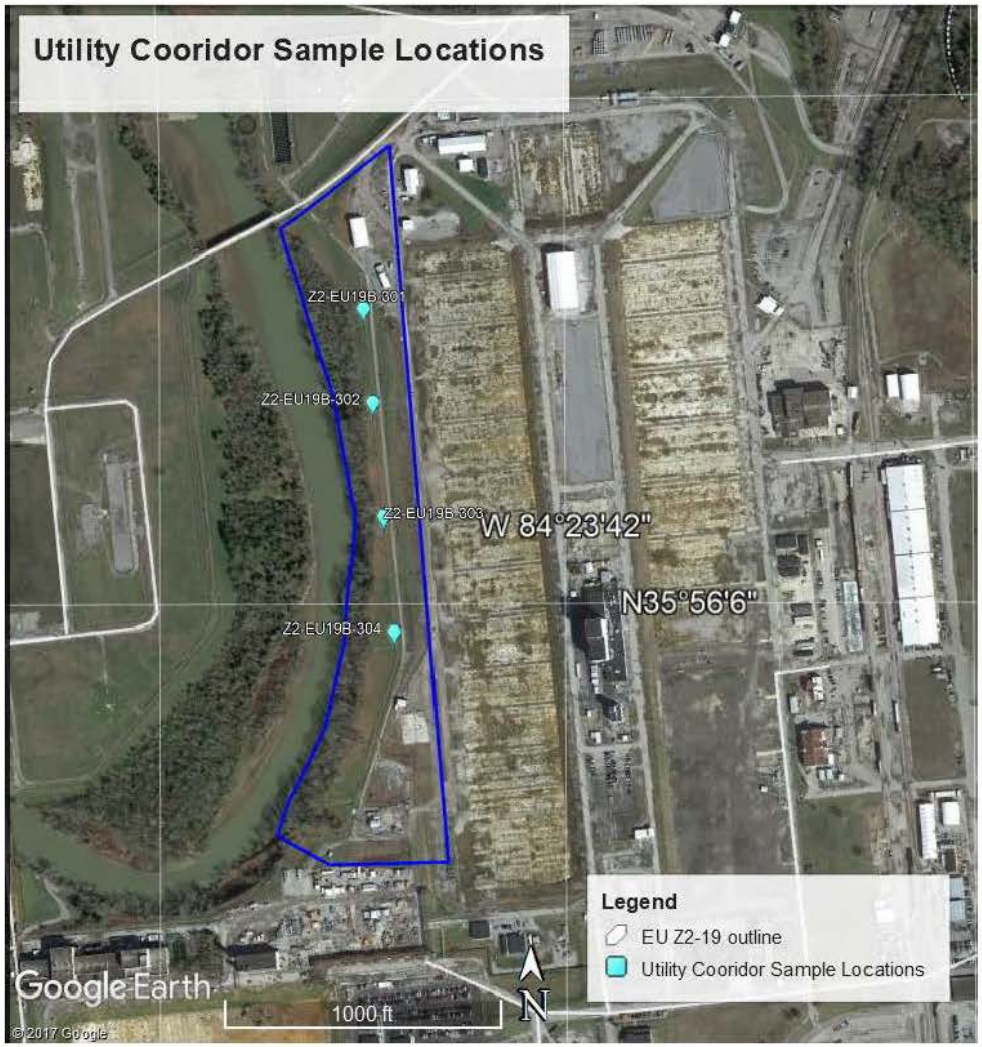


Class 3 SU Characterization Requirement 2
Four Biased Locations Near Utility Corridors

0 to 10 ft., 3-point composite samples; all samples analyzed for metals, PCBs, radionuclides, SVOCs

Z2-EU19B-301
Z2-EU19B-302
Z2-EU19B-303
Z2-EU19B-304

No criteria exceedances



Class 3 SU Characterization Requirement 3
Sample Storm Drains Where Sufficient Sediment Exists

No sediment observed in storm drains.
Instead 0 to 10 ft., 3-point composite sample next to storm drain; analyzed for metals, PCBs, radionuclides, SVOCs, VOCs

Z2-EU19B-305

No criteria exceedances

Delineation Sampling

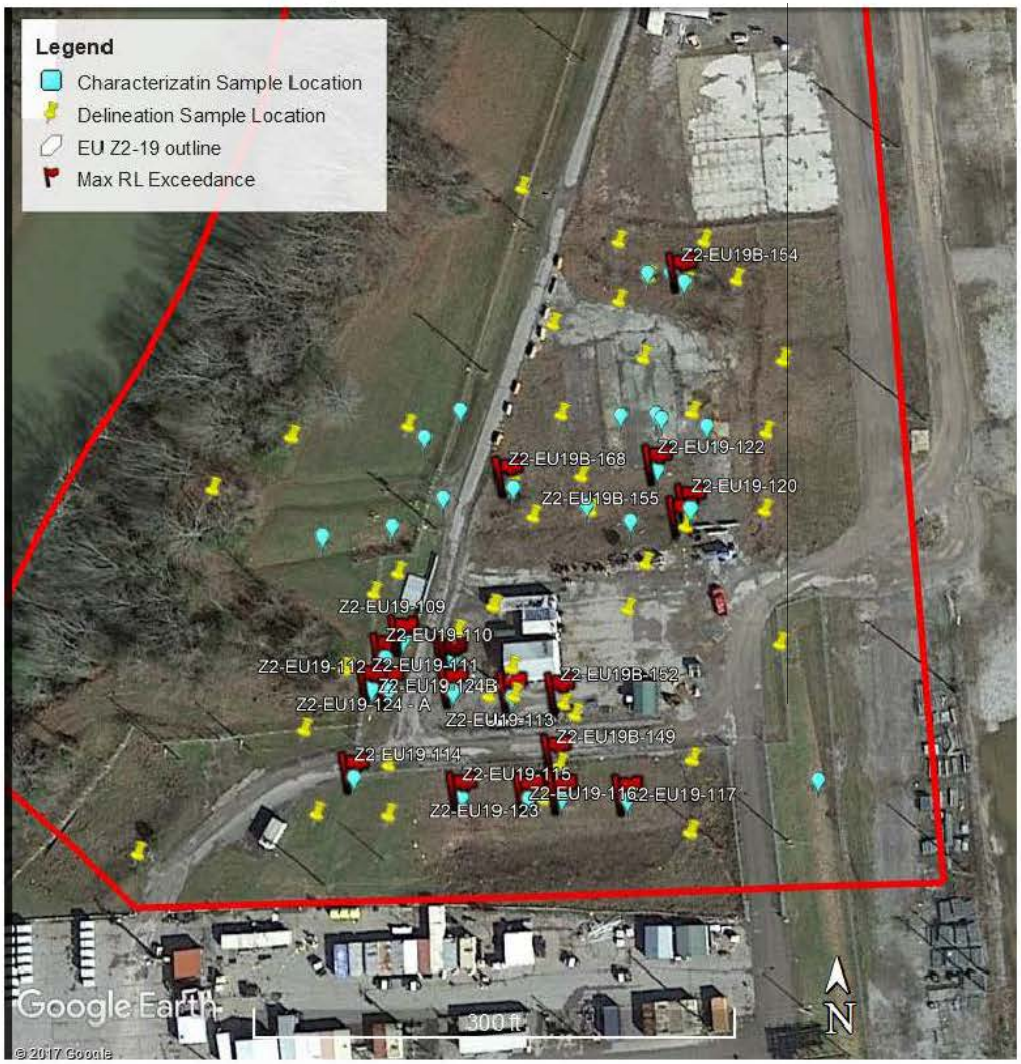
Conducted to bound criteria exceedances observed in characterization samples

57 sample locations

Characterization and Delineation Samples Max RL Exceedances

Delineation Samples Max RL Exceedances

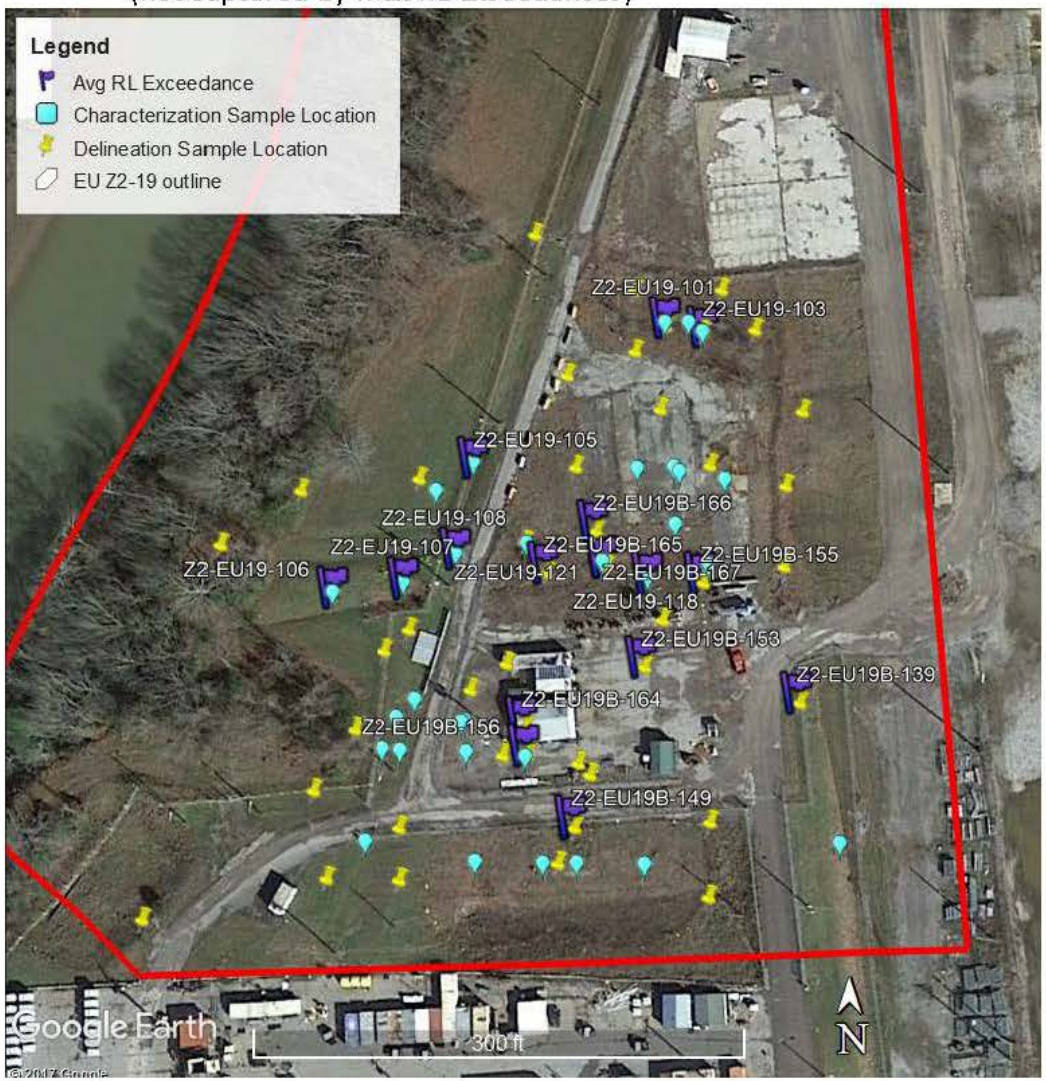
Location	Analyte
Z2-EU19-149	Ra/Th decay series
Z2-EU19-152	Ra/Th decay series
Z2-EU19-154	Cesium-137
	Ra/Th decay series
Z2-EU19-155A	Cesium-137
Z2-EU19-157	Cesium-137
	Ra/Th decay series
	Uranium-235
	Uranium-238
Z2-EU19-114	Cesium-137
	Ra/Th decay series
	Uranium-238
Z2-EU19-168C	Uranium-235



Characterization and Delineation Samples Avg RL Exceedances

(not captured by Max RL exceedances)

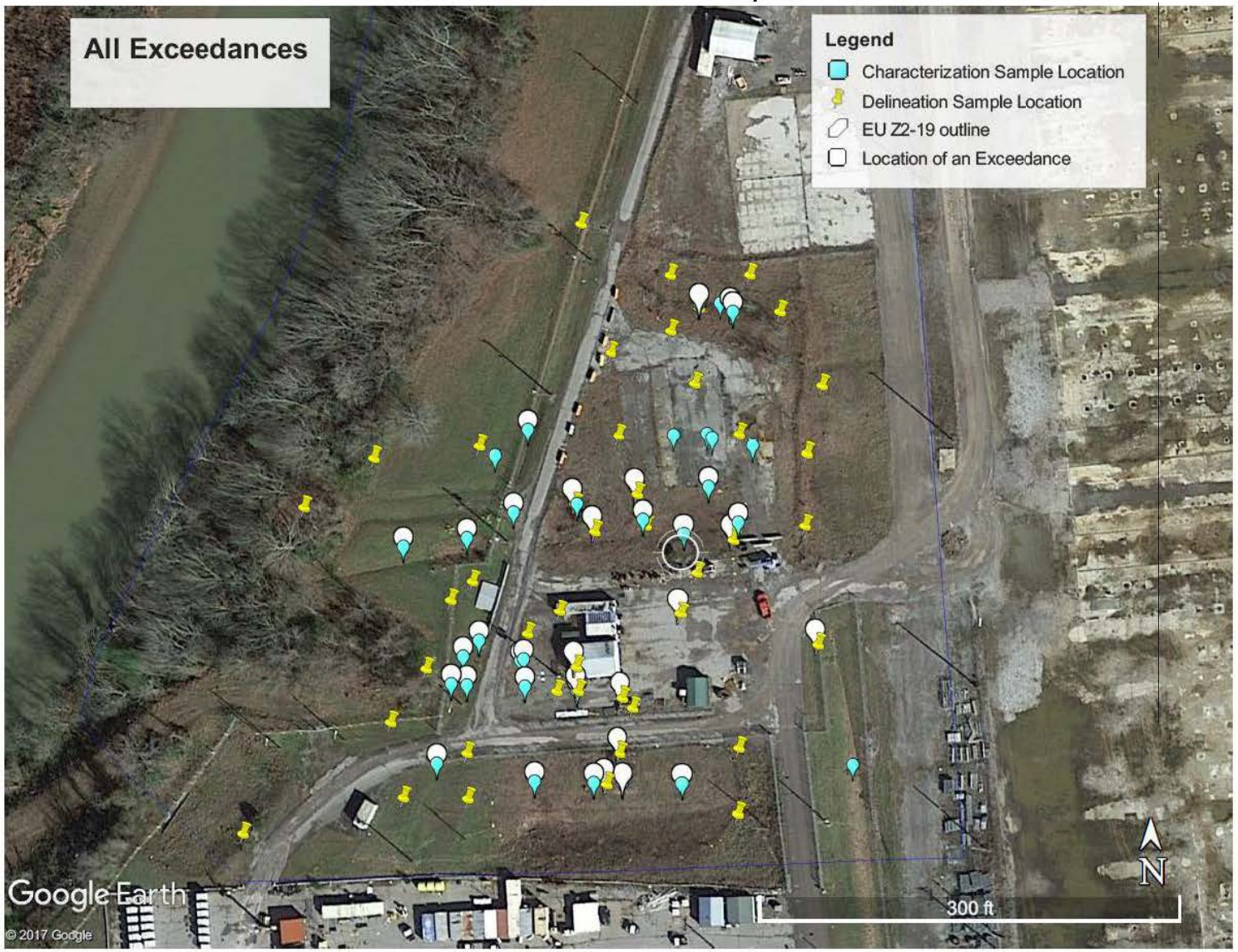
See attached
EU Z2-19 Criteria
Exceedance Table
for exceedance details



Characterization and Delineation Samples GW SSL Exceedances

See attached
EU Z2-19 Criteria
Exceedance Table
for exceedance details

Characterization and Delineation Samples All Criteria Exceedances



Path Forward – Remedial Actions

3 areas will be included in 2 RAs:

RA1 – 2 northern areas

RA2 – southern area including K-1410 slab

Path Forward (cont.)

- Complete 4 Class 3 SU assessment points
- Investigate the high CA (drainage ditch) in the Class 3 SU
- Evaluate pits and vaults
- Evaluate K-1031 slab

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ATTACHMENT 2:
EU Z2-19 CREEK BANK AREA
DATA QUALITY OBJECTIVES FOR
FINAL CHARACTERIZATION
May 2019

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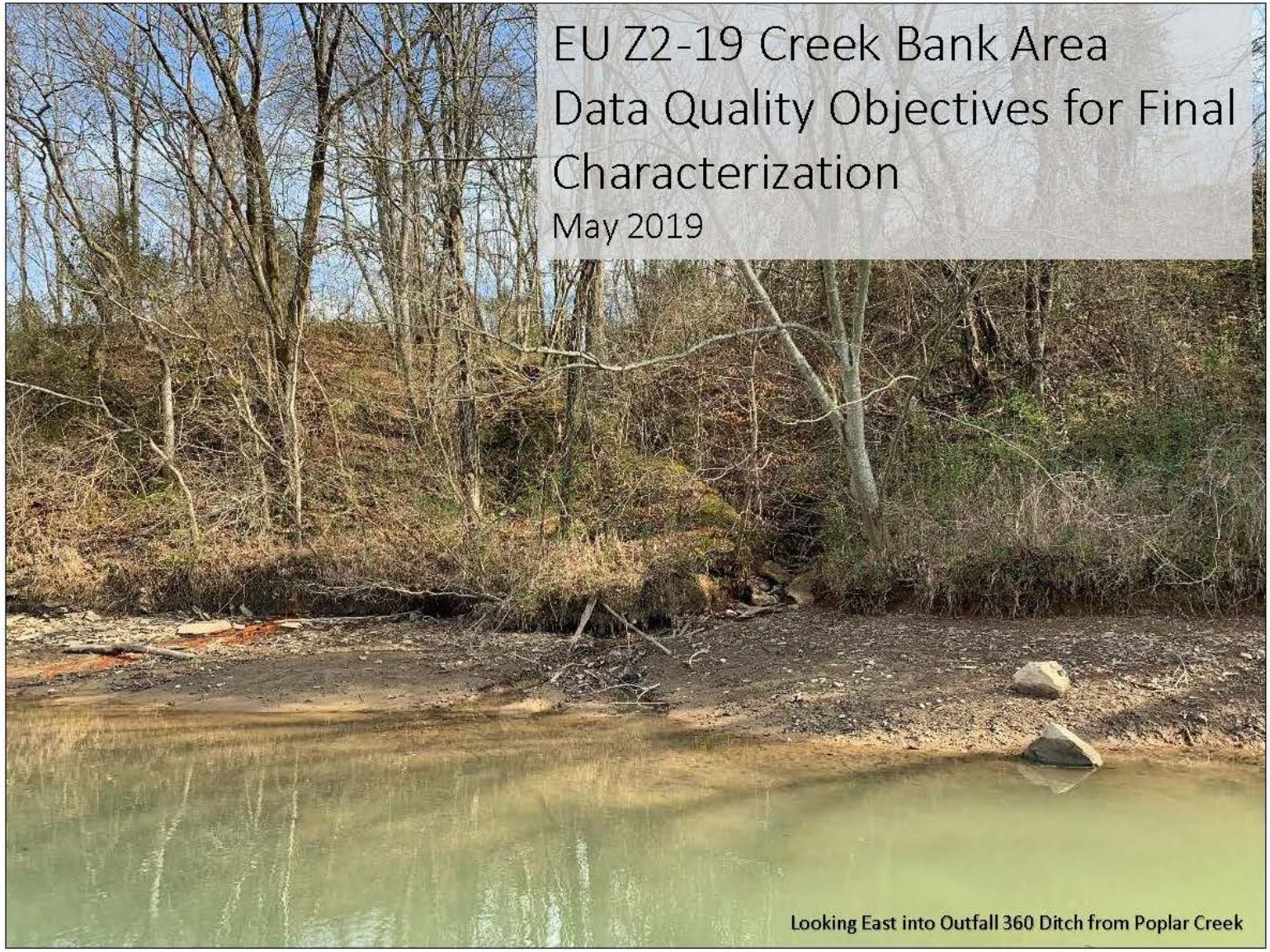

EU Z2-19 Creek Bank Area
Data Quality Objectives for Final Characterization
May 2019
Looking East into Outfall 360 Ditch from Poplar Creek

DQO APPROVALS

The undersigned have prepared, reviewed, and/or provided comments to this DQO and hereby approve the sampling approach, as defined herein, for implementation to provide characterization data to support determination of remedial requirements in EU Z2-19

APPROVED BY:

Steven Clemons — 7/19/19

U.S. Department of Energy — Date

Christine A. Jones — 7/17/2019

U.S. Environmental Protection Agency — Date

Randall Hoffmeister — 7/19/19

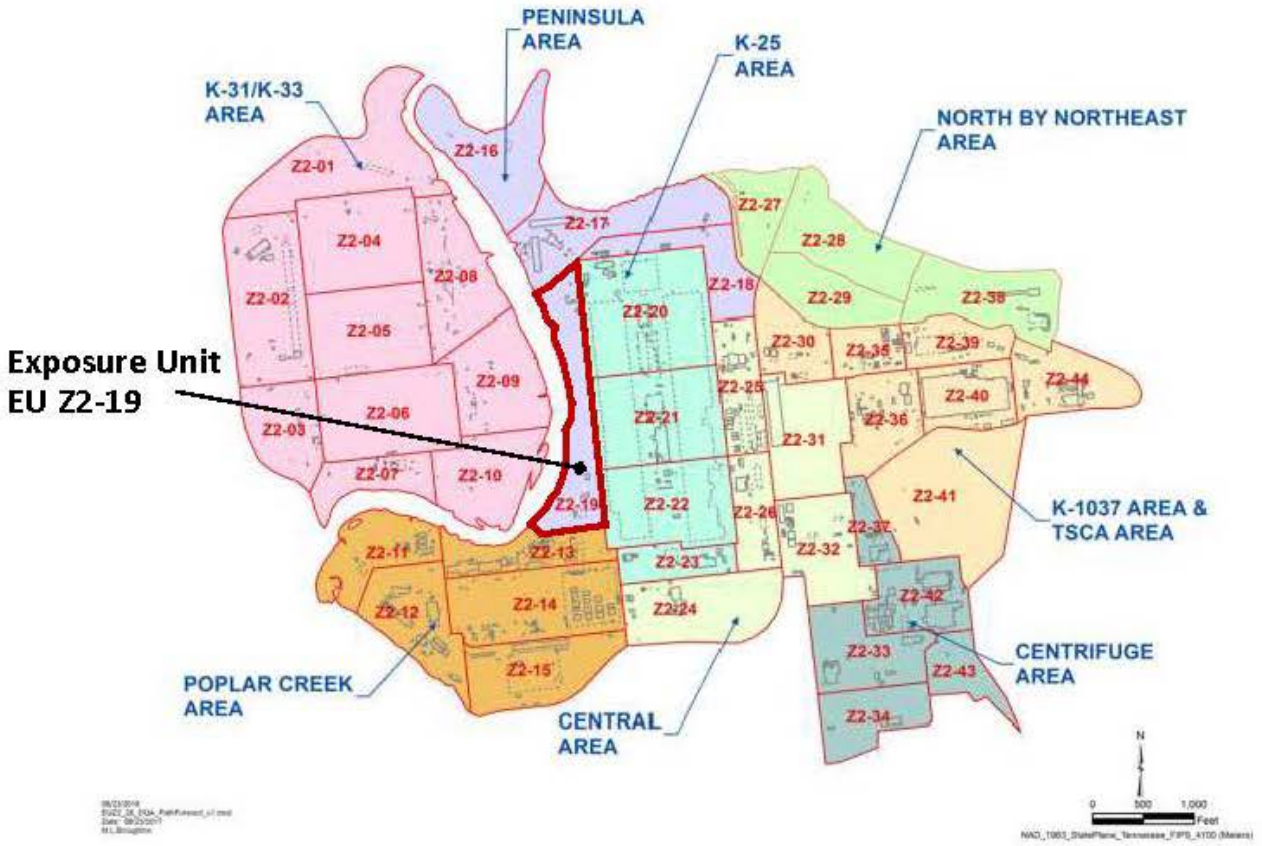
Tennessee Department of Environment and Conservation — Date

DQO for Areas Outside the Fence in EU Z2-19 Rev. 2

Objectives

- Review historical operations, process knowledge (PK) and historical data for the facilities in EUs Z2-19 that impact areas along Poplar Creek, west of the security fence (i.e., areas outside the fence)
- Follow the DQO process to identify data gaps associated with determining whether a remedial action is needed
- Develop a characterization strategy for resolving those gaps
- Reach consensus on the scope of a Sampling and Plan (SAP) to implement characterization strategy
- Scope does not include areas or facilities located inside the fence

Location of EU EU Z2-19

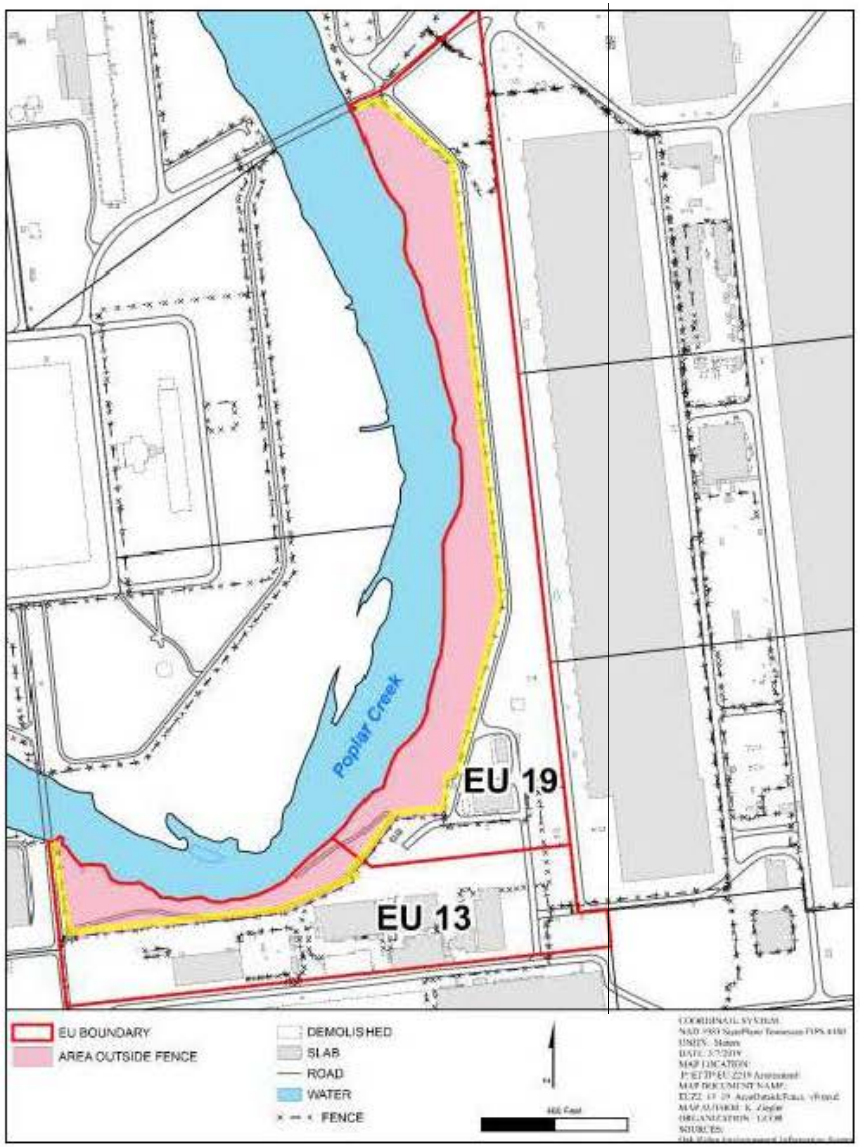


2-6

Area Outside the Fence in EU Z2-19

Areas inside the fence in EU Z2-19 were addressed separately through historical and recent documentation:

- DQO Scoping Package for the Poplar Creek Group (EUs Z2-11, Z2-12 and Z2-19), Apr 2009
- Zone 2 Exposure Unit Z2-19, Radiation Walkover Survey Results and Proposed Path Forward, Aug 2016
- FCN-ETTP-Zone 2-194 for Revisions to the 2009 DQO Scoping Package for EU Z2-19, Nov 2016
- EU Z2-19 Data Quality Assessment and Path Forward, Dec 2017
- FCN-ETTP-Zone 2-225 for EU Z2-19 RA (includes EU Z2-19 Class 1 Soil Unit Technical Memorandum), May 2018



PK for Areas of Potential Concern in EU Z2-19

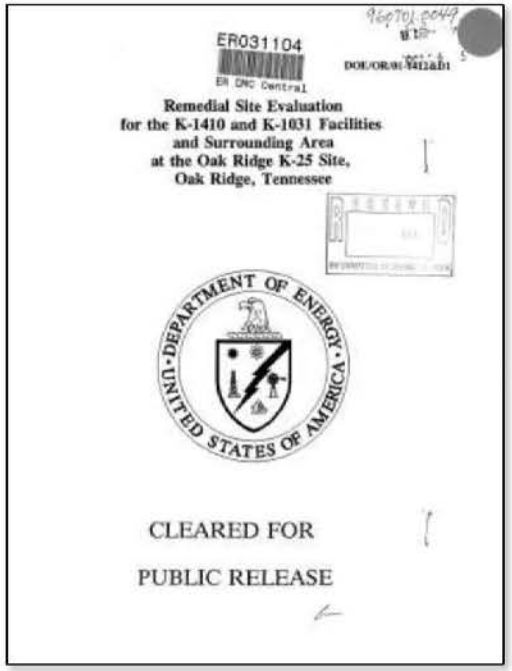
- Building K-1410 Operations and Process Drains
- K-1410-A and K-1410-A Annex
- Outfall 360 Ditch, including Outfalls 360 and 362
- K-1410 Acid Disposal Pit (former Outfall 352)
- Building 1031
- Storm Drain Outfall 350 and K-1031 associated ditche

Outfall 360 Ditch Leading to Poplar Creek

Facilities in EU Z2-19

K-1410 Operations

- K-1410 constructed in 1945; original operations involved storage of clean trapping materials (alumina, carbon, NaF), mixing carbon and cadmium-coated alumina for use in carbon traps
- 1947 -- Began operations to separate carbon from the alumina in spent trapping media for uranium recovery
- 1948 -- Building converted to a cleaning and decontamination facility when use of carbon in cascade traps was discontinued
  - Conversion included installation of 2 spray facilities in west end of building for decontaminating large pieces of equipment
  - Spray facilities included two 8x2x25 stainless steel spray tanks in pits with floor pans to collect spray
  - A degreaser that used tetrachloroethene, carbon tetrachloride and TCE was installed between the 2 pits
- A contaminated material incinerator was constructed on near SW corner of building (*no info on what was burned*)
- Cleaning and decontamination included degreasing in a spray tank with TCE or Freon
  - Also used peroxide solutions, sulfuric acid


ER031104

ER ONC Central

Remedial Site Evaluation
for the K-1410 and K-1031 Facilities
and Surrounding Area
at the Oak Ridge K-25 Site,
Oak Ridge, Tennessee

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

CLEARED FOR

PUBLIC RELEASE

1995 RSE provided detailed historical information

2-10

K-1410 Operations (*cont.*)

- 1953/1954 -- K-1410 was dedicated to decontamination of equipment from K-1131 Feed Manufacturing Plant (FMP), which processed spent reactor fuel from other DOE sites
- During this period, and likely at other times, contaminated process equipment was stored periodically in outdoor areas adjacent to K-1410 (and K-1031)
- One documented episode involved outdoor storage of ash receivers associated with the FMP fluorination towers
  - The ash receivers were staged to allow time for short-lived isotopes to decay
  - Receivers were opened daily for stirring and off-gassing

2-11

K-1410 Operations (*cont.*)

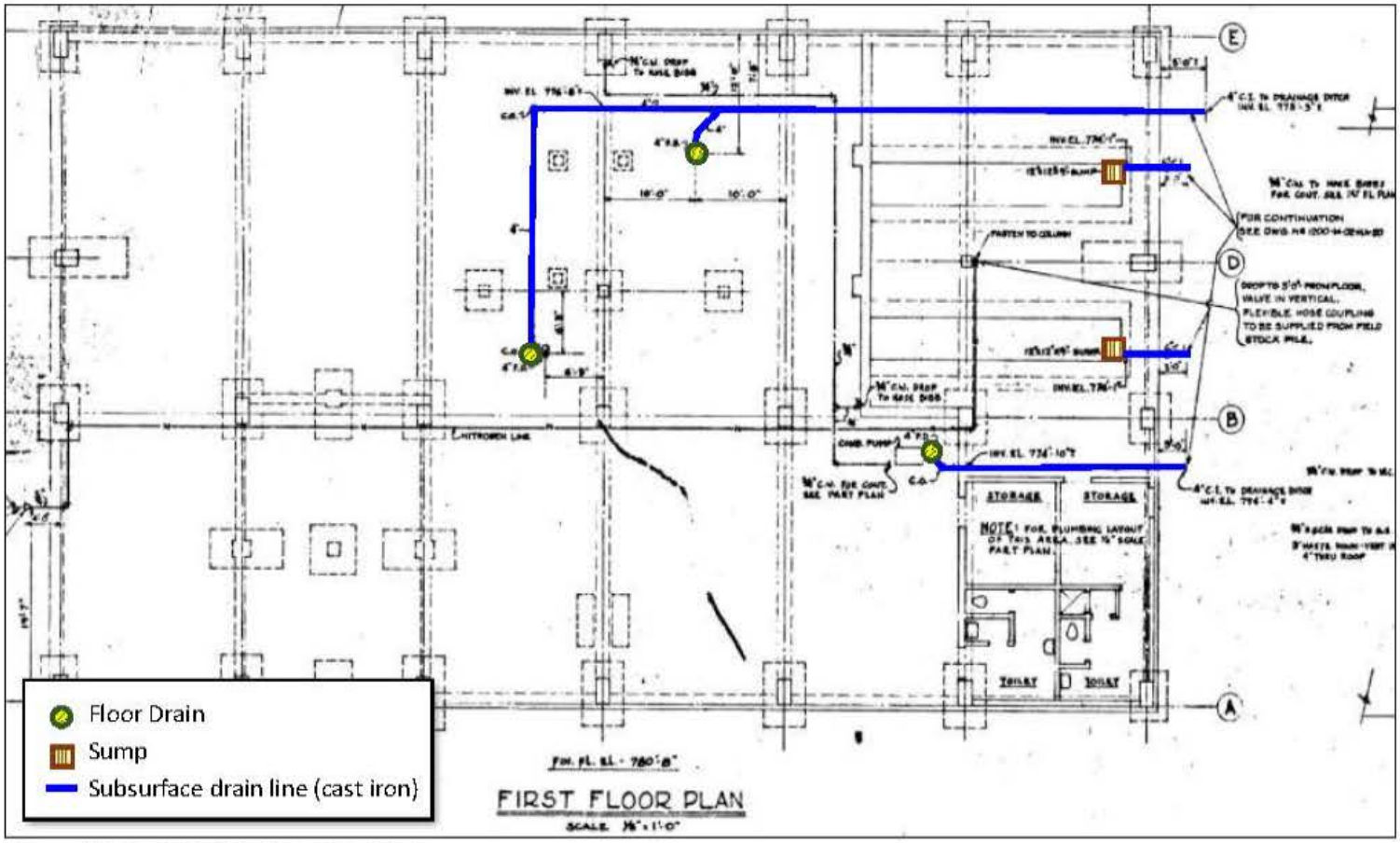
- 1963/1964 -- converted to an electroplating facility
- Conversion entailed filling in the spray pits, installing plating equipment and adding a new degreasing station
- Also constructed a limestone neutralization pile near Poplar Creek to neutralize acid discharges from plating operations
- 1975 a concrete pit (K-1410-B) installed with equipment to allow for neutralization prior to discharge (discharge from the new pit were into the original limestone pile)
- Plating process used hydrochloric acid dips, alkali dips, sulfuric acid dips, and solvents for degreasing
- Electroplating was a solution of nickel sulfate, nickel chloride, boric acid, etc. (*items were nickel plated*)
- Facility was deactivated in 1979
- Demolition occurred in 1999
- K-1410 slab and both neutralization pits remain

K-1410 Drain Lines

- Floor drains inside K-1410 tied into a drain line that terminated at what was later designated Outfall 360
- K-1410 discharges through this line began in 1945 and continued from the mid-1960's
- Historical records indicate decontamination solutions containing uranium, acids solutions, spent solvents and other materials were discharged into the floor drains during this period of time
- Upon conversion to a plating facility in the mid-1960's, the floor drains and other discharges were routed to the neutralization pits
- Floor drain discharges from K-1410 comprise one of the primary sources of contamination detected in the Outfall 360 ditch


Looking west across K-1410 Slab toward Outfall 360.

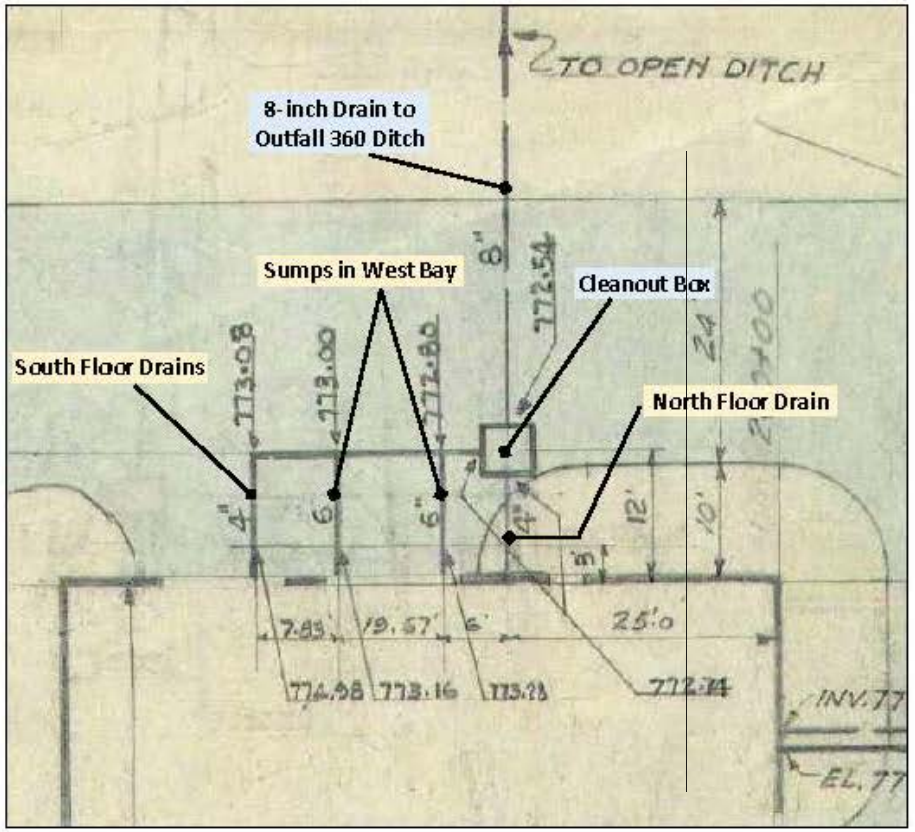
K-1410 Drain Lines Leading to Outfall 360



Source: Kellex Dwg 1410X-K30-GA, Rev. 4. March 1945

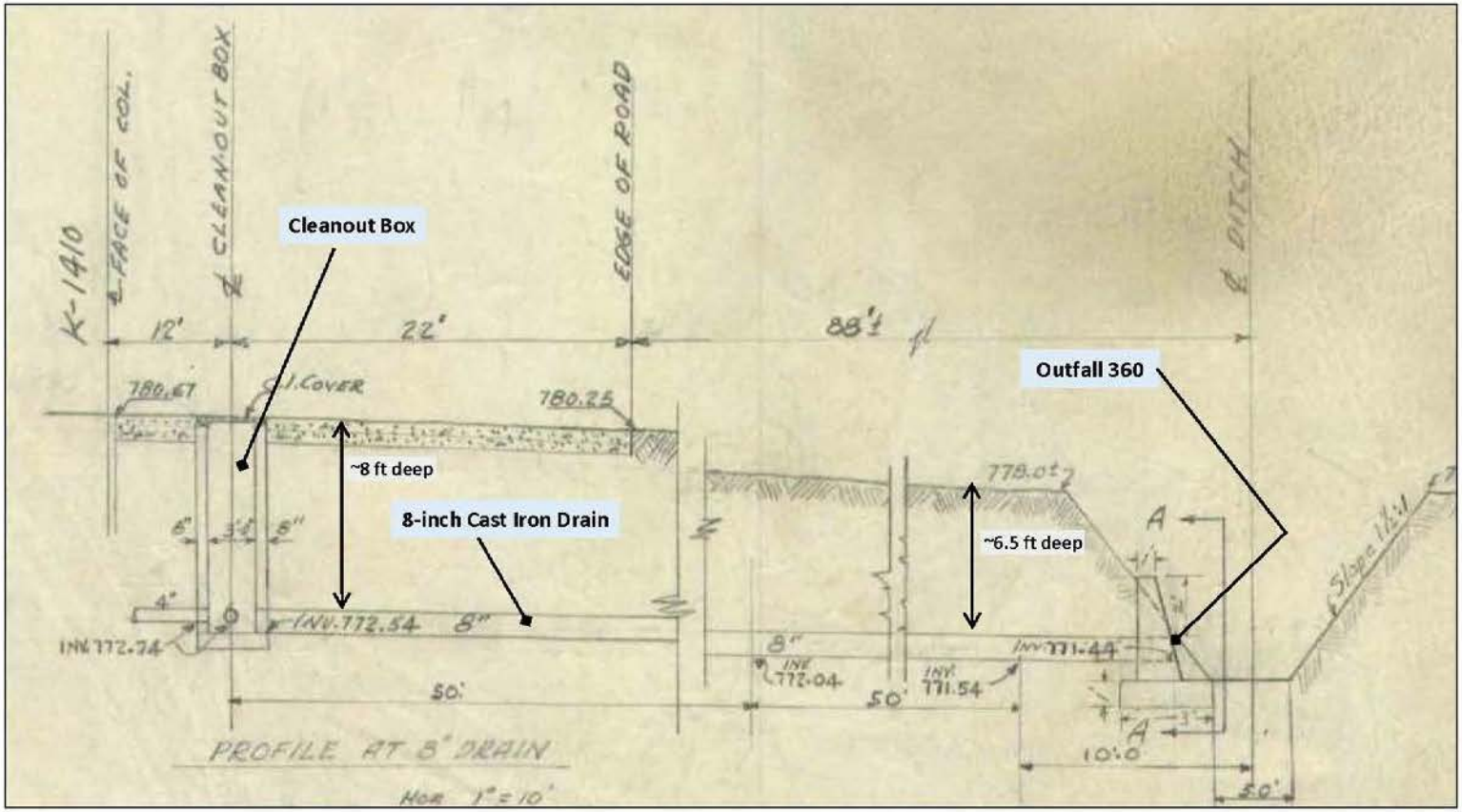
K-1410 Drain Lines Leading to Outfall 360 (*cont.*)

- Floor drains and sumps connected to 4" and 6" cast iron pipes beneath slab
- Drain pipes were 6 – 8 ft below top of slab (780.7 ft MSL)
- Connected to 8 ft deep cleanout box (manhole) that was 12 ft west of slab
- 8-inch cast iron drain line led to the Outfall 360/362 ditch.



Source: Kellex Dwg 1200-M-02-HA-20 Rev.5, Dec 1945 (As-Built)

Profile View of K-1410 Process Drain to Outfall 360



Source: Kellex Dwg 1200-M-02-HA-20 Rev.5, Dec 1945 (As-Built)

K-1410 COCs

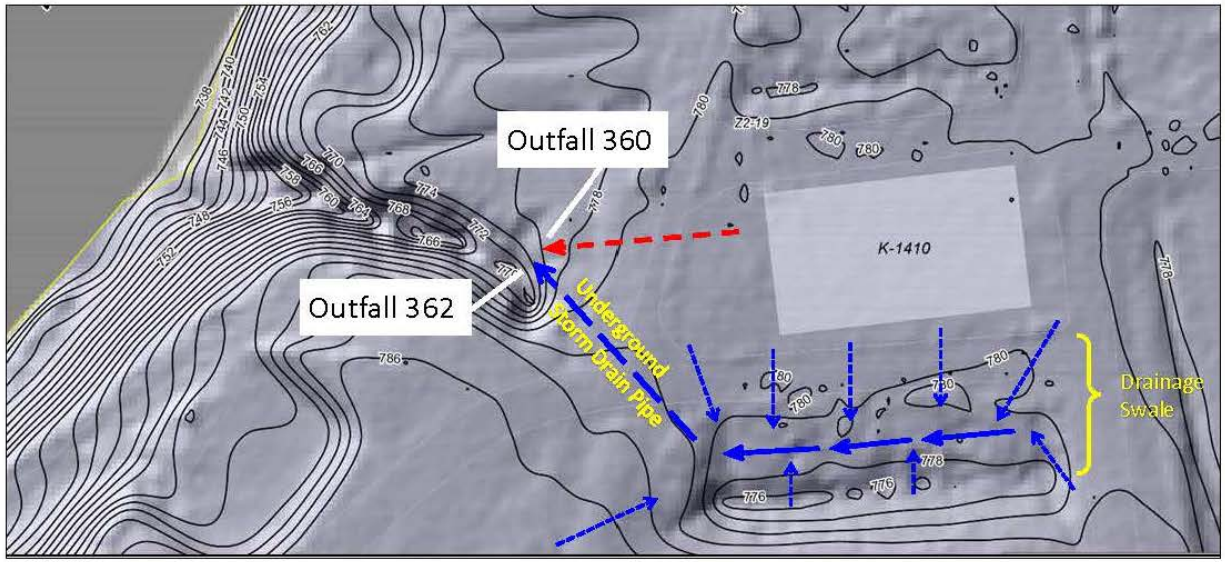
COCs varied during different operational phases:

- 1945 - 1947 trap media operations: uranium, cadmium and other metals
  - Decontamination experiments during this period of operation reportedly sent waste solutions with peroxides, hydroxides, sulfuric acid, nitric acid down the floor drains
- 1948 – 1962 operation as decontamination facility: UF6 and other uranium compounds, Freon, TCE and other chlorinated solvents), acids, metals, Cs-137, Tc-99, transuranics
- 1963 -1979 plating operations: acids and caustic solutions, nickel and other metals, TCE and other solvents, possibly PCBs

2-17

Storm Drain Outfall 362

- Drainage swale south of K-1410 conveys surface runoff and storm flow to Outfall 362, adjacent to Outfall 360 (process drain from K-1410)
- Surface and near surface soils between the swale and K-1410 shown to be contaminated with U and other radionuclides
- Source of this contamination may be related to the outdoor storage of process equipment
- Outfall 360 and 362 are authorized to discharge storm water runoff under NPDES Permit TN0002950.



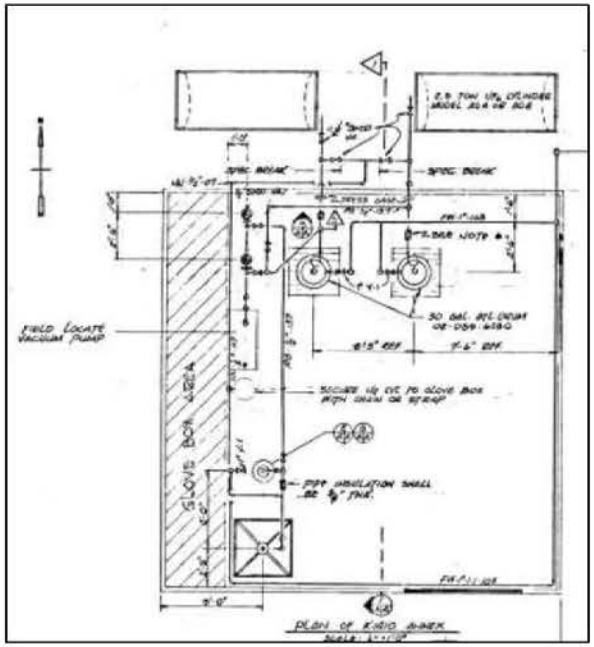
K-1410-A and Annex

K-1410-A Sand Blasting Shop constructed in mid-1950s immediately west of K-1410

- Used to decontaminate "heavily encrusted" K-1131 equipment
- Glove boxes were installed for protection during sand blasting
- COCs would be uranium and other radionuclides, metals, PCBs

In 1974, K-1410-A was modified for a UF_6 transfer and "burping" station (K-1410-A Annex)

- Cylinders were "burped" if contents were above atmospheric pressure
- Offgases (*from the burping*) were a mixture of N, O, H, Fl^-, F_2 and Freon
- Cylinders were heated to evacuate contents to a receiver cylinder, which were immersed in slush baths (Freon or TCE + dry ice)
- No operational information, other than ~30 cylinders were processed at this facility
- COCs include uranium, Fl^-, chlorinated VOCs
- Runoff of contaminated water and sediment would be toward drainage swale to south and Outfall 362

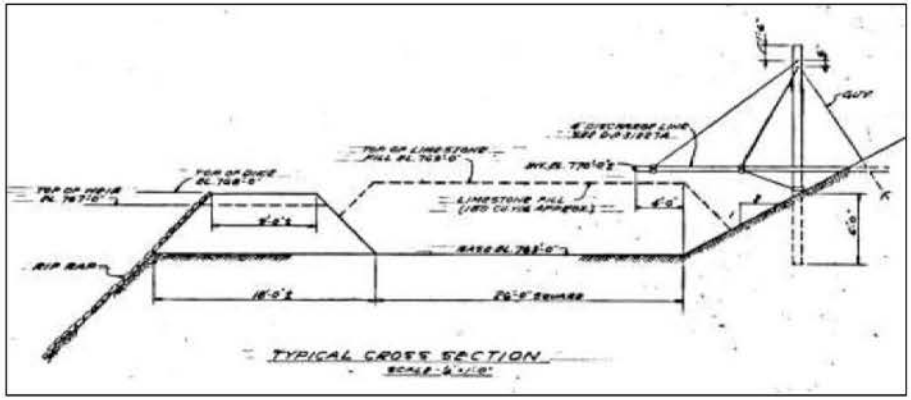


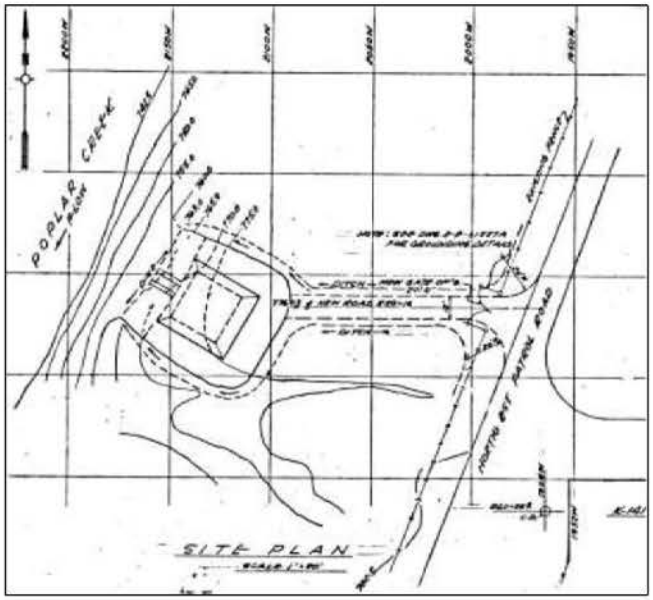
2-19

K-1410 Limestone Acid Disposal Pit

- Constructed in 1964 +/-
- Designed to treat corrosive plating waste from K-1410
- Connected to K-1410 via underground, 4" vitrified clay pipe
- 26 ft x 26 ft diked area filled with limestone gravel
- Discharge through a rip-rap lined weir to rip-rap-covered slope down to Poplar Creek
- Discharge of liquid wastes may have percolated to underlying soils in addition to flowing down slope to creek

The pipe was previously identified as Outfall 352, but was plugged in the late 1990's and was identified in the 1997 permit renewal as "sealed and no longer requiring permitting".





Source: UCC Dwg E-S-31227B Rev0, Dec 1965

2-20

K-1410 Acid Disposal Pit (Feb 2019)

K-1031 Maintenance Support Building

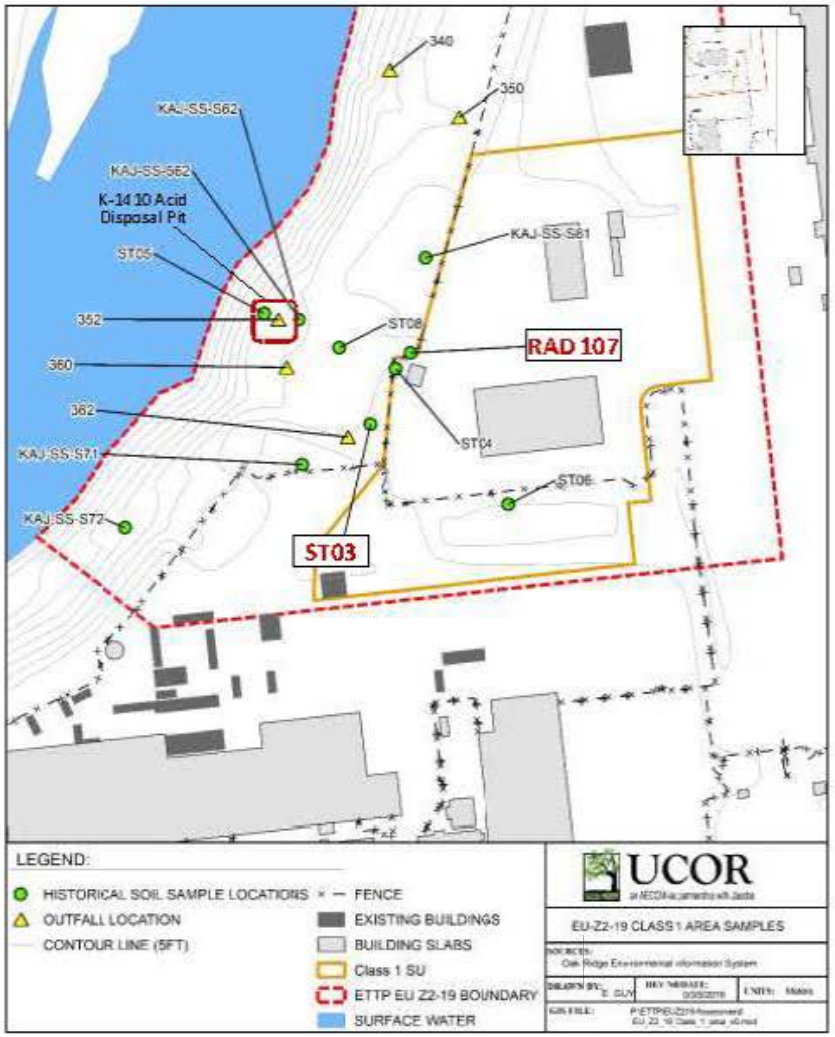
- Constructed in 1945 as maintenance support facility for K-25
- Used to store and dispense trapping media for spent cascade traps
- Later used as a cutting area for size reduction of process equipment removed from the Fercleve Thermal Diffusion Plant
- Early 1960s used for paint storage/mixing, storage of equipment and materials
- Demolished in 1999
- COCs include Cd and uranium from spent cascade traps

K-1031 Maintenance Support Building (cont.)

