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ATTACHMENT A

Environmental Baseline Survey Report for the Title Transfer of the K-792 Switchyard Complex at the East Tennessee Technology Park, Oak Ridge, Tennessee

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Environmental Baseline Survey Report for the Title Transfer of the K-792 Switchyard Complex at the East Tennessee Technology Park, Oak Ridge, Tennessee

Date Issued—December 2009

Prepared by
Science Applications International Corporation
Oak Ridge, Tennessee
under subcontract 23900-BA-PR007U
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Prepared for the
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BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Y-12 National Security Complex   Oak Ridge National Laboratory
under contract DE-AC05-98OR22700
for the
U. S. DEPARTMENT OF ENERGY

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This report is intended to be used in its entirety. Excerpts, which are taken out-of-context, run the risk of being misinterpreted and are, therefore, not representative of the findings of this assessment. Opinions and recommendations presented in this report apply only to site conditions and features as they existed at the time of SAIC's site visit, and those inferred from information observed or available at that time, and cannot be applied to conditions and features of which SAIC is unaware and has not had the opportunity to evaluate.

The results of this report are based on record reviews, site reconnaissance, interviews, and the radiological report reviewed and approved by BJC. SAIC has not made, nor has it been asked to make, any independent investigation concerning the accuracy, reliability, or completeness of such information.

All sources of information on which SAIC has relied in making its conclusions are identified in Chap. 8 of this report. Any information, regardless of its source, not listed in Chap. 8 has not been evaluated or relied upon by SAIC in the context of this report.

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FIGURES

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ABBREVIATIONS

ACM	asbestos-containing material
bgs	below ground surface
BJC	Bechtel Jacobs Company LLC
CDR	Covenant Deferral Request
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
cm	centimeter
COC	contaminant of concern
COE	U. S. Army Corps of Engineers
cpm	counts per minute
CROET	Community Reuse Organization of East Tennessee
DCE	dichloroethene
DCGL	derived concentration guideline level
$DCGL_{EMC}$	derived concentration guideline level $_{\text{elevated measurement comparison}}$
DOE	U. S. Department of Energy
dpm	disintegrations per minute
DVS	Dynamic Verification Strategy
EBS	environmental baseline survey
ELCR	excess lifetime cancer risk
EM	Environmental Management
EPA	U. S. Environmental Protection Agency
ESU	exterior survey unit
ETTP	East Tennessee Technology Park
EU	exposure unit
FFA	Federal Facility Agreement
FSU	furnishings survey unit
H_o	null hypothesis
H_a	alternative hypothesis
HI	hazard index
HP	health physicist
ISU	interior survey unit
m^2	square meters
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual*
MCL	maximum contaminant level
NaI	sodium iodide
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORO	Oak Ridge Office
ORR	Oak Ridge Reservation
OWS	oil/water separator
QA/QC	quality assurance/quality control
PCB	polychlorinated biphenyl
PEMS	Project Environmental Measurements System
ppm	parts per million
PRG	preliminary remediation goal
RA	remedial action
RADCON	Radiological Control Organization
RCRA	Resource Conservation and Recovery Act of 1976
RL	remediation level

ROD	Record of Decision
ROW	right-of-way
RQ	reportable quantity
SAIC	Science Applications International Corporation
SL	screening level
SU	soil unit
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCE	trichloroethene
TDEC	Tennessee Department of Environment and Conservation
TL	trigger level
TRU	transuranic
TVA	Tennessee Valley Authority
UST	underground storage tank
VOC	volatile organic compound
WIP	Walkover Inspection Protocol

EXECUTIVE SUMMARY

This environmental baseline survey (EBS) documents the baseline environmental conditions of the U. S. Department of Energy's (DOE's) K-792 Switchyard Complex, which includes the former K-792 Switchyard, the K-791-B building, the K-796-A building, and the K-792 Northern Expansion Area located in the northwestern portion of the East Tennessee Technology Park (ETTP). The total area of the property is approximately 19.91 acres. DOE is proposing to transfer the title of this land area and buildings to the Heritage Center, LLC (Heritage Center), a subsidiary corporation of the Community Reuse Organization of East Tennessee (CROET). This report provides supporting information for the transfer of this government-owned facility at ETTP to a non-federal entity.

The area proposed for title transfer includes the former K-792 Switchyard, the K-792 Northern Expansion Area, Bldg. K-791-B, Bldg. K-796-A, and the underlying property known as the underlying fee. Located within the K-792 Switchyard footprint but not included in the transfer are Bldg. K-1310-MP and Bldg. K-1310-MQ, two buildings owned by a private company that leases space in the northern portion of the Switchyard. The transfer footprint is bounded by Perimeter Road to the north and west, the parking area for Portal 8 to the south, and primarily the former K-792 Powerhouse Complex and Avenue "U" North to the east; however, the eastern boundary along the Northern Expansion area has no physical features associated with it.

This EBS is based upon the requirements of Sect. 120(h) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and relies partly upon regulatory-approved documentation in two Phased Construction Completion Reports (PCCRs) and partly on data collected specifically to support the transfer. The PCCRs that were approved by the U. S. Environmental Protection Agency (EPA) Region 4 and Tennessee Department of Environment and Conservation (TDEC) summarize the environmental data evaluation, the human health risk evaluation, and the No Further Action (NFA) determinations for the components of the K-792 land parcel. The two PCCRs listed below were used for source information and address Exposure Unit (EU) Z2-02 and EU Z2-01, respectively:

- *FY 2006 PCCR for the Zone 2 Soils, Slabs, and Subsurface Structures at ETTP, Oak Ridge, Tennessee* (DOE/OR/01-2317&D2), December 2006 (DOE 2006), and

- *FY 2007 PCCR for the Zone 2 Soils, Slabs, and Subsurface Structures at ETTP, Oak Ridge, Tennessee* (DOE/OR/01-2723&D2), September 2007 (DOE 2007a).

The NFA determinations documented in the referenced PCCRs were reached using the Environmental Management (EM) Program's Dynamic Verification Strategy (DVS) protocol (DOE 2007b), a process designed to facilitate real-time decision-making. A description of the DVS process can be found in the PCCRs that are cited in this document. This process is in use for remedial action decision-making across the ETTP, which has been divided into Zones 1 and 2 and further subdivided into Geographic Areas, then Groups, then EUs. For consistency with the EM nomenclature, this EBS uses the EU as the basis for discussion. Of the approximately 19.91 acres of land in the K-792 Switchyard Complex, approximately 3 acres are included in portions of EU Z2-01, and the remaining 17 acres are included in EU Z2-02.

For purposes of the EBS, information is presented on the land proposed for transfer in its entirety because the parcel is proposed for transfer in its entirety. However, in order to provide context and a tie-in with the EM Program's status in these two component EUs, the EBS provides regulatory details by EU in Chap. 3 and technical details by EU in Chap. 6.

Zone 2 remedial action objectives were developed by the DVS to support the future use of ETTP as a mixed-use commercial and industrial park. Therefore, remediation criteria were designed for the protection of the future industrial worker under the assumption the worker normally would not have the potential for exposure to soils at depths below 10 ft below ground surface (bgs). Accordingly, land use controls (LUCs) have been established to restrict disturbance of soils below 10 ft deep and to limit future land use to industrial/commercial activities. Where the need for LUCs below 10 ft bgs is not warranted, this is so stated and explained. Once all actions associated with the DVS for Zone 1 and Zone 2 are completed and the data support it, there will be a re-evaluation with EPA and TDEC for the restriction on excavation below 10 ft.

The DVS process and the preparation of this report included visual and physical inspections of the property and adjacent properties, a detailed records search, sampling and analysis of soils, radiological walkover surveys, and a risk evaluation. Resources evaluated as part of the records search included Federal Government records, title documents, aerial photographs that may reflect prior uses, and interviews with current and former employees[1] involved in the operations on the real property to identify any areas on the property where hazardous substances and petroleum products, or their derivatives, and acutely hazardous wastes were stored for one year or more, known to have been released, or disposed of. In addition, radiological surveys of Bldgs. K-791-B and K-796-A were conducted to assess the buildings' radiological condition. Soil vapor sampling and polychlorinated biphenyl (PCB) swipe sampling also were conducted within the buildings. The following is a summary of the findings of the evaluation that was performed:

- The primary historical use of Bldgs. K-791-B and K-796-A has been as a maintenance shop and for storage of electrical maintenance supplies and tools, respectively. More recently, the buildings were used for office space and a conference room, respectively, for the DOE contractor performing decontamination activities in the K-29, K-31, and K-33 process buildings.

- No evidence was found that chemicals exceeding 1000 kg have been stored in the transfer footprint for one year or more.

- Soil samples from the transfer footprint were analyzed for chemical constituents. Levels of volatile organic compounds (VOCs), semivolatile compounds (SVOCs), PCBs, and metals were detected in the samples. No detected chemical constituent for VOCs exceeded preliminary remediation goals (PRGs), which have been established for the site and were calculated at the 1E-5 excess lifetime cancer risk (ELCR), or the 1.0 hazard quotient (HQ) levels. However, four detections of PCBs, one detection of SVOCs [benzo(*a*)pyrene], and one detection of lead exceeded their respective PRGs established for the site and calculated at the 1E-5 ELCR or the 1.0 HQ levels.

- Soil samples from the transfer footprint were analyzed for radiological constituents to determine whether any residual soil contamination exceeded the remediation levels (RLs) established in the ETTP Zone 2 Record of Decision (ROD) or established PRGs. No individual results exceeded the maximum RLs, with two individual results (^{137}Cs and ^{235}U) greater than the Zone 2 average RLs. Six radionuclides (^{137}Cs, ^{226}Ra, ^{228}Th, ^{232}Th, ^{235}U, and ^{238}U) exceeded the PRG limits. Three radionuclide results (^{226}Ra, ^{230}Th, and ^{238}U) exceeded their background values. All average detected concentrations were below the Zone 2 ROD limits.

- Swipe sampling of the interior bay areas of Bldgs. K-791-B and K-796-A was conducted to assess the potential for PCB contamination. PCBs were detected in 13 of 15 sample locations within the bay

[1] BJC 2008. Personal communications with Bob Kiser (currently employed at the East Tennessee Technology Park) in May.

floor areas of the buildings. However, the detected concentrations are well below the 10-$\mu g/100\text{-}cm^2$ guideline found in 40 *Code of Federal Regulations* Part 761 for classification as "PCB-contaminated" and the risk screen performed using these data was within EPA's generally acceptable target risk range of E-04 to E-06.

- The construction materials for Bldg. K-796-A were not suspected of containing asbestos, and no samples were collected or analyzed for asbestos. However, 13 samples of tile and insulation materials were collected from Bldg. K-791-B in March and April 2006 and submitted for laboratory analysis for asbestos. All 13 samples analyzed were determined to be negative (< 1%) for asbestos.

- Radiological surveys of the transfer footprint were conducted. The data were analyzed to determine whether any residual contamination was present and might exceed the derived concentration guideline level established for each of the survey units. Survey results show that the K-792 Switchyard Complex had no areas of elevated residual radioactivity present above DOE contamination limits.

- Data and risk evaluations were conducted to evaluate unrestricted industrial use to 10 ft bgs. Contamination anywhere within the 0- to 10-ft bgs interval had an equal weighting in the risk assessment (i.e., all soil in the interval was presumed to be equally accessible to an industrial worker).

- The EPA has established a generally acceptable target risk range of E-04 to E-06 and a generally acceptable hazard index (HI) of 1. The risk estimate is a value that represents the excess cancer incidence that might be expected due to the exposure scenario evaluated. The HI is a value that represents the potential for toxic effects to an exposed individual. The results of the risk evaluation are as follows:

  — the risk estimate for the study area soils of the K-792 Switchyard Complex indicated that the cumulative risks did not exceed the generally acceptable target risk range of E-04 to E-06 or an HI of 1, and

  — the risk calculation for the building survey units for both K-791-B and K-796-A resulted in a risk below EPA's generally acceptable target risk range of E-04 to E-06 and an HI below 1.

- Sub-slab vapor samples were collected in September 2006 and February 2007 to determine if a potential source for VOCs exists under the buildings. Based upon the results of the sampling events, none of the VOCs detected exceeded trigger levels (TLs), and the sum of the TL fractions was below 1.0. Based upon these findings the vapor intrusion pathway is not considered complete beneath the buildings.

- Because most radiological survey and soil sampling results were below established RLs, and because the risk screen indicated a low likelihood of adverse health effects associated with exposure to the transfer footprint, the K-792 Switchyard Complex is suitable for transfer for the intended use.

CONCLUSIONS

Based on the U. S. Department of Energy's (DOE's) review of the existing information, including discussions and interviews referenced herein, and evaluation of the data gathered in preparation of the environmental baseline survey (EBS) for the K-792 Switchyard Complex, DOE recommends the following:

1. Due to the uncertainty associated with the nature of the on-site groundwater and the need to evaluate and possibly address groundwater in the future, DOE recommends that the transfer of the K-792 Switchyard Complex be achieved by a covenant deferral per the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Sect. 120(h)(3)(c). Land use restrictions associated with the covenant deferral are described below.

LAND USE RESTRICTIONS

Land use restrictions are an important component of a CERCLA covenant deferral; they help to ensure that transfer of the property is protective for the intended use. The restrictions that will apply to the K-792 Switchyard Complex are summarized below. Full details are found in the Covenant Deferral Request (CDR) package.

1. The property shall not be developed in a manner that is inconsistent with the land use assumptions of "industrial use" contained in the approved applicable Record of Decision (ROD) for Zone 2 (*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).

2. Development of the property must comply with all applicable federal, state, and local laws and regulations with respect to any present or future development of the property.

3. All structures, facilities, and improvements requiring a water supply shall be required to connect to an appropriate water system for any and all usage. Extraction, consumption, exposure, or use, in any way, of the groundwater underlying the property is prohibited without the prior written approval of DOE, U. S. Environmental Protection Agency (EPA) Region 4, and Tennessee Department of Environment and Conservation (TDEC).

4. Disturbance of the ground surface on the transferred property is prohibited unless the transferee complies with the site process for obtaining an excavation/penetration permit. The excavation and penetration permit program will be retained by DOE until it has been determined that all necessary soil remediation on the property has been taken.

5. Disturbance of any portion of the property deeper than 10 ft below ground surface without the prior written approval of DOE, EPA Region 4, and TDEC is prohibited.

6. In order to ensure that the vapor intrusion pathway [i.e., the migration of volatile organic compounds (VOCs) in contaminated groundwater and/or soil to indoor air] does not contribute to an unacceptable risk to human health, DOE will address the potential for vapor intrusion in the East Tennessee Technology Park final Sitewide ROD, which is scheduled to be signed by September 30, 2013, and will take interim protective measures to ensure protectiveness until the ROD is signed. Any new building or structure built on the Property that is intended to be occupied by workers 8 hours or more per scheduled workday or by public visitors must be designed and constructed to minimize potential exposure to VOC vapors, including the use of engineered barriers as noted in the Quitclaim deed. A

waiver from this requirement may be sought from EPA, TDEC, and DOE based on alternative commitments or new information.

7. DOE reserves the right of access to all portions of the property for environmental investigation, remediation, or other corrective action.

RESPONSE TO REGULATOR COMMENTS ON THE ENVIRONMENTAL BASELINE SURVEY REPORT FOR THE K-792 SWITCHYARD COMPLEX

DOE received comments from EPA Region 4 and TDEC on the CDR and EBS report for the K-792 Switchyard Complex on May 21, 2009, and April 22, 2009, respectively. There were questions about buildings owned by a private company that are located within the transfer footprint and the transfer status of the soils beneath buildings. There were also questions about water in the vaults located within the switchyard. The majority of the comments were suggestions for improving clarity and readability. The full text of comments and responses is provided in Sect. 7 of the CDR.

RESPONSE TO PUBLIC COMMENTS

The CDR package was available for public review from July 30, 2009, until August 31, 2009, and the availability of the documents for review was announced in four area newspapers. No comments were received.

1. PROPERTY IDENTIFICATION

The area discussed in this environmental baseline survey (EBS) report is located in the northwestern portion of the East Tennessee Technology Park (ETTP) [formerly the Oak Ridge Gaseous Diffusion Plant (ORGDP) or K-25 Site] on the Oak Ridge Reservation (ORR) in Roane County, Tennessee. Figure 1.1 shows the location of the transfer footprint within the study area, and Fig. 1.2 designates the boundary of the footprint. Figure 1.3 is an aerial photo of the K-792 Complex showing existing and former structures within the transfer footprint.

The area proposed for title transfer is approximately 19.91 acres and includes the former K-792 Switchyard (Fig. 1.4), the K-792 Northern Expansion Area (Fig. 1.5), Bldg. K-791-B (Fig. 1.6), Bldg. K-796-A (Fig. 1.7), and the underlying property known as the underlying fee. Located within the K-792 Switchyard footprint but not included in the transfer are Bldg. K-1310-MP, a metal building, and two trailers, Bldgs. K-1310-MQ and K-1310-MS, owned by a private company that leases space in the northern portion of the Switchyard Complex. The transfer footprint is bounded by Perimeter Road to the north and west, the parking area for Portal 8 to the south, and primarily the former K-792 Powerhouse Complex and Avenue "U" North to the east; however, the eastern boundary along the Northern Expansion area has no physical features associated with it. Past and present operations at the former K-792 Switchyard, Bldgs. K-791-B and K-796-A, and the Northern Expansion area are described in more detail in Chap. 4 of this report.

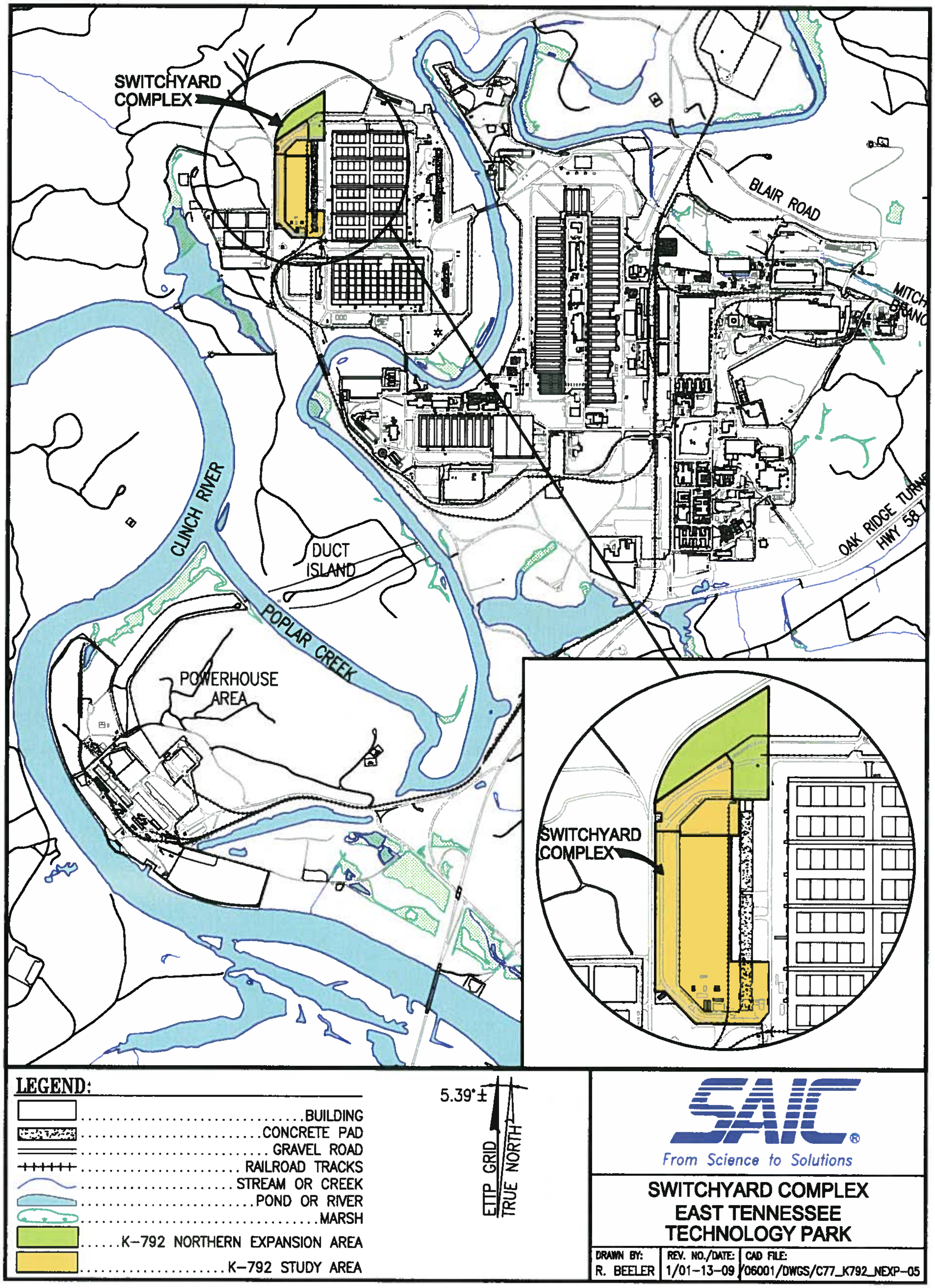

Fig. 1.1. Location of the K-792 Switchyard Complex within ETTP.

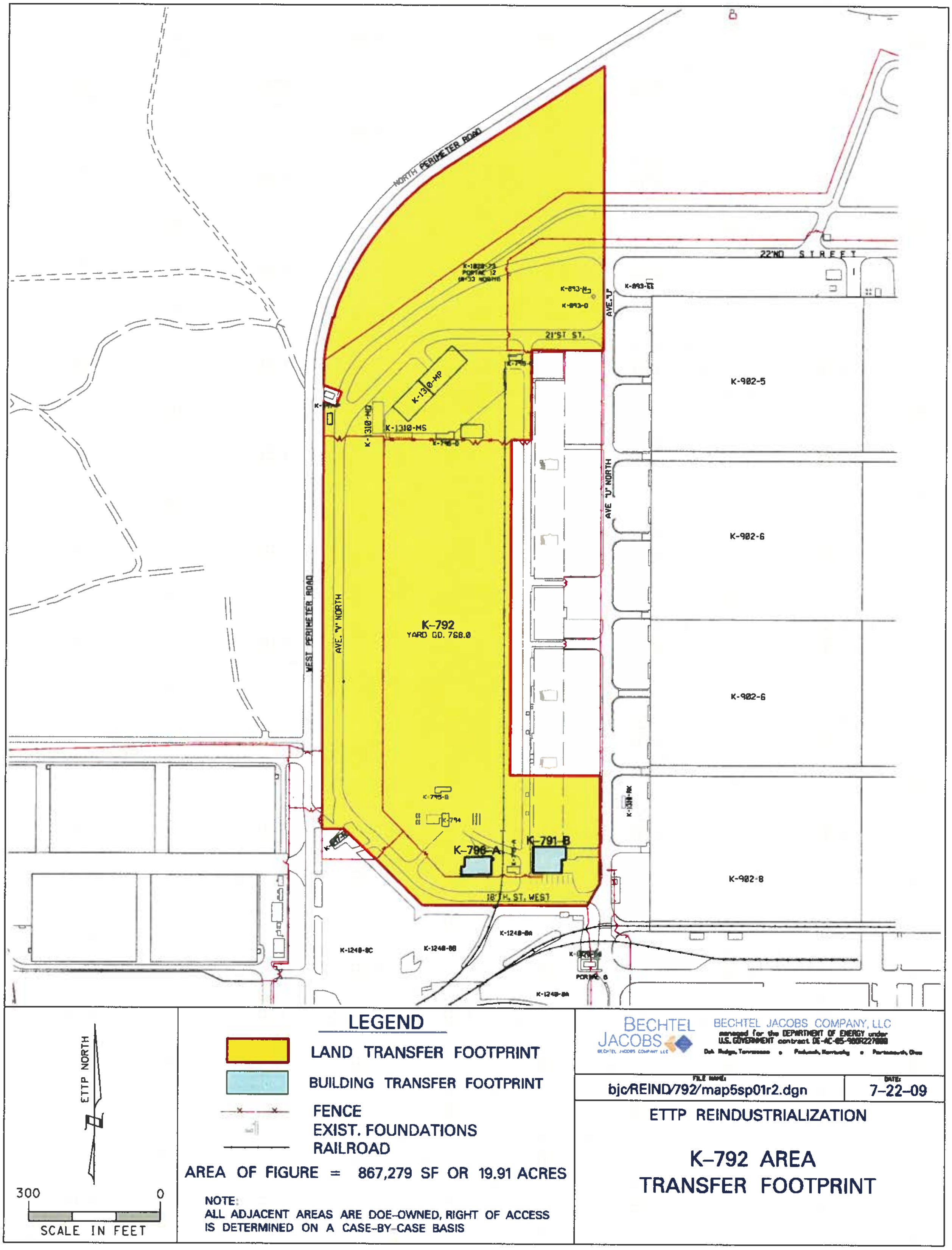

Fig. 1.2. Transfer footprint for the K-792 Switchyard Complex.

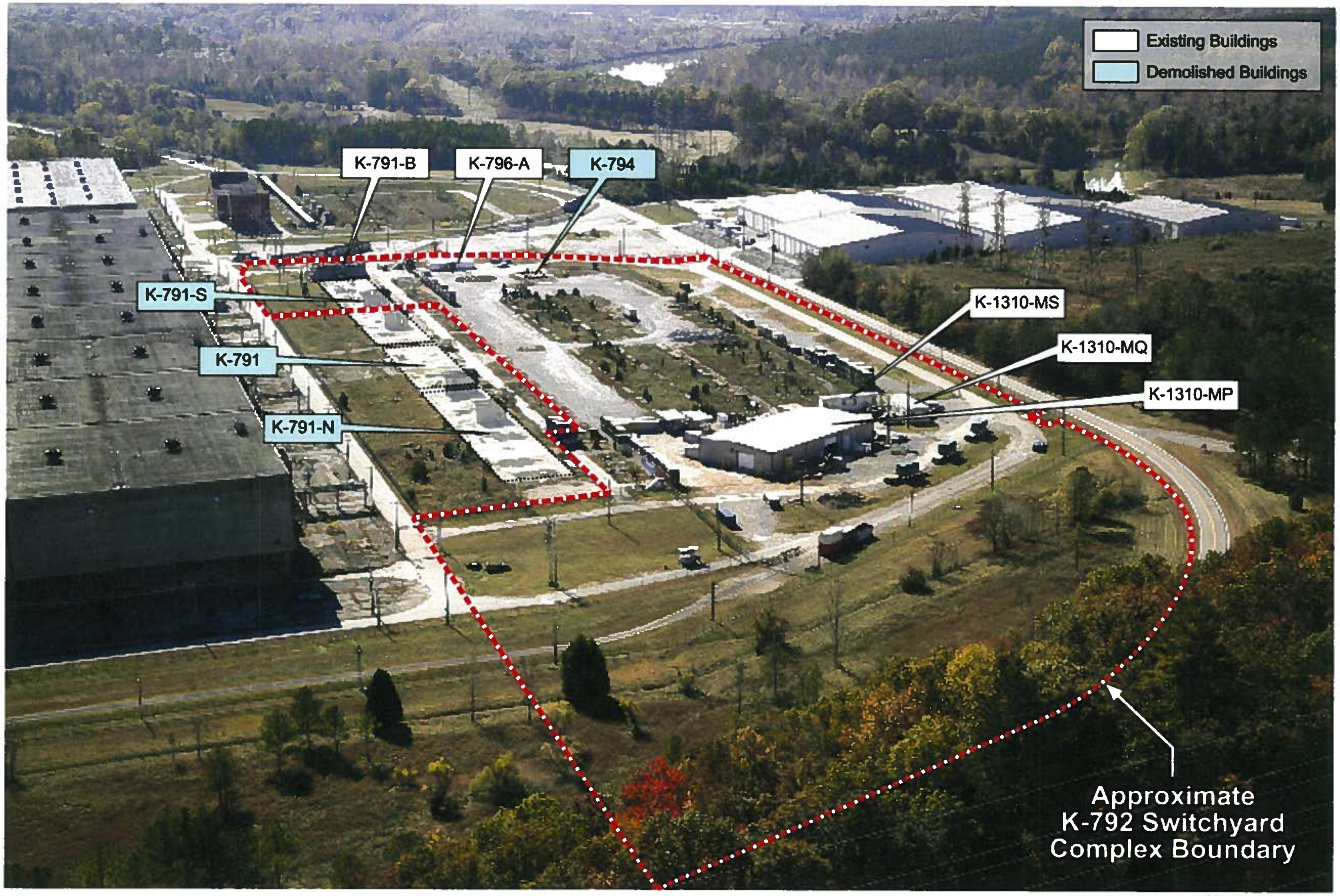

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Fig. 1.3. Aerial photo of existing and former structures located within the K-792 Switchyard Complex, circa 2009.

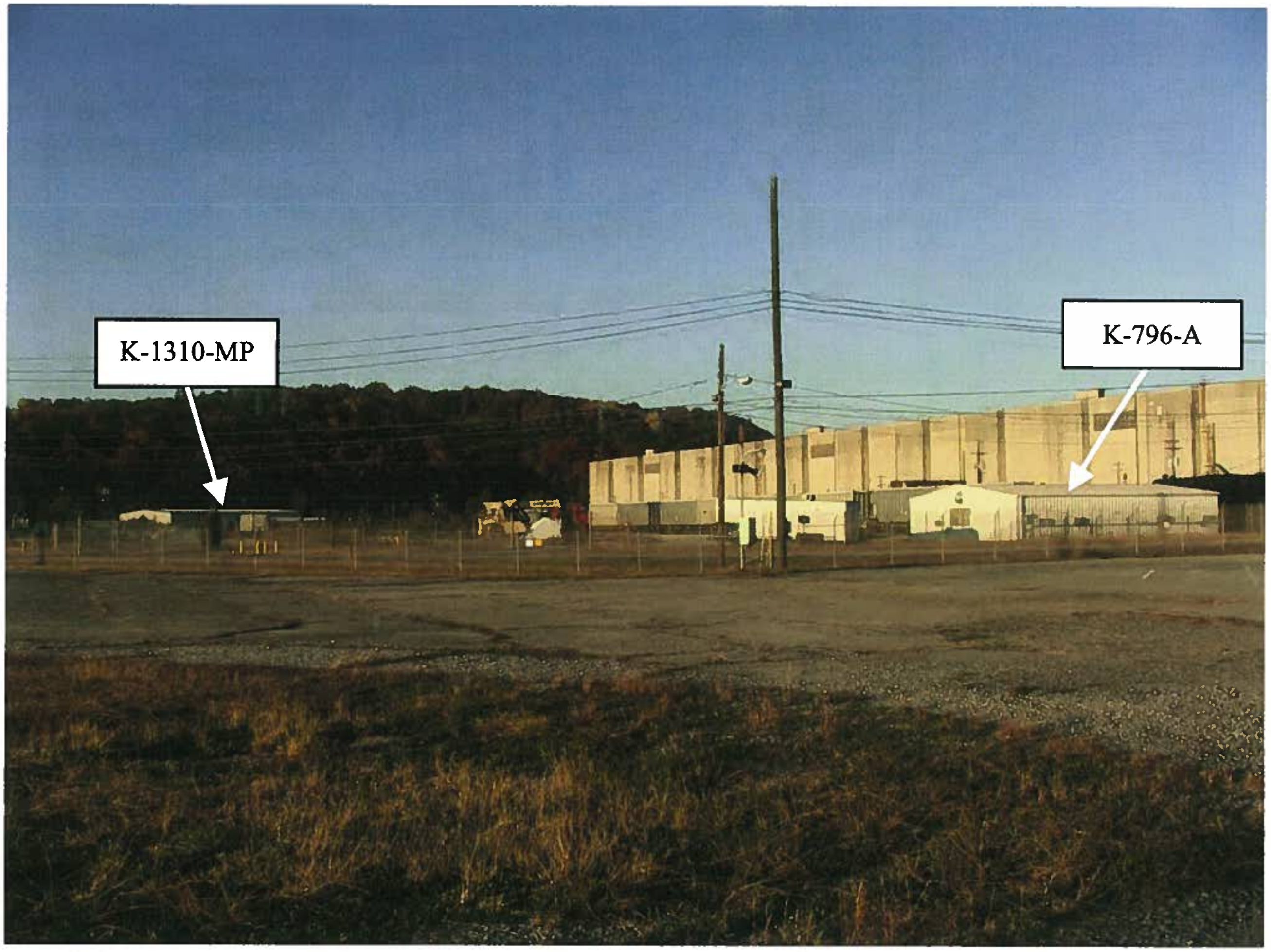

Fig. 1.4. K-792 Switchyard Complex, looking north, circa 2008.

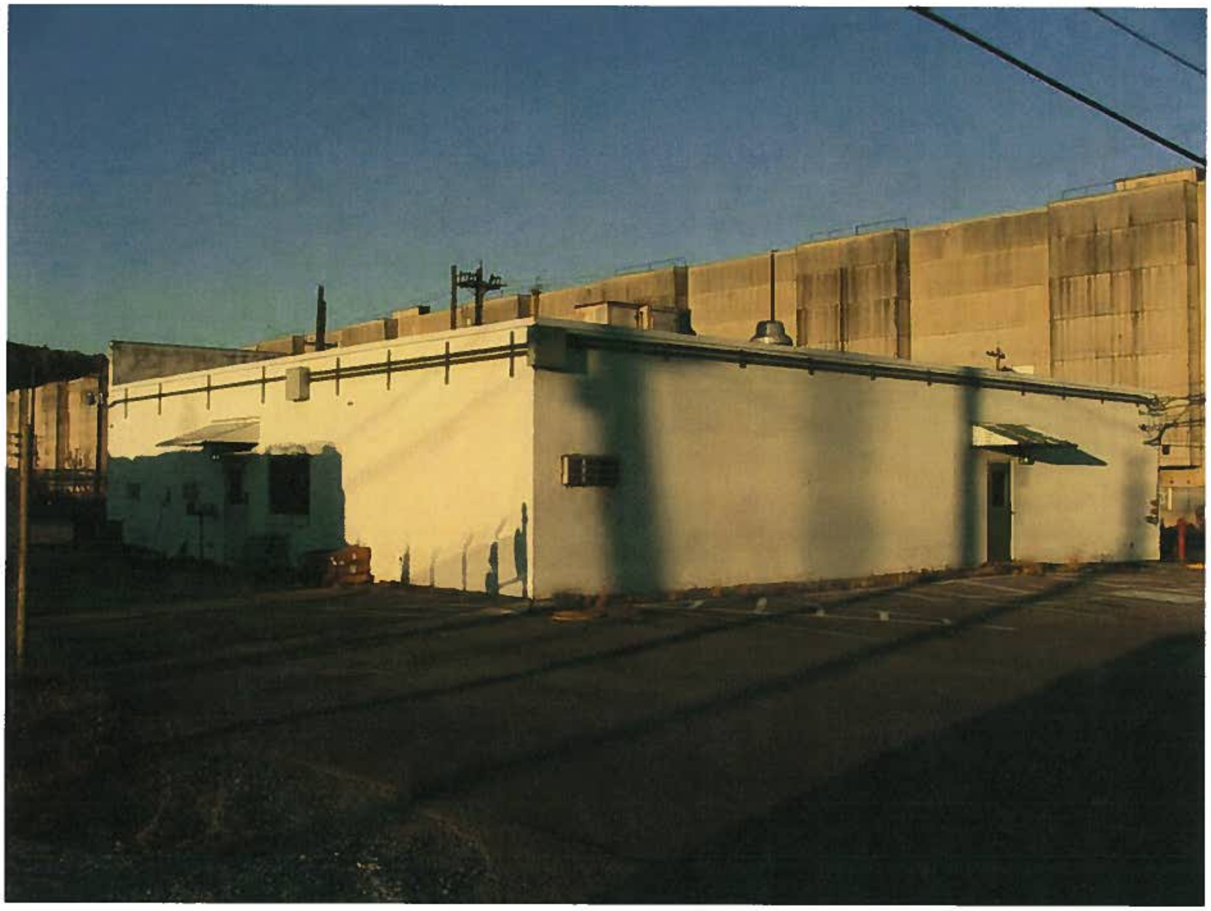

Fig. 1.5. Building K-791-B, circa 2008.

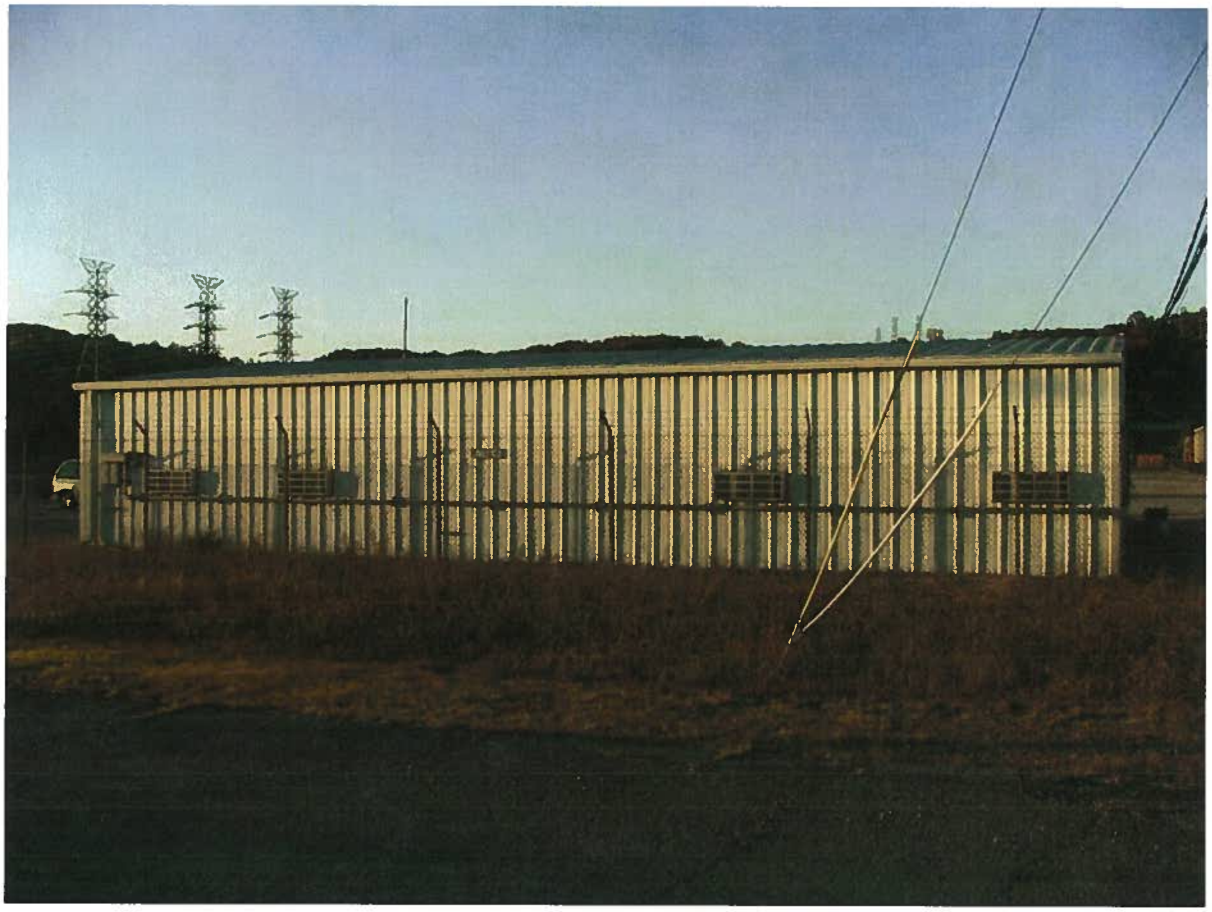

Fig. 1.6. Building K-796-A, circa 2008.