- Adjacent surface soils contaminated with uranium, fission products (Cs-137) and transuranics due to outdoor storage of K-1131 ash receivers
- Drainage swales north and south of K-1031 are Soil CAs
  - Potential sources of contaminated runoff/sediment via storm flow toward Poplar Creek (Outfall 350 North of K-1031 and ditch south of K-1031)

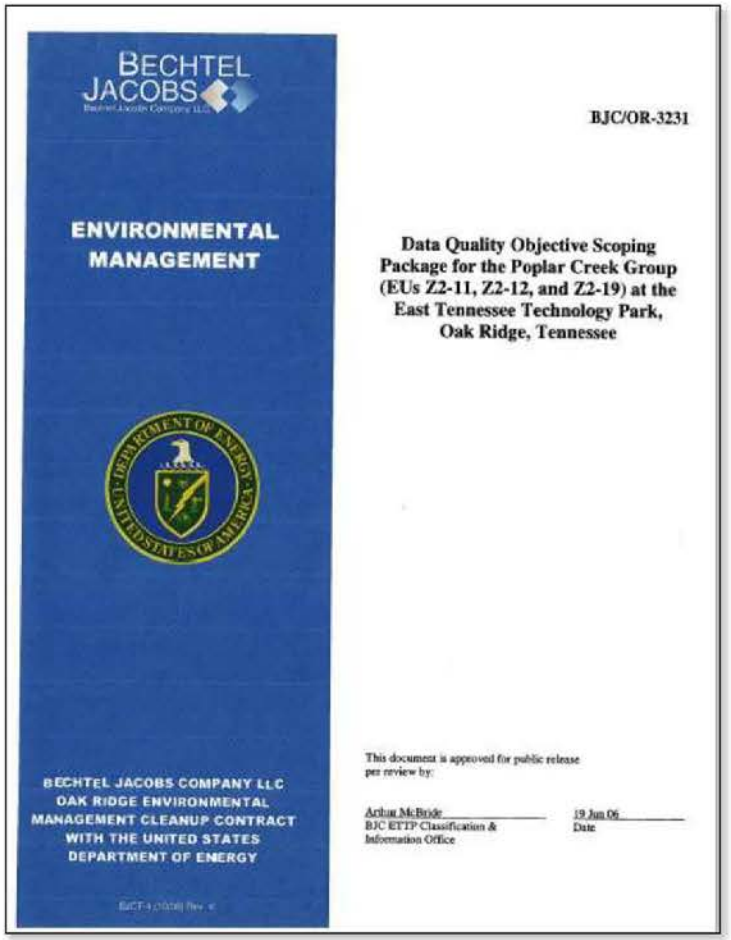
EU Z2-19 Historical Sampling Locations

- 12 soil samples collected 1994 - 95
- 8 surface soil (0-6 inch) samples, one from 0-2 ft, and 3 locations with subsurface soil to 9 ft
- Sample RAD107 (0-6 inches) from ditch south of K-1031 had U and other radionuclides, including Cs-137 and Ra/Th, above the average RL
  - Source of contamination is likely surface runoff from drainage between K-1410 and K-1034
- Soil boring (ST03) east of the Outfall 360 ditch did not detect any contamination (one sample from 6-8 ft)
- Surface/near surface soil samples (0-6 inch and 0-2 ft) at the K-1410 acid disposal pit did not identify any contamination issues



EU Z2-19 DQO Scoping Package

- Poplar Creek DQO Scoping Package issued in 2009
- Identified a Class 1 Soil Unit surrounding K-1410 and K-1031
- Designated the area outside the fence as a Class 3 Soil Unit
  - Proposed a walkover assessment based on a random grid of assessment points, with biased sampling if necessary
- DQO did not identify the need to evaluate the Outfall 360 ditch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ENVIRONMENTAL MANAGEMENT

Data Quality Objective Scoping Package for the Poplar Creek Group (EUs Z2-11, Z2-12, and Z2-19) at the East Tennessee Technology Park, Oak Ridge, Tennessee

BECHTEL JACOBS COMPANY LLC
OAK RIDGE ENVIRONMENTAL MANAGEMENT CLEANUP CONTRACT
WITH THE UNITED STATES DEPARTMENT OF ENERGY

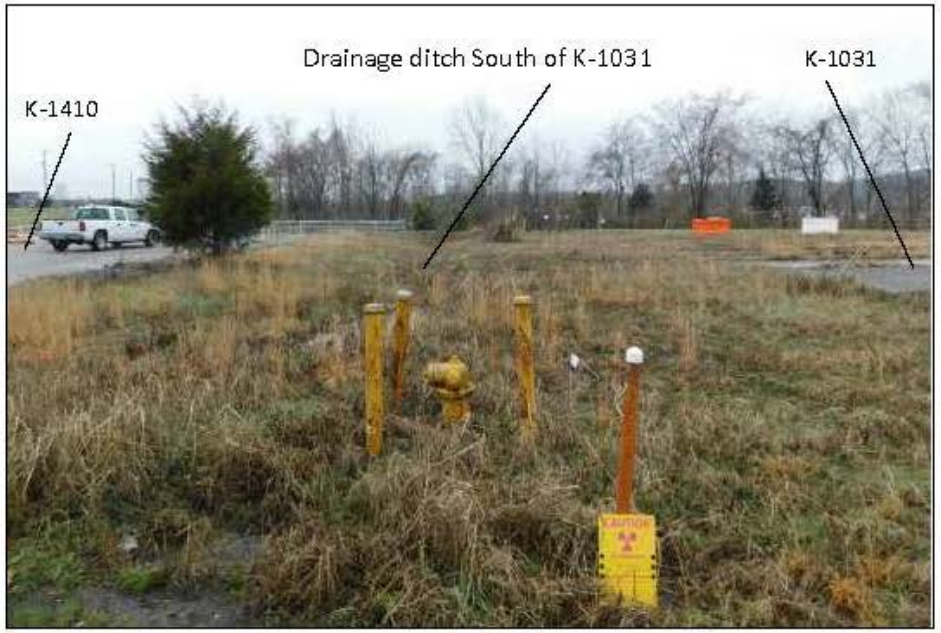
This document is approved for public release per review by:

Arthur McBride — 19 Jun 06
BJC ETTP Classification & Information Office — Date

2-25

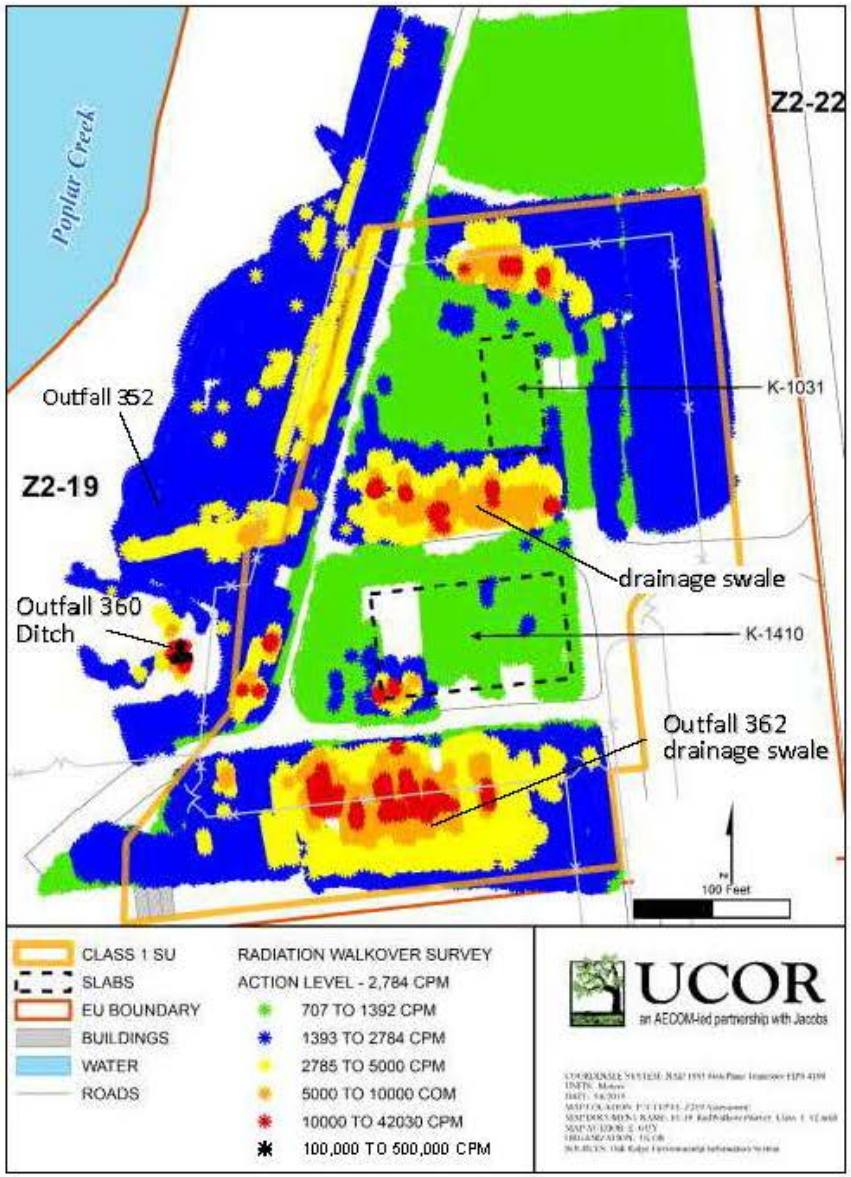
Characterization of Class 1 Soil Unit

- Implementation of the 2009 DQOs focused on Class I Soil Unit (SU)
  - Initial characterization activities were completed in 2016
- Follow-on sampling was done in 2017 and 2018 to support delineation of the RA and waste disposition
- Majority of the sampling focused on the Class 1 SU but included limited sampling outside the fence



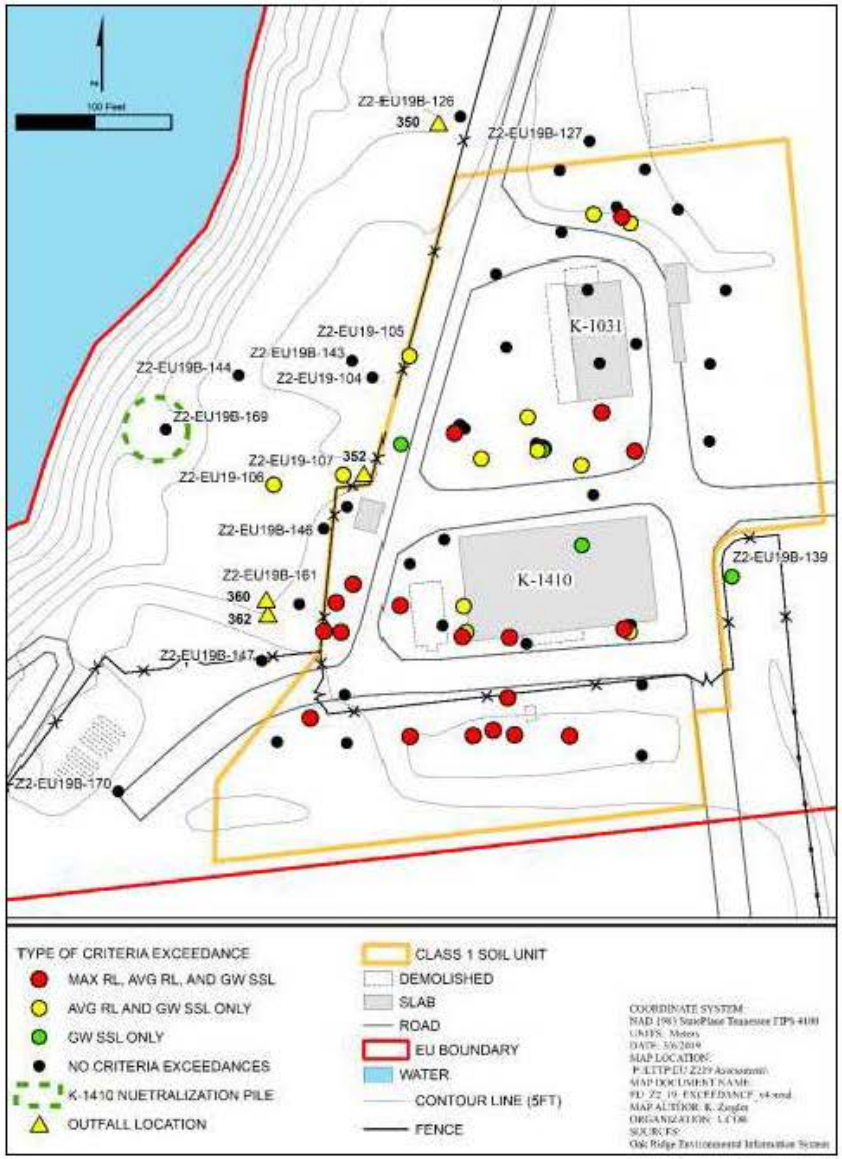
EU Z2-19 Rad Walkover Surveys

- Background radioactivity ranges from ~700 to ~1,400 counts per minute (CPM)
- The Yellow shaded areas represent more than twice the background
- Orange and red identify higher levels of radioactivity, with red areas essentially hot spots
- Black areas within the Outfall 360 ditch are associated with levels up to 500,000 CPM
- Highest readings were taken directly below the K-1410 drain line (Outfall 360)



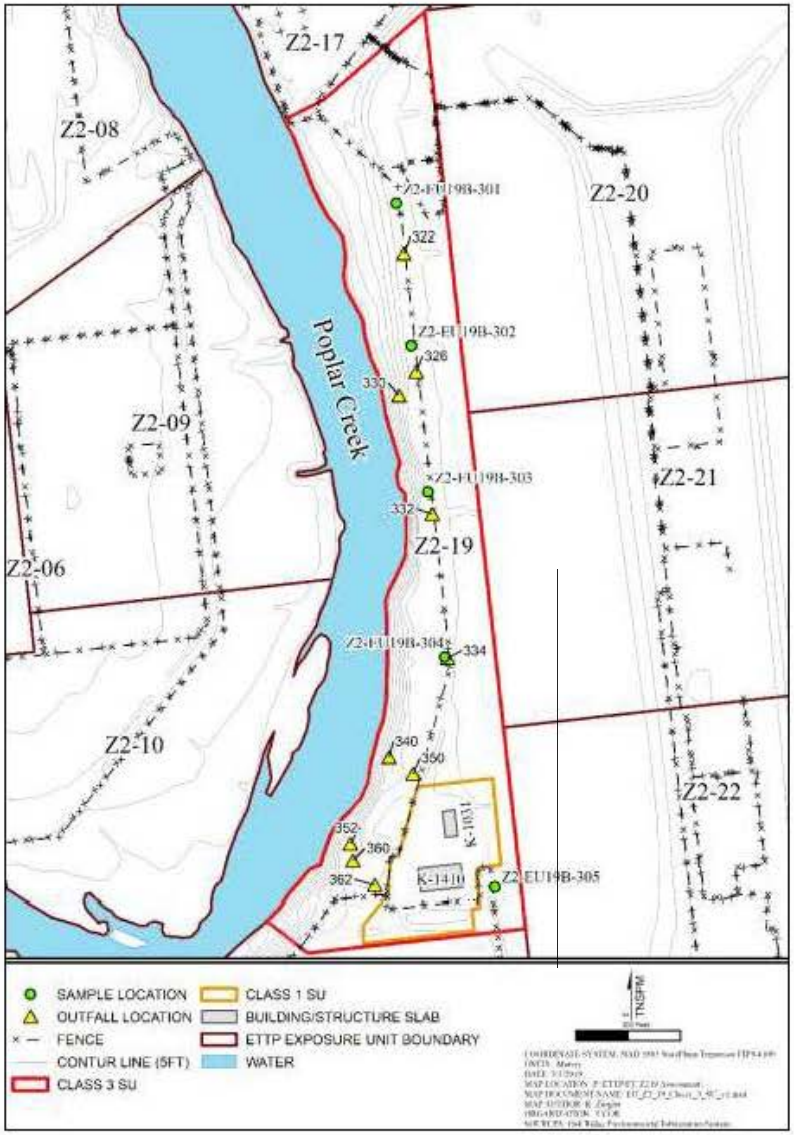
Class 1 Sampling Results

- SVOCs – typical runoff from asphalt paving and roadways
- Metals – generally elevated in drainages leading away from 1031 and 1410, no exceedances of RLs
- PCBs – no results above average RL but detected in soil at 4 locations, mostly in upper 1 -2 ft of soil
- Rad –Drainage swale south of K-1031 had U-238,
  U-235, Ra/Th decay series, and Cs-137 above Avg RLs
  - Portion of the drainage swale south of K-1031 included with Class 1 SU excavation
- Shallow (0-6", 6"-24") soil samples from B-161 near Outfall 360 headwall did not identify any rad contamination
- Overall conclusion from limited scope of evaluation: storm water runoff was (is) an active migration pathway for contaminants from the Class 1 area



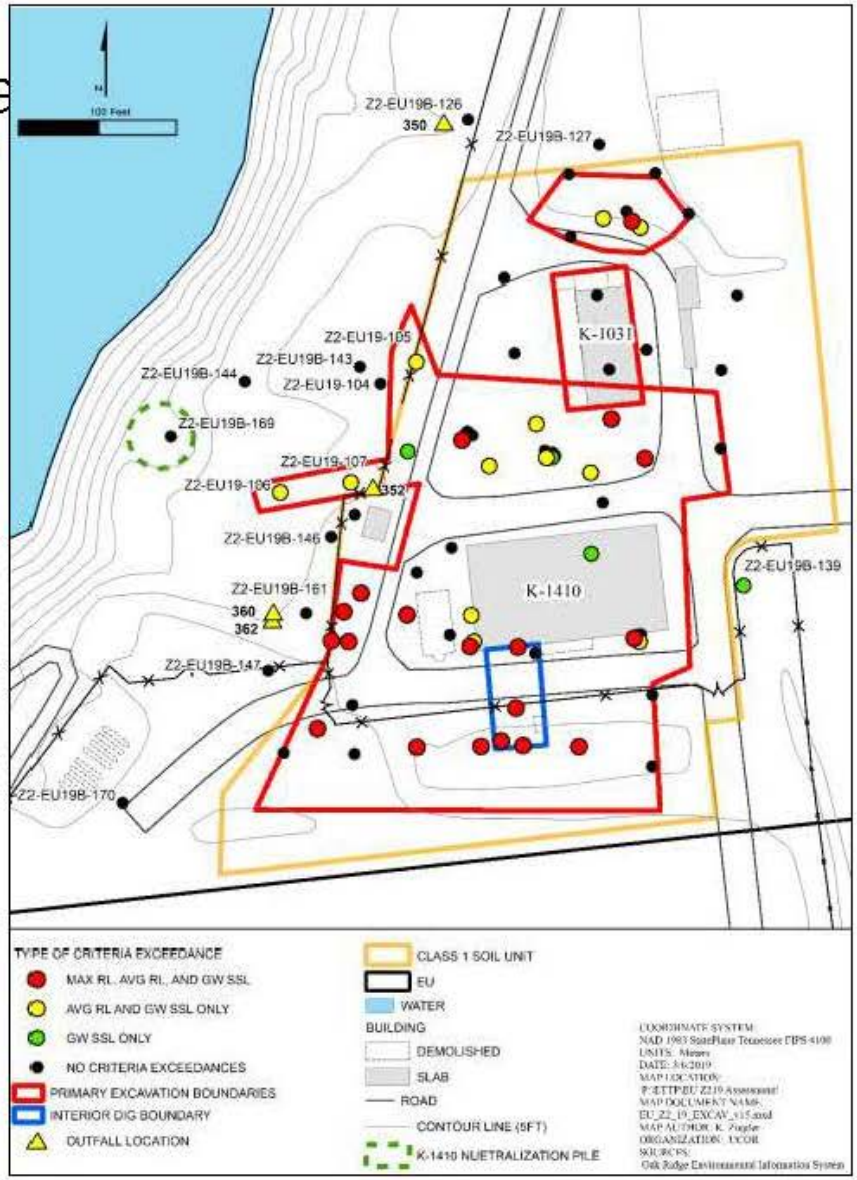
EU Z2-19 Utility Corridor Samples

- B-301, -302, -303, -304 taken near storm drain outfalls along Poplar Creek north of K-1031 in March 2017
- All locations were 10 ft borings with 3 interval composite sample from 0-0.5, 0.5-2, and a 1.5 ft section from the 2-10 ft interval
- Analyzed for metals, PCBs, Rad, SVOCs
- No exceedances of RLs or otherwise noteworthy evidence of impact
- Land uses in this area have been minimal and the most likely sources of contamination would be overland flow (runoff, erosion/deposition) from storm water
- Due to this area not being industrialized, and the investigation prescribed by DVS not identifying any Zone 2 criteria exceedances, further evaluation of the area north of the Class 1 area is not needed



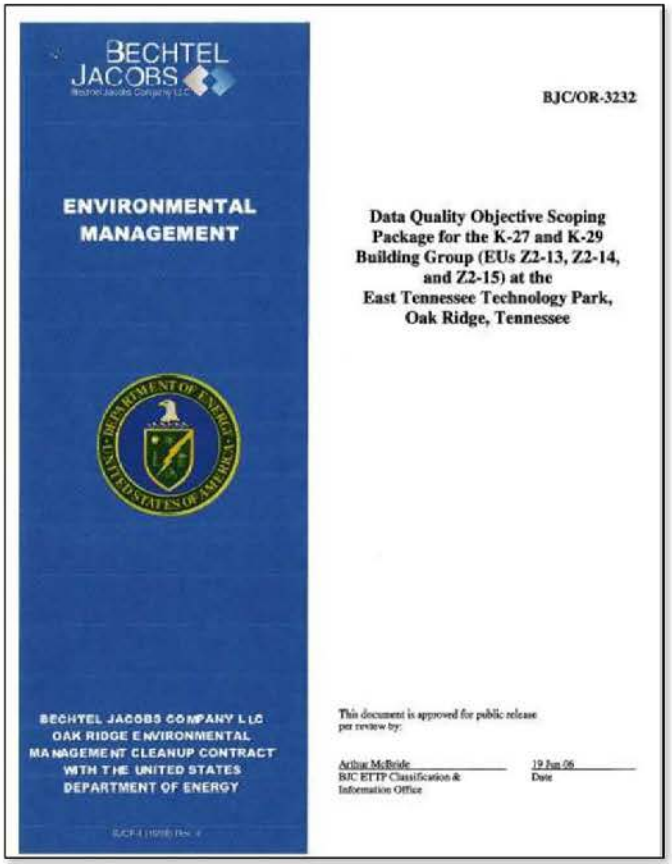
EU Z2-19 RA (Class 1 Area

- EU Z2-19 Data Quality Assessment for Class 1 SU presented to EPA and TDEC in April of 2018
  - RA described in Concurrence Form FCN-ETTP-Zone 2-225, approved by TDEC and EPA in May of 2018
  - Recommended a remedial action (excavation) of a large part of the Class 1 SU
  - Included a Technical Memorandum for the Class 1 SU
- A small portion of the planned excavation extends westward beyond the fence – associated with drainage swale south of K-1031



~~EU 13 DQO~~

- ~~K-27 and K-29 Building Group DQO Scoping Package issued in 2009~~
- ~~Identified the entire creek bank area as a Class I Soil Unit~~
- ~~Proposed a confirmation sample (0-1 ft) at location of max RL exceedance~~
- ~~Proposed additional rad walkover surveys at both historical sampling locations and all other accessible areas~~
  - ~~Grid sampling of surface soils would be developed on the basis of rad surveys~~
  - ~~20% of locations would be 10 ft borings with a 3 interval composite sample~~
- ~~DQOs issued prior to discovery of uranium hot spot at utility pole (location B112)~~



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ENVIRONMENTAL MANAGEMENT

Data Quality Objective Scoping Package for the K-27 and K-29 Building Group (EUs Z2-13, Z2-14, and Z2-15) at the East Tennessee Technology Park, Oak Ridge, Tennessee

BECHTEL JACOBS COMPANY LLC
OAK RIDGE ENVIRONMENTAL MANAGEMENT CLEANUP CONTRACT
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Arthur McBride — BJC ETTP Classification & Information Office — 19 Jun 06 — Date

2-31

Conceptual Site Model

Primary Sources	Facilities	Primary COCs	Secondary Sources	Release Mechanism	Migration Pathways
Historical operations: Decontamination & degreasing, plating, UF_6 processing	K-1410	• U-234, -235, -238 • Tc-99 & other fission products • TCE & other VOCs	• Process drains • Storm drains & catch basins • Contaminated soil	• Discharge onto creek bank • Ventilation hoods • Spills, Leaks • Demolition & downsizing	• Surface run-off • Erosion • Air dispersion • Downward percolation to GW
Outdoor storage of process equipment	K-1410 K-1031	• U-234, -235, -238 • Tc-99 & other fission products • Transuranics • Fluorides	• Contaminated soil • Sediment accumulation areas • Storm drains & catchbasins	• Spills, Leaks • Contact with rain • Routine discharges	• Surface run-off • Erosion • Air dispersion
Acid neutralization piles	K-1410	• Uranium • Metals • Acid residues • Fluorides	• Contaminated soil • Sediment accumulation areas	• Routine discharges • Leaching from rainfall	• Surface run-off • Erosion • Downward percolation to GW

- Principal contamination issue is likely to be discharge or leaks/spills of wastes along with runoff and erosion/deposition of contamination, with the likely impacts (due to topography) limited to surface soils
- Areas of waste discharge (Process Drain piping, drainage swales, and outfalls, K-1410 Neutralization Piles) also may be associated with subsurface soil contamination due to downward percolation of waste liquids and contaminated precipitation liquids

Revised/Updated DQOs for EU Z2-~~13/~~19 Creek Bank

Step 1: State the Problem

Former facility operations within EU Z2-19 may have released Zone 2 COCs that could contribute to contamination of soil with the potential to impact surface water and sediment in Poplar Creek as well as future reuse of the site. The potential for contamination of underlying groundwater is also a concern.

The 2009 DQOs did not effectively address all potential contamination issues in those portions of EU Z2-19 that border Poplar Creek. These areas will be the focus of the DQO characterization activities.

Step 2: Identify the decisions:

1. Determine whether soil, accumulated sediment (in drainage ditches) or subsurface structures are contaminated above Zone 2 ROD remediation levels for the protection of human health.
2. Determine whether sources for actual or potential surface water or groundwater contamination are present in soils, subsurface structures or related media.
3. Define the boundaries for excavation or removal as part of any required remedial action.
4. Generate sufficient data to support a final no further action decision for the EU (after any required remedial actions).

DQO Planning (*cont.*)

Step 3 – Inputs to the decision

1. Concentrations of contaminants in soil, concrete and related media compared to average and maximum remediation levels (RLs) from the Zone 2 ROD
2. Concentrations of contaminants in soil, concrete and related media compared to established risk criteria (e.g., PRGs)
3. Concentrations of contaminants in soil, accumulated sediment and related media compared to soil screening levels (SSLs) for the protection of groundwater as defined by the Zone 2 ROD
4. Horizontal and vertical extent of impacted soils that need to be removed based on No. 1 and No. 2 above.
5. Contemporaneous groundwater quality and water level data necessary to accurately evaluate No. 3 above.

Step 4 – Study Boundary

Portions of EU Z2-19 outside (west) of the security fence, as shown in previous slides, including surface soil, accumulated sediment, man-made features, and associated subsurface soils down to the depth of the water table or top of bedrock

DQO Planning (*cont.*)

Step 5 – Decision Rules

1. If soil concentrations for Zone 2 COCs are greater than maximum RLs, conduct a remedial action until concentrations are below maximum RLs
2. If soil concentrations for Zone 2 COCs are greater than average RLs, conduct a remedial action until concentrations across the entire EU are below average RLs
3. If soil concentrations exceed established risk criteria (PRGs), calculate the aggregate risk to human health; if the risk exceeds Zone 2 ROD criteria ($>10^{-4}$ or HI > 1), conduct a remedial action until Zone 2 ROD risk criteria are met
4. If soil concentrations exceed SSLs for protection of groundwater, conduct a remedial action until concentrations are below SSLs
5. If soil concentrations are below RLs, SSLs, and risk-based criteria, no further action is required.

Step 6 – Limits on Decision Error

The potential for decision error is minimized through collection of more than the minimum required data. This translates into more sampling locations, more discrete samples collected at each location, and expanded analyses to investigation all potential contaminants

Uncertainty is also minimized through compliance with the Zone 2 QAPP (Appendix A of the Zone 2 RDR/RAWP).

DQO Planning (*cont.*)

Step 7 – Optimize Sample Design

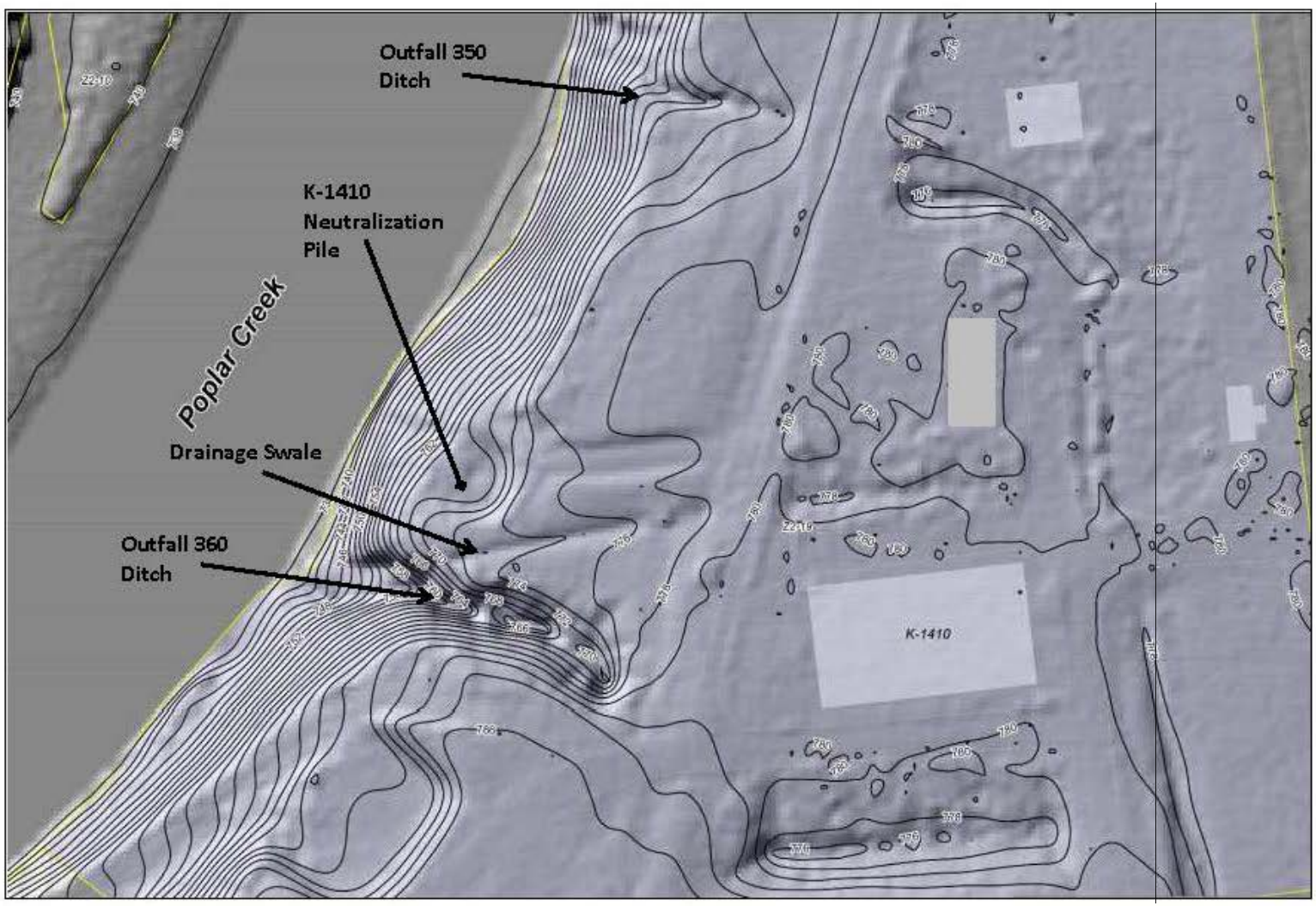
Proposed sampling scheme integrates the CSM with DQO requirements to support decisions on the following:

1. The need for and extent of any required remedial actions
2. Final status determination of No Further Action for both EUs, following completion of any required remedial actions.

Characterization Objectives for EU Z2-19 Creek Bank

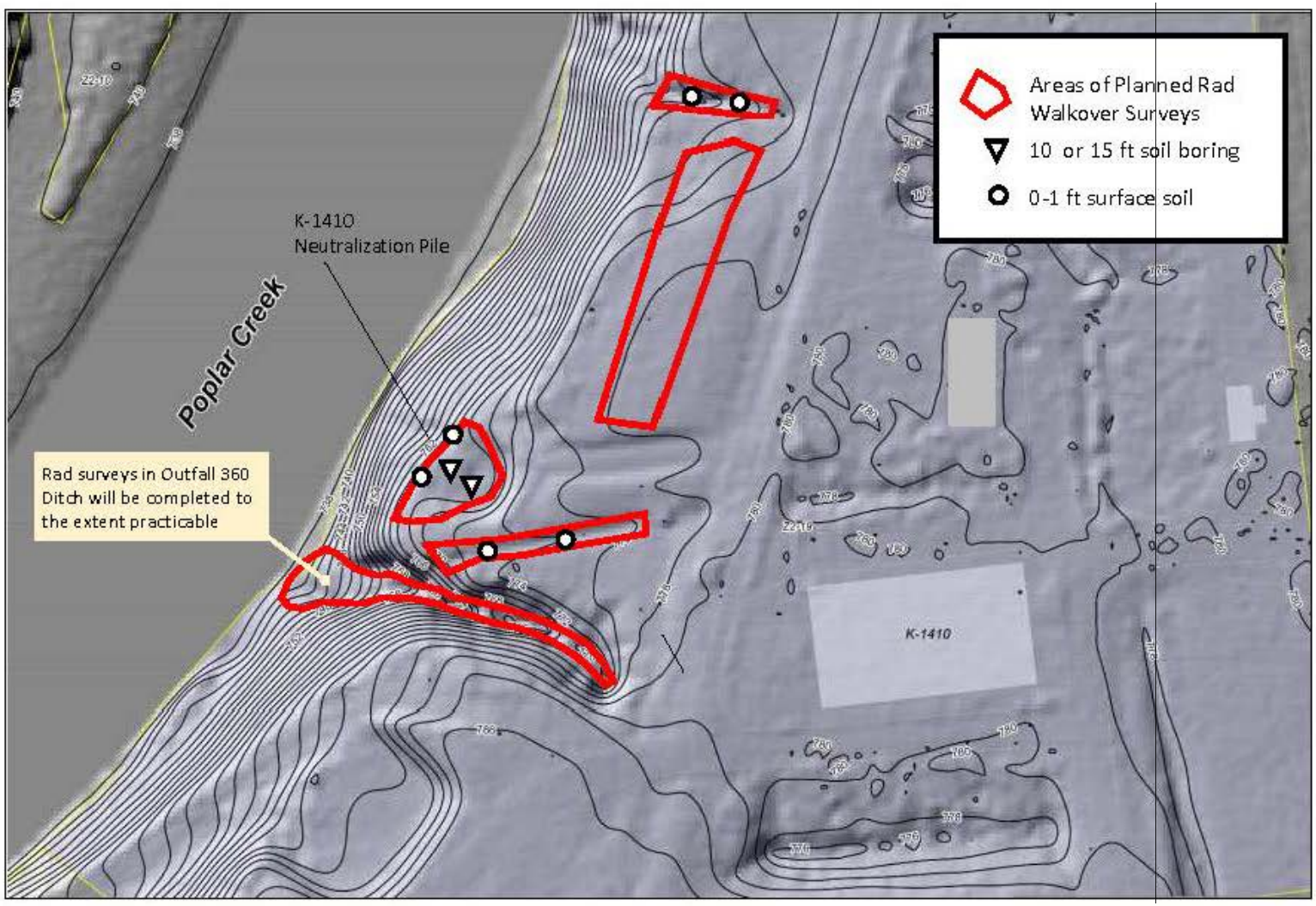
- Determine nature/extent of surficial contamination related to historic waste discharges in the Outfall 360 Ditch
  - Conduct rad walkover surveys in accessible portions of ditch, focusing on areas potentially impacted by retention of contaminated sediment
  - Biased sampling of accumulated sediment or surface soils (0-1 ft) based on rad survey results and/or field observations
- Determine whether downward percolation of liquid wastes discharged at Outfall 360 have impacted subsurface soils
  - Biased soil borings (15 ft) adjacent to drain lines leading to Outfall 360 and 362
- Investigate the presence of surface contamination in drainage ditches associated with outfalls downstream of known contamination areas
  - Conduct rad walkover surveys in accessible portions of ditch south of K-1031 (*downstream of area included with RA*) and Outfall 350 ditch
  - Biased surface soil samples (0-1 ft) based on rad survey or field observations
- Determine whether historical waste discharges and subsequent runoff or percolation have impacted subsurface soils at the K-1410 Neutralization pile
  - Biased soil borings (15 ft) within the former limits of the pile
  - Biased surface soil samples downstream of the pile

Surface Topography Along Poplar Creek in EU Z2-19



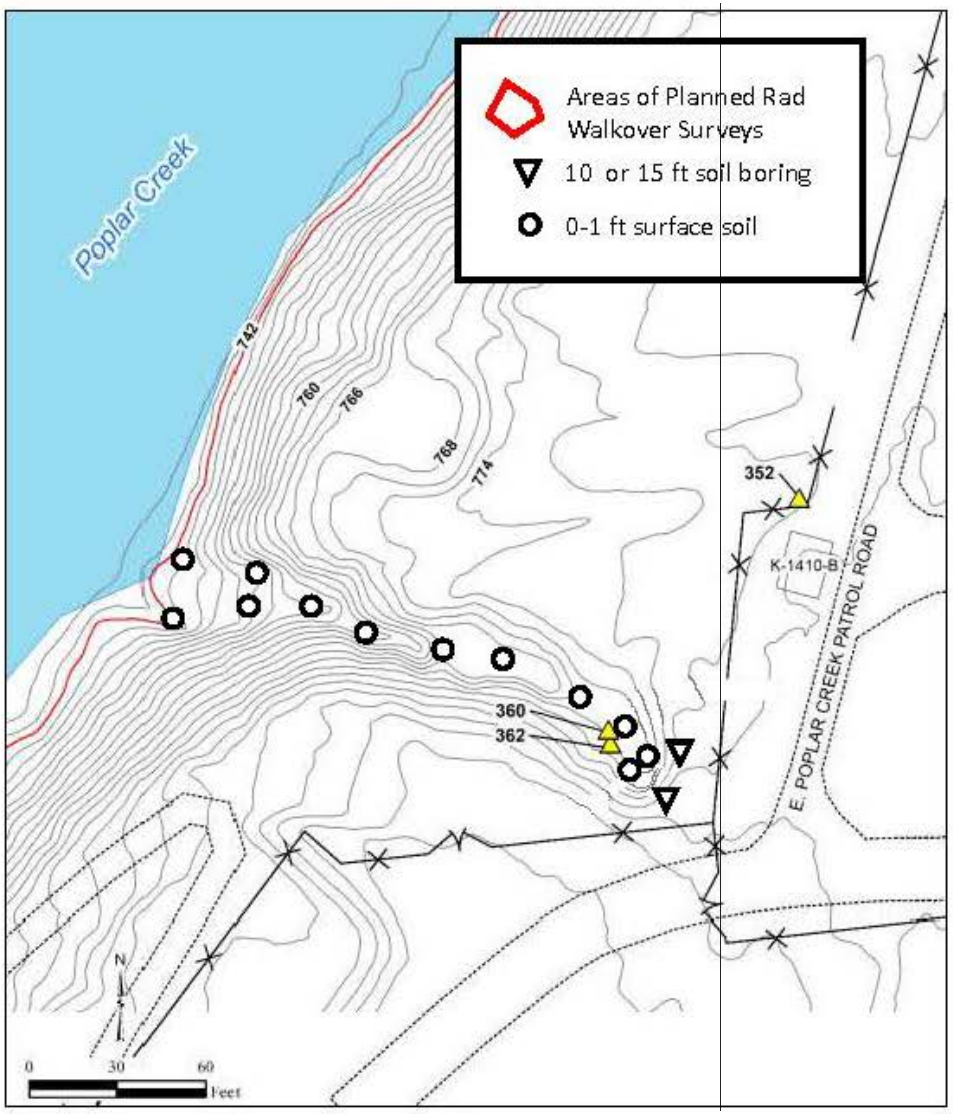
EU Z2-19 Outside the Fence Sampling

Proposed Surveys and Sampling in EU Z2-19



Proposed Sampling in Outfall 360 Ditch

- Number and exact locations of samples will depend on the accessibility of ditch segments for sampling
- 15 locations assumed
- Depth of soil or sediment is expected to be variable
  - Bedrock is exposed in much of lower reaches of ditch
- Soil borings will be located near drain lines leading to outfalls from K-413 and K-1410
- Three locations will be sediment samples in the flood plain [the area between summer (741 msl) and winter pool (736 msl)].



Soil Sampling Summary Table – EU Z2-19

EU Z2-19	Plan	Depth	Samples/ Location	Planned Analyses: Interval (ft)	U-iso	Ra/Th	Tc-99	Cs-137	Metals	VOCs	PCBs	Fl-
Surface Soils												
Outfall 360 Ditch	12	0-1 ft	1	0-1	√	√	√		√		√	
K1410 NP Drainage	2	0-1 ft	1	0-1	√				√			√
Outfall 350/drainage swale S of K-1031	4	0-1 ft	1	0-1	√	√	√	√	√		√	
Sediment samples in flood plain	3	0-2 ft	2	0-2	√	√	√	√	√		√	
TBD Locations	4	0-1 ft	1	0-1	√				√		√	
Subtotal	*25*	--	--	--	*28*	*22*	*22*	*10*	*28*	*0*	*26*	*2*
Soil Borings												
Outfall 360 Drains	2	0-15 ft	5	0, 2	√	√	√	√	√		√	
				5, 10, 15	√		√		√	√		
K-1410 NP	2	0-15 ft	5	0, 2	√				√			√
				5, 10, 15	√				√			
TBD Locations	1	0-15 ft	5	0, 2	√			√	√		√	
TBD = To Be Determined NP = Neutralization Pile				5, 10, 15	√				√	√		
Subtotal	*5*	--	--	--	*25*	*4*	*10*	*6*	*25*	*9*	*5*	*4*

Path Forward

- Incorporate comments or changes into DQO after EPA and TDEC review
  - Submit revised DQO for approval by EPA and TDEC
- Develop Sampling and Analysis Plan to document DQO results
  - Submit SAP for approval by EPA and TDEC
- Implement field sampling and analysis activities
- Evaluate results and present recommendations in Data Quality Assessment (DQA) with EPA and TDEC

Looking East into Outfall 360 Ditch from Poplar Creek

Attachments

1. Historical data (*from OREIS*)
2. DVS data to date (*from PEMS*)

Note: Due to file sizes, attachments to be provided separately.

ATTACHMENT 3:
EU-19 TM SAMPLE SUMMARY TABLE

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Date sampled	Sample location	Coordinates[a]		Sample Interval	Off-site laboratory analyses							Comments and notes
		X	Y		Metals	TCLP Metals	PCB	RAD	TCLP SVOC	SVOC	VOC	
		Dig 2 Expansion Sample Locations										
4/17/19	Z2-EU19B-601	744565.1	178639.8	0-1 ft	1		1	1				
4/17/19	Z2-EU19B-602	744569.4	178641.2	0-1 ft	1		1	1				
4/17/19	Z2-EU19B-603	744570.3	178643.9	0-0.5 ft	1		1	1				
4/17/19	Z2-EU19B-604	744568.5	178643.2	0-1 ft	1		1	1				
4/17/19	Z2-EU19B-605	744567.2	178645.4	0-1 ft	1		1	1				
4/17/19	Z2-EU19B-606	744565.3	178648.6	0-1 ft	1		1	1				
4/17/19	Z2-EU19B-607	744554.1	178652.0	0-1 ft	1		1	1				
4/17/19	Z2-EU19B-608	744541.2	178653.9	0-0.3 ft	1		1	1				
4/17/19	Z2-EU19B-609	744515.1	178656.6	0-0.5 ft	1		1	1				
9/12/19	Z2-EU19B-610	744511.3	178656.6	0-1 ft	1		1	1		1	1	
9/12/19	Z2-EU19B-611	744513.2	178659.9	0-0.5 ft	1		1	1		1	1	
9/12/19	Z2-EU19B-612	744517.0	178659.9	0-1 ft	1		1	1		1	1	
12/11/19	Z2-EU19B-613	744562	178642	0-15 ft	1		1	1				
12/11/19	Z2-EU19B-614	744571	178635	0-15 ft	1		1	1				
12/12/19	Z2-EU19B-615	744572.3	178645.9	0-10 ft	1		1	1				
12/12/19	Z2-EU19B-616	744566	178650	0-10 ft	1		1	1				
12/12/19	Z2-EU19B-617	744558	178655	0-10 ft	1		1	1				
1/21/20	Z2-EU19B-618	744567.0	178643.1	0-2 ft	1		1	1		1	1	
1/21/20	Z2-EU19B-619	744570.1	178642.6	1.1-2.7 ft	1		1	1		1	1	
1/22/20	Z2-EU19-620	744566.8	178646.1	1-4 ft	1		1	1		1	1	
1/22/20	Z2-EU19-621	744569.0	178645.4	2.5-4 ft	1		1	1		1	1	
1/22/20	Z2-EU19-622	744566.5	178644.3	1-2 ft	1		1	1		1	1	
1/22/20	Z2-EU19-623	744568.3	178646.9	1-4 ft	1		1	1		1	1	
1/22/20	Z2-EU19-624	744567.0	178647.1	1-4 ft	1		1	1		1	1	
1/22/20	Z2-EU19-625	744566.1	178648.6	3-4 ft	1		1	1		1	1	
1/22/20	Z2-EU19B-605	744567.2	178645.4	1-4 ft	1		1	1		1	1	
1/30/20	Z2-EU19B-632	744514.0	178663.41	0-1 ft				1				
1/30/20	Z2-EU19B-633	744513.4	178661.97	0-1 ft				1				
1/30/20	Z2-EU19B-634	744512.7	178660.3	0-1 ft				1				
1/30/20	Z2-EU19B-635	744511.507	178659.0	0-1 ft				1				
1/30/20	Z2-EU19B-636	744510.2	178657.0	0-1 ft				1				
1/30/20	Z2-EU19B-637	744516.3	178662.5	0-1 ft				1				
1/30/20	Z2-EU19B-638	744514.9	178660.6	0-1 ft				1				
1/30/20	Z2-EU19B-639	744513.8	178659.3	0-1 ft				1				
1/30/20	Z2-EU19B-640	744513.2	178658.3	1-2 ft				1				
1/30/20	Z2-EU19B-641	744512.0	178657.1	0-2 ft				1				
1/30/20	Z2-EU19B-642	744511.3	178656.0	0-2 ft				1				
1/30/20	Z2-EU19B-643	744516.4	178664.1	0-2 ft				1				
1/30/20	Z2-EU19B-644	744517.5	178661.6	0-2 ft				1				
1/30/20	Z2-EU19B-645	744516.4	178659.8	0-2 ft				1				
1/30/20	Z2-EU19B-646	744515.1	178658.2	0-2 ft				1				
1/30/20	Z2-EU19B-647	744513.8	178656.8	0-3 ft				1				
1/30/20	Z2-EU19B-648	744512.9	178656.0	0-2 ft				1				
1/30/20	Z2-EU19B-649	744512.1	178654.9	0-2 ft				1				
1/30/20	Z2-EU19B-650	744517.7	178659.9	0-2 ft				1				

Date sampled	Sample location	Coordinates[a]		Sample Interval	Off-site laboratory analyses							Comments and notes
		X	Y		Metals	TCLP Metals	PCB	RAD	TCLP SVOC	SVOC	VOC	
1/30/20	Z2-EU19B-651	744515.7	178657.3	1-2 ft				1			1	
1/30/20	Z2-EU19B-652	744514.3	178656.7	0-2 ft				1				
		Concrete Samples										
3/15/18	Z2-EU19-417	744637.6	178699.2	0-3 in	1		1	1		1		K-1031 slab
3/15/18	Z2-EU19-419	744634.6	178694.0	0-3 in	1		1	1		1		K-1031 slab
3/15/18	Z2-EU19-420	744631.6	178688.8	0-3 in	1		1	1		1		K-1031 slab
3/15/18	Z2-EU19-421	744637.6	178688.8	0-3 in	1		1	1		1		K-1031 slab
3/19/18	Z2-EU19-414	744628.6	178704.3	0-3 in	1		1	1		1		K-1031 slab
3/19/18	Z2-EU19-415	744634.6	178704.3	0-3 in	1		1	1		1		K-1031 slab
3/19/18	Z2-EU19-416	744631.6	178699.2	0-3 in	1		1	1		1		K-1031 slab
3/19/18	Z2-EU19-418	744628.6	178694.0	0-3 in	1		1	1		1		K-1031 slab
3/20/18	Z2-EU19-401	744614.2	178656.0	0-3 in	1		1	1		1		K-1410 slab
3/20/18	Z2-EU19-402	744622.3	178656.0	0-3 in	1		1	1		1		K-1410 slab
3/20/18	Z2-EU19-403	744630.3	178656.0	0-3 in	1		1	1		1		K-1410 slab
3/20/18	Z2-EU19-406	744618.3	178649.1	0-3 in	1		1	1		1		K-1410 slab
3/20/18	Z2-EU19-407	744626.3	178649.1	0-3 in	1		1	1		1		K-1410 slab
3/20/18	Z2-EU19-411	744622.3	178642.1	0-3 in	1		1	1		1		K-1410 slab
3/20/18	Z2-EU19-412	744630.3	178642.1	0-3 in	1		1	1		1		K-1410 slab
3/22/18	Z2-EU19-400	744606.2	178656.0	0-3 in	1		1	1		1		K-1410 slab
3/22/18	Z2-EU19-404	744638.3	178656.0	0-3 in	1		1	1		1		K-1410 slab
3/22/18	Z2-EU19-408	744634.3	178649.1	0-3 in	1		1	1		1		K-1410 slab
3/22/18	Z2-EU19-409	744642.3	178649.1	0-3 in	1		1	1		1		K-1410 slab
3/22/18	Z2-EU19-410	744607.2	178642.1	0-3 in	1		1	1		1		K-1410 slab
3/22/18	Z2-EU19-413	744638.3	178642.1	0-3 in	1		1	1		1		K-1410 slab
3/22/18	Z2-EU19-437	744630.0	178709.1	0-3 in	1		1	1		1		K-1410 slab
3/22/18	Z2-EU19B-438	744614.2	178642.1	0-3 in	1		1	1		1		K-1410 slab
4/25/18	Z2-EU19-405	744610.2	178649.1	0-3 in	1		1	1		1		K-1410 slab
11/7/19	Z2-EU19-9707	744646.6	178742.0	0-3 in	1		1	1		1		K-1066-D slab
11/7/19	Z2-EU19-9708	744646.1	178759.2	0-3 in	1		1	1		1		K-1066-D slab
11/7/19	Z2-EU19-9709	744659.9	178762.1	0-3 in	1		1	1		1		K-1066-D slab
11/7/19	Z2-EU19-9710	744659.7	178743.36	0-3 in	1		1	1		1		K-1066-D slab
		Characterization Sample Locations										
3/21/17	Z2-EU19-124	744595.0	178637.1	0-1 ft	1		1	1		1		
3/22/17	Z2-EU19-110	744582.8	178641.3	0-1 ft	1		1	1		1		
3/22/17	Z2-EU19-111	744580.2	178637.6	0-1 ft	1		1	1		1		
3/22/17	Z2-EU19-112	744583.1	178637.8	0-1 ft	1		1	1		1		
3/22/17	Z2-EU19-113	744607.1	178636.7	0-1 ft	1		1	1		1		
3/23/17	Z2-EU19-109	744585.6	178646.5	0-1 ft	1		1	1		1		
3/23/17	Z2-EU19-114	744576.6	178619.8	0-1 ft	1		1	1		1		
3/23/17	Z2-EU19-115	744598.4	178617.3	0-1 ft	1		1	1		1		
3/23/17	Z2-EU19-116	744611.1	178617.3	0-1 ft	1		1	1		1		
3/23/17	Z2-EU19-117	744630.2	178617.3	0-1 ft	1		1	1		1		
3/23/17	Z2-EU19-123	744617.5	178617.3	0-1 ft	1		1	1		1		
3/27/17	Z2-EU19-101	744632.9	178719.0	0-1 ft	1		1	1		1		
3/27/17	Z2-EU19-102	744636.7	178720.3	0-1 ft	1		1	1		1		
3/27/17	Z2-EU19-103	744639.4	178718.1	0-1 ft	1		1	1		1		

Date sampled	Sample location	Coordinates[a]		Sample Interval	Off-site laboratory analyses							Comments and notes
		X	Y		Metals	TCLP Metals	PCB	RAD	TCLP SVOC	SVOC	VOC	
3/27/17	Z2-EU19-105	744595.1	178691.4	0-1 ft	1		1	1		1		
3/27/17	Z2-EU19-108	744592.2	178674.4	0-1 ft	1		1	1		1		
3/28/17	Z2-EU19-118	744631.0	178671.6	0-1 ft	1		1	1		1		
3/28/17	Z2-EU19-119	744609.6	178675.4	0-1 ft	1		1	1		1		
3/28/17	Z2-EU19-120	744640.3	178673.2	0-1 ft	1		1	1		1		
3/28/17	Z2-EU19-121	744621.0	178673.9	0-10 ft	1		1	1		1		
3/28/17	Z2-EU19-122	744634.8	178681.3	0-10 ft	1		1	1		1		
3/29/17	Z2-EU19-104	744588.9	178685.8	0-1 ft	1		1	1		1		
3/29/17	Z2-EU19-106	744568.8	178666.3	0-1 ft	1		1	1		1		
3/29/17	Z2-EU19-125	744644.5	178688.9	0-1 ft	1		1	1		1		
3/29/17	Z2-EU19B-305	744667.1	178621.5	0-10 ft	1		1	1		1	1	
3/30/17	Z2-EU19-107	744582.8	178669.0	0-10 ft	1		1	1		1		
3/30/17	Z2-EU19B-301	744591.1	179192.3	0-10 ft	1		1	1		1		
3/30/17	Z2-EU19B-302	744603.1	179089.1	0-10 ft	1		1	1		1		
3/30/17	Z2-EU19B-303	744616.6	178964.9	0-10 ft	1		1	1		1		
3/30/17	Z2-EU19B-304	744629.6	178838.8	0-10 ft	1		1	1		1		
9/26/17	Z2-EU19B-129	744642.4	178727.8	0-4 ft				1				
9/26/17	Z2-EU19B-131	744658.4	178704.2	0-4 ft				1				
9/26/17	Z2-EU19B-132	744655.3	178689.6	0-4 ft				1				
9/27/17	Z2-EU19B-138	744655.2	178674.3	0-10 ft	1		1	1		1		
9/27/17	Z2-EU19B-155	744640.3	178673.2	0-4 ft				1				
9/27/17	Z2-EU19B-155A	744640.3	178673.8	0-3 ft	1			1				
9/27/17	Z2-EU19B-155B	744640.9	178673.5	0-3 ft	1			1				
9/27/17	Z2-EU19B-155C	744639.9	178672.8	0-3 ft	1			1				
9/27/17	Z2-EU19B-155D	744639.5	178673.5	0-3 ft	1			1				
9/28/17	Z2-EU19B-133	744640.6	178693.6	0-4 ft				1				
9/28/17	Z2-EU19B-154	744638.8	178719.4	0-4 ft	1		1	1		1		
10/2/17	Z2-EU19B-127	744631.4	178733.4	0-4 ft				1				
10/2/17	Z2-EU19B-128	744625.4	178727.6	0-4 ft				1				
10/3/17	Z2-EU19B-130	744648.9	178719.9	0-4 ft	1		1	1		1		
10/3/17	Z2-EU19B-135	744612.8	178707.4	0-4 ft				1				
10/3/17	Z2-EU19B-136	744614.8	178692.9	0-4 ft				1				
10/4/17	Z2-EU19B-134	744625.8	178715.4	0-4 ft	1		1	1		1		
10/4/17	Z2-EU19B-167	744621.0	178673.9	0-4 ft				1				
10/4/17	Z2-EU19B-167A	744621.0	178674.2	0-3 ft	1			1				
10/4/17	Z2-EU19B-167B	744621.3	178673.9	0-3 ft	1			1				
10/4/17	Z2-EU19B-167C	744621.0	178673.6	0-3 ft	1			1				
10/4/17	Z2-EU19B-167D	744620.7	178673.9	0-3 ft	1			1				
10/5/17	Z2-EU19B-168	744605.6	178677.3	0-4 ft				1				
10/5/17	Z2-EU19B-168A	744605.6	178677.6	0-3 ft	1			1				
10/5/17	Z2-EU19B-168B	744605.9	178677.3	0-3 ft	1			1				
10/5/17	Z2-EU19B-168C	744605.6	178677.0	0-3 ft	1			1				
10/5/17	Z2-EU19B-168D	744605.3	178677.3	0-3 ft	1			1				
10/9/17	Z2-EU19B-165	744609.8	178672.3	0-4 ft				1				
10/9/17	Z2-EU19B-166	744619.1	178680.5	0-4 ft				1				
10/10/17	Z2-EU19B-141	744595.7	178650.0	0-4 ft				1				

Date sampled	Sample location	Coordinates[a]		Sample Interval	Off-site laboratory analyses							Comments and notes
		X	Y		Metals	TCLP Metals	PCB	RAD	TCLP SVOC	SVOC	VOC	
10/10/17	Z2-EU19B-142	744602.5	178654.9	0-4 ft	1		1	1		1		
10/11/17	Z2-EU19B-152	744616.6	178636.5	0-10 ft				1				
10/11/17	Z2-EU19B-156	744606.8	178637.9	0-10 ft				1				
10/11/17	Z2-EU19B-163	744602.2	178637.8	0-4 ft				1				
10/11/17	Z2-EU19B-164	744606.3	178643.0	0-4 ft				1				
10/12/17	Z2-EU19B-139	744658.6	178648.6	0-4 ft				1				
10/12/17	Z2-EU19B-140	744632.1	178663.7	0-4 ft				1				
10/16/17	Z2-EU19B-147	744566.6	178630.9	0-4 ft				1				
10/16/17	Z2-EU19B-148	744618.8	178634.3	0-4 ft				1				
10/16/17	Z2-EU19B-162	744602.2	178637.8	0-4 ft	1		1	1		1		
10/16/17	Z2-EU19B-170	744538.1	178605.0	0-4 ft				1				
10/17/17	Z2-EU19B-158	744569.6	178614.8	0-4 ft	1		1	1		1		
10/17/17	Z2-EU19B-159	744583.5	178614.6	0-4 ft				1				
10/17/17	Z2-EU19B-160	744583.0	178624.1	0-4 ft				1				
10/18/17	Z2-EU19B-126	744605.7	178738.3	0-4 ft	1		1	1		1		
10/18/17	Z2-EU19B-143	744584.5	178690.3	0-4 ft				1				
10/18/17	Z2-EU19B-144	744562.0	178687.4	0-4 ft				1				
10/19/17	Z2-EU19B-146	744578.9	178657.0	0-10 ft	1		1	1		1		
10/19/17	Z2-EU19B-161	744574.0	178642.1	0-4 ft				1				
10/24/17	Z2-EU19B-145	744583.5	178661.3	0-4 ft				1				
10/24/17	Z2-EU19B-169	744547.6	178676.7	0-4 ft				1				
10/25/17	Z2-EU19B-149	744616.2	178624.6	0-4 ft				1				
10/25/17	Z2-EU19B-150	744641.8	178626.1	0-4 ft	1		1	1		1		
10/25/17	Z2-EU19B-151	744641.7	178612.1	0-4 ft				1				
10/25/17	Z2-EU19B-157	744613.3	178618.1	0-10 ft				1				
10/26/17	Z2-EU19B-153	744628.8	178654.8	0-4 ft			1	1				
3/13/18	Z2-EU19B-168C-1	744605.3	178675.4	0-0.5 ft	1							
3/13/18	Z2-EU19B-168C-2	744604.6	178672.0	0-0.5 ft	1							
3/13/18	Z2-EU19B-168C-3	744602.5	178671.3	0-0.5 ft	1							
3/14/18	Z2-EU19B-182	744641.4	178673.4	0-1 ft				1				
3/27/18	Z2-EU19-422	744634.8	178682.0	0-0.5 ft	1			1				
3/27/18	Z2-EU19-423	744635.6	178681.3	0-0.5 ft	1			1				
3/27/18	Z2-EU19-424	744634.8	178680.5	0-0.5 ft	1			1				
3/27/18	Z2-EU19-425	744634.1	178681.3	0-0.5 ft	1			1				
3/27/18	Z2-EU19-426	744640.3	178674.2	0-0.5 ft	1			1				
3/27/18	Z2-EU19-427	744641.2	178673.5	0-0.5 ft	1			1				
3/27/18	Z2-EU19-428	744639.8	178672.4	0-0.5 ft	1			1				
3/27/18	Z2-EU19-429	744639.1	178673.6	0-0.5 ft	1			1				
4/4/18	Z2-EU19-431	744608.7	178636.7	0-7.5 ft	1			1				
4/4/18	Z2-EU19-434	744615.5	178637.8	0-10 ft	1			1				
4/5/18	Z2-EU19-430	744605.6	178636.7	0-10 ft	1			1				
4/5/18	Z2-EU19-432	744607.1	178636.7	0-6 ft	1			1				
4/9/18	Z2-EU19-433	744607.1	178635.2	0-10 ft	1			1				
4/9/18	Z2-EU19B-178A	744619.1	178624.1	0-10 ft	1		1	1		1		
4/10/18	Z2-EU19B-178B	744620.7	178622.3	0-10 ft	1		1	1		1		
4/10/18	Z2-EU19B-178C	744619.0	178620.3	0-10 ft	1		1	1		1		