Fig. 1.7. K-792 Northern Expansion area, looking northeast, circa 2008.

2. TITLE SEARCH

On June 4, 1996, a visit was made to the state of Tennessee Roane County Recorder's Office to conduct a review of the recorded deeds documenting previous ownership of the land tract K-1007, where the K-792 Switchyard Complex is located. The deeds contained no information or references to other recorded evidence that, prior to U. S. Department of Energy (DOE) or predecessor agency ownership, the property was utilized for the storage of hazardous substances and/or petroleum products or their derivatives. Additionally, no information contained in the deeds would indicate that hazardous substances and/or petroleum products or their derivatives were released from or disposed of on the property. Prior to acquisition by the government, the area was farmland and was a combination of cultivated fields, pastures, and forested areas.

The deeds that conveyed the property from the previous owner to the U. S. Government, and any deeds that conveyed the property to that previous owner, were reviewed as a part of the title search. Generally, the deeds from the previous two owners of a particular ORR parcel provide information that goes back to the early 1900s or even earlier. The deeds were reviewed for any references to previous land uses (e.g., homestead, farm, school, business, etc.). Also reviewed were any easements or conveyances referenced in the deeds that might indicate that portions of the land were used for pipelines, power lines, etc. Partial disposal or acquisition conveyance deeds were also reviewed because, in some instances, the land comprising a large farm had been acquired via several separate acquisitions.

In addition, property assessment records from the County Property Assessor's Office were reviewed because these documents may also contain evidence of a particular land use. Survey or subdivision maps referenced in deeds and maintained in the Register of Deeds office were also reviewed for any indications of a previous land use. Furthermore, because the Tennessee Valley Authority (TVA) was the previous owner of several large tracts of ORR land, the TVA Real Estate Office was contacted regarding their knowledge of any previous land uses. The U. S. Army Corp of Engineers (COE) was another source of information that was contacted.[2]

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[2] Energy Systems 1996. *Real Estate Section of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Sect. 120(h) Review*, authored by W. W. Teer, Jr., Real Estate Manager, Lockheed Martin Energy Systems, Inc., Oak Ridge, TN, August 9, 1996.

3. FEDERAL RECORDS SEARCH AND REGULATORY SUMMARY

3.1 FEDERAL RECORDS SEARCH

The TVA in Knoxville, Tennessee, and the COE District Office in Nashville, Tennessee, were contacted in 1996, 1997, and again in 1998, to determine if they maintained any records reflecting past or present land use relative to the land presently comprising ETTP (TVA 1998; COE 1998). Neither TVA nor COE had any information regarding the history of past or present land use that would indicate if hazardous substances or petroleum products or their derivatives were stored or released on the DOE-owned property currently comprising the ETTP.

In February 1997, DOE real estate records that document previous ownership of land tract K-1007, where the K-792 Switchyard Complex is located, were examined. Page A-3 of Appendix A is a statement from the Realty Officer of the DOE Oak Ridge Office (ORO) that the real estate records contained no information or references to other recorded evidence that, prior to DOE ownership, the property was utilized for the storage of hazardous substances. Additionally, no information contained in these records would indicate that hazardous substances were released from or disposed of on the property.

The following pre-construction aerial photographs and maps reflecting prior use of this land were also reviewed. Copies of these photographs and maps are maintained on file in the DOE-ORO Real Estate Office.

Aerial Photographs:

Photograph Nos. and Date	Flight By	Source
No. 130-3-9, dated 1939	Unknown	DOE-ORO, Real Estate Office
Nos. 820-2-20 through -23 and 820-3-20 through -24, dated September 25, 1942	Aero Service Corp. for Stone and Webster	DOE-ORO, Real Estate Office

These photographs, which were taken in 1939 and 1942, show that the land where the study area is located was predominantly used for agricultural purposes. The remaining land was wooded.

Topographic and real estate maps:

1. A November 2, 1942, topographic map identified as Section A-1 of ORR was prepared by Aero Services Corporation for Stone and Webster.

2. A February 19, 1945, real estate map (sheet 9 of 16) prepared by the U. S. Army shows the boundaries of all land tracts upon which facilities at the site are currently located.

Neither the aforementioned photographs nor maps contained any information regarding the history of the past land use that would indicate that storage or releases of hazardous substances or petroleum products or their derivatives have occurred on the land where Land Tract K-1007 is located. Copies of the 1942 topographic map and real estate map are maintained in the DOE-ORO Real Estate Office.[3]

3.2 REGULATORY SUMMARY

As mentioned previously, this EBS relies upon regulatory-approved documentation in two PCCRs (listed below) for the foundational information to support transfer. Approval letters from the U. S. Environmental Protection Agency (EPA) and Tennessee Department of Environment and Conservation (TDEC) for the PCCRs are presented in Appendix B. The PCCRs were prepared as part of the Environmental Management's (EM) Dynamic Verification Process (DVS). This process is in use for remedial action (RA) decision-making across the ETTP, and decisions are based on hierarchical land unit divisions of Zones, then Geographic Areas, then Groups, then Exposure Units (EUs).

Of the approximately 19.91 acres of land in the K-792 Switchyard Complex, approximately 3 acres are included in portions of EU Z2-01, and the balance of the acreage, approximately 17 acres, is included in EU Z2-02. Both EUs are located in Zone 2. The component EUs and the extent of the K-792 Switchyard Complex within the EUs are shown on Fig. 3.1.

The PCCRs listed below and back-up documentation to the PCCRs have already evaluated the environmental data for the transfer footprint, evaluated the potential risk to receptors, documented the RAs completed within the boundaries of the parcel, and concluded that no further RAs are needed within the component EUs within the parcel:

- *FY 2006 PCCR for the Zone 2 Soils, Slabs, and Subsurface Structures at ETTP, Oak Ridge, Tennessee* (DOE/OR/01-2317&D2), December 2006 (DOE 2006), which covers EU Z2-02, and

- *FY 2007 PCCR for the Zone 2 Soils, Slabs, and Subsurface Structures at ETTP, Oak Ridge, Tennessee* (DOE/OR/01-2723&D2), September 2007 (DOE 2007a), which covers EU Z2-01.

3.2.1 The EM DVS Protocol and the K-792 Switchyard Complex

Regulatory information for Zone 2, as it relates to the K-792 Switchyard Complex, is discussed below along with a summary of the EM DVS approach. Technical information for each of the component EUs is presented in Chap. 6.

The ETTP is divided into Zones 1 and 2 and further subdivided into geographic areas. The boundaries of geographic areas are based on natural boundaries of major water bodies, topographic divides, surface water drainages, and/or property boundaries. The geographic areas are subdivided into groups and then into EUs. EUs are the smallest land areas used for assessing risks to an exposed individual.

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[3] Energy Systems 1996. *Real Estate Section of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Sect. 120(h) Review*, authored by W. W. Teer, Jr., Real Estate Manager, Lockheed Martin Energy Systems, Inc., Oak Ridge, TN, August 9, 1996.

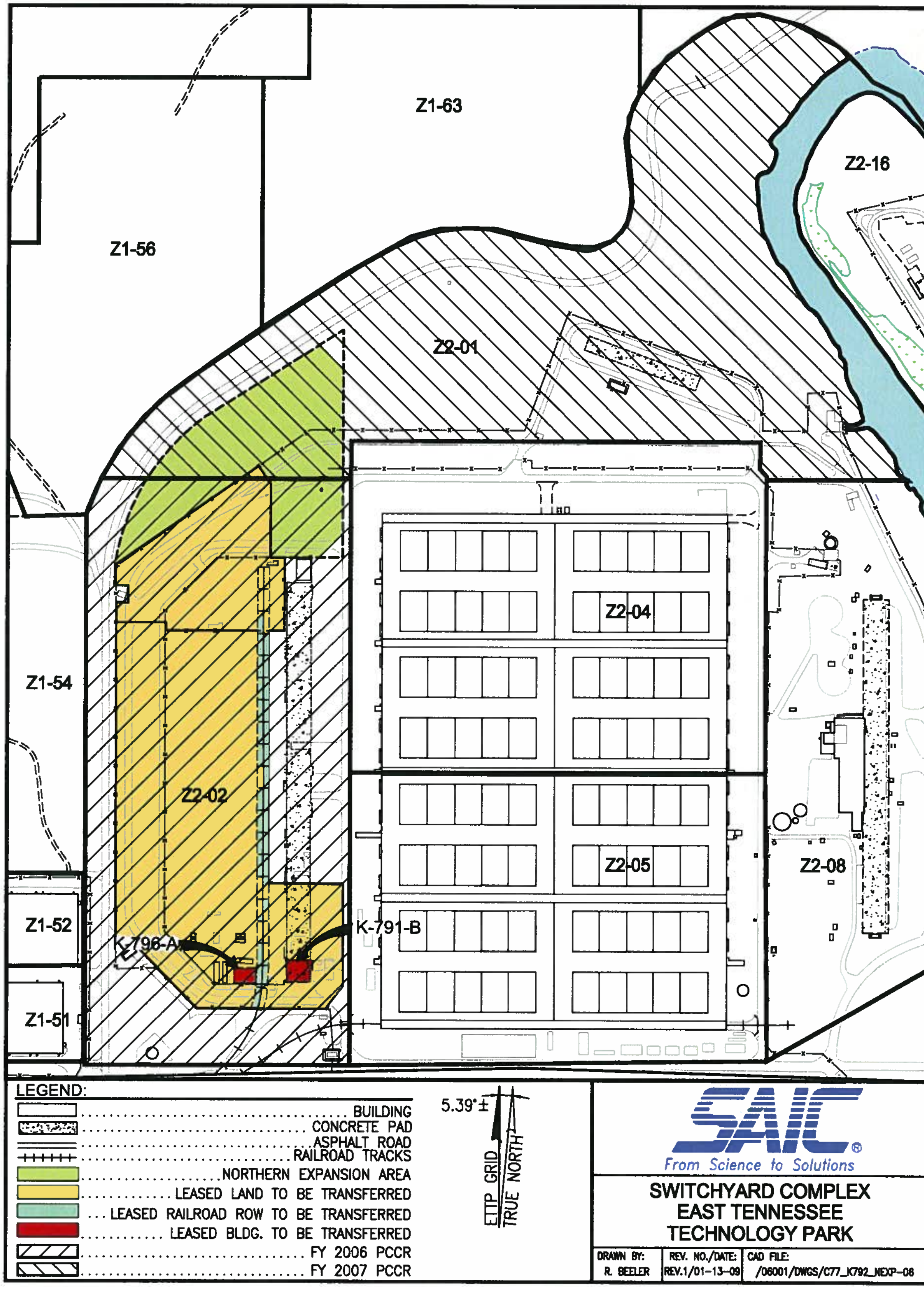

Fig. 3.1. Exposure unit coverage of the K-792 Switchyard Complex.

The EM DVS process was designed to facilitate real-time decision-making in the evaluation of the individual EUs and includes five steps:

1. preparation of Data Quality Objective scoping packages,
2. classification of soil units using a graded approach,
3. determination of additional sampling or surveying needs,
4. determination of the need for RA using decision rules, and
5. use of confirmation sampling to determine if RA is complete.

The decision rules mentioned in Step 4 were based on one or more of the following criteria:

- exceedance of a maximum remediation level (RL) at any location,
- exceedance of an average RL across the EU,
- unacceptable future threat to groundwater, or
- unacceptable cumulative excess lifetime cancer risk (ELCR) of $> 1 \times 10^{-4}$ and hazard index (HI) > 1 across the EU.

Decision rule 4, a threat to groundwater by Zone 2 soils, is evaluated by reviewing historical groundwater data and, if necessary, screening soil data against established screening levels. Based on the screening, site-specific modeling may be conducted. Consideration of an action on groundwater is required if any of these steps indicate a site may be a potential source of contamination to groundwater. A Sitewide Record of Decision (ROD) will evaluate all threats to groundwater.

3.2.2 Actions Taken Within the K-792 Switchyard Complex Exposure Units

The K-792 Switchyard Complex occupies portions of two EUs: EU Z2-01 and Z2-02 (see Fig. 3.1). For the purposes of risk evaluation, the entire EU is considered because there are no barriers or impediments preventing access to the balance of the EUs that are not in the K-792 Switchyard Complex.

Located within the two EUs are sites designated as requiring special attention because they were listed in the Federal Facilities Agreement (FFA) as having the potential for contamination. These FFA sites have been the focus of several RAs across the ETTP. The discussion below addresses the regulatory status of each of the EUs located partially within the K-792 Switchyard Complex and summarizes any action taken at associated FFA sites. Table 3.1 summarizes the components of the K-792 Switchyard Complex, the FFA sites addressed in each EU, and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) decision for each EU.

Table 3.1. K-792 Switchyard Complex components[a] and summary of CERCLA decisions

Zone	Geographic area	Group	PCCR	EU (acreage)[b]	Associated FFA sites	Decision
Zone 2	K-31/33 Area	K-31/33	FY 2007 PCCR for Zone 2 Soils, Slabs, and Subsurface Structures at ETTP	Z2-01 (28.3 acres)	K-892-J Cooling Tower	Sampling and analysis of EU resulted in NFA concurrence from EPA Region 4.
			FY 2006 PCCR for Zone 2 Soils, Slabs, and Subsurface Structures at ETTP	Z2-02 (29.7 acres)	K-792 Switchyard soils K-897-N Oil Containment Structure K-897-P Oil Containment Structure K-1206-E Sandblasting Residue	Sampling and analysis of EU resulted in NFA concurrence from EPA Region 4.

[a] Component names and acreages as provided in the PCCRs listed in Sect. 3.2.
[b] Acreages given are total for the EU.
CERCLA = Comprehensive Environmental Response, Compensation and Liability Act of 1980.
EPA = U. S. Environmental Protection Agency.
ETTP = East Tennessee Technology Park.
EU = exposure unit.
FFA = Federal Facility Agreement.
FY = fiscal year.
NFA = No Further Action.
PCCR = Phased Construction Completion Report.

The Zone 2 components of the K-792 Switchyard Complex are contiguous and are part of the K-31/33 Group. No RAs were conducted at any of the five FFA sites located within the K-792 Switchyard Complex, and EPA concurrence has been received for No Further Action (NFA) decisions for both of the EUs within the K-792 Switchyard Complex.

4. PAST AND PRESENT ACTIVITIES

4.1 PAST AND PRESENT ACTIVITIES FOR THE REAL PROPERTY PROPOSED FOR TRANSFER

Prior to the acquisition of the land by the government in the 1940s, the entire area now known as ETTP was farmland or forested land. Over 800 acres of land were leveled and prepared in support of the Manhattan Project (to supply enriched uranium for nuclear weapons production). The K-792 Switchyard was constructed in 1954 to support the operation of the K-33 uranium enrichment cascade facility and is approximately 1000 ft by 300 ft in size. The switchyard operated from 1954 until 1985, when the enrichment activities ceased and the switchyard was de-energized and shut down.

The K-792 Northern Expansion Area is currently vacant, grass-covered land that is sparsely populated with trees. Located partially outside of the perimeter main plant fence, the expansion area has remained undeveloped throughout the history of operations at ETTP. The area is mowed on a routine basis during the growing season. Following are discussions of the components of the switchyard complex and the EUs where the switchyard is located.

Former K-792 Switchyard

The former K-792 Switchyard Complex is located in the northwest section of ETTP just west of the K-33 Building. Figure 4.1 shows the former facilities located within the K-792 transfer footprint. The specific function of the switchyard was to decrease the incoming voltage from a TVA transmission level of 161 kV to a distribution level of 13.8 kV. To accomplish this function, the switchyard contained several large pieces of electrical equipment. During construction of the switchyard, a series of French drains were installed immediately under the switchyard's gravel bed to facilitate drainage. The French drains connected to oil/water separators (O/WSs) located on the southwest, northwest, and northeast corners of the switchyard (outside of the transfer footprint). Grounding cables were also installed below grade. In addition, four underground firewater deluge system valve vaults were installed in the switchyard during initial construction. The valve vaults mentioned above (K-795-A, K-795-B, K-795-C, and K-795-D) are located within the transfer footprint and are shown on Fig. 1.2. Each vault is comprised of a reinforced-concrete, underground pit structure with a monolithic beam and slab roof at grade. A concrete-walled access structure extends above grade level from each vault. There is also a small hatch in the roof of each vault. Trenches in the floor slabs contained piping, and sump pumps removed any water that infiltrated the vaults. Each vault contained a main firewater header pump with valves, and 8 to 10 branch valves. Signaling devices were installed to indicate valve positions remotely. The piping has been disconnected and the valves removed. These vaults are flooded with water since the sump pumps have been disconnected.

The major electrical equipment in the former K-792 Switchyard consisted of 16 power transformers, 16 current transformers, 12 potential transformers, 16 grounding transformers, 39 oil circuit breakers, and 2 line reactors. When the former K-792 Switchyard became operational in 1954, all electrical equipment contained mineral oil that was classified as "polychlorinated biphenyl (PCB)-free" at that time. (Prior to the 1970s, oil could contain low concentrations of PCBs and be classified as PCB-free; this was the case in K-792.) Some "PCB-free" transformers were cross-contaminated as a result of mixing PCB-contaminated mineral oil with clean mineral oil in a holding tank during routine maintenance. Subsequent refilling of transformers with mineral oil from the contaminated tank resulted in the spread of PCB contamination in the oils.

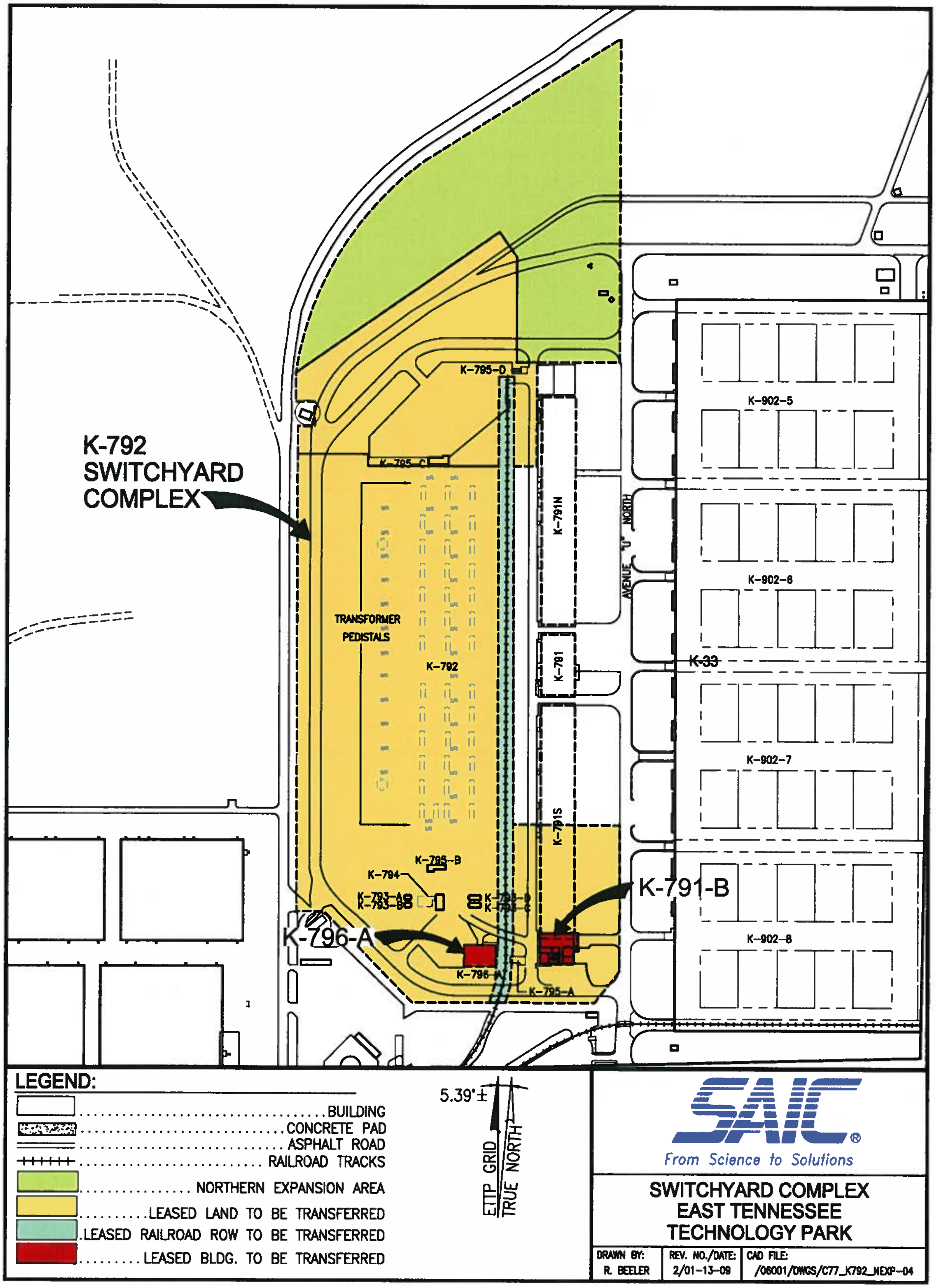

Fig. 4.1. Former facilities located within the transfer footprint for the K-792 Switchyard Complex.

Possible releases from the various ETTP power operations switchyards are mentioned in a report prepared to document the potential environmental, health, and safety concerns at ETTP (Mitchell 1983); however, this report contains no reference to specific releases from the K-792 Switchyard.

In the late 1980s, a PCB Abatement Program was initiated to reduce the concentration of PCBs in electrical equipment. The oil was drained from the equipment and the equipment retrofilled and operated for 90 days. The equipment oil was then resampled and labeled accordingly. If the concentration of PCBs in the equipment was between 50 and 500 parts per million (ppm), it was posted as PCB contaminated, and if above 500 ppm, it was posted as PCB equipment. In 1992, the PCB inventory indicated the highest concentrations of PCBs in the former K-792 Switchyard were in two grounding reactors with 1190 and 1360 ppm. The only record of PCB releases in the K-792 Switchyard was small leaks from valves and gaskets (Energy Systems 1988). Based on information available, there is no indication that there were spills or releases that exceeded the reportable quantity.

A preliminary assessment conducted at the former K-792 Switchyard in March 1997 (ATI 1997) indicated that PCB signs had been posted on the gates into the switchyard and that all PCB oil-filled equipment had been drained with the exception of one pole-mounted PCB transformer stored "in the back of the yard." The preliminary assessment stated that other surplus electrical equipment was stored in the yard and that radiologically contaminated material was stored in the yard in B-25 boxes. The assessment did not include maps so the exact location of the storage site is not known. The preliminary assessment also stated that oil stains had been found on soil outside the K-794 Oil Pump/Oil Storage Building. The K-794 building has since been demolished. Its former location is just to the south of the K-795-B valve vault. This former facility and all associated oil-stained soils have been evaluated by the Environmental Management (EM) Program (DOE 2006). Based on information available, there is no indication that there were spills or releases that exceeded the reportable quantity or storage of any chemicals exceeding 1000 kg for one year or more.

Two former oil storage tanks (K-793-C and K-793-D) were located to the southeast of the K-795-B Valve Vault and north of Bldg. K-796-A. It is unknown when these tanks were removed.

The transfer space includes the northern portion of a railroad spur that lies on the east edge of the transfer footprint. The spur terminates near the previously mentioned K-795-C valve vault (see Fig. 1.2.).

The northern portion of the switchyard did not contain any of the operational equipment. Rather, this portion of the switchyard was used sporadically as a lay-down area for equipment that was not energized. A Preliminary Hazard Screening Document for K-792, prepared in 1991 (MMES 1991b), reported that, "Some spare equipment is stored in the north end of the yard, e.g., small transformers, insulators, switches." As of 1999, transformers and other electrical equipment were continuing to be stored in the transfer footprint. They were removed by early 2000.

During 2006, the EM Program conducted multi-media sampling within the proposed transfer footprint per the *Remedial Action Work Plan for the Zone 2 Dynamic Verification Strategy (DVS)* [DOE 2005a]. Radiological surveys were also conducted. Details of the sampling results are found in Chap. 6.

The entire former K-792 Switchyard is listed as a Solid Waste Management Unit (SWMU) under the Resource Conservation and Recovery Act of 1976 (RCRA) and is also listed in the FFA for the ORR (DOE 1992). This agreement was entered into by DOE, the state of Tennessee, and EPA-Region 4 under the authority of CERCLA.

In December 2006, a portion of the northern part of the K-792 property was leased to Heritage Center, LLC (Heritage Center), a subsidiary corporation of the Community Reuse Organization of East Tennessee (CROET), and was subleased to Impact Services, Inc. (IMPACT) for the construction of a commercial waste management operation on this portion of the former K-792 Switchyard. Building K-1310-MP was constructed by IMPACT for use as storage and office space in support of their waste management operations. Trailers K-1310-MQ and K-1310-MS are also owned by IMPACT and used for storage and office space. IMPACT has a radiological license from TDEC [State Radioactive Material License #R-73024-E07, authorizing processing of radioactive materials] and will operate within its parameters. In November 2006, a *Baseline Environmental Analysis Report for the Northern Portion of the K-792 Switchyard* (BJC/OR-2615) [BJC 2006a] was prepared to support this lease activity. In May 2007, a *Baseline Environmental Analysis Report for the Southern Portion of the K-792 Switchyard and Buildings K-791-B and K-796-A* (BJC/OR-2754) [BJC 2007] was prepared to support an additional lease of the southern portion of the switchyard and referenced buildings to the Heritage Center. In April 2008, the southern portion of the K-792 Switchyard and Bldgs. K-796-A and K-791-B were leased by DOE to CROET. In April 2009, a *Baseline Environmental Analysis Report for the K-792 Northern Expansion Area at the East Tennessee Technology Park, Oak Ridge, Tennessee* (BJC/OR-3090) was prepared to support another additional lease to Heritage Center.

Building K-791-B

The K-791-B building is a single-story, block-construction building built upon a slab foundation in 1978. The location of the K-791-B building is depicted in Fig. 1.2, and a floor plan is shown on Fig. 4.2. The building was originally connected to Bldg. K-791-S, which was located immediately north of K-791-B. These buildings were connected by a double door that was weather sealed after K-791-S was demolished.

Carpeting installed in the bay area (Room 104) and in an adjoining office (Room 102) was removed to enable radiological surveys to occur. The southern half of the building contains offices, a breakroom, and restrooms. Room 103 has a raised floor that has been partially removed to enable radiological surveys and soil vapor sampling to occur. Portions of the floors within the southern half of Bldg. K-791-B have non-asbestos-containing material (ACM) vinyl tile (SAIC 2006). Tiled areas include the breakroom, entrance hallway, restrooms, janitorial closet, and two office areas. The restrooms and the janitor's closets have either ceramic or non-ACM vinyl tile floor covering installed over the concrete slab. The restrooms and the computer room were originally part of the change house that served operations in Bldg. K-791-B and the former K-792 Switchyard.

Operations within the 4,020-ft^2 K-791-B building included maintenance of electrical components from switchyards across the ORR, including the Y-12 National Security Complex (Y-12 Complex) and the Oak Ridge National Laboratory. The machine shop historically located within Bldg. K-791-B consisted of a lathe, band saw, drill press, grinders, sanders, and a milling machine (MMES 1991). Information, however, is not available on the origin of the electrical components prior to transfer to the K-791-B building or their contamination status. Additionally, no information is available as to whether or not the lathe, band saw, and/or other shop machines were used on radiologically contaminated parts. The machine shop area also contains the remains of an overhead crane that runs the east–west length of the shop. The machine shop operations were moved to the Elza K-741-B facility at the Y-12 Complex in 1999. Building K-791-B was then converted to an office area for personnel involved with the ETTP Three-Building Decontamination and Decommissioning and Recycle Project. As mentioned above, this building has been leased by DOE to CROET for use as storage and/or office space.

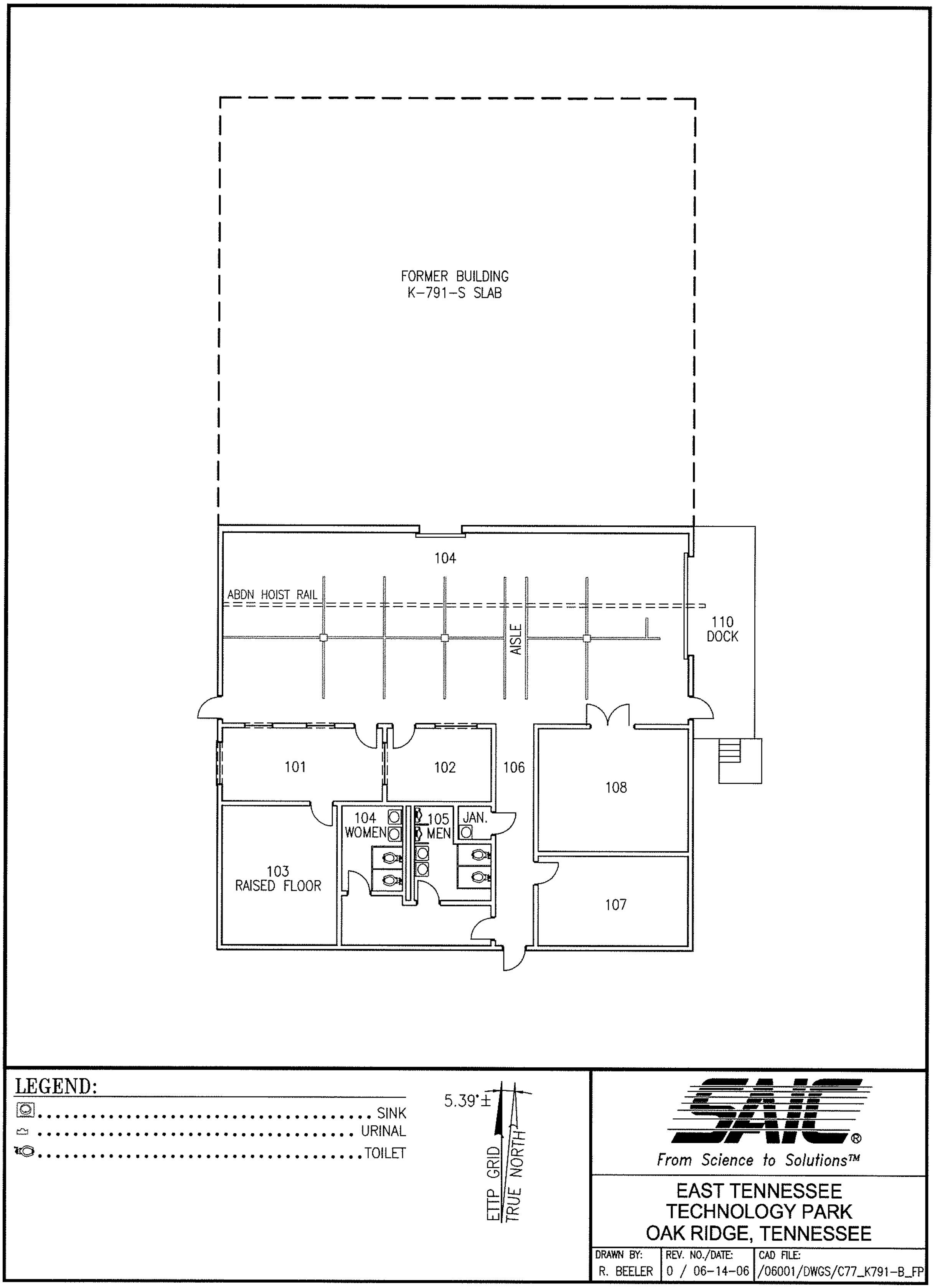

Fig. 4.2. Building K-791-B floor plan.

Building K-796-A

The K-796-A building is a single-story, pre-engineered, steel-framed, corrugated-metal-skin building. The 2780-ft^2 building measures approximately 60 ft by 40 ft and was constructed in 1978. A review of historic site maps and aerial photos of the immediate vicinity of Bldg. K-796-A did not find any evidence of facilities in the area prior to construction of Bldg. K-796-A. From its construction until 1998, Bldg. K-796-A was historically used for storage of electrical maintenance supplies and tools that were used to support power transmission and switchyard operations at the three plants on the ORR. During this time, various items of electrical equipment (such as small transformers, oil-filled circuit breakers, and oil-filled transformer bushings) were temporarily stored at Bldg. K-796-A. During active operations of the K-31 and K-33 process buildings, Bldg. K-796-A was also used to conduct overflow maintenance from Bldg. K-791-B located east of K-796-A and also was used for electrical equipment maintenance. This overflow maintenance had the potential to include equipment that contained PCB dielectric fluids. The K-796-A facility was also used for fabrication of conduit runs. Equipment used in those activities included conduit benders, pipe-threading equipment, and band saws. The floor plan for the building is provided in Fig. 4.3.

Between 2000 and 2005, Bldg. K-796-A was used by the DOE contractor performing decontamination activities in the K-29, K-31, and K-33 process buildings. They used K-796-A for conference space. The interior walls indicated in Fig. 4.3 were constructed during the period from 2000 to 2005.

As mentioned previously, Bldg. K-796-A has been leased by DOE to CROET for storage and/or office space uses.

Zone 2 EU Z2-01

EU Z2-01 consists of an area of approximately 32.6 acres and occupies the northern extent of Zone 2 that merges directly with the forested Zone 1 EUs. The northeastern portion of this EU is forested (with forest making up approximately 10% of the EU). The southern portion of the EU, which is cleared and industrialized, contains infrastructure for support of the K-33 Building. This EU is generally flat in the southern portion but has a relatively steep grade in the northern portion, which is located on the southern flank of Blackoak Ridge. The EU drains to Poplar Creek on the east and to the K-901-A Holding Pond on the southwest. The K-892-J Cooling Tower Basin is the only FFA site included in this EU.

Zone 2 EU Z2-02

EU Z2-02 is located in the K-31/K-33 Area EU Group and has an area of approximately 28.3 acres. The EU is bounded on the north by EU Z2-01, on the south by EU Z2-03, on the east by the K-33 Building (EU Z2-04 and EU Z2-05), and on the west by the Zone 1 K-901 North Area. All land area in EU Z2-02 has been affected by site operations. These include construction of buildings, roads, and parking lots. The EU is generally flat-lying ground having very low relief and drains to Poplar Creek. EU Z2-02 includes four Zone 2 ROD Appendix A FFA sites:

- K-792 Switchyard soils,
- K-897-N Oil Containment Structure,
- K-897-P Oil Containment Structure, and
- K-1206 Sandblasting Residue.

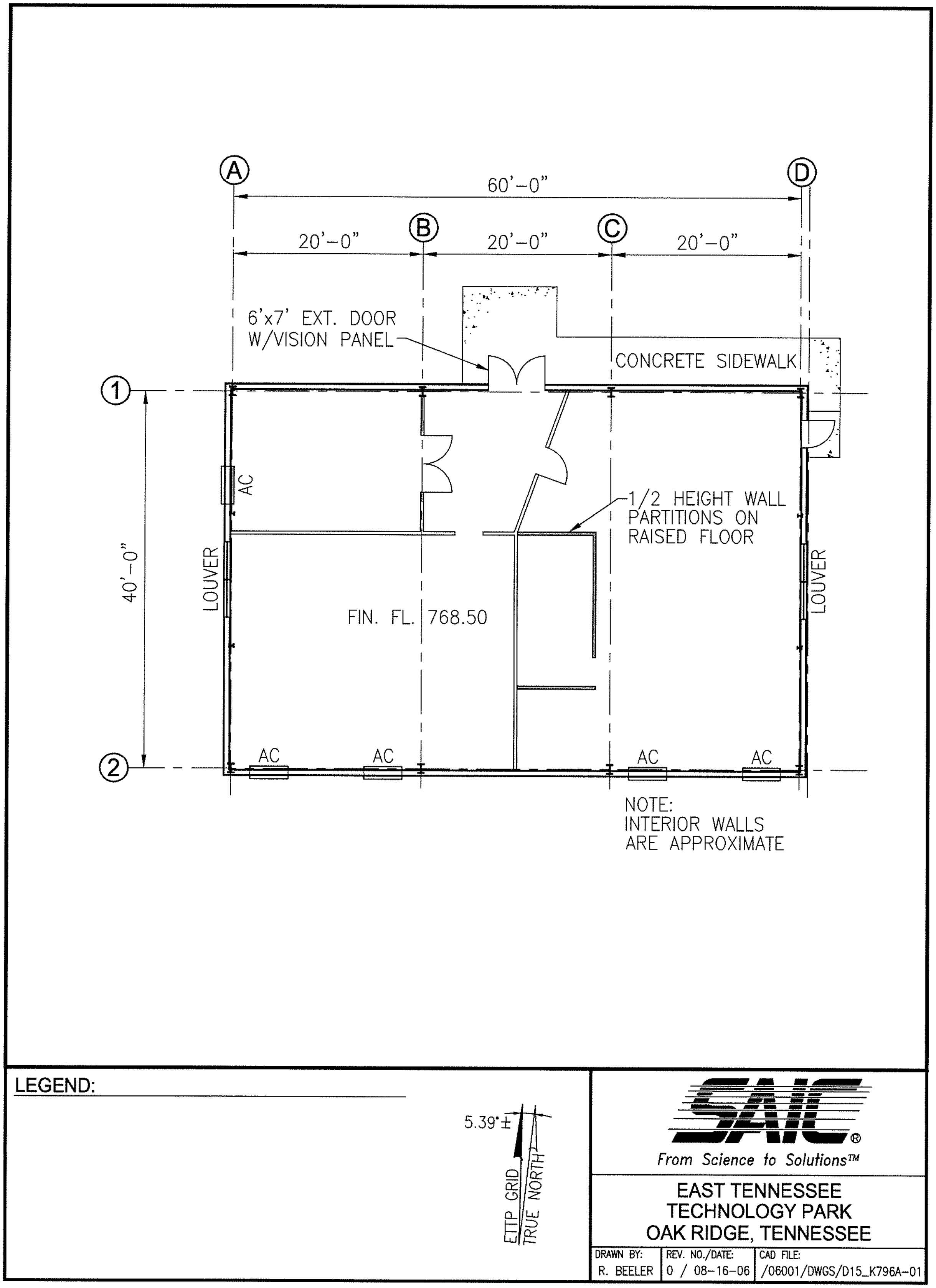

Fig. 4.3. Building K-796-A floor plan.

4.2 PAST AND PRESENT ACTIVITIES FOR THE ADJACENT PROPERTY

The study area is located in the northwestern portion of ETTP. The nearest non-DOE property is Highway 58/Oak Ridge Turnpike, which is located 0.75 miles south of the K-792 Switchyard Complex. There is no indication that activities from this non-DOE area would have contributed any contamination to the area to be transferred.

The K-792 Powerhouse Complex, a three-building complex, that consisted of the K-791-N Switch House, K-791 Control House, and the K-791-S Switch House, was originally designed to receive the power from the former K-792 Switchyard and distribute it to the K-33 process facility and K-892 Pump House. The footprints of these former buildings lie to the east of the former K-792 Switchyard, across the railroad spur, and are not part of the transfer footprint. In 1998, demolition of the switchyard and switch houses began as part of the ETTP Three-Building Decontamination and Decommissioning and Recycle Project. Since that time the K-791-N Switch House, K-791-Control House, and K-791-S Switch House have been demolished down to their concrete pads.

Several nearby facilities that are in close proximity to the K-792 Switchyard Complex have potential areas of contamination. These areas are listed as potential environmental restoration units in *Site Descriptions of the Environmental Restoration Units at the Oak Ridge K-25 Site, Oak Ridge, Tennessee*, K/ER-47/R1 (Energy Systems 1995). That report was prepared to "baseline" conditions (at the time of the evaluation), so that decisions could be made to establish cleanup priorities. Some of these areas are being addressed for possible remediation under the FFA (DOE 1992). The restoration units in the vicinity of the K-792 Switchyard Complex are:

- K-31 Process Building,
- K-33 Process Building,
- K-1065-A through -H Hazardous Waste Storage Units,
- K-1206-E Sandblasting Residue,
- K-897-N Oil Containment Structure, and
- K-897-P Oil Containment Structure.

The K-31 Building is located to the southeast of the study area and is a two-story structure with a total floor area of approximately 32 acres. It is of steel column and beam construction with reinforced concrete floors. The roof is a steel assembly. The walls are constructed of corrugated asbestos-cement (transite) siding. The north exterior wall on the Operations Floor is constructed of concrete masonry block.

The K-33 Process Building, of steel construction with cement-asbestos composite siding, is located to the east of the former K-792 Switchyard. Building K-33 was the largest of the cascades used for the enrichment of uranium isotopes, covering a 64-acre footprint. After the enrichment activities were shut down in 1985, portions of the building were used to store RCRA-regulated waste containers, and those portions of the building were listed as RCRA SWMUs. Currently, nickel scrap metal from the uranium enrichment processes is stored in Bldg. K-33.

Both K-31 and K-33 and associated equipment have historical radiological and chemical contamination from past operations and are being addressed under the ORR FFA under CERCLA authority. Between 1997 and 2005, a CERCLA removal action was undertaken by DOE to remove the process equipment and to decontaminate the facilities (DOE 1997). All process and non-process equipment and associated piping, ducting, and electrical services have been removed from the K-31 and K-33 Buildings. Wastes and materials previously stored in the buildings have been removed.

The K-1065 Hazardous Waste Storage Units, located southwest of the study area, consist of five separate buildings used for compliant storage of hazardous wastes prior to final disposition.

The K-1206 Sandblasting Residue is located in a grassy area immediately surrounding the former K-1206-E water tower. The water tower was demolished in 2006. The sandblasting residue is estimated to occupy approximately 5000 ft^2. The water tower was built in the early- to mid-1950s, and sandblasting to remove old paint occurred in the late 1970s or early 1980s, or possibly an earlier occasion.

The K-897-N and K-897-P Oil Containment Structures are located at the southwest and northwest corners of the former K-792 Switchyard, respectively. The purpose of these structures is to receive runoff from the switchyard.

4.3 HYDROGEOLOGIC ENVIRONMENT

This information is being presented to provide the basis for the evaluation of the potential for vapor intrusion into Bldgs. K-791-B and K-796-A.

The K-792 Switchyard Complex is located in the northwestern portion of the ETTP. This portion of the ETTP is underlain by bedrock of the upper Knox Group and the lower Chickamauga Supergroup formations (Fig. 4.4). The Knox Group in the vicinity of the K-792 study area consists of the Mascot Dolomite and the Kingsport Formation (Lemiszki 1994). Structurally, these formations dip to the southeast in the vicinity of the study area. The angle of dip ranges from 30 to 46 degrees to the southeast based on measurements obtained from bedrock exposures along the Clinch River (see Lemiszki 1994) west of K-792.

The bedrock formations underlying the K-792 Switchyard Complex consist primarily of interbedded limestone and dolomite of the Kingsport Formation and thick-bedded dolomite units of the Mascot Dolomite beneath the majority of the study area. Calcareous shales and argillaceous limestones of the Pond Spring Formation, which overlie the thick-bedded dolomite units of the Mascot Dolomite are present beneath the southeastern portion of the study area. Formations of both the Chickamauga Supergroup and the Knox Group are subject to karst development due to their high carbonate content. Significant karst development is associated with the Knox Group formations in the vicinity of the ETTP. The only documented, enterable caves in the vicinity of the ETTP are developed in the Knox Group (DOE 1996). Drilling in the K-1070-A Burial Ground located northwest of K-792 area encountered cavities ranging up to 22 ft in height; however, borehole surveys indicate that the geometry of these cavities is more indicative of vertical shaft development than an elongated passage. Although less prone to karst development than the Knox Group rocks, the Chickamauga formations are, nevertheless, also subject to the development of karst. Evidence of karst development in the Chickamauga also includes cavities encountered in drilling at ETTP. Approximately 30% of the monitoring wells completed in the Chickamauga at ETTP encountered cavities ranging in size from a few inches up to 7 ft. Pre-construction topographic maps indicate the occurrence of sinkholes in the vicinity of the K-792 study area. A closed depression that appears to be a large sinkhole existed beneath what is now the west side of the K-33 Building, and additional closed depressions existed less than 500 ft south and west of the study area. All of these sinkholes were filled during construction of the K-31/K-33 buildings circa 1950.

Hydrogeologic characterization data for K-792 are limited because currently only five groundwater monitoring wells (BRW-027, BRW-028, BRW-067, UNW-039, and UNW-040) exist in the vicinity of the study area (Fig. 4.4). Much of the hydrogeologic characterization data discussed below for the

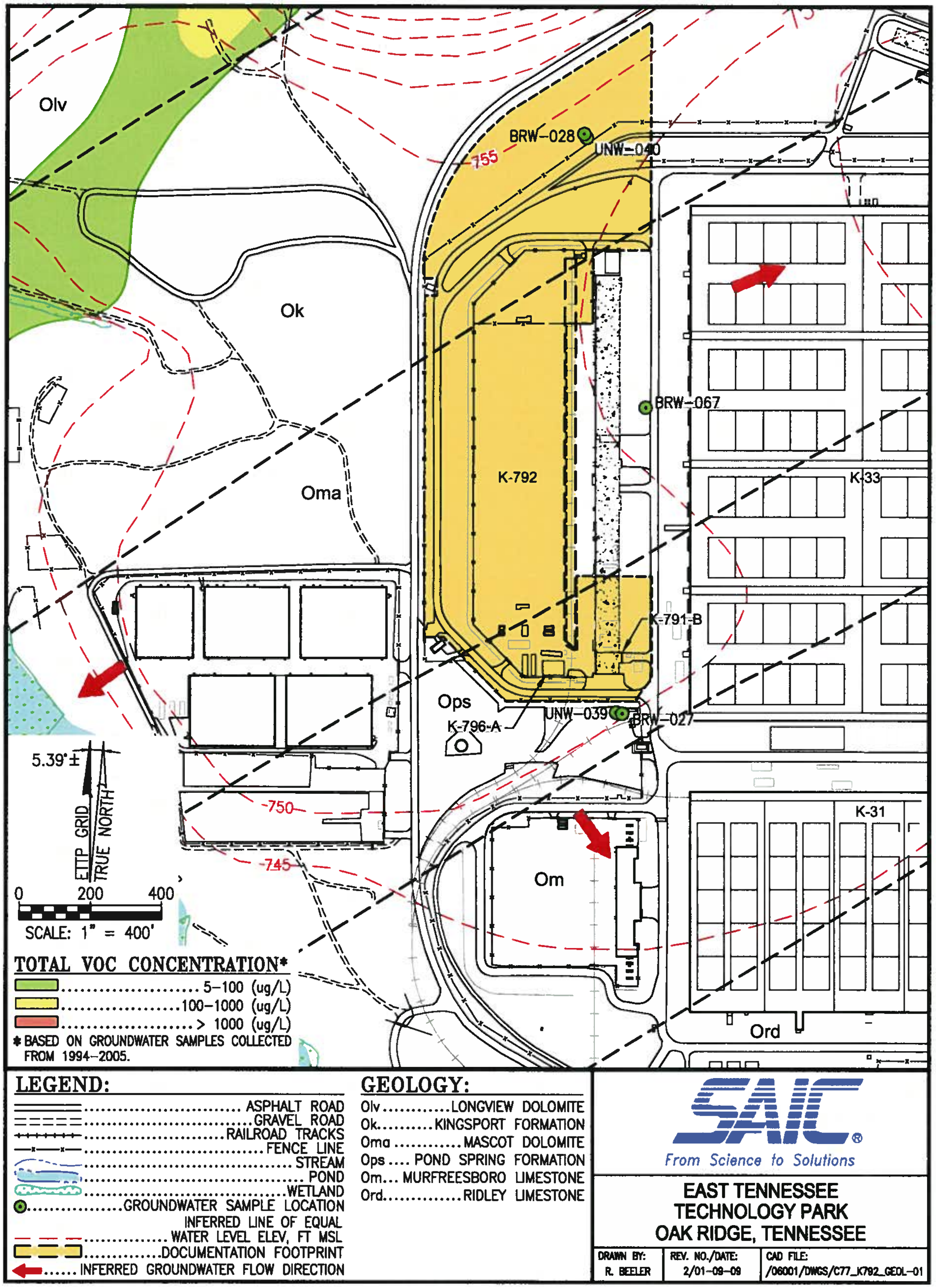

Fig. 4.4. Geologic map of the K-792 Switchyard Complex area.

K-792 Switchyard Complex reflect the information available from these wells and from other available ETTP sitewide information.

The water table at ETTP generally mimics topography with shallow groundwater flowing from higher topographic areas to the surrounding surface water bodies. Groundwater flowpaths in bedrock are a key uncertainty in the conceptual model of ETTP, but fractures, bedding planes, and hydraulic gradient are expected to be the primary controlling factors. Based on the data obtained during installation of monitoring wells in the vicinity of the K-792 study area, it appears likely that bedrock occurs at depths from approximately 10 to greater than 30 ft below ground surface (bgs). Based on pre-construction topographic maps, it appears that over 10 ft of fill material were potentially placed in the sinkhole near the eastern boundary of the K-792 study area (under the K-33 Building) during construction of ETTP.

Water levels obtained from the wells in the vicinity of the K-792 study area indicate depths to water ranging from 10 to 20 ft bgs with shallow groundwater flow anticipated to be to the east and southeast toward Poplar Creek, and to the southwest toward the K-901 Pond. Vertical hydraulic gradients determined from the paired unconsolidated zone and bedrock monitoring wells (BRW-027 and UNW-039) indicate downward gradients from the unconsolidated zone to the bedrock at this well pair. A slight upward vertical gradient has been observed at the well pair BRW-028 and UNW-040 located in the northern portion of the study area. Hydraulic conductivity of subsurface materials has been determined from slug tests conducted in numerous monitoring wells throughout ETTP. Based on these tests average values for the Knox and Chickamauga bedrock and the overburden materials above bedrock have been determined. These values are presented in Table 4.1 in addition to other hydrogeologic parameters for the K-792 study area.

Table 4.1. Summary of hydrogeologic conditions at the K-792 Switchyard Complex

Parameter	Site conditions
Is a groundwater plume present beneath the site?	None identified
Distance from site to nearest upgradient plume (ft)	800
Is karst present?	Yes
Depth to bedrock (ft)	10 to >30
Depth to groundwater (ft)	10–20[a]
Are fill materials present at the site?	Yes
Composition of overburden materials present.	Primarily silty clay
Shallow groundwater flow direction	East, southeast, and southwest
Hydraulic conductivity of overburden materials (cm/sec)	1.25E-03[b]
Hydraulic conductivity of bedrock (cm/sec)	4.28E-03[c]
Hydraulic gradient at the site (ft/ft)	0.008[a]
Is a perched water table present at the site?	None identified

[a] Represents interpolated value based available data.
[b] Represents average hydraulic conductivity of unconsolidated zone at ETTP based on slug test results for wells completed in overburden materials at ETTP.
[c] Represents average hydraulic conductivity of bedrock at ETTP based on slug test results.

A groundwater plume has not been identified beneath or within the vicinity of the K-792 Switchyard Complex. The nearest identified plume is located approximately 800 ft northwest of the study area and is sourced from the K-1070-A Burial Ground. Although available potentiometric maps indicate that this plume may be considered to be upgradient of K-792, groundwater data and dye tracer studies indicate that flow from the K-1070-A Burial Ground is to the southwest toward the K-901 Pond and not southeastward toward the K-792 study area. Analytical data for the well pair of BRW-028 and UNW-040 located adjacent to the northern boundary of the K-792 study area indicate the general absence of VOCs in both the bedrock and unconsolidated zone materials north of the study area (Table 4.2). With the exception of a single detection of acetone at well BRW-028, VOCs were not detected in five sampling events conducted between 1994 and 1998 at these wells. Acetone was reported at a concentration of 51 micrograms per liter (µg/L) during the March 1995 sampling event at well BRW-028; however, this compound was not detected in three subsequent sampling events at this well. In contrast, several VOCs, including 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene (DCE), 1,2-DCE, chloroform, and trichloroethene (TCE), have been detected at bedrock well BRW-067 located approximately 200 ft east of the K-792 study area. Although VOCs have been detected at this well, a plume has not been defined because these compounds have only been detected in this single, isolated bedrock well. As mentioned previously, groundwater flowpaths in bedrock are a key uncertainty at ETTP, and these compounds occur in bedrock groundwater; however, existing data indicate that groundwater flow from this area would likely be to the east, away from the K-792 study area. Analytical data for the well pair of BRW-027 and UNW-039 located within 200 ft of Bldg. K-791-B indicate the general absence of VOCs in both the bedrock and unconsolidated zone materials. Only low estimated concentrations of 2-butanone (3 µg/L) and TCE (1 µg/L) were reported in one of five sampling events (August 1998) at the bedrock well BRW-027. August 1998 is the last sampling event of record for this well, and these compounds had not been detected in the previous four sampling events at this well. Only a single detection of acetone (16 µg/L) in 1994 has been reported at well UNW-039, completed in the overburden materials near K-791-B.

Table 4.2 summarizes the analytical results for the VOCs detected in groundwater samples collected from the monitoring wells located in the vicinity of the K-792 study area. Table 4.2 represents all data available for these monitoring wells since 1994. Although VOCs have been detected above federal drinking water maximum contaminant levels (MCLs) in monitoring well BRW-067 located east of the study area, it can be seen in Table 4.2 that VOCs are generally absent from groundwater in the other two well pairs located north and south of the K-792 study area. Although the available data suggest the absence of VOCs in the groundwater north and south of the study area, there is uncertainty concerning groundwater flow paths due to the limited number of monitoring wells in the area and the potential karst conditions in the bedrock. Additionally, the underground conduit runs between the K-33 Building and the former K-792 Switchyard may serve as preferential flow paths for shallow groundwater in the area.

Table 4.2. Summary of VOCs detected in groundwater samples from bedrock monitoring wells in the vicinity of the K-792 Switchyard Complex

Analyte	MCL (µg/L)	BRW-027					UNW-039			BRW-067				
		Sep-94	**Mar-95**	**Sep-95**	**Jun-98**	**Aug-98**	**Sep-94**	**Mar-95**	**Sep-95**	**Sep-94**	**Mar-95**	**Sep-95**	**Jun-98**	**Sep-98**
1,1,1-Trichloroethane	200	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5 U	2 J	6	2 J	4 J
1,1-Dichloroethane	NA	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1 J	2 J
1,1-Dichloroethene	7	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	2 J	5 U	7 J	3 J	6
1,2-Dichloroethene	70[a]	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	14	8	11	7	5
2-Butanone	NA	10 U	10 UJ	10 U	10 UJ	3 J	10 U	10 UJ	10 U	10 UJ	10 UJ	10 U	10 U	10 U
Acetone	NA	10 U	10 UJ	10 U	10 UJ	10 U	16 J	10 UJ	59 U	10 U	10 UJ	10 U	10 U	10 U
Chloroform	100[b]	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	1 J	5 U	1 J	1 J	5 U
Methylene chloride	5	5 U	5 U	5 U	7 UJ	5 U	6 U	5 U	5 U	5 U	5 U	1 J	17 U	6 U
Trichloroethene	5	5 U	5 U	5 U	5 UJ	1 J	5 U	5 U	5 U	**35**	**24**	**34**	**13**	**15**

Analyte	MCL (µg/L)	BRW-028					UNW-040	
		Sep-94	**Mar-95**	**Sep-95**	**Jun-98**	**Aug-98**	**Mar-95**	**Sep-95**
1,1,1-Trichloroethane	200	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethene	7	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethene	70[a]	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Butanone	NA	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U
Acetone	NA	10 U	51 J	10 U	10 U	10 U	10 UJ	10 U
Chloroform	100[b]	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Methylene chloride	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U

[a] Represents MCL for the *cis*-1,2-dichloroethene isomer. Individual isomers not reported by laboratory.
[b] Represents MCL for total trihalomethanes.
BRW = bedrock well.
MCL = maximum contaminant level.
J = estimated concentration.
U = analyte not detected at indicated concentration.
UJ = analyte not detected at indicated concentration, which represents an estimated concentration.
Bold indicates the concentration exceeds the MCL.
NA = not available.
UNW = unconsolidated zone well.
µg/L = microgram per liter.

4.4 EVALUATING THE POTENTIAL FOR VAPOR INTRUSION AT EAST TENNESSEE TECHNOLOGY PARK FACILITIES TARGETED FOR TRANSFER

EPA issued the *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Draft Vapor Intrusion Guidance)*, EPA530-F-052, in November 2002. This guidance is intended to help determine if the vapor intrusion exposure pathway poses a significant risk to human health; it was originally written in support of the environmental indicators program. Vapor intrusion is the migration of VOCs in contaminated groundwater and/or soil to indoor air. According to the *Draft Vapor Intrusion Guidance*, in extreme cases, the vapors may accumulate in occupied buildings to levels that may pose safety hazards and/or adverse health effects. Typically, however, the chemical concentration levels are low or, depending on site-specific conditions, vapors may not be present at detectable concentrations. Generally, the *Draft Vapor Intrusion Guidance* is intended for residential settings and does not apply to occupational settings. However, due to the occurrence of VOCs in shallow groundwater in some areas at ETTP, and because a covenant deferral approach under CERCLA Sect. 120(h) will be used to support most transfers, EPA Region 4 recommended investigation of the vapor intrusion pathway for ETTP facilities that are targeted for transfer to CROET or other qualified parties.

In accordance with the *Draft Vapor Intrusion Guidance*, and through consultation with representatives from EPA Region 4, DOE-ORO has developed a process to evaluate the potential for vapor intrusion at existing ETTP properties to be transferred to the private sector under a CERCLA Sect. 120(h) Covenant Deferral Request (CDR). The following outlines that process and includes March 2006 guidance from EPA Region 4 (EPA 2006).

ORO, EPA Region 4, and TDEC agree that vapor intrusion will be addressed in the ETTP final Site Wide ROD, which is scheduled to be signed by September 30, 2013. Until those actions of the ROD related to vapor intrusion are implemented, ORO will implement interim measures to ensure that transfer of these properties is protective of human health.

As part of the guidance received from EPA in March 2006 (letter from H. W. Taylor, Jr., to S. M. Cange, titled "Proposed Modifications to the Evaluation of the Vapor Intrusion Pathway in Support of Property Transfers at the East Tennessee Technology Park (ETTP), January 6, 2006, Oak Ridge, Tennessee"), it was determined that all properties (buildings and land parcels) will be considered for evaluation on a case-by-case basis. However, it should be noted that sampling is not planned for facilities not suited for occupancy, such as the railroad and its right-of-way. Additionally, sampling is not proposed in the future on land parcels. Deed requirements will note that at least until the measures identified in the final Site Wide ROD are implemented and shown to be effective, all future buildings planned for occupancy will be constructed with engineered barriers to prevent vapor intrusion.

In evaluating the vapor intrusion pathway, ORO will collect soil-vapor samples for facilities proposed for transfer as follows:

a. EPA will review the soil-vapor planned sampling locations prior to implementation.

b. Two sampling events will be conducted, one during the winter ("wet" hydroperiod) and one during the summer ("dry" hydroperiod), to account for seasonal variability. The goal is to collect soil vapor samples around the hydrologic seasons; therefore, the dates when samples are collected will not necessarily coincide with the calendar-determined dates of the seasons.

c. Mean sample results for individual constituents will be compared to pre-established trigger levels (TLs) for soil vapor that were developed using an HI of 0.1 and a risk value of 10^{-5} (see Appendix C).

d. If the mean soil-vapor analytical results are below the TLs, interim monitoring may be conducted if building conditions change, and/or at the necessary frequency (see below for further details).

e. If the mean soil vapor analytical results are above the TLs, discussions will be held with EPA and TDEC to determine if indoor air samples should be collected to determine whether the vapor intrusion pathway is complete. Factors that will be considered to determine if air sampling is necessary will include the contaminant and how significant the exceedance is (i.e., whether the risk from the vapor intrusion pathway is greater than 10^{-4}, etc.).

f. If building air samples are collected, the mean results for individual constituents will be compared to the 25-year industrial preliminary remediation goals (PRGs). If the results exceed the PRGs, the risks will be deemed unacceptable, and the vapor intrusion pathway will be considered complete. If this occurs, ORO will consult with the transferee (e.g., CROET) to determine if they are still interested in transfer. If the transferee desires the building, it will be retrofitted as necessary to eliminate or reduce the risk to acceptable levels, and confirmatory sampling will be conducted.

g. If the mean results for indoor air samples of individual constituents do not exceed the PRGs, risks will be considered acceptable, and the building will be transferred. Annual indoor-air sampling will be conducted to ensure that the vapor intrusion pathway has not become complete due to any changed conditions in the integrity of the building structure.

h. After the initial evaluation (consisting of the winter and summer sampling events), and in accordance with EPA's *Draft Vapor Intrusion Guidance* and/or other appropriate EPA guidance, re-evaluation of the vapor intrusion pathway for the building may be conducted if the building use changes and/or as determined using the risk and hazard equations from the CERCLA risk assessment guidance. This will be done by aggregating the winter and summer sampling results and identifying the maximum detected concentration for each analyte. Next, the risk and hazard equations will be rearranged to solve for the quotient exposure duration. This approach will determine the number of years a worker would need to be exposed to the maximum detected concentrations of VOCs in order to have a cumulative risk of 1.0×10^{-6} or an HI of 1.0 and, hence, the frequency of sampling needed in order to be protective of workers. For perspective, the frequency of sampling corresponding to a cumulative risk of 1E-04 will also be determined. Once the frequency has been established, re-sampling will be conducted inside or immediately outside the building. The determination of inside or outside will depend on (1) the potential impact to the future owners, and (2) the calculated frequency. The complete approach for determining the interim monitoring frequency is contained in an agreement between EPA Region 4 and ORO titled *Approach to Interim Monitoring of the Vapor Intrusion Pathway for Transferred Facilities at the East Tennessee Technology Park (ETTP)* [DOE 2005b]. Additionally, comprehensive changes to the building structure or infrastructure (e.g., replacement of the heating, ventilating, and air-conditioning system) that have the potential to alter previous conclusions may require re-evaluation. If such changes are made, the transferee (i.e., CROET) will notify ORO and, if necessary, ORO will re-evaluate to ensure that the pre-transfer determination has not changed. It should be noted that the buildings will continue to be used for occupational purposes in accordance with deed restrictions.

i. A re-evaluation, as stated in h above, will consist of additional soil-vapor sampling and, if necessary, indoor-air sampling. If the results of the re-evaluation indicate that vapor intrusion poses a significant risk to human health, ORO will take necessary actions to ensure protectiveness.

Evaluation of the K-791-B and K-796-A buildings includes the analysis of soil vapor samples. Soil vapor sampling activities and data are discussed in Chap. 6 of this EBS.

5. RESULTS OF VISUAL AND PHYSICAL INSPECTIONS

5.1 VISUAL AND PHYSICAL INSPECTIONS OF THE PROPERTY FOR TRANSFER

A visual and physical inspection of the property was conducted on May 28, 2008. The study area was generally flat containing concrete pads and asphalt paving with minor grass-covered areas. All equipment in the switchyard has been removed, but most of the concrete foundations and pedestals associated with the equipment remain in place. In the past, efforts have been made to remove a portion of the pedestals and foundations located in the western side of the switchyard, but because the foundations extend to such a great depth (~ 8 ft), their removal proved difficult. In these locations the underground conduit runs that are made of clay pipe were exposed by the removals. Based upon the observations made during the site walkdowns, it is anticipated that the bulk of the clay conduits remain in place.

The northern portion of the former switchyard consisted primarily of an asphalt-paved, lay-down area. The Northern Expansion Area of the K-792 Switchyard Complex is grass-covered with scattered deciduous and evergreen trees. The ETTP main plant fence and three access roads (Northwest Patrol Road, 22nd Street, and an unnamed switchyard access road) cross the northern portion of the study area. A small drainage ditch, which flows from northeast to southwest, bisects the northern-most portion of the study area. This drainage ditch is tree-lined throughout segments of its path across the study area. A second ditch parallels Perimeter Road and flows to the north. At the time of the inspection, a small amount of water was present in this ditch; however, no water was observed in the northeast-southwest drainage ditch.

As noted previously in Sect. 4.1, the northern portion of the proposed transfer space is leased by DOE to CROET and subleased by CROET to IMPACT, a waste management company. IMPACT constructed a new facility in the northwestern area of the transfer space. This metal building is approximately 12,000 ft^2 in size and has been designated as K-1310-MP. There are also two temporary office trailers associated with IMPACT's operations. The larger trailer (K-1310-MQ) is 24 ft by 60 ft. The smaller trailer (K-1310-MS) is 8 ft by 20 ft in size, and the plans are to replace it with another 24-ft by 60-ft trailer in the future. The K-792 north yard houses a privately owned and operated waste treatment facility. At present the land is owned by DOE; after transfer it will be owned by the transferee. The balance of the former K-792 Switchyard is planned for use as a transload area by companies seeking loading and offloading access to the rail spur that runs along the eastern portion of the transfer footprint. The southern portion of the former K-792 Switchyard is now operated by Heritage Center through a real estate lease.

During the visual inspection of the transfer space, no other equipment or materials were present within the proposed transfer footprint. Small quantities of concrete and asphalt rubble were observed from historical decommissioning activities.

Building K-791-B

Building K-791-B consists of nine rooms and two hallways. The building is constructed of concrete block with concrete floor covered with vinyl tiles, and a built-up concrete composite roof of tar and gravel. The roof is equipped with raised-grated roof drains. The building is protected by a wet-pipe sprinkler system and lit with fluorescent fixtures. The rooms consist of a breakroom with a sink (tile), men's and women's bathrooms, a utility closet with sink, a large bullpen style area used for cubicles that was previously the receiving area with a 2-ton overhead hand crane, a large office, a computer room with a raised floor (converted from the shower portion of the old change house), and two smaller offices off the large receiving area. Large steel, double doors open to the concrete loading dock on the east end of the receiving area room. A wall-mounted metal ladder is present in the northwest corner of the receiving area. Most rooms were equipped with wall-mounted, air-conditioning units. An approximate 3-ft-wide concrete sidewalk adjoins K-791-B on the south and west sides with asphalt extending outward from the concrete. An open, grass-covered area adjoins the southern half of the outside wall on the east, and south of the loading dock.

The bay area (Room 104 and Room 102) had carpeting installed over the concrete floor slab. The carpeting has recently been removed from these areas to enable radiological surveys to occur. The former computer room (Room 103) has a raised floor that has been partially removed to enable radiological surveys to occur. Portions of the floors within the southern half of Bldg. K-791-B have non-asbestos-containing material (ACM) vinyl tile (SAIC 2006). Tiled areas include the breakroom, entrance hallway, restrooms, janitorial closet, and two office areas. The restrooms and the janitor's closets have either ceramic or non-ACM vinyl tile floor covering installed over the concrete slab. Because the building was constructed in 1978, there is the potential for lead-based paint to be in the building (Brumback 2007). The federal lead phase-out requirements in 1978 did not include non-residential structures.

There are floor drains in Bldg. K-791-B located in the men's and women's restrooms, and drains are also presumed to be present beneath the raised-floor area used to house computer servers (former shower). The drains beneath the raised floor were not plugged prior to remodeling of the building. These floor drains are believed to be connected to the sanitary sewer.

Building K-796-A

Building K-796-A is a pre-fabricated building that originally consisted of one unsegmented interior area. However, in 2000, use of the building for office and conference room space began, and interior walls were put in place to create five rooms. Because the building was fabricated in 1978, there is the potential for lead-based paint to be in the building. The federal lead phase-out requirements in 1978 did not include non-residential structures.

A walkdown of the facility, conducted in August 2006, determined that there are not any floor drains in the facility. There is no potable water, and there are no fire water or sanitary sewer connections, including underground service lines in the building. Electrical service is provided by an overhead 220-V line.

5.2 VISUAL AND PHYSICAL INSPECTION OF ADJACENT PROPERTY

The adjacent areas are owned by DOE and have been assessed to determine actual or potential releases of hazardous substances or petroleum products or their derivatives. Information about each of the adjacent areas that may contain contamination is provided in Sect. 4.2.

On the northwestern corner and outside of the transfer space is the K-897-P O/WS. On the southwestern corner and outside of the transfer space is the K-897-N O/WS. These units receive runoff and water from the French drain system that underlies the former K-792 Switchyard. The primary purpose of these units was to intercept and collect any oil spills or releases that might have occurred within the former K-792 Switchyard. No oil was observed within either unit during the visual inspection.

The former K-791 Powerhouse Complex bounds the eastern side of the former K-792 Switchyard. The Powerhouse Complex (comprised of Bldgs. K-791-N, K-791, and K-791-S) was demolished during decommissioning of the former K-792 Switchyard. At the time of the visual inspection, only the foundations of these structures remained with the exception of the four synchronous condenser foundations (two each at K-791-N and K-791-S) that are constructed of reinforced concrete. During the walkdown, limited basement areas of K-791-N and K-791-S were observed that had been filled with rubble when the Powerhouse buildings were demolished. Some oil stains were noted where cable runs had been cut just above the foundations of K-791-N and K-791-S. The cable conduit was historically filled with mineral oil that appears to have migrated from the underground conduit and has left staining at the surface. It is not known whether this migration is associated with the displacement of oil by water filling the underground conduit or through "wicking" of the oil along the paper-lined cable. The stained areas were sampled by the EM Program, and the oil was found to be non-PCB. Further east of the remains of the K-791 buildings is Bldg. K-33. A security fence separates the switchyard from the K-33 Building.

To the south of the former K-792 Switchyard is a parking lot that was historically used for personnel working within the switchyards or the K-31 or K-33 buildings. The K-1065 waste management facility is located west of Perimeter Road from the K-792-Switchyard Complex. This permitted RCRA facility is used to store hazardous waste materials and is fenced with gates to control access. The K-1066-K cylinder yard is to the south of the K-1065 facility.

6. SAMPLING AND SURVEY RESULTS

As mentioned previously, this report relies upon regulatory-approved documentation in two PCCRs (listed below) for the foundational information to support the lease of the study area. The PCCRs were prepared as part of the EM DVS. This process is in use for RA decision-making across the ETTP, and decisions are based on hierarchical land unit divisions of Zones, then Geographic Areas, then Groups, then EUs.

Of the approximately 19.91 acres of land in the K-792 Switchyard Complex, all acres are contiguous within Zone 2 and include portions of EUs Z2-01 and Z2-02. The extent of the study area within the EUs is shown on Fig. 3.1.

- *FY 2006 PCCR for the Zone 2 Soils, Slabs, and Subsurface Structures at ETTP, Oak Ridge, Tennessee* (DOE/OR/01-2317&D2), December 2006 (DOE 2006), and
- *FY 2007 PCCR for the Zone 2 Soils, Slabs, and Subsurface Structures at ETTP, Oak Ridge, Tennessee* (DOE/OR/01-2723&D1), September 2007 (DOE 2007a).

CERCLA decisions for the two EUs in which the K-792 Switchyard Complex is located are indicated in Table 6.1. These two EUs were assessed under approved Work Plans (DOE 2007b) prepared according to the DVS process. All verified and validated data used to make regulatory decisions have been placed in the Oak Ridge Environmental Information System database (www.oreis.bechteljacobs.org/oreis/help/oreishome.html) and are available for review. The soil sampling locations within the K-792 Switchyard Complex are shown in Fig. 6.1. The sampling results and data evaluation can be found in Appendix A of the respective PCCRs (DOE 2006 and DOE 2007a). These data were deemed sufficient to reach NFA decisions for both of the EUs.

Although the K-792 Switchyard Complex is comprised of portions of EU Z2-01 and EU Z2-02 (see Fig. 3.1), for purposes of risk evaluation, the entire EU is considered because there are no barriers or impediments preventing access to the balance of the EUs that is not in the K-792 Switchyard Complex.

Table 6.1. Summary of CERCLA decisions for the EUs occupied by the K-792 Switchyard Complex

Geographic area	Group	EU (acreage)[a]	Associated FFA sites[b]	Decision
K-31/K-33 Area	K-31/K-33	Z2-01 (28.3 acres)	K-892-J Cooling Tower Basin	Sampling and analysis resulted in NFA concurrence
		Z2-02 (29.7 acres)	K-792 Switchyard Soils[b] K-897-N Oil Containment Structure K-897-P Oil Containment Structure K-1206-E Sandblasting Residue	Sampling and analysis resulted in NFA concurrence

[a] Acreages given represent only the areas of the two EUs (Z2-01 and Z2-02) that include the K-792 Switchyard Complex.

[b] FFA sites indicated are located within the cited EUs, but only the K-792 Switchyard Soils is located within the transfer footprint.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980.
EU = exposure unit.
FFA = Federal Facility Agreement.
NFA = no further action.

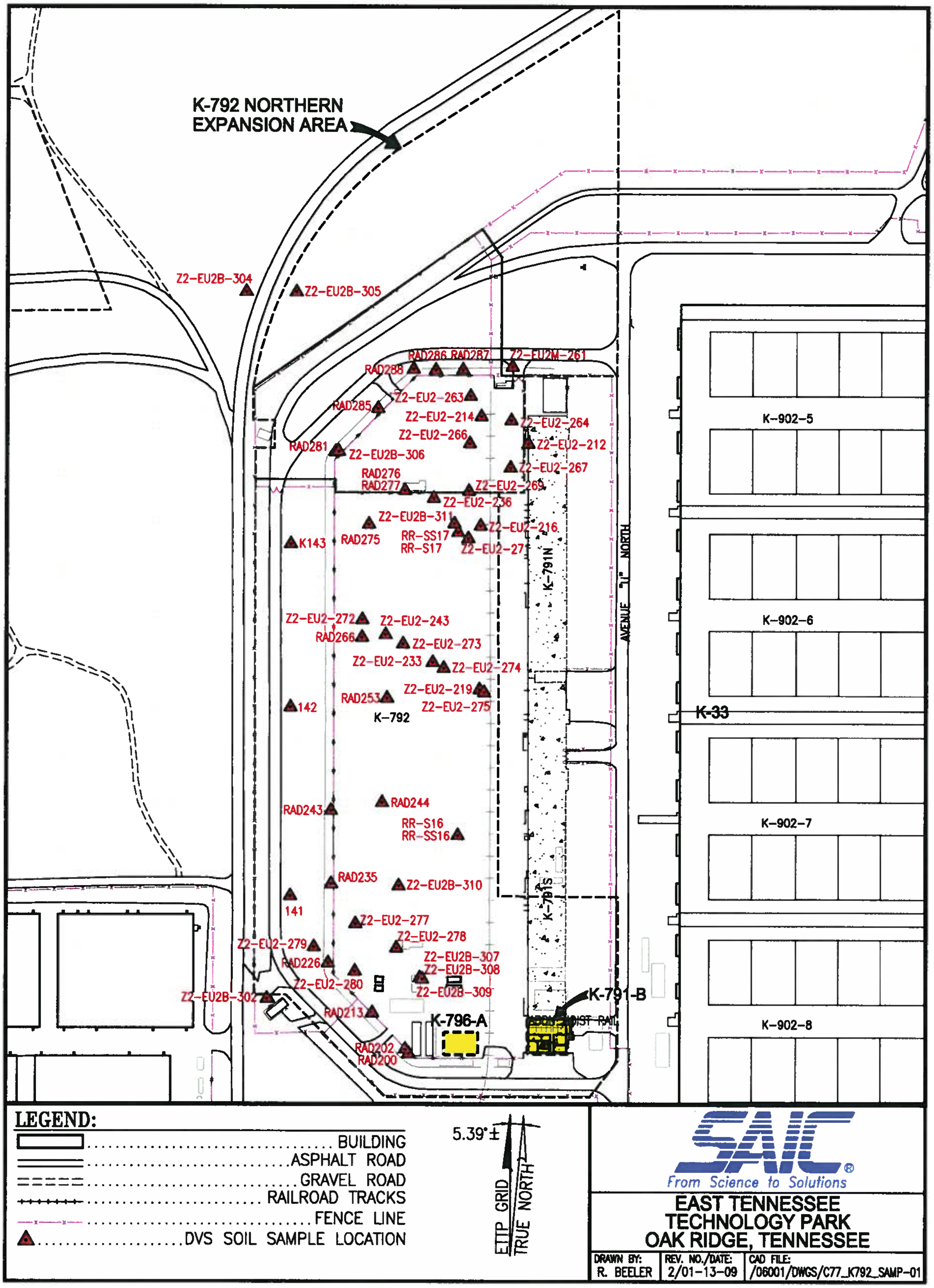

Fig. 6.1. K-792 Switchyard Complex soil sampling locations.

In addition to the evaluation conducted under the DVS, PCB swipe sampling and soil vapor sampling were conducted within Bldgs. K-791-B and K-796-A to support the transfer of these facilities. Because of the construction materials used, portions of Bldg. K-791-B were also sampled for asbestos, and one PCB sample was collected from the roof. The results of these sampling events are presented in Sect. 6.1.

6.1 CHEMICAL SAMPLING

6.1.1 2006 PCB Swipe and Roof Core Sampling for Building K-791-B

Because of the historical use of Bldg. K-791-B as a maintenance facility for electrical equipment, swipe sampling of the interior bay area of the building was required to assess the potential for contamination. A review of available documentation does not indicate that a release of PCBs occurred within the building; however, to ensure that PCBs are not present in the building, six swipe samples were collected from the bay floor and analyzed according to the *Sampling and Analysis Plan for Collection of Soil Vapor and PCB Swipe Samples for the K-791-B Building at the East Tennessee Technology Park, Oak Ridge, Tennessee* (BJC/OR-2571). This sampling plan is included as Appendix C. Sampling locations are shown in Fig. C.6.1 of Appendix C, and detected results are shown in Table 6.2 below.

As shown on Table 6.2, low levels of PCB-1254 were detected at four of the six locations and PCB-1260 was detected at two of the six locations. All of these detections were far below the 10-μg/100-cm^2 guideline found in 40 *Code of Federal Regulations* (*CFR*) Part 761. These data were used in the risk evaluation to determine the associated risk to a hypothetical industrial/office worker who might be exposed to the bay floor within the building.

Table 6.2. Building K-791-B PCB swipe sample results

Location ID	Chemical name	Units[a]	Result	Validation qualifier
NS-06-01-791B	PCB-1254	μg/wipe	0.16	=
NS-05-01-791B	PCB-1254	μg/wipe	0.11	J
NS-08-01-791B	PCB-1254	μg/wipe	0.11	J
NS-04-01-791B	PCB-1254	μg/wipe	0.14	J
NS-06-01-791B	PCB-1260	μg/wipe	0.29	=
NS-08-01-791B	PCB-1260	μg/wipe	0.17	J

[a] Wipe = 100-cm^2 area.
μg = microgram.
PCB = polychlorinated biphenyl.

One core sample of the roof material of Bldg. K-791-B was collected in April 2006 and submitted for laboratory analysis for PCBs. The analytical results for this sample indicate that PCBs were not detected in this roof material sample.