Date sampled	Sample location	Coordinates[a]		Sample Interval	Off-site laboratory analyses							Comments and notes
		X	Y		Metals	TCLP Metals	PCB	RAD	TCLP SVOC	SVOC	VOC	
4/10/18	Z2-EU19B-178D	744617.1	178622.2	0-10 ft	1		1	1		1		
4/11/18	Z2-EU19-113	744607.1	178636.7	0-1 ft	1							
4/11/18	Z2-EU19-125B	744636.1	178690.6	0-1 ft	1							
4/11/18	Z2-EU19-125C	744634.1	178691.3	0-1 ft	1							
4/11/18	Z2-EU19-125D	744627.0	178691.1	0-1 ft	1							
4/16/18	Z2-EU19B-173	744684.3	178633.2	0-0.5 ft	1		1	1		1	1	
4/17/18	Z2-EU19B-172	744661.4	178648.3	0-05. ft	1		1	1		1	1	
4/18/18	Z2-EU19-113	744607.1	178636.7	2-2.5 ft				1				
4/24/18	Z2-EU19B-175	744668.6	178723.4	0-2 ft	1		1	1		1	1	
5/30/18	Z2-EU19B-177	744591.0	178661.2	0-0.5 ft	1		1	1		1	1	
7/12/18	Z2-EU19B-186	744602.6	178626.5	1.5-8.5 ft						1	1	
7/12/18	Z2-EU19B-187	744617.0	178626.5	1.5-8.5 ft						1	1	
7/12/18	Z2-EU19B-188	744644.6	178627.7	1.5-8.5 ft						1	1	
7/16/18	Z2-EU19B-183	744606.4	178666.9	2-8 ft						1	1	
7/16/18	Z2-EU19B-184	744624.9	178668.4	2-8 ft						1	1	
7/16/18	Z2-EU19B-185	744640.1	178673.5	2-8 ft						1	1	
8/30/18	Z2-EU19-438	744637.6	178713.3	3-10 ft				1		1	1	
8/30/18	Z2-EU19-439	744627.9	178696.4	3-10 ft				1		1	1	
8/30/18	Z2-EU19-442	744637.6	178679.5	3-10 ft				1		1	1	
9/5/18	Z2-EU19-440	744598.6	178679.5	3-10 ft				1		1	1	
9/5/18	Z2-EU19-441	744618.1	178679.5	3-10 ft				1		1	1	
9/5/18	Z2-EU19-444	744608.4	178662.6	3-10 ft				1		1	1	
9/6/18	Z2-EU19-445	744627.9	178662.6	3-10 ft				1		1	1	
9/6/18	Z2-EU19-446	744647.4	178662.6	3-10 ft				1		1	1	
9/6/18	Z2-EU19-453	744627.9	178628.9	3-15 ft				1		1	1	
9/10/18	Z2-EU19-451	744588.9	178628.9	3-10 ft				1		1	1	
9/10/18	Z2-EU19-452	744608.4	178628.9	3-15 ft				1		1	1	
9/10/18	Z2-EU19-454	744579.1	178612.0	3-10 ft				1		1	1	
9/19/18	Z2-EU19-450	744637.6	178645.8	3-10 ft	1		1	1		1	1	
9/19/18	Z2-EU19B-470	744619.4	178626.6	2-15 ft				1		1	1	
9/19/18	Z2-EU19B-472	744617.5	178633.1	2-8 ft	1		1	1		1	1	
9/24/18	Z2-EU19-447	744580.1	178645.8	3-10 ft	1		1	1		1	1	
9/24/18	Z2-EU19-448	744598.6	178645.8	3-10 ft	1		1	1		1	1	
9/24/18	Z2-EU19B-467	744647	178654	2-15 ft	1		1	1		1	1	
10/1/18	Z2-EU19-443	744569.4	178665.6	3-10 ft				1		1	1	
10/1/18	Z2-EU19B-468	744586.9	178656.4	2-15 ft	1		1	1		1	1	
10/2/18	Z2-EU19B-458	744586	178646	2-15 ft	1		1	1		1	1	
10/2/18	Z2-EU19B-459	744593	178648	2-15 ft	1		1	1		1	1	
10/2/18	Z2-EU19B-461	744605	178647	2-15 ft	1		1	1		1	1	
10/3/18	Z2-EU19B-460	744602	178650	2-15 ft	1		1	1		1	1	
10/3/18	Z2-EU19B-463	744605	178637	2-15 ft	1		1	1		1	1	
10/4/18	Z2-EU19-455	744598.6	178612.0	3-10 ft				1		1	1	
10/4/18	Z2-EU19B-471	744608	178619.7	2-15 ft				1		1	1	
10/9/18	Z2-EU19-456	744618.1	178612.0	3-11.8 ft				1		1	1	
10/9/18	Z2-EU19-457	744637.6	178612.0	3-10 ft				1		1	1	
10/10/18	Z2-EU19B-464	744610	178640	4-15 ft	1		1	1		1	1	

Date sampled	Sample location	Coordinates[a]		Sample Interval	Off-site laboratory analyses							Comments and notes
		X	Y		Metals	TCLP Metals	PCB	RAD	TCLP SVOC	SVOC	VOC	
10/10/18	Z2-EU19B-469	744607.2	178637.18	4-15 ft	1		1	1		1	1	
10/15/18	Z2-EU19B-462	744603	178642	2-15 ft	1		1	1		1	1	
10/15/18	Z2-EU19B-466	744628	178649	2-15 ft	1		1	1		1	1	
10/16/18	Z2-EU19B-465	744615	178650	2-15 ft	1			1		1	1	
7/18/19	Z2-EU19-708	744687.0	178629.4	14-24 ft				1		1	1	TCE Investigation
7/22/19	Z2-EU19-707	744680.7	178734.1	2-13.5 ft				1		1	1	TCE Investigation
7/23/19	Z2-EU19-709	744517.6	178595.5	37-47 ft				1		1	1	TCE Investigation
7/24/19	Z2-EU19-706	744617.4	178626.6	0-28 ft				1		1	1	TCE Investigation
7/24/19	Z2-EU19B-721	744575.6	178633.0	0-15 ft	1		1	1		1	1	
7/24/19	Z2-EU19B-722	744580.7	744580.7	0-15 ft	1		1	1		1	1	
7/25/19	Z2-EU19-702	744595.5	178643.6	0-10 ft				1		1	1	TCE Investigation
7/25/19	Z2-EU19B-724	744547.1	178672.9	0-14.5 ft	1			1				
7/29/19	Z2-EU19-701	744640.9	178672.4	0-37.3 ft				1		1	1	TCE Investigation
7/29/19	Z2-EU19B-723	744544.0	178677.4	0-10 ft	1			1				
7/30/19	Z2-EU19-703	744605.5	178644.4	0-9.4 ft				1		1	1	TCE Investigation
7/30/19	Z2-EU19-705	744605.8	178635.5	0-27.9 ft				1		1	1	TCE Investigation
7/30/19	Z2-EU19B-713	744538.8	178674.1	0-1 ft	1		1	1				
7/30/19	Z2-EU19B-714	744551.1	178682.4	0-1 ft	1		1	1				
7/30/19	Z2-EU19B-715	744550.1	178662.8	0-1 ft	1		1	1				
7/30/19	Z2-EU19B-716	744566.9	178665.5	0-1 ft	1		1	1				
7/31/19	Z2-EU19-710	744594.4	178642.1	13.9-20.75 ft				1		1	1	TCE Investigation
7/31/19	Z2-EU19B-717	744585.2	178740.5	0-1 ft	1		1	1				
7/31/19	Z2-EU19B-718	744594.0	178739.0	0-1 ft	1		1	1				
7/31/19	Z2-EU19B-719	744597.8	178732.9	0-1 ft	1		1	1				
1/32/20	Z2-EU19B-717A	744586.3	178745.3	0-1 ft				1				
1/23/20	Z2-EU19B-717B	744584.7	178738.3	0-1 ft				1				
1/23/20	Z2-EU19B-717C	744579.3	178745.0	0-1 ft				1				
		EU Z2-19 Historical Sample Locations										
7/18/94	RAD101	744586.4	178646.4	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
7/18/94	RAD107	744586.4	178667.6	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
7/18/94	RAD115	744644.2	178689.8	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
7/18/94	RAD116	744635.5	178691.5	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
7/18/94	RAD117	744634.3	178692.3	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
7/18/94	RAD118	744627.3	178691.7	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/25/94	RAD106	744641.4	178673.4	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/25/94	RAD109	744617.6	178673.3	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/25/94	RAD110	744621.1	178673.9	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/25/94	RAD111	744633.4	178675.4	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/25/94	RAD112	744626.1	178674.7	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/25/94	RAD113	744634.8	178681.1	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/26/94	RAD100	744645.1	178649.0	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/26/94	RAD120	744632.3	178728.3	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/26/94	RAD121	744632.6	178728.4	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/26/94	RAD124	744636.3	178750.1	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/26/94	RAD92	744624.3	178635.4	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/26/94	RAD93	744598.8	178633.9	Surface soil 0-0.5 ft				1				K-25 Radiation Survey

Date sampled	Sample location	Coordinates[a]		Sample Interval	Off-site laboratory analyses							Comments and notes
		X	Y		Metals	TCLP Metals	PCB	RAD	TCLP SVOC	SVOC	VOC	
8/26/94	RAD94	744596.8	178635.0	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/26/94	RAD95	744595.9	178637.2	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/26/94	RAD97	744617	178646	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/26/94	RAD98	744594.8	178642.8	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
8/26/94	RAD99	744595.5	178643.2	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
9/3/94	RAD119	744652.0	178700.5	Surface soil 0-0.5 ft				1				K-25 Radiation Survey
7/12/95	ST04	744581.8	178662.7	7-9 ft	1							K-1410 Exterior Characterization and Site
7/12/95	ST08	744564.8	178669.1	4-8 ft				1				K-1410 Exterior Characterization and Site
7/13/95	ST03	744574.3	178645.8	6-8 ft				1				K-1410 Exterior Characterization and Site
7/13/95	ST06	744616.	178621.4	0-6 ft			1					K-1410 Exterior Characterization and Site
7/14/95	ST02	744585.0	178648.2	6-8 ft				1				K-1410 Exterior Characterization and Site
7/14/95	ST05	744541.7	178679.6	0-2 ft	1			1				K-1410 Exterior Characterization and Site
7/17/95	ST01	744602.5	178650.7	0-8 ft				1			1	K-1410 Exterior Characterization and Site
10/23/95	KAJ-SS-S11	744543.7	179271.1	Surface soil 0-0.5 ft				1				K-1410 Exterior Characterization and Site
10/23/95	KAJ-SS-S12	744579.7	179228.6	Surface soil 0-0.5 ft				1				K-25 Radiological Survey Phase II
10/23/95	KAJ-SS-S21	744571.7	179157.1	Surface soil 0-0.5 ft				1				K-25 Radiological Survey Phase II
10/23/95	KAJ-SS-S31	744603.5	179045.6	Surface soil 0-0.5 ft				1				K-25 Radiological Survey Phase II
10/23/95	KAJ-SS-S41	744616.7	178896.9	Surface soil 0-0.5 ft				1				K-25 Radiological Survey Phase II
10/23/95	KAJ-SS-S51	744611.6	178784.5	Surface soil 0-0.5 ft				1				K-25 Radiological Survey Phase II
10/23/95	KAJ-SS-S61	744590.8	178696.5	Surface soil 0-0.5 ft				1				K-25 Radiological Survey Phase II
10/23/95	KAJ-SS-S62	744552.6	178677.7	Surface soil 0-0.5 ft				1				K-25 Radiological Survey Phase II
10/23/95	KAJ-SS-S71	744553.6	178633.5	Surface soil 0-0.5 ft				1				K-25 Radiological Survey Phase II
10/23/95	KAJ-SS-S72	744499.8	178614.3	Surface soil 0-0.5 ft				1				K-25 Radiological Survey Phase II
10/28/04	PCC-SS5	744523.7	179259.8	0-1 ft	1		1	1		1	1	K-25 Sitewide Residual Contamination

[a]*Coordinates are in Tennessee state plane meters.*

EU = Exposure Unit
PCB = polychlorinated biphenyl
RAD = radionuclide except when used in a sample location name
SVOC = semivolatile organic compound
VOC = volatile organic compound

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ATTACHMENT 4:
EU-19 DATA SUMMARY TABLES

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Sumary Statistics for Soil Samples from Dig 2 Expansion

Area	Type	Frequency of detects	Analyte	Min Detected	Max Detected	Avg Detected Result	Units	Avg RL	No. Detects ≥ Avg RL	Max RL	No. Detects ≥ Max RL	GW SSL	No. Detects ≥ GW SSL	PRG	No. Detects ≥ GW SSL
Bottom of Ditch	METAL	4/4	Aluminum	12800	28700	20375	mg/kg							1100000	0
Bottom of Ditch	METAL	4/4	Arsenic	5.75	8.03	7.22	mg/kg	300	0	900	0	66.3	0	300	0
Bottom of Ditch	METAL	4/4	Barium	69.7	102	82.2	mg/kg					9150	0	220000	0
Bottom of Ditch	METAL	4/4	Beryllium	1.14	1.64	1.36	mg/kg							2300	0
Bottom of Ditch	METAL	4/4	Boron	4.79	14.4	9.5	mg/kg							230000	0
Bottom of Ditch	METAL	4/4	Cadmium	0.217	3.98	1.5545	mg/kg							980	0
Bottom of Ditch	METAL	4/4	Calcium	3530	18500	10950	mg/kg								
Bottom of Ditch	METAL	4/4	Chromium	12.3	63.1	35.8	mg/kg					172	0	1800000	0
Bottom of Ditch	METAL	4/4	Cobalt	13.2	23.4	19.48	mg/kg							350	0
Bottom of Ditch	METAL	4/4	Copper	24.4	628	355.35	mg/kg							47000	0
Bottom of Ditch	METAL	4/4	Iron	23700	34500	28950	mg/kg							820000	0
Bottom of Ditch	METAL	4/4	Lead	20.9	34.4	29.375	mg/kg					3370	0	800	0
Bottom of Ditch	METAL	4/4	Lithium	33.2	53.8	46.35	mg/kg							2300	0
Bottom of Ditch	METAL	4/4	Magnesium	1940	9560	4720	mg/kg								
Bottom of Ditch	METAL	4/4	Manganese	567	1140	886.5	mg/kg								
Bottom of Ditch	METAL	4/4	Mercury	0.267	3.53	1.40	mg/kg	600	0	1800	0			600	0
Bottom of Ditch	METAL	2/4	Molybdenum	0.4	2.1	1.25	mg/kg							5800	0
Bottom of Ditch	METAL	4/4	Nickel	21.9	1540	687.0	mg/kg							22000	0
Bottom of Ditch	METAL	4/4	Potassium	1260	6350	3670	mg/kg								
Bottom of Ditch	METAL	1/4	Selenium	1.31	1.31	1.31	mg/kg							5800	0
Bottom of Ditch	METAL	4/4	Sodium	55.2	744	330.3	mg/kg								
Bottom of Ditch	METAL	4/4	Thallium	0.324	0.458	0.38	mg/kg					10.8	0	12	0
Bottom of Ditch	METAL	4/4	Uranium	35.5	1160	484.88	mg/kg							230	3
Bottom of Ditch	METAL	4/4	Vanadium	28	44.3	38.5	mg/kg							5800	0
Bottom of Ditch	METAL	4/4	Zinc	65.8	199	115.25	mg/kg							350000	0
Bottom of Ditch	PPCB	4/4	PCB-1254	9.77	6360	2086.57	ug/kg	10000	0	100000	0			10000	0
Bottom of Ditch	PPCB	3/4	PCB-1260	6.26	2050	911.42	ug/kg	10000	0	100000	0			10000	0
Bottom of Ditch	PPCB	4/4	Total PCBs	9.77	8410	2770.13	ug/kg	10000	0	100000	0			10000	0
Bottom of Ditch	RADS	35/35	Actinium-228	1.08	31.4	3.16	pCi/g							10700	0
Bottom of Ditch	RADS	37/37	Alpha activity	30.1	3950	449.04	pCi/g								
Bottom of Ditch	RADS	6/37	Americium-241	1.01	14.9	4.45	pCi/g							47.6	0
Bottom of Ditch	RADS	37/37	Beta activity	34.7	1450	300.37	pCi/g								
Bottom of Ditch	RADS	26/26	Bismuth-212	1.24	24.6	3.65	pCi/g								
Bottom of Ditch	RADS	36/36	Bismuth-214	0.962	19.4	2.916	pCi/g							109000	0
Bottom of Ditch	RADS	25/37	Cesium-137	0.105	99.6	10.51	pCi/g	2	11	20	3			2	11
Bottom of Ditch	RADS	1/1	Lead-210	1.42	1.42	1.42	pCi/g							37.6	0
Bottom of Ditch	RADS	37/37	Lead-212	1.18	27	2.81	pCi/g							57200	0
Bottom of Ditch	RADS	37/37	Lead-214	1.01	24.1	3.44	pCi/g							648000	0
Bottom of Ditch	RADS	6/37	Neptunium-237	0.543	7.22	2.44	pCi/g	5	1	50	0			5	1
Bottom of Ditch	RADS	1/37	Plutonium-238	0.346	0.346	0.35	pCi/g							148	0
Bottom of Ditch	RADS	15/37	Plutonium-239/240	0.294	84.3	10.80	pCi/g								
Bottom of Ditch	RADS	37/37	Potassium-40	15.3	42.2	20.17	pCi/g							2.2	37
Bottom of Ditch	RADS	21/21	Protactinium-234m	8.37	698	182.77	pCi/g								
Bottom of Ditch	RADS	37/37	Ra226_Th232	1.37	77.2	8.31	pCi/g	5.2	10	18.2	3				
Bottom of Ditch	RADS	36/37	Radium-226	1.25	43.7	5.18	pCi/g								
Bottom of Ditch	RADS	1/3	Strontium-90	5.22	5.22	5.22	pCi/g							384	0
Bottom of Ditch	RADS	23/37	Technetium-99	8.86	1410	122.08	pCi/g	12100	0	121000	0	85.6	5	12100	0
Bottom of Ditch	RADS	37/37	Th230_Th232	1.75	1503.5	120.45	pCi/g	5.15	27	18.15	15				
Bottom of Ditch	RADS	36/36	Thallium-208	0.31	7.54	0.82	pCi/g							298000	0
Bottom of Ditch	RADS	36/37	Thorium-228	0.983	24.6	2.81	pCi/g								
Bottom of Ditch	RADS	36/37	Thorium-230	1.54	1470	120.44	pCi/g								
Bottom of Ditch	RADS	37/37	Thorium-232	1.14	33.5	3.27	pCi/g								
Bottom of Ditch	RADS	36/37	Thorium-234	5.54	620	105.42	pCi/g							24500	0

Sumary Statistics for Soil Samples from Dig 2 Expansion

Area	Type	Frequency of detects	Analyte	Min Detected	Max Detected	Avg Detected Result	Units	Avg RL	No. Detects ≥ Avg RL	Max RL	No. Detects ≥ Max RL	GW SSL	No. Detects ≥ GW SSL	PRG	No. Detects ≥ GW SSL
Bottom of Ditch	RADS	37/37	Uranium-234	5.26	638	111.00	pCi/g	700	0	7000	0	61.1	14	700	0
Bottom of Ditch	RADS	2/3	Uranium-235	7.93	21.4	14.67	pCi/g	8	1	80	0	61.1	0	8	1
Bottom of Ditch	RADS	32/37	Uranium-235/236	0.327	54.2	8.68	pCi/g								
Bottom of Ditch	RADS	37/37	Uranium-238	6.07	625	113.31	pCi/g	50	17	500	2	61.1	14	50	17
Bottom of Ditch	SVOA	1/3	Acenaphthene	114	114	114	ug/kg							45000000	0
Bottom of Ditch	SVOA	1/3	Anthracene	204	204	204	ug/kg							230000000	0
Bottom of Ditch	SVOA	2/3	Benz(a)anthracene	45.5	502	273.75	ug/kg							210000	0
Bottom of Ditch	SVOA	1/3	Benzo(a)pyrene	457	457	457	ug/kg							21000	0
Bottom of Ditch	SVOA	1/3	Benzo(b)fluoranthene	658	658	658	ug/kg							210000	0
Bottom of Ditch	SVOA	1/3	Benzo(ghi)perylene	274	274	274	ug/kg								
Bottom of Ditch	SVOA	1/3	Benzo(k)fluoranthene	180	180	180	ug/kg							2100000	0
Bottom of Ditch	SVOA	1/3	Carbazole	113	113	113	ug/kg								
Bottom of Ditch	SVOA	1/3	Chrysene	432	432	432	ug/kg							21000000	0
Bottom of Ditch	SVOA	1/3	Dibenz(a,h)anthracene	67.1	67.1	67.1	ug/kg							21000	0
Bottom of Ditch	SVOA	2/3	Fluoranthene	59.3	1070	564.65	ug/kg							30000000	0
Bottom of Ditch	SVOA	1/3	Fluorene	103	103	103	ug/kg							30000000	0
Bottom of Ditch	SVOA	1/3	Indeno(1,2,3-cd)pyrene	323	323	323	ug/kg							210000	0
Bottom of Ditch	SVOA	1/3	Phenanthrene	979	979	979	ug/kg								
Bottom of Ditch	SVOA	2/3	Pyrene	46.9	1140	593.45	ug/kg							23000000	0
Bottom of Ditch	VOA	3/4	Acetone	17.7	32.3	24.4	ug/kg							670000000	0
Upper Ditch	METAL	47/47	Aluminum	8460	44600	17405.11	mg/kg							1100000	0
Upper Ditch	METAL	18/47	Antimony	0.362	5.22	1.24	mg/kg					144	0	470	0
Upper Ditch	METAL	47/47	Arsenic	2.76	14	7.83	mg/kg	300	0	900	0	66.3	0	300	0
Upper Ditch	METAL	47/47	Barium	30.2	689	91.50	mg/kg					9150	0	220000	0
Upper Ditch	METAL	45/47	Beryllium	0.325	4.71	1.05	mg/kg							2300	0
Upper Ditch	METAL	33/47	Boron	1.81	37.9	8.83	mg/kg							230000	0
Upper Ditch	METAL	45/47	Cadmium	0.0244	34.1	1.40	mg/kg							980	0
Upper Ditch	METAL	47/47	Calcium	131	69600	8026.94	mg/kg								
Upper Ditch	METAL	47/47	Chromium	11.9	1140	66.53	mg/kg					172	3	1800000	0
Upper Ditch	METAL	47/47	Cobalt	7.64	72.1	19.47	mg/kg							350	0
Upper Ditch	METAL	47/47	Copper	6.74	2180	300.78	mg/kg							47000	0
Upper Ditch	METAL	47/47	Iron	17800	60400	30121.28	mg/kg							820000	0
Upper Ditch	METAL	47/47	Lead	10.7	1850	84.03	mg/kg					3370	0	800	1
Upper Ditch	METAL	47/47	Lithium	7.08	579	42.10	mg/kg							2300	0
Upper Ditch	METAL	47/47	Magnesium	377	38100	2969.87	mg/kg								
Upper Ditch	METAL	47/47	Manganese	118	3750	1375.64	mg/kg								
Upper Ditch	METAL	47/47	Mercury	0.0184	22.8	0.68	mg/kg	600	0	1800	0			600	0
Upper Ditch	METAL	35/47	Molybdenum	0.396	58.2	4.75	mg/kg							5800	0
Upper Ditch	METAL	47/47	Nickel	4.25	2540	277.67	mg/kg							22000	0
Upper Ditch	METAL	47/47	Potassium	396	31300	3198.19	mg/kg								
Upper Ditch	METAL	11/47	Selenium	1.02	5.19	2.59	mg/kg							5800	0
Upper Ditch	METAL	12/47	Silver	0.285	57.6	7.30	mg/kg							5800	0
Upper Ditch	METAL	45/47	Sodium	8.23	6840	382.85	mg/kg								
Upper Ditch	METAL	46/47	Thallium	0.18	1.65	0.44	mg/kg					10.8	0	12	0
Upper Ditch	METAL	47/47	Uranium	0.839	53800	2622.91	mg/kg							230	11
Upper Ditch	METAL	46/47	Vanadium	8.92	64.7	41.15	mg/kg							5800	0
Upper Ditch	METAL	47/47	Zinc	10.6	656	95.51	mg/kg							350000	0
Upper Ditch	PPCB	1/47	PCB-1248	11.1	11.1	11.10	ug/kg	10000	0	100000	0			10000	0
Upper Ditch	PPCB	28/47	PCB-1254	5.12	324000	14941.79	ug/kg	10000	4	100000	1			10000	4
Upper Ditch	PPCB	26/47	PCB-1260	4.37	102000	5180.25	ug/kg	10000	2	100000	1			10000	2
Upper Ditch	PPCB	1/47	PCB-1268	16.2	16.2	16.20	ug/kg	10000	0	100000	0			10000	0
Upper Ditch	PPCB	28/47	Total PCBs	9.49	426000	19752.99	ug/kg	10000	4	100000	1			10000	4
Upper Ditch	RADS	40/40	Actinium-228	0.701	2590	97.97	pCi/g							10700	0

Sumary Statistics for Soil Samples from Dig 2 Expansion

Area	Type	Frequency of detects	Analyte	Min Detected	Max Detected	Avg Detected Result	Units	Avg RL	No. Detects ≥ Avg RL	Max RL	No. Detects ≥ Max RL	GW SSL	No. Detects ≥ GW SSL	PRG	No. Detects ≥ GW SSL
Upper Ditch	RADS	46/47	Alpha activity	10.5	696000	19810.68	pCi/g								
Upper Ditch	RADS	9/47	Americium-241	0.909	230	67.03	pCi/g							47.6	3
Upper Ditch	RADS	47/47	Beta activity	15.9	138000	4239.20	pCi/g								
Upper Ditch	RADS	28/28	Bismuth-212	1.26	2810	139.41	pCi/g								
Upper Ditch	RADS	41/41	Bismuth-214	0.645	8180	242.26	pCi/g							109000	0
Upper Ditch	RADS	20/47	Cesium-137	0.121	518	60.63	pCi/g	2	12	20	7			2	12
Upper Ditch	RADS	6/6	Lead-210	1.79	1320	242.08	pCi/g							37.6	2
Upper Ditch	RADS	43/43	Lead-212	0.941	2770	93.57	pCi/g							57200	0
Upper Ditch	RADS	43/43	Lead-214	0.765	9230	259.36	pCi/g							648000	0
Upper Ditch	RADS	10/47	Neptunium-237	1.28	197	38.79	pCi/g	5	6	50	2			5	6
Upper Ditch	RADS	6/47	Plutonium-238	1.03	12.9	4.59	pCi/g							148	0
Upper Ditch	RADS	13/47	Plutonium-239/240	1.38	3320	417.57	pCi/g								
Upper Ditch	RADS	40/47	Potassium-40	5.69	55.1	21.87	pCi/g							2.2	40
Upper Ditch	RADS	2/2	Protactinium-233	0.517	37.6	19.06	pCi/g								
Upper Ditch	RADS	10/10	Protactinium-234m	89.3	28000	4417.03	pCi/g								
Upper Ditch	RADS	47/47	Ra226_Th232	0.677	15990	455.46	pCi/g	5.2	13	18.2	10				
Upper Ditch	RADS	47/47	Radium-226	0.677	12300	339.51	pCi/g								
Upper Ditch	RADS	23/47	Technetium-99	8.18	22700	1320.03	pCi/g	12100	1	121000	0	85.6	11	12100	1
Upper Ditch	RADS	43/43	Th230_Th232	2.39	555690	15868.54	pCi/g	5.15	22	18.15	12				
Upper Ditch	RADS	43/43	Thallium-208	0.268	847	29.09	pCi/g							298000	0
Upper Ditch	RADS	41/47	Thorium-228	0.97	2370	90.18	pCi/g								
Upper Ditch	RADS	43/47	Thorium-230	1.09	552000	15741.81	pCi/g								
Upper Ditch	RADS	41/47	Thorium-232	1.18	3690	132.92	pCi/g								
Upper Ditch	RADS	28/47	Thorium-234	2.08	16200	1106.59	pCi/g							24500	0
Upper Ditch	RADS	46/47	Uranium-234	0.644	20500	812.96	pCi/g	700	5	7000	2	61.1	16	700	5
Upper Ditch	RADS	6/6	Uranium-235	2.2	52.1	15.41	pCi/g	8	3	80	0	61.1	0	8	3
Upper Ditch	RADS	21/47	Uranium-235/236	0.781	1140	108.66	pCi/g								
Upper Ditch	RADS	46/47	Uranium-238	1.16	21300	845.25	pCi/g	50	16	500	7	61.1	15	50	16
Upper Ditch	SVOA	1/9	Benz(a)anthracene	86.5	86.5	86.5	ug/kg							210000	0
Upper Ditch	SVOA	1/9	Benzo(a)pyrene	58.1	58.1	58.1	ug/kg							21000	0
Upper Ditch	SVOA	1/9	Benzo(b)fluoranthene	78.8	78.8	78.8	ug/kg							210000	0
Upper Ditch	SVOA	1/9	Bis(2-ethylhexyl)phthalate	143	143	143	ug/kg					2350000	0	1600000	0
Upper Ditch	SVOA	1/9	Chrysene	59.4	59.4	59.4	ug/kg							21000000	0
Upper Ditch	SVOA	1/9	Fluoranthene	96.8	96.8	96.8	ug/kg							30000000	0
Upper Ditch	SVOA	1/9	Pyrene	87.8	87.8	87.8	ug/kg							23000000	0
Upper Ditch	VOA	1/9	1,1-Dichloroethene	5.24	5.24	5.24	ug/kg					1750	0	1000000	0
Upper Ditch	VOA	1/9	1,2-Dichloroethane	0.429	0.429	0.43	ug/kg					729	0	20000	0
Upper Ditch	VOA	1/9	Acetone	4.92	4.92	4.92	ug/kg							670000000	0
Upper Ditch	VOA	6/9	cis-1,2-Dichloroethene	1.29	3490	622.05	ug/kg							2300000	0
Upper Ditch	VOA	2/9	Tetrachloroethene	0.619	1.35	0.98	ug/kg					4720	0	390000	0
Upper Ditch	VOA	1/9	Toluene	0.504	0.50	0.50	ug/kg					502000	0	47000000	0
Upper Ditch	VOA	3/9	trans-1,2-Dichloroethene	0.545	12.3	4.65	ug/kg							23000000	0
Upper Ditch	VOA	6/9	Trichloroethene	0.726	39.3	9.27	ug/kg					1720	0	19000	0
Upper Ditch	VOA	1/9	Vinyl chloride	21.1	21.1	21.1	ug/kg					176	0	17000	0

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EU Z2-19 Data Summary 012920[1]

Analyte	Frequency of detect	Min detect[2,3]	Max detect[2,3]	Avg detected result[3]	Max RL[4]	Number of detects ≥ Max RL[5]	Avg RL[6]	Number of detects ≥ Avg RL[5]	PRG[7] (10^{-5} or HI=1)	Number of detects ≥ PRG[5]	GW SSL[8]	Number of detects ≥ GW SSL[5]
Anions (mg/kg)												
Fluoride	6/6	0.514	4.19	2.22								
Inorganics (mg/kg)												
Aluminum	247/247	283	46200J	13199					1100000	0		
Antimony	46/247	0.314J	26.3	1.78					470	0	144	0
Arsenic	245/250	0.723J	62.9J	7.92	900	0	300	0	300	0	66.3	0
Barium	250/250	0.285	841J	69.1					220000	0	9150	0
Beryllium	237/247	0.19J	15.2	1.33					2300	0		
Boron	168/247	1.1J	37.9	5.57					230000	0		
Cadmium	247/250	0.0229J	298	4.36					980	0		
Calcium	246/246	147	307000	29299								
Chromium	247/250	1.14	1140	31.6					1800000	0	172	4
Cobalt	247/247	0.198J	624	16.1					350	1		
Copper	246/247	6.2	2180	98.2					47000	0		
Iron	247/247	1360	82100	25090					820000	0		
Lead	234/250	0.0119	22200J	143					800	2	3370	1
Lithium	247/247	2.49	579	31.8					2300	0		
Magnesium	247/247	310	131000	7363								
Manganese	247/247	70.5J	8910	973					26000	0		
Mercury	206/214	0.00419J	30	0.439	1800	0	600	0	600	0		
Molybdenum	222/247	0.261J	58.2	2.08					5800	0		
Nickel	247/247	1.88	4300	134					22000	0		
Potassium	247/247	142	18500	1407								
Selenium	118/249	0.55J	12.9J	2.01					5800	0		
Silver	89/250	0.112J	57.6	1.56					5800	0		
Sodium	225/247	7.92J	6840	136								
Thallium	201/246	0.156	4.65J	0.444					12	0	10.8	0
Uranium	250/250	0.203	53800	861					230	46		
Vanadium	246/247	5.94	81.4J	33.3					5800	0		
Zinc	247/247	4.51	2530	125					350000	0		
Polychlorinated biphenyls (µg/kg)												
PCB-1016	0/164				100000	0	10000	0	10000	0		
PCB-1221	0/164				100000	0	10000	0	10000	0		
PCB-1232	0/164				100000	0	10000	0	10000	0		
PCB-1242	0/164				100000	0	10000	0	10000	0		
PCB-1248	5/164	50.6	14800	4290	100000	0	10000	1	10000	1		

Analyte	Frequency of detect	Min detect[2,3]	Max detect[2,3]	Avg detected result[3]	Max RL[4]	Number of detects ≥ Max RL[5]	Avg RL[6]	Number of detects ≥ Avg RL[5]	PRG[7] (10^{-5} or HI=1)	Number of detects ≥ PRG[5]	GW SSL[8]	Number of detects ≥ GW SSL[5]
PCB-1254	106/164	2.69J	324000	8264	100000	2	10000	15	10000	15		
PCB-1260	100/164	1.73J	102000	1948	100000	1	10000	3	10000	3		
PCB-1262	0/143				100000	0	10000	0	10000	0		
PCB-1268	4/143	10.9	429	120	100000	0	10000	0	10000	0		
Total PCBs	116/164	1.73J	426000	9419	100000	2	10000	15	10000	15		
Radionuclides (pCi/g)												
Actinium-228	257/259	0.312	2590	15.8					10700	0		
Alpha activity	348/349	3.29	696000	3156								
Americium-241	40/340	0.0436	230	22.1					47.3	5		
Beta activity	348/349	2.62J	138000	864								
Bismuth-212	56/59	1.15J	2810	70.7					531000	0		
Bismuth-214	303/303	0.25	8180	32.6					109000	0		
Cesium-137	127/341	0.0528	4060	56.1	20	21	2	44	2	44		
Cobalt-60	0/341								0.483	0		
Curium-244	0/141								348	0		
Curium-247	0/2											
Europium-152	0/2								0.574	0		
Europium-154	0/2								0.697	0		
Europium-155	0/2								52.6	0		
Lead-210	9/9	1.25	1320	162					37.6	2		
Lead-212	312/312	0.143	2770	13.5					53400	0		
Lead-214	313/313	0.21	9230	35.7					599000	0		
Neptunium-237	16/332	0.471	197	21.5	50	2	5	4	5	4		
Niobium-94	0/2								0.243	0		
Plutonium-238	8/332	0.429J	12.9	3.6					148	0		
Plutonium-239	57/332	0.0622J	3320	103					128	6		
Plutonium-241	1/141	0.887J	0.887J	0.887					15300	0		
Potassium-40	337/341	0.772	56.7	22.2					2.2	320		
Protactinium-234	2/2	2.59	20.8	11.7								
Protactinium-234m	98/98	14.6	28000	1270					1.51E+08	0		
Ra/Th decay series[9]	340/341	0	555687	1980	15	35	5	52				
Radium-226[10]	323/341	0.22	12300	49.4								
Strontium-90	10/144	0.936	125	16.8					384	0		
Technetium-99	66/347	2.04	22700	461	121000	0	12100	1	12100	1	85.6	15
Thallium-208	263/263	0.0702	847	4.8					298000	0		
Thorium-228[10]	309/341	0.225	2370	12.6								
Thorium-230[10]	335/341	0.27	552000	1994								
Thorium-232[10]	315/341	0.274	3690	18.5								

Analyte	Frequency of detect	Min detect[2,3]	Max detect[2,3]	Avg detected result[3]	Max RL[4]	Number of detects ≥ Max RL[5]	Avg RL[6]	Number of detects ≥ Avg RL[5]	PRG[7] (10^{-5} or HI=1)	Number of detects ≥ PRG[5]	GW SSL[8]	Number of detects ≥ GW SSL[5]
Thorium-234	253/341	0.889	16200	360					24500	0		
Uranium-234	371/374	0.46	57300J	448	7000	6	700	19	700	19	61.1	91
Uranium-235	198/413	0.249	4250J	65.6	80	16	8	72	8	72	61.1	20
Uranium-238	373/376	0.396	21300	285	500	22	50	86	50	86	61.1	74
Semivolatile organic compounds (µg/kg)												
1,2,4-Trichlorobenzene	0/120								260000	0		
1,2-Dichlorobenzene	0/120								9300000	0		
1,3-Dichlorobenzene	0/120											
1,4-Dichlorobenzene	0/186								110000	0		
2,3,4,6-Tetrachlorophenol	0/120								25000000	0		
2,4,5-Trichlorophenol	0/120								82000000	0		
2,4,6-Trichlorophenol	0/120								820000	0		
2,4-Dichlorophenol	0/120								2500000	0		
2,4-Dimethylphenol	0/120								16000000	0		
2,4-Dinitrophenol	0/119								1600000	0		
2,4-Dinitrotoluene	0/120								74000	0		
2,6-Dinitrotoluene	0/120								15000	0		
2-Chloronaphthalene	0/120								60000000	0		
2-Chlorophenol	0/120								5800000	0		
2-Methyl-4,6-dinitrophenol	0/120								66000	0		
2-Methylnaphthalene	10/120	14.4J	120J	39.3					3000000	0		
2-Methylphenol	0/120								41000000	0		
2-Nitrobenzenamine	0/120								8000000	0		
2-Nitrophenol	0/120											
3,3'-Dichlorobenzidine	0/116								51000	0		
3-Nitrobenzenamine	0/120											
4-Bromophenyl phenyl ether	0/120											
4-Chloro-3-methylphenol	0/120								82000000	0		
4-Chlorobenzenamine	0/120								110000	0		
4-Chlorophenyl phenyl ether	0/120											
4-Nitrobenzenamine	0/120								1100000	0		
4-Nitrophenol	0/120											
Acenaphthene	6/120	14.9J	764J	196					45000000	0		
Acenaphthylene	5/120	14J	176J	54.1								
Aniline	0/120								4000000	0		
Anthracene	10/120	13.8J	4490	570					2.3E+08	0		

Analyte	Frequency of detect	Min detect[2,3]	Max detect[2,3]	Avg detected result[3]	Max RL[4]	Number of detects ≥ Max RL[5]	Avg RL[6]	Number of detects ≥ Avg RL[5]	PRG[7] (10^{-5} or HI=1)	Number of detects ≥ PRG[5]	GW SSL[8]	Number of detects ≥ GW SSL[5]
Benz(a)anthracene	35/116	13.3J	81100	2521					210000	0		
Benzenemethanol	0/120								82000000	0		
Benzo(a)pyrene	31/118	16.1J	70400J	2513					21000	1		
Benzo(b)fluoranthene	32/118	15.5J	114000J	3907					210000	0		
Benzo(ghi)perylene	35/120	18.7J	27100J	1369								
Benzo(k)fluoranthene	21/118	15.3J	37000J	1925					2100000	0		
Benzoic acid	0/119								3.3E+09	0		
Bis(2-chloroethoxy)methane	0/120								2500000	0		
Bis(2-chloroethyl) ether	0/120								10000	0		
Bis(2-chloroisopropyl) ether	0/120								47000000	0		
Bis(2-ethylhexyl)phthalate	6/116	15.3J	1080	223					1600000	0	2350000	0
Butyl benzyl phthalate	1/116	12.8J	12.8J	12.8					12000000	0		
Carbazole	10/120	19.3J	3500	506								
Chrysene	32/116	12.6J	69100	2395					21000000	0		
Dibenz(a,h)anthracene	16/120	26.8J	9750J	1315					21000	0		
Dibenzofuran	1/120	166J	166J	166					1000000	0		
Diethyl phthalate	1/120	15.6J	15.6J	15.6					6.6E+08	0		
Dimethyl phthalate	1/120	239J	239J	239								
Di-n-octylphthalate	0/118								8200000	0		
Diphenylamine	0/120								82000000	0		
Fluoranthene	39/120	13.2J	86100	2497					30000000	0		
Fluorene	6/120	16.7J	913J	320					30000000	0		
Hexachlorobenzene	0/120								9600	0		
Hexachlorobutadiene	0/120								53000	0		
Hexachlorocyclopentadiene	0/119								7500	0		
Hexachloroethane	0/120								80000	0		
Indeno(1,2,3-cd)pyrene	27/120	15J	35300J	1856					210000	0		
Isophorone	3/120	730	1660	1307					24000000	0		
m+p Methylphenol	0/120											
Naphthalene	9/120	16.7J	620	108					170000	0		
Nitrobenzene	0/120								220000	0		
N-Nitroso-di-n-propylamine	0/120								3300	0		
Pentachlorophenol	0/120								40000	0		
Phenanthrene	30/120	13.8J	14500	708								
Phenol	1/120	149J	149J	149					2.5E+08	0		

Analyte	Frequency of detect	Min detect[2,3]	Max detect[2,3]	Avg detected result[3]	Max RL[4]	Number of detects ≥ Max RL[5]	Avg RL[6]	Number of detects ≥ Avg RL[5]	PRG[7] (10^{-5} or HI=1)	Number of detects ≥ PRG[5]	GW SSL[8]	Number of detects ≥ GW SSL[5]
Pyrene	38/116	12.5J	135000	3842					23000000	0		
Pyridine	2/120	369J	556	462					1200000	0		
Volatile organic compounds (µg/kg)												
1,1,1-Trichloroethane	0/191								36000000	0	97900	0
1,1,2,2-Tetrachloroethane	0/190								27000	0		
1,1,2-Trichloroethane	0/191								6300	0	1370	0
1,1-Dichloroethane	1/191	0.596	0.596	0.596					160000	0		
1,1-Dichloroethene	2/191	0.958	1.2	1.08					1000000	0	1750	0
1,2-Dichloroethane	0/191								20000	0	729	0
1,2-Dichloropropane	0/191								66000	0		
2-Butanone	16/191	1.53	19.1J	4.7					1.9E+08	0		
2-Hexanone	0/191								1300000	0		
4-Methyl-2-pentanone	0/191								1.4E+08	0		
Acetone	86/191	1.75	279J	13.9					6.7E+08	0		
Benzene	4/191	0.314	0.834	0.591					51000	0	1150	0
Bromodichloromethane	0/191								13000	0		
Bromoform	0/191								860000	0		
Bromomethane	0/191								30000	0		
Carbon disulfide	2/191	4.49	7.06J	5.78					3500000	0		
Carbon tetrachloride	0/191								29000	0	2770	0
Chlorobenzene	0/191								1300000	0		
Chloroethane	0/191								57000000	0		
Chloroform	0/191								14000	0	1230	0
Chloromethane	0/191								460000	0		
cis-1,2-Dichloroethene	40/191	0.396	175	18.8					2300000	0		
cis-1,3-Dichloropropene	0/190											
Dibromochloromethane	0/191								390000	0		
Ethylbenzene	3/191	0.767	1.37	1.08					250000	0		
Methylene chloride	7/191	2.9	6.13	4					3200000	0	241	0
Styrene	0/190								35000000	0		
Tetrachloroethene	28/191	0.396	54.7	10.3					390000	0	4720	0
Toluene	19/191	0.422	18.6	2.29					47000000	0	502000	0
Total Xylene	2/191	2.65	5.51	4.08					2500000	0		
trans-1,2-Dichloroethene	13/191	0.433	62.1	10.2					23000000	0		
trans-1,3-Dichloropropene	0/191											
Trichloroethene	43/191	0.475	45.6	5					19000	0	1720	0
Vinyl chloride	18/191	0.5	52.4	10.4					17000	0	176	0

Analyte	Frequency of detect	Min detect[2,3]	Max detect[2,3]	Avg detected result[3]	Max RL[4]	Number of detects ≥ Max RL[5]	Avg RL[6]	Number of detects ≥ Avg RL[5]	PRG[7] (10^{-5} or HI=1)	Number of detects ≥ PRG[5]	GW SSL[8]	Number of detects ≥ GW SSL[5]
[1]Stations in summary include Z2-EU19-101, Z2-EU19-102, Z2-EU19-103, Z2-EU19-104, Z2-EU19-105, Z2-EU19-106, Z2-EU19-107, Z2-EU19-108, Z2-EU19-109, Z2-EU19-110, Z2-EU19-111, Z2-EU19-112, Z2-EU19-113, Z2-EU19-114, Z2-EU19-115, Z2-EU19-116, Z2-EU19-117, Z2-EU19-118, Z2-EU19-119, Z2-EU19-120, Z2-EU19-121, Z2-EU19-122, Z2-EU19-123, Z2-EU19-124, Z2-EU19-125, Z2-EU19-182, Z2-EU19-400, Z2-EU19-401, Z2-EU19-402, Z2-EU19-403, Z2-EU19-404, Z2-EU19-405, Z2-EU19-406, Z2-EU19-407, Z2-EU19-408, Z2-EU19-409, Z2-EU19-410, Z2-EU19-411, Z2-EU19-412, Z2-EU19-413, Z2-EU19-414, Z2-EU19-415, Z2-EU19-416, Z2-EU19-417, Z2-EU19-418, Z2-EU19-419, Z2-EU19-420, Z2-EU19-421, Z2-EU19-422, Z2-EU19-423, Z2-EU19-424, Z2-EU19-425, Z2-EU19-426, Z2-EU19-427, Z2-EU19-428, Z2-EU19-429, Z2-EU19-430, Z2-EU19-431, Z2-EU19-432, Z2-EU19-433, Z2-EU19-434, Z2-EU19-437, Z2-EU19-438, Z2-EU19-439, Z2-EU19-440, Z2-EU19-441, Z2-EU19-442, Z2-EU19-443, Z2-EU19-444, Z2-EU19-445, Z2-EU19-446, Z2-EU19-447, Z2-EU19-448, Z2-EU19-450, Z2-EU19-451, Z2-EU19-452, Z2-EU19-453, Z2-EU19-454, Z2-EU19-455, Z2-EU19-456, Z2-EU19-457, Z2-EU19-701, Z2-EU19-702, Z2-EU19-703, Z2-EU19-705, Z2-EU19-706, Z2-EU19-707, Z2-EU19-708, Z2-EU19-709, Z2-EU19-710, Z2-EU19B-126, Z2-EU19B-127, Z2-EU19B-128, Z2-EU19B-129, Z2-EU19B-130, Z2-EU19B-131, Z2-EU19B-132, Z2-EU19B-133, Z2-EU19B-134, Z2-EU19B-135, Z2-EU19B-136, Z2-EU19B-137, Z2-EU19B-138, Z2-EU19B-139, Z2-EU19B-140, Z2-EU19B-141, Z2-EU19B-142, Z2-EU19B-143, Z2-EU19B-144, Z2-EU19B-145, Z2-EU19B-146, Z2-EU19B-147, Z2-EU19B-148, Z2-EU19B-149, Z2-EU19B-150, Z2-EU19B-151, Z2-EU19B-152, Z2-EU19B-153, Z2-EU19B-154, Z2-EU19B-155, Z2-EU19B-155A, Z2-EU19B-155B, Z2-EU19B-155C, Z2-EU19B-155D, Z2-EU19B-156, Z2-EU19B-157, Z2-EU19B-158, Z2-EU19B-159, Z2-EU19B-160, Z2-EU19B-161, Z2-EU19B-162, Z2-EU19B-163, Z2-EU19B-164, Z2-EU19B-165, Z2-EU19B-166, Z2-EU19B-167, Z2-EU19B-167A, Z2-EU19B-167B, Z2-EU19B-167C, Z2-EU19B-167D, Z2-EU19B-168, Z2-EU19B-168A, Z2-EU19B-168B, Z2-EU19B-168C, Z2-EU19B-168C-1, Z2-EU19B-168C-2, Z2-EU19B-168C-3, Z2-EU19B-168D, Z2-EU19B-169, Z2-EU19B-170, Z2-EU19B-172, Z2-EU19B-173, Z2-EU19B-175, Z2-EU19B-177, Z2-EU19B-178A, Z2-EU19B-178B, Z2-EU19B-178C, Z2-EU19B-178D, Z2-EU19B-183, Z2-EU19B-184, Z2-EU19B-185, Z2-EU19B-186, Z2-EU19B-187, Z2-EU19B-188, Z2-EU19B-301, Z2-EU19B-302, Z2-EU19B-303, Z2-EU19B-304, Z2-EU19B-305, Z2-EU19B-438, Z2-EU19B-458, Z2-EU19B-459, Z2-EU19B-460, Z2-EU19B-461, Z2-EU19B-462, Z2-EU19B-463, Z2-EU19B-464, Z2-EU19B-465, Z2-EU19B-466, Z2-EU19B-467, Z2-EU19B-468, Z2-EU19B-469, Z2-EU19B-470, Z2-EU19B-471, Z2-EU19B-472, Z2-EU19B-601, Z2-EU19B-602, Z2-EU19B-603, Z2-EU19B-604, Z2-EU19B-605, Z2-EU19B-606, Z2-EU19B-607, Z2-EU19B-608, Z2-EU19B-609, Z2-EU19B-610, Z2-EU19B-611, Z2-EU19B-612, Z2-EU19B-713, Z2-EU19B-714, Z2-EU19B-715, Z2-EU19B-716, Z2-EU19B-717, Z2-EU19B-718, Z2-EU19B-719, Z2-EU19B-721, Z2-EU19B-722, Z2-EU19B-723, and Z2-EU19B-724.												
[2]The "J" validation qualifier means that the analyte was positively identified and the result is the approximate concentration in the sample.												
[3]Blanks indicate that the analyte was not detected.												
[4]Max RL values are presented; blanks indicate that there is no Max RL for the analyte. Max RLs are from Zone 2 ROD Table 2.13 except for technetium-99 which is presented in Zone 2 RDR/RAWP Sect. 3.1.2.												
[5]Blanks indicate that the criterion does not apply to the analyte.												
[6]Avg RL values are presented; blanks indicate that there is no Avg RL for the analyte. Avg RLs are from Zone 2 ROD Table 2.14 except for technetium-99 which is presented in Zone 2 RDR/RAWP Sect. 3.1.2.												
[7]PRG values are presented; blanks indicate that there is no PRG for the analyte. Chemical PRGs were calculated from regional screening levels using the website at http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search, November 2019 revision; radionuclide PRGs were calculated during November 2019 using the website at http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search.												
[8]GW SSL values are presented; blanks indicate that there is no GW SSL for the analyte. GW SSLs are from Zone 2 ROD Table C.5 except for technetium-99 which is presented in Zone 2 RDR/RAWP Sect. 3.1.2.												
[9]The 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. Because the calculation involves subtraction of background from analytical results and negative numbers are not allowed, 0 (zero) is a legitimate result.												
[10]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.												

Avg = average	Min = minimum
EU = exposure unit.	PRG = preliminary remediation goal
GW = groundwater	RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
HI = hazard index	RL = remediation level
Max = maximum	ROD = Record of Decision

ATTACHMENT 5:
CONCURRENCE FORMS

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Project Team Concurrence

1. INTRODUCTION

The purpose of this concurrence form is to make changes to the sample plan presented in BJC/OR/3231 *Data Quality Objective Scoping Package for the Poplar Creek Group (EUs Z2-11, Z2-12, and Z2-19) at the East Tennessee Technology Park, Oak Ridge, Tennessee* (Poplar Creek DQO Scoping Package), for characterizing the exposure unit (EU) Z2-19 Class 1 soil unit (SU). The material contained in this concurrence was presented to the Project Team during a teleconference held on August 24, 2016.

2. AREA

Zone 2 Poplar Creek EU Group, EU Z2-19.

3. BACKGROUND

Exposure Unit Z2-19 is located immediately west of the former Bldg. K-25 on the east bank of Poplar Creek (Fig. 1). The EU Z2-19 boundaries encompass approximately 20 acres of land, which the Poplar Creek DQO Scoping Package divided into approximately 3 acres of Class 1 SUs and 17 acres of Class 3 SUs (Fig. 2). According to the Poplar Creek DQO Scoping Package, characterization of EU Z2-19 was to be conducted as described below.

Class 1 SU Characterization

- Perform radiological survey of the 3 acres first to define the contamination boundaries (at least 80 percent of the Class 1 SU will be surveyed with a target of 100 percent).
- Calculate the remedial action boundary (RAB) of this Class 1 SU using the Visual Sampling Plan™ (VSP) software after review of the survey results by the Project Team.
- Collect all samples from 0-1 ft. and analyze for metals, polychlorinated biphenyls (PCBs), and/or semivolatile organic compounds (SVOCs). Samples will be screened for radiation and volatile organic compounds (VOCs) and will be analyzed for radionuclides and VOCs if the respective action levels are exceeded during screening.
- Select randomly 20 percent of the samples for full suite analysis.
- Collect at least two samples as 0-10 ft., three-interval composite samples. For locations that fall on paved surfaces, the sampling interval will begin at the base of the paved surface. These samples will be analyzed for metals, PCBs, radionuclides, SVOCs, and VOCs.
- Select 25 percent of the historical samples exceeding the maximum (Max) remediation levels (RLs) for confirmation sampling based on the results of the radiological survey. Samples will be collected from 0-1 ft. beginning beneath the pavement or concrete.

Class 3 SU Characterization

- Conduct the Class 3 SU walkover assessment according to protocol.
- Sample four biased locations near the underground utility corridors.
- Collect samples from soil between 0-10 ft. or to native material.
- Examine storm drain lines at entry points in the interior of facilities. Take a sample where sufficient sediment is found.
- Collect samples as close as possible to the infrastructure when sampling infrastructure where there may be leachable constituents.
- Screen all samples for radionuclides and VOCs and analyze for metals, PCBs, and SVOCs.

Project Team Concurrence

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Area: Poplar Creek EU Group
FCN-ETTP-Zone 2-194
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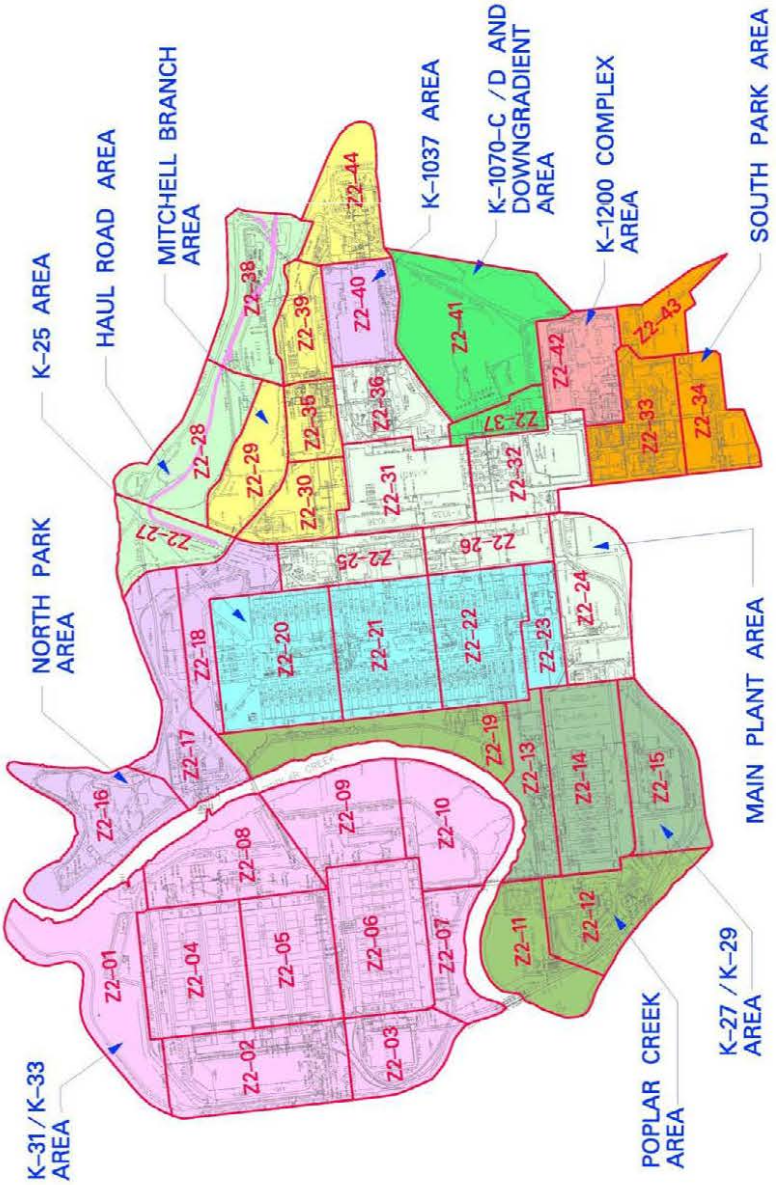

Fig. 1. Zone 2 Exposure Units.

Project Team Concurrence

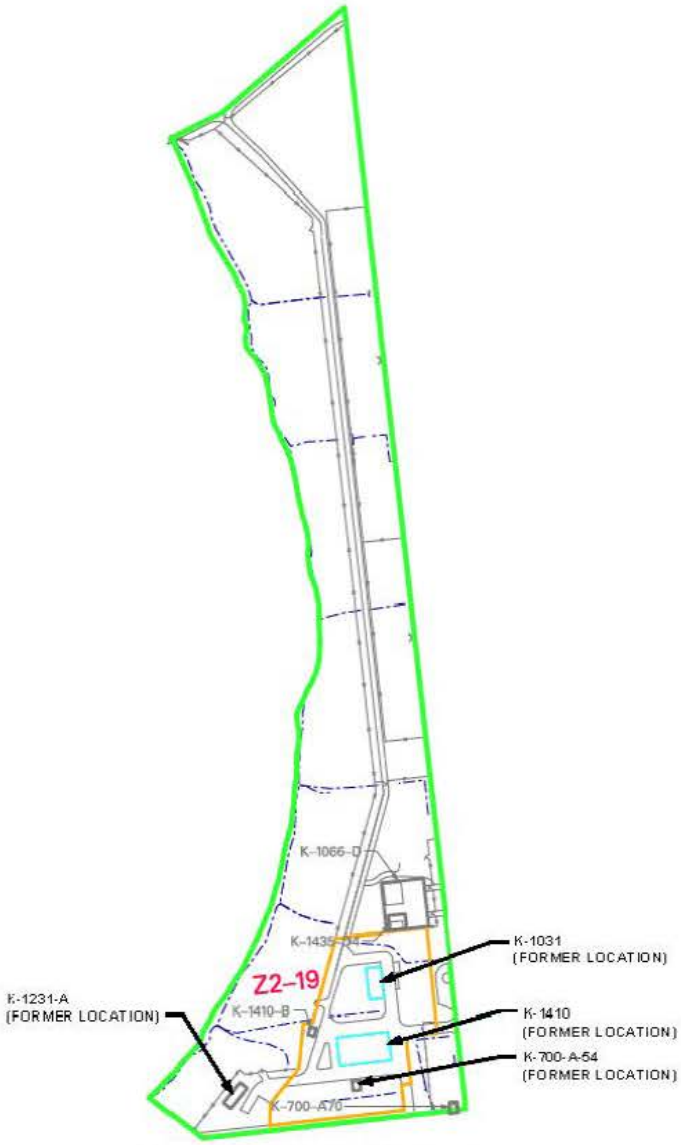

Fig. 2. EU Z2-19 Class 1 (yellow outline) and Class 3 (green outline) soil unit boundaries.

In-place Concrete

The Poplar Creek DQO Scoping Package specifically calls out K-700-A-54, K-1031, K-1410, and K-1410-A concrete slabs in EU Z2-19 for characterization:

- Review historical data and process knowledge to identify most probable locations of contamination.
- Inspect visually to identify most probable locations of contamination.
- Conduct radiological and chemical field screens at locations of probable contamination.
- Propose a sampling grid consistent with the Dynamic Verification Strategy (DVS) for Project Team concurrence once the area of contamination is approximated.

4. CLASS 1 SU RADIATION WALKOVER SURVEY RESULTS

The Class 1 SU radiation walkover survey in EU Z2-19 was conducted during July 2016. The results of the survey are depicted graphically on Fig. 3. The survey covered almost 100 percent of the Class 1 SU and was extended north and west into the Class 3 SU to ensure completeness. The survey was conducted according to the DVS radiation walkover survey protocol. Background radiation was determined according to the protocol to be 1392 counts per minute (cpm) and the action level was set at 2 times background (2784 cpm) as specified by the protocol. As shown on Fig. 3, there are three relatively large areas in the Class 1 SU that exceed the action level (yellow, orange, and red colors), plus several smaller areas with action level exceedances. Also, there are three relatively large and several smaller areas in the Class 3 SU with action level exceedances. Finally, there are relatively large areas of the survey footprint that are less than the survey's background value (green areas) as well as large areas with radiation measurements falling between background and the action level (blue areas).