6.1.2 2006 PCB Swipe Sampling for Bldg. K-796-A

Because of the historical use of Bldg. K-796-A as a storage and maintenance facility for electrical equipment, swipe sampling of the interior bay area of the building was required to assess the potential for contamination. A review of available documentation does not indicate that a release of PCBs occurred within the building; however, to ensure that PCBs are not present in the building, nine swipe samples were collected from the bay floor and analyzed according to the *Sampling and Analysis Plan for Collection of Soil Vapor and PCB Swipe Samples for the K-796-A Building at the East Tennessee Technology Park,* *Oak Ridge, Tennessee* (BJC/0R-2612). This sampling plan is included as Appendix D. Sampling locations are shown in Fig. D.6.1 of Appendix D, and detected results are shown in Table 6.3 below.

As shown on Table 6.3, PCB-1254 was detected at one of the nine locations and PCB-1260 was detected at all nine locations. All of these detections were far below the 10-µg/100-cm^2 guideline found in 40 *CFR* Part 761. These data were used in the risk evaluation to determine the associated risk to a hypothetical industrial/office worker who might be exposed to the bay floor within the building.

Table 6.3. Building K-796-A PCB swipe sample results

Location ID	Chemical name	Units	Result	Validation qualifier
NS-06-01-796A	PCB-1254	µg/wipe	0.14	J
NS-11-01-796A	PCB-1260	µg/wipe	0.15	=
NS-05-01-796A	PCB-1260	µg/wipe	0.17	=
NS-04-01-796A	PCB-1260	µg/wipe	0.29	=
NS-03-01-796A	PCB-1260	µg/wipe	0.37	=
NS-06-01-796A	PCB-1260	µg/wipe	0.68	=
NS-09-01-796A	PCB-1260	µg/wipe	0.12	J
NS-07-01-796A	PCB-1260	µg/wipe	0.16	J
NS-08-01-796A	PCB-1260	µg/wipe	0.17	J
NS-10-01-796A	PCB-1260	µg/wipe	0.61	J

[a] Wipe = 100-cm^2 area.
µg = microgram.
PCB = polychlorinated biphenyl.

6.1.3 2006 Asbestos Sampling for Bldg. K-791-B

Thirteen samples of tile and insulation materials were collected from Bldg. K-791-B in March and April 2006 and submitted for laboratory analysis for asbestos. All thirteen samples analyzed were determined to be negative (< 1%) for asbestos. Thus, it is assumed that asbestos is not present in the construction materials within Bldg. K-791-B.

6.1.4 K-791-B Soil Vapor Sampling

The results of soil vapor sampling conducted in September 2006 and February 2007 at Bldg. K-791-B are presented in Table 6.4 and Table 6.5, respectively. This sampling was conducted to determine if a potential source of VOCs exists under the building. Samples were collected from four locations (shown on Fig. C.5.1 in Appendix C). The sampling results were validated, and the average concentration for each VOC was calculated and compared to its respective soil vapor TL, a concentration calculated to be health protective. In addition, to ensure that the VOCs did not cumulatively exceed TLs, the average concentration for each VOC was divided by its respective TL to determine what fraction the concentration represented. The resulting fractions were then added for all VOCs that had at least one detection. If, collectively, the VOC concentrations had exceeded the TLs, the resulting value would be above 1.0 (i.e., the fractions would add up to over 1.0).

None of the VOCs detected in the sampling events had average concentrations that exceeded TLs for Bldg. K-791-B, and the sum of TL fractions was below 1.0. Therefore, based on the soil vapor sampling results, the vapor intrusion pathway is not considered complete beneath the building, and there is a low likelihood of adverse impacts to human health.

Table 6.4. September 2006 sub-slab vapor results for Building K-791-B

Analyte	Freq. detect	Minimum detect concentration	Maximum detect concentration	Arithmetic mean concentration	Scenario A Trigger level [a]	Trigger level exceeded?	Arithmetic mean fraction of TL
Volatile organic compounds (μg/m³)							
1,1,1-Trichloroethane	1/3	4.20E+00	4.20E+00	2.50E+00	3.00E+05	No	8.33E-06
1,1,2,2-Tetrachloroethane	0/3			2.10E+00	6.69E+02	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	1/3	3.00E+01	3.00E+01	1.14E+01	3.98E+06	No	2.88E-06
1,1,2-Trichloroethane	0/3			1.67E+00	1.91E+03	NA	NA
1,1-Dichloroethane	0/3			1.20E+00	6.89E+04	NA	NA
1,1-Dichloroethene	0/3			1.17E+00	7.42E+02	NA	NA
1,2-Dichloroethane	0/3			1.20E+00	1.38E+03	NA	NA
1,2-Dichloroethene	0/3			2.30E+00	2.52E+03	NA	NA
1,2-Dichloropropane	0/3			1.40E+00	5.44E+02	NA	NA
1,2-Dimethylbenzene	3/3	6.40E+00	3.00E+01	1.58E+01	NA	No	NA
2-Butanone	3/3	3.50E+00	1.40E+01	1.02E+01	6.82E+05	No	1.49E-05
2-Hexanone	0/3			1.25E+00	7.95E+02	NA	NA
4-Methyl-2-pentanone	2/3	4.10E+00	2.80E+01	1.11E+01	4.02E+05	No	2.76E-05
Acetone	3/3	1.20E+02	1.80E+02	1.43E+02	3.85E+05	No	3.72E-04
Benzene	3/3	1.40E+01	3.70E+01	2.37E+01	3.99E+03	No	5.93E-03
Bromodichloromethane	0/3			2.00E+00	2.73E+03	NA	NA
Bromoform	0/3			3.10E+00	1.49E+04	NA	NA
Bromomethane	0/3			1.10E+00	6.91E+02	NA	NA
Carbon disulfide	2/3	1.80E+00	2.30E+00	1.65E+00	8.99E+04	No	1.84E-05
Carbon tetrachloride	0/3			1.85E+00	3.34E+02	NA	NA
Chlorobenzene	0/3			1.40E+00	2.76E+03	NA	NA
Chloroethane	0/3			7.50E-01	1.38E+06	NA	NA
Chloroform	0/3			1.35E+00	1.56E+03	NA	NA
Chloromethane	1/3	1.60E+00	1.60E+00	9.33E-01	1.24E+04	No	7.51E-05
Dibromochloromethane	0/3			2.55E+00	1.34E+04	NA	NA
Ethylbenzene	3/3	3.30E+00	1.30E+01	7.37E+00	3.50E+04	No	2.11E-04
M + P Xylene	3/3	1.80E+01	8.10E+01	4.40E+01	NA	No	NA
Methylene chloride	0/3			1.05E+00	7.68E+04	NA	NA
Styrene	0/3			1.30E+00	1.39E+05	NA	NA
Tetrachloroethene	1/3	2.00E+01	2.00E+01	8.03E+00	6.68E+04	No	1.20E-04
Toluene	3/3	2.20E+01	8.10E+01	5.10E+01	5.32E+04	No	9.58E-04

Table 6.4. September 2006 sub-slab vapor results for Building K-791-B (continued)

Analyte	Freq. detect	Minimum detect concentration	Maximum detect concentration	Arithmetic mean concentration	Scenario A Trigger level [a]	Trigger level exceeded?	Arithmetic mean fraction of TL
Total Xylene	3/3	2.40E+01	1.10E+02	5.93E+01	1.39E+04	No	4.26E-03
Trichloroethene	0/3			1.60E+00	5.43E+03	NA	NA
Vinyl chloride	0/3			7.00E-01	4.07E+03	NA	NA
cis-1,2-Dichloroethene	0/3			1.20E+00	4.82E+03	NA	NA
cis-1,3-Dichloropropene	0/3			1.40E+00	2.84E+03	NA	NA
trans-1,2-Dichloroethene	0/3			1.10E+00	9.72E+04	NA	NA
trans-1,3-Dichloropropene	0/3			1.45E+00	4.97E+03	NA	NA
						Sum of Fractions	**1.20E-02**

[a] Trigger level was developed with the Johnson-Ettinger model assuming an indoor air preliminary remediation goal based on risk level of 1E-5 and hazard index of 0.1 for industrial exposure (250 d/year, 25 years).
NA - not applicable based on sampling or toxicological data.

Scenario A
L - Loam (used for Silty Clay, 45 to 75% fines)
Contaminant 5 ft (1.5 m) below slab
Conservative building assumptions

Table 6.5. February 2007 sub-slab vapor results for Building K-791-B

Analyte	Freq. detect	Minimum detect concentration	Maximum detect concentration	Arithmetic mean concentration	Scenario A Trigger level [a]	Trigger level exceeded?	Arithmetic mean fraction of TL
Volatile organic compounds (μg/m³)							
1,1,1-Trichloroethane	0/3			8.00E+00	3.00E+05	NA	NA
1,1,2,2-Tetrachloroethane	0/3			1.00E+01	6.69E+02	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	0/3			1.05E+01	3.98E+06	NA	NA
1,1,2-Trichloroethane	0/3			8.50E+00	1.91E+03	NA	NA
1,1-Dichloroethane	0/3			6.00E+00	6.89E+04	NA	NA
1,1-Dichloroethene	0/3			5.50E+00	7.42E+02	NA	NA
1,2-Dichloroethane	0/3			6.00E+00	1.38E+03	NA	NA
1,2-Dichloroethene	0/3			5.50E+00	2.52E+03	NA	NA
1,2-Dichloropropane	0/3			7.00E+00	5.44E+02	NA	NA
1,2-Dimethylbenzene	0/3			6.50E+00	NA	NA	NA
2-Butanone	1/3	2.50E+01	2.50E+01	1.12E+01	6.82E+05	NO	1.64E-05
2-Hexanone	0/3			6.00E+00	7.95E+02	NA	NA
4-Methyl-2-pentanone	0/3			6.00E+00	4.02E+05	NA	NA
Acetone	3/3	1.90E+01	6.30E+01	3.60E+01	3.85E+05	NO	9.35E-05
Benzene	0/3			4.70E+00	3.99E+03	NA	NA
Bromodichloromethane	0/3			1.00E+01	2.73E+03	NA	NA
Bromoform	0/3			1.55E+01	1.49E+04	NA	NA
Bromomethane	1/3	3.90E+02	3.90E+02	1.34E+02	6.91E+02	NO	1.93E-01
Carbon disulfide	1/3	1.30E+02	1.30E+02	4.62E+01	8.99E+04	NO	5.14E-04
Carbon tetrachloride	0/3			9.00E+00	3.34E+02	NA	NA
Chlorobenzene	0/3			7.00E+00	2.76E+03	NA	NA
Chloroethane	0/3			3.60E+00	1.38E+06	NA	NA
Chloroform	0/3			6.50E+00	1.56E+03	NA	NA
Chloromethane	0/3			2.80E+00	1.24E+04	NA	NA
Dibromochloromethane	0/3			1.25E+01	1.34E+04	NA	NA
Ethylbenzene	0/3			6.50E+00	3.50E+04	NA	NA
M + P Xylene	0/3			6.50E+00	NA	NA	NA
Methylene chloride	0/3			5.00E+00	7.68E+04	NA	NA
Styrene	0/3			6.50E+00	1.39E+05	NA	NA
Tetrachloroethene	0/3			1.00E+01	6.68E+04	NA	NA

Table 6.5. February 2007 sub-slab vapor results for Building K-791-B (continued)

Analyte	Freq. detect	Minimum detect concentration	Maximum detect concentration	Arithmetic mean concentration	Scenario A Trigger level [a]	Trigger level exceeded?	Arithmetic mean fraction of TL
Toluene	0/3			5.50E+00	5.32E+04	NA	NA
Total Xylene	0/3			6.50E+00	1.39E+04	NA	NA
Trichloroethene	0/3			8.00E+00	5.43E+03	NA	NA
Vinyl chloride	0/3			3.50E+00	4.07E+03	NA	NA
cis-1,2-Dichloroethene	0/3			6.00E+00	4.82E+03	NA	NA
cis-1,3-Dichloropropene	0/3			7.00E+00	2.84E+03	NA	NA
trans-1,2-Dichloroethene	0/3			5.50E+00	9.72E+04	NA	NA
trans-1,3-Dichloropropene	0/3			7.00E+00	4.97E+03	NA	NA
						Sum of Fractions	**1.94E-01**

[a] Trigger level was developed with the Johnson-Ettinger model assuming an indoor air preliminary remediation goal based on risk level of 1E-5 and hazard index of 0.1 for industrial exposure (250 d/year, 25 years).
NA – not applicable based on sampling or toxicological data.

Scenario A
L – Loam (used for Silty Clay, 45 to 75 % fines).
Contaminant 5 ft (1.5 m) below slab.
Conservative building assumptions.

Dataset evaluated consisted of sampling conducted February 2007.

In accordance with the *Approach to Interim Monitoring of the Vapor Intrusion Pathway for Transferred Facilities at ETTP* (DOE 2005b), the re-sampling frequency for Bldg. K-791-B was calculated using all of the available soil vapor data. The calculated re-sampling frequency is 322 years. The result indicates that should maximum soil vapor concentrations remain constant, a hypothetical individual working in the building would be exposed to a risk of 1E-6 and a hazard of 1.0 over the 322-year period due to all soil vapor constituents combined. The primary constituent contributing to the re-sampling frequency was benzene (0.037 mg/m^3 from the Fall 2006 results).

6.1.5 K-796-A Soil Vapor Sampling

The results of soil vapor sampling conducted in September 2006 and February 2007 at Bldg. K-796-A are presented in Table 6.6 and Table 6.7, respectively. This sampling was conducted to determine if a potential source of VOCs exists under the building. Samples were collected from two locations (shown on Fig. D.5.1 in Appendix D). The sampling results were validated, and the average concentration for each VOC was calculated and compared to its respective soil vapor TL, a concentration calculated to be health protective. In addition, to ensure that the VOCs did not cumulatively exceed TLs, the average concentration for each VOC was divided by its respective TL to determine what fraction the concentration represented. The resulting fractions were then added for all VOCs that had at least one detection. If, collectively, the VOC concentrations had exceeded the TLs, the resulting value would be above 1.0 (i.e., the fractions would add up to over 1.0).

None of the VOCs detected in the sampling events had average concentrations that exceeded TLs for Bldg. K-796-A, and the sum of TL fractions was below 1.0. Therefore, based on the soil vapor sampling results, the vapor intrusion pathway is not considered complete beneath the building, and there is a low likelihood of adverse impacts to human health.

The re-sampling frequency for Bldg. K-796-A, based on all available data, is 297 years. The result indicates that should maximum soil vapor concentrations remain constant, a hypothetical individual working in the building would be exposed to a risk of 1E-6 and a hazard of 1.0 over the 297-year period due to all constituents combined. Primary constituents contributing to the re-sampling frequency were benzene (0.022 mg/m3 from Fall 2006 results) and TCE (0.028 mg/m3 from Fall 2006 results).

6.2 RADIOLOGICAL SURVEYS

This section presents and discusses the radiological survey data collected between June 1994 and May 2006 from the two buildings located within the study area. The historical survey results are briefly summarized in Sect. 6.2.1.1, followed by the recent (2006) survey results in Sect. 6.2.1.2. The process history of the ETTP Site indicates that uranium (natural, depleted, and/or enriched) is the most prominent radiological contaminant potentially present associated with gaseous diffusion enrichment activities. Any contamination of the K-792 Switchyard and the associated buildings would be due to tracking of contamination from any adjacent, on-site buildings or from spills along the road. Uranium-235 enrichment levels expected from operations since the early 1960s would be anticipated to be between 0.2 and 6.0 wt % associated with the gaseous diffusion process. Most areas are potentially contaminated via tracking from enrichments of less than 3%.[4] If tracking did occur and involve the K-792 Switchyard Complex, it is expected this contamination would also be from enrichments of less than 3%.[5]

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[4] Contracted Health Physics Technician Training handouts, K-25 Site, 1993.

[5] *Baseline Environmental Analysis Report for Building K-791 and the K-792 Switchyard at the East Tennessee Technology Park, Oak Ridge, Tennessee*, BJC/OR-330, Bechtel Jacobs Company LLC, July 1999.

Table 6.6. September 2006 sub-slab vapor results for Building K-796-A

Analyte	Freq. detect	Minimum detect concentration	Maximum detect concentration	Arithmetic mean concentration	Scenario A Trigger level [a]	Trigger level exceeded?	Arithmetic mean fraction of TL
Volatile organic compounds (μg/m³)							
1,1,1-Trichloroethane	0/2			1.65E+00	3.00E+05	NA	NA
1,1,2,2-Tetrachloroethane	0/2			2.10E+00	6.69E+02	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	2/2	5.10E+00	7.40E+00	6.25E+00	3.98E+06	No	1.57E-06
1,1,2-Trichloroethane	0/2			1.68E+00	1.91E+03	NA	NA
1,1-Dichloroethane	0/2			1.20E+00	6.89E+04	NA	NA
1,1-Dichloroethene	0/2			1.18E+00	7.42E+02	NA	NA
1,2-Dichloroethane	0/2			1.20E+00	1.38E+03	NA	NA
1,2-Dichloroethene	0/2			2.30E+00	2.52E+03	NA	NA
1,2-Dichloropropane	0/2			1.40E+00	5.44E+02	NA	NA
1,2-Dimethylbenzene	2/2	1.10E+01	1.10E+01	1.10E+01	NA	No	NA
2-Butanone	2/2	3.60E+00	1.70E+01	1.03E+01	6.82E+05	No	1.51E-05
2-Hexanone	1/2	5.80E+00	5.80E+00	3.53E+00	7.95E+02	No	4.43E-03
4-Methyl-2-pentanone	0/2			1.25E+00	4.02E+05	NA	NA
Acetone	2/2	1.30E+00	7.40E+01	3.77E+01	3.85E+05	No	9.77E-05
Benzene	2/2	1.10E+01	2.20E+01	1.65E+01	3.99E+03	No	4.13E-03
Bromodichloromethane	0/2			2.00E+00	2.73E+03	NA	NA
Bromoform	0/2			3.10E+00	1.49E+04	NA	NA
Bromomethane	1/2	1.00E+01	1.00E+01	5.55E+00	6.91E+02	No	8.03E-03
Carbon disulfide	1/2	2.90E+00	2.90E+00	1.88E+00	8.99E+04	No	2.09E-05
Carbon tetrachloride	0/2			1.85E+00	3.34E+02	NA	NA
Chlorobenzene	0/2			1.40E+00	2.76E+03	NA	NA
Chloroethane	0/2			7.50E-01	1.38E+06	NA	NA
Chloroform	0/2			1.35E+00	1.56E+03	NA	NA
Chloromethane	1/2	2.00E+00	2.00E+00	1.30E+00	1.24E+04	No	1.05E-04
Dibromochloromethane	0/2			2.55E+00	1.34E+04	NA	NA
Ethylbenzene	2/2	6.10E+00	8.10E+00	7.10E+00	3.50E+04	No	2.03E-04
M + P Xylene	2/2	2.50E+01	2.60E+01	2.55E+01	NA	No	NA
Methylene chloride	0/2			1.05E+00	7.68E+04	NA	NA
Styrene	0/2			1.30E+00	1.39E+05	NA	NA
Tetrachloroethene	0/2			2.05E+00	6.68E+04	NA	NA
Toluene	2/2	3.00E+01	4.40E+01	3.70E+01	5.32E+04	No	6.95E-04
Total Xylene	2/2	3.60E+01	3.60E+01	3.60E+01	1.39E+04	No	2.59E-03

Table 6.6. September 2006 sub-slab vapor results for Building K-796-A (continued)

Analyte	Freq. detect	Minimum detect concentration	Maximum detect concentration	Arithmetic mean concentration	Scenario A Trigger level [a]	Trigger level exceeded?	Arithmetic mean fraction of TL
Trichloroethene	2/2	2.30E+01	2.80E+01	2.55E+01	5.43E+03	No	4.70E-03
Vinyl chloride	0/2			7.00E-01	4.07E+03	NA	NA
cis-1,2-Dichloroethene	0/2			1.20E+00	4.82E+03	NA	NA
cis-1,3-Dichloropropene	0/2			1.40E+00	2.84E+03	NA	NA
trans-1,2-Dichloroethene	0/2			1.10E+00	9.72E+04	NA	NA
trans-1,3-Dichloropropene	0/2			1.45E+00	4.97E+03	NA	NA
					Sum of Fractions		**2.50E-02**

[a] Trigger level was developed with the Johnson-Ettinger model assuming an indoor air preliminary remediation goal based on risk level of 1E-5 and hazard index of 0.1 for industrial exposure (250 d/year, 25 years).
NA – not applicable based on sampling or toxicological data.

Scenario A
L – Loam (used for Silty Clay, 45 to 75 % fines)
Contaminant 5 ft (1.5 m) below slab
Conservative building assumptions

Table 6.7. February 2007 sub-slab vapor results for Building K-796-A

Analyte	Freq. detect	Minimum detect concentration	Maximum detect concentration	Arithmetic mean concentration	Scenario A Trigger level [a]	Trigger level exceeded?	Arithmetic mean fraction of TL
Volatile organic compounds (μg/m3)							
1,1,1-Trichloroethane	0/2			8.00E+00	3.00E+05	NA	NA
1,1,2,2-Tetrachloroethane	0/2			1.00E+01	6.69E+02	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	0/2			1.00E+01	3.98E+06	NA	NA
1,1,2-Trichloroethane	0/2			8.00E+00	1.91E+03	NA	NA
1,1-Dichloroethane	0/2			6.00E+00	6.89E+04	NA	NA
1,1-Dichloroethene	0/2			5.50E+00	7.42E+02	NA	NA
1,2-Dichloroethane	0/2			6.00E+00	1.38E+03	NA	NA
1,2-Dichloroethene	0/2			5.50E+00	2.52E+03	NA	NA
1,2-Dichloropropane	0/2			6.50E+00	5.44E+02	NA	NA
1,2-Dimethylbenzene	0/2			6.50E+00	NA	NA	NA
2-Butanone	0/2			4.20E+00	6.82E+05	NA	NA
2-Hexanone	0/2			6.00E+00	7.95E+02	NA	NA
4-Methyl-2-pentanone	0/2			6.00E+00	4.02E+05	NA	NA
Acetone	2/2	9.70E+00	1.50E+01	1.24E+01	3.85E+05	NO	3.21E-05
Benzene	0/2			4.60E+00	3.99E+03	NA	NA
Bromodichloromethane	0/2			9.50E+00	2.73E+03	NA	NA
Bromoform	0/2			1.50E+01	1.49E+04	NA	NA
Bromomethane	1/2	2.60E+01	2.60E+01	1.55E+01	6.91E+02	NO	2.24E-02
Carbon disulfide	0/2			4.15E+00	8.99E+04	NA	NA
Carbon tetrachloride	0/2			9.00E+00	3.34E+02	NA	NA
Chlorobenzene	0/2			6.50E+00	2.76E+03	NA	NA
Chloroethane	0/2			3.50E+00	1.38E+06	NA	NA
Chloroform	0/2			6.50E+00	1.56E+03	NA	NA
Chloromethane	0/2			2.75E+00	1.24E+04	NA	NA
Dibromochloromethane	0/2			1.20E+01	1.34E+04	NA	NA
Ethylbenzene	0/2			6.00E+00	3.50E+04	NA	NA
M + P Xylene	0/2			6.00E+00	NA	NA	NA
Methylene chloride	0/2			4.90E+00	7.68E+04	NA	NA
Styrene	0/2			6.00E+00	1.39E+05	NA	NA
Tetrachloroethene	0/2			9.50E+00	6.68E+04	NA	NA

Table 6.7. February 2007 sub-slab vapor results for Building K-796-A (continued)

Analyte	Freq. detect	Minimum detect concentration	Maximum detect concentration	Arithmetic mean concentration	Scenario A Trigger level [a]	Trigger level exceeded?	Arithmetic mean fraction of TL
Toluene	0/2			5.50E+00	5.32E+04	NA	NA
Total Xylene	0/2			6.50E+00	1.39E+04	NA	NA
Trichloroethene	0/2			7.50E+00	5.43E+03	NA	NA
Vinyl chloride	0/2			3.40E+00	4.07E+03	NA	NA
cis-1,2-Dichloroethene	0/2			5.50E+00	4.82E+03	NA	NA
cis-1,3-Dichloropropene	0/2			6.50E+00	2.84E+03	NA	NA
trans-1,2-Dichloroethene	0/2			5.50E+00	9.72E+04	NA	NA
trans-1,3-Dichloropropene	0/2			7.00E+00	4.97E+03	NA	NA
						Sum of Fractions	**2.25E-02**

[a] Trigger level was developed with the Johnson-Ettinger model assuming an indoor air preliminary remediation goal based on risk level of 1E-5 and hazard index of 0.1 for industrial exposure (250 d/year, 25 years).
NA – not applicable based on sampling or toxicological data.

Scenario A
L – Loam (used for Silty Clay, 45 to 75 % fines).
Contaminant 5 ft (1.5 m) below slab.
Conservative building assumptions.

Dataset evaluated consisted of sampling conducted February 2007.

Other radionuclides (^{60}Co, ^{137}Cs, $^{89/90}Sr$, ^{237}Np, ^{99}Tc, and $^{238/239/240}Pu$) have also been detected on-site at ETTP. These other radionuclides originated from the introduction of contaminated materials from the Oak Ridge National Laboratory and/or from the Hanford and Savannah River Reactor Returns Uranium Reprocessing Program; however, these radionuclides are expected to be found in much lower quantities than uranium and to be undetectable in this area, based upon its operational history as part of the K-792 Switchyard. If radionuclides were present, it is assumed that they would be present at ratios of 1140:1 for uranium to transuranic (U:TRU) and 350:1 for uranium to technetium-99 (U:^{99}Tc) [both ratios are process buildings weighted averages].[6]

6.2.1 Radiological Surveys

6.2.1.1 Historical surveys

Radiological surveys were compared to the fixed and removable contamination limits given in Table 6.8.

Table 6.8. Contamination limits (DCGLs) for radiological survey units

	DCGL (dpm/100 cm^2)	DCGL$_{EMC}$ (dpm/area)
Total alpha	5,000	15,000
Removable alpha	1,000	N/A
Total beta-gamma	5,000	15,000
Removable beta-gamma	1,000	N/A

DCGL = derived concentration guideline level.
DCGL$_{EMC}$ = derived concentration guideline level elevated measurement comparison.
dpm = disintegrations per minute.
N/A = not applicable.

Building K-791-B

A search of the Bechtel Jacobs Company LLC (BJC) Radiological Control (RADCON) electronic survey data collected between 1996 and 2006 showed 24 various surveys, including characterization and equipment release performed during this time frame, associated with the K-791-B area. However, only one survey, 19970326KA36182001, was associated with the K-791-B building. This survey was performed for off-site release of equipment (four oil gauges with thermocouples and two electric relays). Survey results revealed both fixed and removable contamination were less than off-site release limits [Table 6.8 derived concentration guideline level (DCGL) values] for unrestrictive use. Alpha results were less than 24.5 dpm/100 cm^2 with beta/gamma results at less than 57.6 dpm/100 cm^2 for removable contamination. Total results for both alpha and beta/gamma were less than the instruments' critical level of detection at 339.2 dpm/100 cm^2 and 74.5 dpm/100 cm^2, respectively.

Building K-796-A

A search of the BJC RADCON electronic survey data collected between 1996 and 2006 showed two characterization surveys, performed during this time frame, associated with the K-796-A building. The first survey, performed in 1997 (19970721KA36193001), consisted of both total and removable contamination. The second survey, taken in 2006 (20060804EBVDESK003), consisted only of area dose

[6] BJC 1999. *Isotopic Distribution of Contamination Found at the U. S. Department of Energy Gaseous Diffusion Plants*, BJC/OR-407, Oak Ridge, TN, October.

rates. The 1997 survey results revealed both fixed and removable contamination were less than off-site release limits (Table 6.8 DCGL values) for unrestrictive use. Only two locations were surveyed. Alpha results were less than 27.2 dpm/100 cm^2 with beta/gamma results at less than 50.4 dpm/100 cm^2 for removable contamination. Total results for both alpha and beta/gamma were less than the instruments' critical levels of detection at 78.9 dpm/100 cm^2 and 548 dpm/100 cm^2, respectively. No other radiological survey data were found.

6.2.1.2 2006 Surveys

Building K-791-B

A total of 22 radiological surveys [including all associated quality assurance/quality control (QA/QC) surveys] were conducted at Bldg. K-791-B in 2006. The survey numbers are listed in Table 6.9. The surveys were performed during July and August 2006, in accordance with ETTP RADCON procedures, the survey design document, and the survey plan.

Radiological survey procedures and area survey units were described in the survey plan (Appendix E). Hand-held meter survey results were taken and compared to the values in Table 6.8, which are the appropriate 10 *Code of Federal Regulations* (*CFR*) 835 and DOE Order 5400.5[7] surface contamination gross alpha or gross beta criteria, which are referred to as DCGLs in the design document, for the survey area.

Table 6.9. ETTP current radiological surveys for Building K-791-B

20060804A14DESK001	200607224CYDESK001	20060722WCUDESK003
20060804EBVDESK001	200607224CYDESK002	20060722WCUDESK004
20060804EBVDESK002	200607224CYDESK003	20060724WCUDESK001
20060818EBVDESK001	200607224CYDESK004	200607274CYDESK001
20060818REWDESK001	200607224CYDESK005	20060727REWDESK001
200607214CYDESK003	200607224CYDESK006	200608044CYDESK001
20060721AQEDESK001	20060722WCUDESK001	
20060721AQEDESK002	20060722WCUDESK002	

Each survey unit data set was first evaluated by comparing the maximum result after background subtraction to the SL for the survey unit classification. If the net maximum survey result was less than the SL for the specific survey unit (e.g., 25% DCGL limits for Class 3 survey units), then the unit was said to pass [i.e., the null hypothesis, (H_o), that the residual contamination in each of the individual survey units exceeds the survey unit DCGL, was rejected]. If the net maximum result was greater than the SL for any single reading, further readings were obtained in the 1-square meter (m^2) area to determine the average for the square meter. If the net average reading for the square meter was greater than the SL for the specific survey unit, then Class 3 and 2 survey units were reclassified and resurveyed under the protocol of the new classification. If the net maximum result was greater than the DCGL for Class 1 units, the non-parametrical statistical Sign test was used to evaluate the data, as outlined in the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* [NRC 1997].[8]

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[7] (DOE 1990). *Radiation Protection of the Public and Environment*, DOE Order 5400.5, Fig. IV-1, "Surface Contamination Guidelines," p. IV-6, U. S. Department of Energy, February.

[8] (NRC 1997). *Multi-Agency Radiation Survey and Site Investigation Manual, Final Edition*, NUREG-1575, Nuclear Regulatory Commission, December.

Building K-791-B Interior Survey Units

The interior survey units (ISUs) were classified as Class 1, 2, or 3, as shown in Table 6.10. The ISUs consisted of two survey units classified as Class 3 and one survey unit classified as Class 2. No Class 3 areas required reclassification as Class 2. The K-791-B building ISU directly associated with machine shop operations, or containing carpeted flooring similar to the machine shop, was classified as Class 2 due to the limited survey history, the history of machine shop activities, and the close proximity to the K-31 and K-33 gaseous diffusion buildings. None of the areas exceeded the DCGL and, therefore, did not require reclassification as Class 1.

Table 6.10. Survey unit classifications for Building K-791-B

Interior survey units	Initial classification
K-791-B Rooms 102, 104 (ISU 1)	Class 2
K-791-B Rooms 101, 106, 107, 108, janitor's closet (ISU 2)	Class 3
K-791-B Rooms 103, 104, 105 (ISU 3)	Class 3
Exterior survey units	
K-791-B Loading dock (ESU 1)	Class 3
K-791-B Roof, B HVAC unit and associated ducts (ESU 2)	Class 3
K-791-B Exterior walls, fan, and through-the-wall heating/cooling units, and drain spouts (ESU 3)	Class 3

ESU = exterior survey unit.
HVAC = heating, ventilating, and air-conditioning.
ISU = interior survey unit.

All ISUs had results below 25% of the DCGL, including the tiled area underneath the raised wooden floor. Because all results were less than the SL for all ISUs, no further statistical analysis was performed. From an inspection of the individual surveys, including QA/QC surveys, all total activities were less than or equal to 57.2 dpm/100 cm^2 total alpha and 1,221.2 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than or equal to 7.2 dpm/100 cm^2 removable alpha and 13.6 dpm/100 cm^2 removable beta-gamma. The maximum tissue-equivalent dose rate was 0.014 mrem/hour. See Table 6.9 for the summary of the survey results for all ISUs.

Building K-791-B Exterior Survey Units

The three exterior survey units (ESUs) were initially classified as Class 3, as shown in Table 6.10. Radiological survey procedures and area survey units were described in the survey plan (Appendix E).

Results of the initial ESU Class 3 survey indicated ESUs 1 (loading dock) and 2 (roof) had total and removable contamination levels less than 25% of the DCGL. ESU 3 (exterior walls), however, had total beta-gamma levels greater than 25% (see Table 6.11) of the DCGL. Survey results are as follows: all four west wall total beta-gamma results were greater than 25% of the DCGL, three out of four south wall total results were greater than 25% of the DCGL, all three north wall total results were greater than 25% of the DCGL, and three out of four east wall total beta-gamma results were greater than 25% of the DCGL. All total results were taken at a height of 8 ft or less. From an inspection of the individual surveys, including QA/QC surveys, the highest total activity was 53.64 dpm/100 cm^2 total alpha and 2,495.18 dpm/100 cm^2 total beta-gamma. All removable contamination results were less than or equal to

3.25 dpm/100 cm^2 removable alpha and 8.72 dpm/100 cm^2 removable beta-gamma. Refer to Table 6.11 for the summary of the survey results for the Class 3 ESUs. The maximum tissue-equivalent dose rate was 0.01 mrem/hour.

Because the initial ESU 3 (exterior walls) results were greater than the screening level for the survey unit, ESU 3 was reclassified as Class 2 as shown in Table 6.12, separated into individual survey units with new survey unit designations, and resurveyed according to an addendum to the survey plan (Appendix E). None of the areas exceeded the DCGL and, therefore, did not require reclassification as Class 1.

The Class 2 survey results of the reclassified survey units revealed the four ESUs had results below 25% of the DCGL with the exception of one individual total beta-gamma result in ESU 4 (north wall) at 1,794 dpm/100 cm^2. This result was less than the DCGL. Because all results were less than the DCGL, no further statistical analysis was performed. From an inspection of the individual surveys, including QA/QC surveys, the highest total activities were 71.52 dpm/100 cm^2 total alpha and 1,794 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than or equal to 3.5 dpm/100 cm^2 removable alpha and 12.9 dpm/100 cm^2 removable beta-gamma. The maximum tissue-equivalent dose rate was 0.006 mrem/hour. See Table 6.13 for the summary of the survey results for the Class 2 ESUs.

Building K-791-B Furnishings and Equipment Survey Units

All furnishings survey units (FSUs) for Bldg. K-791-B were classified as Class 2, based upon their as-found condition, process knowledge, and historical data, if available. Furnishings are defined as furniture, equipment racks, equipment, etc., and classified as Class 3 for newer furnishings and Class 2 as older furnishings. Radiological survey procedures were described in the survey plan (Appendix E).

The FSU had results below 25% of the DCGL. Because all results were less than the screening level, no further statistical analysis was performed. From an inspection of the individual surveys, including QA/QC surveys, all total activities were less than or equal to 17.6 dpm/100 cm^2 total alpha and 558.06 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than or equal to 7.2 dpm/100 cm^2 removable alpha and 6.26 dpm/100 cm^2 removable beta-gamma. No further analysis was required. Refer to Table 6.11 for the summary of the survey results for the K-791-B FSU.

QA/QC Surveys

A 5% verification survey of the data gathered from each survey unit was performed in each survey unit for QA/QC. All QA/QC survey data gathered were in agreement with the initial survey unit data, within the uncertainty of the measurements.

Table 6.11. Summary of initial classification contamination and dose rates for Building K-791-B

Location	Alpha total				Alpha removable				Beta-gamma total				Beta-gamma removable				Dose equivalent rate (mrem/h)
	Min.		Max.		Min.		Max.		Min.		Max.		Min.		Max.		
Interior survey units – Class 2																	
ISU 1		4.4		30.8	<	2.48		7.2	<-448.72	-448.72		1,205.58	<	4.87		8.72	0.012
Interior survey units – Class 3																	
ISU 2		4.4		44	<	2.48		3.31	<	-447.3		914.48	<	4.87		8.72	0.012
ISU 3		4.4		57.2	<	2.48		3.31	<	-63.9		1,187.12	<	4.87		13.6	0.014
ISU 4	<	0		35.2	<	2.48	<	2.48	<	-119.28		1,221.2	<	4.87		8.72	0.012
Exterior survey units– Class 3																	
ESU 1	<	-4.47		107.28	<	-4.02		3.25	<	-669.76		456	<	-3.44		8.72	0.005
ESU 2	<	-18.12		172.14	<	2.48		7.2	<	-45.64		254.28	<	4.87		8.72	0.004
ESU 3	<	0		53.64	<	-4.02		3.25	<	-406.64		2,495.18	<	-4.02		5.93	0.01
Furnishings survey units – Class 3																	
FSU 1		NR		NR		NR		NR		NR		NR		NR		NR	NR
Furnishings survey units – Class 2																	
FSU 3	<	-4.4		17.6	<	2.48		7.2		174.66		558.06	<	4.87		6.26	NR
DOE contamination limits				5,000				1,000				5,000				1,000	20

Notes: All readings are in units of disintegrations per minute (dpm)/100 cm^2.
A "<" preceding a value indicates that the result cannot be distinguished from background at the 95% confidence level.
DOE = U. S. Department of Energy.
ESU = exterior survey unit.
FSU = furnishings survey unit.
ISU = interior survey unit.
NR = not recorded.

Table 6.12. Survey unit reclassification designations for Building K-791-B

Area	Survey unit
North wall	ESU 4
South wall	ESU 5
West wall	ESU 6
East wall	ESU 7

ESU = exterior survey unit.

Table 6.13. Summary of reclassified Class 2 exterior wall contamination and dose rates for Building K-791-B

Location	Alpha total Min.	Alpha total Max.	Alpha removable Min.	Alpha removable Max.	Beta-gamma total Min.	Beta-gamma total Max.	Beta-gamma removable Min.	Beta-gamma removable Max.	Dose equivalent rate (mrem/h)
Exterior survey units – Class 2									
ESU 4	< 8.94	62.58	< 2.03	2.03	< 586.04	1,794	< 3.48	3.48	0.006
ESU 5	< 4.47	49.17	< 2.03	2.03	< 382.72	1,010.62	< 3.48	10.5	0.005
ESU 6	4.47	71.52	< 2.03	3.5	< 418.6	1,046.5	< 3.48	12.9	0.005
ESU 7	< 0	35.76	< 2.03	3.5	< -598	867.1	< 3.48	12.9	0.004
DOE contamination limits		5,000		1,000		5,000		1,000	20

Notes: All readings are in units of disintegrations per minute (dpm)/100 cm^2.
A "<" preceding a value indicates that the result cannot be distinguished from background at the 95% confidence level.
DOE = U. S. Department of Energy.
ESU = exterior survey unit.

Building K-791-B Survey Data Review and Analysis

A DOE contractor, RADCON-certified health physicist (HP), or another designated HP, reviewed, evaluated, and validated the survey results, including assessment of the QA/QC information and data, prior to generation of the radiological survey report. All surveys were conducted in accordance with the survey plan according to the contractor HP (correct number of survey units, data points per survey unit, instrumentation data, QA/QC survey performed, etc.).

Results of the surveys performed at Bldg. K-791-B and the statistical test performed on the data gathered in each survey unit indicate that the interior, exterior, and present furnishings are below the DOE surface contamination limits and within the acceptable dose equivalent rate range for building interior and exterior surfaces. Because all results were less than the DCGL, no statistical analysis of the data for each survey unit was required, and, therefore, the survey units can be released without radiological restrictions.

Building K-796-A

A total of eight radiological surveys (including all associated QA/QC surveys) were conducted at Bldg. K-796-A. The survey numbers are listed in Table 6.14. The surveys were performed during September 2006, in accordance with ETTP RADCON procedures, the survey design document[9] (BJC 2006b), and the survey plan (BJC 2006a). Radiological survey procedures and area survey units were described in the survey plan. Only one ISU was designated for the entire building and it was classified as Class 3 (see Table 6.15). Four ESUs (exterior walls) were initially classified as Class 2, as shown in Table 6.15 with one ESU (roof) classified as Class 3.

Table 6.14. ETTP current radiological surveys for Building K-796-A

200609144CYDESK001	20060914REWDESK004
20060914REWDESK001	20060914REWDESK005
20060914REWDESK002	20060914REWDESK006
20060914REWDESK003	200609158GADESK006

Table 6.15. Survey unit classifications for Building K-796-A

Interior survey unit	**Initial classification**
K-796-A all rooms (ISU 1)	Class 3
Exterior survey unit	
K-796-A north wall, including any HVACs and support equipment (ESU 1)	Class 2
K-796-A south wall, including any HVACs and support equipment (ESU 2)	Class 2
K-796-A east wall, including any HVACs and support equipment (ESU 3)	Class 2
K-796-A west wall, including any HVACs and support equipment (ESU 4)	Class 2
K-796-A roof (ESU 5)	Class 3

ESU = exterior survey unit.
HVAC = heating, ventilating, and air-conditioning.
ISU = interior survey unit.

[9] (BJC 2006b). *Design of Radiological Survey and Sampling to Support Title Transfer or Lease of Property on the Department of Energy Oak Ridge Reservation*, BJC/OR-554-R1, August.

Radiological survey procedures and area survey units were described in the survey plan (Appendix F). Hand-held meter survey results were taken and evaluated in the same way as described for K-791-B above against the values in Table 6.8.

Building K-796-A Interior Survey Units

The Bldg. K-796-A ISU consisted of one survey unit classified as Class 3. No Class 3 areas required reclassification as Class 2. All ISU results were below 25% of the DCGL. Because results were less than the screening level for the ISU, no further statistical analysis was performed. From an inspection of the individual surveys, including QA/QC surveys, all total activities were less than or equal to 72.48 dpm/100 cm^2 total alpha and 290.14 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than or equal to 3.5 dpm/100 cm^2 removable alpha and 12.9 dpm/100 cm^2 removable beta-gamma. The maximum tissue-equivalent dose rate was 0.006 mrem/hour. See Table 6.16 for the summary of the survey results for the ISU.

Building K-796-A Exterior Survey Units

Results of the Class 3 survey of the ESU 5 were below 25% of the DCGL. Because all results were less than the screening level for the ESU, no further statistical analysis was performed. From an inspection of the individual surveys, including QA/QC surveys, all total activities were less than or equal to 144.96 dpm/100 cm^2 total alpha and 290.14 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than or equal to 3.5 dpm/100 cm^2 removable alpha and 12.9 dpm/100 cm^2 removable beta-gamma.

Four ESUs (exterior walls) were classified as Class 2, as shown in Table 6.13. The Class 2 survey results revealed all four ESUs (see Table 6.16) were below 25% of the DCGL. Because all results were less than the screening level for the ESUs, no further statistical analysis was performed. From an inspection of the individual surveys, including QA/QC surveys, all total activities were less than or equal to 72.48 dpm/100 cm^2 total alpha and 290.14 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than or equal to 10.5 dpm/100 cm^2 removable alpha and 16.1 dpm/100 cm^2 removable beta-gamma. See Table 6.16 for the summary of the survey results.

QA/QC Surveys

A 5% verification survey of the data gathered from each survey unit was performed in each survey unit for QA/QC. All QA/QC survey data gathered were in agreement with the initial survey unit data, within the uncertainty of the measurements.

Building K-796-A Survey Data Review and Analysis

A DOE contractor, RADCON-certified health physicist, or another designated health physicist, reviewed, evaluated, and validated the Bldg. K-796-A survey results, including assessment of the QA/QC information and data, prior to generation of the radiological survey report. All surveys were conducted in accordance with the survey plan according to the contractor health physicist (correct number of survey units, data points per survey unit, instrumentation data, QA/QC survey performed, etc.).

Table 6.16. Summary of contamination and dose rates for Building K-796-A

Location	Alpha total		Alpha removable		Beta-gamma total		Beta-gamma removable		Dose equivalent rate (mrem/h)
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Interior survey unit – Class 3									
ISU 1	< -9.06	13.59	< 1.98	3.23	48.9	254.28	< 3.54	9.3	0.006
Exterior survey units – Class 2									
ESU 1	0	45.3	< 1.98	10.5	< -146.7	< -13.04	< 3.54	4.77	0.005
ESU 2	4.53	54.36	< 1.98	6.85	< -133.7	9.78	< 3.54	4.77	0.006
ESU 3	< -4.53	67.95	< 1.98	3.23	< -146.7	130.4	< 3.54	4.77	0.005
ESU4	0	13.59	< 1.98	3.23	< -65.2	149.96	< 3.54	16.1	0.006
Exterior survey units – Class 3									
ESU 5	40.77	144.96	< 1.98	3.23	71.12	257.54	< 3.54	9.3	0.006
DOE contamination		5,000		1,000		5,000		1,000	20

Notes: All readings are in units of disintegrations per minute (dpm)/100 cm^2.
A "<" preceding a value indicates that the result cannot be distinguished from background at the 95% confidence level.
DOE = U. S. Department of Energy.
ESU = exterior survey unit.
ISU = interior survey unit.
NR = not recorded.

Results of the surveys performed at Bldg. K-796-A and the statistical test performed on the data gathered in each survey unit indicate that the interior, exterior, and present furnishings are below the DOE surface contamination limits and within the acceptable dose equivalent rate range for the building's interior and exterior surfaces. Because all results were less than the DCGL, no statistical analysis of the data for each survey unit was required, and, therefore, the survey units can be released without radiological restrictions.

7. RISK EVALUATION

Zone 2 remedial action objectives were developed by the DVS to support the future use of ETTP as a mixed-use commercial and industrial park. Therefore, remediation criteria were designed for the protection of the future industrial worker under the assumption the worker normally would not have the potential for exposure to soils at depths below 10 ft bgs.

Within that constraint the decision rules established in the DVS were based on one or more of the following criteria:

- exceedance of a maximum RL at any location,
- exceedance of an average RL across the EU,
- unacceptable future threat to groundwater, or
- unacceptable cumulative ELCR of $> 1 \times 10^{-4}$ and HI > 1 across the EU.

Table 7.1 summarizes the decisions for the two component EUs within the K-792 Switchyard Complex and/or the decisions for the FFA sites located within the EUs. While the study area occupies only portions of EUs Z2-01 and Z2-02, for purposes of risk evaluation, the entire EU is considered because there are no barriers or impediments preventing access to the balance of the EUs that is not in the K-792 Complex.

Table 7.1. K-792 Switchyard Complex risk evaluation results

EU	Associated FFA sites	Decision rule evaluation				Risk evaluation
		Max RL	Avg RL	Risk	GW	
Z2-01	K-892-J Cooling Tower[a]	NFA	NFA	NFA	NFA	Passes
Z2-02	K-792 Switchyard Soils[b]	NFA	NFA	NFA	NFA	Passes
	K-897-N Oil Containment Structure[b]	NFA	NFA	NFA	NFA	Passes
	K-897-P Oil Containment Structure[b]	NFA	NFA	NFA	NFA	Passes
	K-1206-E Sandblasting Residue[b]	NFA	NFA	NFA	NFA	Passes

[a] Decision rule and risk evaluation information are from DOE/OR/01-2723&D2.
[b] Decision rule and risk evaluation information are from DOE/OR/01-2317&D2.
FFA = Federal Facility Agreement.
GW = groundwater.
NFA = No Further Action.
RL = remediation level.

RAs have been completed and confirmatory sampling has been obtained to support numerous NFA decisions in Zone 2. All of the EU components to the K-792 Switchyard Complex have obtained NFA concurrence; therefore, the entire footprint of the K-792 Switchyard Complex is suitable for transfer.

To determine the potential for adverse health effects associated with Bldgs. K-791-B and K-796-A, located within the K-792 Switchyard Complex, a risk screen was performed. Specifically, the objectives of the evaluation were to determine exposure to constituents based on available data for the buildings and to use those data to provide an estimate of the potential for adverse effects to human health.

The representative exposure scenarios considered for the risk screen are for an industrial/office worker. The workers are defined by individuals who spend time doing office work within a building. Two exposure scenarios were analyzed for the building risk screen: (1) an office/industrial worker who works in K-791-B and (2) an office/industrial worker who works in K-796-A. Details of the risk screen conducted for Bldgs. K-791-B and K-796-A are provided in Appendix G.

The risk calculation for the building survey units for both K-791-B and K-796-A resulted in a risk below EPA's generally acceptable target risk range of E-04 to E-06 and an HI below 1. Thus, the risk screening was considered indicative of the low likelihood of adverse health effects associated with worker exposure to the buildings.

DOE also considered risks from exposure to the larger ETTP site through evaluation of a "roving worker" who may access multiple areas at ETTP. The purpose of this effort was to evaluate the risk posed to workers when they are not inside the buildings. The roving worker scenario is considered to be applicable to all facilities at ETTP, including those transferred.

This evaluation was based on certain assumptions, including: (1) the worker will not be exposed to areas that are inaccessible due to radiological or other controls, such as fences or other barriers, or postings that prevent casual entry by a worker at a nearby building, and (2) there are no "hot spots" of contamination at ETTP that are accessible to these workers. The results of the roving worker risk screen, which used all available data, show that risks/hazards are within EPA's acceptable risk range.

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SAIC (Science Applications International Corporation) 2006. Letter, James Michael Crenshaw (SAIC) to Lesley Cusick (BJC), "Assessment of K-791-B and K-796-A Friable Asbestos," August 17.

TVA (Tennessee Valley Authority). 1998. Personal communication with Jimmy Massengill of the Tennessee Valley Authority on April 6, 1998.

APPENDIX A

STUDY AREA MAPS FROM RECORDS SEARCH

PROPOSED REAL ESTATE ACTION
OAK RIDGE RESERVATION, TN

FILES RESEARCH FOR HAZARDOUS SUBSTANCE ACTIVITY

- Proposed interim lease of the northern portion of the K-792 area
- Proposed transfer of the K-792 area including the aforementioned northern portion
- Proposed transfer of Building K-791B
- Proposed transfer of Building K-796A

The following statement is provided in support of guidance promulgated under Section 120(h) of the Comprehensive Environmental Response, Liability, and Compensation Act, as amended (CERCLA) 42 U.S.C 9620(h) and in support of regulations issued by the Environmental Protection Agency at 40 CFR part 373.

The undersigned has made a complete search of existing and available Department of Energy (DOE) records, documentation, and data within the real estate files relating to the property that is subject to the proposed real estate action listed above at the East Tennessee Technology Park within the Oak Ridge Reservation, Tennessee. The proposed action would result in transfer to the Heritage Railroad Corporation (HRC), a sub-corporation of the Community Reuse Organization of East Tennessee (CROET) under a 10 CFR 770 Proposal. The search conducted was considered reasonable with a good faith effort expended to identify whether any hazardous substances were known to have been released or disposed of on the property. The available real estate records of this office do not reflect any determinable reference that hazardous substance activity as defined by Section 101(14) of CERCLA took place on or in the property during the time the property has been owned by the United States of America.

Lands affected by this action are identified as portions of the following original acquisition tracts in which the United States of America acquired title, (having been acquired for the Atomic Energy Commission as a forerunner of the Department of Energy) by Civil Action No. 429 filed in the United States District Court for the Eastern District of Tennessee, Northern Division:

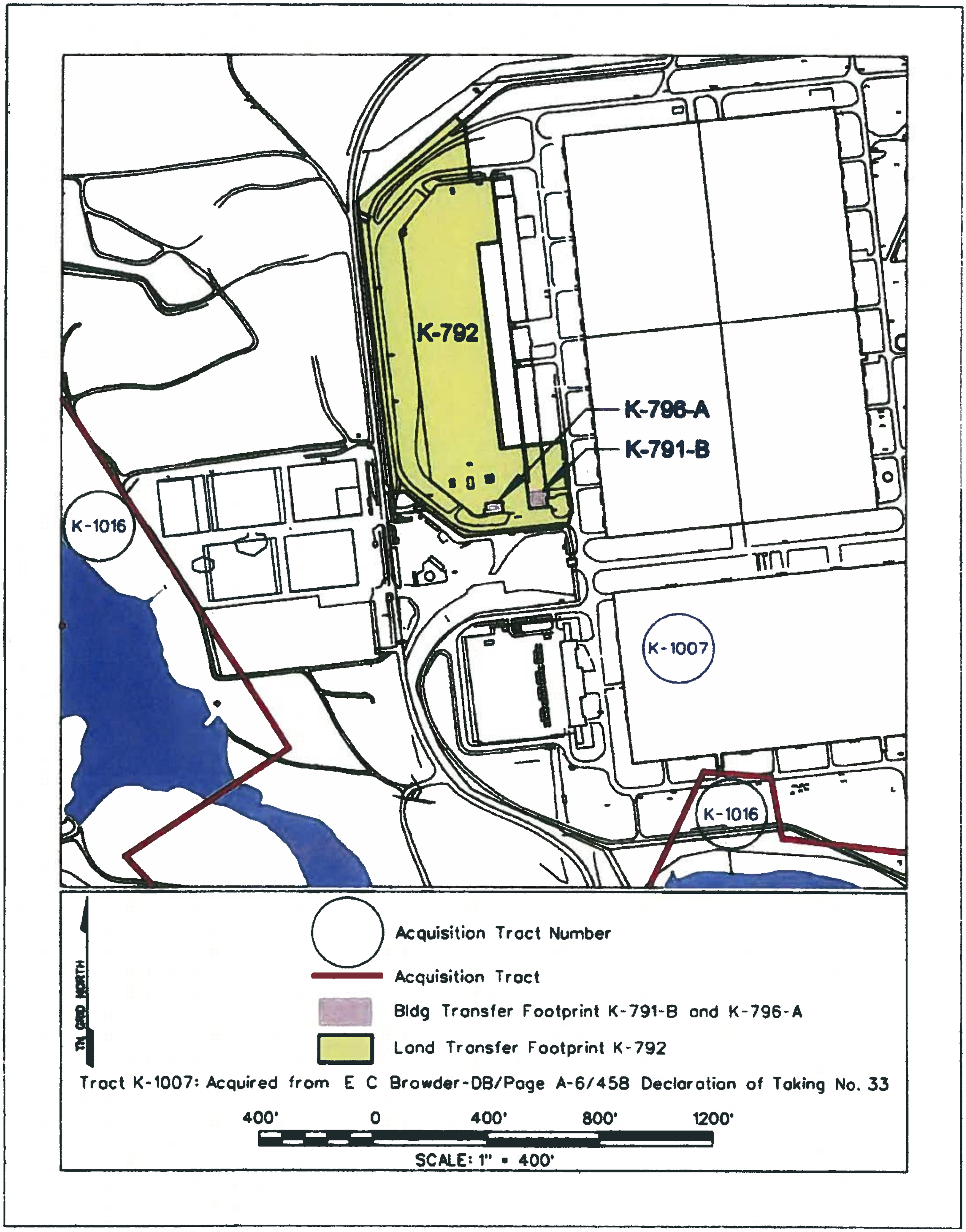
> K-792 and Buildings K-791B and K-796A are located on a portion of Tract K-1007. Judgment on Declaration of Taking number 33, dated December 27, 1943, is filed for public record in Deed Book A-6, Page 458, in the Roane County Register's Office, Tennessee.

This record shall be made a part of the CERCLA reports currently being prepared.

Cindy Hunter 9/12/06

Cindy Hunter, Realty Officer
U. S. Department of Energy
Oak Ridge Office

Attachments
Plat Exhibits


K-792
K-796-A
K-791-B
K-1016
K-1007
K-1016
TN GRID NORTH
Acquisition Tract Number
Acquisition Tract
Bldg Transfer Footprint K-791-B and K-796-A
Land Transfer Footprint K-792
Tract K-1007: Acquired from E C Browder-DB/Page A-6/458 Declaration of Taking No. 33
400' 0 400' 800' 1200'
SCALE: 1" = 400'

PROPOSED REAL ESTATE ACTION
OAK RIDGE RESERVATION, TN

FILES RESEARCH FOR HAZARDOUS SUBSTANCE ACTIVITY

- Proposed interim lease of the K-792 northern expansion area
- Proposed transfer of the K-792 northern expansion area

The following statement is provided in support of guidance promulgated under Section 120(h) of the Comprehensive Environmental Response, Liability, and Compensation Act, as amended (CERCLA) 42 U.S.C 9620(h) and in support of regulations issued by the Environmental Protection Agency at 40 CFR part 373.

The undersigned has made a complete search of existing and available Department of Energy (DOE) records, documentation, and data within the real estate files relating to the property that is subject to the proposed real estate action listed above at the East Tennessee Technology Park within the Oak Ridge Reservation, Tennessee. The proposed action would result in an interim lease then transfer to the Heritage Railroad Corporation (HRC), a sub-corporation of the Community Reuse Organization of East Tennessee (CROET) under a 10 CFR 770 Proposal. The search conducted was considered reasonable with a good faith effort expended to identify whether any hazardous substances were known to have been released or disposed of on the property. The available real estate records of this office do not reflect any determinable reference that hazardous substance activity as defined by Section 101(14) of CERCLA took place on or in the property during the time the property has been owned by the United States of America.

Lands affected by this action are identified as portions of the following original acquisition tracts in which the United States of America acquired title, (having been acquired for the Atomic Energy Commission as a forerunner of the Department of Energy) by Civil Action No. 429 filed in the United States District Court for the Eastern District of Tennessee, Northern Division:

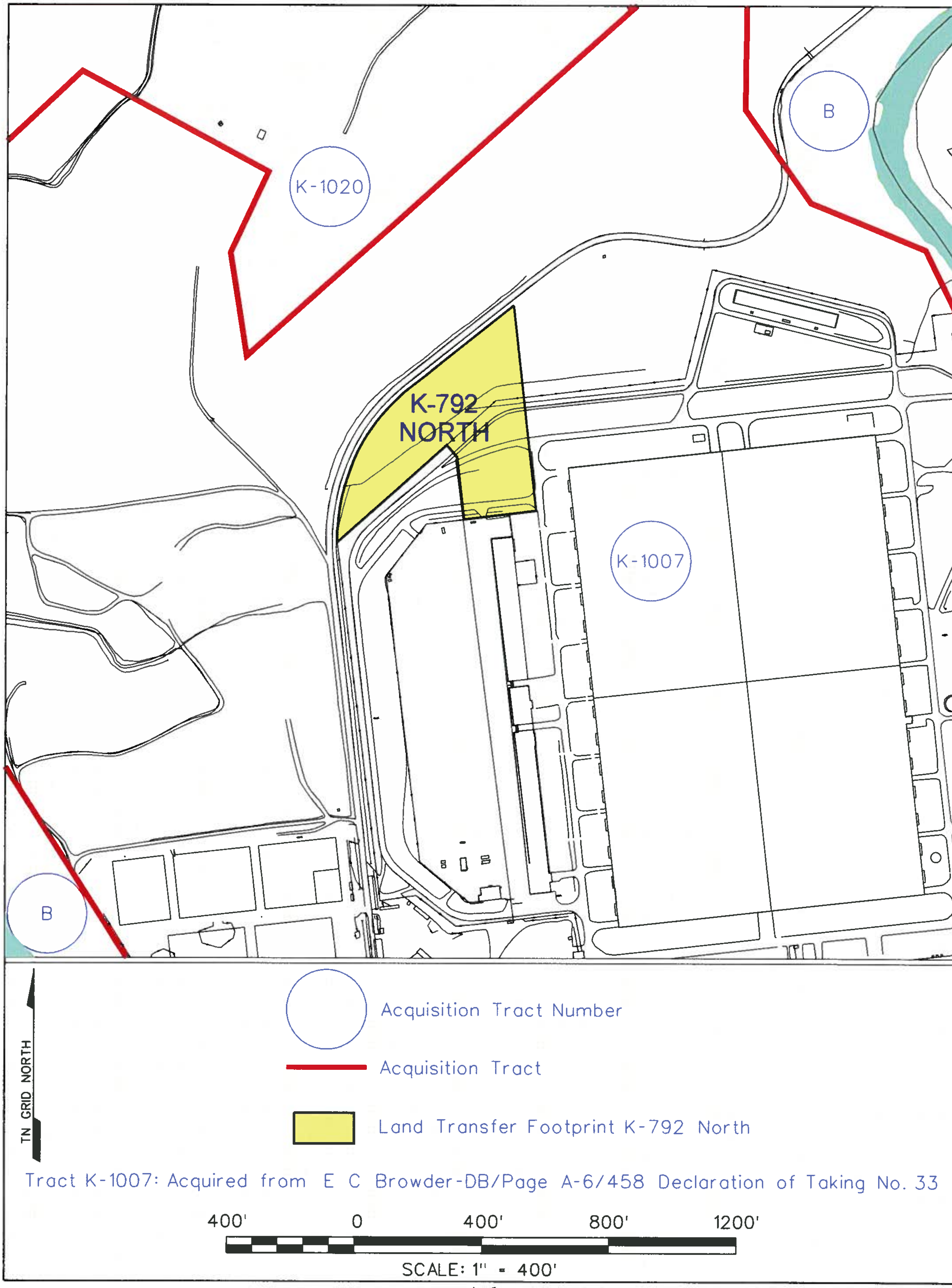
> K-792 northern expansion is located on a portion of Tract K-1007. Judgment on Declaration of Taking number 33, dated December 27, 1943, is filed for public record in Deed Book A-6, Page 458, in the Roane County Register's Office, Tennessee.

This record shall be made a part of the CERCLA reports currently being prepared.

Cindy Finn 1/20/09

Cindy Finn, Realty Officer
U. S. Department of Energy
Oak Ridge Office

Attachment
Plat Exhibit


K-1020
B
K-792
NORTH
K-1007
B
TN GRID NORTH
Acquisition Tract Number
Acquisition Tract
Land Transfer Footprint K-792 North
Tract K-1007: Acquired from E C Browder-DB/Page A-6/458 Declaration of Taking No. 33
400'
0
400'
800'
1200'
SCALE: 1" = 400'

APPENDIX B

PCCR APPROVAL LETTERS

DOE-06-0921

I-10033-0256

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DOE OVERSIGHT DIVISION
761 EMORY VALLEY ROAD
OAK RIDGE, TENNESSEE 37830-7072

December 8, 2006

Mr. David Adler
DOE FFA Project Manager
PO Box 2001
Oak Ridge, TN 37830

Dear Mr. Adler

TDEC Approval Letter
PCCR for the Zone 2 Soils, Slabs, and Subsurface Structures
East Tennessee Technology Park, Oak Ridge, Tennessee
DOE/OR/01-2317&D1, September 2006

The Tennessee Department of Environment and Conservation, DOE Oversight Division has reviewed the above referenced document pursuant to the Federal Facility Agreement for the Oak Ridge Reservation. The State approves this document upon resolution of the EPA's comments.

Questions or comments concerning the contents of this letter should be directed to Erin Dixon or Thomas Gebhart at the above address or by phone at (865) 481-0995.

Respectfully

R. Doug McCoy
FFA Project Manager

cc Jeff Crane – EPA
Pat Halsey – DOE
Donna Perez – DOE

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DOE-08-B0§4

Tonya & Bhand

I-10033-0385

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DOE OVERSIGHT DIVISION
761 EMORY VALLEY ROAD
OAK RIDGE, TENNESSEE 37830-7072

February 6, 2008

David Adler
DOE FFA Project Manager
PO Box 2001
Oak Ridge, TN 37830

Dear Mr. Adler

TDEC Approval Letter
Fiscal Year 2007 Phased Construction Completion Report for the Zone 2 Soils, Slabs, and Subsurface Structures at East Tennessee Technology Park
Oak Ridge, Tennessee
DOE/OR/01-2723&D1
September, 2007

The Tennessee Department of Environment and Conservation, DOE Oversight Division has reviewed the above referenced document pursuant to the Federal Facility Agreement for the Oak Ridge Reservation and approves the document contingent on satisfaction of comments submitted by the EPA in their transmittal dated December 17, 2007.

Questions or comments concerning the contents of this letter should be directed to Thomas Gebhart at the above address or by phone at (865) 481-0995.

Respectfully

Roger Petrie
FFA Project Manager

cc Jeff Crane – EPA
Pat Halsey – DOE
Jack Howard – DOE

er865

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DOE-07-0114

Dwg# 323283
Jcnyp

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

I-10033-0278

FEB 6 2007

Certified Mail
Return Receipt Requested

4WD-FFB

Mr. David G. Adler, Project Manager
Federal Facilities Agreement
Oak Ridge Reservation Management Group
Department of Energy
P.O. Box 2001
Oak Ridge, TN 37831

SUBJ: EPA Approval of the Fiscal Year 2006 Phased Construction Completion Report for the Zone 2 Soils, Slabs, and Subsurface Structures at East Tennessee Technology Park, Oak Ridge, Tennessee (DOE/OR/01-2317&D2)

Dear Mr. Adler:

The Environmental Protection Agency (EPA) has reviewed the above-referenced document which was submitted on January 29, 2007. The Phased Construction Completion Report (PCCR) for the Zone 2 Soils, Slabs, and Substructures serves to:

- document the characterization results of the Dynamic Verification Strategy (DVS) for the accessible Exposure Units (EU) in Zone 2;
- describe and document the risk evaluation for each EU evaluated under the DVS and the determination of whether the EU met the Zone 2 Record of Decision (ROD) requirements for unrestricted industrial use to 10 feet below ground surface;
- identify additional areas not defined in the Zone 2 ROD that require remediation based on the DVS evaluation results;
- evaluates 20 Federal Facility Agreement (FFA) sites and recommends no further action (NFA) for 11 of these sites;
- deferring NFA determination on the remaining nine FFA sites located in EU Z2-42 until the remedial action (removing approximately 30 cubic feet of soil) is complete in that EU;
- recommends 108.8 acres for unrestricted industrial use to 10 feet below ground surface; and

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- provided a qualitative assessment that the 108.8 acres had a low probability of being released for unrestricted industrial land use throughout the soil zone.

The EPA has no further comments on this document and is approving the PCCR as submitted. Although this interim remedial action document is approved, the Department of Energy should ensure that the Zone 2 Remedial Action Report (RAR) clearly specifies all land use controls implemented for all acreage within Zone 2, including all changes to the dig restrictions below 10 feet. Revising the industrial land use restrictions may require further specification of the remaining land use controls (e.g., restrictions on digging into contaminated aquifers). The current discussions to remove these controls need to conclude with an agreement between the FFA Parties regarding the specific conditions to apply prior to submitting the D1 RAR.

The EPA commends the efforts of the Remedial Action Core Team to achieve this major milestone for Zone 2. If you have any questions regarding this matter, please feel free to contact Constance Jones of my staff at (404) 562-8551.

Sincerely,

Arthur L. Collins, Acting Chief
Federal Facilities Branch
Superfund Division

cc: R. Doug McCoy, TDEC
Patricia Halsey, DOE
James Kopotic, DOE
Thomas Gebhart, TDEC
SSAB
LOC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

June 9, 2008

Certified Mail
Return Receipt Requested

4SF-FFB

Mr. David G. Adler, Project Manager
Federal Facilities Agreement
Oak Ridge Reservation Management Group
Department of Energy
P.O. Box 2001
Oak Ridge, TN 37831

SUBJ: EPA Approval of the Fiscal Year 2007 Phased Construction Completion Report for the Zone 2 Soils, Slabs, and Subsurface Structures at East Tennessee Technology Park, Oak Ridge, Tennessee (DOE/OR/01-2723&D2)

Dear Mr. Adler:

The Environmental Protection Agency (EPA) reviewed the D2 of the Fiscal Year 2007 Phased Construction Completion Report (PCCR) for the Zone 2 Soils, Slabs, and Substructures at East Tennessee Technology Park, which was submitted March 2008. The Department of Energy has addressed all comments submitted by the EPA.

Based on the information provided, the PCCR serves to:

- provide information on the execution of the Dynamic Verification Strategy (DVS) for 11 Exposure Units (EU) in Zone 2 completed in FY 2007;
- describe and document the risk evaluation for each EU evaluated under the DVS and the determination of whether the EU met the Zone 2 Record of Decision (ROD) requirements for unrestricted industrial use to 10 feet below ground surface;
- describe remedial actions performed in EUs Z2-33, Z2-35, and Z2-36;
- identify two additional areas not defined in the Zone 2 ROD that require remediation based on the DVS evaluation results;
- describe the Remedial Actions performed in Zone 2;
- evaluate approximately 195.5 acres and recommends 143 acres for unrestricted industrial use to 10 feet below ground surface;

- evaluate 16 Federal Facility Agreement sites and recommend No Further Action for 14;
- describe remaining remedial action in EU Z2-28 and EU Z2-41; and
- provide a qualitative assessment that 5 of the 11 EUs that have a probability of being released for unrestricted industrial land use throughout the soil zone.

The EPA has no further comments on this document and is approving the PCCR as submitted, which includes the erratum on that corrects Figures C.2 through C.5 in Appendix C and updates to Figures F.2 and F.4 through F.6 in Appendix F. Although this interim remedial action document is approved, the Department of Energy should ensure that the Zone 2 Remedial Action Report (RAR) clearly specifies all land use controls implemented for all acreage within Zone 2, including all changes to the dig restrictions below 10 feet. Revising the industrial land use restrictions may require further specification of the remaining land use controls (e.g., restrictions on digging into contaminated aquifers). The current discussions to remove these controls need to conclude with an agreement between the FFA Parties regarding the specific conditions to apply prior to submitting the D1 RAR.

If you have any questions regarding this matter, please feel free to contact Constance Jones of my staff at (404) 562-8551.

Sincerely,

Arthur L. Collins

Arthur L. Collins, Chief
Federal Facilities Branch
Superfund Division

cc: Roger Petrie, TDEC
Patricia Halsey, DOE
James Kopotic, DOE
Michael Travaglini, DOE
Greg Eidam, Bechtel-Jacobs
Thomas Gebhart, TDEC
SSAB
LOC

APPENDIX C

SAMPLING AND ANALYSIS PLAN FOR COLLECTION OF SOIL VAPOR AND PCB SAMPLES FOR THE K-791-B BUILDING

BJC/OR-2571
FINAL

Sampling and Analysis Plan for Collection of Soil Vapor and PCB Samples for the K-791-B Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

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

BJC/OR-2571

Sampling and Analysis Plan for Collection of Soil Vapor and PCB Samples for the K-791-B Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

Date Issued—September 2006

Prepared by
Science Applications International Corporation
Oak Ridge, Tennessee
under subcontract 23900-BA-PR007U
under work release 000500

Prepared for the
U. S. Department of Energy
Office of Nuclear Fuel Supply

BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Y-12 National Security Complex   Oak Ridge National Laboratory
under contract DE-AC05-98OR22700
for the
U. S. DEPARTMENT OF ENERGY

06-201(E)/090106

CONTENTS

FIGURES

TABLES

ACRONYMS

ACM	asbestos-containing material
DCE	dichloroethene
DOE	U. S. Department of Energy
EPA	U. S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
MCL	maximum contaminant level
NaI	sodium iodide
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
QC	quality control
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SSC	sampling subcontractor
SVOC	semivolatile organic compound
TCE	trichloroethene
VOC	volatile organic compound
Y-12	Y-12 National Security Complex

C.1. INTRODUCTION

This Sampling and Analysis Plan (SAP) describes sampling efforts to be undertaken in order to evaluate the potential for vapor intrusion of volatile organic compounds (VOCs) from shallow groundwater into the K-791-B building at the East Tennessee Technology Park (ETTP). This SAP also includes sampling activities to assess potential contamination from polychlorinated biphenyls (PCBs) within the bay area where maintenance on electrical equipment occurred.

The K-791-B building is a single-story, block-construction building built upon a slab foundation in 1978. The location of the K-791-B building is depicted in Fig. C.1.1. The building was originally connected to Bldg. K-791-S, which was located immediately north of K-791-B. These buildings were connected by a double door that was weather sealed after K-791-S was demolished.

C.2. SITE DESCRIPTION AND HISTORY

C.2.1 PAST AND PRESENT ACTIVITIES CONDUCTED AT THE K-791-B BUILDING

Operations within the 4020-ft^2 K-791-B building included maintenance of electrical components from switchyards across the Oak Ridge Reservation (ORR), including the Y-12 National Security Complex (Y-12 Complex) and the Oak Ridge National Laboratory. The machine shop historically located within Bldg. K-791-B consisted of a lathe, band saw, drill press, grinders, sanders, and a milling machine (MMES 1991). These operations were relocated to the Y-12 Complex in 1999. Figure C.2.1 presents the proposed transfer footprint for the subject area.

The bay area (Room 104) had carpeting installed over the concrete floor slab. One of the offices (Room 102) along the southern half of the building was also carpeted. The carpeting has recently been removed from these areas to enable radiological surveys to occur. The southern half of the building contains offices, breakroom, and restrooms. Room 103 has a raised floor that has been partially removed to enable radiological surveys and soil vapor sampling to occur. Portions of the floors within the southern half of Bldg. K-791-B have non-asbestos-containing material (ACM) vinyl tile. Tiled areas include the breakroom, entrance hallway, restrooms, janitorial closet, and two office areas (Fig. C.2.2). The restrooms and the janitor's closets have either ceramic or non-ACM vinyl tile floor covering installed over the concrete slab.

These rooms and the computer room were originally part of the change house that served operations in Bldg. K-791 and the K-792 Switchyard.

There are floor drains in Bldg. K-791-B located in the men's and women's restrooms, and drains are also presumed to be present beneath the raised-floor area used to house computer servers (former shower). The drains beneath the raised floor were not plugged prior to remodeling of the building. These floor drains are believed to be connected to the sanitary sewer.

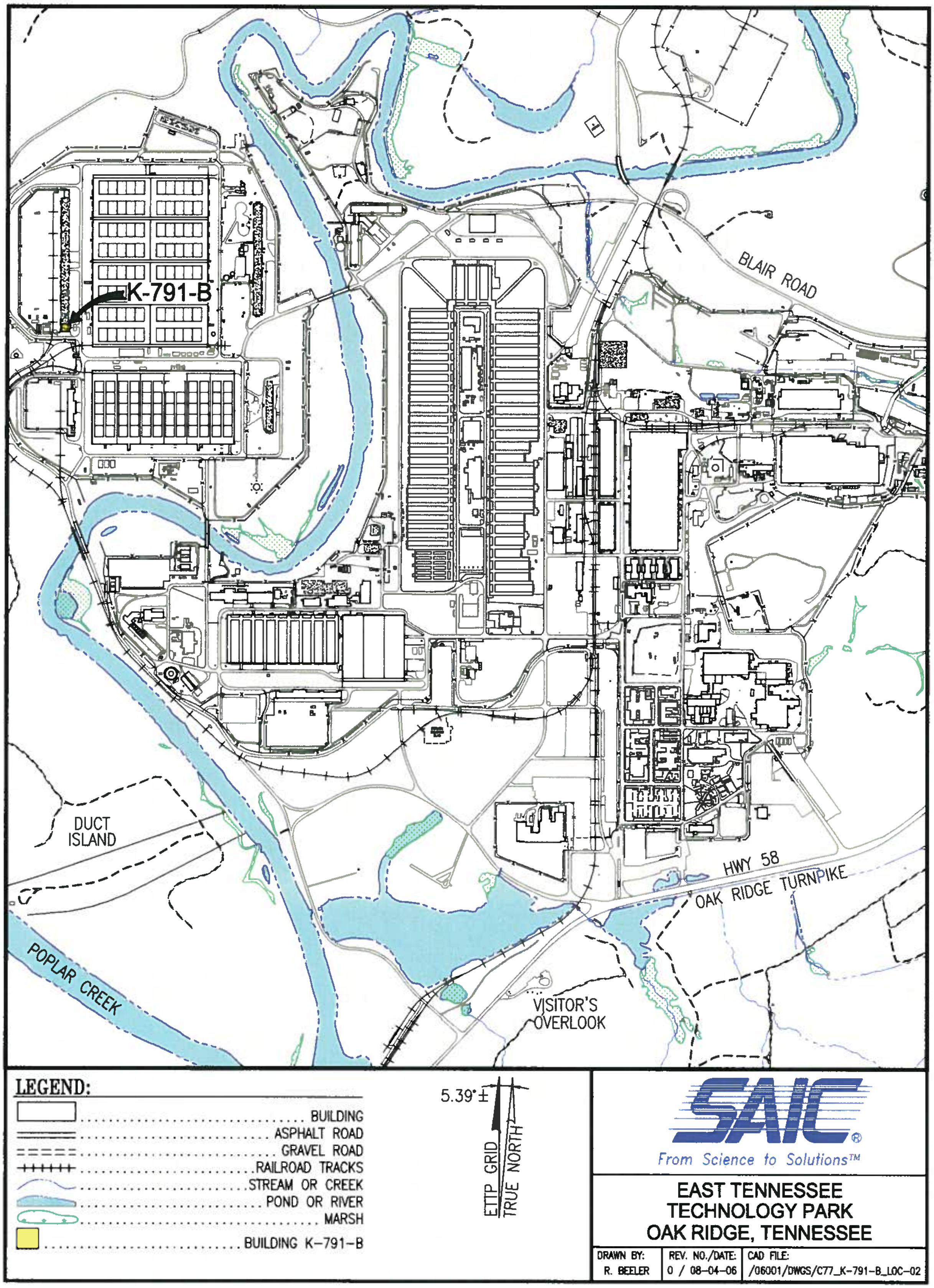

Fig. C.1.1. Location of the K-791-B building within ETTP.