5. RATIONALE FOR CHANGING THE DQO SCOPING CHARACTERIZATION APPROACH

As stated in Sect. 1, the purpose of this concurrence is to propose changing the approach to the characterization of EU Z2-19 as is described in the Poplar Creek DQO Scoping Package. There are two reasons described below for changing this approach. These reasons include evidence for redistribution of contaminants and the need to implement a characterization strategy that will define the nature and extent of contamination as it exists today.

5.1 Contaminant Redistribution

Figure 4 illustrates the locations of historical samples collected in EU Z2-19. The inset of Fig. 4 focuses on the portion of the radiation walkover survey area that included the 12 historical sample locations with Max RL exceedances (Table 1).

Table 1. EU Z2-19 historical sample locations with Max RL exceedances

Sample locations		
RAD95[a]	RAD110	RAD115[a]
RAD98[a]	RAD111	RAD116[a]
RAD99[a]	RAD112	RAD117[a]
RAD109	RAD113	RAD118[a]

[a]Occurs in below-background radiation walkover survey area.

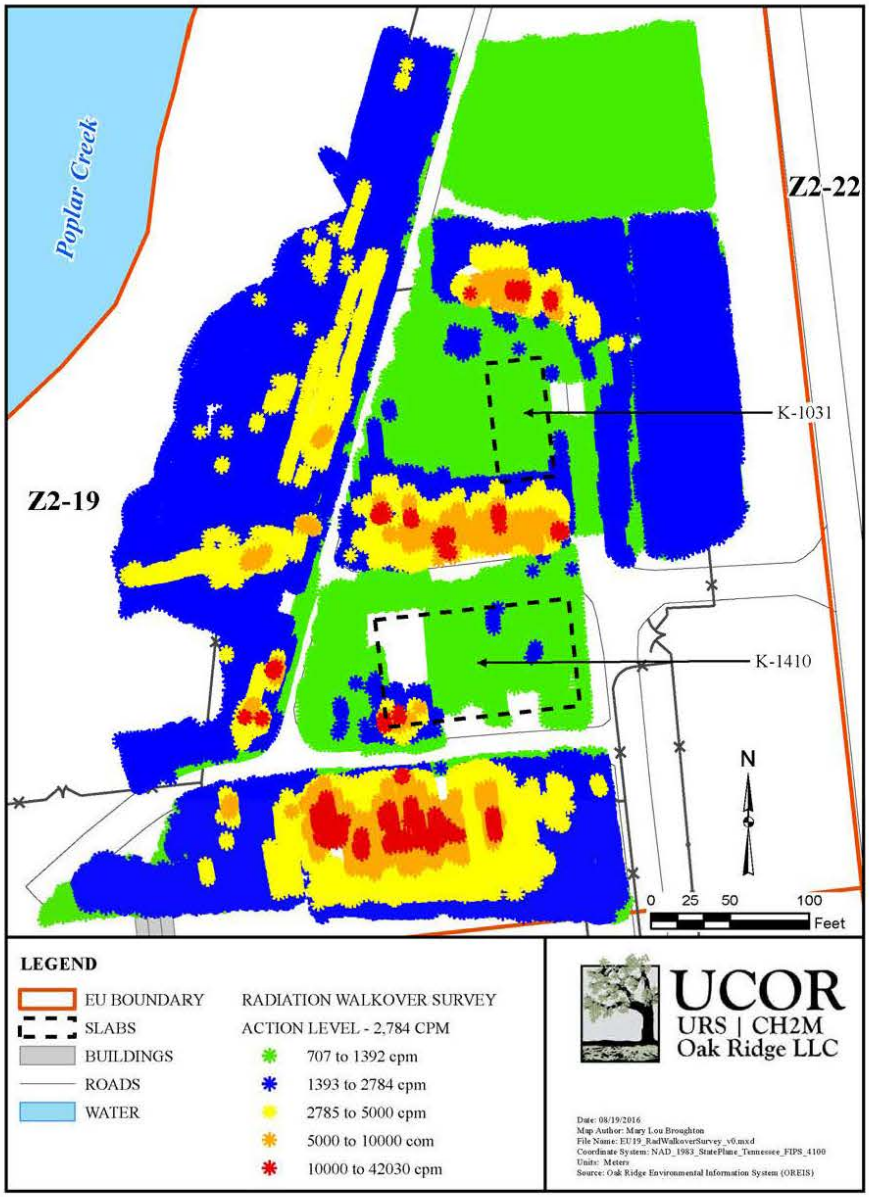

Fig. 3. EU Z2-19 Class 1 SU radiation walkover survey results.

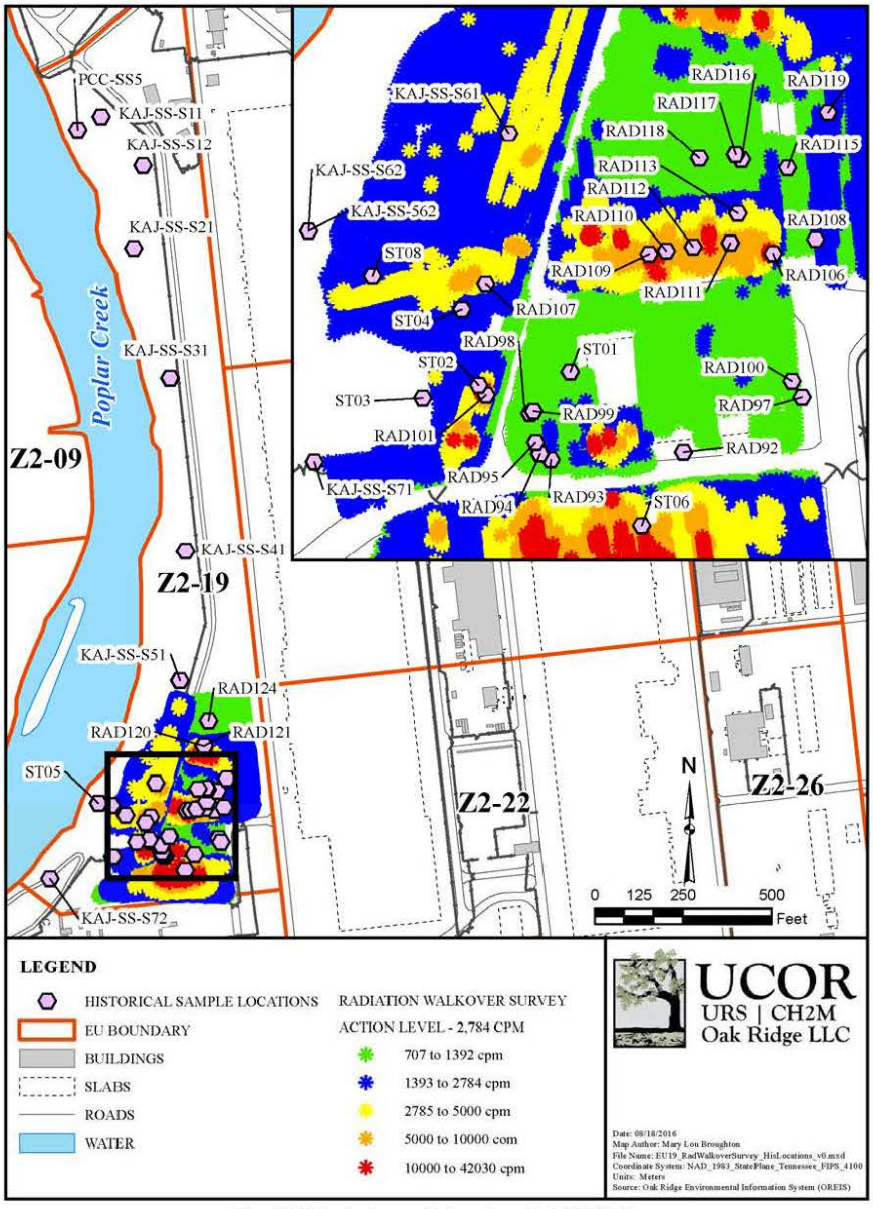

Fig. 4. Historical sample locations in EU Z2-19.

Inspection of Fig. 4 and Table 1 shows that seven of the 12 historical sample locations with Max RL exceedances occur in radiation walkover survey areas of below-background radiation. All of these historical sample locations originally were identified during a radiation walkover survey conducted in 1994. The samples themselves were collected from 0 to 6 in. below ground surface, therefore representing the uppermost soil levels. Based on the overlay of the historical Max RL exceedance sample locations with the current radiation walkover survey results, it is concluded that there has been a redistribution of surface contamination over the more than 20 years since the historical samples were collected. The redistribution of contamination is most evident for the seven historical sample locations currently in below-background areas of the current radiation survey for which redistribution has occurred on a large scale. Based on this large-scale contaminant redistribution, it can be inferred that there is a reasonable probability that contaminant redistribution also has occurred at the historical sample locations in above-action level areas of the current radiation walkover survey, but on a smaller scale.

5.2 Refine the Existing Sampling Plan to Correspond to Existing Conditions

The Poplar Creek DQO Scoping Package gives direction for two sampling approaches in the EU Z2-19 Class 1 SU that will no longer adequately characterize the nature and extent of contamination in the SU to make remedial action decisions.

First, the Poplar Creek DQO Scoping Package says that 25 percent of the historical sample locations with Max RL exceedances are to be sampled. As discussed in Sect. 5.1 of this concurrence, more than half of the historical sample locations with Max RL exceedances now occur in areas in which below-background levels of radioactivity are characteristic. The interpretation of this observation includes that some locations of the Class 1 SU have had a large-scale migration of contaminants and that there has probably been migration on smaller scales throughout the SU. As a result, resampling historical locations at their recorded coordinates is not likely to sample the contamination originally observed at those coordinates.

Second, the Poplar Creek DQO Scoping Package says that upon completion of the Class 1 SU radiation walkover survey and review of the survey results, a systematic grid of sample locations will be calculated to define RABs. In accordance with this direction, systematic sample grids were calculated for the larger of the above-action level areas delineated during the radiation walkover survey discussed in Sect. 4. The sample grids are shown overlain on the radiation walkover survey graphical results on Fig. 5. Systematic sample location grids are not shown for the smaller areas of above-action level radiation because only one or two sample locations per area resulted from the calculations. Inspection of Fig. 5 shows that the calculated grid sample locations do not fall on most of the locations with highest radioactivity as determined by the radiation walkover survey. Therefore, the systematic grid sample locations required by the Poplar Creek DQO Scoping Package will not provide information on the nature of the contaminants that would likely cause the greatest risk and/or potential threats to groundwater. A primary contributing factor to this conclusion is the fact that location information for the major contaminants, which was determined in 1994, has been lost owing to redistribution of contaminants.

6. PROPOSED CLASS 1 SU CHARACTERIZATION STRATEGY

A characterization strategy is proposed that uses data from the radiation walkover survey conducted during July 2016 (Sect. 4) to effectively and efficiently determine the nature and extent of contamination in the EU Z2-19 Class 1 SU. Using the data collected during this approach, decisions will be made on the need for remedial actions and subsequent sampling will delineate RABs. Only a new characterization approach to the Class 1 SU is proposed. Characterization of the EU Z2-19 Class 3 SU will proceed as described in the Poplar Creek DQO Scoping Package and concrete slabs will be addressed with the DVS in-place concrete assessment protocol. The Class 3 SU sample locations (Z2-EU19B-301 through Z2-U19B-305) are shown on Fig. 6 and the details of sampling and analysis at these locations are presented in Table 2. The proposed Class 1 SU characterization strategy is a two-phase approach as described below.

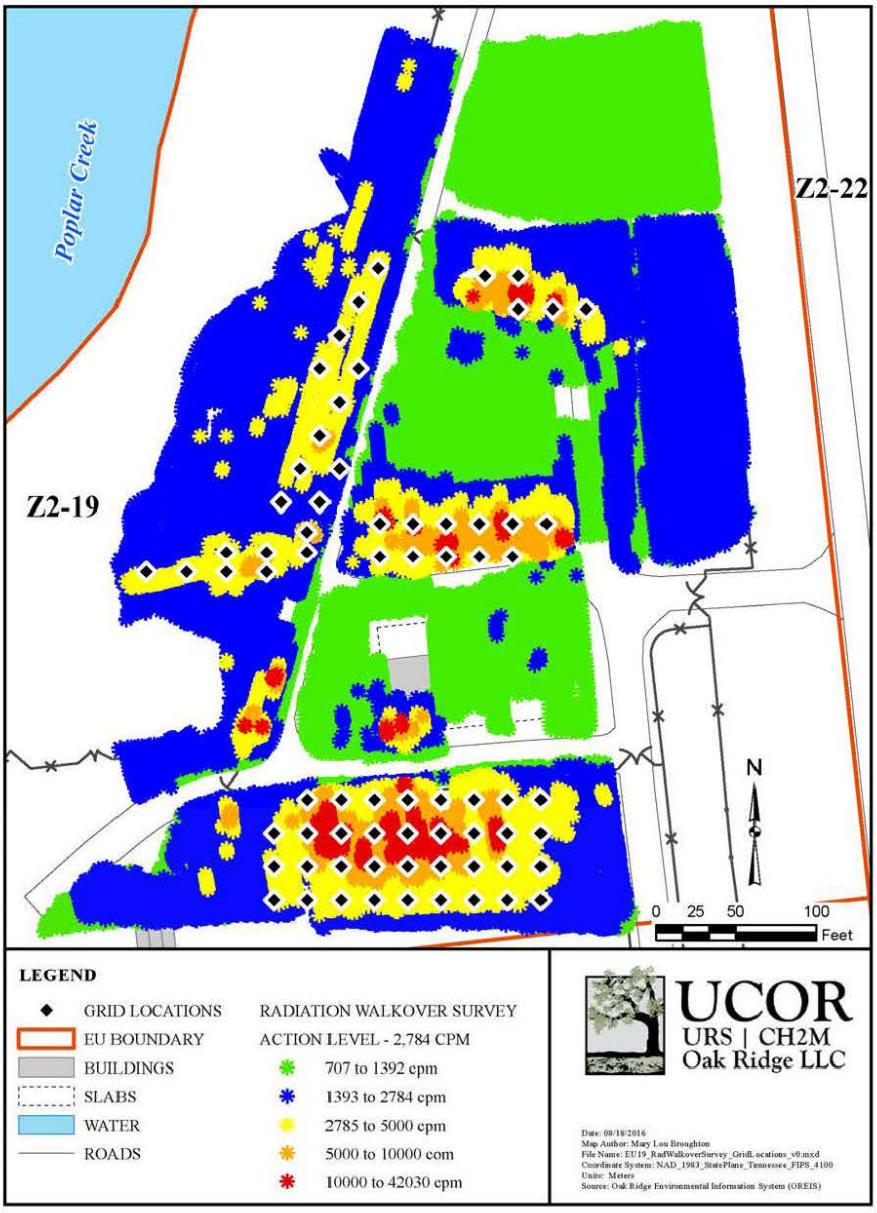

Fig. 5. Systematic grid sample locations on EU Z2-19 radiation walkover survey above-action level areas.

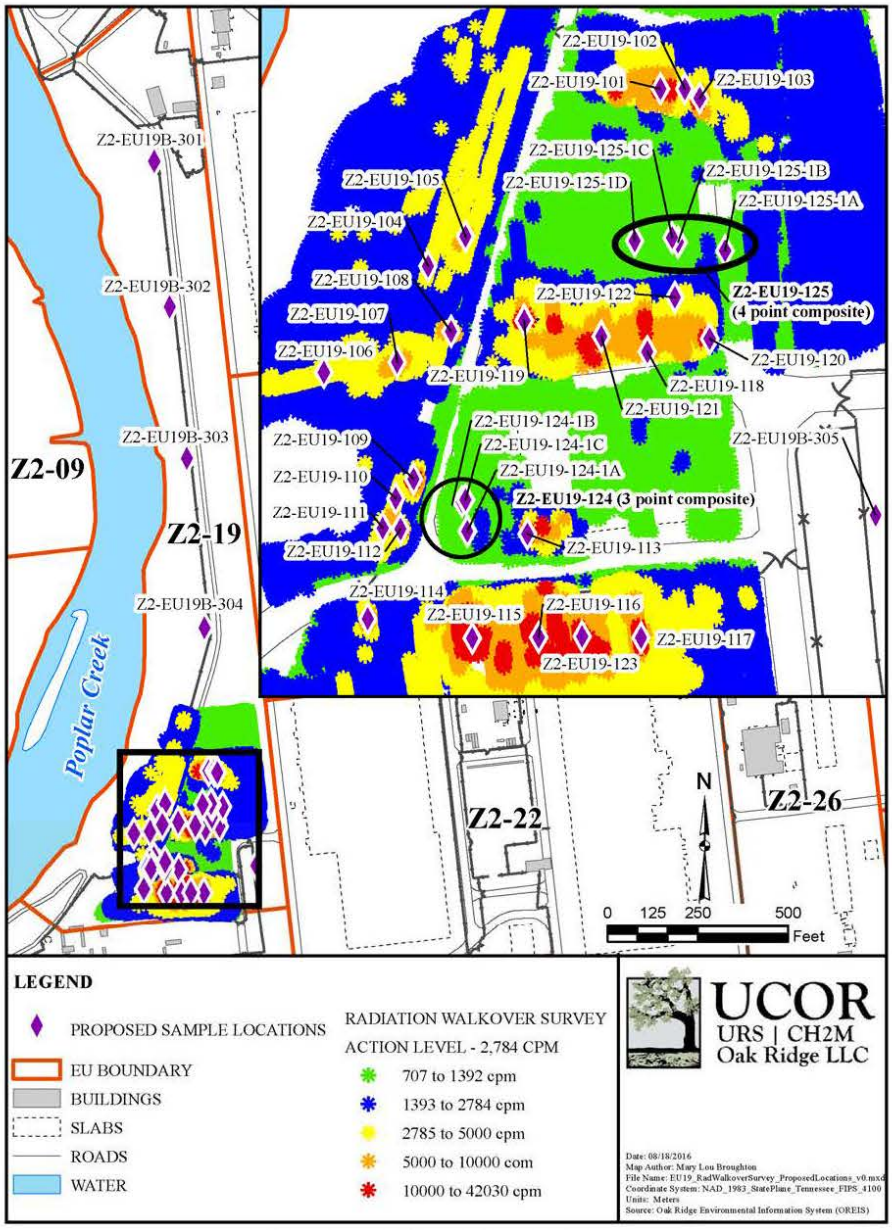

Fig. 6. Proposed EU Z2-19 sample locations.

6.1 Determine If and Where Remedial Actions Are Required

The first phase of the proposed Class 1 SU characterization strategy will be implemented by performing the following:

- Collect samples from radiation walkover survey spots of highest radiation measurements (designated red on Fig. 3) to determine the nature of contamination and whether that contamination requires remedial action.
- Collect samples at locations with lower radiation measurements, but still above the action level (designated yellow areas on Fig. 3) to understand the relationship between the radiation walkover survey measurements and contaminant concentrations.
- Collect surface samples to correlate analytical data with survey measurement results.
- Collect subsurface samples to determine contaminant distribution with depth.
- Verify the absence of historical Max RL exceedances by compositing samples from the areas in which the historical Max RL occurred.

The proposed Class 1 SU sample locations are shown on Fig. 6 and the details of sampling and analysis at each location are presented in Table 2. In summary, the following shall be performed:

- Collect 20 sample locations (Z2-EU19-101 through Z2-EU19-120) in radiation walkover survey above-action level areas (depicted as yellow, orange, and red colors on Fig. 6) with samples collected from the 0- to 1-ft-depth interval and analyzed for metals, PCBs, radionuclides, and SVOCs, plus conditional VOCs if screening action levels are exceeded.
- Three sample locations (Z2-EU19-121 through Z2-EU19-123) in radiation walkover survey above-action level areas (depicted as yellow, orange, and red colors on Fig. 6) with samples collected at three discrete depth intervals from the 0- to 10-ft-depth interval and analyzed for metals, PCBs, radionuclides, and SVOCs, plus conditional VOCs if screening action levels are exceeded.
- One three-point composite sample at an area of historical Max RL exceedances unconfirmed by the current radiation walkover survey (labeled Z2-EU19-124 on Fig. 6) with sample points collected from the 0- to 1-ft-depth interval and analyzed for metals, PCBs, radionuclides, and SVOCs, plus conditional VOCs if screening action levels are exceeded.
- One four-point composite sample at an area of historical Max RL exceedances unconfirmed by the current radiation walkover survey (labeled Z2-EU19-125 on Fig. 6) with sample points collected from the 0- to 1-ft-depth interval and analyzed for metals, PCBs, radionuclides, and SVOCs, plus conditional VOCs if screening action levels are exceeded.

6.2 Follow-on Sampling after Determining Where Remedial Actions Are Required

After determining where remedial actions are required in the first phase of characterization, follow-on sampling will be conducted to determine the extent of the remedial actions by conducting delineation sampling around sample locations identified during the first phase of sampling as requiring remedial actions. Subsurface sample data from the first phase of sampling will be used to plan sample depths for the remedial action delineation sample locations.

Project Team Concurrence

7. CONCLUSION AND SUMMARY

This concurrence form proposes an alternate characterization strategy for the EU Z2-19 Class 1 that will more effectively define the nature and extent of contamination in the SU and thereby better enable delineation of remedial action boundaries if such actions are determined to be necessary. The proposed sample locations for this alternate characterization strategy are shown on Fig. 6 of this concurrence and the details of sampling and analysis at each location are presented in Table 2. No change is being proposed for sampling the EU Z2-19 Class 3 SU; concrete slabs in the EU will be addressed with the in-place concrete assessment protocol. The characterization start is currently planned for June 19, 2017.

Concurrence:

M. A Iavazzi — 11/4/16
U.S. Department of Energy — Date

Randall Hoffman — 11/4/16
Tennessee Department of Environment and Conservation — Date

Christie Jones — 11/3/16
U.S. Environmental Protection Agency — Date

Table 2. EU Z2-19 Class 1 SU (proposed) and Class 3 SU sampling

Sample location	X	Y	Sampling interval	Laboratory analysis					Comments
				Metal	PCB	RAD	SVOC	VOC	
Proposed Class 1 SU sample locations									
Z2-EU19-101	744632.19	178720.36	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-102	744636.76	178720.36	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-103	744639.51	178718.60	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-104	744588.61	178686.99	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-105	744595.62	178692.63	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-106	744569.01	178667.15	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-107	744582.81	178669.10	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-108	744592.87	178674.80	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-109	744585.86	178647.12	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-110	744582.51	178643.49	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-111	744580.07	178637.82	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-112	744583.42	178637.64	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-113	744607.20	178636.73	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-114	744577.33	178620.63	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-115	744596.83	178616.98	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-116	744609.33	178617.16	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-117	744628.53	178617.10	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-118	744629.75	178670.99	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-119	744606.59	178676.87	0-1 ft soil	1	1	1	1	[a]	
Z2-EU19-120	744641.44	178673.45	0-1 ft soil at RAD106	1	1	1	1	[a]	
Z2-EU19-121	744621.06	178673.94	0-10 ft three discrete-interval soil 0-0.5, 0.5-2, 2-10 ft at historical location RAD110	3	3	5	3	[a]	[b]
Z2-EU19-122	744634.88	178681.17	0-10 ft three discrete-interval soil 0-0.5, 0.5-2, 2-10 ft at historical location RAD113	3	3	5	3	[a]	[b]
Z2-EU19-123	744617.54	178617.32	0-10 ft three discrete interval soil 0-0.5, 0.5-2, 2-10 ft	3	3	5	3	[a]	[b]
Z2-EU19-124	744595.94 (RAD95) 744594.88 (RAD98)	178637.25 (RAD95) 178642.88 (RAD98)	0-1 ft three-point composite at historical locations RAD95, RAD98and , RAD99	1	1	1	1	[a]	[c]
Z2-EU19-124 (cont.)	744595.56 (RAD99)	178643.23 (RAD99)		1	1	1	1	[a]	[c]
Z2-EU19-125	744644.25	178689.89	0-1 ft three-point composite at	1	1	1	1	[a]	[c]

Table 2. EU Z2-19 Class 1 SU (proposed) and Class 3 SU sampling (cont.)

Sample location	X	Y	Sampling interval	Laboratory analysis					Comments
				Metal	PCB	RAD	SVOC	VOC	
	(RAD115)	(RAD115)	historical locations RAD115, RAD116, RAD117, RAD118						
	744635.5 (RAD116)	178691.48 (RAD116)							
	744634.38 (RAD117)	178692.38 (RAD117)							
	744627.38 (RAD118)	178691.75 (RAD118)							
Class 3 SU sample locations									
Z2-EU19B-301	744586.35	179235.44	0-10 ft three-interval composite soil 0-0.5, 0.5-2, 2-10 ft	1	1	c	1	[a]	
Z2-EU19B-302	744599.36	179112.54	0-10 ft three-interval composite soil 0-0.5, 0.5-2, 2-10 ft	1	1	c	1	[a]	
Z2-EU19B-303	744614.02	178984.92	0-10 ft three-interval composite soil 0-0.5, 0.5-2, 2-10 ft	1	1	c	1	[a]	
Z2-EU19B-304	744628.68	178840.75	0-10 ft three-interval composite soil 0-0.5, 0.5-2, 2-10 ft	1	1	c	1	[a]	
Z2-EU19B-305	744672.57	178640.28	0-10 ft three-interval composite soil 0-0.5, 0.5-2, 2-10 ft	1	1	c	1	[a]	
			Total EU Z2-19 analyses	**36**	**36**	**37/5**[a]	**36**	**1/29**[a]	

[a]Conditional analysis based on screening results.

[b]Three discrete intervals: VOCs conditional at each interval; RAD discrete at highest reading at each interval (even if action level is not exceeded); metals, PCBs, and SVOCs co-located with RAD sample based on visual cues at each interval; up to two additional discrete samples may be collected for radiological analysis within the 2- to 10-ft interval based on RAD screening; one of the two additional discrete samples will be collected at the bottom of the 10-ft interval; second additional discrete sample will either be collected between 2 ft and the discrete sample collected based on the RAD survey or between the discrete sample collected based on the RAD survey and 10 ft.

[c]Discrete samples will be held at the lab pending composite sample results.

EU = exposure unit
PCB = polychlorinated biphenyl
RAD = radionuclide
SU = soil unit
SVOC = semivolatile organic compound
VOC = volatile organic compound

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Project Team Agreement Log # 390
Area: Poplar Creek EU Group
FCN-ETTP-Zone 2-225

Core Team Concurrence

Area:

This concurrence form documents the characterization efforts to determine the need for and extent of remedial action (RA) within the Class 1 Soil Unit (SU), and adjacent areas as deemed appropriate, in Exposure Unit (EU) Z2-19 in accordance with *Data Quality Objective Scoping Package for the Poplar Creek Group (EUs Z2-11, Z2-12, and Z2-19) at the East Tennessee Technology Park, Oak Ridge, Tennessee* (BJC/OR-3231) (Poplar Creek DQO Scoping Package). Sampling locations for EU Z2-19 are identified in Appendix G of *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&D5) (RDR/RAWP). Modifications to the sampling plan for the Class 1 SU were approved in FCN-ETTP-Zone 2-194. This concurrence form presents a summary of the background information, characterization objectives and strategy, evaluation of sample results, and the extent of the three planned RAs within the Class 1 SU.

Summary Information:

Description: EU Z2-19 is located immediately west of the former Bldg. K-25 on the east bank of Poplar Creek. The EU Z2-19 boundaries encompass approximately 20 acres of land, which the Poplar Creek DQO Scoping Package divided into approximately 3 acres of Class 1 SUs and 17 acres of Class 3 SUs. This concurrence is primarily in the Class 1 SU, which includes the former Bldg. K-1031 concrete slab and the former Bldg. K-1410 concrete slab.

Constructed in 1945 as a maintenance support facility for the K-25 building, Bldg. K-1031was used to store and dispense trapping media for spent cascade traps and was later used as a cutting and size reduction area for process equipment from the Fercleve Thermal Diffusion Plan. Prior to demolition, the building was used for equipment and material storage. Only the concrete slab remains. Walkover surveys performed indicate low levels of contamination exist throughout the site, with small areas of higher activity to the north and south of the building.

The Bldg. K-1410 was used to mix media from the spent cascade traps for use in the K-25 Gaseous Diffusion Plant. Subsequently, it was used for decontamination and recovery of uranium from large pieces of equipment. The building included two spray facilities to solubilize and remove uranium with nitric acid and to degrease pumps with trichloroethene. Finally, the facility was converted to an electroplating facility by removing the decontamination tanks and filling the degreasing pits with concrete. Only a concrete slab remains.

Both the K-1031 and K-1410 slabs have been covered with asphalt. Within the Class 1 SU, three distinct soil excavation actions are to take place, designated as Dig 1, Dig 2, and Dig 3, based on the results of the characterization effort.

Data Quality Objectives:

The goal of the EU Z2-19 Class 1 SU is to release this area for its intended future end use. To achieve this goal, the types, distributions, and concentrations of chemicals and radionuclides in soils, building slabs, and related media must be determined to make decisions of RA or no further action (NFA). Characterization of the Class 1 SU is used to answer the following two primary decision statements:

1. If the concentration of chemicals and/or radionuclides in the Class 1 SU and related media exceed acceptable limits, then conduct an RA to achieve acceptable end state conditions; otherwise, take NFA.
2. If sources of potential groundwater contamination are found to exist in soils within the Class 1 SU, then conduct a RA to achieve acceptable end-state conditions; otherwise, take NFA.

Characterization Summary:

A radiological walkover survey in and around the EU Z2-19 Class 1 SU was conducted during spring 2016. Based on these results, FCN-ETTP-Zone 2-194 approved the soil sampling approach to address areas with elevated radioactivity. Specifics of the samples collected are presented in Attachment 1 and the sample locations are shown on Fig. 4 of the Technical Memorandum.

The EU Z2-19 Class 1 SU data are evaluated against the Zone 2 Record of Decision remedial action objective decision criteria as described 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&D5, Sect. 3.2) (Zone 2 RDR/RAWP). Table 1 presents the summary of the results of the Class 1 SU characterization samples following data evaluation.

Table 1. Data summary for EU Z2-19 Class 1 SU

Analyte	Type of RL exceedance
Total PCBs	Maximum RL
Chromium	Groundwater SSL
Uranium (total)	Industrial RSL
Ra/Th decay series	Maximum RL, Average RL
Cesium-137	Maximum RL, Average RL
Uranium-234	Maximum RL, Average RL, Groundwater SSL
Uranium-235	Maximum RL, Average RL, Groundwater SSL
Uranium-238	Maximum RL, Average RL, Groundwater SSL
Plutonium-239	Industrial RSL
Technetium-99	Groundwater SSL

EU = Exposure Unit
PCB = polychlorinated biphenyl
Ra = radium
RL = remediation level
RSL = risk screening level
SSL = soil screening level
SU = Soil Unit
Th = thorium

Radiological surveys of the slabs demonstrated the presence of elevated radioactivity which resulted in the slabs being designated as Contamination Area (K-1031) and High Contamination Area (K-1410). Based on their location within the area of EU Z2-19 which has been demonstrated to pose a threat to the industrial worker and a probable threat to groundwater (i.e., Class 1 SU) as a result of the presence of radiological contamination, it is concluded that the slabs themselves pose similar risks. Removal of the slabs will eliminate the risks associated with them.

RA Decision:

Based on the presence of remediation level (RL) exceedances in soils and a probable threat to groundwater from primarily isotopic uranium in soils, a decision was made to conduct an RA in EU Z2-19. As demonstrated in the Technical Memorandum (see Fig. 5), the sample locations with RL exceedances and residual groundwater (GW) soils screening level (SSL) exceedances are clustered near the interior of the Class 1 SU and are largely surrounded by sample locations with no criteria exceedances. Therefore, the

areal extents of the RAs are known with a high degree of certainty; confirmation sampling conducted following the RA (described below) will verify the RA has been successful.

The EU Z2-19 RA will be conducted within three primary boundaries referred to as Dig 1, Dig 2 and Dig 3, with the smaller dig, Dig 3, located within the boundaries of Dig 2 (see the Technical Memorandum, Fig. 6). In addition, the K-1031 and K-1410 concrete slabs will be removed as part of Dig 2. The K-1410 slab portion of Dig 2 will be to a depth of 4 ft with the exception of the pit area. The area of the filled pit will be excavated to the depth of the pit. The K-1031 slab portion of Dig 2 will be concrete and incidental soil only. A summary of the planned RAs in EU Z2-19 Class 1 SU are presented in Table 2.

Table 2. Summary of planned RAs in EU Z2-19 Class 1 SU

RA Dig #	RA material	Depth of excavation (ft)	Estimated volume (cy)
1	Soil	3	422
2	Soil	4	8773
	Concrete	1	634
3	Soil	6	178

EU = Exposure Unit
RA = remedial action
SU = Soil Unit

Soil and concrete excavation will commence using standard earthmoving equipment and dump trucks and/or dedicated waste containers for waste shipments. Excavation will progress from an initial starting point on a perimeter of a dig area until the entire area and depth is reached. The area of Dig 2 may be subdivided into smaller excavation area due to the need to have less area open at a given time to minimize storm water collection. Water management actions, including run-on/run-off controls and cover (using clean fill or membranes), will be implemented during ongoing excavation actions pending receipt of analytical confirmation samples results to protect the integrity of the excavation.

Most of the materials excavated during the EU Z2-19 RA will be disposed at the Environmental Management Waste Management Facility in accordance with an applicable Zone 2 waste profile, with smaller volumes of material being disposed offsite, as required. Actual waste volumes disposed and disposal facilities used will be presented in the RA completion report.

Confirmation Sampling:

Upon completion of both the lateral and vertical extent of a dig and excavation of the concrete slabs or when excavation activities warrant safe access to the excavation areas, a radiological survey of the excavation walls and floor will be performed to semi-quantitatively identify potential areas within the excavation that exceed 2 times background. Locations exhibiting unacceptably high readings will be marked for additional excavation (nominally 1 ft. in all applicable directions into the underlying material) and the locations re-surveyed. This process will continue until it is determined that excavation surfaces meet this criterion.

Following the radiological survey and final excavation actions, the area consisting of the walls and floor will be determined. Similar to the characterization sampling, a statistical sampling approach has been developed based on the area using a superimposed two-dimensional grid spanning the excavation areas (or portions thereof, if required) using site coordinates and field measurements. The appropriate number of

confirmatory samples based on statistical parameters of 95% confidence and 80% coverage was determined and a triangular grid with a random start was prepared for each dig area (see Fig. 7). Using this approach, 11 sample locations will be selected from the floor and 3 from the wall of Dig 1. Similarly, 17grid locations were identified for the floor of Dig 2 with an additional 3 locations from the wall (area including Dig 3). Finally, biased samples will be collected as determined in the field, with up to 2 biased samples collected from Dig 1 (approximately 16 sample locations in Dig 1), with up to 6 biased samples collected from Dig 2 and up to three collected from Dig 3 (approximately 29 sample locations in Dig 2). Once excavation in an area is deemed complete, the grid nodes in the area will be marked in the excavation and sample collected from the 0-1 ft. interval and sent to a laboratory for analysis with a nominal 3-day turnaround. Biased samples will be collected based on the highest radiological reading in an open excavation. The confirmatory samples will be discrete samples.

When the average concentration of all constituents of concern are less than their respective average remediation level (both average RL and GW SSL), the excavation will be declared complete and may be filled with clean fill and the site stabilized as necessary.

EU Z2-19 Class 1 SU Closure Actions:

When final confirmation sampling indicates there are no RL or GW SSL exceedances in an excavation, then the excavation area that the confirmation samples represents will be backfilled and the entire area will be contoured and stabilized, as appropriate.

Provisional Management for slabs K-1031 and K-1410:

The RDR/RAWP Appendix K, Provisional Management of Slabs, requires slabs requiring remediation have provisional management if not remediated within 60 days or a period agreed to by the project team. Slabs K-1031 and K-1410 will not be remediated within the 60 days, but have planned remediation dates of August 2018 and October 2018, respectively. Since the slabs are covered by asphalt, the provisional management would be an annual inspection to ensure contaminant migration is prevented by the asphalt cover. Due to the removal of the slabs being planned for removal in less than a year, no provisional management is proposed.

Conclusion and Summary:

This concurrence form proposes that three RAs be taken within the EU Z2-19 Class 1 SU to remove threats to the industrial worker and underlying groundwater. The proposed RA aerial boundaries are shown in the Technical Memorandum (see Fig. 6). Following impacted material excavation and disposal, confirmation samples will be collected to demonstrate that the RAs have achieved the remedial action objectives presented in the Zone 2 ROD.

Project Team Agreement Log # 390
Area: Poplar Creek EU Group
FCN-ETTP-Zone 2-225

Concurrence:

Steven Clemons — 5/29/18

U.S. Department of Energy — **Date**

Randall Hoffmeister — 5/29/18

Tennessee Department of Environment and Conservation — **Date**

SC Underdahl-Foster — 5/24/2018

U.S. Environmental Protection Agency — **Date**

ATTACHMENT 1.
EXPOSURE UNIT EU Z2-19 CLASS 1 SOIL UNIT
TECHNICAL MEMORANDUM

EXPOSURE UNIT (EU) GROUP: EU Z2-19	
	INTRODUCTION

This Technical Memorandum presents the background information, analytical results, data evaluations, and other related information that serve as the rationale for recommending a remedial action (RA) in the Class 1 soil unit (SU), and areas in close proximity as deemed necessary, of Exposure Unit (EU) Z2-19, located in the west central area of ETTP along the east side of Poplar Creek (Figs. 1 and 2). Figure 2 identifies two Federal Facilities Agreement sites in EU Z2-19: K-1031 pad and K-1410 pad. Upon completion of the RA, the Class 1 SU will have been fully addressed and require no further action (NFA) under DOE/OR/01-2161&D2, *Record of Decision for Soil, Buried Waste, and Subsurface Structure Actions in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee* (Zone 2 ROD).

On December 14, 2017, the ETTP Core Team was briefed on the field sampling results presented herein. As discussed, additional characterization activities will be conducted in EU Z2-19 to address pits, vaults, buildings, and soils outside the Class 1 SU. After completing the remaining characterization activities, the Core Team will be briefed on the results and a path forward for the remaining portions of the EU, as appropriate.

1.0	BACKGROUND INFORMATION AND EU SUMMARY

Exposure Unit Z2-19 is located immediately west of the former Bldg. K-25 on the east bank of Poplar Creek. The EU Z2-19 boundaries encompass approximately 20 acres of land, which the Poplar Creek Data Quality Objective Scoping Package divided into approximately 3 acres of Class 1 SUs and 17 acres of Class 3 SUs. This technical memorandum and RA concurrence is limited to the Class 1 SU and a small adjacent area only, which includes the former Bldg. K-1031 concrete slab, the former Bldg. K-1410 concrete slab, and soil areas in and around these slabs.

A radiological walkover survey in and around the EU Z2-19 Class 1 SU was conducted during the spring 2016. The survey results are depicted graphically on Fig. 3. FCN-ETTP-Zone 2-194 approved the soil sampling approach to address areas with elevated radioactivity. Specifics of the samples collected are presented in Attachment 1A and the sample locations are shown on Fig. 4.

1.1	CHARACTERIZATION AND DELINATION SAM PLING ANALYTICAL RESULTS

Attachment 1B presents a summary of the data collected and a comparison of those data to Zone 2 remediation levels (RLs) consistent with the ROD remedial action objectives (RAOs) for protection of the industrial worker and groundwater. This summary shows that there are multiple exceedances of RLs, including maximum RLs, average RLs, industrial risk screening levels (RSL), and groundwater (GW) soil screening levels (SSL) in EU Z2-19.

Attachment 1C presents a comprehensive list of criteria exceedances in the existing data for EU Z2-19. There are 19 sample locations with one or more exceedance of the maximum RLs, 36 sample locations with exceedances of the average RLs, 15 additional sample locations with RSL exceedances, and 31 sample locations with GW SSL exceedances. The sample locations with exceedances of RLs are shown on Fig. 5.

Note that several sample locations exhibit multiple exceedances of different RLs, mostly within the shallow interval (i.e., 0 - 1 ft.) although average RLs, industrial RSLs, and GW SSLs are exceeded in depths up to 10 ft. These results are used to define the nature and extent of contamination within the Class 1 SU and define the RA necessary to reduce contaminant mass and achieve the RAOs in EU-Z2-19 as discussed below.

1.2	EU Z2-19 CLASS 1 SU DATA EVALUATION

The EU Z2-19 Class 1 SU data are evaluated against the Zone 2 ROD RAO decision criteria as described in 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&D5, Sect. 3.2) (Zone 2 RDR/RAWP).

Maximum RL Screening. There are 19 sample locations in the EU Z2-19 Class 1 SU with maximum RL exceedances, with 18 in the 0-1-ft depth and 1 within the 0-2-ft depth. Table 1 indicates the analytes and the number of exceedances observed. There are no maximum exceedances at depths greater than 2 ft (Attachment 1C). The distribution of sample locations is shown on Fig. 5 and information regarding specific sample locations is presented in Attachment 1C. According to the Zone 2 ROD, the area represented by these 19 sample locations requires an RA.

Table 1. Class 1 SU analytes with maximum detected concentrations exceeding maximum RLs

Analyte with maximum RL exceedance(s)	Number of exceedances	SU maximum detected concentration	Maximum RL (pCi/g)
Ra/Th decay series	15	6,254 pCi/g	15
Cesium-137	6	4,060 pCi/g	20
Uranium-234	2	57,300 pCi/g	7000
Uranium-235	7	4,250 pCi/g	80
Uranium-238	8	17,300	500

Ra = radium
RL = remediation level
SU = Soil Unit
Th = thorium

Average RL Screening. The process presented in Sect. 3.2 of the Zone 2 RDR/RAWP for conducting an average RL screen arrives at a conclusion about whether the EU average concentration of a primary COC exceeds the average RL. Typically, the average RL screen is conducted across the EU; however, since EU-wide characterization is not complete, the average RL exceedances within SU 1 are used to help define the excavation boundaries for the Class 1 SU.

There are 36 sample locations with maximum detected concentrations exceeding average RLs, excluding locations with maximum RL exceedances, 33 have constituents in the 0-4-ft depth interval and 3 have constituents up to 10 ft in depth. Table 2 indicates the analytes and the number of exceedances observed. The distribution of the sample locations are shown on Fig. 5.

Table 2. Class 1 SU analytes with maximum detected concentrations exceeding average RLs

Analyte with maximum RL exceedance(s)	Number of exceedances	SU maximum detected concentration	Average RL
Total PCBs	1	26,300 µg/kg	10,000
Ra/Th decay series	8	11.7 pCi/g	5 pCi/g
Cesium-137	8	13.8 pCi/g	2 pCi/g
Uranium-234	4	6,690 pCi/g	700 pCi/g
Uranium-235	33	75.3 pCi/g	8 pCi/g
Uranium-238	34	362 pCi/g	50 pCi/g

Ra = radium
Th = thorium
PCB = polychlorinated biphenyl
RL = remediation level
SU = Soil Unit

Industrial RSL evaluation. This evaluation is performed to insure that the additional non-contaminant of concern (COC) chemicals and radionuclides, in which either maximum or average RLs are not defined, do not result in a total risk greater than 1×10^{-4} (for carcinogens) or a total hazard index of 1 (for noncarcinogens). Remediation screening levels (RSLs) for carcinogenic constituents are set at 1×10^{-5} to ensure the total risk (i.e., sum of individual constituent risks) meets the 1×10^{-4} total risk goal. RSLs for non-carcinogenic constituents are set at a hazard quotient (HQ) of 0.1 to ensure the Hazard Index (HI) (i.e., the sum of HQs) meets the target HI goal of 1. Similar to the average RL exceedance evaluation, this evaluation arrives at a conclusion about whether the average "non-COC" constituent concentrations within the SU that do not have RLs defined do not exceed the total risk and HI targets for the industrial exposure scenario. Because the EU-wide characterization is not complete, the RSL exceedances within SU 1 also are used to define the excavation boundaries for the Class 1 SU.

There are 15 sample locations with maximum detected concentrations exceeding industrial RSLs, 14 having constituents within the 0-2-ft depth interval and 1 has constituents up to 10 ft deep. Attachment 1C provides the results of chemicals and radionuclides with maximum detections greater than their respective RSLs. As such, the area represented by these sample locations indicates that an RA is required. Table 3 indicates the analytes and the number of exceedances observed.

Table 3. Class 1 SU analytes with maximum detected concentrations exceeding industrial RSLs

Analyte with maximum RL exceedance(s)	Number of exceedances	SU maximum detected concentration	Industrial RSL
Uranium (total)	17	21,000 µg/kg	230 µg/kg
Plutonium-239	1	154	128 pCi/g

RL = remediation level
RSL = risk screening level
SU = Soil Unit

With the exception of sample location Z2-EU19-107, all sample locations with maximum detected concentrations of both total uranium and plutonium-239 exceed corresponding industrial RSLs are coincident with locations defined by the constituents presented above that exceed maximum or average RLs. When the uranium total concentrations coincident with the locations that have the maximum RL exceedances are eliminated, the resultant average uranium total within the Class 1 SU (47.4 µg/kg) would be less than the industrial RSL.

According to the Zone 2 RDR/RAWP (see Sect. 3.2), the final step in the risk evaluation is to evaluate the cumulative impact on risk over an entire EU from all chemicals and radionuclides with RSL exceedances by comparing the sum of fractions (SOF) (average detected concentration/RSL) to 7.5 (because RSLs for carcinogens are set at 10 times less than their 1×10^{-4} excess lifetime cancer risks, the 7.5 SOF is approximately 75 percent of the Zone 2 ROD risk limit). Following complete characterization and RA within EU Z2-19, a final SOF for the EU Z2-19 risk screen will be performed.

Threat to groundwater. This evaluation is performed to ensure constituent concentrations in soil do not exceed modeled concentrations (GW SSLs) such that leaching would lead to groundwater concentrations in excess of drinking water standards. Should constituents exceed GW SSLs, RA is required to protect groundwater. There are 31 sample locations with maximum detected concentrations exceeding GW SSLs, 31 have constituents within the 0-4-ft depth and 3 have constituents up to 10 ft deep. Table 4 indicates the analytes and the number of exceedances observed.

Table 4. Class 1 SU analytes with maximum detected concentrations exceeding GW SSLs

Analyte with Maximum RL exceedance(s)	Number of exceedances	SU maximum detected concentration	Industrial RSL
Chromium	1	530 µg/kg	172 µg/kg
Uranium-234	41	57,300	61.1
Uranium-235	8	4,250	61.1
Uranium-238	34	17,300	61.1
Technetium-99	1	154	128 pCi/g

GS = groundwater
RL = remediation level
RSL = risk screening level
SSL = soil screening level
SU = Soil Unit

One step in evaluating possible threats to groundwater is to estimate the volumetric extent and mass of analytes with GW SSL exceedances to determine whether the analytes pose a threat to groundwater (Zone 2 RDR/RAWP, Sect. 3.2). The distribution of residual GW SSL exceedance locations forms a cluster near the interior of the Class 1 SU (Fig. 5) to the point where there is probably sufficient volume of contaminated soil so that the mass of the detected constituents pose a threat to groundwater. As such, the area represented by these sample locations indicates that a RA is required.

1.4 K-1031 Concrete Slab

Building K-1031 was constructed in 1945 as a maintenance support facility for Bldg. K-25. Building K-1031 was first used to store and dispense trapping media for spent cascade traps and was later used as a cutting and size-reduction area for process equipment removed from the Fercleve Thermal Diffusion Plant. Beginning in the early 1960s,

Bldg. K-1031 was used for paint storage and mixing. Prior to demolition, the building was used for equipment and material storage.

Building K-1031 was demolished in 1999, leaving an approximately 4400 sf concrete slab in place. Demolition of Bldg. K-1031 is described in the *Removal Action Report for the K-25 Auxiliary Facilities Decommissioning Group I Buildings Demolition Project at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-1829&D1) (K-25 Auxiliary Facilities RmAR). A radiological survey of the concrete slab was conducted in 1999 (Appendix A) that showed elevated radioactivity over the slab ranging up to 224,084 dpm/100 cm². Based on the radiological survey results, the K-1031 concrete slab was designated as a Contamination Area. Following the radiological survey, the slab was covered with 2 in. of asphalt, which is its current state. Based on this information, a RA is required.

1.5	K-1410 Concrete Slab

Building K-1410 was constructed in 1944 to mix media from spent cascade traps for use in the K-25 Gaseous Diffusion Plant. Later the building was used for decontamination and recovery of uranium from large pieces of equipment. Two spray facilities were used to solubilize and remove uranium contamination with nitric acid and to degrease pumps with trichloroethene. In 1963, Bldg. K-1410 was converted to an electroplating facility by removing the decontamination tanks and filling the degreasing pits with concrete.

Building K-1410 was demolished in 1999 leaving an approximately 8700 sf concrete slab in place. Demolition of Bldg. K-1410 is described in the K-25 Auxiliary Facilities RmAR. A radiological survey of the building floor was conducted in 1998 prior to demolition (Appendix B1), which showed elevated radioactivity over the floor ranging up to 48,000 dpm/100 cm². A second radiological survey was conducted on a pit inside the facility in 1998 (Appendix B2). The results of the pit survey showed elevated radioactivity over the slab ranging up to 11,216 dpm/100 cm². A final radiological survey was conducted after demolition in 1999 on the end of an exposed pipe in the southwest corner of the concrete slab (Appendix B3). Results of the pipe survey showed elevated radioactivity of 1,718,200 dpm/100 cm². The survey technicians reported the presence of "visible product inside and around the pipe openings".

Based on the radiological survey results, the Bldg. K-1410 concrete slab was designated as a High Contamination Area. Following building demolition and after final radiological surveying, the slab was covered with 2 in. of asphalt, which is its current state. Based on this information, a RA is required.

Decision

Based on the presence of maximum (Max) RL exceedances in soils, the presence of average (Ave) RL exceedances in soils, and a probable threat to groundwater from primarily isotopic uranium in soils, a decision has been made to conduct an RA in EU Z2-19. As demonstrated on Fig. 5, the sample locations with Max RL exceedances, Ave RL exceedances, and residual GW SSL exceedances are clustered near the interior of the Class 1 SU and largely surrounded by sample locations with no criteria exceedances. Therefore, the areal extents of the RAs are known with a high degree of certainty. Confirmation sampling conducted following the RA (described below) will verify that the RA has been successful.

In addition to soil excavation, the RA will also remove the Bldgs. K-1031 and K-1410 concrete slabs. The two slabs are located within or adjacent to the boundaries for soil excavation (see Remedial Action Description section), but both slabs have been covered with approximately 2 in. of asphalt. The two slabs are listed in Appendix K of the Zone 2 RDR/RAWP as potentially contaminated. Evaluation of potentially contaminated slabs under the Zone 2 RDR/RAWP requires radiological surveys, visual inspections, and sampling in response to survey and visual observations. Because of the asphalt covering on each slab, neither slab can be evaluated in the manner prescribed by the Zone 2 RDR/RAWP. However, pre-asphalt radiological surveys of the slabs (Appendices A, B1, and B2) demonstrated the presence of elevated radioactivity, which resulted in the slabs' designations as Contamination Area (K-1031) and High Contamination Area (K-1410). Based on the location within the area of EU Z2-19, which has been demonstrated to pose a threat to the industrial worker and a probable threat to groundwater as a result of radiological contamination, combined with historical radiological surveys of the slabs that show the slabs are radiologically contaminated, it is concluded that the slabs themselves pose a risk to the industrial worker under the Zone 2 ROD.

Remedial Action Description

The EU Z2-19 RA will be conducted within three primary boundaries referred to as Dig 1, Dig 2 and Dig 3 (Fig. 6), with the smaller dig, Dig 3, located within the boundaries of Dig 2 (Fig. 6). Concrete demolishing equipment will be used to break up slabs, including any filled pits that are encountered, into dimensions that are acceptable for disposal. Typical earth moving equipment will be used to excavate soil to the requisite depths as previously described. Remedial actions will begin at a pre-determined dig boundary and proceed inward and around to the lateral extent of the dig boundaries. Clean fill may be used for clean working surfaces and for creating in-excavation berms for water control to prevent a potential for cross contaminating finished excavations pending confirmation sampling.

The K-1410 and K-1031 concrete slabs are also located within the Dig 2 boundaries (Fig. 6).

Sample locations to be removed during the excavation of each dig are presented in Table 5. The contaminant mass characterized by these samples locations, in addition to the volume surrounding the sample locations, will be removed and replaced ultimately with clean fill. The RAs will result in both contaminant mass reduction and exposure pathway elimination, thereby providing protection to the industrial worker and groundwater. Following are descriptions of the digs that make up the RA:

Dig 1. Dig 1 is located on the north end of the EU Z2-19 Class 1 SU (Fig. 6). The area of Dig 1 is approximately 3800 sf and excavation will be conducted to a depth of 3 ft.

Dig 2. Dig 2 is the largest of the EU Z2-19 RA digs (Fig. 6). The area of Dig 2 is approximately 62,400 sf and excavation will be conducted to a depth of 4 ft, except in Dig 3 (below). The approximately 8700-sf K-1410 concrete slab will be excavated during excavation of Dig 2; therefore, the depth of excavation at the K-1410 footprint will be 4 ft. One exception will be in the area of the filled pit, where the area be removed to the depth of the pit. The approximately 4400-sf K-1031 concrete slab is located on the north end of Dig 2 (Fig. 6). The K-1031 slab excavation will include the slab and incidental soil.

Dig 3. Dig 3 encompasses an area of approximately 4400 sf and the depth of excavation in Dig 3 will be 6 ft. The purpose for Dig 3 is to excavate the GW SSL exceedances at sample locations Z2-EU19B-152 and Z2-EU19B-157, which occur at depths between 5-6 ft below ground surface (Attachment 1C).

During the remedial actions the boundaries of Dig 1 and Dig 2, including the K-1410 footprint, the K-1031 footprint, and the footprint of Dig 3 to a depth of 6 ft in Dig 2, will be recorded using geospatial coordinates by means of an in-field global positioning system instrument. This approach will "map" the excavations for future reference as necessary.

Table 5. EU Z2-19 sample locations included in the remedial action boundaries

Dig 1 sample locations		
Z2-EU19-101[a]	Z2-EU19-128	Z2-EU19B-134
Z2-EU19-102	Z2-EU19-129	Z2-EU19B-154[a]
Z2-EU19-103[a]	Z2-EU19-130	
Dig 2 sample locations		
Z2-EU19-105[a]	Z2-EU19-121[a]	Z2-EU19B-15[a]
Z2-EU19-106[a]	Z2-EU19-124[a]	Z2-EU19B-158
Z2-EU19-107[a]	Z2-EU19B-138	Z2-EU19B-159
Z2-EU19-108[a]	Z2-EU19B-139[a]	Z2-EU19B-160
Z2-EU19-109[a]	Z2-EU19B-140	Z2-EU19B-162[a]
Z2-EU19-110[a]	Z2-EU19B-141	Z2-EU19B-163
Z2-EU19-111[a]	Z2-EU19B-142	Z2-EU19B-164[a]
Z2-EU19-112[a]	Z2-EU19B-145	Z2-EU19B-165[a]
Z2-EU19-113[a]	Z2-EU19B-148	Z2-EU19B-166[a]
Z2-EU19-114[a]	Z2-EU19B-149[a]	Z2-EU19B-167[a]
Z2-EU19-115[a]	Z2-EU19B-168C[a]	Z2-EU19B-167A[a]
Z2-EU19-116[a]	Z2-EU19B-150	Z2-EU19B-167B[a]
Z2-EU19-117[a]	Z2-EU19B-151	Z2-EU19B-167C
Z2-EU19-118[a]	Z2-EU19B-155[a]	Z2-EU19B-167D[a]

Table 5. EU Z2-19 sample locations included in the remedial action boundaries (cont.)

Dig 2 sample locations (cont.)		
Z2-EU19-119	Z2-EU19B-155A	Z2-EU19B-168
Z2-EU19-120 [a]	Z2-EU19B-155B	Z2-EU19B-168A
Z2-EU19-122 [a]	Z2-EU19B-155C	Z2-EU19B-168B
Z2-EU19-123 [a]	Z2-EU19B-155D	Z2-EU19B-168D
Dig 3 sample locations		
Z2-EU19B-152 [a]	Z2-EU19B-157 [a]	
K-1031 concrete slab sample locations		
Z2-EU19B-137 (concrete only)		
K-1410 concrete slab sample locations		
Z2-EU19B-153 [a] (concrete and sub-slab soil)		

[a]Zone 2 ROD criteria exceedances locations; see Attachment 1C for exceedance details.

Waste Disposition

Most of the materials excavated during the EU Z2-19 RA will be disposed at the Environmental Management Waste Management Facility (EMWMF) in accordance with an applicable Zone 2 waste profile, with smaller volumes of material being disposed offsite as required. Table 6 presents the current estimate of waste for disposal. Actual waste volumes and disposal facilities will be presented in the RA completion report.

Table 6. Projected volumes of material for disposal from the EU Z2-19 remedial action

Waste medium	Projected volume for disposal (cy)
Soil	10,644
Concrete	888

EU = Exposure Unit

Confirmation Sampling

The following describes the process of sampling to confirm the RA in the EU Z2-19 Class 1 SU has successfully removed threats to the industrial worker and groundwater:

- Upon completion of both the lateral and vertical extent of a dig and excavation of the concrete slabs or when excavation activities warrant safe access to the excavation areas, a radiological survey of the excavation walls and floor will be performed to semi-quantitatively identify potential areas within the excavation that exceed 2 times background. Locations exhibiting unacceptably high readings will be marked for additional excavation (nominally 1 ft. in all applicable directions into the underlying material) and the locations re-surveyed. This process will continue until it is determined that excavation surfaces meet this criterion.
- Following the radiological survey and final excavation actions, the area consisting of the walls and floor will be determined. Similar to the characterization sampling, a statistical sampling approach has been developed based on the area using a superimposed two-dimensional grid spanning the excavation areas (or portions thereof, if required) using site coordinates and field measurements. The appropriate number of confirmatory samples based on statistical parameters of 95% confidence and 80% coverage was determined over a triangular grid with a random start for each dig area (see Fig. 7). Using this approach, approximately 11 sample locations will be selected from the floor and 3 from the wall of Dig 1. Similarly, 17 grid locations were identified for the floor of Dig 2 with an additional 3 locations from the wall (which includes Dig 3). Finally, biased samples will be collected as determined in the field, with up to 2 biased samples collected from Dig 1 (total of 16 samples), with up to 6 biased samples collected from Dig 2 and up to three collected from Dig 3 (approximately 29 samples in Dig 2/3). Once excavation in an area is deemed complete, the grid nodes in the area will be marked in the excavation and sample collected from the 0-1 ft. interval and sent to a laboratory for analysis with a nominal 3-day turnaround. Biased samples will be collected based on the highest radiological reading in an open excavation with the locations marked and recorded. The confirmatory samples will be discrete samples.