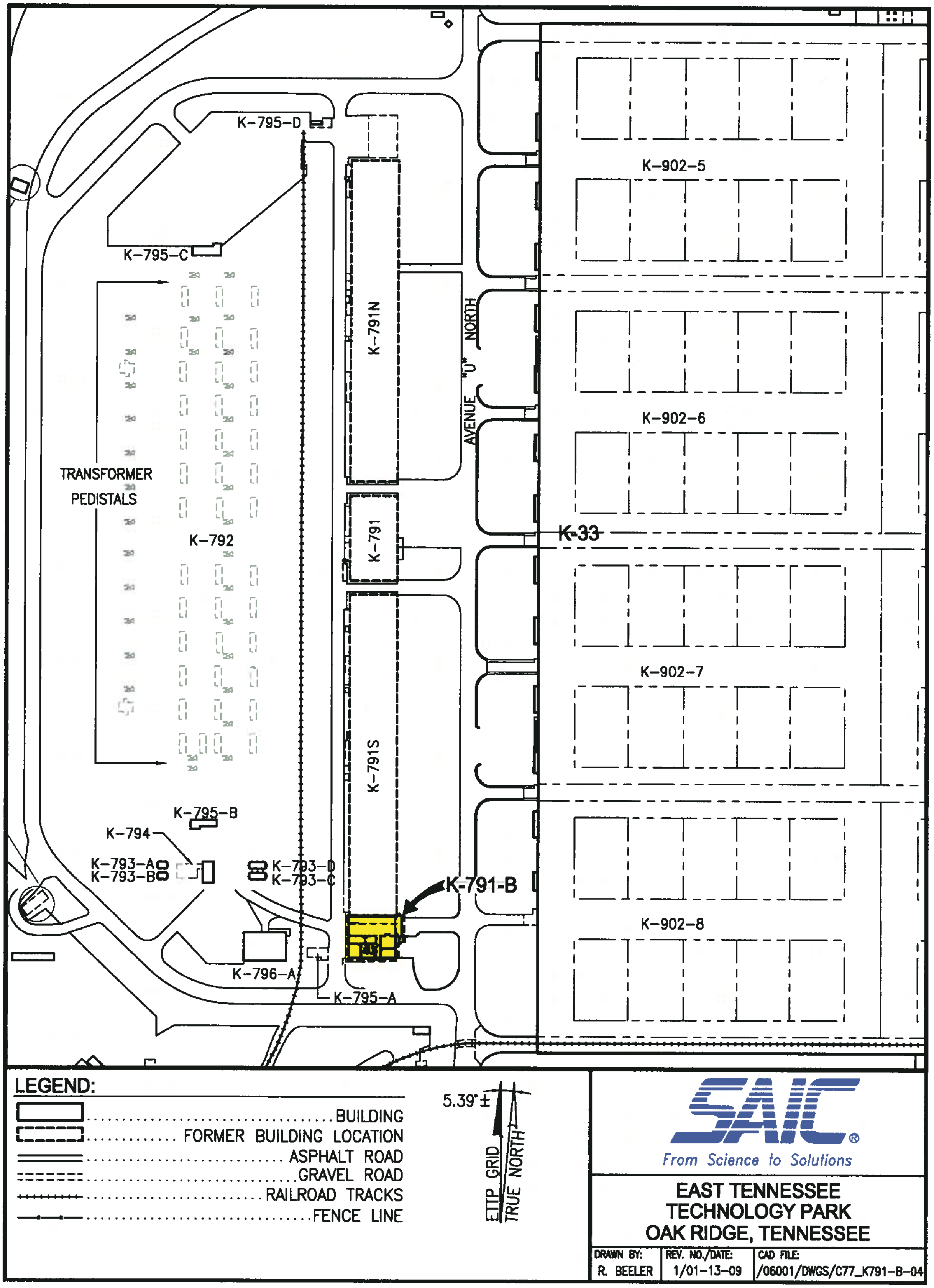

Fig. C.2.1. Transfer footprint for the K-791-B building.

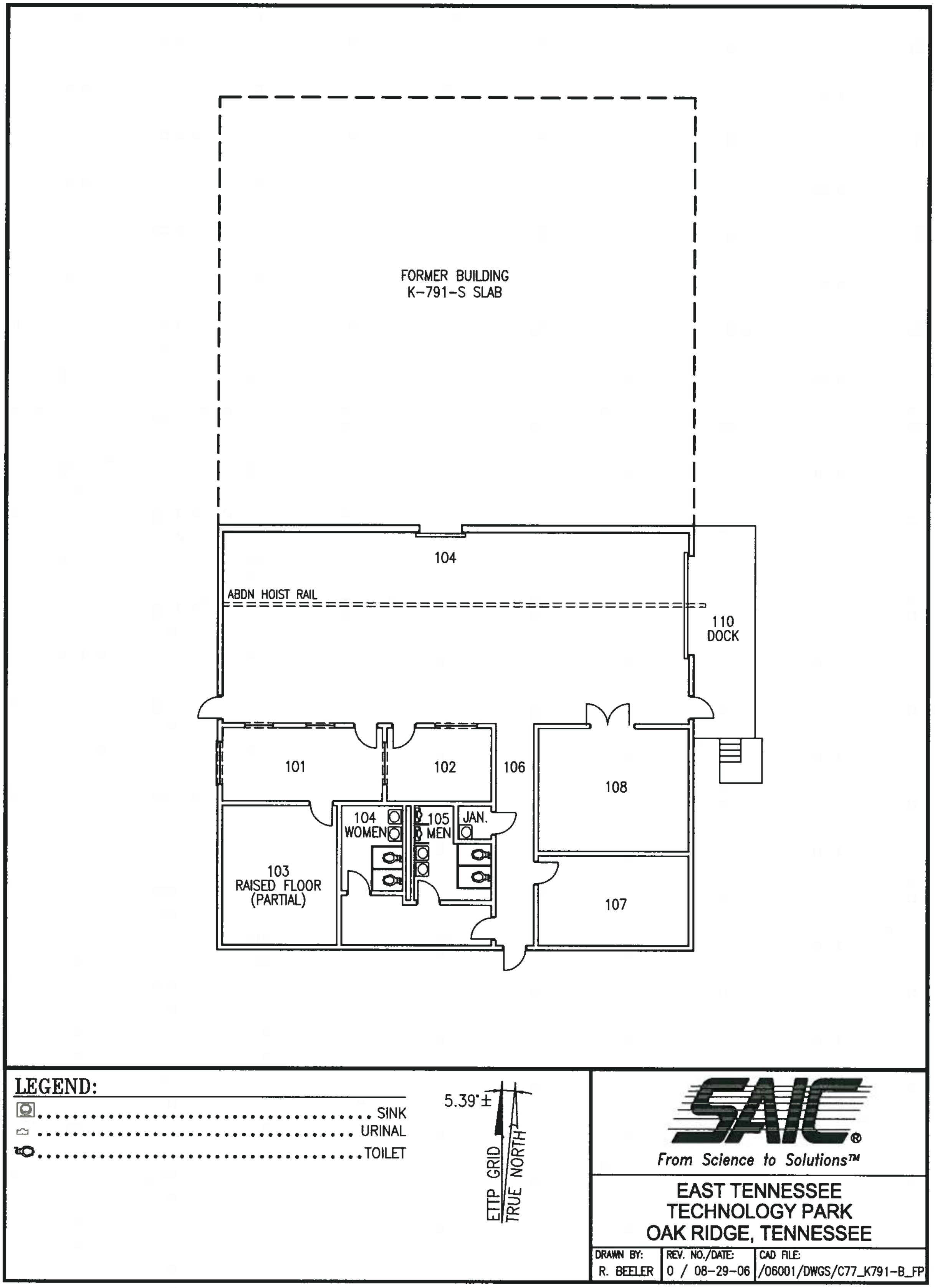

Fig. C.2.2. Building K-791-B floor plan.

C.2.2 PAST AND PRESENT ACTIVITIES FOR THE ADJACENT PROPERTY

The K-791-B building is located within the former K-792 Switchyard. Activities in the former switchyard supported operations in the K-33 building. The switchgear was removed between 1997 and 2005 during the equipment removal project involving K-29, K-31, and K-33.

Sampling of the soil in the K-792 Switchyard is not proposed in order to support the title transfer of Bldg. K-791-B. In 2006, the Environmental Management (EM) Program sampled the Zone 2, Exposure Unit (EU) 2 area, which includes the entire K-792 yard (and K-791-B). EM used the approved data quality objectives (DQOs) package for EU Z2-02 (BJC 2006a). Systematic and biased sampling occurred in accordance with the EM Dynamic Verification Strategy (DVS) process (DOE 2005). Sample results did not indicate the need for a response action. Further, the DQO package did not specify the collection of any samples in the K-791-B underlying fee. For these reasons, the only samples proposed for transfer are soil vapor samples and PCB samples as described in Chap. C.4.

C.3. EXISTING/HISTORICAL DATA

Building K-791-B is located in the northwestern portion of the ETTP. This portion of the ETTP is underlain by bedrock of the lower Chickamauga Supergroup and the upper Knox Group formations. The Knox Group in the vicinity of K-791-B consists of the Mascot Dolomite (Lemiszki 1994). The Chickamauga Supergroup formations in this area include the Pond Spring Formation and Murfreesboro Limestone (Fig. C.3.1). Structurally, these formations dip to the southeast in the vicinity of Bldg. K-791-B. The angle of dip ranges from 30 to 46 degrees to the southeast based on measurements obtained from bedrock exposures along the Clinch River west of K-791-B (Lemiszki 1994).

The bedrock formations underlying K-791-B generally consist of calcareous shales and argillaceous limestones of the Pond Spring Formation, which overlie the thick-bedded dolomite units of the Mascot Dolomite. Formations of both the Chickamauga Supergroup and the Knox Group are subject to karst development due to their high carbonate content. Significant karst development is associated with the Knox Group formations in the vicinity of the ETTP. The only documented, enterable caves in the vicinity of the ETTP are developed in the Knox Group (DOE 1996). Drilling in the K-1070-A Burial Ground located northwest of K-791-B encountered cavities ranging up to 22 ft in height; however, borehole surveys indicate that the geometry of these cavities is more indicative of vertical shaft development than an elongated passage. Although less prone to karst development than the Knox Group rocks, the Chickamauga formations are, nevertheless, also subject to the development of karst. Evidence of karst development in the Chickamauga includes cavities encountered in drilling at ETTP. Approximately 30% of the monitoring wells completed in the Chickamauga at ETTP encountered cavities ranging in size from a few inches up to 7 ft. Pre-construction topographic maps indicate the occurrence of sinkholes in the vicinity of K-791-B. A closed depression that appears to be a large sinkhole existed beneath what is now the west side of the K-33 building, and additional closed depressions existed less than 500 ft south and west of K-791-B. All of these sinkholes were filled during construction of the K-31/K-33 buildings circa 1950.

Hydrogeologic characterization data for K-791-B are limited because only two groundwater monitoring wells (BRW-027 and UNW-039) exist in the vicinity of this building (Fig. C.3.1). An additional bedrock monitoring well (BRW-067) exists approximately 800 ft northeast of K-791-B. Much of the hydrogeologic characterization data discussed below for K-791-B reflect the information available from these wells and from other available ETTP site-wide information.

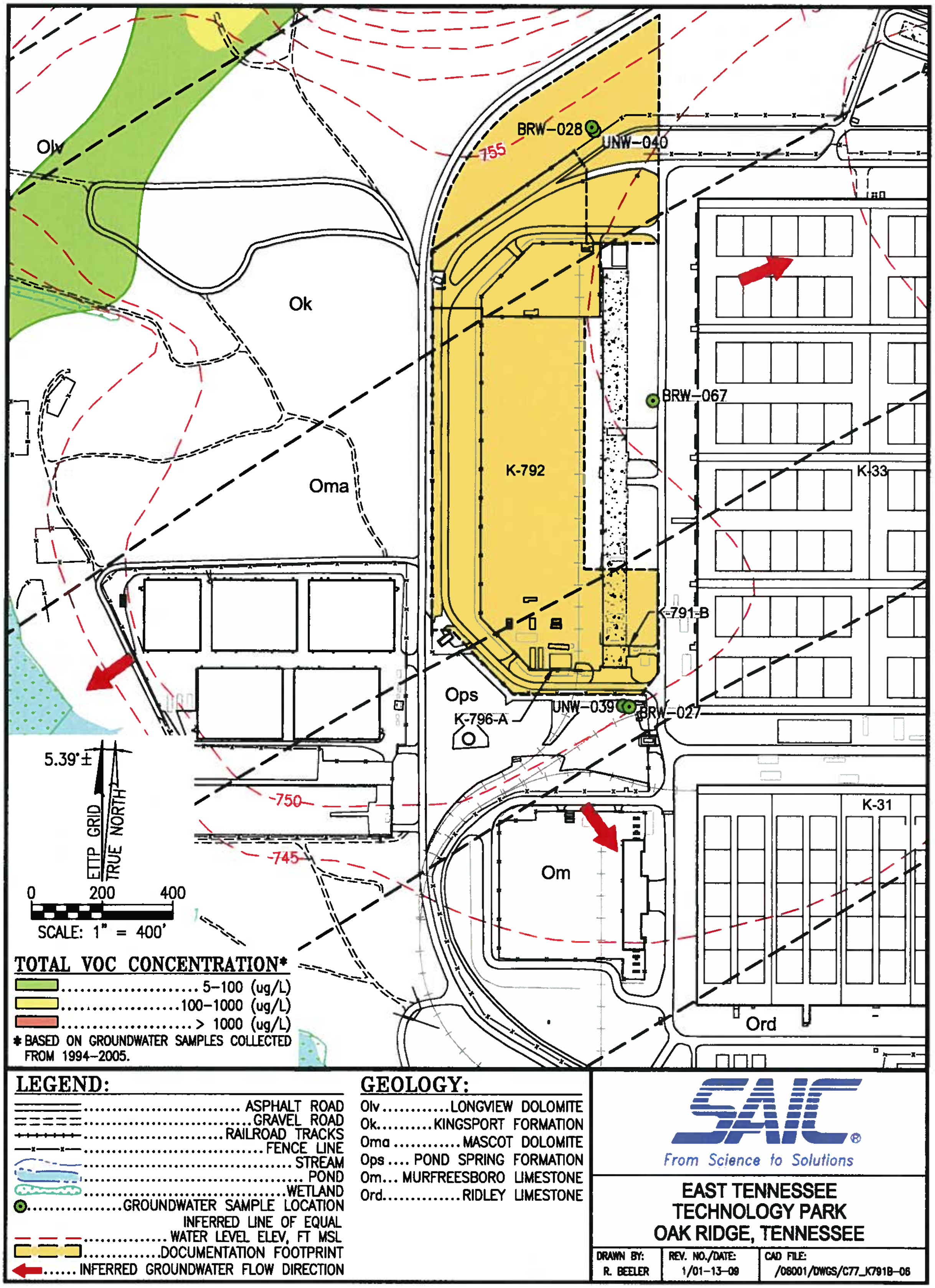

Fig. C.3.1. Geologic map of the K-791-B area.

The water table at ETTP generally mimics topography with shallow groundwater flowing from higher topographic areas to the surrounding surface water bodies. Water levels obtained from the wells in the vicinity of K-791-B indicate depths to water ranging from 10 to 20 ft below ground surface (bgs). Based on the local topography, a potentiometric high is anticipated to exist to the north/northwest of Bldg. K-791-B. Based on surface contours and the presence of nearby surface water, shallow groundwater flow from the vicinity of this high is inferred to be toward southeast, southwest, and northeast. In the vicinity of K-791-B, local shallow groundwater flow is inferred to the southeast and southwest, but these anticipated flow paths can not be definitively determined due to the limited number of wells in the unconsolidated zone.

Groundwater flowpaths in bedrock are a key uncertainty in the conceptual model of ETTP, but fractures, bedding planes, and hydraulic gradient are expected to be the primary controlling factors. Based on the data obtained during installation of monitoring wells in the vicinity of K-791-B, it appears likely that bedrock occurs at depths from approximately 10 to greater than 30 ft bgs. Based on pre-construction topographic maps, it appears that over 10 ft of fill material were potentially placed in the sinkhole east of K-791-B (under the K-33 building) during construction of ETTP.

Vertical hydraulic gradients determined from the paired unconsolidated zone and bedrock monitoring wells located southeast of K-791-B indicate downward gradients from the unconsolidated zone to the bedrock at this well pair. Hydraulic conductivity of subsurface materials has been determined from slug tests conducted in numerous monitoring wells throughout ETTP. Based on these tests, average values for the Knox and Chickamauga bedrock and the overburden materials above bedrock have been determined. These values are presented in Table C.3.1 in addition to other hydrogeologic parameters for K-791-B.

Table C.3.1. Summary of hydrogeologic conditions at K-791-B

Parameter	Site conditions
Is a groundwater plume present beneath the site?	None identified
Distance from site to nearest upgradient plume (ft)	1600
Is karst present?	Yes
Depth to bedrock (ft)	10 to >30
Depth to groundwater (ft)	10–20[a]
Are fill materials present at the site?	Yes
Composition of overburden materials present	Primarily silty clay
Shallow groundwater flow direction	Southeast and southwest
Hydraulic conductivity of overburden materials (cm/sec)	1.25E-03[b]
Hydraulic conductivity of bedrock (cm/sec)	4.28E-03[c]
Hydraulic gradient at the site (ft/ft)	8.0E-03[a]
Is a perched water table present at the site?	None identified

[a] Represents interpolated value based available data.

[b] Represents average hydraulic conductivity of unconsolidated zone at ETTP based on slug test results for wells completed in overburden materials at ETTP.

[c] Represents average hydraulic conductivity of bedrock at ETTP based on slug test results.

Due to the limited number of wells in the vicinity of Bldg. K-791-B, a groundwater plume has not been determined to exist beneath or within the vicinity of the building. The nearest identified plume is located approximately 1600 ft northwest of the building and is sourced from the K-1070-A Burial Ground. Although available potentiometric maps indicate that this plume can be considered to be upgradient of K-791-B, groundwater data and dye tracer studies indicate that flow from the K-1070-A Burial Ground is to the southwest toward the K-901 Pond and not southeastward toward K-791-B.

Analytical data for the well pair of BRW-027 and UNW-039 located within 200 ft of K-791-B indicate the general absence of VOCs in both the bedrock and unconsolidated zone materials. Only low estimated concentrations of 2-butanone (3 μg/L) and trichloroethene (TCE) [1 μg/L] were reported in one of five sampling events (August 1998) at the bedrock well BRW-027. August 1998 is the last sampling event of record for this well, and these compounds had not been detected in the previous four sampling events at this well. Only a single detection of acetone (16 μg/L) in 1994 has been reported at well UNW-039, completed in the overburden materials near K-791-B. It should be noted that this well pair is downgradient or cross-gradient of the inferred groundwater flow path, and, therefore, the absence of VOC detections does not indicate whether an upgradient plume may be present.

In contrast, several VOCs, including 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene (DCE), 1,2-DCE, chloroform, and TCE, have been detected at bedrock well BRW-067 located 800 ft northeast of K-791-B. Although VOCs have been detected at this well, the existence of a plume can not be determined because of the limited number of wells in this area. As mentioned previously, groundwater flowpaths in bedrock are a key uncertainty at ETTP, and these compounds occur in bedrock groundwater. Existing data from well BRW-027 indicate that this contamination is not present in bedrock in the area expected to be immediately downgradient of K-791-B.

Table C.3.2 summarizes the analytical results for the VOCs detected in groundwater samples collected from the monitoring wells located in the vicinity of K-791-B. Table C.3.2 represents all data available for these monitoring wells since 1994. Although VOCs have been detected above federal drinking water maximum contaminant levels (MCLs) in monitoring well BRW-067 located northeast of Bldg. K-791-B, it can be seen in Table C.3.2 that VOCs are essentially absent from groundwater in the two wells that are expected to be immediately downgradient of K-791-B.

Although the available data suggest the absence of VOCs in the groundwater in the immediate vicinity of Bldg. K-791-B, VOC contamination is present in the area upgradient of the building. As stated, there is uncertainty concerning groundwater flow paths due to the limited number of unconsolidated zone wells in the area and karst conditions in the bedrock. Additionally, the underground conduit runs between K-33 and K-791-B may serve as a preferential flow path for shallow groundwater in the area. Therefore, soil vapor sampling in K-791-B will be performed to reduce the uncertainties concerning the potential for migration of VOCs beneath the K-791-B building.

C.4. SCOPE

The overall scope of this SAP is to determine: (1) VOC concentrations in the soil vapor directly beneath the K-791-B building slab to evaluate the vapor intrusion pathway, and (2) whether PCBs are present within the bay area of the building where work on electrical equipment occurred. These overall objectives will be met by sampling soil vapor directly beneath the slab using U. S. Environmental Protection Agency (EPA)-approved methods with detection limits that are sufficient to determine if the exposure pathway is complete and conducting limited sampling for PCBs as discussed in Chaps. C.5 and C.6 of this SAP.

Table C.3.2. Summary of VOCs detected in groundwater samples from bedrock monitoring wells in the vicinity of Building K-791-B

Analyte	MCL	BRW-027					UNW-039			BRW-067				
		Sep-94	**Mar-95**	**Sep-95**	**Jun-98**	**Aug-98**	**Sep-94**	**Mar-95**	**Sep-95**	**Sep-94**	**Mar-95**	**Sep-95**	**Jun-98**	**Sep-98**
1,1,1-Trichloroethane	200	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5 U	2 J	6	2 J	4 J
1,1-Dichloroethane	NA	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1 J	2 J
1,1-Dichloroethene	7	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	2 J	5 U	7 J	3 J	6
1,2-Dichloroethene	70[a]	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	14	8	11	7	5
2-Butanone	NA	10 U	10 UJ	10 U	10 UJ	3 J	10 U	10 UJ	10 U	10 UJ	10 UJ	10 U	10 U	10 U
Acetone	NA	10 U	10 UJ	10 U	10 UJ	10 U	16 J	10 UJ	59 U	10 U	10 UJ	10 U	10 U	10 U
Chloroform	100[b]	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	1 J	5 U	1 J	1 J	5 U
Methylene chloride	5	5 U	5 U	5 U	7 UJ	5 U	6 U	5 U	5 U	5 U	5 U	1 J	17 U	6 U
Trichloroethene	5	5 U	5 U	5 U	5 UJ	1 J	5 U	5 U	5 U	**35**	**24**	**34**	**13**	**15**

[a] Represents MCL for the *cis*-1,2-dichloroethene isomer. Individual isomers not reported by laboratory.
[b] Represents MCL for total trihalomethanes.
BRW = bedrock well.
MCL = maximum contaminant level.
J = estimated concentration.
U = analyte not detected at indicated concentration.
UJ = analyte not detected at indicated concentration, which represents an estimated concentration.
Bold indicates the concentration exceeds the MCL.
NA = not available.
UNW = unconsolidated zone well.

If VOC concentrations in the soil vapor directly beneath the building slab exceed trigger levels specified in this SAP, a separate sampling plan would be developed. The plan would identify the need for indoor air samples collected at normal breathing zone height from within the building to determine exposure concentrations. If required, indoor air samples would also be collected using EPA-approved methods with detection limits that are sufficient to support the risk assessment. The objectives and rationale for soil vapor sampling are discussed in Chap. C.5 of this SAP.

Evaluation of potential PCB contamination located within the bay area of the building shall be conducted by taking swipe or chip samples at various locations. Specific sampling locations and rationale are discussed within Chap. C.6 of this SAP.

C.5. SOIL VAPOR SAMPLING RATIONALE AND DESIGN

C.5.1 SAMPLING OBJECTIVES FOR SOIL VAPOR

In accordance with the *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Draft Vapor Intrusion Guidance)* [EPA 2003] and the guidance provided by EPA Region 4 (EPA 2006), the U. S. Department of Energy (DOE)-Oak Ridge Office has developed a process to evaluate the potential for vapor intrusion at existing ETTP properties that are being transferred to the private sector.

Although the available data suggest the absence of VOCs in the groundwater in the immediate vicinity of K-791-B, VOC contamination is present in the area upgradient of the building. As stated there is uncertainty concerning groundwater flow paths due to the limited number of wells in the area and karst conditions in the bedrock. Additionally, the underground conduit runs between K-33 and K-791-B may serve as a preferential flowpath for shallow groundwater in the area. Therefore, in order to reduce the uncertainties concerning the potential for migration of VOCs beneath K-791-B, DOE plans to collect three soil vapor samples from beneath the building slab.

To achieve the objective of assessing the vapor intrusion pathway, sampling and analytical protocols for soil vapor samples must ensure that VOCs are quantified at levels that are equal to or below transport-derived trigger levels that would indicate the need for indoor air sampling in order to further evaluate the potential risks associated with the vapor intrusion pathway. For ambient air (indoor and outdoor) samples, the sampling and analytical protocols must ensure that VOCs are quantified at or below the 25-year industrial preliminary remediation goals (PRGs). The 25-year industrial PRGs are the lower of the airborne concentrations corresponding to an excess lifetime cancer risk of 10^{-5} or a hazard quotient of 0.1. A preliminary set of analytes of interest for the vapor intrusion pathway was identified for Bldg. K-791-B based upon groundwater present at ETTP. This set of analytes of interest also includes the degradation (and parent) compounds of the detected VOCs. The list of analytes of interest for Bldg. K-791-B is provided in Table C.5.1. Table C.5.1 also provides the 25-year industrial PRGs for the preliminary set of analytes of interest. Any VOCs that are currently analyzed by the groundwater program that are detected will also be reported.

Table C.5.1. Analytes of interest for the vapor intrusion pathway at Building K-791-B

Chemical	Industrial PRGs[a] (mg/m^3)
Acetone	4.6E-01
2-Butanone	7.31E-01
Carbon tetrachloride	3.58E-04
Chloroethane	1.46E00
Chloromethane	1.31E-02
Chloroform	1.78E-03
1,1 -Dichloroethane	7.31E-02
1,1-Dichloroethene	8.18E-04
1,2-Dichloroethene	4.60E-03
cis-1,2-Dichloroethene	5.11E-03
Methylene chloride	8.67E-02
1,1,1 Trichloroethane	3.21E-01
Trichloroethene	5.83E-03

[a] Industrial 25-year PRGs are the lower of the concentrations corresponding to an excess lifetime cancer risk of 10^{-5} or a hazard quotient of 0.1.

mg/m^3 = milligram per cubic meter.

PRG = preliminary remediation goal.

C.5.2 VAPOR SAMPLING DESIGN

Soil vapor action levels (or "trigger levels") will inherently be larger than risk-screening criteria due to the attenuation within the foundation materials and dilution effects as the vapors migrate into the indoor air volume of the building. Therefore, detection and reporting limits for indoor air samples are suitable to meet the established objectives for soil vapor samples. Detection and reporting limits for the VOCs to be reported in soil vapor are further identified in Chap. C.7 of this SAP.

In order to evaluate the potential for VOC vapor intrusion into the ETTP buildings designated for transfer, the general sampling approach has been divided into two phases. The first phase involves collection of soil vapor samples from directly beneath the slab of the building's lowest floor. The second phase of sampling involves collection of indoor ambient air samples at the normal breathing zone height within the building. The indoor air sampling will be implemented only if the soil vapor trigger levels were exceeded in the first-phase samples. Additional indoor air samples would be collected at locations that are separate from the soil vapor sampling stations to identify VOC contributions to indoor ambient air from any existing industrial activities that may be sources of such emissions. An outdoor ambient air sample would also be collected in this second phase to identify any potential external sources that may contribute VOCs detected in the indoor air samples.

C.5.2.1 Phase 1 – Sub-slab Soil Vapor

During the first phase, three sub-slab vapor samples will be collected directly beneath the concrete slab of Bldg. K-791-B. The VOC concentrations measured in these sub-slab soil vapor samples reflect equilibrium conditions resulting from attenuation in the soil column beneath the building. Samples taken in this fashion eliminate the uncertainty associated with partitioning modeling calculations.

The three sample locations for the sub-slab vapor sampling have been located on the basis of best professional judgment. Sample locations 01 and 02 were selected on the basis of preferential pathways. These sampling locations are in rooms with floor drains and, as such, the sub-slab piping runs provide preferential pathways if VOCs are present in the sub-surface. Sample location 03 was added to provide additional coverage throughout the building. Sample locations have been located toward the building interior to avoid in-leakage of atmospheric air that can dilute the soil vapor sample if collected near the building's edge.

The soil vapor samples shall be collected by drilling a small (~ 7/8-in.-diameter) penetration through the first floor or foundation slab (estimated thickness of 6 to 12 in.). Care shall be taken to avoid disturbance or penetration of the underlying soil or aggregate. Soil vapor samples shall be grab samples (sample collection duration of less than 60 s) collected using 5-L, pre-evacuated SUMMA canisters. Vapor samples will be taken from immediately beneath the concrete slab (estimated 4 to 6 in.). Any VOCs that are currently analyzed by the groundwater program that are detected will also be reported.

C.5.2.2 Phase 2 – Ambient Air Sampling

If VOC concentrations in the Phase 1 soil vapor sampling exceed the site-specific soil vapor trigger levels presented in Table C.5.2, then Phase 2 ambient air sampling would be performed. Sampling stations for the Phase 2 indoor air samples will generally coincide with the locations selected for sub-slab soil vapor sampling. If necessary, a sampling addendum to this plan will be developed outlining the sampling locations and number of samples required in the event an exceedance of the site-specific trigger levels occurs in the sub-slab samples.

C.5.3 SOIL VAPOR SAMPLING PLAN

Prior to the mobilization event for the soil vapor sampling, the sampling subcontractor (SSC) will obtain evacuated 5-L SUMMA canisters that have been cleaned, conditioned, and certified in accordance with the requirements of EPA Method TO-15 (EPA 1999). Other sampling system components shall be cleaned in accordance with Method TO-15 prior to assembly of the sampling system. Non-metallic parts shall be rinsed in deionized water and dried in a vacuum at 50°C. Stainless steel parts and fittings shall be cleaned in an ultrasonic bath, using methanol followed by ultrasonic cleaning in hexane. These parts shall be subsequently rinsed in deionized water and baked in a vacuum oven at 100°C for 12 to 24 h. Soil vapor samples will be collected from directly beneath the floor slab of the building.

The sampling systems for soil vapor shall be 5-L sub atmospheric SUMMA canisters. For collection of the soil vapor samples, flow restriction will be provided by a critical orifice set to charge the canisters to the desired end pressure over a 60-s sample collection period. The sampling systems shall be assembled in accordance with Fig. 1 of EPA Method TO-15 prior to mobilization to the field.

Three sub-slab soil vapor samples shall be collected during the sampling event at locations shown in Fig. C.5.1. Two alternative locations have also been identified to replace any of the designated locations if sampling is prevented by physical constraints. A penetration permit will be required for installation of the sub-slab sample ports. Floor penetrations shown in Fig. C.5.1 are approximate only and must be field located prior to installation based upon the requirements of the penetration permit. Coordinates for each station shall be recorded in the field logbook and maintained as part of the sampling record.

Prior to penetration of the floor slab, the sampling system shall be located at the stations indicated in Fig. C.5.1. Once the sampling system has been set up at the designated locations, the SSC shall record temperature, humidity, and other parameters indicated by Method TO-15. The inlet tubing to the sampling system shall be as short as possible. Samples will be taken by drilling small (~ 7/8-in.-diameter) holes through the slab, taking care not to disturb the materials underlying the slab. If a vapor barrier is present, penetration of the barrier will be required. Consistent with EPA guidance, a capped brass or stainless steel tube will be inserted into the penetration. Immediately following insertion of the sampling tube, any annular space between it and the concrete will be sealed using non-VOC-bearing caulk or other appropriate materials. After completion of the penetration, the cap shall be removed from the stainless steel tube to attach the inlet tubing for the sampling system. The inlet line of the sample system shall be attached to the floor penetration tube and the flow valves opened.

Table C.5.2. Site-specific soil vapor trigger levels indicating the need for indoor air sampling

Volatile organic compound	Trigger level (mg/m^3)	Concentration in building ($\mu g/m^3$)	Alpha[a]
1,1,1-Trichloroethane	3.01E+02	3.21E+02	1.07E-03
1,1,2,2-Tetrachloroethane	6.67E-01	7.05E-01	1.06E-03
1,1,2-Trichloroethane	1.91E+00	2.04E+00	1.07E-03
1.1.2-Trichloro-1,2,2-trifluoroethane	4.04E+03	4.38E+03	1.08E-03
1,1-Dichloroethane	6.88E+01	7.31E+01	1.06E-03
1,1-Dichloroethene	7.55E-01	8.18E-01	1.08E-03
1,2-Dichloroethane	1.43E+00	1.57E+00	1.10E-03
1,2-Dichloroethene	3.95E+00	4.60E+00	1.16E-03
1,2-Dichloropropane	5.45E-01	5.83E-01	1.07E-03
2-Butanone	6.84E+02	7.31E+02	1.07E-03
2-Hexanone	2.51E+01[b]	2.92E+01[b]	1.16E-03
4-Methyl-2-pentanone	4.06E+02	4.38E+02	1.08E-03
Acetone	4.13E+02	4.60E+02	1.11E-03
Benzene	4.05E+00	4.38E+00	1.08E-03
Bromodichloromethane	2.62E+00	2.38E+00	9.11E-04
Bromoform	1.39E+01	1.02E+01	7.38E-04
Bromomethane	6.89E-01	7.31E-01	1.06E-03
Carbon disulfide	9.31E+01	1.02E+02	1.10E-03
Carbon tetrachloride	3.35E-01	3.58E-01	1.07E-03
Chlorobenzene	2.75E+00	2.92E+00	1.06E-03
Chloroethane	1.38E+03	1.46E+03	1.06E-03
Chloroform	1.62E+00	1.78E+00	1.10E-03
Chloromethane	1.24E+01	1.31E+01	1.06E-03
cis-1,2-Dichloroethene	4.81E+00	5.11E+00	1.06E-03
cis-1,3-Dichloropropene	2.80E+00	2.92E+00	1.04E-03
Dibromochloromethane	1.26E+01	1.02E+01	8.11E-04
Ethylbenzene	3.49E+01	3.72E+01	1.06E-03
Methylene chloride	7.92E+01	8.67E+01	1.09E-03
Styrene	1.38E+02	1.46E+02	1.06E-03
Tetrachloroethene	6.66E+01	7.05E+01	1.06E-03
Toluene	5.39E+01	5.83E+01	1.08E-03
trans-1,2-Dichloroethene	9.67E+01	1.02E+02	1.06E-03
trans-1,3-Dichloropropene	4.91E+00	5.11E+00	1.04E-03
Trichloroethene	5.45E+00	5.83E+00	1.07E-03
Vinyl chloride	4.23E+00	4.65E+00	1.10E-03

[a] Alpha is the infinite source indoor attenuation coefficient and directly correlates the soil vapor concentration with the indoor air concentration.

[b] Toxicity data for 2-Hexanone are unavailable; values represent those associated with n-Hexane – a surrogate chemical approved for use for this purpose by Region 4 of the U. S. Environmental Protection Agency.

mg/m^3 = milligram per cubic meter.

$\mu g/m^3$ = microgram per cubic meter.

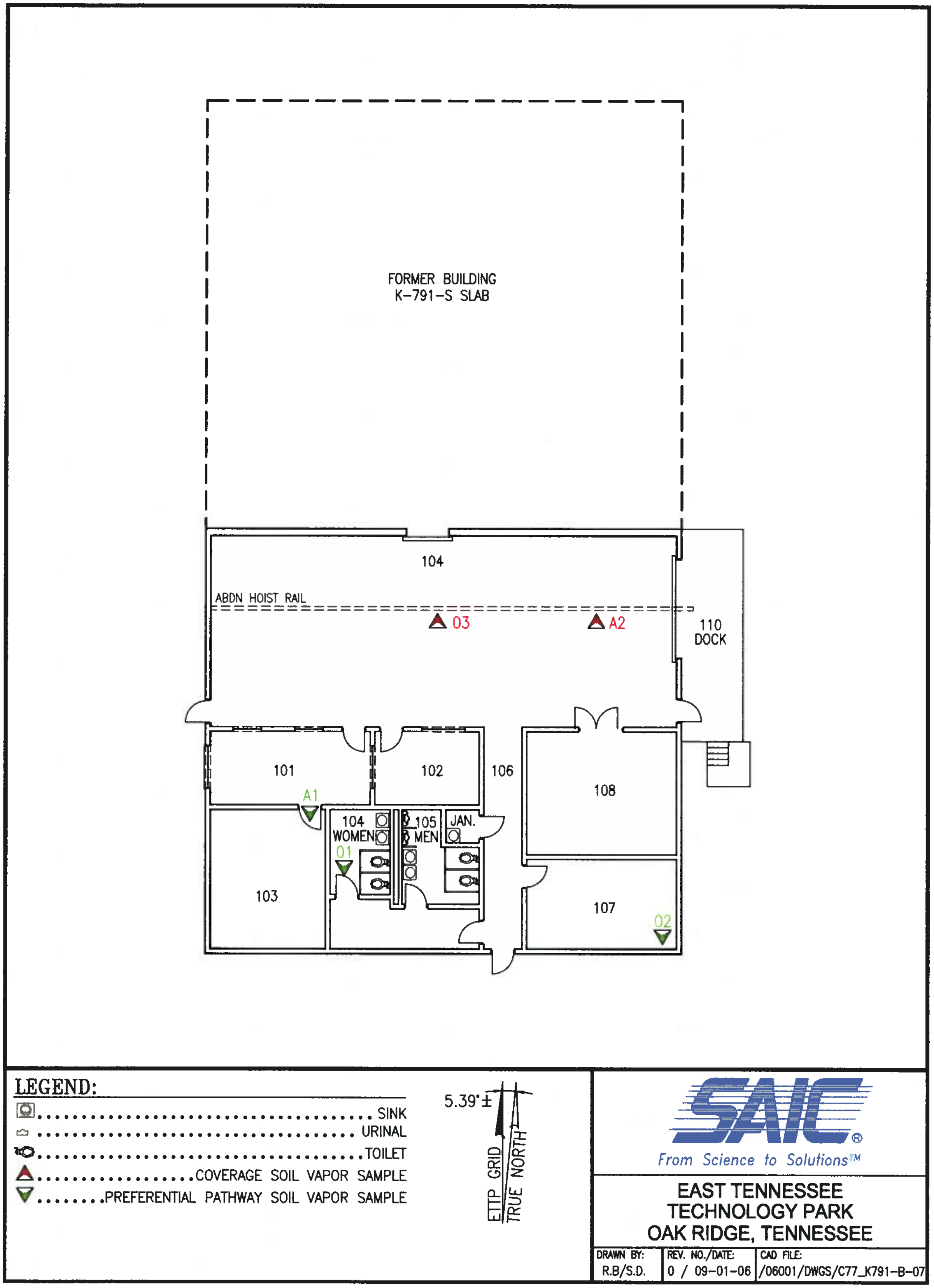

Fig. C.5.1. Building K-791-B soil vapor sample locations.

Upon collection of the soil vapor samples, the SUMMA canisters shall be valved closed. The sampling line shall be disconnected from the canister and the canister removed from the sampling system. Upon collection of the samples, the final pressure shall be checked and recorded. The final system pressure should be ~ 88 Kpa (~ 90 to 100 torr vacuum).

Upon collection of the SUMMA canister, it shall be labeled as required by the SSC's standard operating procedures (SOPs). The canisters shall be shipped to the laboratory in a canister shipping case as required by the manufacturer's specifications or the SSC's SOPs.

After the soil vapor sample has been collected, the floor penetration or sampling port shall be temporarily sealed by an appropriate method. The temporary seal shall ensure that the sampling port or penetration is vapor tight and does not present a trip hazard. After completion of all soil vapor sampling, the floor penetration shall be sealed by cutting it level with the floor or removing it and backfilling with a non-shrinking grout. A layer of non-shrinking grout should be applied to the floor, covering the penetration and immediate surrounding area, and it should be finished smooth with the surrounding surface.

Decontamination of sampling equipment used for collection of air samples is not required. All equipment, including the sampling inlet line, used at each sampling station shall be dedicated.

Field quality control (QC) samples are required only for ambient air sampling. The required QC samples are field equipment blanks and a duplicate. All samples shall have the appropriate radiological screening performed to comply with shipping protocols. Sample container, preservation, and holding time requirements are summarized in Table C.5.3.

C.5.4 ANALYTICAL REQUIREMENTS, DATA MANAGEMENT, AND REPORTING FOR SOIL VAPOR SAMPLES

Soil vapor air samples will be quantitated for VOCs using gas chromatography/mass spectrometry analyses as required by EPA Method TO-15 (EPA 1999). Any of the VOCs indicated in Table C.5.4 that are detected shall be reported. Additionally, the laboratory shall report up to 20 tentatively identified compounds. Quantitation of VOCs in air samples shall meet the reporting and detection limits specified in Table C.5.4.