- Water management actions, including run-on/run-off controls, cover using clean fill or membranes will be implemented pending receipt of analytical confirmation samples results to protect the integrity of the excavation.
- If an analytical result exceeds an RL or GW SSL in a wall or floor confirmation sample, then the areas of the excavation that are below criteria will undergo backfilling or covering with clean fill and an additional 1 ft of soil (moving radially away from the sample location in all applicable directions) will be excavated from the location represented by the confirmation sample. As discussed above, water management controls will be implemented to ensure the integrity of the additional excavated area pending receipt of sample analytical results.
- When confirmation sampling shows there are no RL or GW SSL exceedances in an excavation area, then the excavation area that the additional confirmation sample(s) represents will be backfilled. The entire area will be contoured and stabilized as appropriate once all excavation areas have been backfilled.

Expected Post-RA Conditions

As previously discussed, complete characterization of EU Z2-19 is pending. As such, data from additional sample locations will be combined with current locations outside of the RA in the Class 1 SU, as well as with applicable data within the footprints of the RAs not impacted by the excavations, to determine a final risk condition throughout the entire EU. Based on this evaluation, either a NFA will be determined for the EU or additional actions, as necessary, will be taken to ensure protection of the industrial worker and groundwater.

Attachment 1A. Sample summary for EU Z2-19

EU	Date collected	Sample location	Sample interval	Laboratory analyses					Comments/descriptions
				Metals	PCB	RAD	SVOC	VOC	
Characterization Sampling									
Z2-19	3/27/2017	Z2-EU19-101	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/27/2017	Z2-EU19-102	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/27/2017	Z2-EU19-103	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/29/2017	Z2-EU19-104	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/27/2017	Z2-EU19-105	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/29/2017	Z2-EU19-106	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/30/2017	Z2-EU19-107	0-10 ft 3-interval composite	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/27/2017	Z2-EU19-108	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/23/2017	Z2-EU19-109	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/22/2017	Z2-EU19-110	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/22/2017	Z2-EU19-111	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/22/2017	Z2-EU19-112	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/22/2017	Z2-EU19-113	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/23/2017	Z2-EU19-114	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/23/2017	Z2-EU19-115	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/23/2017	Z2-EU19-116	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/23/2017	Z2-EU19-117	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/28/2017	Z2-EU19-118	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/28/2017	Z2-EU19-119	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/28/2017	Z2-EU19-120	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/28/2017	Z2-EU19-121	0-10 ft - 3 discrete interval soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft - at RAD110	3	3	4	3		Class 1 SU RAD walkover survey above-action level
Z2-19	3/28/2017	Z2-EU19-122	0-10 ft - 3 discrete interval soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft - at RAD113	3	3	4	3		Class 1 SU RAD walkover survey above-action level
Z2-19	3/23/2017	Z2-EU19-123	0-10 ft - 3 discrete interval soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft	3	3	4	3		Class 1 SU RAD walkover survey above-action level
Z2-19	3/21/2017	Z2-EU19-124	0-1 ft - 3-point composite	1	1	1	1		3-point composite in area of historical Max RL
Z2-19	3/29/2017	Z2-EU19-125	0-1 ft - 4-point composite	1	1	1	1		4-point composite in area of historical Max RL

Attachment 1A. Sample summary for EU Z2-19 (cont.)

EU	Date collected	Sample location	Sample interval	Laboratory analyses					Comments/descriptions
				Metals	PCB	RAD	SVOC	VOC	
Delineation Sampling									
Z2-19	10/18/17	Z2-EU19B-126	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	10/2/17	Z2-EU19B-127	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/2/18	Z2-EU19B-128	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	9/26/17	Z2-EU19B-129	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/3/17	Z2-EU19B-130	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	9/26/17	Z2-EU19B-131	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	9/26/17	Z2-EU19B-132	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	9/28/17	Z2-EU19B-133	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/4/17	Z2-EU19B-134	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	10/3/17	Z2-EU19B-135	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/3/17	Z2-EU19B-136	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/30/17	Z2-EU19B-137	10 ft - 4-interval - 0.5, 2, 4, and 4-10 ft; concrete grab		1	4			4-10 ft sample is conditional based on field screening; location is on the concrete pad (covered with asphalt, collect concrete sample for PCBs and RAD [remove asphalt])
Z2-19	9/27/17	Z2-EU19B-138	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	4	4	4	4		4-10 ft sample is conditional based on field screening
Z2-19	10/12/17	Z2-EU19B-139	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/12/17	Z2-EU19B-140	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/10/17	Z2-EU19B-141	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/10/17	Z2-EU19B-142	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	10/18/17	Z2-EU19B-143	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/18/17	Z2-EU19B-144	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/24/17	Z2-EU19B-145	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/19/17	Z2-EU19B-146	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	4	4	4	4		4-10 ft sample is conditional based on field screening
Z2-19	10/16/17	Z2-EU19B-147	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/16/17	Z2-EU19B-148	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/25/17	Z2-EU19B-149	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/25/17	Z2-EU19B-150	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	10/25/17	Z2-EU19B-151	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/11/17	Z2-EU19B-152	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			4			4-10 ft sample is conditional based on field screening
Z2-19	10/26/17	Z2-EU19B-153	10 ft - 4-interval - 0.5, 2, 4, and 4-10 ft; concrete grab		1	4			4-10 ft sample is conditional based on field screening; location is on the concrete pad (covered with asphalt, collect concrete sample for PCBs and RAD [remove asphalt])
Z2-19	9/28/17	Z2-EU19B-154	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	9/27/17	Z2-EU19B-155	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			At former location Z2-EU19-120; 4-10 ft sample is conditional based on field screening
Z2-19	9/27/17	Z2-EU19B-155A	3 ft - 3-interval - 0.5 ft, 2 ft, and 3 ft	3		3			1 ft north of Z2-EU19B-155; U-235 analysis and metals
Z2-19	9/27/17	Z2-EU19B-155B	3 ft - 3-interval - 0.5 ft, 2 ft, and 3 ft	3		3			1 ft east of Z2-EU19B-155; U-235 analysis and metals

Attachment 1A. Sample summary for EU Z2-19 (cont.)

EU	Date collected	Sample location	Sample interval	Laboratory analyses					Comments/descriptions
				Metals	PCB	RAD	SVOC	VOC	
Z2-19	9/27/17	Z2-EU19B-155C	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft south of Z2-EU19B-155; U-235 analysis and metals
Z2-19	9/27/17	Z2-EU19B-155D	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft west of Z2-EU19B-155; U-235 analysis and metals
Z2-19	10/11/17	Z2-EU19B-156	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			4			4-10 ft sample is conditional based on field screening
Z2-19	10/25/17	Z2-EU19B-157	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			4			4-10 ft sample is conditional based on field screening
Z2-19	10/17/17	Z2-EU19B-158	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	10/17/17	Z2-EU19B-159	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/17/17	Z2-EU19B-160	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/19/17	Z2-EU19B-161	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/16/17	Z2-EU19B-162	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	10/11/17	Z2-EU19B-163	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/11/17	Z2-EU19B-164	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/9/17	Z2-EU19B-165	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/9/17	Z2-EU19B-166	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/4/17	Z2-EU19B-167	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			At former location RAD110; 4-10 ft sample is conditional based on field screening
Z2-19	10/4/17	Z2-EU19B-167A	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft north of Z2-EU19B-167; U2-35 analysis and metals
Z2-19	10/4/17	Z2-EU19B-167B	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft east of Z2-EU19B-167; U-235 analysis and metals
Z2-19	10/4/17	Z2-EU19B-167C	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft south of Z2-EU19B-167; U-235 analysis and metals
Z2-19	10/4/17	Z2-EU19B-167D	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft west of Z2-EU19B-167; U-235 analysis and metals
Z2-19	10/5/17	Z2-EU19B-168	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			At hot spot based on BAR survey (general area of former location Z2-EU19-119); 4-10 ft sample is conditional based on field screening
Z2-19	10/5/17	Z2-EU19B-168A	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft north of Z2-EU19B-168; U-235 analysis metals
Z2-19	10/5/17	Z2-EU19B-168B	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft east of Z2-EU19B-168; U-235 analysis metals
Z2-19	10/5/17	Z2-EU19B-168C	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft south of Z2-EU19B-168; U-235 and U-238 analysis metals
Z2-19	10/5/17	Z2-EU19B-168D	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft west of Z2-EU19B-168; U-235 analysis metals
Z2-19	10/24/17	Z2-EU19B-169	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			Pipe draining into the CA; 4-10 ft sample is conditional based on field screening
Z2-19	10/16/17	Z2-EU19B-170	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			Hot spot near staircase; 4-10 ft sample is conditional based on field screening
Class 3 Soil Unit Sampling									
Z2-19	3/30/2017	Z2-EU19B-301	0-10 ft - 3 interval composite soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft	1	1	1	1		Class 3 SU utility corridor sample location
Z2-19	3/30/2017	Z2-EU19B-302	0-10 ft. 3 interval composite soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft	1	1	1	1		Class 3 SU utility corridor sample location
Z2-19	3/30/2017	Z2-EU19B-303	0-10 ft. 3 interval composite soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft	1	1	1	1		Class 3 SU utility corridor sample location

Attachment 1A. Sample summary for EU Z2-19 (cont.)

EU	Date collected	Sample location	Sample interval	Laboratory analyses					Comments/descriptions
				Metals	PCB	RAD	SVOC	VOC	
Z2-19	3/30/2017	Z2-EU19B-304	0-10 ft. 3 interval composite soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft	1	1	1	1		Class 3 SU utility corridor sample location
Z2-19	3/29/2017	Z2-EU19B-305	0-10 ft. 3 interval composite soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft	1	1	1	1	1	Class 3 SU adjacent to storm drain
			Total EU Z2-19 Analyses	**104**	**70**	**182**	**68**	**1**	

BAR = biased area radiation
CA = contamination area
EU = Exposure Unit
Max = maximum
PCB = polychlorinated biphenyl
RAD = radiological
RL = remediation level
SU = Soil Unit
SVOC = semivolatile organic compound
VOC = volatile organic compound

Attachment 1B. EU Z2-19 Class 1 SU data summary[a]

Analyte	Frequency of detect	Min detect[b,c]	Max detect[b,c]	Avg detected result[d]	Max RL[d]	Number of detects ≥ Max RL[e]	Avg RL[f]	Number of detects ≥ Avg RL[e]	RSL[g] (10^{-5} or HI=1)	Number of detects ≥ RSL[e]	GW SSL[h]	Number of detects ≥ GW SSL[e]
Inorganics (mg/kg)												
Aluminum	104/104	2860	32000J	13126					1100000	0		
Antimony	7/104	0.362J	6.07J	1.61					470	0	144	0
Arsenic	104/104	3.14J	62.9J	8.57	900	0	300	0	300	0	66.3	0
Barium	104/104	17J	221	66.7					220000	0	9150	0
Beryllium	98/104	0.383J	2.99	1.24					2300	0		
Boron	78/104	1.53J	11.8	4.83					230000	0		
Cadmium	103/104	0.0307J	298	6.74					980	0		
Calcium	103/103	283	223000J	13414								
Chromium	104/104	6.93	530	27.1					1800000	0	172	1
Cobalt	104/104	0.198J	28.6J	12.7					350	0		
Copper	104/104	6.2	836	39.5					47000	0		
Iron	104/104	8730	82100	26586					820000	0		
Lead	102/104	1.43J	428J	37.3					800	0	3370	0
Lithium	104/104	6.75J	152	29.5					2300	0		
Magnesium	104/104	452J	40000J	3900								
Manganese	104/104	108J	7820J	1096					26000	0		
Mercury	67/68	0.0128J	0.928	0.131	1800	0	600	0	600	0		
Molybdenum	94/104	0.328J	39.2	1.68					5800	0		
Nickel	104/104	5.88	957	54.8					22000	0		
Potassium	104/104	331J	10800J	1201								
Selenium	67/103	0.567J	12.9J	2.09					5800	0		
Silver	43/104	0.135J	7.13J	0.583					5800	0		
Sodium	102/104	7.92J	3940J	78.1								
Thallium	97/104	0.164J	4.65J	0.405					12	0	10.8	0
Uranium	104/104	1.16J	21000J	346					230	17		
Vanadium	104/104	9.56	79.9	35.8					5800	0		
Zinc	104/104	7.41J	821	104					350000	0		
Polychlorinated biphenyls (µg/kg)												
PCB-1016	0/70				100000	0	10000	0	10000	0		
PCB-1221	0/70				100000	0	10000	0	10000	0		
PCB-1232	0/70				100000	0	10000	0	10000	0		
PCB-1242	0/70				100000	0	10000	0	10000	0		
PCB-1248	1/70	2790	2790	2790	100000	0	10000	0	10000	0		
PCB-1254	39/70	3.2J	21700	811	100000	0	10000	1	10000	1		
PCB-1260	39/70	1.73J	4590	288	100000	0	10000	0	10000	0		
PCB-1262	0/70				100000	0	10000	0	10000	0		
PCB-1268	1/70	429	429	429	100000	0	10000	0	10000	0		
Total PCBs	44/70	1.73J	26300	1048	100000	0	10000	1	10000	1		
Radionuclides (pCi/g)												
Actinium-228	136/138	0.513	26.3J	2.16					10700	0		
Alpha activity	181/181	7.27J	60100	913								
Americium-241	17/180	0.0436	32.7J	4.57					47.6	0		
Beta activity	180/181	8.08J	29800J	326								
Bismuth-212	5/5	2.7	9.99	7.03					536000	0		

Attachment 1B. EU Z2-19 Class 1 SU data summary[a] (cont.)

Analyte	Frequency of detect	Min detect[b,c]	Max detect[b,c]	Avg detected result[d]	Max RL[d]	Number of detects ≥ Max RL[e]	Avg RL[f]	Number of detects ≥ Avg RL[e]	RSL[g] (10^{-5} or HI=1)	Number of detects ≥ RSL[e]	GW SSL[h]	Number of detects ≥ GW SSL[e]
Bismuth-214	167/167	0.525	64.8	2.43					109000	0		
Cesium-137	65/181	0.0829J	4060	67.8	20	6	2	14	2	14		
Cobalt-60	0/181								0.483	0		
Curium-244	0/141								348	0		
Lead-210	1/1	2.14	2.14	2.14					37.6	0		
Lead-212	174/174	0.666	9.71	1.69					57200	0		
Lead-214	173/173	0.683	54.2	2.36					648000	0		
Neptunium-237	4/181	0.471	1.23	0.781	50	0	5	0	5	0		
Plutonium-238	3/181	0.836	2.35J	1.47					148	0		
Plutonium-239	32/181	0.0622J	154J	13.7					128	1		
Plutonium-241	1/141	0.887J	0.887J	0.887					15300	0		
Potassium-40	179/181	1.09	51.6	20.7					2.2	177		
Protactinium-234m	43/43	28.1	17300	646					1.5E+08	0		
Ra/Th decay series[i]	181/181	0.00001	6254	76.7	15	15	5	23	5	23		
Radium-226[i]	175/181	0.342	71.7	2.52								
Strontium-90	9/141	0.936	125	18					384	0		
Technetium-99	23/181	2.04	2640J	134	121000	0	12100	0	12100	0	85.6	1
Thallium-208	142/142	0.215	2.81	0.534					298000	0		
Thorium-228[j]	174/181	0.557	10.4J	1.51								
Thorium-230[j]	181/181	0.43	6170J	76.6								
Thorium-232[j]	177/181	0.63	86.7J	2.68								
Thorium-234	135/181	0.974	11400	165					24500	0		
Uranium-234	181/181	1.11J	57300J	507	7000	2	700	6	700	6	61.1	41
Uranium-235	114/217	0.249	4250J	71.2	80	7	8	40	8	40	61.1	8
Uranium-238	181/182	0.995	17300J	163	500	8	50	42	50	42	61.1	34
Semivolatile organic compounds (µg/kg)												
1,2,4-Trichlorobenzene	0/68								260000	0		
1,2-Dichlorobenzene	0/68								9300000	0		
1,3-Dichlorobenzene	0/68											
1,4-Dichlorobenzene	0/68								110000	0		
2,3,4,6-Tetrachlorophenol	0/68								25000000	0		
2,4,5-Trichlorophenol	0/68								82000000	0		
2,4,6-Trichlorophenol	0/68								820000	0		
2,4-Dichlorophenol	0/68								2500000	0		
2,4-Dimethylphenol	0/68								16000000	0		
2,4-Dinitrophenol	0/68								1600000	0		
2,4-Dinitrotoluene	0/68								74000	0		
2,6-Dinitrotoluene	0/68								15000	0		
2-Chloronaphthalene	0/68								60000000	0		
2-Chlorophenol	0/68								5800000	0		
2-Methyl-4,6-dinitrophenol	0/68								66000	0		
2-Methylnaphthalene	8/68	14.4J	120J	43					3000000	0		
2-Methylphenol	0/68								41000000	0		
2-Nitrobenzenamine	0/68								8000000	0		
2-Nitrophenol	0/68											
3,3'-Dichlorobenzidine	0/68								51000	0		
3-Nitrobenzenamine	0/68											
4-Bromophenyl phenyl ether	0/68											

Attachment 1B. EU Z2-19 Class 1 SU data summary[a] (cont.)

Analyte	Frequency of detect	Min detect[b,c]	Max detect[b,c]	Avg detected result[d]	Max RL[d]	Number of detects ≥ Max RL[e]	Avg RL[f]	Number of detects ≥ Avg RL[e]	RSL[g] (10^{-5} or HI=1)	Number of detects ≥ RSL[e]	GW SSL[h]	Number of detects ≥ GW SSL[e]
4-Chloro-3-methylphenol	0/68								82000000	0		
4-Chlorobenzenamine	0/68								110000	0		
4-Chlorophenyl phenyl ether	0/68											
4-Nitrobenzenamine	0/68								1100000	0		
4-Nitrophenol	0/68											
Acenaphthene	4/68	14.9J	209J	74.6					45000000	0		
Acenaphthylene	4/68	22.5J	176J	64.1								
Aniline	0/68								4000000	0		
Anthracene	6/68	21.5J	608J	162					2.3E+08	0		
Benz(a)anthracene	24/68	13.3J	902	148					210000	0		
Benzenemethanol	0/68								82000000	0		
Benzo(a)pyrene	21/68	16.1J	703	146					21000	0		
Benzo(b)fluoranthene	22/68	15.5J	929	189					210000	0		
Benzo(ghi)perylene	20/68	18.7J	332J	88.9								
Benzo(k)fluoranthene	14/68	15.3J	365	111					2100000	0		
Benzoic acid	0/68								3.3E+09	0		
Bis(2-chloroethoxy)methane	0/68								2500000	0		
Bis(2-chloroethyl) ether	0/68								10000	0		
Bis(2-chloroisopropyl) ether	0/68								47000000	0		
Bis(2-ethylhexyl)phthalate	1/68	166J	166J	166					1600000	0	2350000	0
Butyl benzyl phthalate	0/68								12000000	0		
Carbazole	6/68	19.3J	1030	232								
Chrysene	23/68	12.6J	857	150					21000000	0		
Dibenz(a,h)anthracene	6/68	33.2J	138	68					21000	0		
Dibenzofuran	1/68	166J	166J	166					1000000	0		
Diethyl phthalate	0/68								6.6E+08	0		
Dimethyl phthalate	0/68											
Di-n-octylphthalate	0/68								8200000	0		
Diphenylamine	0/68								82000000	0		
Fluoranthene	28/68	13.2J	1950J	215					30000000	0		
Fluorene	4/68	16.7J	725J	226					30000000	0		
Hexachlorobenzene	0/68								9600	0		
Hexachlorobutadiene	0/68								53000	0		
Hexachlorocyclopentadiene	0/68								7500	0		
Hexachloroethane	0/68								80000	0		
Indeno(1,2,3-cd)pyrene	13/68	15J	338	116					210000	0		
Isophorone	1/68	730	730	730					24000000	0		
m+p Methylphenol	0/68											
Naphthalene	7/68	17.3J	620	133					170000	0		
Nitrobenzene	0/68								220000	0		
N-Nitroso-di-n-propylamine	0/68								3300	0		
Pentachlorophenol	0/68								40000	0		
Phenanthrene	23/68	13.8J	3300J	226								
Phenol	1/68	149J	149J	149					2.5E+08	0		
Pyrene	27/68	12.5J	1800J	195					23000000	0		
Pyridine	0/68								1200000	0		
Volatile organic compounds (µg/kg)												
1,1,1-Trichloroethane	0/1								36000000	0	97900	0

Attachment 1B. EU Z2-19 Class 1 SU data summary[a] (cont.)

Analyte	Frequency of detect	Min detect[b,c]	Max detect[b,c]	Avg detected result[d]	Max RL[d]	Number of detects ≥ Max RL[e]	Avg RL[f]	Number of detects ≥ Avg RL[e]	RSL[g] (10^{-5} or HI=1)	Number of detects ≥ RSL[e]	GW SSL[h]	Number of detects ≥ GW SSL[e]
1,1,2,2-Tetrachloroethane	0/1								27000	0		
1,1,2-Trichloroethane	0/1								6300	0	1370	0
1,1-Dichloroethane	0/1								160000	0		
1,1-Dichloroethene	0/1								1000000	0	1750	0
1,2-Dichloroethane	0/1								20000	0	729	0
1,2-Dichloropropane	0/1								66000	0		
2-Butanone	1/1	3.49J	3.49J	3.49					1.9E+08	0		
2-Hexanone	0/1								1300000	0		
4-Methyl-2-pentanone	0/1								1.4E+08	0		
Acetone	1/1	15.8J	15.8J	15.8					6.7E+08	0		
Benzene	0/1								51000	0	1150	0
Bromodichloromethane	0/1								13000	0		
Bromoform	0/1								860000	0		
Bromomethane	0/1								30000	0		
Carbon disulfide	0/1								3500000	0		
Carbon tetrachloride	0/1								29000	0	2770	0
Chlorobenzene	0/1								1300000	0		
Chloroethane	0/1								57000000	0		
Chloroform	0/1								14000	0	1230	0
Chloromethane	0/1								460000	0		
cis-1,2-Dichloroethene	0/1								2300000	0		
cis-1,3-Dichloropropene	0/1											
Dibromochloromethane	0/1								390000	0		
Ethylbenzene	0/1								250000	0		
Methylene chloride	0/1								3200000	0	241	0
Styrene	0/1								35000000	0		
Tetrachloroethene	0/1								390000	0	4720	0
Toluene	0/1								47000000	0	502000	0
Total Xylene	0/1								2500000	0		
trans-1,2-Dichloroethene	0/1								23000000	0		
trans-1,3-Dichloropropene	0/1											
Trichloroethene	0/1								19000	0	1720	0
Vinyl chloride	0/1								17000	0	176	0

[a]Stations in summary include Z2-EU19-101, Z2-EU19-102, Z2-EU19-103, Z2-EU19-104, Z2-EU19-105, Z2-EU19-106, Z2-EU19-107, Z2-EU19-108, Z2-EU19-109, Z2-EU19-110, Z2-EU19-111, Z2-EU19-112, Z2-EU19-113, Z2-EU19-114, Z2-EU19-115, Z2-EU19-116, Z2-EU19-117, Z2-EU19-118, Z2-EU19-119, Z2-EU19-120, Z2-EU19-121, Z2-EU19-122, Z2-EU19-123, Z2-EU19-124, Z2-EU19-125, Z2-EU19B-126, Z2-EU19B-127, Z2-EU19B-128, Z2-EU19B-129, Z2-EU19B-130, Z2-EU19B-131, Z2-EU19B-132, Z2-EU19B-133, Z2-EU19B-134, Z2-EU19B-135, Z2-EU19B-136, Z2-EU19B-137, Z2-EU19B-138, Z2-EU19B-139, Z2-EU19B-140, Z2-EU19B-141, Z2-EU19B-142, Z2-EU19B-143, Z2-EU19B-144, Z2-EU19B-145, Z2-EU19B-146, Z2-EU19B-147, Z2-EU19B-148, Z2-EU19B-149, Z2-EU19B-150, Z2-EU19B-151, Z2-EU19B-152, Z2-EU19B-153, Z2-EU19B-154, Z2-EU19B-155, Z2-EU19B-155A, Z2-EU19B-155B, Z2-EU19B-155C, Z2-EU19B-155D, Z2-EU19B-156, Z2-EU19B-157, Z2-EU19B-158, Z2-EU19B-159, Z2-EU19B-160, Z2-EU19B-161, Z2-EU19B-162, Z2-EU19B-163, Z2-EU19B-164, Z2-EU19B-165, Z2-EU19B-166, Z2-EU19B-167, Z2-EU19B-167A, Z2-EU19B-167B, Z2-EU19B-167C, Z2-EU19B-167D, Z2-EU19B-168, Z2-EU19B-168A, Z2-EU19B-168B, Z2-EU19B-168C, Z2-EU19B-168D, Z2-EU19B-169, Z2-EU19B-170, Z2-EU19B-301, Z2-EU19B-302, Z2-EU19B-303, Z2-EU19B-304, and Z2-EU19B-305.

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

[c]Blanks indicate the analyte was not detected.

[d]Max RL values are presented; blanks indicate there is no Max RL for the analyte. Max RLs are from Zone 2 ROD Table 2.13, except for technetium-99, which is presented in Zone 2 RDR/RAWP Sect. 3.1.2.

[e]Blanks indicate the criterion does not apply to the analyte.

[f]Avg RL values are presented; blanks indicate there is no Avg RL for the analyte. Avg RLs are from Zone 2 ROD Table 2.14, except for technetium-99, which is presented in Zone 2 RDR/RAWP Sect. 3.1.2.

Attachment 1B. EU Z2-19 Class 1 SU data summary[a] (cont.)

Analyte	Frequency of detect	Min detect[b,c]	Max detect[b,c]	Avg detected result[d]	Max RL[d]	Number of detects ≥ Max RL[e]	Avg RL[f]	Number of detects ≥ Avg RL[e]	RSL[g] (10^{-5} or HI=1)	Number of detects ≥ RSL[e]	GW SSL[h]	Number of detects ≥ GW SSL[e]

[a]RSL values are presented; blanks indicate there is no RSL for the analyte. Chemical RSLs were calculated using the website at http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search, June 2017 revision; radionuclide RSLs were calculated during June 2017 using the website at http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search.

[h]GW SSL values are presented; blanks indicate there is no GW SSL for the analyte. GW SSLs are from Zone 2 ROD Table C.5, except for technetium-99, which is presented in Zone 2 RDR/RAWP Sect. 3.1.2.

[i]The 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. Because the calculation involves subtraction of background from analytical results and negative numbers are not allowed, 0 (zero) is a legitimate result.

[j]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.

Avg = average
EU = exposure unit.
GW = groundwater
HI = hazard index
Max = maximum
Min = minimum
PCB = polychlorinated biphenyl
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RL = remediation level
ROD = Record of Decision
RSL = risk screening level
SSL = soil screening level
SU = Soil Unit

Attachment 1C. Details of Zone 2 ROD criteria exceedances in EU Z2-19, Class 1 SU characterization and delineation samples

Sample location	Start depth (ft)	End depth (ft)	Analyte	Result[a]	Criterion value[b]
Max RL exceedances					
Z2-EU19-109	0	1	Ra/Th decay series	6254	15
Z2-EU19-110	0	1	Ra/Th decay series	4113	15
Z2-EU19-111	0	1	Cesium-137	38.4	20
			Ra/Th decay series	881	15
Z2-EU19-112	0	1	Cesium-137	46.9	20
			Ra/Th decay series	1330	15
Z2-EU19-113	0	1	Cesium-137	4060	20
			Ra/Th decay series	569	15
			Uranium-234	16900	7000
			Uranium-235	977	80
			Uranium-238	17300	500
Z2-EU19-114	0	1	Cesium-137	24.9	20
			Ra/Th decay series	28.4	15
			Uranium-238	599	500
Z2-EU19-115	0	1	Uranium-235	106	80
			Uranium-238	1390	500
Z2-EU19-116	0	1	Ra/Th decay series	28.1	15
Z2-EU19-117	0	1	Ra/Th decay series	28.1	15
Z2-EU19-120	0	1	Ra/Th decay series	59	15
			Uranium-234	57300	7000
			Uranium-235	4250	80
			Uranium-238	1950	500
Z2-EU19-122	0	0.5	Uranium-235	473	80
			Uranium-238	501	500
Z2-EU19-123	0	0.5	Ra/Th decay series	90.9	15
			Uranium-235	112	80
			Uranium-238	1260	500
Z2-EU19-124	0	1	Ra/Th decay series	15.7	15
Z2-EU19B-149	0	0.5	Ra/Th decay series	53.1	15
Z2-EU19B-152	0	0.5	Ra/Th decay series	18.9	15
Z2-EU19B-154	0	0.5	Cesium-137	125	20
			Ra/Th decay series	132.8	15
Z2-EU19B-155A	0.5	0.5	Uranium-235	780	80
Z2-EU19B-157	0	0.5	Cesium-137	20.8	20
			Ra/Th decay series	79.83	15
			Uranium-238	516	500
	2	2	Uranium-238	571	500
Z2-EU19B-168C	0.5	0.5	Uranium-235	495	80
Avg RL exceedances (not accounted for by Max RL exceedances)					
Z2-EU19-101	0	1	Uranium-238	61.9	50
Z2-EU19-103	0	1	Uranium-235	18.2	8
			Uranium-238	180	50
Z2-EU19-105	0	1	Uranium-235	12	8
			Uranium-238	119	50
Z2-EU19-106	0	1	Uranium-238	50.7	50
Z2-EU19-107	0	1	Cesium-137	2.13	2
			Ra/Th decay series	5.43	5
			Uranium-235	8.77	8
			Uranium-238	83.8	50
Z2-EU19-108	0	1	Ra/Th decay series	11.7	5

Attachment 1C. Details of Zone 2 ROD criteria exceedances in EU Z2-19, Class 1 SU characterization and delineation samples (cont.)

Sample location	Start depth (ft)	End depth (ft)	Analyte	Result[a]	Criterion value[b]
Z2-EU19-109	0	1	Cesium-137	4.04	2
			Uranium-235	8.95	8
			Uranium-238	83.7	50
Z2-EU19-110	0	1	Uranium-238	55.8	50
Z2-EU19-111	0	1	Uranium-235	18.3	8
			Uranium-238	221	50
Z2-EU19-112	0	1	Uranium-235	9.16	8
			Uranium-238	103	50
Z2-EU19-114	0	1	Uranium-235	55.4	8
Z2-EU19-115	0	1	Uranium-234	1280	700
Z2-EU19-116	0	1	Cesium-137	12.5	2
			Uranium-235	9.12	8
			Uranium-238	66.2	50
Z2-EU19-117	0	1	Cesium-137	16.4	2
			Uranium-235	20.6	8
			Uranium-238	246	50
Z2-EU19-118	0	1	Uranium-235	19	8
			Uranium-238	274	50
Z2-EU19-121	0	0.5	Ra/Th decay series	5.4	5
			Uranium-234	728	700
			Uranium-235	47.2	8
			Uranium-238	290	50
Z2-EU19-122	0	0.5	Ra/Th decay series	5.1	5
			Uranium-234	6960	700
Z2-EU19-123	0	0.5	Cesium-137	11.4	2
			Uranium-234	1220	700
	0.5	2	Uranium-235	26.1	8
			Uranium-238	322	50
Z2-EU19-124	0	1	Cesium-137	5.17	2
			Uranium-238	78.1	50
Z2-EU19B-139	0	0.5	Ra/Th decay series	5.61	5
	2	2	Uranium-238	55.2	50
Z2-EU19B-149	0	0.5	Cesium-137	13.8	2
			Uranium-238	52.5	50
	2	2	Uranium-235	28.3	8
			Uranium-238	246	50
	4	4	Uranium-235	8.37	8
			Uranium-238	99.3	50
Z2-EU19B-152	0	0.5	Uranium-235	8.12	8
			Uranium-238	79.7	50
	5	5	Uranium-235	8.36	8
			Uranium-238	56.7	50
Z2-EU19B-153	0	3	Total PCBs	26300	10000
Z2-EU19B-154	0	0.5	Uranium-235	9.57	8
			Uranium-238	94.6	50
	2	2	Ra/Th decay series	10.83	5
			Uranium-238	57.5	50
Z2-EU19B-155	0.5	0.5	Cesium-137	2.77	2
			Ra/Th decay series	6.23	5
Z2-EU19B-155A	2	2	Uranium-235	74.3	8

Attachment 1C. Details of Zone 2 ROD criteria exceedances in EU Z2-19, Class 1 SU characterization and delineation samples (cont.)

Sample location	Start depth (ft)	End depth (ft)	Analyte	Result[a]	Criterion value[b]
Z2-EU19B-156	2	2	Uranium-238	111	50
	4	4	Uranium-235	15.8	8
			Uranium-238	207	50
	5.25	5.25	Uranium-238	58.1	50
Z2-EU19B-157	0	0.5	Uranium-235	44.4	8
	2	2	Ra/Th decay series	7.06	5
			Uranium-235	51.8	8
	4	4	Uranium-235	33.7	8
			Uranium-238	362	50
	5.7	5.7	Uranium-238	83.6	50
Z2-EU19B-164	0	0.5	Uranium-235	15.1	8
	0	0.5	Uranium-238	160	50
	2	2	Uranium-238	79.9	50
	4	4	Uranium-235	22.4	8
			Uranium-238	200	50
Z2-EU19B-165	0	0.5	Uranium-235	13.5	8
			Uranium-238	95.2	50
Z2-EU19B-166	0	0.5	Uranium-235	8.6	8
Z2-EU19B-167	0	0.5	Uranium-235	14.8	8
			Uranium-238	78.6	50
Z2-EU19B-167A	0	0.5	Uranium-235	25.4	8
	2	2	Uranium-235	16.3	8
Z2-EU19B-167B	0	0.5	Uranium-235	24.7	8
Z2-EU19B-167D	0	0.5	Uranium-235	13.7	8
Z2-EU19B-168C	2	2	Uranium-235	23.3	8
	3	3	Uranium-235	23.5	8
			Uranium-238	52.2	50
RSL exceedances (not accounted for by RL exceedances)					
Z2-EU19-103	0	1	Uranium	574	230
Z2-EU19-107	0	10	Uranium	421	230
Z2-EU19-109	0	1	Uranium	273	230
Z2-EU19-110	0	1	Uranium	388	230
Z2-EU19-111	0	1	Uranium	260	230
Z2-EU19-112	0	1	Uranium	391	230
			Plutonium-239	154	128
Z2-EU19-113	0	1	Uranium	21000	230
Z2-EU19-114	0	1	Uranium	1090	230
Z2-EU19-115	0	1	Uranium	1100	230
Z2-EU19-121	0	0.5	Uranium	365	230
Z2-EU19-122	0	0.5	Uranium	325	230
Z2-EU19-123	0	0.5	Uranium	2940	230
	0.04	0.17	Uranium	1060	230
Z2-EU19-124	0	1	Uranium	520	230
Z2-EU19B-167A	2	2	Uranium	236	230
Z2-EU19B-168C	0.5	0.5	Uranium	1850	230
	2	2	Uranium	239	230
GW SSL exceedances					
Z2-EU19-101	0	1	Uranium-234	71.8	61.1
			Uranium-238	61.9	61.1
Z2-EU19-103	0	1	Uranium-234	194	61.1
			Uranium-238	180	61.1

Attachment 1C. Details of Zone 2 ROD criteria exceedances in EU Z2-19, Class 1 SU characterization and delineation samples (cont.)

Sample location	Start depth (ft)	End depth (ft)	Analyte	Result[a]	Criterion value[b]
Z2-EU19-105	0	1	Uranium-234	114	61.1
			Uranium-238	119	61.1
Z2-EU19-106	0	1	Uranium-234	78.1	61.1
Z2-EU19-107	0	1	Uranium-234	113	61.1
			Uranium-238	83.8	61.1
Z2-EU19-109	0	1	Uranium-234	83.4	61.1
			Uranium-238	83.7	61.1
Z2-EU19-111	0	1	Uranium-234	215	61.1
			Uranium-238	221	61.1
Z2-EU19-112	0	1	Uranium-234	90.9	61.1
			Uranium-238	103	61.1
Z2-EU19-113	0	1	Chromium	530	172
			Technetium-99	2640	85.6
			Uranium-234	16900	61.1
			Uranium-235	977	61.1
			Uranium-238	17300	61.1
Z2-EU19-114	0	1	Uranium-234	563	61.1
			Uranium-238	599	61.1
Z2-EU19-115	0	1	Uranium-234	1280	61.1
			Uranium-235	106	61.1
			Uranium-238	1390	61.1
Z2-EU19-116	0	1	Uranium-234	69.7	61.1
			Uranium-238	66.2	61.1
Z2-EU19-117	0	1	Uranium-234	291	61.1
			Uranium-238	246	61.1
Z2-EU19-118	0	1	Uranium-234	280	61.1
			Uranium-238	274	61.1
Z2-EU19-120	0	1	Uranium-234	57300	61.1
			Uranium-235	4250	61.1
			Uranium-238	1950	61.1
Z2-EU19-121	0	0.5	Uranium-234	728	61.1
			Uranium-238	290	61.1
Z2-EU19-122	0	0.5	Uranium-234	6960	61.1
			Uranium-235	473	61.1
			Uranium-238	501	61.1
	4.4	4.4	Uranium-234	70.9	61.1
Z2-EU19-123	0	0.5	Uranium-234	1220	61.1
			Uranium-235	112	61.1
			Uranium-238	1260	61.1
	0.5	2	Uranium-234	318	61.1
			Uranium-238	322	61.1
Z2-EU19-124	0	1	Uranium-234	85.3	61.1
			Uranium-238	78.1	61.1
Z2-EU19B-149	2	2	Uranium-234	247	61.1
			Uranium-238	246	61.1
	4	4	Uranium-234	103	61.1
			Uranium-238	99.3	61.1
Z2-EU19B-152	0	0.5	Uranium-234	87.9	61.1
			Uranium-238	79.7	61.1
	5	5	Uranium-234	100	61.1

Attachment 1C. Details of Zone 2 ROD criteria exceedances in EU Z2-19, Class 1 SU characterization and delineation samples (cont.)

Sample location	Start depth (ft)	End depth (ft)	Analyte	Result[a]	Criterion value[b]
Z2-EU19B-154	0	0.5	Uranium-234	103	61.1
			Uranium-238	94.6	61.1
	2	2	Uranium-234	65.3	61.1
Z2-EU19B-155	2	2	Uranium-234	64.4	61.1
Z2-EU19B-155A	0.5	0.5	Uranium-235	780	61.1
	2	2	Uranium-235	74.3	61.1
Z2-EU19B-156	2	2	Uranium-234	112	61.1
			Uranium-238	111	61.1
	4	4	Uranium-234	200	61.1
			Uranium-238	207	61.1
Z2-EU19B-157	0	0.5	Uranium-234	459	61.1
			Uranium-238	516	61.1
	2	2	Uranium-234	568	61.1
			Uranium-238	571	61.1
	4	4	Uranium-234	237	61.1
			Uranium-238	362	61.1
	5.7	5.7	Uranium-234	79.4	61.1
			Uranium-238	83.6	61.1
Z2-EU19B-164	0	0.5	Uranium-234	178	61.1
			Uranium-238	160	61.1
	2	2	Uranium-234	89.6	61.1
			Uranium-238	79.9	61.1
	4	4	Uranium-234	220	61.1
			Uranium-238	200	61.1
Z2-EU19B-165	0	0.5	Uranium-234	175	61.1
			Uranium-238	95.2	61.1
Z2-EU19B-166	0	0.5	Uranium-234	107	61.1
Z2-EU19B-167	0	0.5	Uranium-234	168	61.1
			Uranium-238	78.6	61.1
	2	2	Uranium-234	83.6	61.1
Z2-EU19B-168C	0.5	0.5	Uranium-235	495	61.1

[a]Units: metals = mg/kg, PCBs = µg/kg, and radionuclides = pCi/g.

Avg = average
EU = Exposure Unit
GW = groundwater
Max = maximum
PCB = polychlorinated biphenyl
RL = remediation level
ROD = Record of Decision
RSL = risk screening level
SSL = soil screening level
SU = Soil Unit

Attachment 1D. EU Z2-19 Class 1 SU characterization and delineation sample locations with Avg RL, RSL, and GW SSL exceedances after removal of sample locations with Max RL exceedances to a depth of 4 ft[a]

Sample location	Analyte
Residual Avg RL Exceedances	
Z2-EU19-101	Uranium -238
Z2-EU19-103	Uranium-235, uranium-238
Z2-EU19-105	Uranium-235, uranium-238
Z2-EU19-106	Uranium -238
Z2-EU19-107	Cesium-137, Ra/Th decay series, uranium-235, uranium-238
Z2-EU19-108	Ra/Th decay series
Z2-EU19-118	Uranium-235, uranium-238
Z2-EU19-121	Ra/Th decay series, uranium-234, uranium-235, uranium-238
Z2-EU19B-139	Ra/Th decay series, uranium-238
Z2-EU19B-152 (5-5 ft)[b]	Uranium-235, uranium-238
Z2-EU19B-153	Total PCBs
Z2-EU19B-155	Cesium-137, Ra/Th decay series
Z2-EU19B-156	Uranium-235, uranium-238
Z2-EU19B-157 (5.7-5.7 ft.)[b]	Uranium-235, uranium-238
Z2-EU19B-164	Uranium-235, uranium-238
Z2-EU19B-165	Uranium-235, uranium-238
Z2-EU19B-166	Uranium-235
Z2-EU19B-167	Uranium-235, uranium-238
Z2-EU19B-167A	Uranium-235
Z2-EU19B-167B	Uranium-235
Z2-EU19B-167D	Uranium-235
Residual RSL exceedances (not including residual Avg RL exceedances or potassium-40)[c,d]	
Z2-EU19-103	Uranium
Z2-EU19-107	Uranium
Z2-EU19-121	Uranium
Z2-EU19B-167A	Uranium
Residual GW SSL exceedances	
Z2-EU19-103	Uranium-234, uranium-238
Z2-EU19-105	Uranium-234, uranium-238
Z2-EU19-106	Uranium-234, uranium-238
Z2-EU19-107	Uranium-234, uranium-238
Z2-EU19-118	Uranium-234, uranium-238
Z2-EU19-121	Uranium-234, uranium-238
Z2-EU19B-122 (4.4 to 4.4 ft.)(2)	Uranium-234
Z2-EU19B-152 (5 to 5 ft.)(2)	Uranium-234
Z2-EU19B-155	Uranium-234
Z2-EU19B-156	Uranium-234, uranium-238
Z2-EU19B-157 (5.7 to 5.7 ft.)(2)	Uranium-235, uranium-238
Z2-EU19B-164	Uranium-234, uranium-238
Z2-EU19B-165	Uranium-234, uranium-238
Z2-EU19B-166	Uranium-234
Z2-EU19B-167	Uranium-234, uranium-238

[a]Details of residual criteria exceedances, including sample depths and analyte concentrations at each sample location and criterion values can be found in Attachment 3.

[b]Max RL exceedances will be excavated at these sample locations from depths up to 4 ft.

[c]RSL values are the same as Avg RL values for all of the analytes with residual Avg RL exceedances except for the Ra/Th decay series. There is no Ra/Th decay series RSL because radium and thorium isotopes are not included in EU risk calculations as discussed in the Zone 2 ROD.

[d]Potassium-40 is not evaluated for risk if its average concentration is less than the potassium-40 background concentration (32.12 pCi/g). The average potassium-40 concentration in EU Z2-19 is presented in Table 3.

Avg = average
EU = Exposure Unit
GW = groundwater
Max = maximum
PCB = polychlorinated biphenyl
RL = remediation level
ROD = Record of Decision
RSL = risk screening level
SSL = soil screening level

FIGURES

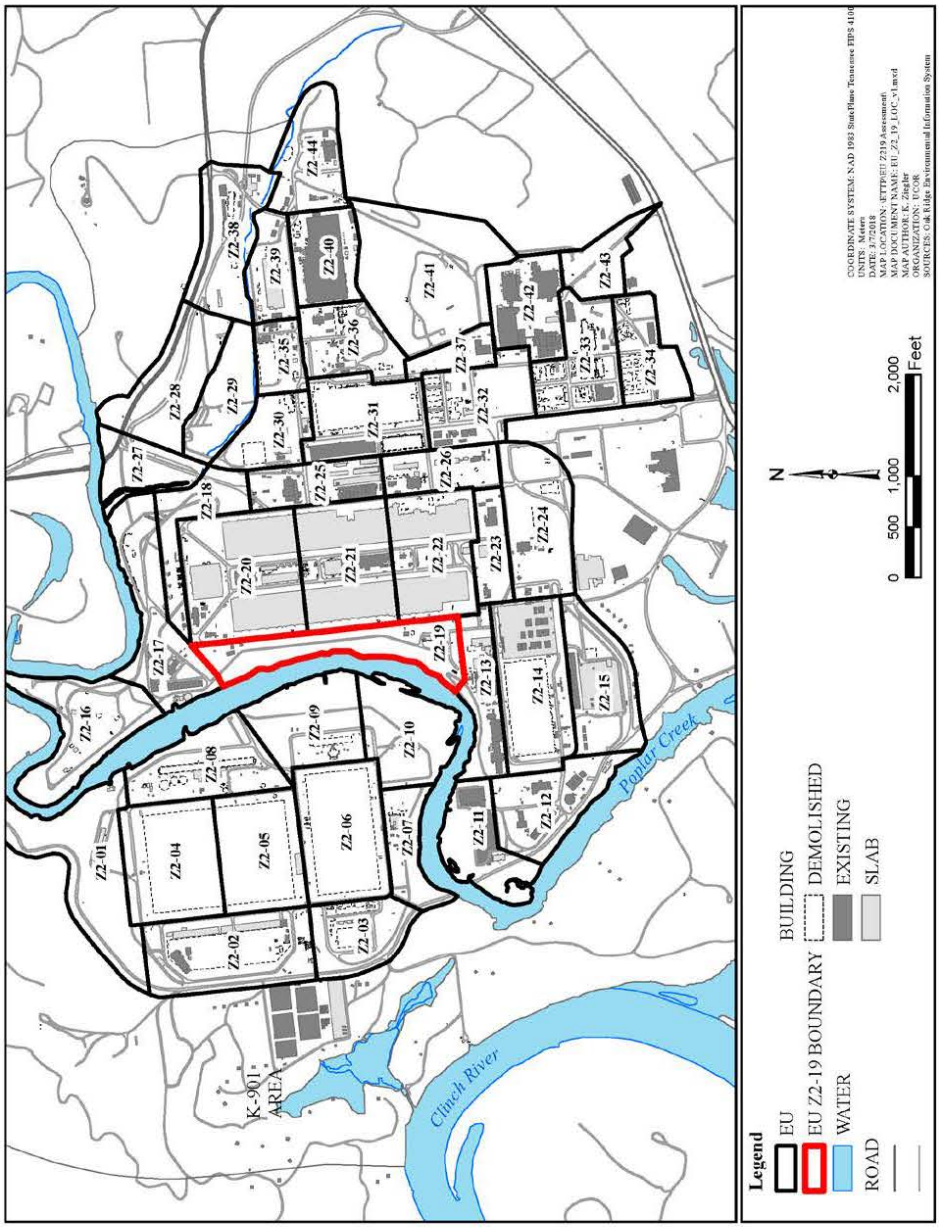

Fig. 1. Location of EU Z2-19 at ETTP.

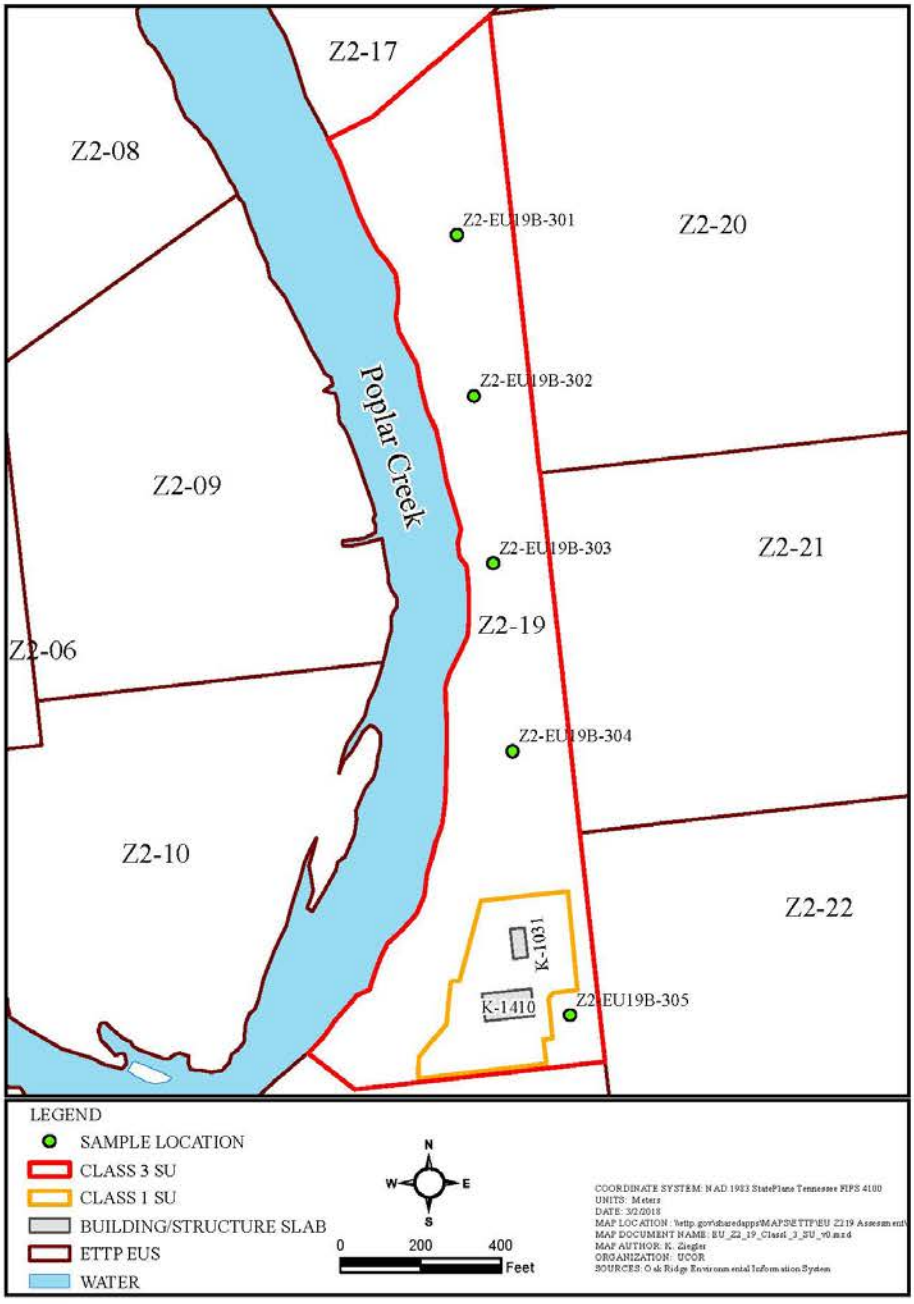

Fig. 2. Location of Class 1 SU within EU Z2-19.

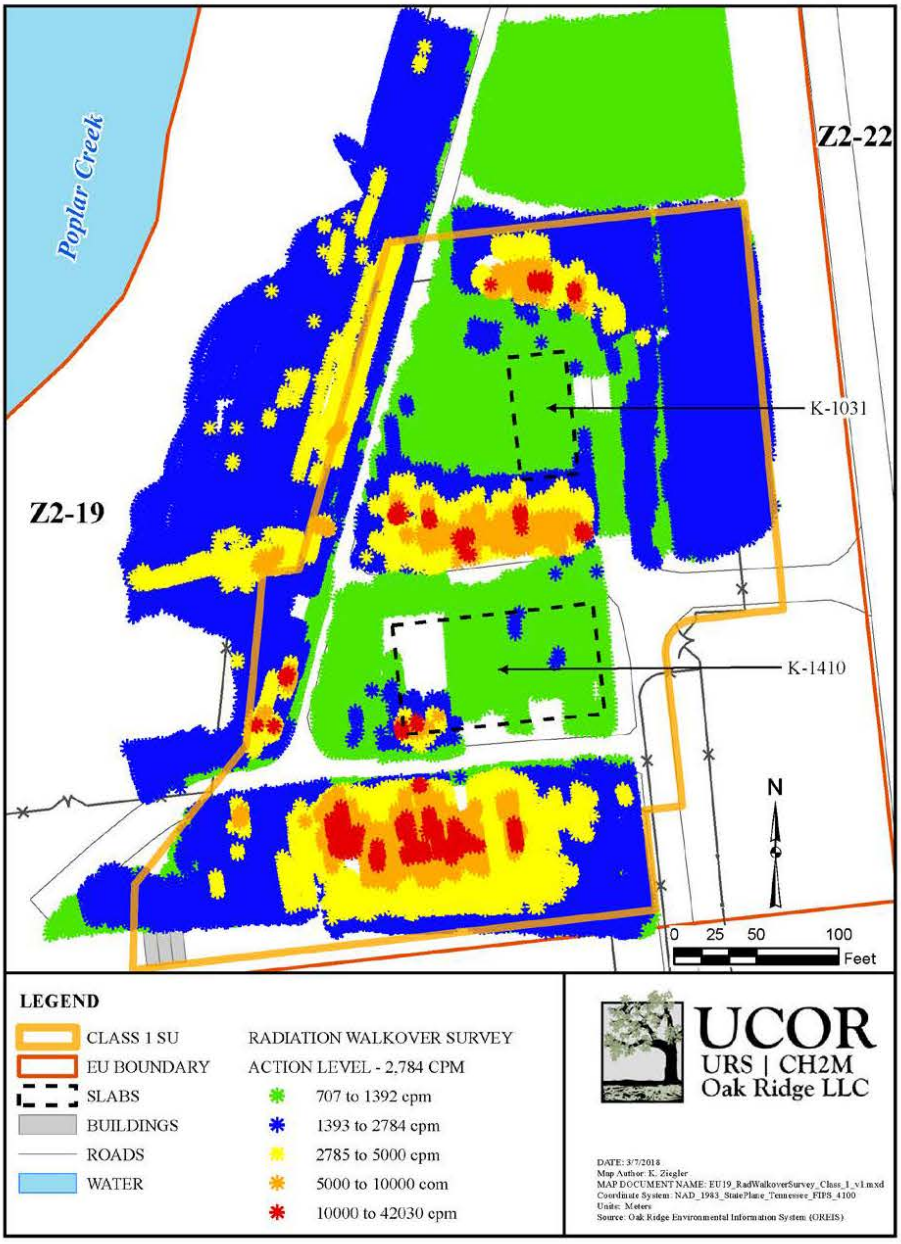

Fig. 3. Walkover survey results for Class 1 SU in EU Z2-19.

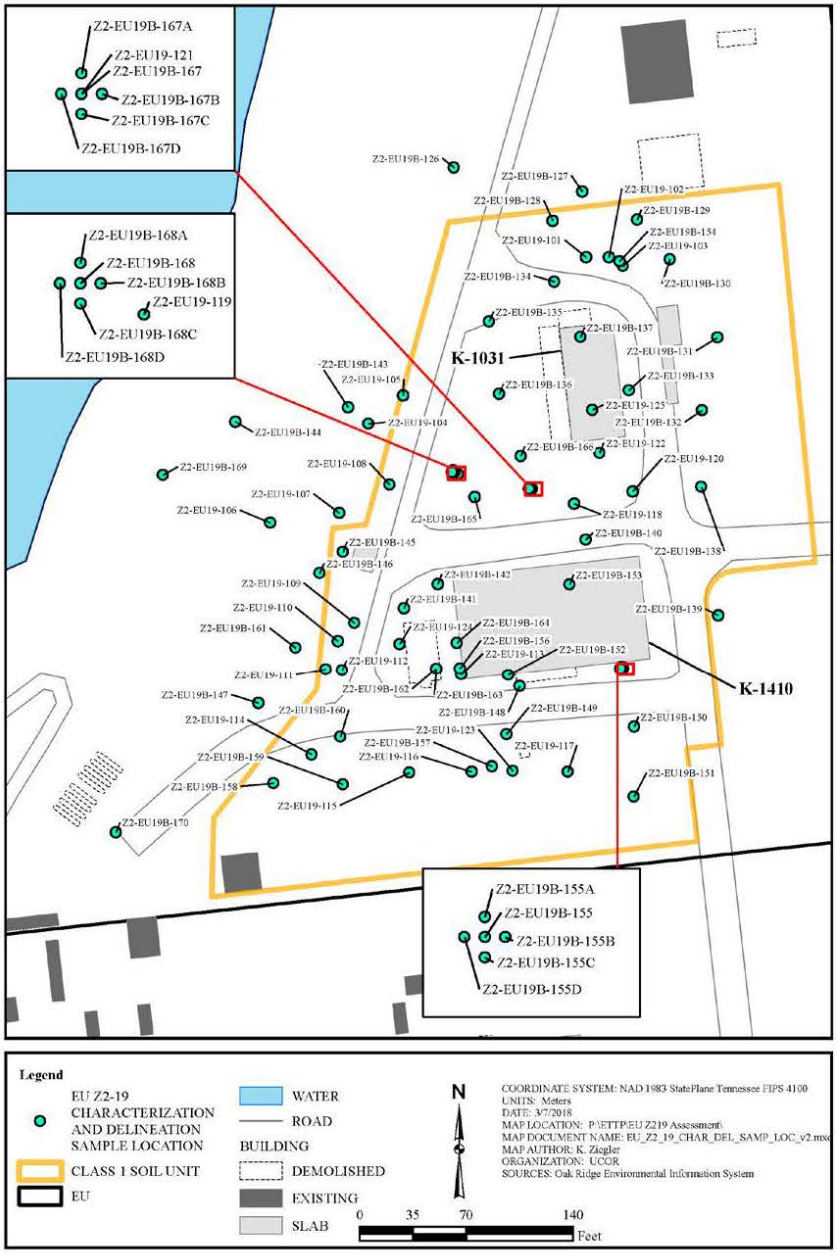

Fig. 4. Soil sample locations in the Class 1 SU in EU Z2-19.