Data obtained from this sampling event shall be managed in accordance with the requirements of the *Data Management Implementation Plan for the Reindustrialization Program, Oak Ridge, Tennessee*, BJC/OR-865, Rev. 2 (BJC 2006b). Results will be provided to EPA Region 4 and to the Tennessee Department of Environment and Conservation DOE-Oversight Office.

Table C.5.3. Sample container, preservation, and holding time requirements for Building K-791-B soil vapor samples

Event	Sample number[a]	Sample type	Parameters of concern	Analytical protocols	Container type/volume	Preservation	Holding time
			Vapor sub-slab sampling				
01	NS-01-61-791B-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 days
01	NS-02-61-791B-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 days
01	NS-03-61-791B-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 days
01	NS-A1-61-791B-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 days
01	NS-A2-61-791B-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 days

[a] Sample station nomenclature is NS-AA-BC-DDDD-EE where the AA field is the station number 01-89. Stations A1–A2 are alternate locations to replace any designated stations where samples could not be obtained. The BC field designates the fiscal year and sampling event in that year. The DDDD field designates the building number. The EE field designates the sample type where V = soil vapor; I = indoor air; A = outdoor air; B = blank; and D = duplicate.

[b] Volatile organics of concern for air sampling at Bldg. K-791-B include Acetone, 2-Butanone, Carbon tetrachloride, Chloroethane, Chloroform, Chloromethane 1,1-Dichloroethane, Methylene chloride, Trichloroethene, 1,2-Dichloroethene, 1,1-Dichloroethene, *cis*-1,2,-Dichloroethene, and 1,1,1-Trichloroethane.

Table C.5.4. VOCs and their respective quantitation and detection limits for soil vapor sampling

Analyte	Analytical method	Air quantitation level (mg/m^3)	Air detection level (mg/m^3)
1,1,1-Trichloroethane	TO-15	3.01E+02	3.01E+01
1,1,2,2-Tetrachloroethane	TO-15	6.67E-01	6.67E-02
1,1,2-Trichloroethane	TO-15	1.91E+00	1.91E-01
1,1,2-Trichloro-1,2,2-trifluoroethane	TO-15	4.04E+03	4.04E+02
1,1-Dichloroethane	TO-15	6.88E+01	6.88E+00
1,1-Dichloroethene	TO-15	7.55E-01	7.55E-02
1,2-Dichloroethane	TO-15	1.43E+00	1.43E-01
1,2-Dichloroethene	TO-15	3.95E+00	3.95E-01
1,2-Dichloropropane	TO-15	5.45E-01	5.45E-02
2-Butanone	TO-15	6.84E+02	6.84E+01
2-Hexanone	TO-15	2.51E+01[a]	2.51E+00[a]
4-Methyl-2-pentanone	TO-15	4.06E+02	4.06E+01
Acetone	TO-15	4.13E+02	4.13E+01
Benzene	TO-15	4.05E+00	4.05E-01
Bromodichloromethane	TO-15	2.62E+00	2.62E-01
Bromoform	TO-15	1.39E+01	1.39E+00
Bromomethane	TO-15	6.89E-01	6.89E-02
Carbon disulfide	TO-15	9.31E+01	9.31E+00
Carbon tetrachloride	TO-15	3.35E-01	3.35E-02
Chlorobenzene	TO-15	2.75E+00	2.75E-01
Chloroethane	TO-15	1.38E+03	1.38E+02
Chloroform	TO-15	1.62E+00	1.62E-01
Chloromethane	TO-15	1.24E+01	1.24E+00
cis-1,2-Dichloroethene	TO-15	4.81E+00	4.81E-01
cis-1,3-Dichloropropene	TO-15	2.80E+00	2.80E-01
Dibromochloromethane	TO-15	1.26E+01	1.26E+00
Ethylbenzene	TO-15	3.49E+01	3.49E+00
Methylene chloride	TO-15	7.92E+01	7.92E+00
Styrene	TO-15	1.38E+02	1.38E+01
Tetrachloroethene	TO-15	6.66E+01	6.66E+00
Toluene	TO-15	5.39E+01	5.39E+00
trans-1,2-Dichloroethene	TO-15	9.67E+01	9.67E+00
trans-1,2-Dichloropropene	TO-15	4.91E+00	4.91E-01
Trichloroethene	TO-15	5.45E+00	5.45E-01
Vinyl chloride	TO-15	4.23E+00	4.23E-01
Xylenes (total)	TO-15	1.38E+01	1.38E+00

[a]Toxicity data for 2-Hexanone are unavailable; values represent those associated with n-Hexane – a surrogate chemical approved for use for this purpose by U. S. Environmental Protection Agency Region 4.

mg/m^3 = milligram per cubic meter.

µg/m3 = microgram per cubic meter.

VOC = volatile organic compound.

C.6. PCB SWIPE SAMPLING RATIONALE AND DESIGN

C.6.1 SAMPLING OBJECTIVES FOR FLOOR SAMPLES

Operations within Bldg. K-791-B included the maintenance of electrical components from switchyards across the ORR. Because some of this equipment was filled with oil that contained PCBs, there is a potential for PCB contamination to be present within the building. A review of available documentation does not indicate that a release of PCBs has occurred; however, in order to ensure that PCBs are not present within the building, limited sampling will be conducted within the northern portion of the building in the former bay area where the historic electrical maintenance activities were conducted. Therefore, the objective of this sampling is to demonstrate whether or not PCBs are present in or upon the floor of the former bay area of Bldg. K-791.

As indicated in Sect. C.2.1, this area of the floor had carpeting installed over the concrete floor. This carpeting has been removed to facilitate sampling. Swipe sampling is the method preferred by DOE to determine whether PCB contamination may be present in this portion of the building. However, removal of the carpeting revealed that the concrete floor had been painted at some time, and it is unknown whether the floor was painted when the historic maintenance activities were conducted. Additionally, some glue residue remains on portions of the floor. Both the paint and glue residue may serve as a barrier to adsorption of PCBs during swipe sampling or may function as a fixation medium preventing release of PCBs during swipe sampling. These conditions may require the use of an alternate sampling technique. Therefore, this SAP specifies two different methods to meet the initial characterization objective to demonstrate that PCBs are not present in the former bay area of K-791. Selection of the appropriate method will be determined by the field sampling team based on their professional judgment upon inspection of the conditions of the floor.

C.6.2 PCB SAMPLING DESIGN

Sampling conducted under this SAP is concerned with obtaining data to determine if the PCBs are present within the former bay area of the building where electrical maintenance work occurred. Characterization requirements for porous surface PCB remediation wastes are specified in 40 *Code of Federal Regulation* (*CFR*) 761, Subpart N. The procedures of Subpart N involve overlaying the subject area with a 3-m^2 (~ 10-ft^2) grid system and collecting samples at each grid node or within each grid in the area of concern. The grid sampling system of 40 *CFR* 761, Subpart N, is applied both vertically (i.e., to walls) and horizontally (i.e., to floors). Because there is no documentation of PCB release within the building, the sampling protocol for the number, type, or location of samples specified by Subpart N of 40 *CFR* Part 761 is not applicable.

The preferred method of sampling to determine if a release of PCBs occurred in the building from former maintenance activities involves the use of standard swipe samples. As indicated above, the former bay area had carpeting glued directly to the concrete floor. Although the carpeting has been removed to facilitate sampling, some glue residue remains on the floor. It is unknown whether this residue will act as a barrier to collection of swipe samples from the floor or whether any PCB contamination that may be present may be partially fixed within the residue. If these conditions are determined to exist and are judged to potentially make swipe samples inaccurate, chip samples of the surface material (glue residue, concrete and paint) will be collected for analysis of PCBs. The field sampling team will determine which sampling procedure to use based on an evaluation of the floor's condition at the time that sub-slab vapor sampling locations discussed in Sect. C.5.3 are identified. Based on the evaluation of the field sampling team, all samples for PCB analysis will be either swipe or chip samples. A mixture of swipe and chip samples will not be collected. Sample locations were selected using professional judgment based upon the size of the room and traffic areas where PCBs might be expected in the event that releases occurred during maintenance activities.

C.6.3 SAMPLING PLAN

Swipe or chip samples shall be taken at six locations in Room 104 of Bldg. K-791-B as shown in Fig. C.6.1. Samples will consist of either swipe or chip samples (only one type of sample will be collected). In addition, one (1) co-located duplicate sample will be taken at sample location 6. The duplicate shall consist of a second sample being taken immediately adjacent to the primary sample acquired at the sample station. Samples will be analyzed for total PCBs and individual PCB Aroclors as indicated in Table C.6.1. Table C.6.2 provides the sample station location in both latitude and longitude and the state plane coordinate system to allow for identification of the sample location using a Global Positioning System unit.

Swipe samples for PCBs shall be collected from the surfaces of the floors in accordance with 40 *CFR* 761.123 and the Sampling Sub-Contractor's (SSC's) contract specifications. The sampling procedure provided below is intended only as a general description and does not supersede 40 *CFR* 761.123 or the SSC's standard specifications.

The swipe samples shall be collected using a standard sized, swipe gauze pad saturated with hexane. This sampling medium shall be prepared in the lab and stored in a sealed glass container until use. The wiping medium should not be removed from its container until the area to be sampled has been delineated. The area to be sampled will be delineated by a 10-cm by 10-cm template. At each designated location, the swipe sample will be collected from the area of the grid indicated in Fig. C.6.1. Upon removal of the sampling medium from its container, it should be firmly wiped over the entire area to be sampled. Upon collection of the sample, the wipe shall be packaged in amber glass containers and sent to a laboratory for analysis using EPA Method 8082 (EPA 1993) as indicated in Table C.6.3.

Chip samples will consist of surface-level concrete chips collected from the indicated sample location on the containment bay floor to an approximate depth of 0.125 to 0.25 in. The sample material will be collected using a precleaned pneumatic hammer or hand-held hammer and chisel in accordance with the SSC's contract specifications. Concrete chip sample material shall be size reduced in the field to less than 0.5-in. diameter. A minimum of 200 g of sample material shall be collected from each location and transferred to a 4-oz glass jar. These samples shall be quantified for total PCBs and individual Aroclors as previously indicated.

C.6.4 ANALYTICAL REQUIREMENTS, DATA MANAGEMENT, AND REPORTING FOR PCB SAMPLES

Analytical protocols for the analyte groups specified for the samples collected under this SAP are indicated in Table C.6.4. Samples for chemical analyses of PCBs will be measured by the relevant EPA SW-846 Methods.

Data obtained from this sampling event shall be managed in accordance with the requirements of the *Data Management Implementation Plan for the Reindustrialization Program, Oak Ridge, Tennessee*, BJC/OR-865, Rev. 2 (BJC 2006). Results will be provided to EPA Region 4 and to the Tennessee Department of Environment and Conservation DOE-Oversight Office.

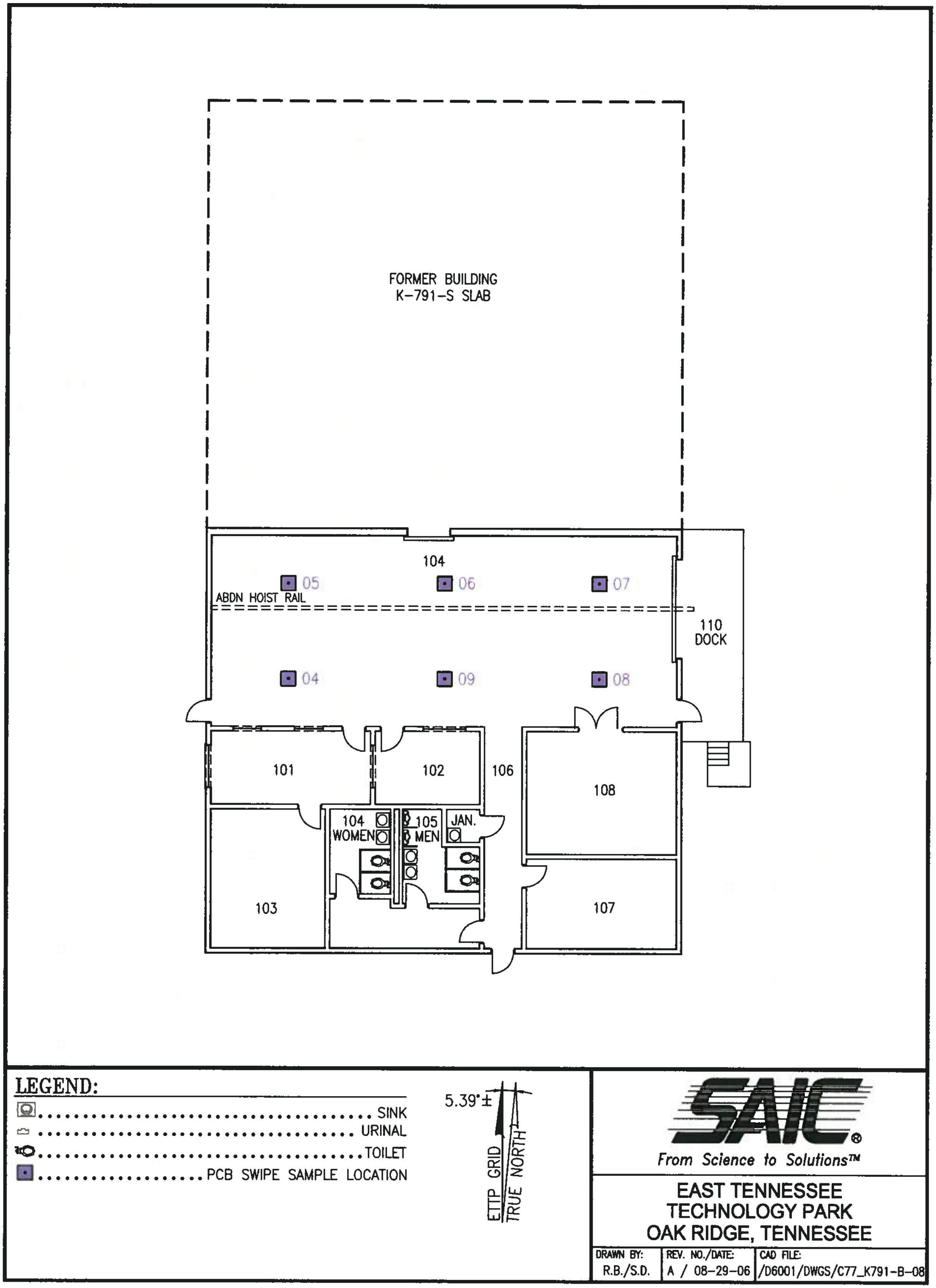

Fig. C.6.1. K-791-B PCB swipe sampling locations.

Table C.6.1. Summary of analyses for PCB samples in Building K-791-B

Sample number[a]	Sample type	Total PCBs	PCBs (Aroclors)
NS-04-01-791B	Swipe or chip	X	X
NS-05-01-791B	Swipe or chip	X	X
NS-06-01-791B	Swipe or chip	X	X
NS-07-01-791B	Swipe or chip	X	X
NS-08-01-791B	Swipe or chip	X	X
NS-09-01-791B	Swipe or chip	X	X
NS-06-D1-791B[b]	Swipe or chip	X	X
NS-ER-01-791B[c]	Rinsate	X	X

[a] Sample numbers 01–03 are assigned to the soil vapor samples.

[b] Sample designation NS-XX-D1-ZZZZ indicates a replicate sample.

[c] Samples designated NS-ER and NS-FB are equipment rinsates and field blanks, respectively.

PCB = polychlorinated biphenyl.

Table C.6.2. Coordinates for PCB swipe or chip sampling stations

Sample ID	Latitude	Longitude	State Planar East	State Planar North
NS-04-01-791B	35.9373330	84.4065928	2440177.2495	5877.04.6262
NS-05-01-791B	35.9373386	84.4065192	2440199.0028	587707.0393
NS-06-01-791B	35.9373443	84.4064456	2440220.7560	587709.4524
NS-07-01-791B	35.9373074	84.4064413	2440222.2443	587696.0361
NS-08-01-791B	35.9373017	84.4065149	2440200.4911	587693.6230
NS-09-01-791B	35.9372961	84.4065885	2440178.7378	587691.2098
NS-06-D1-791B	35.9373386	84.4065192	2440199.0028	587707.0393

Table C.6.3. Container, preservation, and holding time requirements for Building K-791-B samples

Sample location	Parameters of concern	Container type/volume	Preservation	Holding time
Location 04	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 05	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 06	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 07	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 08	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 09	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Equipment rinsates	PCBs (Aroclors)	(2) 1-L A-glass – Teflon™ closure[c]	Cool 4°C	7 days[b]
Field blanks	PCB (Aroclors)	(2) 1-L A-glass – Teflon™ closure[c]	Cool 4°C	7 days[b]

[a] Holding time is 14 days to extraction and 40 days from extraction to analysis.
[b] Holding time is 7 days to extraction and 40 days from extraction to analysis.
[c] A-glass = amber glass.
PCB = polychlorinated biphenyl.

Table C.6.4. Analytical requirements for Building K-791-B PCB swipe or chip samples

Parameters of concern	Analytical protocols
PCBs (Aroclors)	8082

PCB = polychlorinated biphenyl.

C.7. REFERENCES

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APPENDIX D

SAMPLING AND ANALYSIS PLAN FOR COLLECTION OF SOIL VAPOR AND PCB SWIPE SAMPLES FOR THE K-796-A BUILDING

BJC/OR-2612
FINAL

Sampling and Analysis Plan for Collection of Soil Vapor and PCB Swipe Samples for the K-796-A Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

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

BJC/OR-2612
FINAL

Sampling and Analysis Plan for Collection of Soil Vapor and PCB Swipe Samples for the K-796-A Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

Date Issued—September 2006

Prepared by
Science Applications International Corporation
Oak Ridge, Tennessee
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Prepared for the
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BECHTEL JACOBS COMPANY LLC
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East Tennessee Technology Park
Y-12 National Security Complex Oak Ridge National Laboratory
under contract DE-AC05-98OR22700
for the
U. S. DEPARTMENT OF ENERGY

06-239(E)/090106

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TABLES

ACRONYMS

bgs	below ground surface
DCE	dichloroethene
DOE	U. S. Department of Energy
EPA	U. S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
MCL	maximum contaminant level
ORR	Oak Ridge Reservation
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
QC	quality control
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SSC	sampling subcontractor
SVOC	semivolatile organic compound
TCE	trichloroethene
TDEC	Tennessee Department of Environment and Conservation
VOC	volatile organic compound

D.1. INTRODUCTION

This Sampling and Analysis Plan (SAP) describes sampling efforts to be undertaken in order to evaluate the potential for vapor intrusion of volatile organic compounds (VOCs) from shallow groundwater into the K-796-A building at the East Tennessee Technology Park (ETTP). This SAP also includes sampling activities to assess potential contamination from polychlorinated biphenyls (PCBs) that may have resulted from historical electrical equipment maintenance. This SAP presents the rationale and details of soil vapor sampling and PCB swipe sampling that will be conducted to support transfer. These activities are being performed to determine: (1) the potential for vapor intrusion into the building by VOCs that may be present within the subsurface via groundwater, and (2) the potential of PCB contamination in the bay area that may have resulted from electrical maintenance activities.

The K-796-A building is a single-story, pre-engineered, steel-framed, corrugated metal panel building built upon a slab foundation in 1978. The location of the K-796-A building is depicted in Fig. D.1.1.

D.2. SITE DESCRIPTION AND HISTORY

D.2.1 PAST AND PRESENT ACTIVITIES CONDUCTED AT THE K-796-A BUILDING

The 2780-ft^2 K-796-A building was constructed in 1978. A review of historic site maps and aerial photos of the immediate vicinity of Bldg. K-796-A did not find any evidence of facilities in the area prior to construction of Bldg. K-796-A. From its construction until 1998, Bldg. K-796-A was historically used for storage of electrical maintenance supplies and tools that were used to support power transmission and switchyard operations at the three plants on the Oak Ridge Reservation (ORR). During this time, various items of electrical equipment (such as small transformers, oil-filled circuit breakers, and oil-filled transformer bushings) were temporarily stored at Bldg. K-796-A. During active operations of the K-31 and K-33 process buildings, Bldg. K-796-A was also used to conduct overflow maintenance from Bldg. K-791-B located east of K-796-A and also involved in electrical equipment maintenance. This overflow maintenance had the potential to include equipment that contained PCB dielectric fluids. The K-796-A facility was also used for fabrication of conduit runs. Equipment used in those activities included conduit benders, pipe-threading equipment, and band saws. The floor plan for the building is provided in Fig. D.2.1.

Between 2000 and 2005, Bldg. K-796-A was used by the U. S. Department of Energy (DOE) contractor performing decontamination activities in the K-29, K-31, and K-33 process buildings. They used K-796-A for conference space. The interior walls indicated in Fig. D.2.1 were constructed during that time.

A walkdown of the facility, conducted in August 2006, determined that there are not any floor drains in the facility. There is no potable water, fire water, or sanitary sewer connections, including underground service lines in the building. Electrical service is provided by an overhead 220-V line.

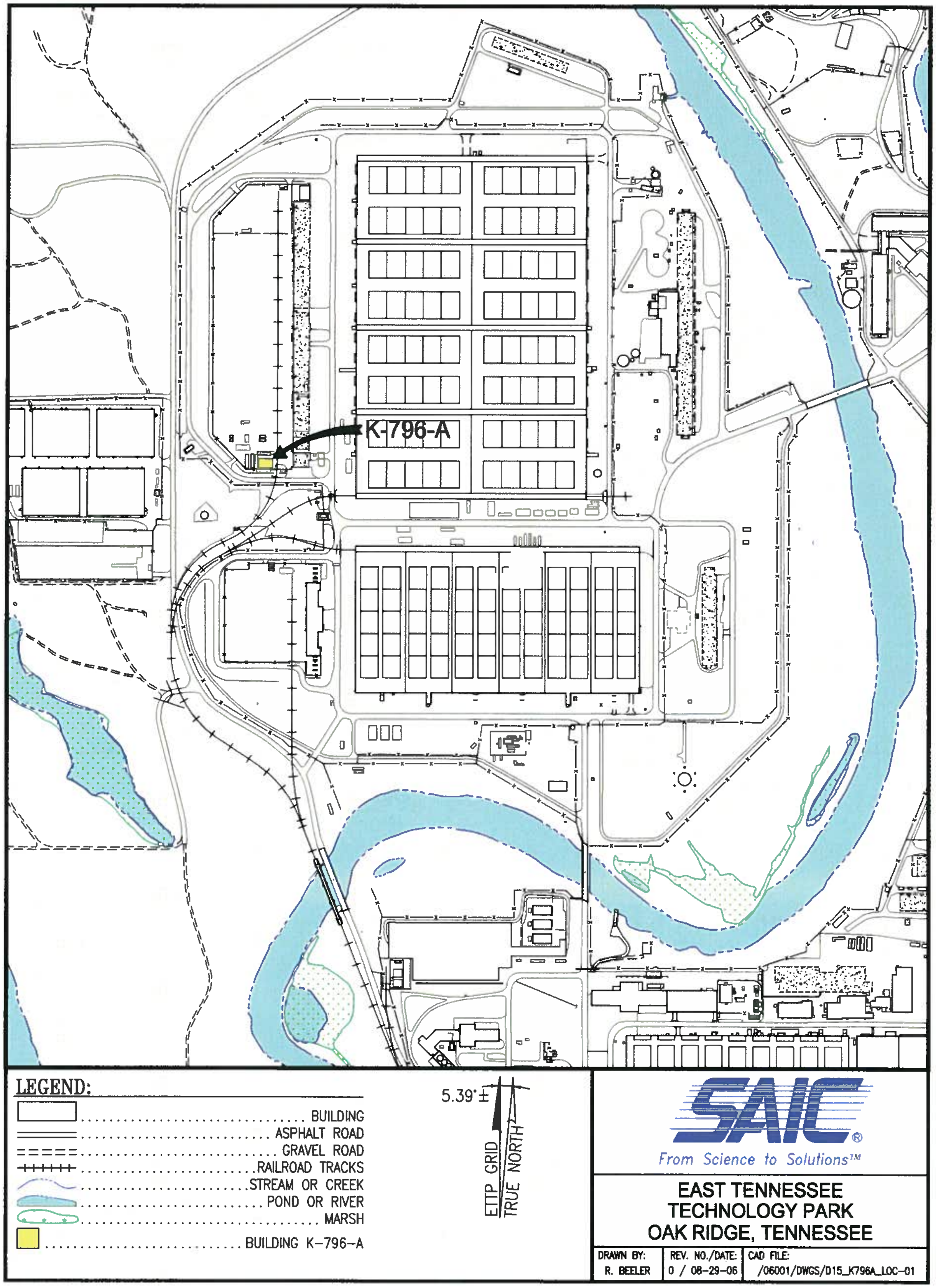

Fig. D.1.1. Location of the K-796-A building within ETTP.

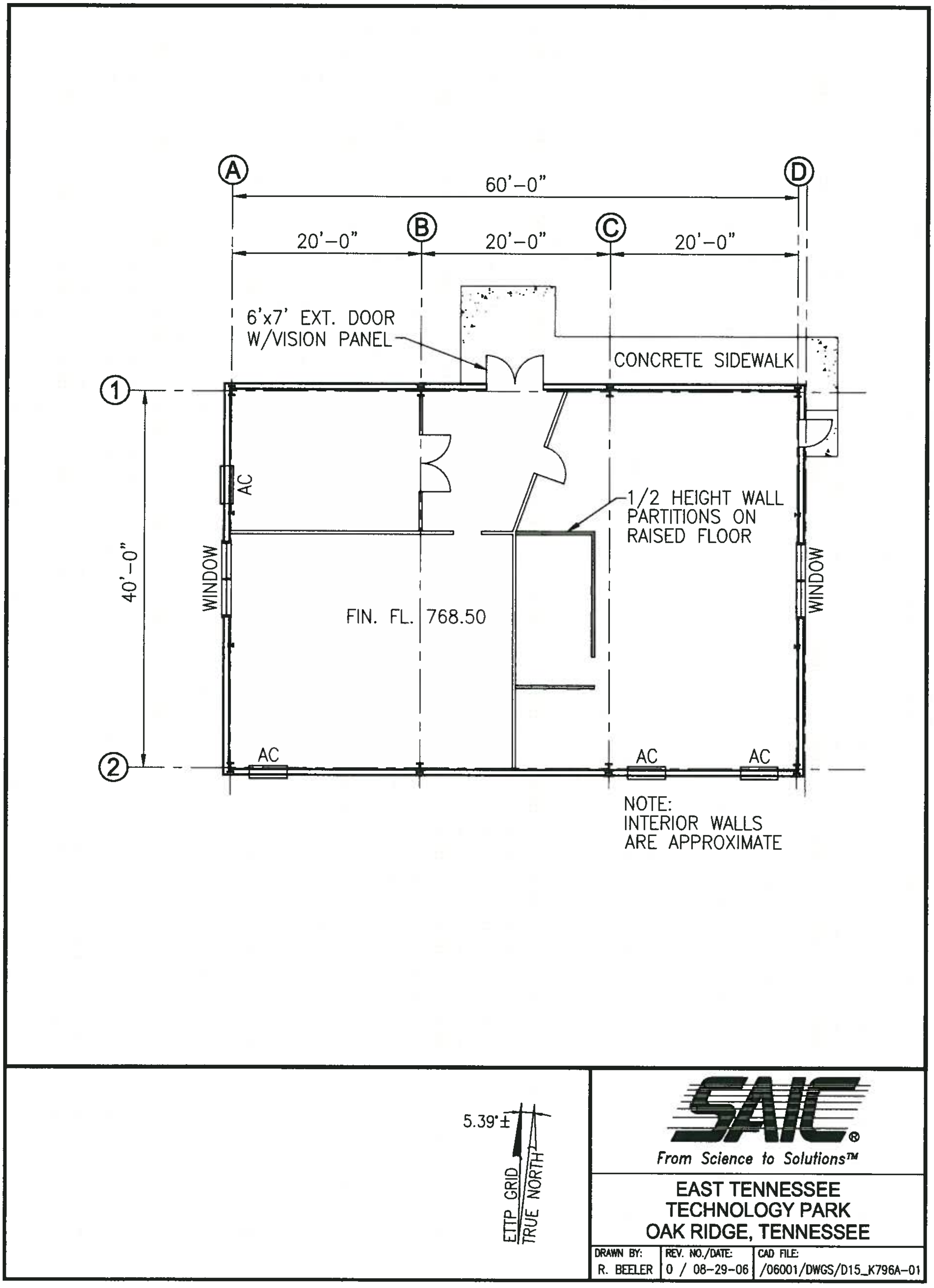

Fig. D.2.1. Building K-796-A floor plan.

D.2.2 PAST AND PRESENT ACTIVITIES FOR THE ADJACENT PROPERTY

The K-796-A building is located within the former K-792 Switchyard. Activities in the former switchyard supported operations in the K-33 building. The switchgear was removed between 1997 and 2005 during the equipment removal project involving K-29, K-31, and K-33.

Sampling of the soil in the K-792 Switchyard is not proposed in order to support the title transfer of Bldg. K-796-A. In 2006, the Environmental Management (EM) Program sampled the Zone 2, Exposure Unit (EU) 2 area, which includes the entire K-792 yard (and K-791-B). EM used the approved data quality objectives (DQOs) package for EU Z2-02 (BJC 2006a). Systematic and biased sampling occurred in accordance with the EM Dynamic Verification Strategy (DVS) process (DOE 2005). Sample results did not indicate the need for a response action. Further, the DQO package did not specify the collection of any samples in the K-791-B underlying fee. For these reasons, the only samples proposed for transfer are soil vapor samples and PCB samples as described in Chap. D.4.

D.3. EXISTING/HISTORICAL DATA

Building K-796-A is located in the northwestern portion of the ETTP. This portion of the ETTP is underlain by bedrock of the lower Chickamauga Supergroup and the upper Knox Group formations. The Knox Group in the vicinity of Bldg. K-796-A consists of the Mascot Dolomite (Lemiszki 1994). The Chickamauga Supergroup formations in this area include the Pond Spring Formation and Murfreesboro Limestone (Fig. D.3.1). Structurally, these formations dip to the southeast in the vicinity of Bldg. K-796-A. The angle of dip ranges from 30 to 46 degrees to the southeast based on measurements obtained from bedrock exposures along the Clinch River west of K-796-A (Lemiszki 1994).

The bedrock formations underlying K-796-A generally consist of calcareous shales and argillaceous limestones of the Pond Spring Formation, which overlie the thick-bedded dolomite units of the Mascot Dolomite. Formations of both the Chickamauga Supergroup and the Knox Group are subject to karst development due to their high carbonate content. Significant karst development is associated with the Knox Group formations in the vicinity of the ETTP. The only documented, enterable caves in the vicinity of the ETTP are developed in the Knox Group (DOE 1996). Drilling in the K-1070-A Burial Ground, located northwest of K-796-A, encountered cavities ranging up to 22 ft in height; however, borehole surveys indicate that the geometry of these cavities is more indicative of vertical shaft development than an elongated passage. Although less prone to karst development than the Knox Group rocks, the Chickamauga formations are, nevertheless, also subject to the development of karst. Evidence of karst development in the Chickamauga includes cavities encountered in drilling at ETTP. Approximately 30% of the monitoring wells completed in the Chickamauga at ETTP encountered cavities ranging in size from a few inches up to 7 ft. Pre-construction topographic maps indicate the occurrence of sinkholes in the vicinity of K-796-A. A closed depression that appears to be a large sinkhole existed beneath what is now the west side of the K-33 building, and additional closed depressions existed less than 500 ft south and west of K-796-A. All of these sinkholes were filled during construction of the K-31/K-33 buildings circa 1950.

Hydrogeologic characterization data for K-796-A are limited because only two groundwater monitoring wells (BRW-027 and UNW-039) exist in the vicinity of this building (Fig. D.3.1). An additional bedrock monitoring well (BRW-067) exists approximately 800 ft northeast of K-796-A. Much of the hydrogeologic characterization data discussed below for K-796-A reflect the information available from these wells and from other available ETTP sitewide information.

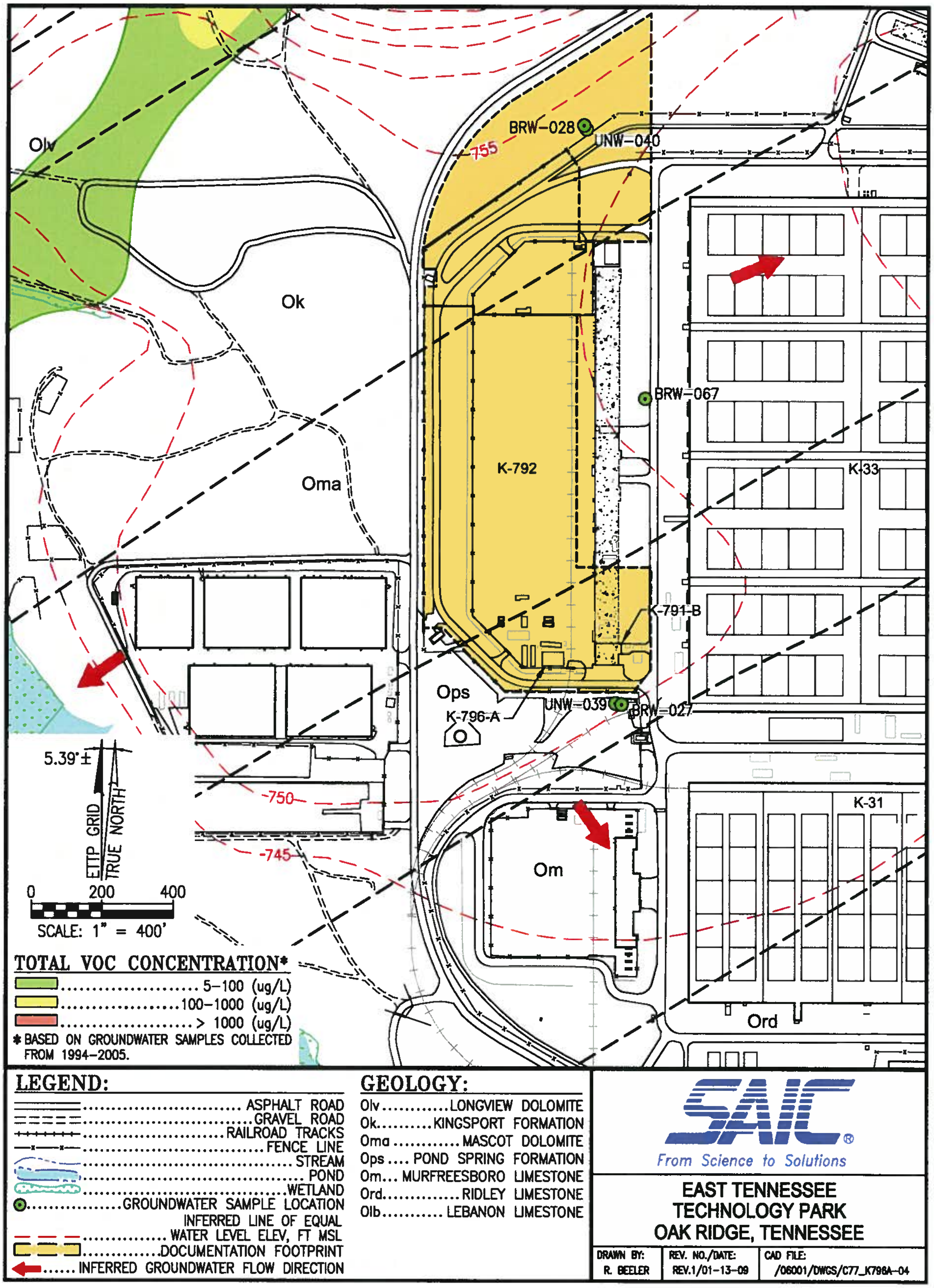

Fig. D.3.1. Geologic map of the K-796-A area.

The water table at ETTP generally mimics topography with shallow groundwater flowing from higher topographic areas to the surrounding surface water bodies. Water levels obtained from the wells in the vicinity of K-796-A indicate depths to water ranging from 10 to 20 ft below ground surface (bgs). Based on the local topography, a potentiometric high is anticipated to exist to the north/northwest of Bldg. K-796-A. Based on surface contours and the presence of nearby surface water, shallow groundwater flow from the vicinity of this high is inferred to be toward southeast, southwest, and northeast. In the vicinity of K-796-A, local shallow groundwater flow is inferred to the southeast and southwest, but these anticipated flow paths cannot be definitively determined due to the limited number of wells in the unconsolidated zone.

Groundwater flowpaths in bedrock are a key uncertainty in the conceptual model of ETTP, but fractures, bedding planes, and hydraulic gradient are expected to be the primary controlling factors. Based on the data obtained during installation of monitoring wells in the vicinity of K-796-A, it appears likely that bedrock occurs at depths from approximately 10 to greater than 30 ft bgs. Based on pre-construction topographic maps, it appears that over 10 ft of fill material were potentially placed in the sinkhole east of K-796-A (under the K-33 building) during construction of the ETTP.

Vertical hydraulic gradients determined from the paired unconsolidated zone and bedrock monitoring wells located southeast of K-796-A indicate downward gradients from the unconsolidated zone to the bedrock at this well pair. Hydraulic conductivity of subsurface materials has been determined from slug tests conducted in numerous monitoring wells throughout ETTP. Based on these tests, average values for the Knox and Chickamauga bedrock and the overburden materials above bedrock have been determined. These values are presented in Table D.3.1, in addition to other hydrogeologic parameters for K-796-A.

Table D.3.1. Summary of hydrogeologic conditions at K-796-A

Parameter	Site conditions
Is a groundwater plume present beneath the site?	None identified
Distance from site to nearest upgradient plume (ft)	1600
Is karst present?	Yes
Depth to bedrock (ft)	10 to >30
Depth to groundwater (ft)	10–20[a]
Are fill materials present at the site?	Yes
Composition of overburden materials present	Primarily silty clay
Shallow groundwater flow direction	Southeastand southwest
Hydraulic conductivity of overburden materials (cm/sec)	1.25E-03[b]
Hydraulic conductivity of bedrock (cm/sec)	4.28E-03[c]
Hydraulic gradient at the site (ft/ft)	8.0E-03[a]
Is a perched water table present at the site?	None identified

[a] Represents interpolated value based available data.

[b] Represents average hydraulic conductivity of unconsolidated zone at ETTP based on slug test results for wells completed in overburden materials at ETTP.

[c] Represents average hydraulic conductivity of bedrock at ETTP based on slug test results.

Due to the limited number of wells in the vicinity of Bldg. K-796-A, a groundwater plume has not been determined to exist beneath, or within the vicinity of, the building. The nearest identified plume is located approximately 1600 ft northwest of the building and is sourced from the K-1070-A Burial Ground. Although available potentiometric maps indicate that this plume can be considered to be upgradient of K-796-A, groundwater data and dye tracer studies indicate that flow from the K-1070-A Burial Ground is to the southwest toward the K-901 Pond and not southeastward toward K-796-A.

Analytical data for the well pair of BRW-027 and UNW-039 located within 200 ft of K-796-A indicate the general absence of VOCs in both the bedrock and unconsolidated zone materials. Only low estimated concentrations of 2-butanone (3 μg/L) and trichloroethene (TCE) [1 μg/L] were reported in one of five sampling events (August 1998) at the bedrock well BRW-027. August 1998 is the last sampling event of record for this well, and these compounds had not been detected in the previous four sampling events at this well. Only a single detection of acetone (16 μg/L) in 1994 has been reported at well UNW-039, completed in the overburden materials near K-796-A. It should be noted that this well pair is downgradient or cross-gradient of the inferred groundwater flow path, and, therefore, the absence of VOC detections does not indicate whether an upgradient plume may be present.