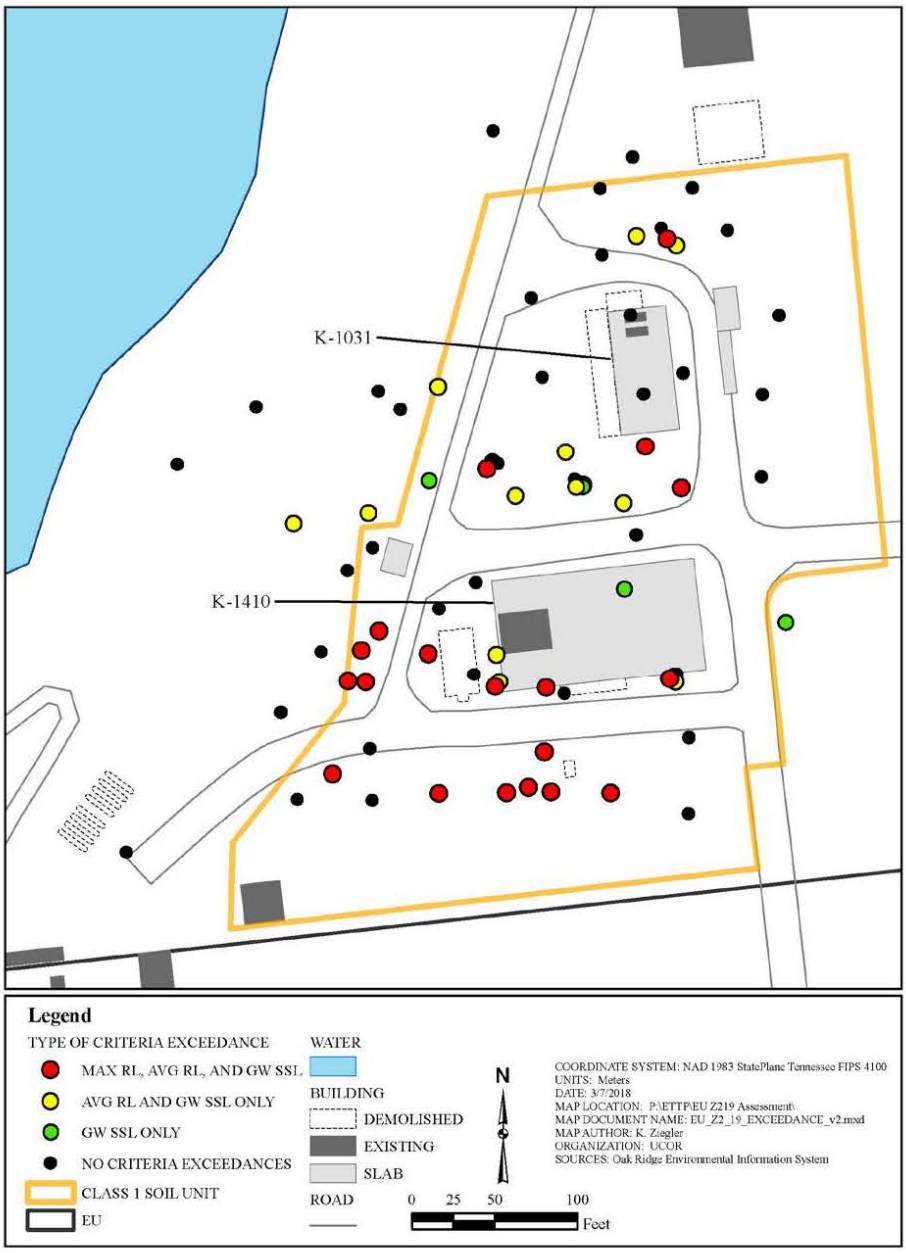

Fig. 5. Summary of RL/GW SSL exceedances.

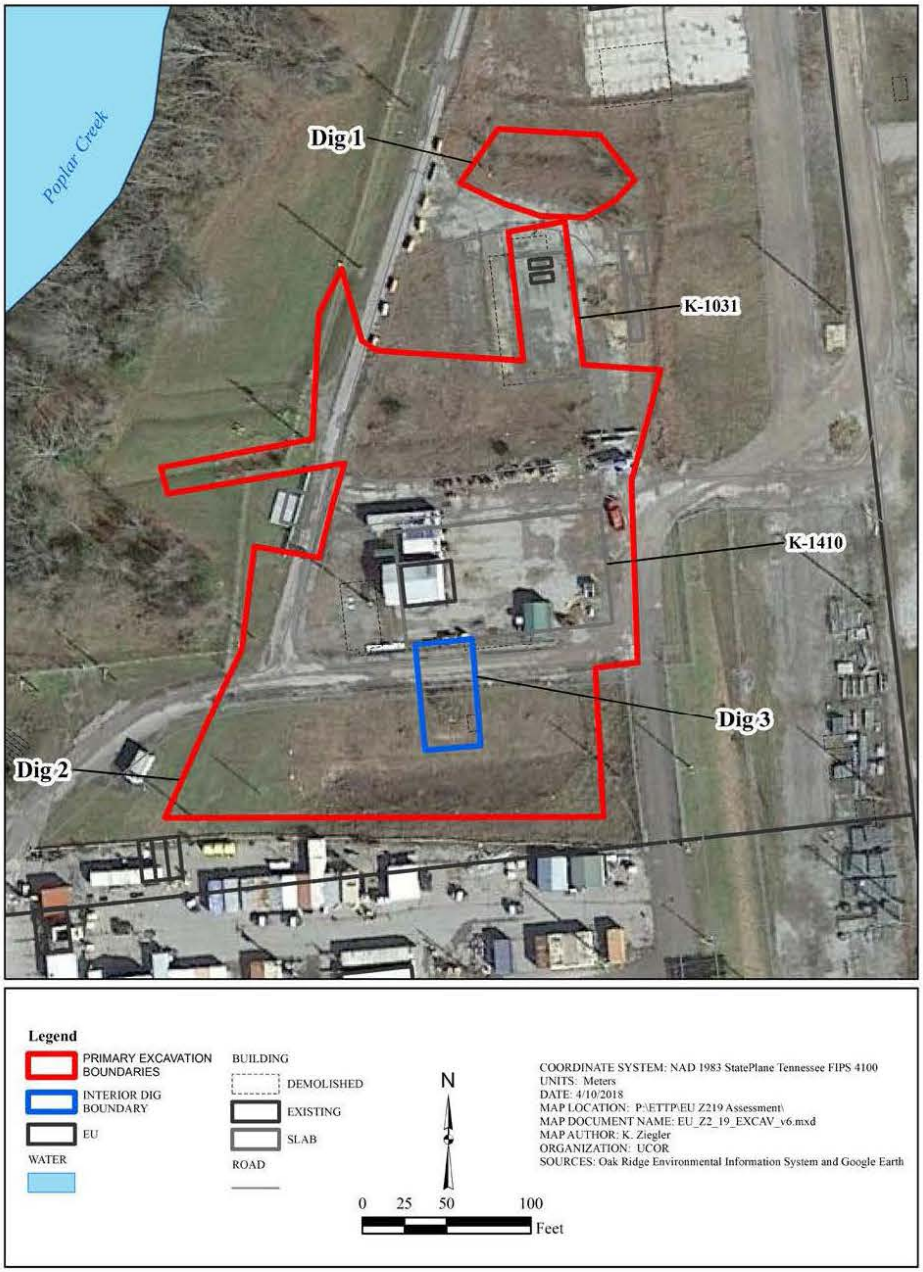

Fig. 6. EU Z2-19 Class 1 SU RA dig locations.

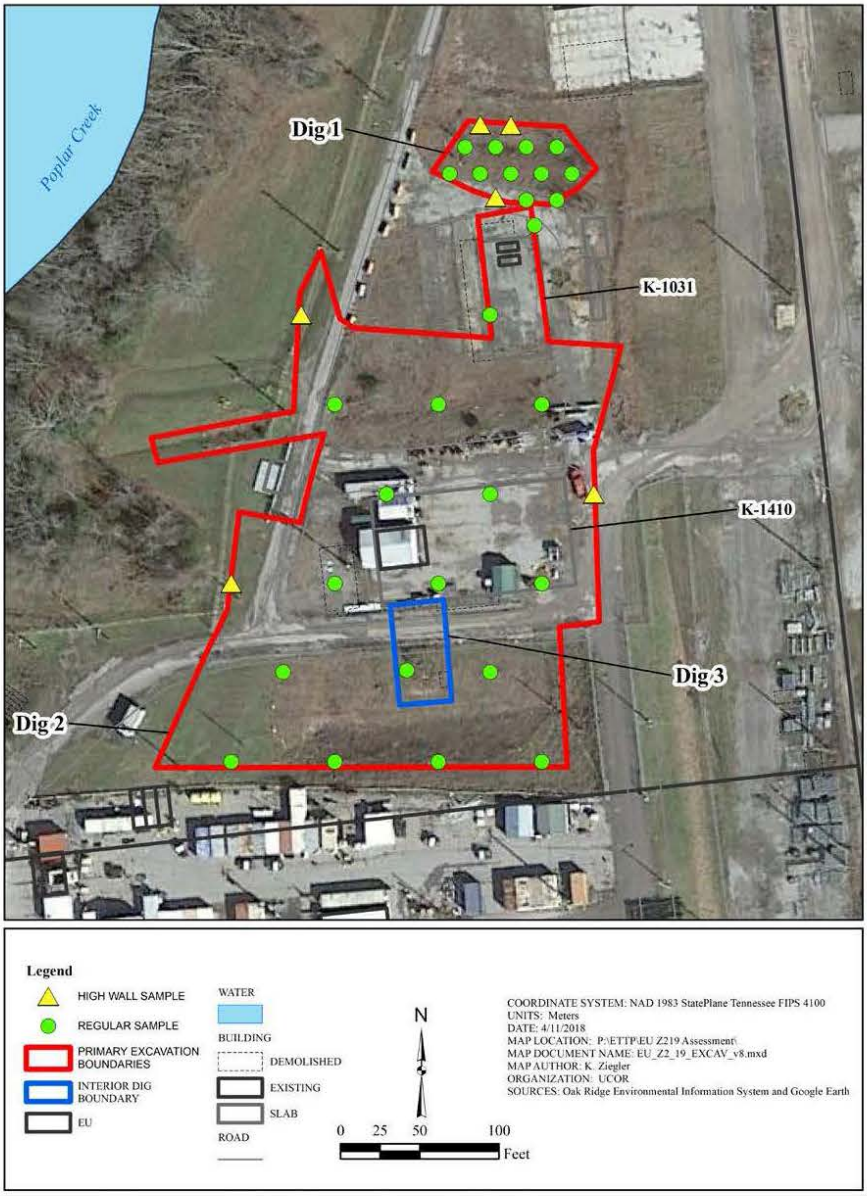

Fig. 7. EU Z2-19 Class 1 SU RA dig areas with approximate confirmation sample locations.

ATTACHMENT 6:
BORING LOGS

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UCOR BORING LOG

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PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	1 of 3	Z2-EU19-701

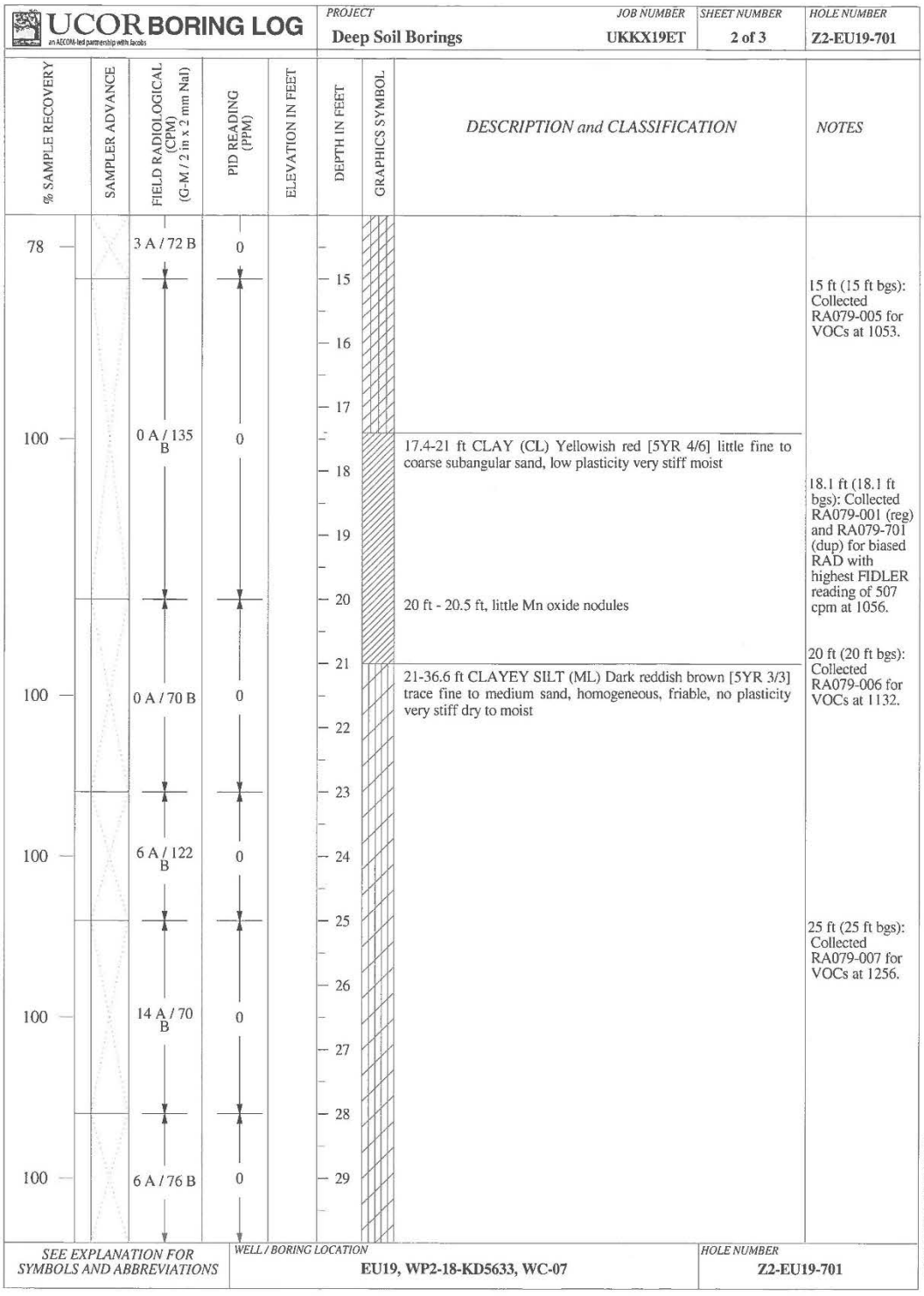
DRILLING COMPANY	DRILLING RIG	SITE	BEGUN	FINISHED
Cascade Drilling	Geoprobe 6620DT	ETTP K-1410, EU19 Poplar Creek TCE Investigation	7-29-19	7-29-19

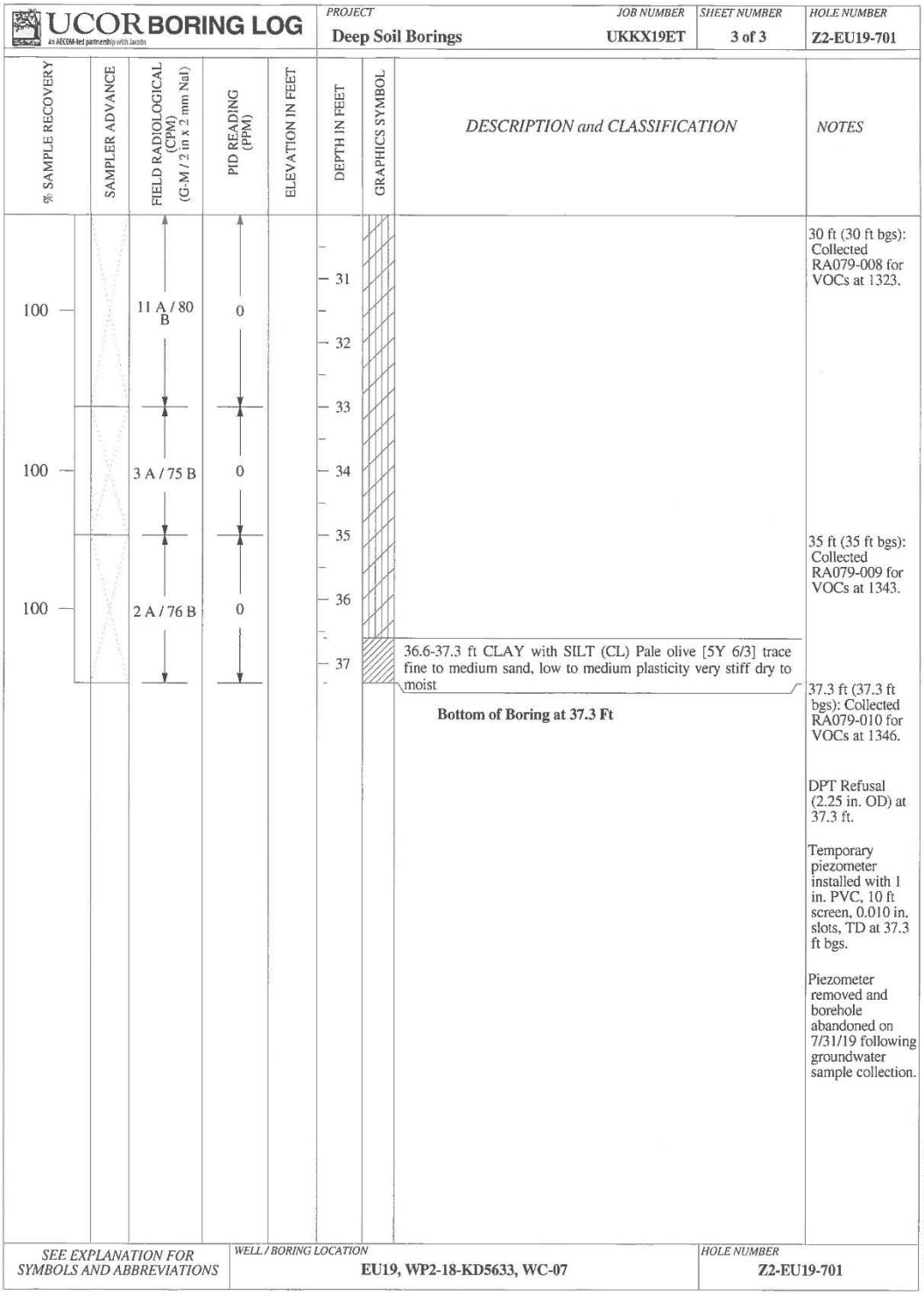
DRILLING METHOD	HAMMER WEIGHT / FALL	SITE LOCATION or MAP DESCRIPTION	ELEVATION	TOTAL DEPTH
Direct-Push	n.a.	N 178,672.5 E 744,640.9	not surveyed	37.3 ft

DEPTH / ELEVATION TO WATER	TOC ELEVATION	LOGGED BY	REVIEWED BY	ANGLE (from Horiz.)	HOLE DIAMETER
▽ 7.7 ft / ▼ 16.3 ft / Piezometer DTW ft bgs	not surveyed	K. Heffernan	M. Martin 11·12·19	Vertical	2.25 in

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
					0		0-0.7 ft ORGANIC SOIL (OL) Very dark gray [10YR 3/1] trace fine to coarse subangular sand, trace fine gravel, fuel odor, weak cementation, soft dry	Discrete Soil Sampling: RA079-FSL001
					1		0.5 ft - 0.7 ft, GRAVEL (GW), fine limestone gravel lense, subangular, FILL	Logbook: ETTP-DPBORE-007
					2		0.7-2.3 ft CLAY (CH) Reddish brown [5YR 4/4] trace fine to coarse subangular sand, trace fine gravel, high plasticity stiff dry to moist	
78		4 A / 62 B	0		3		2.3-6.4 ft SILTY CLAY (CL) Dark reddish brown [5YR 3/3] trace fine to coarse subangular sand, medium plasticity stiff moist	Radiological readings: A = alpha B = beta
					4			0 ft (0 ft bgs): Collected RA079-002 for VOCs at 0938.
					5			5 ft (5 ft bgs): Collected RA079-003 for VOCs at 1006.
					6			
					7		6.4-8.7 ft CLAY (CH) Reddish brown [5YR 4/4] trace fine to medium sand, trace fine to coarse gravel, chert, high plasticity firm moist to wet	
100		4 A / 52 B	0		8		7.7 ft - 8.7 ft, firm to soft	
					9		8.7-17.4 ft SILTY CLAY (CL) Dark reddish brown [5YR 3/3] trace fine to medium sand, medium plasticity soft wet	
					10			10 ft (10 ft bgs): Collected RA079-004 (reg) and RA079-702 (dup) for VOCs at 1026.
					11			
78		3 A / 72 B	0		12			
					13			

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-701


UCOR BORING LOG
an AECOM-led partnership with Jacobs
PROJECT
Deep Soil Borings
JOB NUMBER
UKKX19ET
SHEET NUMBER
2 of 3
HOLE NUMBER
Z2-EU19-701
% SAMPLE RECOVERY
SAMPLER ADVANCE
FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)
PID READING (PPM)
ELEVATION IN FEET
DEPTH IN FEET
GRAPHICS SYMBOL
DESCRIPTION and CLASSIFICATION
NOTES
78
3 A / 72 B
0
100
0 A / 135 B
0
100
0 A / 70 B
0
100
6 A / 122 B
0
100
14 A / 70 B
0
100
6 A / 76 B
0
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
17.4-21 ft CLAY (CL) Yellowish red [5YR 4/6] little fine to coarse subangular sand, low plasticity very stiff moist
20 ft - 20.5 ft, little Mn oxide nodules
21-36.6 ft CLAYEY SILT (ML) Dark reddish brown [5YR 3/3] trace fine to medium sand, homogeneous, friable, no plasticity very stiff dry to moist
15 ft (15 ft bgs): Collected RA079-005 for VOCs at 1053.
18.1 ft (18.1 ft bgs): Collected RA079-001 (reg) and RA079-701 (dup) for biased RAD with highest FIDLER reading of 507 cpm at 1056.
20 ft (20 ft bgs): Collected RA079-006 for VOCs at 1132.
25 ft (25 ft bgs): Collected RA079-007 for VOCs at 1256.
SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS
WELL / BORING LOCATION
EU19, WP2-18-KD5633, WC-07
HOLE NUMBER
Z2-EU19-701


UCOR BORING LOG
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PROJECT
Deep Soil Borings
JOB NUMBER
UKKX19ET
SHEET NUMBER
3 of 3
HOLE NUMBER
Z2-EU19-701
% SAMPLE RECOVERY
SAMPLER ADVANCE
FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)
PID READING (PPM)
ELEVATION IN FEET
DEPTH IN FEET
GRAPHICS SYMBOL
DESCRIPTION and CLASSIFICATION
NOTES
100
11 A / 80 B
0
100
3 A / 75 B
0
100
2 A / 76 B
0
31
32
33
34
35
36
37
36.6-37.3 ft CLAY with SILT (CL) Pale olive [5Y 6/3] trace fine to medium sand, low to medium plasticity very stiff dry to moist
Bottom of Boring at 37.3 Ft
30 ft (30 ft bgs): Collected RA079-008 for VOCs at 1323.
35 ft (35 ft bgs): Collected RA079-009 for VOCs at 1343.
37.3 ft (37.3 ft bgs): Collected RA079-010 for VOCs at 1346.
DPT Refusal (2.25 in. OD) at 37.3 ft.
Temporary piezometer installed with 1 in. PVC, 10 ft screen, 0.010 in. slots, TD at 37.3 ft bgs.
Piezometer removed and borehole abandoned on 7/31/19 following groundwater sample collection.
SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS
WELL / BORING LOCATION
EU19, WP2-18-KD5633, WC-07
HOLE NUMBER
Z2-EU19-701
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UCOR BORING LOG

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PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	1 of 2	Z2-EU19-702

DRILLING COMPANY	DRILLING RIG	SITE	BEGUN	FINISHED
Cascade Drilling	Geoprobe 6620DT	ETTP K-1410, EU19 Poplar Creek TCE Investigation	7-25-19	7-25-19

DRILLING METHOD	HAMMER WEIGHT / FALL	SITE LOCATION or MAP DESCRIPTION	ELEVATION	TOTAL DEPTH
Direct-Push	n.a.	N 178,643.6 E 744,595.6	not surveyed	15.0 ft

DEPTH / ELEVATION TO WATER	TOC ELEVATION	LOGGED BY	REVIEWED BY	ANGLE (from Horiz)	HOLE DIAMETER
▼ DRY Piezometer	n.a.	K. Heffernan	M. Martin 11·12·19	Vertical	2.25 in

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
					1		0-0.4 ft ORGANIC SOIL (OL) Brown [10YR 4/3] some fine to medium sand, little gravel, accumulated sediment on concrete surface, trace organics	Discrete Soil Sampling: RA079-FSL002
							0.4-1 ft CONCRETE	
							1-1.4 ft GRAVEL with Clay	Logbook: ETTP-DPBORE-007
		2.4 A / 740 B	1		2		1.4-3.3 ft CLAY (CH) Reddish brown [5YR 4/4] trace Mn oxide nodules, high plasticity stiff moist	
66					3		2.3 ft - 2.5 ft, SAND (SP) lense, fine to medium sand, moist	Radiological readings: A = alpha B = beta
					4		3.3-5 ft No Recovery	0 ft (1 ft bgs): Collected RA079-012 for VOCs at 0838 and RA079-011 for biased RAD with FIDLER reading of 474 cpm at 0850.
					5		5-5.9 ft CLAY (CH) Reddish brown [5YR 4/4] trace Mn oxide nodules, high plasticity stiff moist	
					6		5.3 ft - 5.9 ft, firm, moist to wet	
							5.9-15 ft CLAYEY SILT (ML) Reddish brown [5YR 4/4] trace medium sand, homogeneous, firm wet	5 ft (6 ft bgs): Collected RA079-013 for VOCs at 0924.
90		3.4 A / 78 B	0		7			
					8			
					9			
					10		10 ft - 15 ft, very stiff, moist	
					11			10 ft (11 ft bgs): Collected RA079-014 for VOCs at 1002.
92		3.4 A / 114 B	0		12			
					13			

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-702

UCOR BORING LOG
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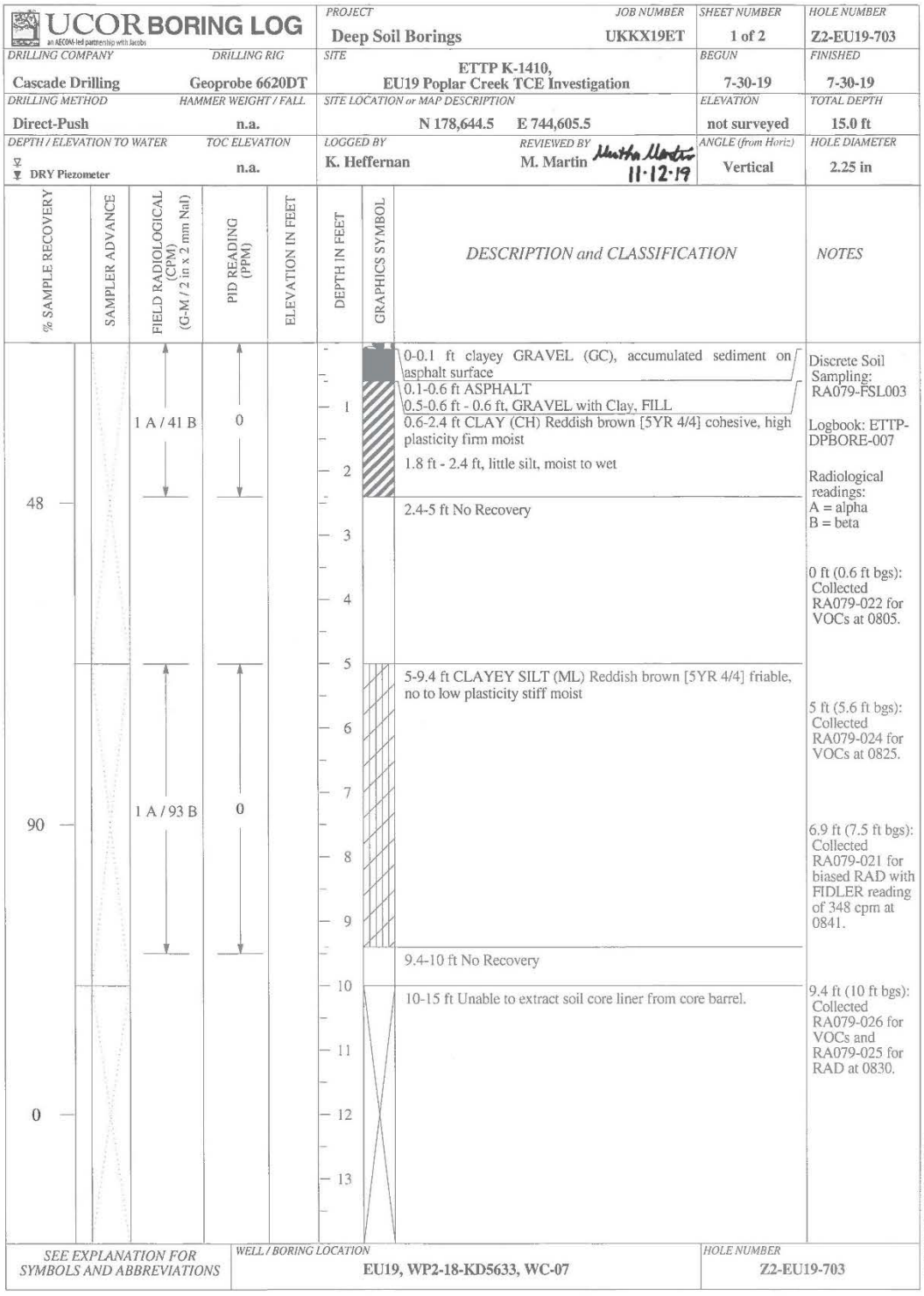
PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	2 of 2	Z2-EU19-702

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
92		3.4 A / 114 B	0		15		14.6-15 ft No Recovery **Bottom of Boring at 15.0 Ft**	14 ft (15 ft bgs): RA079-015 for VOCs inadvertently not collected. DPT Refusal (2.25 in. OD) at 15 ft. Temporary piezometer installed with 1 in. PVC, 10 ft screen, 0.010 in. slots, TD at 15 ft bgs. Piezometer removed and borehole abandoned on 7/29/19 following groundwater sample collection.

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-702



UCOR BORING LOG
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PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	1 of 2	Z2-EU19-703

DRILLING COMPANY	DRILLING RIG	SITE	BEGUN	FINISHED
Cascade Drilling	Geoprobe 6620DT	ETTP K-1410, EU19 Poplar Creek TCE Investigation	7-30-19	7-30-19

DRILLING METHOD	HAMMER WEIGHT / FALL	SITE LOCATION or MAP DESCRIPTION	ELEVATION	TOTAL DEPTH
Direct-Push	n.a.	N 178,644.5 E 744,605.5	not surveyed	15.0 ft

DEPTH / ELEVATION TO WATER	TOC ELEVATION	LOGGED BY	REVIEWED BY	ANGLE (from Horiz)	HOLE DIAMETER
▽ DRY Piezometer	n.a.	K. Heffernan	M. Martin 11·12·19	Vertical	2.25 in

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
					0		0-0.1 ft clayey GRAVEL (GC), accumulated sediment on asphalt surface	Discrete Soil Sampling: RA079-FSL003
							0.1-0.6 ft ASPHALT	
							0.5-0.6 ft - 0.6 ft, GRAVEL with Clay, FILL	
		1 A / 41 B	0		1		0.6-2.4 ft CLAY (CH) Reddish brown [5YR 4/4] cohesive, high plasticity firm moist	Logbook: ETTP-DPBORE-007
					2		1.8 ft - 2.4 ft, little silt, moist to wet	Radiological readings: A = alpha B = beta
48					3		2.4-5 ft No Recovery	
					4			0 ft (0.6 ft bgs): Collected RA079-022 for VOCs at 0805.
					5		5-9.4 ft CLAYEY SILT (ML) Reddish brown [5YR 4/4] friable, no to low plasticity stiff moist	
					6			5 ft (5.6 ft bgs): Collected RA079-024 for VOCs at 0825.
					7			
90		1 A / 93 B	0		8			6.9 ft (7.5 ft bgs): Collected RA079-021 for biased RAD with FIDLER reading of 348 cpm at 0841.
					9			
					10		9.4-10 ft No Recovery	
					11		10-15 ft Unable to extract soil core liner from core barrel.	9.4 ft (10 ft bgs): Collected RA079-026 for VOCs and RA079-025 for RAD at 0830.
0					12			
					13			

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-703

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PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	2 of 2	Z2-EU19-703

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
0					15		**Bottom of Boring at 15.0 Ft**	14.4 ft (15 ft bgs): Unable to extract 10-15 ft soil core; RA079-028 for VOCs and RA079-027 for RAD not collected. DPT Refusal (2.25 in. OD) at 15 ft. Temporary piezometer installed with 1 in. PVC, 10 ft screen, 0.010 in. slots, TD at 14.7 ft bgs. Piezometer removed and borehole abandoned on 8/01/19 following groundwater sample collection.

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-703

UCOR BORING LOG

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PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	1 of 3	Z2-EU19-705

DRILLING COMPANY	DRILLING RIG	SITE	BEGUN	FINISHED
Cascade Drilling	Geoprobe 6620DT	ETTP K-1410, EU19 Poplar Creek TCE Investigation	7-30-19	7-30-19

DRILLING METHOD	HAMMER WEIGHT / FALL	SITE LOCATION or MAP DESCRIPTION	ELEVATION	TOTAL DEPTH
Direct-Push	n.a.	N 178,635.5 E 744,605.9	not surveyed	28.5 ft

DEPTH / ELEVATION TO WATER	TOC ELEVATION	LOGGED BY	REVIEWED BY	ANGLE (from Horiz.)	HOLE DIAMETER
▼ 17.0 ft / Piezometer DTW ft bgs	not surveyed	K. Heffernan	M. Martin 11-12-19	Vertical	2.25 in

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
					0		0-0.3 ft gravelly CLAY with organics, accumulated sediment on asphalt surface	Discrete Soil Sampling: RA079-FSL005
							0.3-0.6 ft ASPHALT	
							0.5 ft - 0.6 ft, GRAVEL with Clay	
					1		0.6-3 ft CLAY (CH) Reddish brown [5YR 4/3] trace fine to coarse subangular sand, high plasticity firm moist	Logbook: ETTP-DPBORE-007
		6 A / 39 B	0		2			Radiological readings: A = alpha B = beta
72							2.7 ft - 3 ft, soft, moist to wet	
					3		3-3.6 ft CLAY (CH) Olive brown [2.5Y 4/4] fuel odor, high plasticity soft moist to wet	
							3.6-5 ft No Recovery	0 ft (0.6 ft bgs): Collected RA079-048 for VOCs at 0942.
					4			
					5		5-7.9 ft CLAY (CH) Olive brown [2.5Y 4/4] fuel odor, high plasticity stiff moist	
					6			5 ft (5.6 ft bgs): Collected RA079-050 for VOCs at 1005.
					7			5.1 ft (5.7 ft bgs): Collected RA079-047 for biased RAD with FIDLER reading of 369 cpm at 1008.
80		1 A / 59 B	0		8		7.9-12.1 ft CLAY (CH) Reddish brown [5YR 4/3] trace fine to coarse subangular sand, fuel odor from 7.9-10 ft, high plasticity firm moist	
					9			
					10			10 ft (10.6 ft bgs): Collected RA079-052 for VOCs and RA079-051 for RAD at 1058.
100		3 A / 68 B	0		11			

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-705

UCOR BORING LOG — an AECOM-led partnership with Jacobs

PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	2 of 3	Z2-EU19-705

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
100		3 A / 68 B	0		13		12.1-16 ft CLAYEY SILT (ML) Light olive brown [2.5Y 5/4] trace fine to medium sand, friable, low plasticity very stiff dry to moist	
100		4 A / 89 B	0		14			
					15			
					16			15 ft (15.6 ft bgs): Collected RA079-054 for VOCs and RA079-053 for RAD at 1309.
100		2 A / 79 B	0		17		16-20.3 ft SILTY CLAY (CL) Dark reddish brown [5YR 3/4] trace fine to medium sand, low plasticity stiff moist	
					18			
100		2 A / 89 B	0		19			
					20			
					21		20.3-28.5 ft CLAYEY SILT (ML) Dark reddish brown [5YR 3/4] trace fine to medium sand, homogeneous, friable, no to low plasticity very stiff dry to moist	20 ft (20.6 ft bgs): Collected RA079-056 (reg) and RA079-706 (dup) for VOCs and RA079-055 (reg) and RA079-705 (dup) for RAD at 1335.
100		1 A / 128 B	0		22			
					23			
100		9 A / 86 B	0		24		23.9 ft - 24.2 ft, light yellowish brown [2.5Y 6/4]	
					25			25 ft (25.6 ft bgs): Collected RA079-058 for VOCs and RA079-057 for RAD at 1408.
100		2 A / 63 B	0					

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-705

UCOR BORING LOG
an AECOM-led partnership with Jacobs

PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	3 of 3	Z2-EU19-705

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
100		2 A / 63 B	0		26 27 28			26.8 ft (27.4 ft bgs): Collected RA079-049 for biased RAD with FIDLER reading of 692 cpm at 1414.
							Bottom of Boring at 28.5 Ft	27.9 ft (28.5 ft bgs): Collected RA079-060 for VOCs and RA079-059 for RAD at 1411. DPT Refusal (2.25 in. OD) at 28.5 ft. Overdrill with 3.25 in. OD tooling not performed. Semi-permanent piezometer installed with 1 in. PVC, 10 ft screen, 0.010 in. slots, TD = 27 ft, bentonite seal only. Note: Larger diameter tooling not used to ensure piezometer placement at total depth. Sand filter pack not installed due to borehole collapse, and pre-packed screen not used due to smaller diameter borehole.

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-705

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UCOR BORING LOG
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PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	1 of 3	Z2-EU19-706

DRILLING COMPANY	DRILLING RIG	SITE	BEGUN	FINISHED
Cascade Drilling	Geoprobe 6620DT	ETTP K-1410, EU19 Poplar Creek TCE Investigation	7-24-19	7-24-19

DRILLING METHOD	HAMMER WEIGHT / FALL	SITE LOCATION or MAP DESCRIPTION	ELEVATION	TOTAL DEPTH
Direct-Push	n.a.	N 178,626.7 E 744,617.5	not surveyed	28.0 ft

DEPTH / ELEVATION TO WATER	TOC ELEVATION	LOGGED BY	REVIEWED BY	ANGLE (from Horiz)	HOLE DIAMETER
▽ 15.8 ft / ▼ 10.4 ft / Piezometer DTW ft bgs	not surveyed	K. Heffernan	M. Martin 11·12·19	Vertical	2.25 in

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
					0		0-0.4 ft ORGANIC SOIL (OL) Dark grayish brown [10YR 4/2] little roots, low plasticity stiff dry to moist	Discrete Soil Sampling: RA079-FSL006
					1		0.4-3.4 ft CLAY (CH) Strong brown [7.5YR 4/6] trace to little fine to coarse subangular sand, trace fine subangular gravel, chert, high plasticity very stiff dry to moist	Logbook: ETTP-DPBORE-007
		3.4 A / 271 B	0		2			Radiological readings: A = alpha B = beta
68					3			
					4		3.4-5 ft No Recovery	0 ft (0 ft bgs): Collected RA079-064 for VOCs at 1524.
					5		5-7.6 ft CLAY (CH) Strong brown [7.5YR 4/6] trace to little fine to coarse subangular sand, trace fine subangular gravel, chert, high plasticity very stiff dry to moist	5 ft (5 ft bgs): Collected RA079-065 for VOCs at 1544.
					6			
					7			
100		0.4 A / 46 B	0		8		7.6-9.5 ft CLAY (CH) Yellowish brown [10YR 5/6] trace fine to coarse sand, high plasticity firm moist to wet	
					9			
					10		9.5-10.7 ft SANDY CLAY (CLS) Dark yellowish brown [10YR 4/4] fine to coarse subangular sand, trace fine subangular gravel, low plasticity firm moist to wet	10 ft (10 ft bgs): Collected RA079-066 for VOCs at 1559.
100		1.4 A / 277 B	0		11		10.7-15.8 ft CLAY (CH) Strong brown [7.5YR 4/6] trace to little fine to coarse subangular sand, trace fine subangular gravel, chert, high plasticity stiff moist to wet	11.1 ft (11.1 ft bgs): See next page.

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-706

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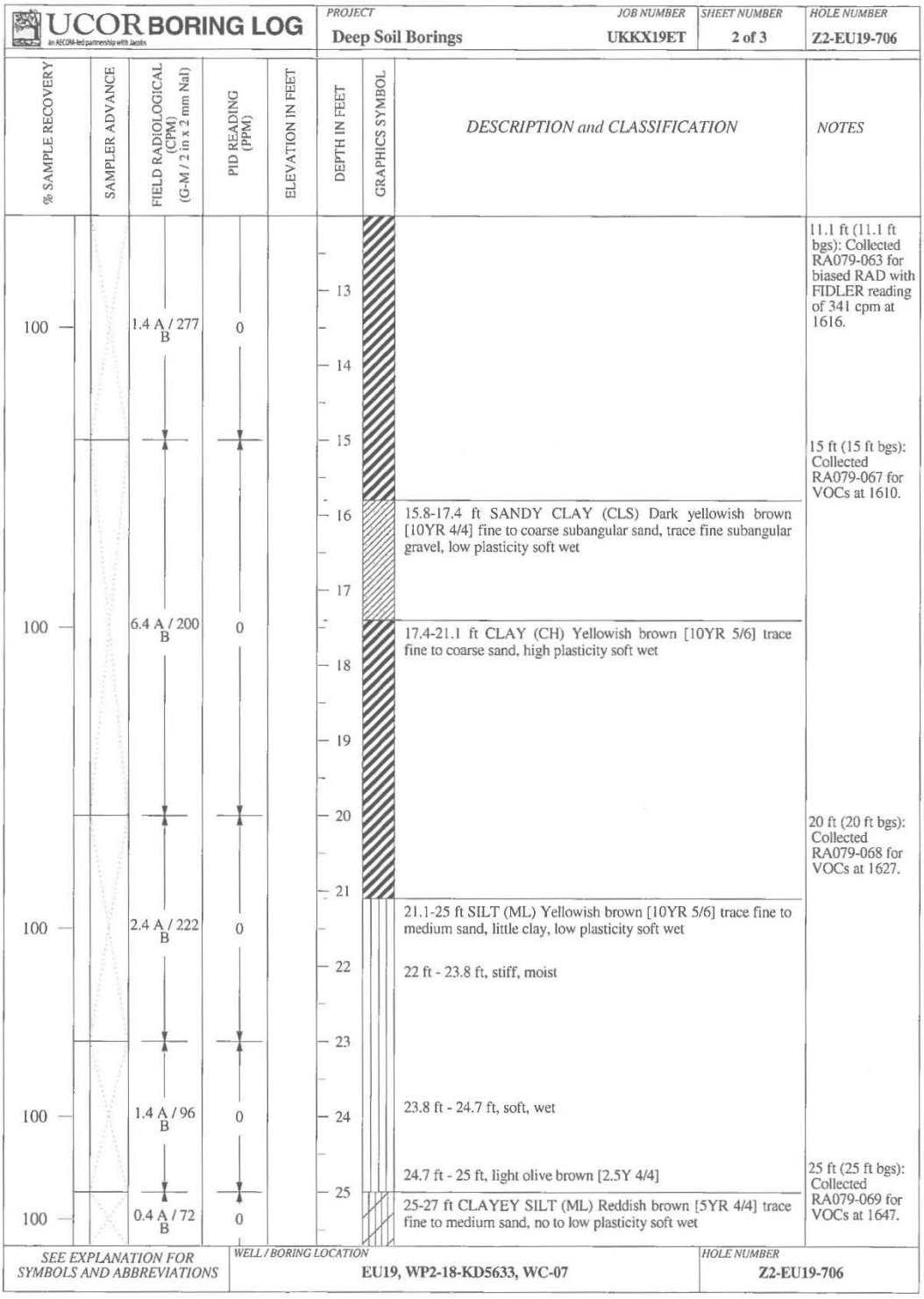
UCOR BORING LOG
an AECOM-led partnership with Jacobs
PROJECT
Deep Soil Borings
JOB NUMBER
UKKX19ET
SHEET NUMBER
2 of 3
HOLE NUMBER
Z2-EU19-706
% SAMPLE RECOVERY
SAMPLER ADVANCE
FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)
PID READING (PPM)
ELEVATION IN FEET
DEPTH IN FEET
GRAPHICS SYMBOL
DESCRIPTION and CLASSIFICATION
NOTES
100
1.4 A / 277 B
0
13
14
15
16
17
18
19
20
21
22
23
24
25
15.8-17.4 ft SANDY CLAY (CLS) Dark yellowish brown [10YR 4/4] fine to coarse subangular sand, trace fine subangular gravel, low plasticity soft wet
17.4-21.1 ft CLAY (CH) Yellowish brown [10YR 5/6] trace fine to coarse sand, high plasticity soft wet
21.1-25 ft SILT (ML) Yellowish brown [10YR 5/6] trace fine to medium sand, little clay, low plasticity soft wet
22 ft - 23.8 ft, stiff, moist
23.8 ft - 24.7 ft, soft, wet
24.7 ft - 25 ft, light olive brown [2.5Y 4/4]
25-27 ft CLAYEY SILT (ML) Reddish brown [5YR 4/4] trace fine to medium sand, no to low plasticity soft wet
6.4 A / 200 B
2.4 A / 222 B
1.4 A / 96 B
0.4 A / 72 B
11.1 ft (11.1 ft bgs): Collected RA079-063 for biased RAD with FIDLER reading of 341 cpm at 1616.
15 ft (15 ft bgs): Collected RA079-067 for VOCs at 1610.
20 ft (20 ft bgs): Collected RA079-068 for VOCs at 1627.
25 ft (25 ft bgs): Collected RA079-069 for VOCs at 1647.
SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS
WELL / BORING LOCATION
EU19, WP2-18-KD5633, WC-07
HOLE NUMBER
Z2-EU19-706

UCOR BORING LOG

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PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	3 of 3	Z2-EU19-706

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
100		0.4 A / 72 B	0		26			
					27		27-28 ft SILT (ML) Yellowish brown [10YR 5/6] trace fine to medium sand, little clay, low plasticity soft wet 27.6 ft - 28 ft, hard, dry to moist	
					28		**Bottom of Boring at 28.0 Ft**	28 ft (28 ft bgs): Collected RA079-070 for VOCs at 1650. DPT Refusal (2.25 in. OD) at 28 ft. Temporary piezometer installed with 1 in. PVC, 10 ft screen, 0.010 in. slots, TD at 28 ft bgs. Piezometer removed and borehole abandoned on 7/25/19 following groundwater sample collection.

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-706

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UCOR BORING LOG

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PROJECT: Deep Soil Borings	JOB NUMBER: UKKX19ET	SHEET NUMBER: 1 of 2	HOLE NUMBER: Z2-EU19-707
DRILLING COMPANY: Cascade Drilling	DRILLING RIG: Geoprobe 6620DT	SITE: ETTP K-1410, EU19 Poplar Creek TCE Investigation	BEGUN: 7-22-19 / FINISHED: 7-22-19
DRILLING METHOD: Direct-Push	HAMMER WEIGHT / FALL: n.a.	SITE LOCATION or MAP DESCRIPTION: N 178,734.2 E 744,680.8	ELEVATION: not surveyed / TOTAL DEPTH: 13.5 ft
DEPTH / ELEVATION TO WATER: ▽ 10.0 ft / ▼ 1.9 ft / Piezometer DTW ft bgs	TOC ELEVATION: not surveyed	LOGGED BY: K. Heffernan / REVIEWED BY: M. Martin 11·12·19	ANGLE (from Horiz): Vertical / HOLE DIAMETER: 2.25 in

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
					1		0-1.2 ft GRAVEL (GW) limestone, FILL	Discrete Soil Sampling: RA079-FSL007
							1.2-9.3 ft CLAYEY SILT (ML) Reddish brown [5YR 4/4] homogeneous, slight cohesion, no to low plasticity firm moist	Logbook: ETTP-DPBORE-007
100		2.4 A / 90 B	1		2			Radiological readings: A = alpha B = beta
					3			2.7 ft (2.7 ft bgs): Collected RA079-077 for biased VOCs with PID reading of 1 ppm at 1014.
					4			
					5			3.5 ft (3.5 ft bgs): Collected RA079-074 for VOCs at 1018.
					6			
					7		7.2 ft - 7.7 ft, olive yellow [2.5Y 6/6]	
100		<Lc A / 156 B	0		8		7.7 ft - 9.3 ft, dark yellowish brown, little Mn oxide nodules, significant weathering	
					9			8.5 ft (8.5 ft bgs): Collected RA079-075 for VOCs at 1044.
							9.3-13.5 ft SILTY CLAY (CL) Dark yellowish brown [10YR 4/4] cohesive, low plasticity soft moist to wet	
					10		10 ft - 10.6 ft, saturated	8.4 ft (8.4 ft bgs): Collected RA079-073 for biased RAD with FIDLER reading of 251 cpm at 1046.
100		1.4 A / 107 B	0		11		10.6 ft - 13.5 ft, wet	

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS

WELL / BORING LOCATION: EU19, WP2-18-KD5633, WC-07

HOLE NUMBER: Z2-EU19-707

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UCOR BORING LOG
an AECOM-led partnership with Jacobs

PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	2 of 2	Z2-EU19-707

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
100		1.4 A / 107 B	0		13		12.8 ft - 13.2 ft, SILT (ML) lense, wet	
							13.5 ft LIMESTONE, laminated, weathered cylinders, highly effervescent **Bottom of Boring at 13.5 Ft**	13.5 ft (13.5 ft bgs): Collected RA079-076 for VOCs at 1115. DPT Refusal (2.25 in. OD) at 13.5 ft. DPT Overdrill Refusal (3.25 in. OD) at 13.5 ft. Semi-permanent piezometer installed with 1 in. PVC, 10 ft pre-packed screen, 0.010 in. slots, TD = 13.25 ft, sand filter pack, bentonite seal.

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-707

UCOR BORING LOG (an AECOM-led partnership with Jacobs)	PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
	Deep Soil Borings	UKKX19ET	1 of 2	Z2-EU19-708
DRILLING COMPANY / DRILLING RIG	SITE		BEGUN	FINISHED
Cascade Drilling / Geoprobe 6620DT	ETTP K-1410, EU19 Poplar Creek TCE Investigation		7-18-19	7-22-19
DRILLING METHOD / HAMMER WEIGHT / FALL	SITE LOCATION or MAP DESCRIPTION		ELEVATION	TOTAL DEPTH
Direct-Push / n.a.	N 178,629.5 E 744,687.0		not surveyed	24.2 ft
DEPTH / ELEVATION TO WATER / TOC ELEVATION	LOGGED BY / REVIEWED BY		ANGLE (from Horiz)	HOLE DIAMETER
⧖ 15.2 ft / ⧗ 9.6 ft / Piezometer DTW ft bgs / not surveyed	K. Heffernan / M. Martin 11·12·19		Vertical	2.25 in

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
		N/A	N/A		1–9		0-10 ft Soil description not required; target depth 10 ft above DPT refusal.	Discrete Soil Sampling: RA079-FSL008 Logbook: ETTP-DPBORE-007 Radiological readings: A = alpha B = beta
					10		10-11.7 ft SILTY CLAY (CL) Brown [7.5YR 4/4] little fine to coarse subangular sand, fine subangular gravel, low plasticity soft wet	
80		3.4 A / 119 B	0		11–13		11.7-14 ft CLAYEY SILT (ML) Light olive brown [2.5Y 5/4] trace fine to coarse subangular sand, trace fine subrounded gravel, no plasticity hard dry 12.4 ft - 14 ft, firm, moist to wet	14 ft (14 ft bgs): Collected RA079-088 for VOCs at 1027.

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-708

UCOR BORING LOG — an AECOM-led partnership with Jacobs

PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	2 of 2	Z2-EU19-708

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
80					15		14-15 ft No Recovery	
					16		15-16.9 ft SILTY CLAY (CL) Brown [7.5YR 4/4] little fine to coarse subangular sand, fine subangular gravel, low plasticity soft wet 15.2 ft - 16.3 ft, saturated 16.3 ft - 16.9 ft, moist to wet	
100		<Lc A / 68 B	0		17		16.9-24.2 ft CLAYEY SILT (ML) Reddish brown [5YR 4/4] trace fine to medium sand, no to low plasticity very stiff moist	
					18			
					19		18.8 ft - 20 ft, hard, dry to moist	19 ft (19 ft bgs): Collected RA079-089 for VOCs at 1107.
					20		20 ft - 21.4 ft, saturated	
					21		21.4 ft - 22.3 ft, firm, wet	
100		2.4 A / 157 B	0		22		22.3 ft - 22.4 ft, gravelly SILT lense, wet 22.4 ft - 22.8 ft, light yellowish brown [2.5Y 6/4], firm, moist to wet 22.8 ft - 24.2 ft, reddish brown [5YR 4/4], very stiff, dry to moist	22.9 ft (22.9 ft bgs): Collected RA079-087 for biased RAD with FIDLER reading of 216 cpm at 1143.
					23			
					24			24 ft (24 ft bgs): Collected RA079-090 for VOCs at 1142.
							Bottom of Boring at 24.2 Ft	DPT Refusal (2.25 in. OD) at 24.2 ft. DPT Overdrill Refusal (3.25 in. OD) at 20 ft on 7/18/19. Semi-permanent piezometer installed on 7/22/19 with 1 in. PVC, 10 ft pre-packed screen, 0.010 in. slots, TD = 20 ft, sand filter pack, bentonite seal.

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-708

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UCOR BORING LOG

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PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	1 of 4	Z2-EU19-709

DRILLING COMPANY	DRILLING RIG	SITE	BEGUN	FINISHED
Cascade Drilling	Geoprobe 6620DT	ETTP K-1410, EU19 Poplar Creek TCE Investigation	7-22-19	7-23-19

DRILLING METHOD	HAMMER WEIGHT / FALL	SITE LOCATION or MAP DESCRIPTION	ELEVATION	TOTAL DEPTH
Direct-Push	n.a.	N 178,595.5 E 744,517.6	not surveyed	47.0 ft

DEPTH / ELEVATION TO WATER	TOC ELEVATION	LOGGED BY	REVIEWED BY	ANGLE (from Horiz)	HOLE DIAMETER
▽ 25.9 ft / ▼ 36.9 ft / Piezometer DTW ft bgs	not surveyed	K. Heffernan	M. Martin 11·12·19	Vertical	2.25 in

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
		N/A	N/A		1		0-0.5 ft ASPHALT	Discrete Soil Sampling: RA079-FSL009
							0.5-1.1 ft GRAVEL with Clay, FILL	
					2		1.1-3.4 ft CLAY with Silt (CL) Yellowish brown [10YR 5/6], stiff, moist, FILL	Logbook: ETTP-DPBORE-007
					3			Radiological readings: A = alpha B = beta
					4		3.4-25 ft CLAYEY SILT (ML) Reddish brown [5YR 4/4] fine to medium sand, no to low plasticity firm to stiff moist	Field screening not required 0-25 ft; target depth 10 ft above DPT refusal.
					5			
					6			
					7			
					8			
					9			
					10			
					11			
					12			
					13			

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-709

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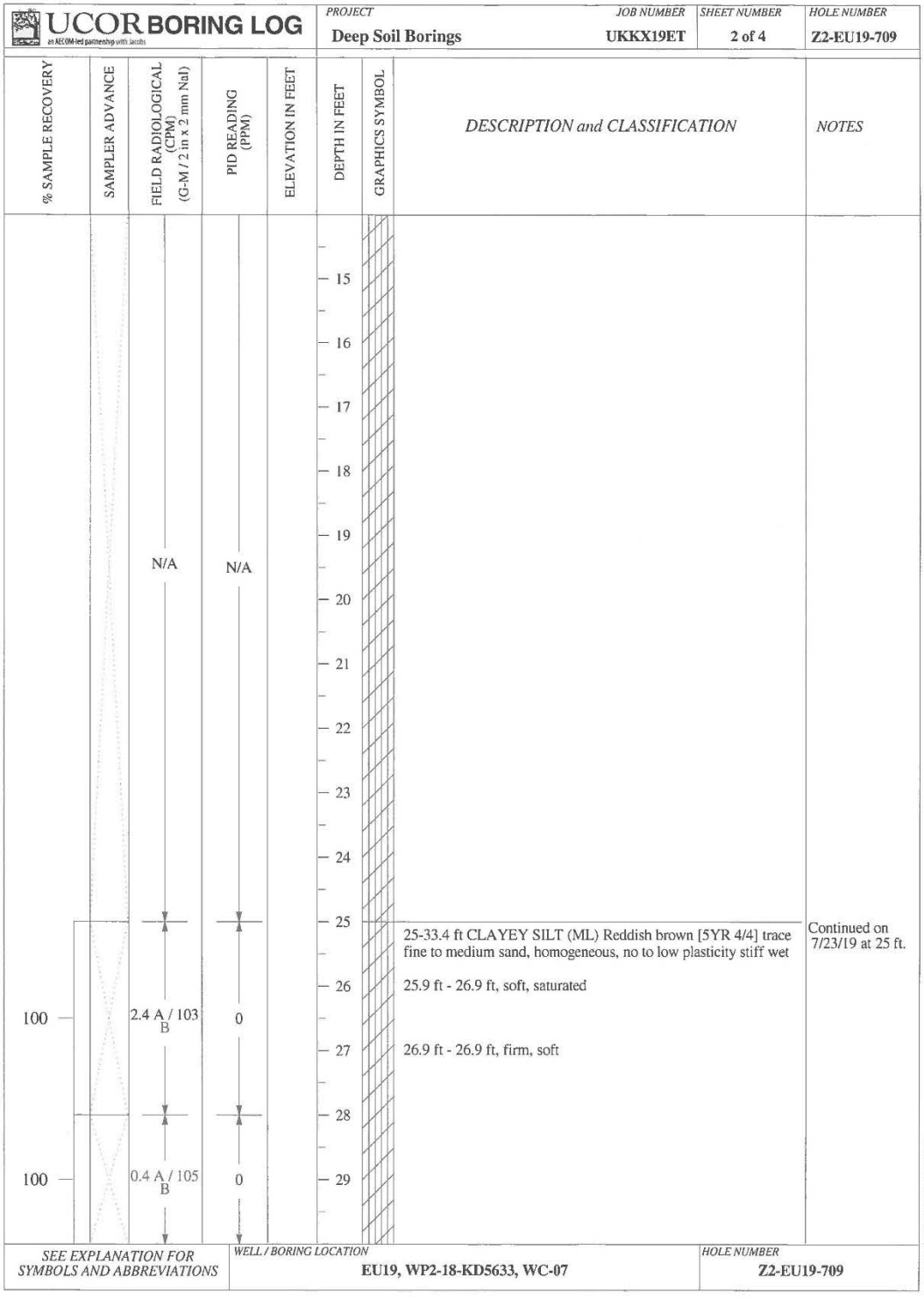
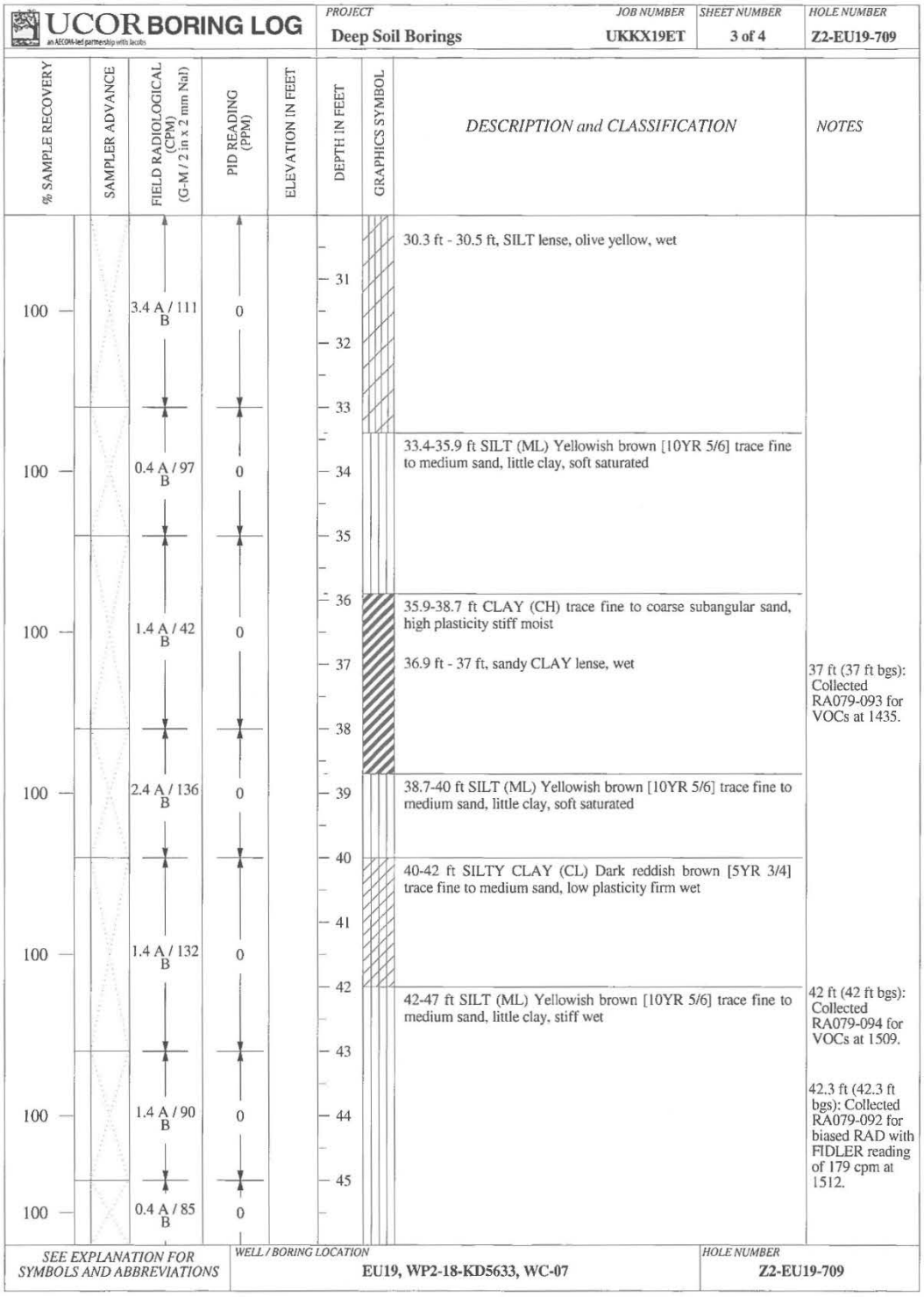

UCOR BORING LOG
an AECOM-led partnership with Jacobs
PROJECT
Deep Soil Borings
JOB NUMBER
UKKX19ET
SHEET NUMBER
2 of 4
HOLE NUMBER
Z2-EU19-709
% SAMPLE RECOVERY
SAMPLER ADVANCE
FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)
PID READING (PPM)
ELEVATION IN FEET
DEPTH IN FEET
GRAPHICS SYMBOL
DESCRIPTION and CLASSIFICATION
NOTES
N/A
N/A
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
25-33.4 ft CLAYEY SILT (ML) Reddish brown [5YR 4/4] trace fine to medium sand, homogeneous, no to low plasticity stiff wet
Continued on 7/23/19 at 25 ft.
25.9 ft - 26.9 ft, soft, saturated
100
2.4 A / 103 B
0
26.9 ft - 26.9 ft, firm, soft
100
0.4 A / 105 B
0
SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS
WELL / BORING LOCATION
EU19, WP2-18-KD5633, WC-07
HOLE NUMBER
Z2-EU19-709



UCOR BORING LOG
an AECOM-led partnership with Jacobs

PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	3 of 4	Z2-EU19-709

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
					31		30.3 ft - 30.5 ft, SILT lense, olive yellow, wet	
100		3.4 A / 111 B	0		32			
					33			
100		0.4 A / 97 B	0		34		33.4-35.9 ft SILT (ML) Yellowish brown [10YR 5/6] trace fine to medium sand, little clay, soft saturated	
					35			
					36		35.9-38.7 ft CLAY (CH) trace fine to coarse subangular sand, high plasticity stiff moist	
100		1.4 A / 42 B	0		37		36.9 ft - 37 ft, sandy CLAY lense, wet	37 ft (37 ft bgs): Collected RA079-093 for VOCs at 1435.
					38			
100		2.4 A / 136 B	0		39		38.7-40 ft SILT (ML) Yellowish brown [10YR 5/6] trace fine to medium sand, little clay, soft saturated	
					40		40-42 ft SILTY CLAY (CL) Dark reddish brown [5YR 3/4] trace fine to medium sand, low plasticity firm wet	
100		1.4 A / 132 B	0		41			
					42		42-47 ft SILT (ML) Yellowish brown [10YR 5/6] trace fine to medium sand, little clay, stiff wet	42 ft (42 ft bgs): Collected RA079-094 for VOCs at 1509.
					43			
100		1.4 A / 90 B	0		44			42.3 ft (42.3 ft bgs): Collected RA079-092 for biased RAD with FIDLER reading of 179 cpm at 1512.
					45			
100		0.4 A / 85 B	0					

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-709

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UCOR BORING LOG
an AECOM-led partnership with Jacobs

PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	4 of 4	Z2-EU19-709

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
100		0.4 A / 85 B	0		47		**Bottom of Boring at 47.0 Ft**	47 ft (47 ft bgs): Collected RA079-095 for VOCs at 1539. DPT Refusal (2.25 in. OD) at 47 ft. Temporary piezometer installed with 1 in. PVC, 10 ft screen, 0.010 in. slots, TD at 47 ft bgs. Piezometer removed and borehole abandoned on 7/25/19 following groundwater sample collection.

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-709

UCOR DNS LOG 11/11/2019 11:03:37 AM

UCOR BORING LOG

an AECOM-led partnership with Jacobs

PROJECT: Deep Soil Borings		JOB NUMBER: UKKX19ET	SHEET NUMBER: 1 of 2	HOLE NUMBER: Z2-EU19-710
DRILLING COMPANY: Cascade Drilling	DRILLING RIG: Geoprobe 6620DT	SITE: ETTP K-1410, EU19 Poplar Creek TCE Investigation	BEGUN: 7-31-19	FINISHED: 7-31-19
DRILLING METHOD: Direct-Push	HAMMER WEIGHT / FALL: n.a.	SITE LOCATION or MAP DESCRIPTION: N 178,642.2 E 744,594.4	ELEVATION: not surveyed	TOTAL DEPTH: 20.8 ft
DEPTH / ELEVATION TO WATER: 20.1 ft / Piezometer DTW ft bgs	TOC ELEVATION: not surveyed	LOGGED BY: K. Heffernan; REVIEWED BY: M. Martin (signed) Martha Martin 11-12-19	ANGLE (from Horiz): Vertical	HOLE DIAMETER: 2.25 in

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
80	0–5	7.4 A / 187 B	0		0–5		0-0.3 ft GRAVELLY CLAY with SAND (OL) Grayish brown [10YR 5/2] trace organics, loose dry 0.3-0.8 ft GRAVEL with CLAY (GW-GC) Grayish brown [10YR 5/2] fine subrounded gravel, loose dry 0.6 ft - 0.8 ft, very dark gray [10YR 3/1] 0.8-1.4 ft SANDY CLAY (OL) Dark olive gray [5Y 3/2] very stiff dry to moist 1.4-8.4 ft CLAY (CH) Brown [7.5YR 4/4] trace fine to coarse subangular sand, trace Mn oxide nodules, high plasticity very stiff	Discrete Soil Sampling: RA079-FSL010 Logbook: ETTP-DPBORE-007 Radiological readings: A = alpha B = beta
68	5–10	4.4 A / 64 B	0		5–10		6.4 ft - 8.1 ft, dark yellowish brown [10YR 4/4], firm, moist to wet 8.1 ft - 8.4 ft, dark yellowish brown [10YR 3/4], stiff, moist 8.4-10 ft No Recovery	
100	10–13.3	9.4 A / 142 B	0		10–13.3		10-11.3 ft CLAY (CH) Dark yellowish brown [10YR 3/4] trace fine to coarse subangular sand, trace Mn oxide nodules, high plasticity stiff moist 11.3-20.75 ft CLAYEY SILT (ML) Reddish brown [5YR 4/3] trace fine to medium sand, homogeneous, friable, firm dry to moist	
100	13.3–	1.4 A / 142 B	0		13.3–		13.6 ft - 14.6 ft, light yellowish brown [2.5Y 6/4]	

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS

WELL / BORING LOCATION: EU19, WP2-18-KD5633, WC-07

HOLE NUMBER: Z2-EU19-710

UCOR BORING LOG
an AECOM-led partnership with Jacobs

PROJECT	JOB NUMBER	SHEET NUMBER	HOLE NUMBER
Deep Soil Borings	UKKX19ET	2 of 2	Z2-EU19-710

% SAMPLE RECOVERY	SAMPLER ADVANCE	FIELD RADIOLOGICAL (CPM) (G-M / 2 in x 2 mm NaI)	PID READING (PPM)	ELEVATION IN FEET	DEPTH IN FEET	GRAPHICS SYMBOL	DESCRIPTION and CLASSIFICATION	NOTES
100		1.4 A / 142 B	0		15		14.6 ft - 20.75 ft, reddish brown [5YR 4/3]	13.9 ft (13.9 ft bgs): Collected RA079-097 for biased RAD with FIDLER reading of 424 cpm at 0956.
100		11.4 A / 149 B	0		16 17 18			15 ft (15 ft bgs): Collected RA079-098 for VOCs at 1021. 20 ft (20 ft bgs): Collected RA079-099 (reg) and RA079-707 (dup) for VOCs at 1039.
100		2.4 A / 136 B	0		19			20.6 ft (20.75 ft bgs): Collected RA079-101 for biased RAD with FIDLER reading of 646 cpm at 1105.
100		1.4 A / 111 B	0		20		**Bottom of Boring at 20.8 Ft**	20.75 ft (20.75 ft bgs): Collected RA079-100 for VOCs at 1101. DPT Refusal (2.25 in. OD) at 20.75 ft. Temporary piezometer installed with 1 in. PVC, 10 ft screen, 0.010 in. slots, TD at 20.75 ft bgs. Piezometer removed and borehole abandoned on 8/01/19 following groundwater sample collection.

SEE EXPLANATION FOR SYMBOLS AND ABBREVIATIONS	WELL / BORING LOCATION	HOLE NUMBER
	EU19, WP2-18-KD5633, WC-07	Z2-EU19-710

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ATTACHMENT 7:
EXPANSION OF
APPROVED REMEDIAL ACTION
IN EU Z2-19
September 17, 2019

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Department of Energy

Oak Ridge Office of Environmental Management
P.O. Box 2001
Oak Ridge, Tennessee 37831

September 17, 2019

CERTIFIED LETTER

Ms. Constance A. Jones
Superfund and Emergency Management Division
U.S. Environmental Protection Agency
Region 4
Atlanta Federal Center
61 Forsyth Street
Atlanta, Georgia 30303-8960

Mr. Randy C. Young
State of Tennessee
Department of Environment and Conservation
Division of Remediation – Oak Ridge
761 Emory Valley Road
Oak Ridge, Tennessee 37830-7072

Dear Ms. Jones and Mr. Young:

EXPANSION OF APPROVED REMEDIAL ACTION IN ZONE 2, EXPOSURE UNIT Z2-19 AT THE EAST TENNESSEE TECHNOLOGY PARK

Pursuant to the agreement reached at the August 22, 2019 East Tennessee Technology Park (ETTP) Project Team meeting, the U.S. Department of Energy is providing notification to the U.S. Evironmental Protection Agency and the Tennessee Department of Environment and Conservation that there will be an expansion in the scope of the approved remedial action (RA) in Exposure Unit (EU) Z2-19. The expanded RA will include the excavation of soil from the Outfall 362 drainage ditch that lies adjacent to and downgradient of the original RA area as defined in FCN-ETTP-Zone 2-225.

FCN-ETTP-Zone 2-225 (Attachment A) was approved in June 2018 to remediate soil in EU Z2-19 under 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). The RA was based on the discovery of soil contamination in excess of Zone 2 ROD remediation levels (RLs) and soil screening levels (SSLs) as summarized in the table below. Attachment B presents the boundaries of the RA as defined in FCN-ETTP-Zone 2-225.

CERTIFIED – RETURN RECEIPT REQUESTED
(JONES 7017 2620 0000 6500 3580)
(YOUNG 7017 2620 0000 6500 3573)

EXPANSION OF APPROVED REMEDIAL ACTION IN ZONE 2, EXPOSURE UNIT Z2-19 AT THE EAST TENNESSEE TECHNOLOGY PARK

	FCN-225 RA in EU Z2-19				Outfall 362 Drainage Ditch			
	Max RL	Avg RL	GW SSL	Ind RSL	Max RL	Avg RL	GW SSL	Ind RSL
Total PCBs	x				x	x		
Chromium			x				x	
Uranium (total)				x				x
Ra/Th decay series	x	x			x	x		
Cesium-137	x	x			x	x		
Uranium-234	x	x	x		x	x	x	
Uranium-235	x	x	x		x	x	x	
Uranium-238	x	x	x		x	x	x	
Plutonium-239				x				x
Technetium-99			x			x	x	

PCBs = Polychlorinated biphenyls Ra = Radium Th = Thorium RL = Remediation Level
RSL = Risk-based screening level

Soil contamination in the Outfall 362 drainage ditch, which lies in EU Z2-19 immediately west and downgradient of the planned RA, was identified as part of an effort to resolve data gaps concerning delineation of the downgradient extent of potential soil contamination derived from the planned excavation area. The delineation was being performed as required 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&D5). Sampling in the ditch was also intended to support initial characterization work being performed under the *EU Z2-19 Creek Bank Area Data Quality Objectives for Final Characterization*, approved by EPA and Tennessee Department of Environment and Conservation in July 2019.

As shown in the table above, preliminary results from the soil sampling analysis indicate that the contamination detected in the ditch are nearly identical to those identified in the excavation area defined in the approved FCN-ETTP-Zone 2-225. Given the presence of maximum RL exceedances in the ditch soils, DOE will expand the planned EU Z2-19 soil remedial action to include the drainage ditch, extending the excavation westward down to the edge of Poplar Creek. Figure 1 also shows the approximate boundaries of the expanded excavation into the drainage ditch. The exact boundaries of the remedial action will be defined on the basis of further delineation sampling. The final RA area will be defined in a technical memorandum for all of EU-19.

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(YOUNG 7017 2620 0000 6500 3573)

EXPANSION OF APPROVED REMEDIAL ACTION IN ZONE 2, EXPOSURE UNIT Z2-19 AT THE EAST TENNESSEE TECHNOLOGY PARK

If you have any questions, or if we can be of further assistance, please contact Steve Clemons at (865) 576-2938.

Sincerely,

James Y. Daffron
Acting Portfolio Federal Project Director

John Michael Japp
Federal Facility Agreement Project Manager

Enclosures:
1. Attachment A
2. Attachment B

cc w/enclosures
Neema Atashi, EPA Region 4
Sid Garland, RSI
Randy Hoffmeister, TDEC
ETTPDMC@ettp.doe.gov
Steve Clemons, EM-921
Pat Halsey, EM-942

CERTIFIED – RETURN RECEIPT REQUESTED
(JONES 7017 2620 0000 6500 3580)
(YOUNG 7017 2620 0000 6500 3573)

Attachment A
Project Team Agreement Log # 390
Area: Poplar Creek EU Group
FCN-ETTP-Zone 2-225

Core Team Concurrence

Area:

This concurrence form documents the characterization efforts to determine the need for and extent of remedial action (RA) within the Class 1 Soil Unit (SU), and adjacent areas as deemed appropriate, in Exposure Unit (EU) Z2-19 in accordance with *Data Quality Objective Scoping Package for the Poplar Creek Group (EUs Z2-11, Z2-12, and Z2-19) at the East Tennessee Technology Park, Oak Ridge, Tennessee* (BJC/OR-3231) (Poplar Creek DQO Scoping Package). Sampling locations for EU Z2-19 are identified in Appendix G of *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&D5) (RDR/RAWP). Modifications to the sampling plan for the Class 1 SU were approved in FCN-ETTP-Zone 2-194. This concurrence form presents a summary of the background information, characterization objectives and strategy, evaluation of sample results, and the extent of the three planned RAs within the Class 1 SU.

Summary Information:

Description: EU Z2-19 is located immediately west of the former Bldg. K-25 on the east bank of Poplar Creek. The EU Z2-19 boundaries encompass approximately 20 acres of land, which the Poplar Creek DQO Scoping Package divided into approximately 3 acres of Class 1 SUs and 17 acres of Class 3 SUs. This concurrence is primarily in the Class 1 SU, which includes the former Bldg. K-1031 concrete slab and the former Bldg. K-1410 concrete slab.

Constructed in 1945 as a maintenance support facility for the K-25 building, Bldg. K-1031was used to store and dispense trapping media for spent cascade traps and was later used as a cutting and size reduction area for process equipment from the Fercleve Thermal Diffusion Plan. Prior to demolition, the building was used for equipment and material storage. Only the concrete slab remains. Walkover surveys performed indicate low levels of contamination exist throughout the site, with small areas of higher activity to the north and south of the building.

The Bldg. K-1410 was used to mix media from the spent cascade traps for use in the K-25 Gaseous Diffusion Plant. Subsequently, it was used for decontamination and recovery of uranium from large pieces of equipment. The building included two spray facilities to solubilize and remove uranium with nitric acid and to degrease pumps with trichloroethene. Finally, the facility was converted to an electroplating facility by removing the decontamination tanks and filling the degreasing pits with concrete. Only a concrete slab remains.

Both the K-1031 and K-1410 slabs have been covered with asphalt. Within the Class 1 SU, three distinct soil excavation actions are to take place, designated as Dig 1, Dig 2, and Dig 3, based on the results of the characterization effort.

Data Quality Objectives:

The goal of the EU Z2-19 Class 1 SU is to release this area for its intended future end use. To achieve this goal, the types, distributions, and concentrations of chemicals and radionuclides in soils, building slabs, and related media must be determined to make decisions of RA or no further action (NFA). Characterization of the Class 1 SU is used to answer the following two primary decision statements:

1. If the concentration of chemicals and/or radionuclides in the Class 1 SU and related media exceed acceptable limits, then conduct an RA to achieve acceptable end state conditions; otherwise, take NFA.
2. If sources of potential groundwater contamination are found to exist in soils within the Class 1 SU, then conduct a RA to achieve acceptable end-state conditions; otherwise, take NFA.

Characterization Summary:

A radiological walkover survey in and around the EU Z2-19 Class 1 SU was conducted during spring 2016. Based on these results, FCN-ETTP-Zone 2-194 approved the soil sampling approach to address areas with elevated radioactivity. Specifics of the samples collected are presented in Attachment 1 and the sample locations are shown on Fig. 4 of the Technical Memorandum.

The EU Z2-19 Class 1 SU data are evaluated against the Zone 2 Record of Decision remedial action objective decision criteria as described 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&D5, Sect. 3.2) (Zone 2 RDR/RAWP). Table 1 presents the summary of the results of the Class 1 SU characterization samples following data evaluation.

Table 1. Data summary for EU Z2-19 Class 1 SU

Analyte	Type of RL exceedance
Total PCBs	Maximum RL
Chromium	Groundwater SSL
Uranium (total)	Industrial RSL
Ra/Th decay series	Maximum RL, Average RL
Cesium-137	Maximum RL, Average RL
Uranium-234	Maximum RL, Average RL, Groundwater SSL
Uranium-235	Maximum RL, Average RL, Groundwater SSL
Uranium-238	Maximum RL, Average RL, Groundwater SSL
Plutonium-239	Industrial RSL
Technetium-99	Groundwater SSL

EU = Exposure Unit
PCB = polychlorinated biphenyl
Ra = radium
RL = remediation level
RSL = risk screening level
SSL = soil screening level
SU = Soil Unit
Th = thorium

Radiological surveys of the slabs demonstrated the presence of elevated radioactivity which resulted in the slabs being designated as Contamination Area (K-1031) and High Contamination Area (K-1410). Based on their location within the area of EU Z2-19 which has been demonstrated to pose a threat to the industrial worker and a probable threat to groundwater (i.e., Class 1 SU) as a result of the presence of radiological contamination, it is concluded that the slabs themselves pose similar risks. Removal of the slabs will eliminate the risks associated with them.

RA Decision:

Based on the presence of remediation level (RL) exceedances in soils and a probable threat to groundwater from primarily isotopic uranium in soils, a decision was made to conduct an RA in EU Z2-19. As demonstrated in the Technical Memorandum (see Fig. 5), the sample locations with RL exceedances and residual groundwater (GW) soils screening level (SSL) exceedances are clustered near the interior of the Class 1 SU and are largely surrounded by sample locations with no criteria exceedances. Therefore, the

areal extents of the RAs are known with a high degree of certainty; confirmation sampling conducted following the RA (described below) will verify the RA has been successful.

The EU Z2-19 RA will be conducted within three primary boundaries referred to as Dig 1, Dig 2 and Dig 3, with the smaller dig, Dig 3, located within the boundaries of Dig 2 (see the Technical Memorandum, Fig. 6). In addition, the K-1031 and K-1410 concrete slabs will be removed as part of Dig 2. The K-1410 slab portion of Dig 2 will be to a depth of 4 ft with the exception of the pit area. The area of the filled pit will be excavated to the depth of the pit. The K-1031 slab portion of Dig 2 will be concrete and incidental soil only. A summary of the planned RAs in EU Z2-19 Class 1 SU are presented in Table 2.

Table 2. Summary of planned RAs in EU Z2-19 Class 1 SU

RA Dig #	RA material	Depth of excavation (ft)	Estimated volume (cy)
1	Soil	3	422
2	Soil	4	8773
	Concrete	1	634
3	Soil	6	178

EU = Exposure Unit
RA = remedial action
SU = Soil Unit

Soil and concrete excavation will commence using standard earthmoving equipment and dump trucks and/or dedicated waste containers for waste shipments. Excavation will progress from an initial starting point on a perimeter of a dig area until the entire area and depth is reached. The area of Dig 2 may be subdivided into smaller excavation area due to the need to have less area open at a given time to minimize storm water collection. Water management actions, including run-on/run-off controls and cover (using clean fill or membranes), will be implemented during ongoing excavation actions pending receipt of analytical confirmation samples results to protect the integrity of the excavation.

Most of the materials excavated during the EU Z2-19 RA will be disposed at the Environmental Management Waste Management Facility in accordance with an applicable Zone 2 waste profile, with smaller volumes of material being disposed offsite, as required. Actual waste volumes disposed and disposal facilities used will be presented in the RA completion report.

Confirmation Sampling:

Upon completion of both the lateral and vertical extent of a dig and excavation of the concrete slabs or when excavation activities warrant safe access to the excavation areas, a radiological survey of the excavation walls and floor will be performed to semi-quantitatively identify potential areas within the excavation that exceed 2 times background. Locations exhibiting unacceptably high readings will be marked for additional excavation (nominally 1 ft. in all applicable directions into the underlying material) and the locations re-surveyed. This process will continue until it is determined that excavation surfaces meet this criterion.

Following the radiological survey and final excavation actions, the area consisting of the walls and floor will be determined. Similar to the characterization sampling, a statistical sampling approach has been developed based on the area using a superimposed two-dimensional grid spanning the excavation areas (or portions thereof, if required) using site coordinates and field measurements. The appropriate number of

confirmatory samples based on statistical parameters of 95% confidence and 80% coverage was determined and a triangular grid with a random start was prepared for each dig area (see Fig. 7). Using this approach, 11 sample locations will be selected from the floor and 3 from the wall of Dig 1. Similarly, 17grid locations were identified for the floor of Dig 2 with an additional 3 locations from the wall (area including Dig 3). Finally, biased samples will be collected as determined in the field, with up to 2 biased samples collected from Dig 1 (approximately 16 sample locations in Dig 1), with up to 6 biased samples collected from Dig 2 and up to three collected from Dig 3 (approximately 29 sample locations in Dig 2). Once excavation in an area is deemed complete, the grid nodes in the area will be marked in the excavation and sample collected from the 0-1 ft. interval and sent to a laboratory for analysis with a nominal 3-day turnaround. Biased samples will be collected based on the highest radiological reading in an open excavation. The confirmatory samples will be discrete samples.

When the average concentration of all constituents of concern are less than their respective average remediation level (both average RL and GW SSL), the excavation will be declared complete and may be filled with clean fill and the site stabilized as necessary.

EU Z2-19 Class 1 SU Closure Actions:

When final confirmation sampling indicates there are no RL or GW SSL exceedances in an excavation, then the excavation area that the confirmation samples represents will be backfilled and the entire area will be contoured and stabilized, as appropriate.

Provisional Management for slabs K-1031 and K-1410:

The RDR/RAWP Appendix K, Provisional Management of Slabs, requires slabs requiring remediation have provisional management if not remediated within 60 days or a period agreed to by the project team. Slabs K-1031 and K-1410 will not be remediated within the 60 days, but have planned remediation dates of August 2018 and October 2018, respectively. Since the slabs are covered by asphalt, the provisional management would be an annual inspection to ensure contaminant migration is prevented by the asphalt cover. Due to the removal of the slabs being planned for removal in less than a year, no provisional management is proposed.

Conclusion and Summary:

This concurrence form proposes that three RAs be taken within the EU Z2-19 Class 1 SU to remove threats to the industrial worker and underlying groundwater. The proposed RA aerial boundaries are shown in the Technical Memorandum (see Fig. 6). Following impacted material excavation and disposal, confirmation samples will be collected to demonstrate that the RAs have achieved the remedial action objectives presented in the Zone 2 ROD.

Concurrence!

Steven Clemons
U.S. Department of Energy

5/29/18
Date

Randall Hoffmeister
Tennessee Department of Environment and Conservation

5/29/18
Date

SC Underwood-Foster
U.S. Environmental Protection Agency

5/24/2018
Date

ATTACHMENT 1.
EXPOSURE UNIT EU Z2-19 CLASS 1 SOIL UNIT
TECHNICAL MEMORANDUM

EXPOSURE UNIT (EU) GROUP: EU Z2-19

INTRODUCTION

This Technical Memorandum presents the background information, analytical results, data evaluations, and other related information that serve as the rationale for recommending a remedial action (RA) in the Class 1 soil unit (SU), and areas in close proximity as deemed necessary, of Exposure Unit (EU) Z2-19, located in the west central area of ETTP along the east side of Poplar Creek (Figs. 1 and 2). Figure 2 identifies two Federal Facilities Agreement sites in EU Z2-19: K-1031 pad and K-1410 pad. Upon completion of the RA, the Class 1 SU will have been fully addressed and require no further action (NFA) under DOE/OR/01-2161&D2, *Record of Decision for Soil, Buried Waste, and Subsurface Structure Actions in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee* (Zone 2 ROD).

On December 14, 2017, the ETTP Core Team was briefed on the field sampling results presented herein. As discussed, additional characterization activities will be conducted in EU Z2-19 to address pits, vaults, buildings, and soils outside the Class 1 SU. After completing the remaining characterization activities, the Core Team will be briefed on the results and a path forward for the remaining portions of the EU, as appropriate.

1.0 BACKGROUND INFORMATION AND EU SUMMARY

Exposure Unit Z2-19 is located immediately west of the former Bldg. K-25 on the east bank of Poplar Creek. The EU Z2-19 boundaries encompass approximately 20 acres of land, which the Poplar Creek Data Quality Objective Scoping Package divided into approximately 3 acres of Class 1 SUs and 17 acres of Class 3 SUs. This technical memorandum and RA concurrence is limited to the Class 1 SU and a small adjacent area only, which includes the former Bldg. K-1031 concrete slab, the former Bldg. K-1410 concrete slab, and soil areas in and around these slabs.

A radiological walkover survey in and around the EU Z2-19 Class 1 SU was conducted during the spring 2016. The survey results are depicted graphically on Fig. 3. FCN-ETTP-Zone 2-194 approved the soil sampling approach to address areas with elevated radioactivity. Specifics of the samples collected are presented in Attachment 1A and the sample locations are shown on Fig. 4.

1.1 CHARACTERIZATION AND DELINATION SAM PLING ANALYTICAL RESULTS

Attachment 1B presents a summary of the data collected and a comparison of those data to Zone 2 remediation levels (RLs) consistent with the ROD remedial action objectives (RAOs) for protection of the industrial worker and groundwater. This summary shows that there are multiple exceedances of RLs, including maximum RLs, average RLs, industrial risk screening levels (RSL), and groundwater (GW) soil screening levels (SSL) in EU Z2-19.

Attachment 1C presents a comprehensive list of criteria exceedances in the existing data for EU Z2-19. There are 19 sample locations with one or more exceedance of the maximum RLs, 36 sample locations with exceedances of the average RLs, 15 additional sample locations with RSL exceedances, and 31 sample locations with GW SSL exceedances. The sample locations with exceedances of RLs are shown on Fig. 5.

Note that several sample locations exhibit multiple exceedances of different RLs, mostly within the shallow interval (i.e., 0 - 1 ft.) although average RLs, industrial RSLs, and GW SSLs are exceeded in depths up to 10 ft. These results are used to define the nature and extent of contamination within the Class 1 SU and define the RA necessary to reduce contaminant mass and achieve the RAOs in EU-Z2-19 as discussed below.

1.2 EU Z2-19 CLASS 1 SU DATA EVALUATION

The EU Z2-19 Class 1 SU data are evaluated against the Zone 2 ROD RAO decision criteria as described in 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&D5, Sect. 3.2) (Zone 2 RDR/RAWP).

Maximum RL Screening. There are 19 sample locations in the EU Z2-19 Class 1 SU with maximum RL exceedances, with 18 in the 0-1-ft depth and 1 within the 0-2-ft depth. Table 1 indicates the analytes and the number of exceedances observed. There are no maximum exceedances at depths greater than 2 ft (Attachment 1C). The distribution of sample locations is shown on Fig. 5 and information regarding specific sample locations is presented in Attachment 1C. According to the Zone 2 ROD, the area represented by these 19 sample locations requires an RA.

Table 1. Class 1 SU analytes with maximum detected concentrations exceeding maximum RLs

Analyte with maximum RL exceedance(s)	Number of exceedances	SU maximum detected concentration	Maximum RL (pCi/g)
Ra/Th decay series	15	6,254 pCi/g	15
Cesium-137	6	4,060 pCi/g	20
Uranium-234	2	57,300 pCi/g	7000
Uranium-235	7	4,250 pCi/g	80
Uranium-238	8	17,300	500

Ra = radium
RL = remediation level
SU = Soil Unit
Th = thorium

Average RL Screening. The process presented in Sect. 3.2 of the Zone 2 RDR/RAWP for conducting an average RL screen arrives at a conclusion about whether the EU average concentration of a primary COC exceeds the average RL. Typically, the average RL screen is conducted across the EU; however, since EU-wide characterization is not complete, the average RL exceedances within SU 1 are used to help define the excavation boundaries for the Class 1 SU.

There are 36 sample locations with maximum detected concentrations exceeding average RLs, excluding locations with maximum RL exceedances, 33 have constituents in the 0-4-ft depth interval and 3 have constituents up to 10 ft in depth. Table 2 indicates the analytes and the number of exceedances observed. The distribution of the sample locations are shown on Fig. 5.

Table 2. Class 1 SU analytes with maximum detected concentrations exceeding average RLs

Analyte with maximum RL exceedance(s)	Number of exceedances	SU maximum detected concentration	Average RL
Total PCBs	1	26,300 µg/kg	10,000
Ra/Th decay series	8	11.7 pCi/g	5 pCi/g
Cesium-137	8	13.8 pCi/g	2 pCi/g
Uranium-234	4	6,690 pCi/g	700 pCi/g
Uranium-235	33	75.3 pCi/g	8 pCi/g
Uranium-238	34	362 pCi/g	50 pCi/g

Ra = radium
Th = thorium
PCB = polychlorinated biphenyl
RL = remediation level
SU = Soil Unit

Industrial RSL evaluation. This evaluation is performed to insure that the additional non-contaminant of concern (COC) chemicals and radionuclides, in which either maximum or average RLs are not defined, do not result in a total risk greater than 1×10^{-4} (for carcinogens) or a total hazard index of 1 (for noncarcinogens). Remediation screening levels (RSLs) for carcinogenic constituents are set at 1×10^{-5} to ensure the total risk (i.e., sum of individual constituent risks) meets the 1×10^{-4} total risk goal. RSLs for non-carcinogenic constituents are set at a hazard quotient (HQ) of 0.1 to ensure the Hazard Index (HI) (i.e., the sum of HQs) meets the target HI goal of 1. Similar to the average RL exceedance evaluation, this evaluation arrives at a conclusion about whether the average "non-COC" constituent concentrations within the SU that do not have RLs defined do not exceed the total risk and HI targets for the industrial exposure scenario. Because the EU-wide characterization is not complete, the RSL exceedances within SU 1 also are used to define the excavation boundaries for the Class 1 SU.

There are 15 sample locations with maximum detected concentrations exceeding industrial RSLs, 14 having constituents within the 0-2-ft depth interval and 1 has constituents up to 10 ft deep. Attachment 1C provides the results of chemicals and radionuclides with maximum detections greater than their respective RSLs. As such, the area represented by these sample locations indicates that an RA is required. Table 3 indicates the analytes and the number of exceedances observed.

Table 3. Class 1 SU analytes with maximum detected concentrations exceeding industrial RSLs

Analyte with maximum RL exceedance(s)	Number of exceedances	SU maximum detected concentration	Industrial RSL
Uranium (total)	17	21,000 µg/kg	230 µg/kg
Plutonium-239	1	154	128 pCi/g

RL = remediation level
RSL = risk screening level
SU = Soil Unit

With the exception of sample location Z2-EU19-107, all sample locations with maximum detected concentrations of both total uranium and plutonium-239 exceed corresponding industrial RSLs are coincident with locations defined by the constituents presented above that exceed maximum or average RLs. When the uranium total concentrations coincident with the locations that have the maximum RL exceedances are eliminated, the resultant average uranium total within the Class 1 SU (47.4 µg/kg) would be less than the industrial RSL.

According to the Zone 2 RDR/RAWP (see Sect. 3.2), the final step in the risk evaluation is to evaluate the cumulative impact on risk over an entire EU from all chemicals and radionuclides with RSL exceedances by comparing the sum of fractions (SOF) (average detected concentration/RSL) to 7.5 (because RSLs for carcinogens are set at 10 times less than their 1×10^{-4} excess lifetime cancer risks, the 7.5 SOF is approximately 75 percent of the Zone 2 ROD risk limit). Following complete characterization and RA within EU Z2-19, a final SOF for the EU Z2-19 risk screen will be performed.

Threat to groundwater. This evaluation is performed to ensure constituent concentrations in soil do not exceed modeled concentrations (GW SSLs) such that leaching would lead to groundwater concentrations in excess of drinking water standards. Should constituents exceed GW SSLs, RA is required to protect groundwater. There are 31 sample locations with maximum detected concentrations exceeding GW SSLs, 31 have constituents within the 0-4-ft depth and 3 have constituents up to 10 ft deep. Table 4 indicates the analytes and the number of exceedances observed.

Table 4. Class 1 SU analytes with maximum detected concentrations exceeding GW SSLs

Analyte with Maximum RL exceedance(s)	Number of exceedances	SU maximum detected concentration	Industrial RSL
Chromium	1	530 µg/kg	172 µg/kg
Uranium-234	41	57,300	61.1
Uranium-235	8	4,250	61.1
Uranium-238	34	17,300	61.1
Technetium-99	1	154	128 pCi/g

GS = groundwater
RL = remediation level
RSL = risk screening level
SSL = soil screening leve
SU = Soil Unit

One step in evaluating possible threats to groundwater is to estimate the volumetric extent and mass of analytes with GW SSL exceedances to determine whether the analytes pose a threat to groundwater (Zone 2 RDR/RAWP, Sect. 3.2). The distribution of residual GW SSL exceedance locations forms a cluster near the interior of the Class 1 SU (Fig. 5) to the point where there is probably sufficient volume of contaminated soil so that the mass of the detected constituents pose a threat to groundwater. As such, the area represented by these sample locations indicates that a RA is required.

1.4 K-1031 Concrete Slab

Building K-1031 was constructed in 1945 as a maintenance support facility for Bldg. K-25. Building K-1031 was first used to store and dispense trapping media for spent cascade traps and was later used as a cutting and size-reduction area for process equipment removed from the Fercleve Thermal Diffusion Plant. Beginning in the early 1960s,

Bldg. K-1031 was used for paint storage and mixing. Prior to demolition, the building was used for equipment and material storage.

Building K-1031 was demolished in 1999, leaving an approximately 4400 sf concrete slab in place. Demolition of Bldg. K-1031 is described in the *Removal Action Report for the K-25 Auxiliary Facilities Decommissioning Group I Buildings Demolition Project at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-1829&D1) (K-25 Auxiliary Facilities RmAR). A radiological survey of the concrete slab was conducted in 1999 (Appendix A) that showed elevated radioactivity over the slab ranging up to 224,084 dpm/100 cm^2. Based on the radiological survey results, the K-1031 concrete slab was designated as a Contamination Area. Following the radiological survey, the slab was covered with 2 in. of asphalt, which is its current state. Based on this information, a RA is required.

1.5	**K-1410 Concrete Slab**

Building K-1410 was constructed in 1944 to mix media from spent cascade traps for use in the K-25 Gaseous Diffusion Plant. Later the building was used for decontamination and recovery of uranium from large pieces of equipment. Two spray facilities were used to solubilize and remove uranium contamination with nitric acid and to degrease pumps with trichloroethene. In 1963, Bldg. K-1410 was converted to an electroplating facility by removing the decontamination tanks and filling the degreasing pits with concrete.

Building K-1410 was demolished in 1999 leaving an approximately 8700 sf concrete slab in place. Demolition of Bldg. K-1410 is described in the K-25 Auxiliary Facilities RmAR. A radiological survey of the building floor was conducted in 1998 prior to demolition (Appendix B1), which showed elevated radioactivity over the floor ranging up to 48,000 dpm/100 cm^2. A second radiological survey was conducted on a pit inside the facility in 1998 (Appendix B2). The results of the pit survey showed elevated radioactivity over the slab ranging up to 11,216 dpm/100 cm^2. A final radiological survey was conducted after demolition in 1999 on the end of an exposed pipe in the southwest corner of the concrete slab (Appendix B3). Results of the pipe survey showed elevated radioactivity of 1,718,200 dpm/100 cm^2. The survey technicians reported the presence of "visible product inside and around the pipe openings".

Based on the radiological survey results, the Bldg. K-1410 concrete slab was designated as a High Contamination Area. Following building demolition and after final radiological surveying, the slab was covered with 2 in. of asphalt, which is its current state. Based on this information, a RA is required.

Decision

Based on the presence of maximum (Max) RL exceedances in soils, the presence of average (Ave) RL exceedances in soils, and a probable threat to groundwater from primarily isotopic uranium in soils, a decision has been made to conduct an RA in EU Z2-19. As demonstrated on Fig. 5, the sample locations with Max RL exceedances, Ave RL exceedances, and residual GW SSL exceedances are clustered near the interior of the Class 1 SU and largely surrounded by sample locations with no criteria exceedances. Therefore, the areal extents of the RAs are known with a high degree of certainty. Confirmation sampling conducted following the RA (described below) will verify that the RA has been successful.

In addition to soil excavation, the RA will also remove the Bldgs. K-1031 and K-1410 concrete slabs. The two slabs are located within or adjacent to the boundaries for soil excavation (see Remedial Action Description section), but both slabs have been covered with approximately 2 in. of asphalt. The two slabs are listed in Appendix K of the Zone 2 RDR/RAWP as potentially contaminated. Evaluation of potentially contaminated slabs under the Zone 2 RDR/RAWP requires radiological surveys, visual inspections, and sampling in response to survey and visual observations. Because of the asphalt covering on each slab, neither slab can be evaluated in the manner prescribed by the Zone 2 RDR/RAWP. However, pre-asphalt radiological surveys of the slabs (Appendices A, B1, and B2) demonstrated the presence of elevated radioactivity, which resulted in the slabs' designations as Contamination Area (K-1031) and High Contamination Area (K-1410). Based on the location within the area of EU Z2-19, which has been demonstrated to pose a threat to the industrial worker and a probable threat to groundwater as a result of radiological contamination, combined with historical radiological surveys of the slabs that show the slabs are radiologically contaminated, it is concluded that the slabs themselves pose a risk to the industrial worker under the Zone 2 ROD.

Remedial Action Description

The EU Z2-19 RA will be conducted within three primary boundaries referred to as Dig 1, Dig 2 and Dig 3 (Fig 6), with the smaller dig, Dig 3, located within the boundaries of Dig 2 (Fig. 6). Concrete demolishing equipment will be used to break up slabs, including any filled pits that are encountered, into dimensions that are acceptable for disposal. Typical earth moving equipment will be used to excavate soil to the requisite depths as previously described. Remedial actions will begin at a pre-determined dig boundary and proceed inward and around to the lateral extent of the dig boundaries. Clean fill may be used for clean working surfaces and for creating in-excavation berms for water control to prevent a potential for cross contaminating finished excavations pending confirmation sampling.

The K-1410 and K-1031 concrete slabs are also located within the Dig 2 boundaries (Fig. 6).

Sample locations to be removed during the excavation of each dig are presented in Table 5. The contaminant mass characterized by these samples locations, in addition to the volume surrounding the sample locations, will be removed and replaced ultimately with clean fill. The RAs will result in both contaminant mass reduction and exposure pathway elimination, thereby providing protection to the industrial worker and groundwater. Following are descriptions of the digs that make up the RA:

Dig 1. Dig 1 is located on the north end of the EU Z2-19 Class 1 SU (Fig. 6). The area of Dig 1 is approximately 3800 sf and excavation will be conducted to a depth of 3 ft.

Dig 2. Dig 2 is the largest of the EU Z2-19 RA digs (Fig. 6). The area of Dig 2 is approximately 62,400 sf and excavation will be conducted to a depth of 4 ft, except in Dig 3 (below). The approximately 8700-sf K-1410 concrete slab will be excavated during excavation of Dig 2; therefore, the depth of excavation at the K-1410 footprint will be 4 ft. One exception will be in the area of the filled pit, where the area be removed to the depth of the pit. The approximately 4400-sf K-1031 concrete slab is located on the north end of Dig 2 (Fig. 6). The K-1031 slab excavation will include the slab and incidental soil.

Dig 3. Dig 3 encompasses an area of approximately 4400 sf and the depth of excavation in Dig 3 will be 6 ft. The purpose for Dig 3 is to excavate the GW SSL exceedances at sample locations Z2-EU19B-152 and Z2-EU19B-157, which occur at depths between 5-6 ft below ground surface (Attachment 1C).

During the remedial actions the boundaries of Dig 1 and Dig 2, including the K-1410 footprint, the K-1031 footprint, and the footprint of Dig 3 to a depth of 6 ft in Dig 2, will be recorded using geospatial coordinates by means of an in-field global positioning system instrument. This approach will "map" the excavations for future reference as necessary.

Table 5. EU Z2-19 sample locations included in the remedial action boundaries

Dig 1 sample locations		
Z2-EU19-101[a]	Z2-EU19-128	Z2-EU19B-134
Z2-EU19-102	Z2-EU19-129	Z2-EU19B-154 [a]
Z2-EU19-103 [a]	Z2-EU19-130	
Dig 2 sample locations		
Z2-EU19-105 [a]	Z2-EU19-121 [a]	Z2-EU19B-15 [a]
Z2-EU19-106 [a]	Z2-EU19-124 [a]	Z2-EU19B-158
Z2-EU19-107 [a]	Z2-EU19B-138	Z2-EU19B-159
Z2-EU19-108 [a]	Z2-EU19B-139 [a]	Z2-EU19B-160
Z2-EU19-109 [a]	Z2-EU19B-140	Z2-EU19B-162 [a]
Z2-EU19-110 [a]	Z2-EU19B-141	Z2-EU19B-163
Z2-EU19-111 [a]	Z2-EU19B-142	Z2-EU19B-164 [a]
Z2-EU19-112 [a]	Z2-EU19B-145	Z2-EU19B-165 [a]
Z2-EU19-113 [a]	Z2-EU19B-148	Z2-EU19B-166 [a]
Z2-EU19-114 [a]	Z2-EU19B-149 [a]	Z2-EU19B-167 [a]
Z2-EU19-115 [a]	Z2-EU19B-168C [a]	Z2-EU19B-167A [a]
Z2-EU19-116 [a]	Z2-EU19B-150	Z2-EU19B-167B [a]
Z2-EU19-117 [a]	Z2-EU19B-151	Z2-EU19B-167C
Z2-EU19-118 [a]	Z2-EU19B-155 [a]	Z2-EU19B-167D [a]

Table 5. EU Z2-19 sample locations included in the remedial action boundaries (cont.)

Dig 2 sample locations (cont.)		
Z2-EU19-119	Z2-EU19B-155A	Z2-EU19B-168
Z2-EU19-120 [a]	Z2-EU19B-155B	Z2-EU19B-168A
Z2-EU19-122 [a]	Z2-EU19B-155C	Z2-EU19B-168B
Z2-EU19-123 [a]	Z2-EU19B-155D	Z2-EU19B-168D
Dig 3 sample locations		
Z2-EU19B-152 [a]	Z2-EU19B-157 [a]	
K-1031 concrete slab sample locations		
Z2-EU19B-137 (concrete only)		
K-1410 concrete slab sample locations		
Z2-EU19B-153 [a] (concrete and sub-slab soil)		

[a]Zone 2 ROD criteria exceedances locations; see Attachment 1C for exceedance details.

Waste Disposition

Most of the materials excavated during the EU Z2-19 RA will be disposed at the Environmental Management Waste Management Facility (EMWMF) in accordance with an applicable Zone 2 waste profile, with smaller volumes of material being disposed offsite as required. Table 6 presents the current estimate of waste for disposal. Actual waste volumes and disposal facilities will be presented in the RA completion report.

Table 6. Projected volumes of material for disposal from the EU Z2-19 remedial action

Waste medium	Projected volume for disposal (cy)
Soil	10,644
Concrete	888

EU = Exposure Unit

Confirmation Sampling

The following describes the process of sampling to confirm the RA in the EU Z2-19 Class 1 SU has successfully removed threats to the industrial worker and groundwater:

- Upon completion of both the lateral and vertical extent of a dig and excavation of the concrete slabs or when excavation activities warrant safe access to the excavation areas, a radiological survey of the excavation walls and floor will be performed to semi-quantitatively identify potential areas within the excavation that exceed 2 times background. Locations exhibiting unacceptably high readings will be marked for additional excavation (nominally 1 ft. in all applicable directions into the underlying material) and the locations re-surveyed. This process will continue until it is determined that excavation surfaces meet this criterion.
- Following the radiological survey and final excavation actions, the area consisting of the walls and floor will be determined. Similar to the characterization sampling, a statistical sampling approach has been developed based on the area using a superimposed two-dimensional grid spanning the excavation areas (or portions thereof, if required) using site coordinates and field measurements. The appropriate number of confirmatory samples based on statistical parameters of 95% confidence and 80% coverage was determined over a triangular grid with a random start for each dig area (see Fig. 7). Using this approach, approximately 11 sample locations will be selected from the floor and 3 from the wall of Dig 1. Similarly, 17 grid locations were identified for the floor of Dig 2 with an additional 3 locations from the wall (which includes Dig 3). Finally, biased samples will be collected as determined in the field, with up to 2 biased samples collected from Dig 1 (total of 16 samples), with up to 6 biased samples collected from Dig 2 and up to three collected from Dig 3 (approximately 29 samples in Dig 2/3). Once excavation in an area is deemed complete, the grid nodes in the area will be marked in the excavation and sample collected from the 0-1 ft. interval and sent to a laboratory for analysis with a nominal 3-day turnaround. Biased samples will be collected based on the highest radiological reading in an open excavation with the locations marked and recorded. The confirmatory samples will be discrete samples.

- Water management actions, including run-on/run-off controls, cover using clean fill or membranes will be implemented pending receipt of analytical confirmation samples results to protect the integrity of the excavation.
- If an analytical result exceeds an RL or GW SSL in a wall or floor confirmation sample, then the areas of the excavation that are below criteria will undergo backfilling or covering with clean fill and an additional 1 ft of soil (moving radially away from the sample location in all applicable directions) will be excavated from the location represented by the confirmation sample. As discussed above, water management controls will be implemented to ensure the integrity of the additional excavated area pending receipt of sample analytical results.
- When confirmation sampling shows there are no RL or GW SSL exceedances in an excavation area, then the excavation area that the additional confirmation sample(s) represents will be backfilled. The entire area will be contoured and stabilized as appropriate once all excavation areas have been backfilled.

Expected Post-RA Conditions

As previously discussed, complete characterization of EU Z2-19 is pending. As such, data from additional sample locations will be combined with current locations outside of the RA in the Class 1 SU, as well as with applicable data within the footprints of the RAs not impacted by the excavations, to determine a final risk condition throughout the entire EU. Based on this evaluation, either a NFA will be determined for the EU or additional actions, as necessary, will be taken to ensure protection of the industrial worker and groundwater.

Attachment 1A. Sample summary for EU Z2-19

EU	Date collected	Sample location	Sample interval	Laboratory analyses					Comments/descriptions
				Metals	PCB	RAD	SVOC	VOC	
Characterization Sampling									
Z2-19	3/27/2017	Z2-EU19-101	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/27/2017	Z2-EU19-102	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/27/2017	Z2-EU19-103	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/29/2017	Z2-EU19-104	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/27/2017	Z2-EU19-105	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/29/2017	Z2-EU19-106	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/30/2017	Z2-EU19-107	0-10 ft 3-interval composite	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/27/2017	Z2-EU19-108	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/23/2017	Z2-EU19-109	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/22/2017	Z2-EU19-110	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/22/2017	Z2-EU19-111	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/22/2017	Z2-EU19-112	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/22/2017	Z2-EU19-113	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/23/2017	Z2-EU19-114	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/23/2017	Z2-EU19-115	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/23/2017	Z2-EU19-116	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/23/2017	Z2-EU19-117	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/28/2017	Z2-EU19-118	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/28/2017	Z2-EU19-119	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/28/2017	Z2-EU19-120	0-1 ft soil	1	1	1	1		Class 1 SU RAD walkover survey above-action level
Z2-19	3/28/2017	Z2-EU19-121	0-10 ft - 3 discrete interval soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft - at RAD110	3	3	4	3		Class 1 SU RAD walkover survey above-action level
Z2-19	3/28/2017	Z2-EU19-122	0-10 ft - 3 discrete interval soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft - at RAD113	3	3	4	3		Class 1 SU RAD walkover survey above-action level
Z2-19	3/23/2017	Z2-EU19-123	0-10 ft - 3 discrete interval soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft	3	3	4	3		Class 1 SU RAD walkover survey above-action level
Z2-19	3/21/2017	Z2-EU19-124	0-1 ft - 3-point composite	1	1	1	1		3-point composite in area of historical Max RL
Z2-19	3/29/2017	Z2-EU19-125	0-1 ft - 4-point composite	1	1	1	1		4-point composite in area of historical Max RL

Attachment 1A. Sample summary for EU Z2-19 (cont.)

EU	Date collected	Sample location	Sample interval	Laboratory analyses					Comments/descriptions
				Metals	PCB	RAD	SVOC	VOC	
Delineation Sampling									
Z2-19	10/18/17	Z2-EU19B-126	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	10/2/17	Z2-EU19B-127	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/2/18	Z2-EU19B-128	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	9/26/17	Z2-EU19B-129	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/3/17	Z2-EU19B-130	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	9/26/17	Z2-EU19B-131	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	9/26/17	Z2-EU19B-132	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	9/28/17	Z2-EU19B-133	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/4/17	Z2-EU19B-134	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	10/3/17	Z2-EU19B-135	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/3/17	Z2-EU19B-136	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/30/17	Z2-EU19B-137	10 ft - 4-interval - 0.5, 2, 4, and 4-10 ft; concrete grab		1	4			4-10 ft sample is conditional based on field screening; location is on the concrete pad (covered with asphalt, collect concrete sample for PCBs and RAD [remove asphalt])
Z2-19	9/27/17	Z2-EU19B-138	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	4	4	4	4		4-10 ft sample is conditional based on field screening
Z2-19	10/12/17	Z2-EU19B-139	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/12/17	Z2-EU19B-140	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/10/17	Z2-EU19B-141	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/10/17	Z2-EU19B-142	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	10/18/17	Z2-EU19B-143	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/18/17	Z2-EU19B-144	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/24/17	Z2-EU19B-145	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/19/17	Z2-EU19B-146	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	4	4	4	4		4-10 ft sample is conditional based on field screening
Z2-19	10/16/17	Z2-EU19B-147	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/16/17	Z2-EU19B-148	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/25/17	Z2-EU19B-149	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/25/17	Z2-EU19B-150	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	10/25/17	Z2-EU19B-151	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/11/17	Z2-EU19B-152	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			4			4-10 ft sample is conditional based on field screening
Z2-19	10/26/17	Z2-EU19B-153	10 ft - 4-interval - 0.5, 2, 4, and 4-10 ft; concrete grab		1	4			4-10 ft sample is conditional based on field screening; location is on the concrete pad (covered with asphalt, collect concrete sample for PCBs and RAD [remove asphalt])
Z2-19	9/28/17	Z2-EU19B-154	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	9/27/17	Z2-EU19B-155	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			At former location Z2-EU19-120; 4-10 ft sample is conditional based on field screening
Z2-19	9/27/17	Z2-EU19B-155A	3 ft - 3-interval - 0.5 ft, 2 ft, and 3 ft	3		3			1 ft north of Z2-EU19B-155; U-235 analysis and metals
Z2-19	9/27/17	Z2-EU19B-155B	3 ft - 3-interval - 0.5 ft, 2 ft, and 3 ft	3		3			1 ft east of Z2-EU19B-155; U-235 analysis and metals

Attachment 1A. Sample summary for EU Z2-19 (cont.)

EU	Date collected	Sample location	Sample interval	Laboratory analyses					Comments/descriptions
				Metals	PCB	RAD	SVOC	VOC	
Z2-19	9/27/17	Z2-EU19B-155C	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft south of Z2-EU19B-155; U-235 analysis and metals
Z2-19	9/27/17	Z2-EU19B-155D	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft west of Z2-EU19B-155; U-235 analysis and metals
Z2-19	10/11/17	Z2-EU19B-156	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			4			4-10 ft sample is conditional based on field screening
Z2-19	10/25/17	Z2-EU19B-157	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			4			4-10 ft sample is conditional based on field screening
Z2-19	10/17/17	Z2-EU19B-158	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	10/17/17	Z2-EU19B-159	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/17/17	Z2-EU19B-160	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/19/17	Z2-EU19B-161	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/16/17	Z2-EU19B-162	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft	3	3	3	3		4-10 ft sample is conditional based on field screening
Z2-19	10/11/17	Z2-EU19B-163	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/11/17	Z2-EU19B-164	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/9/17	Z2-EU19B-165	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/9/17	Z2-EU19B-166	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			4-10 ft sample is conditional based on field screening
Z2-19	10/4/17	Z2-EU19B-167	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			At former location RAD110; 4-10 ft sample is conditional based on field screening
Z2-19	10/4/17	Z2-EU19B-167A	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft north of Z2-EU19B-167; U2-35 analysis and metals
Z2-19	10/4/17	Z2-EU19B-167B	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft east of Z2-EU19B-167; U-235 analysis and metals
Z2-19	10/4/17	Z2-EU19B-167C	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft south of Z2-EU19B-167; U-235 analysis and metals
Z2-19	10/4/17	Z2-EU19B-167D	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft west of Z2-EU19B-167; U-235 analysis and metals
Z2-19	10/5/17	Z2-EU19B-168	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			At hot spot based on BAR survey (general area of former location Z2-EU19-119); 4-10 ft sample is conditional based on field screening
Z2-19	10/5/17	Z2-EU19B-168A	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft north of Z2-EU19B-168; U-235 analysis metals
Z2-19	10/5/17	Z2-EU19B-168B	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft east of Z2-EU19B-168; U-235 analysis metals
Z2-19	10/5/17	Z2-EU19B-168C	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft south of Z2-EU19B-168; U-235 and U-238 analysis metals
Z2-19	10/5/17	Z2-EU19B-168D	3 ft - 3-interval - 0.5, 2, and 3 ft	3		3			1 ft west of Z2-EU19B-168; U-235 analysis metals
Z2-19	10/24/17	Z2-EU19B-169	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			Pipe draining into the CA; 4-10 ft sample is conditional based on field screening
Z2-19	10/16/17	Z2-EU19B-170	10 ft - 4-interval - 0.5, 2, 4, and 4-10ft			3			Hot spot near staircase; 4-10 ft sample is conditional based on field screening
Class 3 Soil Unit Sampling									
Z2-19	3/30/2017	Z2-EU19B-301	0-10 ft - 3 interval composite soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft	1	1	1	1		Class 3 SU utility corridor sample location
Z2-19	3/30/2017	Z2-EU19B-302	0-10 ft. 3 interval composite soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft	1	1	1	1		Class 3 SU utility corridor sample location
Z2-19	3/30/2017	Z2-EU19B-303	0-10 ft. 3 interval composite soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft	1	1	1	1		Class 3 SU utility corridor sample location

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Attachment 1A. Sample summary for EU Z2-19 (cont.)

EU	Date collected	Sample location	Sample interval	Laboratory analyses					Comments/descriptions
				Metals	PCB	RAD	SVOC	VOC	
Z2-19	3/30/2017	Z2-EU19B-304	0-10 ft. 3 interval composite soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft	1	1	1	1		Class 3 SU utility corridor sample location
Z2-19	3/29/2017	Z2-EU19B-305	0-10 ft. 3 interval composite soil 0-0.5, 0.5-2, 1.5 ft within 2-10 ft	1	1	1	1	1	Class 3 SU adjacent to storm drain
			Total EU Z2-19 Analyses	**104**	**70**	**182**	**68**	**1**	

BAR = biased area radiation
CA = contamination area
EU = Exposure Unit
Max = maximum
PCB = polychlorinated biphenyl
RAD = radiological
RL = remediation level
SU = Soil Unit
SVOC = semivolatile organic compound
VOC = volatile organic compound

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Attachment 1B. EU Z2-19 Class 1 SU data summary[a]

Analyte	Frequency of detect	Min detect[b,c]	Max detect[b,c]	Avg detected result[d]	Max RL[d]	Number of detects ≥ Max RL[e]	Avg RL[f]	Number of detects ≥ Avg RL[e]	RSL[f] (10^{-5} or HI=1)	Number of detects ≥ RSL[e]	GW SSL[h]	Number of detects ≥ GW SSL[e]
Inorganics (mg/kg)												
Aluminum	104/104	2860	32000J	13126					1100000	0		
Antimony	7/104	0.362J	6.07J	1.61					470	0	144	0
Arsenic	104/104	3.14J	62.9J	8.57	900	0	300	0	300	0	66.3	0
Barium	104/104	17J	221	66.7					220000	0	9150	0
Beryllium	98/104	0.383J	2.99	1.24					2300	0		
Boron	78/104	1.53J	11.8	4.83					230000	0		
Cadmium	103/104	0.0307J	298	6.74					980	0		
Calcium	103/103	283	223000J	13414								
Chromium	104/104	6.93	530	27.1					1800000	0	172	1
Cobalt	104/104	0.198J	28.6J	12.7					350	0		
Copper	104/104	6.2	836	39.5					47000	0		
Iron	104/104	8730	82100	26586					820000	0		
Lead	102/104	1.43J	428J	37.3					800	0	3370	0
Lithium	104/104	6.75J	152	29.5					2300	0		
Magnesium	104/104	452J	40000J	3900								
Manganese	104/104	108J	7820J	1096					26000	0		
Mercury	67/68	0.0128J	0.928	0.131	1800	0	600	0	600	0		
Molybdenum	94/104	0.328J	39.2	1.68					5800	0		
Nickel	104/104	5.88	957	54.8					22000	0		
Potassium	104/104	331J	10800J	1201								
Selenium	67/103	0.567J	12.9J	2.09					5800	0		
Silver	43/104	0.135J	7.13J	0.583					5800	0		
Sodium	102/104	7.92J	3940J	78.1								
Thallium	97/104	0.164J	4.65J	0.405					12	0	10.8	0
Uranium	104/104	1.16J	21000J	346					230	17		
Vanadium	104/104	9.56	79.9	35.8					5800	0		
Zinc	104/104	7.41J	821	104					350000	0		
Polychlorinated biphenyls (µg/kg)												
PCB-1016	0/70				100000	0	10000	0	10000	0		
PCB-1221	0/70				100000	0	10000	0	10000	0		
PCB-1232	0/70				100000	0	10000	0	10000	0		
PCB-1242	0/70				100000	0	10000	0	10000	0		
PCB-1248	1/70	2790	2790	2790	100000	0	10000	0	10000	0		
PCB-1254	39/70	3.2J	21700	811	100000	0	10000	1	10000	1		
PCB-1260	39/70	1.73J	4590	288	100000	0	10000	0	10000	0		
PCB-1262	0/70				100000	0	10000	0	10000	0		
PCB-1268	1/70	429	429	429	100000	0	10000	0	10000	0		
Total PCBs	44/70	1.73J	26300	1048	100000	0	10000	1	10000	1		
Radionuclides (pCi/g)												
Actinium-228	136/138	0.513	26.3J	2.16					10700	0		
Alpha activity	181/181	7.27J	60100	913								
Americium-241	17/180	0.0436	32.7J	4.57					47.6	0		
Beta activity	180/181	8.08J	29800J	326								
Bismuth-212	5/5	2.7	9.99	7.03					536000	0		

Attachment 1B. EU Z2-19 Class 1 SU data summary[a] (cont.)

Analyte	Frequency of detect	Min detect[b,c]	Max detect[b,c]	Avg detected result[d]	Max RL[e]	Number of detects ≥ Max RL[e]	Avg RL[f]	Number of detects ≥ Avg RL[e]	RSL[g] (10^{-6} or HI=1)	Number of detects ≥ RSL[g]	GW SSL[h]	Number of detects ≥ GW SSL[g]
Bismuth-214	167/167	0.525	64.8	2.43					109000	0		
Cesium-137	65/181	0.0829J	4060	67.8	20	6	2	14	2	14		
Cobalt-60	0/181								0.483	0		
Curium-244	0/141								348	0		
Lead-210	1/1	2.14	2.14	2.14					37.6	0		
Lead-212	174/174	0.666	9.71	1.69					57200	0		
Lead-214	173/173	0.683	54.2	2.36					648000	0		
Neptunium-237	4/181	0.471	1.23	0.781	50	0	5	0	5	0		
Plutonium-238	3/181	0.836	2.35J	1.47					148	0		
Plutonium-239	32/181	0.0622J	154J	13.7					128	1		
Plutonium-241	1/141	0.887J	0.887J	0.887					15300	0		
Potassium-40	179/181	1.09	51.6	20.7					2.2	177		
Protactinium-234m	43/43	28.1	17300	646					1.5E+08	0		
Ra/Th decay series[i]	181/181	0.00001	6254	76.7	15	15	5	23	5	23		
Radium-226[i]	175/181	0.342	71.7	2.52								
Strontium-90	9/141	0.936	125	18					384	0		
Technetium-99	23/181	2.04	2640J	134	121000	0	12100	0	12100	0	85.6	1
Thallium-208	142/142	0.215	2.81	0.534					298000	0		
Thorium-228[i]	174/181	0.557	10.4J	1.51								
Thorium-230[i]	181/181	0.43	6170J	76.6								
Thorium-232[i]	177/181	0.63	86.7J	2.68								
Thorium-234	135/181	0.974	11400	165					24500	0		
Uranium-234	181/181	1.11J	57300J	507	7000	2	700	6	700	6	61.1	41
Uranium-235	114/217	0.249	4250J	71.2	80	7	8	40	8	40	61.1	8
Uranium-238	181/182	0.995	17300J	163	500	8	50	42	50	42	61.1	34
Semivolatile organic compounds (µg/kg)												
1,2,4-Trichlorobenzene	0/68								260000	0		
1,2-Dichlorobenzene	0/68								9300000	0		
1,3-Dichlorobenzene	0/68											
1,4-Dichlorobenzene	0/68								110000	0		
2,3,4,6-Tetrachlorophenol	0/68								25000000	0		
2,4,5-Trichlorophenol	0/68								82000000	0		
2,4,6-Trichlorophenol	0/68								820000	0		
2,4-Dichlorophenol	0/68								2500000	0		
2,4-Dimethylphenol	0/68								16000000	0		
2,4-Dinitrophenol	0/68								1600000	0		
2,4-Dinitrotoluene	0/68								74000	0		
2,6-Dinitrotoluene	0/68								15000	0		
2-Chloronaphthalene	0/68								60000000	0		
2-Chlorophenol	0/68								5800000	0		
2-Methyl-4,6-dinitrophenol	0/68								66000	0		
2-Methylnaphthalene	8/68	14.4J	120J	43					3000000	0		
2-Methylphenol	0/68								41000000	0		
2-Nitrobenzenamine	0/68								8000000	0		
2-Nitrophenol	0/68											
3,3'-Dichlorobenzidine	0/68								51000	0		
3-Nitrobenzenamine	0/68											
4-Bromophenyl phenyl ether	0/68											

Attachment 1B. EU Z2-19 Class 1 SU data summary[a] (cont.)

Analyte	Frequency of detect	Min detect[b,c]	Max detect[b,c]	Avg detected result[d]	Max RL[d]	Number of detects ≥ Max RL[e]	Avg RL[f]	Number of detects ≥ Avg RL[e]	RSL[g] (10^{-5} or HI=1)	Number of detects ≥ RSL[e]	GW SSL[h]	Number of detects ≥ GW SSL[e]
4-Chloro-3-methylphenol	0/68								82000000	0		
4-Chlorobenzenamine	0/68								110000	0		
4-Chlorophenyl phenyl ether	0/68											
4-Nitrobenzenamine	0/68								1100000	0		
4-Nitrophenol	0/68											
Acenaphthene	4/68	14.9J	209J	74.6					45000000	0		
Acenaphthylene	4/68	22.5J	176J	64.1								
Aniline	0/68								4000000	0		
Anthracene	6/68	21.5J	608J	162					2.3E+08	0		
Benz(a)anthracene	24/68	13.3J	902	148					210000	0		
Benzenemethanol	0/68								82000000	0		
Benzo(a)pyrene	21/68	16.1J	703	146					21000	0		
Benzo(b)fluoranthene	22/68	15.5J	929	189					210000	0		
Benzo(ghi)perylene	20/68	18.7J	332J	88.9								
Benzo(k)fluoranthene	14/68	15.3J	365	111					2100000	0		
Benzoic acid	0/68								3.3E+09	0		
Bis(2-chloroethoxy)methane	0/68								2500000	0		
Bis(2-chloroethyl) ether	0/68								10000	0		
Bis(2-chloroisopropyl) ether	0/68								47000000	0		
Bis(2-ethylhexyl)phthalate	1/68	166J	166J	166					1600000	0	2350000	0
Butyl benzyl phthalate	0/68								12000000	0		
Carbazole	6/68	19.3J	1030	232								
Chrysene	23/68	12.6J	857	150					21000000	0		
Dibenz(a,h)anthracene	6/68	33.2J	138	68					21000	0		
Dibenzofuran	1/68	166J	166J	166					1000000	0		
Diethyl phthalate	0/68								6.6E+08	0		
Dimethyl phthalate	0/68											
Di-n-octylphthalate	0/68								8200000	0		
Diphenylamine	0/68								82000000	0		
Fluoranthene	28/68	13.2J	1950J	215					30000000	0		
Fluorene	4/68	16.7J	725J	226					30000000	0		
Hexachlorobenzene	0/68								9600	0		
Hexachlorobutadiene	0/68								53000	0		
Hexachlorocyclopentadiene	0/68								7500	0		
Hexachloroethane	0/68								80000	0		
Indeno(1,2,3-cd)pyrene	13/68	15J	338	116					210000	0		
Isophorone	1/68	730	730	730					24000000	0		
m+p Methylphenol	0/68											
Naphthalene	7/68	17.3J	620	133					170000	0		
Nitrobenzene	0/68								220000	0		
N-Nitroso-di-n-propylamine	0/68								3300	0		
Pentachlorophenol	0/68								40000	0		
Phenanthrene	23/68	13.8J	3300J	226								
Phenol	1/68	149J	149J	149					2.5E+08	0		
Pyrene	27/68	12.5J	1800J	195					23000000	0		
Pyridine	0/68								1200000	0		
Volatile organic compounds (µg/kg)												
1,1,1-Trichloroethane	0/1								36000000	0	97900	0

Attachment 1B, EU Z2-19 Class 1 SU data summary[a] (cont.)

Analyte	Frequency of detect	Min detect[b,c]	Max detect[b,c]	Avg detected result[d]	Max RL[e]	Number of detects ≥ Max RL[f]	Avg RL[f]	Number of detects ≥ Avg RL[f]	RSL[g] (10^{-5} or HI=1)	Number of detects ≥ RSL[g]	GW SSL[h]	Number of detects ≥ GW SSL[g]
1,1,2,2-Tetrachloroethane	0/1								27000	0		
1,1,2-Trichloroethane	0/1								6300	0	1370	0
1,1-Dichloroethane	0/1								160000	0		
1,1-Dichloroethene	0/1								1000000	0	1750	0
1,2-Dichloroethane	0/1								20000	0	729	0
1,2-Dichloropropane	0/1								66000	0		
2-Butanone	1/1	3.49J	3.49J	3.49					1.9E+08	0		
2-Hexanone	0/1								1300000	0		
4-Methyl-2-pentanone	0/1								1.4E+08	0		
Acetone	1/1	15.8J	15.8J	15.8					6.7E+08	0		
Benzene	0/1								51000	0	1150	0
Bromodichloromethane	0/1								13000	0		
Bromoform	0/1								860000	0		
Bromomethane	0/1								30000	0		
Carbon disulfide	0/1								3500000	0		
Carbon tetrachloride	0/1								29000	0	2770	0
Chlorobenzene	0/1								1300000	0		
Chloroethane	0/1								57000000	0		
Chloroform	0/1								14000	0	1230	0
Chloromethane	0/1								460000	0		
cis-1,2-Dichloroethene	0/1								2300000	0		
cis-1,3-Dichloropropene	0/1											
Dibromochloromethane	0/1								390000	0		
Ethylbenzene	0/1								250000	0		
Methylene chloride	0/1								3200000	0	241	0
Styrene	0/1								35000000	0		
Tetrachloroethene	0/1								390000	0	4720	0
Toluene	0/1								47000000	0	502000	0
Total Xylene	0/1								2500000	0		
trans-1,2-Dichloroethene	0/1								23000000	0		
trans-1,3-Dichloropropene	0/1											
Trichloroethene	0/1								19000	0	1720	0
Vinyl chloride	0/1								17000	0	176	0

[a]Stations in summary include Z2-EU19-101, Z2-EU19-102, Z2-EU19-103, Z2-EU19-104, Z2-EU19-105, Z2-EU19-106, Z2-EU19-107, Z2-EU19-108, Z2-EU19-109, Z2-EU19-110, Z2-EU19-111, Z2-EU19-112, Z2-EU19-113, Z2-EU19-114, Z2-EU19-115, Z2-EU19-116, Z2-EU19-117, Z2-EU19-118, Z2-EU19-119, Z2-EU19-120, Z2-EU19-121, Z2-EU19-122, Z2-EU19-123, Z2-EU19-124, Z2-EU19-125, Z2-EU19B-126, Z2-EU19B-127, Z2-EU19B-128, Z2-EU19B-129, Z2-EU19B-130, Z2-EU19B-131, Z2-EU19B-132, Z2-EU19B-133, Z2-EU19B-134, Z2-EU19B-135, Z2-EU19B-136, Z2-EU19B-137, Z2-EU19B-138, Z2-EU19B-139, Z2-EU19B-140, Z2-EU19B-141, Z2-EU19B-142, Z2-EU19B-143, Z2-EU19B-144, Z2-EU19B-145, Z2-EU19B-146, Z2-EU19B-147, Z2-EU19B-148, Z2-EU19B-149, Z2-EU19B-150, Z2-EU19B-151, Z2-EU19B-152, Z2-EU19B-153, Z2-EU19B-154, Z2-EU19B-155, Z2-EU19B-155A, Z2-EU19B-155B, Z2-EU19B-155C, Z2-EU19B-155D, Z2-EU19B-156, Z2-EU19B-157, Z2-EU19B-158, Z2-EU19B-159, Z2-EU19B-160, Z2-EU19B-161, Z2-EU19B-162, Z2-EU19B-163, Z2-EU19B-164, Z2-EU19B-165, Z2-EU19B-166, Z2-EU19B-167, Z2-EU19B-167A, Z2-EU19B-167B, Z2-EU19B-167C, Z2-EU19B-167D, Z2-EU19B-168, Z2-EU19B-168A, Z2-EU19B-168B, Z2-EU19B-168C, Z2-EU19B-168D, Z2-EU19B-169, Z2-EU19B-170, Z2-EU19B-301, Z2-EU19B-302, Z2-EU19B-303, Z2-EU19B-304, and Z2-EU19B-305.

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

[c]Blanks indicate the analyte was not detected.

[d]Max RL values are presented; blanks indicate there is no Max RL for the analyte. Max RLs are from Zone 2 ROD Table 2.13, except for technetium-99, which is presented in Zone 2 RDR/RAWP Sect. 3.1.2.

[e]Blanks indicate the criterion does not apply to the analyte.

[f]Avg RL values are presented; blanks indicate there is no Avg RL for the analyte. Avg RLs are from Zone 2 ROD Table 2.14, except for technetium-99, which is presented in Zone 2 RDR/RAWP Sect. 3.1.2.

Attachment 1B. EU Z2-19 Class 1 SU data summary[a] (cont.)

Analyte	Frequency of detect	Min detect[b,c]	Max detect[b,c]	Avg detected result[d]	Max RL[d]	Number of detects ≥ Max RL[e]	Avg RL[f]	Number of detects ≥ Avg RL[e]	RSL[g] (10^{-5} or HI=1)	Number of detects ≥ RSL[e]	GW SSL[h]	Number of detects ≥ GW SSL[e]

[a]RSL values are presented; blanks indicate there is no RSL for the analyte. Chemical RSLs were calculated using the website at http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search, June 2017 revision; radionuclide RSLs were calculated during June 2017 using the website at http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search.

[h]GW SSL values are presented; blanks indicate there is no GW SSL for the analyte. GW SSLs are from Zone 2 ROD Table C.5, except for technetium-99, which is presented in Zone 2 RDR/RAWP Sect. 3.1.2.

[f]The 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. Because the calculation involves subtraction of background from analytical results and negative numbers are not allowed, 0 (zero) is a legitimate result.

[f]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.

Avg = average
EU = exposure unit.
GW = groundwater
HI = hazard index
Max = maximum
Min = minimum
PCB = polychlorinated biphenyl
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RL = remediation level
ROD = Record of Decision
RSL = risk screening level
SSL = soil screening level
SU = Soil Unit

Attachment 1C. Details of Zone 2 ROD criteria exceedances in EU Z2-19, Class 1 SU characterization and delineation samples

Sample location	Start depth (ft)	End depth (ft)	Analyte	Result[a]	Criterion value[b]
Max RL exceedances					
Z2-EU19-109	0	1	Ra/Th decay series	6254	15
Z2-EU19-110	0	1	Ra/Th decay series	4113	15
Z2-EU19-111	0	1	Cesium-137	38.4	20
			Ra/Th decay series	881	15
Z2-EU19-112	0	1	Cesium-137	46.9	20
			Ra/Th decay series	1330	15
Z2-EU19-113	0	1	Cesium-137	4060	20
			Ra/Th decay series	569	15
			Uranium-234	16900	7000
			Uranium-235	977	80
			Uranium-238	17300	500
Z2-EU19-114	0	1	Cesium-137	24.9	20
			Ra/Th decay series	28.4	15
			Uranium-238	599	500
Z2-EU19-115	0	1	Uranium-235	106	80
			Uranium-238	1390	500
Z2-EU19-116	0	1	Ra/Th decay series	28.1	15
Z2-EU19-117	0	1	Ra/Th decay series	28.1	15
Z2-EU19-120	0	1	Ra/Th decay series	59	15
			Uranium-234	57300	7000
			Uranium-235	4250	80
			Uranium-238	1950	500
Z2-EU19-122	0	0.5	Uranium-235	473	80
			Uranium-238	501	500
Z2-EU19-123	0	0.5	Ra/Th decay series	90.9	15
			Uranium-235	112	80
			Uranium-238	1260	500
Z2-EU19-124	0	1	Ra/Th decay series	15.7	15
Z2-EU19B-149	0	0.5	Ra/Th decay series	53.1	15
Z2-EU19B-152	0	0.5	Ra/Th decay series	18.9	15
Z2-EU19B-154	0	0.5	Cesium-137	125	20
			Ra/Th decay series	132.8	15
Z2-EU19B-155A	0.5	0.5	Uranium-235	780	80
Z2-EU19B-157	0	0.5	Cesium-137	20.8	20
			Ra/Th decay series	79.83	15
			Uranium-238	516	500
	2	2	Uranium-238	571	500
Z2-EU19B-168C	0.5	0.5	Uranium-235	495	80
Avg RL exceedances (not accounted for by Max RL exceedances)					
Z2-EU19-101	0	1	Uranium-238	61.9	50
Z2-EU19-103	0	1	Uranium-235	18.2	8
			Uranium-238	180	50
Z2-EU19-105	0	1	Uranium-235	12	8
			Uranium-238	119	50
Z2-EU19-106	0	1	Uranium-238	50.7	50
Z2-EU19-107	0	1	Cesium-137	2.13	2
			Ra/Th decay series	5.43	5
			Uranium-235	8.77	8
			Uranium-238	83.8	50
Z2-EU19-108	0	1	Ra/Th decay series	11.7	5

Attachment 1C. Details of Zone 2 ROD criteria exceedances in EU Z2-19, Class 1 SU characterization and delineation samples (cont.)

Sample location	Start depth (ft)	End depth (ft)	Analyte	Result[a]	Criterion value[b]
Z2-EU19-109	0	1	Cesium-137	4.04	2
			Uranium-235	8.95	8
			Uranium-238	83.7	50
Z2-EU19-110	0	1	Uranium-238	55.8	50
Z2-EU19-111	0	1	Uranium-235	18.3	8
			Uranium-238	221	50
Z2-EU19-112	0	1	Uranium-235	9.16	8
			Uranium-238	103	50
Z2-EU19-114	0	1	Uranium-235	55.4	8
Z2-EU19-115	0	1	Uranium-234	1280	700
Z2-EU19-116	0	1	Cesium-137	12.5	2
			Uranium-235	9.12	8
			Uranium-238	66.2	50
Z2-EU19-117	0	1	Cesium-137	16.4	2
			Uranium-235	20.6	8
			Uranium-238	246	50
Z2-EU19-118	0	1	Uranium-235	19	8
			Uranium-238	274	50
Z2-EU19-121	0	0.5	Ra/Th decay series	5.4	5
			Uranium-234	728	700
			Uranium-235	47.2	8
			Uranium-238	290	50
Z2-EU19-122	0	0.5	Ra/Th decay series	5.1	5
			Uranium-234	6960	700
Z2-EU19-123	0	0.5	Cesium-137	11.4	2
			Uranium-234	1220	700
	0.5	2	Uranium-235	26.1	8
			Uranium-238	322	50
Z2-EU19-124	0	1	Cesium-137	5.17	2
			Uranium-238	78.1	50
Z2-EU19B-139	0	0.5	Ra/Th decay series	5.61	5
	2	2	Uranium-238	55.2	50
Z2-EU19B-149	0	0.5	Cesium-137	13.8	2
			Uranium-238	52.5	50
	2	2	Uranium-235	28.3	8
			Uranium-238	246	50
	4	4	Uranium-235	8.37	8
			Uranium-238	99.3	50
Z2-EU19B-152	0	0.5	Uranium-235	8.12	8
			Uranium-238	79.7	50
	5	5	Uranium-235	8.36	8
			Uranium-238	56.7	50
Z2-EU19B-153	0	3	Total PCBs	26300	10000
Z2-EU19B-154	0	0.5	Uranium-235	9.57	8
			Uranium-238	94.6	50
	2	2	Ra/Th decay series	10.83	5
			Uranium-238	57.5	50
Z2-EU19B-155	0.5	0.5	Cesium-137	2.77	2
			Ra/Th decay series	6.23	5
Z2-EU19B-155A	2	2	Uranium-235	74.3	8

Attachment 1C. Details of Zone 2 ROD criteria exceedances in EU Z2-19, Class 1 SU characterization and delineation samples (cont.)

Sample location	Start depth (ft)	End depth (ft)	Analyte	Result[a]	Criterion value[b]
Z2-EU19B-156	2	2	Uranium-238	111	50
	4	4	Uranium-235	15.8	8
			Uranium-238	207	50
	5.25	5.25	Uranium-238	58.1	50
Z2-EU19B-157	0	0.5	Uranium-235	44.4	8
	2	2	Ra/Th decay series	7.06	5
			Uranium-235	51.8	8
	4	4	Uranium-235	33.7	8
			Uranium-238	362	50
	5.7	5.7	Uranium-238	83.6	50
Z2-EU19B-164	0	0.5	Uranium-235	15.1	8
	0	0.5	Uranium-238	160	50
	2	2	Uranium-238	79.9	50
	4	4	Uranium-235	22.4	8
			Uranium-238	200	50
Z2-EU19B-165	0	0.5	Uranium-235	13.5	8
			Uranium-238	95.2	50
Z2-EU19B-166	0	0.5	Uranium-235	8.6	8
Z2-EU19B-167	0	0.5	Uranium-235	14.8	8
			Uranium-238	78.6	50
Z2-EU19B-167A	0	0.5	Uranium-235	25.4	8
	2	2	Uranium-235	16.3	8
Z2-EU19B-167B	0	0.5	Uranium-235	24.7	8
Z2-EU19B-167D	0	0.5	Uranium-235	13.7	8
Z2-EU19B-168C	2	2	Uranium-235	23.3	8
	3	3	Uranium-235	23.5	8
			Uranium-238	52.2	50
RSL exceedances (not accounted for by RL exceedances)					
Z2-EU19-103	0	1	Uranium	574	230
Z2-EU19-107	0	10	Uranium	421	230
Z2-EU19-109	0	1	Uranium	273	230
Z2-EU19-110	0	1	Uranium	388	230
Z2-EU19-111	0	1	Uranium	260	230
Z2-EU19-112	0	1	Uranium	391	230
			Plutonium-239	154	128
Z2-EU19-113	0	1	Uranium	21000	230
Z2-EU19-114	0	1	Uranium	1090	230
Z2-EU19-115	0	1	Uranium	1100	230
Z2-EU19-121	0	0.5	Uranium	365	230
Z2-EU19-122	0	0.5	Uranium	325	230
Z2-EU19-123	0	0.5	Uranium	2940	230
	0.04	0.17	Uranium	1060	230
Z2-EU19-124	0	1	Uranium	520	230
Z2-EU19B-167A	2	2	Uranium	236	230
Z2-EU19B-168C	0.5	0.5	Uranium	1850	230
	2	2	Uranium	239	230
GW SSL exceedances					
Z2-EU19-101	0	1	Uranium-234	71.8	61.1
			Uranium-238	61.9	61.1
Z2-EU19-103	0	1	Uranium-234	194	61.1
			Uranium-238	180	61.1

Attachment 1C. Details of Zone 2 ROD criteria exceedances in EU Z2-19, Class 1 SU characterization and delineation samples (cont.)

Sample location	Start depth (ft)	End depth (ft)	Analyte	Result[a]	Criterion value[b]
Z2-EU19-105	0	1	Uranium-234	114	61.1
			Uranium-238	119	61.1
Z2-EU19-106	0	1	Uranium-234	78.1	61.1
Z2-EU19-107	0	1	Uranium-234	113	61.1
			Uranium-238	83.8	61.1
Z2-EU19-109	0	1	Uranium-234	83.4	61.1
			Uranium-238	83.7	61.1
Z2-EU19-111	0	1	Uranium-234	215	61.1
			Uranium-238	221	61.1
Z2-EU19-112	0	1	Uranium-234	90.9	61.1
			Uranium-238	103	61.1
Z2-EU19-113	0	1	Chromium	530	172
			Technetium-99	2640	85.6
			Uranium-234	16900	61.1
			Uranium-235	977	61.1
			Uranium-238	17300	61.1
Z2-EU19-114	0	1	Uranium-234	563	61.1
			Uranium-238	599	61.1
Z2-EU19-115	0	1	Uranium-234	1280	61.1
			Uranium-235	106	61.1
			Uranium-238	1390	61.1
Z2-EU19-116	0	1	Uranium-234	69.7	61.1
			Uranium-238	66.2	61.1
Z2-EU19-117	0	1	Uranium-234	291	61.1
			Uranium-238	246	61.1
Z2-EU19-118	0	1	Uranium-234	280	61.1
			Uranium-238	274	61.1
Z2-EU19-120	0	1	Uranium-234	57300	61.1
			Uranium-235	4250	61.1
			Uranium-238	1950	61.1
Z2-EU19-121	0	0.5	Uranium-234	728	61.1
			Uranium-238	290	61.1
Z2-EU19-122	0	0.5	Uranium-234	6960	61.1
			Uranium-235	473	61.1
			Uranium-238	501	61.1
	4.4	4.4	Uranium-234	70.9	61.1
Z2-EU19-123	0	0.5	Uranium-234	1220	61.1
			Uranium-235	112	61.1
			Uranium-238	1260	61.1
	0.5	2	Uranium-234	318	61.1
			Uranium-238	322	61.1
Z2-EU19-124	0	1	Uranium-234	85.3	61.1
			Uranium-238	78.1	61.1
Z2-EU19B-149	2	2	Uranium-234	247	61.1
			Uranium-238	246	61.1
	4	4	Uranium-234	103	61.1
			Uranium-238	99.3	61.1
Z2-EU19B-152	0	0.5	Uranium-234	87.9	61.1
			Uranium-238	79.7	61.1
	5	5	Uranium-234	100	61.1

Attachment 1C. Details of Zone 2 ROD criteria exceedances in EU Z2-19, Class 1 SU characterization and delineation samples (cont.)

Sample location	Start depth (ft)	End depth (ft)	Analyte	Result[a]	Criterion value[b]
Z2-EU19B-154	0	0.5	Uranium-234	103	61.1
			Uranium-238	94.6	61.1
	2	2	Uranium-234	65.3	61.1
Z2-EU19B-155	2	2	Uranium-234	64.4	61.1
Z2-EU19B-155A	0.5	0.5	Uranium-235	780	61.1
	2	2	Uranium-235	74.3	61.1
Z2-EU19B-156	2	2	Uranium-234	112	61.1
			Uranium-238	111	61.1
	4	4	Uranium-234	200	61.1
			Uranium-238	207	61.1
Z2-EU19B-157	0	0.5	Uranium-234	459	61.1
			Uranium-238	516	61.1
	2	2	Uranium-234	568	61.1
			Uranium-238	571	61.1
	4	4	Uranium-234	237	61.1
			Uranium-238	362	61.1
	5.7	5.7	Uranium-234	79.4	61.1
			Uranium-238	83.6	61.1
Z2-EU19B-164	0	0.5	Uranium-234	178	61.1
			Uranium-238	160	61.1
	2	2	Uranium-234	89.6	61.1
			Uranium-238	79.9	61.1
	4	4	Uranium-234	220	61.1
			Uranium-238	200	61.1
Z2-EU19B-165	0	0.5	Uranium-234	175	61.1
			Uranium-238	95.2	61.1
Z2-EU19B-166	0	0.5	Uranium-234	107	61.1
Z2-EU19B-167	0	0.5	Uranium-234	168	61.1
			Uranium-238	78.6	61.1
	2	2	Uranium-234	83.6	61.1
Z2-EU19B-168C	0.5	0.5	Uranium-235	495	61.1

[a]Units: metals = mg/kg, PCBs = µg/kg, and radionuclides = pCi/g.

Avg = average
EU = Exposure Unit
GW = groundwater
Max = maximum
PCB = polychlorinated biphenyl
RL = remediation level
ROD = Record of Decision
RSL = risk screening level
SSL = soil screening level
SU = Soil Unit

Attachment 1D. EU Z2-19 Class 1 SU characterization and delineation sample locations with Avg RL, RSL, and GW SSL exceedances after removal of sample locations with Max RL exceedances to a depth of 4 ft[a]

Sample location	Analyte
Residual Avg RL Exceedances	
Z2-EU19-101	Uranium -238
Z2-EU19-103	Uranium-235, uranium-238
Z2-EU19-105	Uranium-235, uranium-238
Z2-EU19-106	Uranium -238
Z2-EU19-107	Cesium-137, Ra/Th decay series, uranium-235, uranium-238
Z2-EU19-108	Ra/Th decay series
Z2-EU19-118	Uranium-235, uranium-238
Z2-EU19-121	Ra/Th decay series, uranium-234, uranium-235, uranium-238
Z2-EU19B-139	Ra/Th decay series, uranium-238
Z2-EU19B-152 (5-5 ft)[b]	Uranium-235, uranium-238
Z2-EU19B-153	Total PCBs
Z2-EU19B-155	Cesium-137, Ra/Th decay series
Z2-EU19B-156	Uranium-235, uranium-238
Z2-EU19B-157 (5.7-5.7 ft.)[b]	Uranium-235, uranium-238
Z2-EU19B-164	Uranium-235, uranium-238
Z2-EU19B-165	Uranium-235, uranium-238
Z2-EU19B-166	Uranium-235
Z2-EU19B-167	Uranium-235, uranium-238
Z2-EU19B-167A	Uranium-235
Z2-EU19B-167B	Uranium-235
Z2-EU19B-167D	Uranium-235
Residual RSL exceedances (not including residual Avg RL exceedances or potassium-40)[c,d]	
Z2-EU19-103	Uranium
Z2-EU19-107	Uranium
Z2-EU19-121	Uranium
Z2-EU19B-167A	Uranium
Residual GW SSL exceedances	
Z2-EU19-103	Uranium-234, uranium-238
Z2-EU19-105	Uranium-234, uranium-238
Z2-EU19-106	Uranium-234, uranium-238
Z2-EU19-107	Uranium-234, uranium-238
Z2-EU19-118	Uranium-234, uranium-238
Z2-EU19-121	Uranium-234, uranium-238
Z2-EU19B-122 (4.4 to 4.4 ft.)(2)	Uranium-234
Z2-EU19B-152 (5 to 5 ft.)(2)	Uranium-234
Z2-EU19B-155	Uranium-234
Z2-EU19B-156	Uranium-234, uranium-238
Z2-EU19B-157 (5.7 to 5.7 ft.)(2)	Uranium-235, uranium-238
Z2-EU19B-164	Uranium-234, uranium-238
Z2-EU19B-165	Uranium-234, uranium-238
Z2-EU19B-166	Uranium-234
Z2-EU19B-167	Uranium-234, uranium-238

[a]Details of residual criteria exceedances, including sample depths and analyte concentrations at each sample location and criterion values can be found in Attachment 3.

[b]Max RL exceedances will be excavated at these sample locations from depths up to 4 ft.

[c]RSL values are the same as Avg RL values for all of the analytes with residual Avg RL exceedances except for the Ra/Th decay series. There is no Ra/Th decay series RSL because radium and thorium isotopes are not included in EU risk calculations as discussed in the Zone 2 ROD.

[d]Potassium-40 is not evaluated for risk if its average concentration is less than the potassium-40 background concentration (32.12 pCi/g). The average potassium-40 concentration in EU Z2-19 is presented in Table 3.

Avg = average
EU = Exposure Unit
GW = groundwater
Max = maximum
PCB = polychlorinated biphenyl
RL = remediation level
ROD = Record of Decision
RSL = risk screening level
SSL = soil screening level

FIGURES

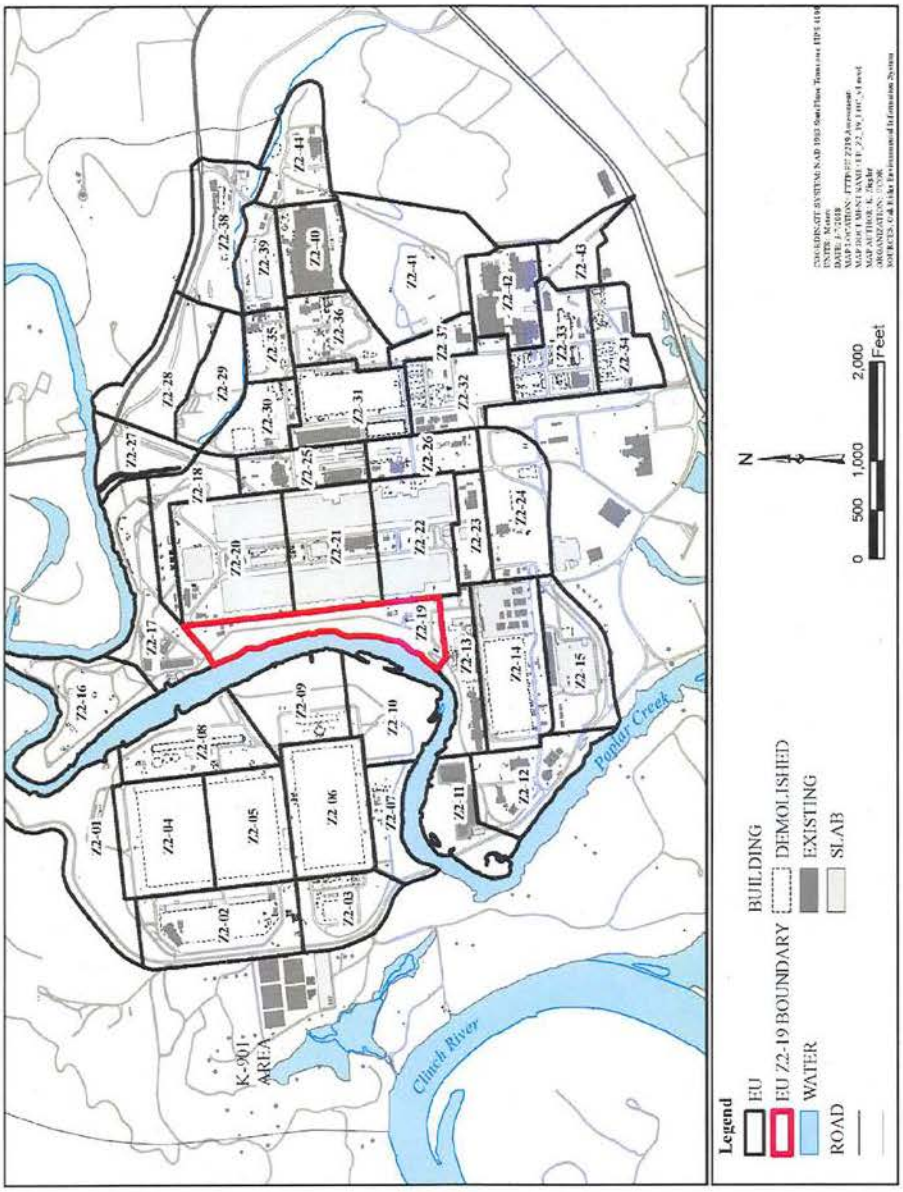


Fig. 1. Location of EU Z2-19 at ETTP.

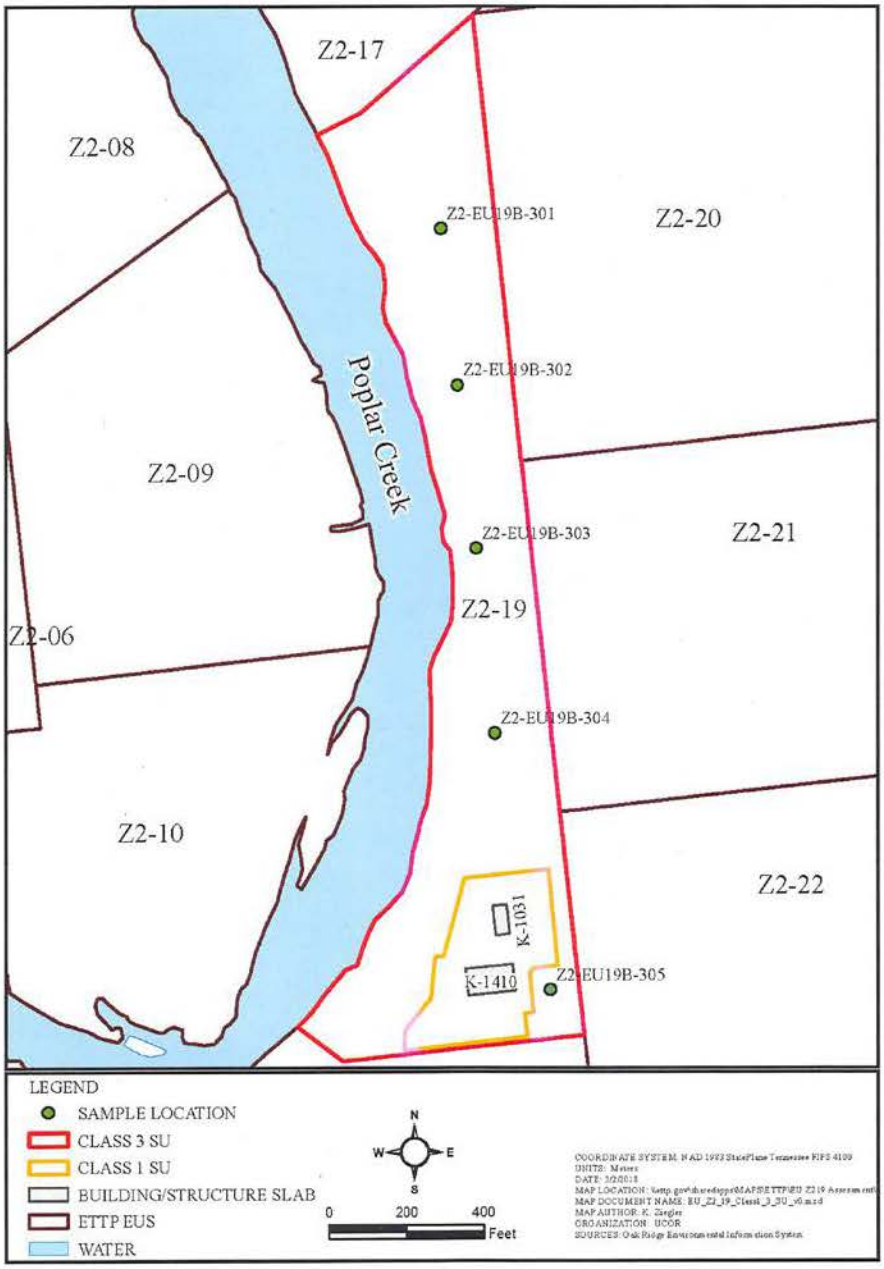


Fig. 2. Location of Class 1 SU within EU Z2-19.

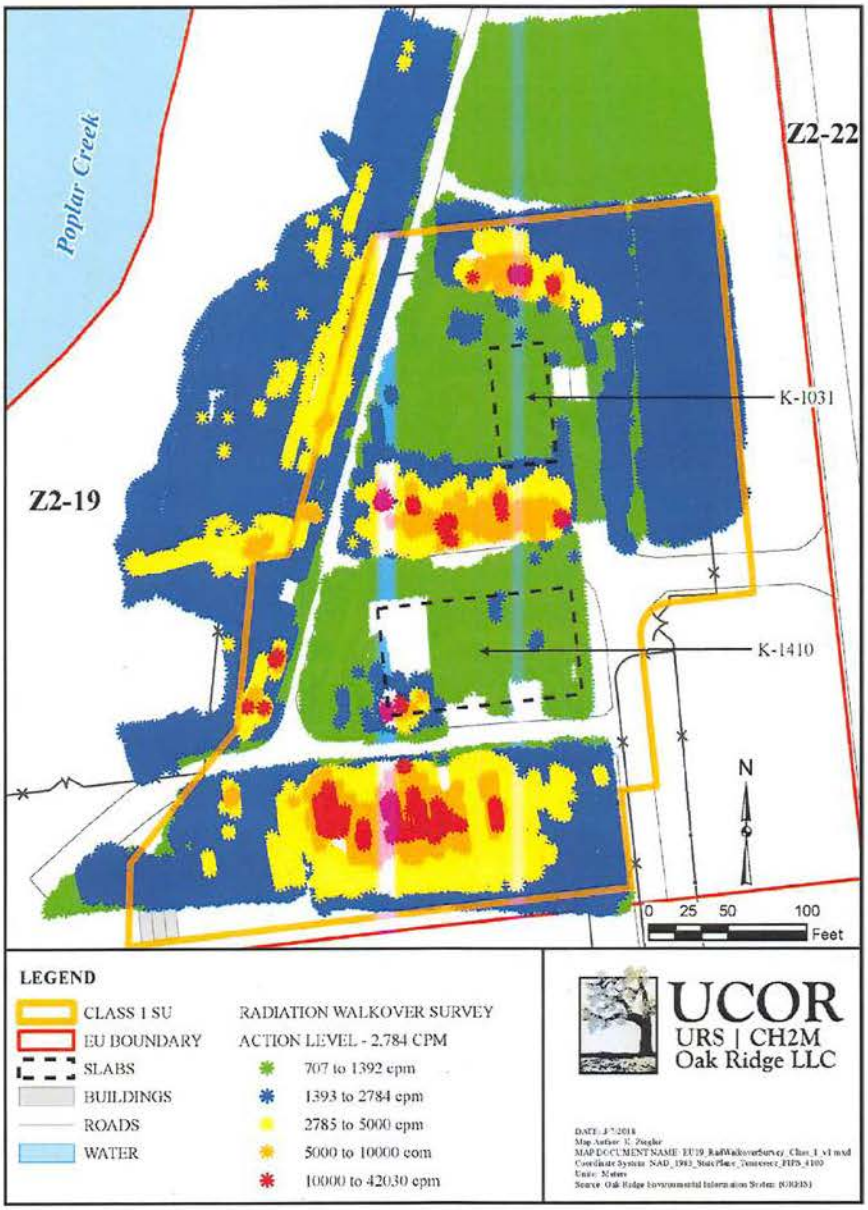


Fig. 3. Walkover survey results for Class 1 SU in EU Z2-19.

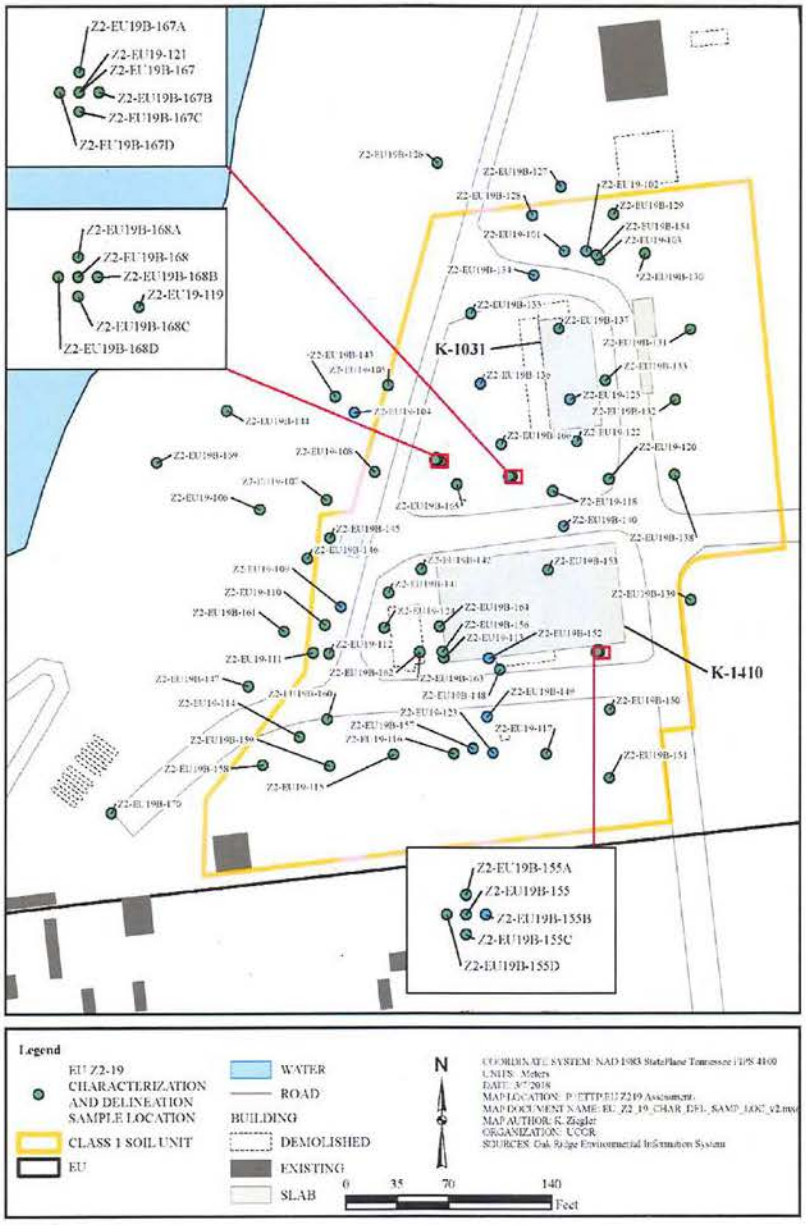


Fig. 4. Soil sample locations in the Class 1 SU in EU Z2-19.

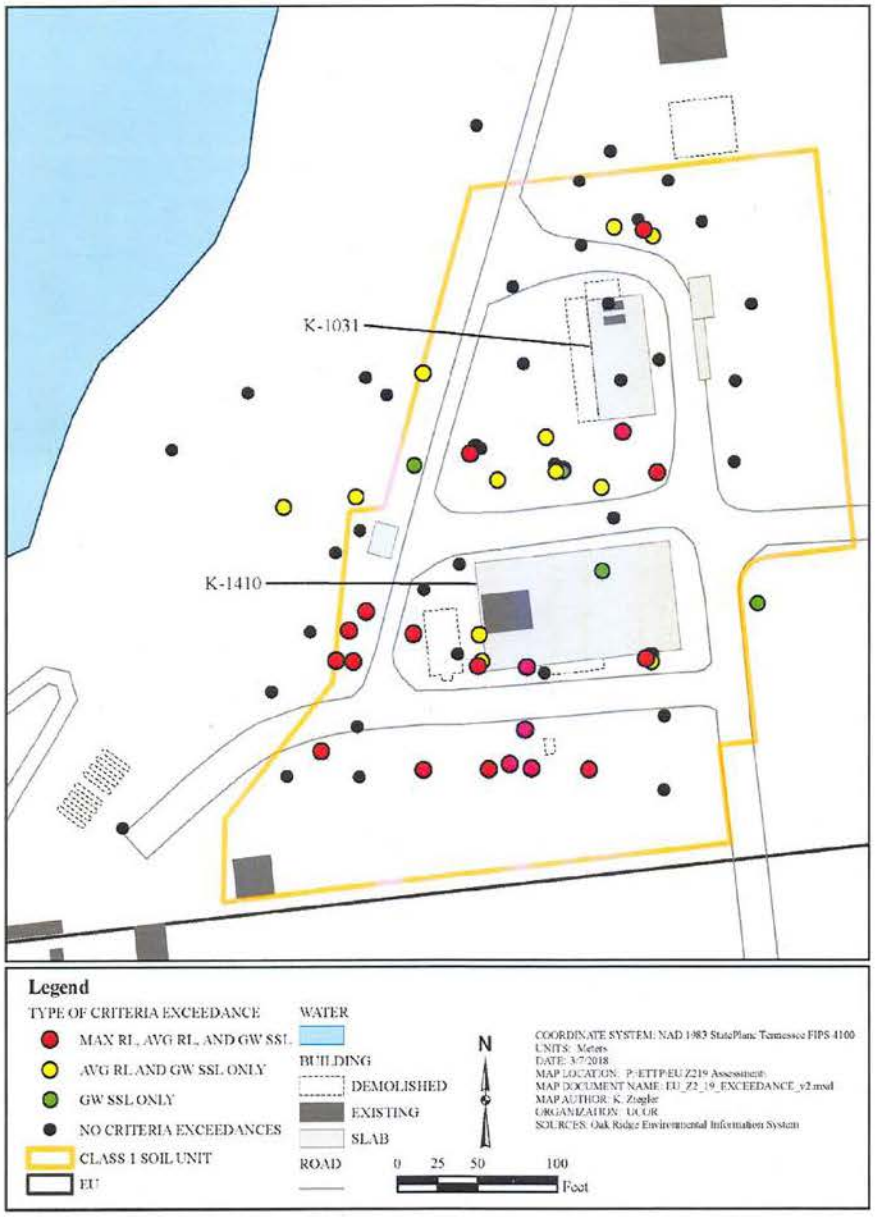


Fig. 5. Summary of RL/GW SSL exceedances.

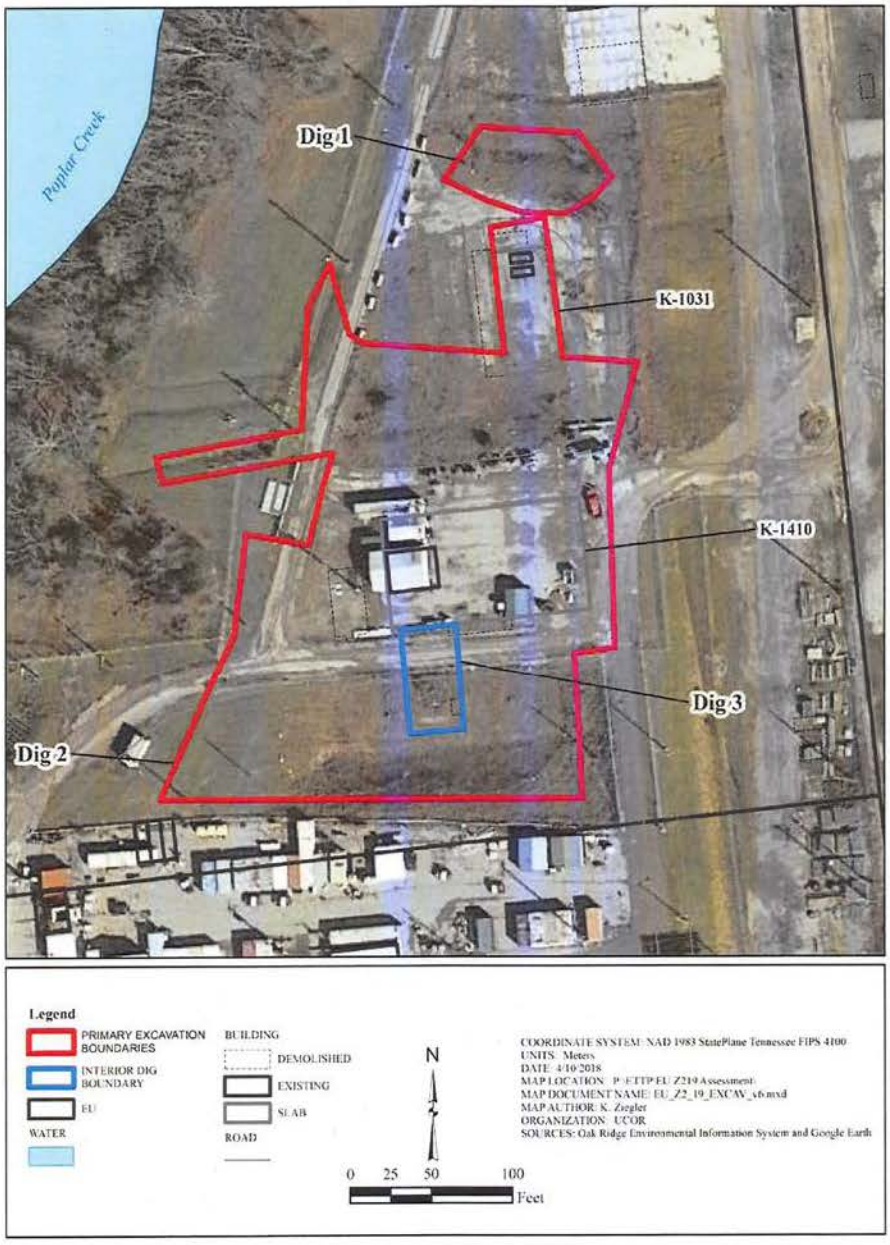


Fig. 6. EU Z2-19 Class 1 SU RA dig locations.

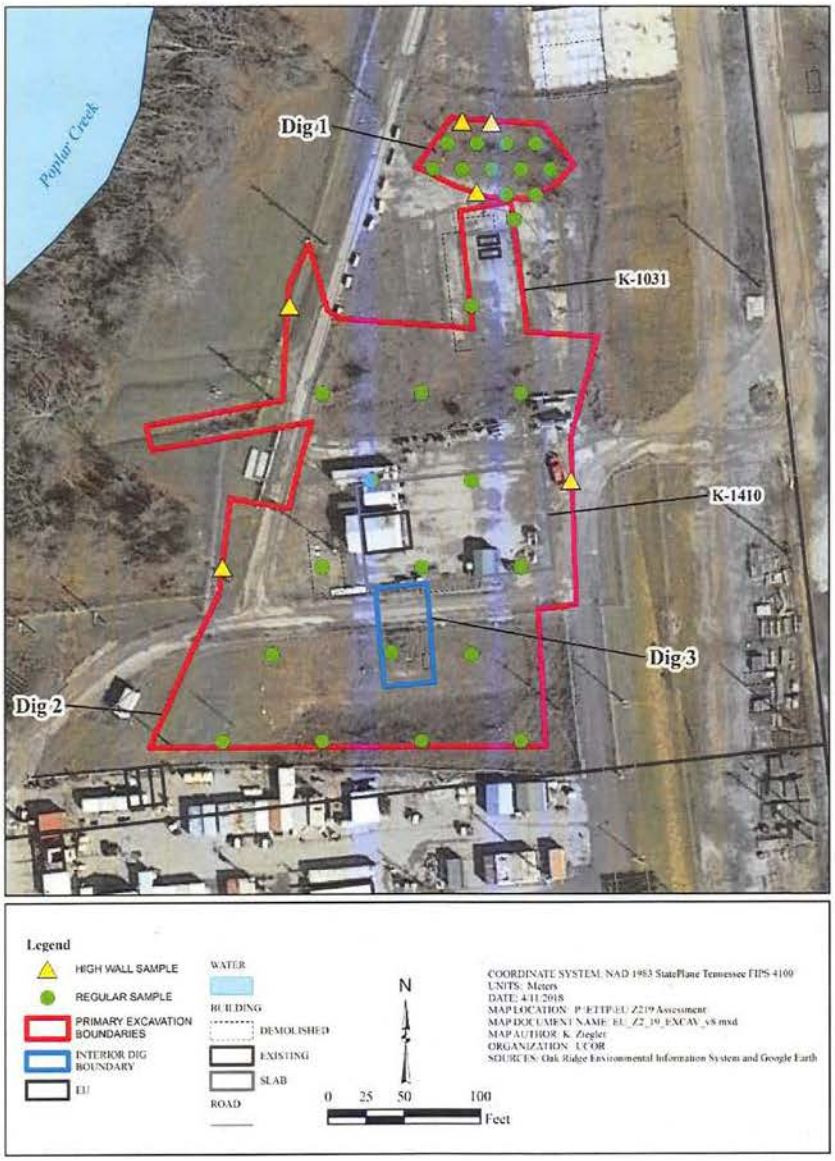
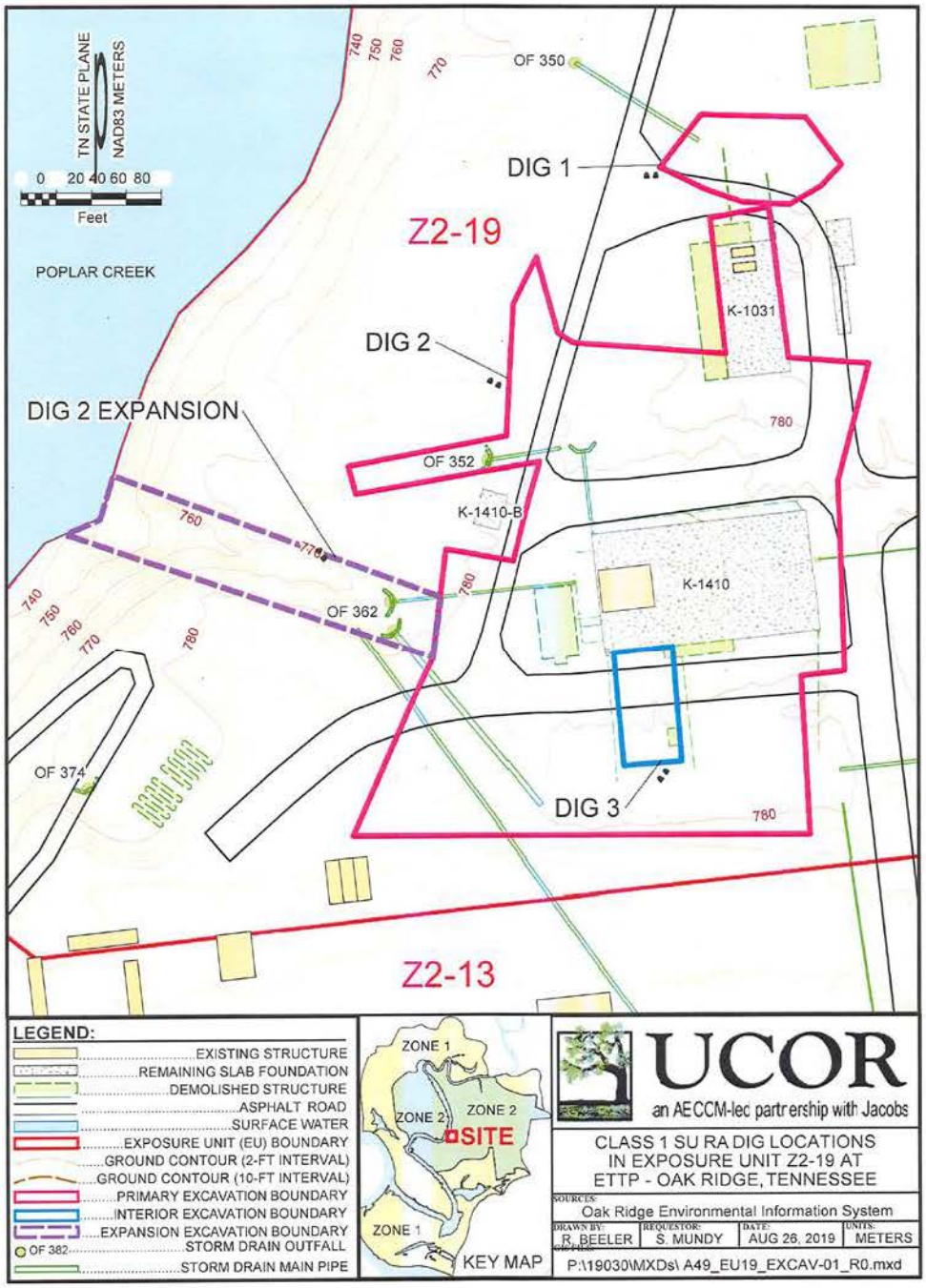


Fig. 7. EU Z2-19 Class 1 SU RA dig areas with approximate confirmation sample locations.

Attachment B



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