In contrast, several VOCs, including 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene (DCE), 1,2-DCE, chloroform, and TCE, have been detected at bedrock well BRW-067 located 800 ft northeast of K-796-A. Although VOCs have been detected at this well, the existence of a plume cannot be determined because of the limited number of wells in this area. As mentioned previously, groundwater flowpaths in bedrock are a key uncertainty at ETTP, and these compounds occur in bedrock groundwater. Existing data from well BRW-027 indicate that this contamination is not present in bedrock in the area expected to be immediately downgradient of K-796-A.

Table D.3.2 summarizes the analytical results for the VOCs detected in groundwater samples collected from the monitoring wells located in the vicinity of K-796-A. Table D.3.2 represents all data available for these monitoring wells since 1994. Although VOCs have been detected above federal drinking water maximum contaminant levels (MCLs) in monitoring well BRW-067, located northeast of Bldg. K-796-A, it can be seen in Table D.3.2 that VOCs are essentially absent from groundwater in the two wells that are expected to be immediately downgradient of K-796-A.

Although the available data suggest the absence of VOCs in the groundwater in the immediate vicinity of Bldg. K-796-A, VOC contamination is present in the area upgradient of the building. As stated, there is uncertainty concerning groundwater flow paths due to the limited number of unconsolidated zone wells in the area and karst conditions in the bedrock. Additionally, the underground conduit runs between the K-33 building and the historical K-791 Switchyard may serve as a preferential flow path for shallow groundwater in the area. Therefore, soil vapor sampling in K-796-A will be performed to reduce the uncertainties concerning the potential for migration of VOCs beneath Bldg. K-796-A.

D.4. SCOPE

The overall scope of this SAP is to determine: (1) VOC concentrations in the soil vapor directly beneath the K-796-A building slab to evaluate the vapor intrusion pathway, and (2) whether PCBs are present within the building due to storage and maintenance of oil-filled electrical equipment. These overall objectives will be met by sampling soil vapor directly beneath the slab using U. S. Environmental Protection Agency (EPA)-approved methods with detection limits that are sufficient to determine if the exposure pathway is complete and conducting limited sampling for PCBs as discussed in Chaps. D.5 and D.6 of this SAP.

Table D.3.2. Summary of VOCs detected in groundwater samples from bedrock monitoring wells in the vicinity of Building K-796-A

Analyte	MCL	BRW-027					UNW-039			BRW-067				
		Sep-94	**Mar-95**	**Sep-95**	**Jun-98**	**Aug-98**	**Sep-94**	**Mar-95**	**Sep-95**	**Sep-94**	**Mar-95**	**Sep-95**	**Jun-98**	**Sep-98**
1,1,1-Trichloroethane	200	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5 U	2 J	6	2 J	4 J
1,1-Dichloroethane	NA	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1 J	2 J
1,1-Dichloroethene	7	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	2 J	5 U	7 J	3 J	6
1,2-Dichloroethene	70[a]	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	14	8	11	7	5
2-Butanone	NA	10 U	10 UJ	10 U	10 UJ	3 J	10 U	10 UJ	10 U	10 UJ	10 UJ	10 U	10 U	10 U
Acetone	NA	10 U	10 UJ	10 U	10 UJ	10 U	16 J	10 UJ	59 U	10 U	10 UJ	10 U	10 U	10 U
Chloroform	100[b]	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	1 J	5 U	1 J	1 J	5 U
Methylene chloride	5	5 U	5 U	5 U	7 UJ	5 U	6 U	5 U	5 U	5 U	5 U	1 J	17 U	6 U
Trichloroethene	5	5 U	5 U	5 U	5 UJ	1 J	5 U	5 U	5 U	**35**	**24**	**34**	**13**	**15**

[a] Represents MCL for the *cis*-1,2-dichloroethene isomer. Individual isomers not reported by laboratory.
[b] Represents MCL for total trihalomethanes.
BRW = bedrock well.
MCL = maximum contaminant level.
J = estimated concentration.
U = analyte not detected at indicated concentration.
UJ = analyte not detected at indicated concentration, which represents an estimated concentration.
Bold indicates the concentration exceeds the MCL.
NA = not available.
UNW = unconsolidated zone well.

If VOC concentrations in the soil vapor directly beneath the building slab exceed trigger levels specified in this SAP, a separate sampling plan would be developed. The plan would identify the need for indoor air samples collected at normal breathing zone height from within the building to determine exposure concentrations. If required, indoor air samples would also be collected using EPA-approved methods with detection limits that are sufficient to support the risk assessment. The objectives and rationale for soil vapor sampling are discussed in Chap. D.5 of this SAP.

Evaluation of potential PCB contamination located within the building shall be conducted by taking swipe samples at various locations. Specific sampling locations and rationale are discussed within Chap. D.6 of this SAP.

D.5. SOIL VAPOR SAMPLING RATIONALE AND DESIGN

D.5.1 SAMPLING OBJECTIVES FOR SOIL VAPOR

In accordance with the *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Draft Vapor Intrusion Guidance)* [EPA 2003], and the guidance provided by EPA Region 4 (EPA 2006), the DOE-Oak Ridge Office has developed a process to evaluate the potential for vapor intrusion at existing ETTP properties that are being transferred to the private sector.

Although the available data suggest the absence of VOCs in the groundwater in the immediate vicinity of K-796-A, VOC contamination is present in the area upgradient of the building. As stated, there is uncertainty concerning groundwater flow paths due to the limited number of wells in the area and karst conditions in the bedrock. Additionally, the underground conduit runs between Bldgs. K-33 and K-796-A may serve as a preferential flowpath for shallow groundwater in the area. Therefore, in order to reduce the uncertainties concerning the potential for migration of VOCs beneath K-796-A, DOE plans to collect three soil vapor samples from beneath the building slab.

To achieve the objective of assessing the vapor intrusion pathway, sampling and analytical protocols for soil vapor samples must ensure that VOCs are quantified at levels that are equal to or below transport-derived trigger levels that would indicate the need for indoor air sampling in order to further evaluate the potential risks associated with the vapor intrusion pathway. For ambient air (indoor and outdoor) samples, the sampling and analytical protocols must ensure that VOCs are quantified at or below the 25-year industrial preliminary remediation goals (PRGs). The 25-year industrial PRGs are the lower of the airborne concentrations corresponding to an excess lifetime cancer risk of 10^{-5} or a hazard quotient of 0.1. A preliminary set of analytes of interest for the vapor intrusion pathway was identified for Bldg. K-796-A based upon groundwater present at ETTP. This set of analytes of interest also includes the degradation (and parent) compounds of the detected VOCs. The list of analytes of interest for Bldg. K-796-A is provided in Table D.5.1. Table D.5.1 also provides the 25-year industrial PRGs for the preliminary set of analytes of interest. Any VOCs that are currently analyzed by the groundwater program that are detected will also be reported.

Table D.5.1. Analytes of interest for the vapor intrusion pathway at Building K-796-A

Chemical	Industrial PRGs[a] (mg/m^3)
Acetone	4.6E-01
2-Butanone	7.31E-01
Carbon tetrachloride	3.58E-04
Chloroethane	1.46E00
Chloromethane	1.31E-02
Chloroform	1.78E-03
1,1 -Dichloroethane	7.31E-02
1,1-Dichloroethene	8.18E-04
1,2-Dichloroethene	4.60E-03
cis-1,2-Dichloroethene	5.11E-03
Methylene chloride	8.67E-02
1,1,1 Trichloroethane	3.21E-01
Trichloroethene	5.83E-03

[a] Industrial 25-year PRGs are the lower of the concentrations corresponding to an excess lifetime cancer risk of 10^{-5} or a hazard quotient of 0.1.
mg/m^3 = milligram per cubic meter.
PRG = preliminary remediation goal.

D.5.2 VAPOR SAMPLING DESIGN

Soil vapor action levels (or "trigger levels") will inherently be larger than risk-screening criteria due to the attenuation within the foundation materials and dilution effects as the vapors migrate into the indoor air volume of the building. Therefore, detection and reporting limits for indoor air samples are suitable to meet the established objectives for soil vapor samples. Detection and reporting limits for the VOCs to be reported in soil vapor are further identified in Sect. D.5.4 of this SAP.

In order to evaluate the potential for VOC vapor intrusion into the ETTP buildings designated for transfer, the general sampling approach has been divided into two phases. The first phase involves collection of soil vapor samples from directly beneath the slab of the building's lowest floor. The second phase of sampling involves collection of indoor ambient air samples at the normal breathing zone height within the building. The indoor air sampling will be implemented only if the soil vapor trigger levels were exceeded in the first-phase samples. Additional indoor air samples would be collected at locations that are separate from the soil vapor sampling stations to identify VOC contributions to indoor ambient air from any existing industrial activities that may be sources of such emissions. An outdoor ambient air sample would also be collected in this second phase to identify any potential external sources that may contribute VOCs detected in the indoor air samples.

D.5.2.1 Phase 1 – Sub-slab Soil Vapor

During the first phase, two sub-slab vapor samples will be collected directly beneath the concrete slab of Bldg. K-796-A. The VOC concentrations measured in these sub-slab soil vapor samples reflect equilibrium conditions resulting from attenuation in the soil column beneath the building. Samples taken in this fashion eliminate the uncertainty associated with partitioning modeling calculations.

The two sample locations for the sub-slab vapor sampling have been located on the basis of best professional judgment. Sample locations have been located toward the building interior to avoid in-leakage of atmospheric air that can dilute the soil vapor sample if collected near the building's edge. The soil vapor samples shall be collected by drilling a small (~ 7/8-in.-diameter) penetration through the first floor or foundation slab (estimated thickness of 6 to 12 in.). Care shall be taken to avoid disturbance or penetration of the underlying soil or aggregate. Soil vapor samples shall be grab samples (sample collection duration of less than 60 s) collected using 5-L, pre-evacuated SUMMA canisters. Vapor samples will be taken from immediately beneath the concrete slab (estimated 4 to 6 in.). Any VOCs that are currently analyzed by the groundwater program that are detected will also be reported.

D.5.2.2 Phase 2 – Ambient Air Sampling

If VOC concentrations in the Phase 1 soil vapor sampling exceed the site-specific soil vapor trigger levels presented in Table D.5.2, then Phase 2 ambient air sampling would be performed. Sampling stations for the Phase 2 indoor air samples will generally coincide with the locations selected for sub-slab soil vapor sampling. If necessary, a sampling addendum to this plan will be developed outlining the sampling locations and number of samples required in the event an exceedance of the site-specific trigger levels occurs in the sub-slab samples.

D.5.3 SOIL VAPOR SAMPLING PLAN

Prior to the mobilization event for the soil vapor sampling, the sampling subcontractor (SSC) will obtain evacuated 5-L SUMMA canisters that have been cleaned, conditioned, and certified in accordance with the requirements of EPA Method TO-15 (EPA 1999). Other sampling system components shall be cleaned in accordance with Method TO-15 prior to assembly of the sampling system. Non-metallic parts shall be rinsed in deionized water and dried in a vacuum at 50°C. Stainless steel parts and fittings shall be cleaned in an ultrasonic bath, using methanol followed by ultrasonic cleaning in hexane. These parts shall be subsequently rinsed in deionized water and baked in a vacuum oven at 100°C for 12 to 24 h. Soil vapor samples will be collected from directly beneath the floor slab of the building.

The sampling systems for soil vapor shall be 5-L sub atmospheric SUMMA canisters. For collection of the soil vapor samples, flow restriction will be provided by a critical orifice set to charge the canisters to the desired end pressure over a 60-s sample collection period. The sampling systems shall be assembled in accordance with Fig. 1 of EPA Method TO-15 prior to mobilization to the field.

Two sub-slab soil vapor samples shall be collected during the sampling event at locations shown in Fig. D.5.1. One alternative location has also been identified to replace any of the designated locations if sampling is prevented by physical constraints. A penetration permit will be required for installation of the sub-slab sample ports. Floor penetrations shown in Fig. D.5.1 are approximate only and must be field located prior to installation based upon the requirements of the penetration permit. Coordinates for each station shall be recorded in the field logbook and maintained as part of the sampling record.

Prior to penetration of the floor slab, the sampling system shall be located at the stations indicated in Fig. D.5.1. Once the sampling system has been set up at the designated locations, the SSC shall record temperature, humidity, and other parameters indicated by Method TO-15. The inlet tubing to the sampling system shall be as short as possible. Samples will be taken by drilling small (~ 7/8-in.-diameter) holes through the slab, taking care not to disturb the materials underlying the slab. If a vapor barrier is present, penetration of the barrier will be required. Consistent with EPA guidance, a capped brass or stainless steel tube will be inserted into the penetration. Immediately following insertion of the sampling tube, any annular space between it and the concrete will be sealed using non-VOC-bearing caulk or other appropriate materials. After completion of the penetration, the cap shall be removed from the stainless steel tube to attach the inlet tubing for the sampling system. The inlet line of the sample system shall be attached to the floor penetration tube and the flow valves opened.

Table D.5.2. Site-specific soil vapor trigger levels indicating the need for indoor air sampling

Volatile organic compound	Trigger level (mg/m^3)	Concentration in building (μg/m^3)	Alpha[a]
1,1,1-Trichloroethane	3.01E+02	3.21E+02	1.07E-03
1,1,2,2-Tetrachloroethane	6.67E-01	7.05E-01	1.06E-03
1,1,2-Trichloroethane	1.91E+00	2.04E+00	1.07E-03
1.1.2-Trichloro-1,2,2-trifluoroethane	4.04E+03	4.38E+03	1.08E-03
1,1-Dichloroethane	6.88E+01	7.31E+01	1.06E-03
1,1-Dichloroethene	7.55E-01	8.18E-01	1.08E-03
1,2-Dichloroethane	1.43E+00	1.57E+00	1.10E-03
1,2-Dichloroethene	3.95E+00	4.60E+00	1.16E-03
1,2-Dichloropropane	5.45E-01	5.83E-01	1.07E-03
2-Butanone	6.84E+02	7.31E+02	1.07E-03
2-Hexanone	2.51E+01[b]	2.92E+01[b]	1.16E-03
4-Methyl-2-pentanone	4.06E+02	4.38E+02	1.08E-03
Acetone	4.13E+02	4.60E+02	1.11E-03
Benzene	4.05E+00	4.38E+00	1.08E-03
Bromodichloromethane	2.62E+00	2.38E+00	9.11E-04
Bromoform	1.39E+01	1.02E+01	7.38E-04
Bromomethane	6.89E-01	7.31E-01	1.06E-03
Carbon disulfide	9.31E+01	1.02E+02	1.10E-03
Carbon tetrachloride	3.35E-01	3.58E-01	1.07E-03
Chlorobenzene	2.75E+00	2.92E+00	1.06E-03
Chloroethane	1.38E+03	1.46E+03	1.06E-03
Chloroform	1.62E+00	1.78E+00	1.10E-03
Chloromethane	1.24E+01	1.31E+01	1.06E-03
cis-1,2-Dichloroethene	4.81E+00	5.11E+00	1.06E-03
cis-1,3-Dichloropropene	2.80E+00	2.92E+00	1.04E-03
Dibromochloromethane	1.26E+01	1.02E+01	8.11E-04
Ethylbenzene	3.49E+01	3.72E+01	1.06E-03
Methylene chloride	7.92E+01	8.67E+01	1.09E-03
Styrene	1.38E+02	1.46E+02	1.06E-03
Tetrachloroethene	6.66E+01	7.05E+01	1.06E-03
Toluene	5.39E+01	5.83E+01	1.08E-03
trans-1,2-Dichloroethene	9.67E+01	1.02E+02	1.06E-03
trans-1,3-Dichloropropene	4.91E+00	5.11E+00	1.04E-03
Trichloroethene	5.45E+00	5.83E+00	1.07E-03
Vinyl chloride	4.23E+00	4.65E+00	1.10E-03

[a] Alpha is the infinite source indoor attenuation coefficient and directly correlates the soil vapor concentration with the indoor air concentration.

[b] Toxicity data for 2-Hexanone are unavailable; values represent those associated with n-Hexane – a surrogate chemical approved for use for this purpose by Region 4 of the U. S. Environmental Protection Agency.

mg/m^3 = milligram per cubic meter.

μg/m^3 =microgram per cubic meter.

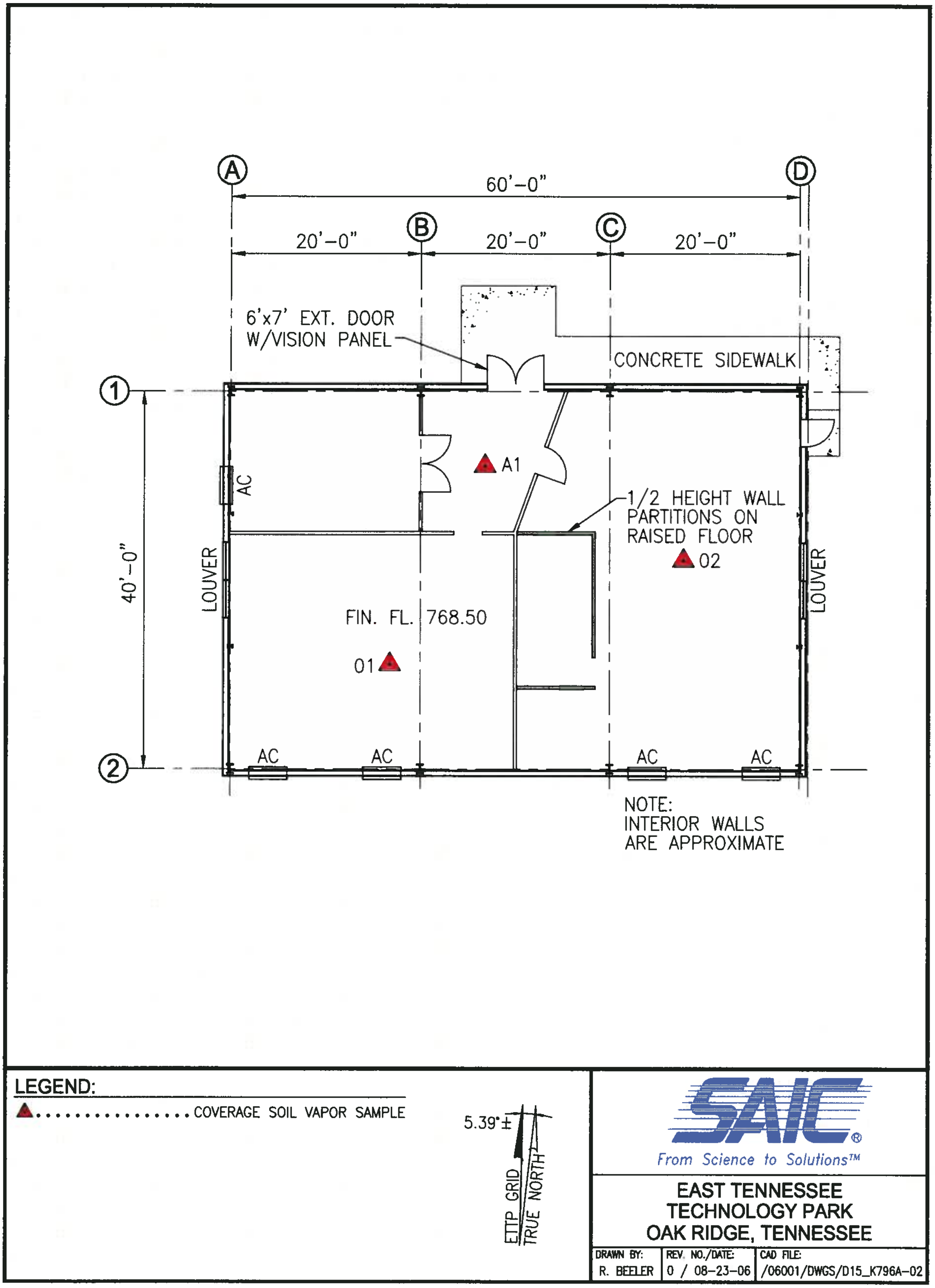

Fig. D.5.1. Building K-796-A soil vapor sampling locations.

Upon collection of the soil vapor samples, the SUMMA canisters shall be valved closed. The sampling line shall be disconnected from the canister and the canister removed from the sampling system. Upon collection of the samples, the final pressure shall be checked and recorded. The final system pressure should be ~ 88 Kpa (~ 90 to 100 torr vacuum).

Upon collection of the SUMMA canister, it shall be labeled as required by the SSC's standard operating procedures (SOPs). The canisters shall be shipped to the laboratory in a canister shipping case as required by the manufacturer's specifications or the SSC's SOPs.

After the soil vapor sample has been collected, the floor penetration or sampling port shall be temporarily sealed by an appropriate method. The temporary seal shall ensure that the sampling port or penetration is vapor tight and does not present a trip hazard. After completion of all soil vapor sampling, the floor penetration shall be sealed by cutting it level with the floor or removing it and backfilling with a non-shrinking grout. A layer of non-shrinking grout should be applied to the floor, covering the penetration and immediate surrounding area, and it should be finished smooth with the surrounding surface.

Decontamination of sampling equipment used for collection of air samples is not required. All equipment, including the sampling inlet line, used at each sampling station shall be dedicated.

Field quality control (QC) samples are required only for ambient air sampling. The required QC samples are field equipment blanks and a duplicate. All samples shall have the appropriate radiological screening performed to comply with shipping protocols. Sample container, preservation, and holding time requirements are summarized in Table D.5.3.

D.5.4 ANALYTICAL REQUIREMENTS, DATA MANAGEMENT, AND REPORTING FOR SOIL VAPOR SAMPLES

Soil vapor air samples will be quantitated for VOCs using gas chromatography/mass spectrometry analyses as required by EPA Method TO-15 (EPA 1999). Any of the VOCs indicated in Table D.5.4 that are detected shall be reported. Additionally, the laboratory shall report up to 20 tentatively identified compounds. Quantitation of VOCs in air samples shall meet the reporting and detection limits specified in Table D.5.4.

Data obtained from this sampling event shall be managed in accordance with the requirements of the *Data Management Implementation Plan for the Reindustrialization Program, Oak Ridge, Tennessee*, BJC/OR-865, Rev. 2 (BJC 2006b). Results will be provided to EPA Region 4 and to the Tennessee Department of Environment and Conservation (TDEC) DOE-Oversight Office.

Table D.5.3. Sample container, preservation, and holding time requirements for Building K-796-A soil vapor samples

Event	Sample number[a]	Sample type	Parameters of concern	Analytical protocols	Container type/volume	Preservation	Holding time
			Vapor sub-slab sampling				
01	NS-01-61-796A-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 days
01	NS-02-61-796A-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 days
01	NS-A1-61-796A-V	Soil vapor-grab	Volatile organics[b]	TO-15	5-L SUMMA Canister	None	14 days

[a]Sample station nomenclature is NS-AA-BC-DDDD-EE where the AA field is the station number 01-89. Stations A1is an alternate location to replace any designated stations where samples could not be obtained. The BC field designates the fiscal year and sampling event in that year. The DDDD field designates the building number. The EE field designates the sample type where V = soil vapor; I = indoor air; A = outdoor air; B = blank; and D = duplicate.

[b]Volatile organics of concern for air sampling at Bldg. K-796-A include Acetone, 2-Butanone, Carbon tetrachloride, Chloroethane, Chloroform, Chloromethane, 1,1-Dichloroethane, Methylene chloride, Trichloroethene, 1,2-Dichloroethene, 1,1-Dichloroethene, *cis*-1,2,-Dichloroethene, and 1,1,1-Trichloroethane.

Table D.5.4. VOCs and their respective quantitation and detection limits for soil vapor sampling

Analyte	Analytical method	Air quantitation level (mg/m^3)	Air detection level (mg/m^3)
1,1,1-Trichloroethane	TO-15	3.01E+02	3.01E+01
1,1,2,2-Tetrachloroethane	TO-15	6.67E-01	6.67E-02
1,1,2-Trichloroethane	TO-15	1.91E+00	1.91E-01
1,1,2-Trichloro-1,2,2-trifluoroethane	TO-15	4.04E+03	4.04E+02
1,1-Dichloroethane	TO-15	6.88E+01	6.88E+00
1,1-Dichloroethene	TO-15	7.55E-01	7.55E-02
1,2-Dichloroethane	TO-15	1.43E+00	1.43E-01
1,2-Dichloroethene	TO-15	3.95E+00	3.95E-01
1,2-Dichloropropane	TO-15	5.45E-01	5.45E-02
2-Butanone	TO-15	6.84E+02	6.84E+01
2-Hexanone	TO-15	2.51E+01[a]	2.51E+00[a]
4-Methyl-2-pentanone	TO-15	4.06E+02	4.06E+01
Acetone	TO-15	4.13E+02	4.13E+01
Benzene	TO-15	4.05E+00	4.05E-01
Bromodichloromethane	TO-15	2.62E+00	2.62E-01
Bromoform	TO-15	1.39E+01	1.39E+00
Bromomethane	TO-15	6.89E-01	6.89E-02
Carbon disulfide	TO-15	9.31E+01	9.31E+00
Carbon tetrachloride	TO-15	3.35E-01	3.35E-02
Chlorobenzene	TO-15	2.75E+00	2.75E-01
Chloroethane	TO-15	1.38E+03	1.38E+02
Chloroform	TO-15	1.62E+00	1.62E-01
Chloromethane	TO-15	1.24E+01	1.24E+00
cis-1,2-Dichloroethene	TO-15	4.81E+00	4.81E-01
cis-1,3-Dichloropropene	TO-15	2.80E+00	2.80E-01
Dibromochloromethane	TO-15	1.26E+01	1.26E+00
Ethylbenzene	TO-15	3.49E+01	3.49E+00
Methylene chloride	TO-15	7.92E+01	7.92E+00
Styrene	TO-15	1.38E+02	1.38E+01
Tetrachloroethene	TO-15	6.66E+01	6.66E+00
Toluene	TO-15	5.39E+01	5.39E+00
trans-1,2-Dichloroethene	TO-15	9.67E+01	9.67E+00
trans-1,2-Dichloropropene	TO-15	4.91E+00	4.91E-01
Trichloroethene	TO-15	5.45E+00	5.45E-01
Vinyl chloride	TO-15	4.23E+00	4.23E-01
Xylenes (total)	TO-15	1.38E+01	1.38E+00

[a]Toxicity data for 2-Hexanone are unavailable; values represent those associated with n-Hexane – a surrogate chemical approved for use for this purpose by U. S. Environmental Protection Agency Region 4.

mg/m^3 = milligram per cubic meter.

VOC = volatile organic compound.

D.6. PCB SWIPE SAMPLING RATIONALE AND DESIGN

D.6.1 SAMPLING OBJECTIVES FOR FLOOR SAMPLES

Operations within Bldg. K-796-A included the storage and maintenance of electrical components from switchyards across the ORR. Because some of this equipment was filled with oil that contained PCBs, there is a potential for PCB contamination to be present within the building. A review of available documentation does not indicate that a release of PCBs has occurred; however, in order to ensure that PCBs are not present within the building, limited sampling will be conducted. The objective of this sampling is to demonstrate whether or not PCBs are present in or upon the floor of the former bay area of Bldg. K-796-A. Swipe sampling is the method preferred by DOE for initial characterization to determine whether PCB contamination may be present in the building.

D.6.2 PCB SAMPLING DESIGN

Sampling conducted under this SAP is concerned with obtaining data to determine if the PCBs are present in the building because of the historical storage and maintenance of oil filled electrical equipment. Characterization requirements for porous surface PCB remediation wastes are specified in 40 *Code of Federal Regulation* (*CFR*) 761, Subpart N. The procedures of Subpart N involve overlaying the subject area with a 3-m^2 (~ 10-ft^2) grid system and collecting samples at each grid node or within each grid in the area of concern. The grid sampling system of 40 *CFR* 761, Subpart N, is applied both vertically (i.e., to walls) and horizontally (i.e., to floors). Because there is no documentation of PCB release within the building, the sampling protocol for the number, type, or location of samples specified by Subpart N of 40 *CFR* Part 761 is not applicable.

The preferred method of sampling to determine if a release of PCBs occurred in the building from former maintenance activities involves the use of standard swipe samples. Sample locations were selected on a judgmental basis based upon the size of the room and traffic areas where PCBs might be expected in the event that releases occurred during maintenance activities.

D.6.3 SAMPLING PLAN

Swipe samples shall be taken at nine locations in Bldg. K-796-A as shown in Fig. D.6.1. In addition, one (1) co-located duplicate sample will be taken at sample location 6. The duplicate shall consist of a second sample being taken immediately adjacent to the primary sample acquired at the sample station. Samples will be analyzed for total PCBs and individual PCB Aroclors as indicated in Table D.6.1. Table D.6.2 provides the sample station location in both latitude and longitude and the state plane coordinate system to allow for identification of the sample location using a Global Positioning System unit.

Swipe samples for PCBs shall be collected from the surfaces of the floors in accordance with 40 *CFR* 761.123 and the Sampling Sub-Contractor's (SSC's) contract specifications. The sampling procedure provided below is intended only as a general description and does not supersede 40 *CFR* 761.123 or the SSC's standard specifications.

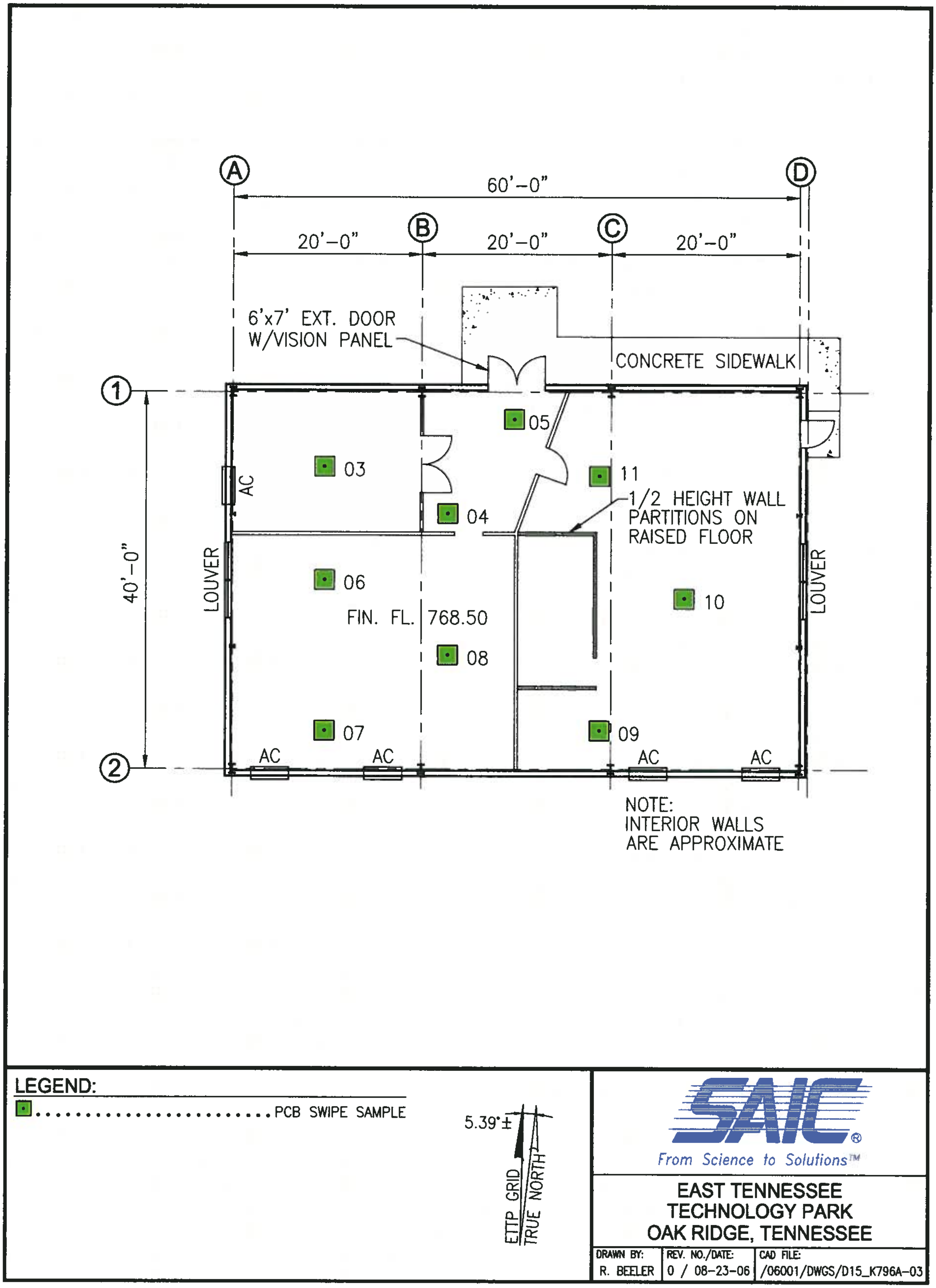

Fig. D.6.1. Building K-796-A PCB swipe sampling locations.

Table D.6.1. Summary of analyses for PCB samples in Building K-796-A

Sample number[a]	Sample type	Total PCBs	PCBs (Aroclors)
NS-03-01-796A	Swipe	X	X
NS-04-01-796A	Swipe	X	X
NS-05-01-796A	Swipe	X	X
NS-06-01-796A	Swipe	X	X
NS-07-01-796A	Swipe	X	X
NS-08-01-796A	Swipe	X	X
NS-09-01-796A	Swipe	X	X
NS-10-01-796A	Swipe	X	X
NS-11-01-796A	Swipe	X	X
NS-06-D1-796A[b]	Swipe	X	X

[a] Sample numbers 01–02 are assigned to the soil vapor samples.
[b] Sample designation NS-XX-D1-ZZZZ indicates a replicate sample.
PCB = polychlorinated biphenyl.

Table D.6.2. Coordinates for PCB swipe sampling stations

Sample ID	Latitude	Longitude	State Planar East	State Planar North
NS-03-01-796A	35.93723	84.40711	2440025.0	587663.2
NS-04-01-796A	35.93722	84.40706	2440038.0	587660.0
NS-05-01-796A	35.93725	84.40705	2440044.0	587670.8
NS-06-01-796A	35.93719	84.40711	2440026.0	587651.4
NS-07-01-796A	35.93715	84.40710	2440028.0	587635.5
NS-08-01-796A	35.93718	84.40706	2440040.0	587645.1
NS-09-01-796A	35.93716	84.40700	2440057.0	587639.3
NS-10-01-796A	35.93720	84.40698	2440064.0	587654.4
NS-11-01-796A	35.93723	84.40701	2440054.0	587666.1
NS-06-D1-796A	35.93719	84.40711	2440026.0	587651.4

The swipe sample shall be collected using a standard sized, swipe gauze pad saturated with hexane. This sampling medium shall be prepared in the lab and stored in a sealed glass container until use. The wiping medium should not be removed from its container until the area to be sampled has been delineated. The area to be sampled will be delineated by a 10-cm by 10-cm template at each designated location. Upon removal of the sampling medium from its container, it should be firmly wiped over the entire area to be sampled. Upon collection of the sample, the wipe shall be packaged in amber glass containers and sent to a laboratory for analysis using EPA Method 8082 (EPA 1993) as indicated in Table D.6.3.

Table D.6.3. Container, preservation, and holding time requirements for Building K-796-A samples

Sample location	Parameters of concern	Container type/volume	Preservation	Holding time
Location 03	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 04	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 05	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 06	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 07	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 08	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 09	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 10	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]
Location 11	PCBs (Aroclors)	4-oz. Amber glass	Cool 4°C	14 days[a]

[a] Holding time is 14 days to extraction and 40 days from extraction to analysis.
PCB = polychlorinated biphenyl.

D.6.4 ANALYTICAL REQUIREMENTS, DATA MANAGEMENT, AND REPORTING FOR PCB SAMPLES

Analytical protocols for the analyte groups specified for the samples collected under this SAP are indicated in Table D.6.4. Samples for chemical analyses of PCBs will be measured by the relevant EPA SW-846 Methods.

Data obtained from this sampling event shall be managed in accordance with the requirements of the *Data Management Implementation Plan for the Reindustrialization Program, Oak Ridge, Tennessee*, BJC/OR-865, Rev. 2 (BJC 2006b). Results will be provided to EPA Region 4 and to the TDEC DOE-Oversight Office.

Table D.6.4. Analytical requirements for Building K-796-A PCB swipe samples

Parameters of concern	Analytical protocols
PCBs (Aroclors)	8082

PCB = polychlorinated biphenyl.

D.7. REFERENCES

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APPENDIX E

RADIOLOGICAL SURVEY PLAN FOR BUILDING K-791-B

E.1 AREA TO BE SURVEYED

The area to be surveyed is the K-791-B building. The building is to be first leased and then, at a later date, the title transferred to the Community Reuse Organization of East Tennessee (CROET). Therefore, this plan will have sections that deal with the requirements for each phase. The K-791-B building is located in the northwest section of the East Tennessee Technology Plant (ETTP), west of the K-33 building and north of Bldg. K-761. For a detailed depiction of the footprint, refer to Fig. E.1.

Building K-791-B is a single-story building addition that was added onto the south end of Bldg. K-791-S in 1976 (DOE 1999). The facility measures approximately 67 ft long by 60 ft wide and has a floor area of 4020 ft^2. The building is constructed of concrete block exterior and interior walls, concrete floor covered with vinyl tiles, and a built-up concrete composite roof of tar and gravel. The roof is equipped with raised, grated roof drains. The building is protected by a wet-pipe sprinkler system and lit with fluorescent fixtures (MMES 1991). Building K-791-B is divided into a material storage room, a computer room, a men's change house, hallway, lunchroom, a janitor's room, and an open shop area. The floor is carpeted in the shop and office area and, with the exception of the change house area, the remainder and majority of the building has vinyl floor tile containing asbestos. The tile is in good condition. The change house floor is covered with clay tile in good condition, with the exception of a small area at the entrance to the latrine portion of the change house. The tile in this area is broken and the concrete slab underneath exposed. The computer room was renovated from a women's change house shower area. A raised, wooden floor exists in the computer room on top of clay tile. The wooden floor is in good condition. The wooden floor does not allow current access to the clay tile for visual inspection; therefore, the tile condition is unknown. Most rooms on an outside wall have a through-the-wall heating/cooling unit. A couple of the rooms' heating/cooling units have been removed and the holes covered. A heating and cooling unit located on the roof currently provides ventilation. See Fig. E.2 for the floor plan of Bldg. K-791-B.

E.2 HISTORY OF THE AREA

The K-791-B facility is a single-story addition that was added to the south end of the K-791-S building in 1976. The K-791-B building is located south of the K-791 and K-792 areas and west of the K-33 building. The K-791 and K-792 surrounding area includes the footprint of the electrical power distribution control house, switchgear house, and switchyard for the K-33 gaseous diffusion building.

The K-791-B building was used to maintain electrical components found throughout the facilities and switchyards at ETTP, the Y-12 National Security Complex (Y-12 Complex), and Oak Ridge National Laboratory (ORNL or X-10). It housed a machine shop, which contained a lathe, band saw, drill press, grinders, sanders, and a milling machine (MMES 1991). Information, however, is not available on the origin of the electrical components prior to transfer to the K-791-B building or their contamination status. Additionally, no information is available as to whether or not the lathe, band saw, and/or other shop machines were used on radiologically contaminated parts. The machine shop area also contains the remains of an overhead crane that runs the east–west length of the shop.

The machine shop operations were moved to the Elza K-741-B facility at the Y-12 Complex in 1999. Building K-791-B was then converted to an office area for personnel involved with the ETTP Three-Building Decontamination and Decommissioning and Recycle Project. The building has no previous lease history.

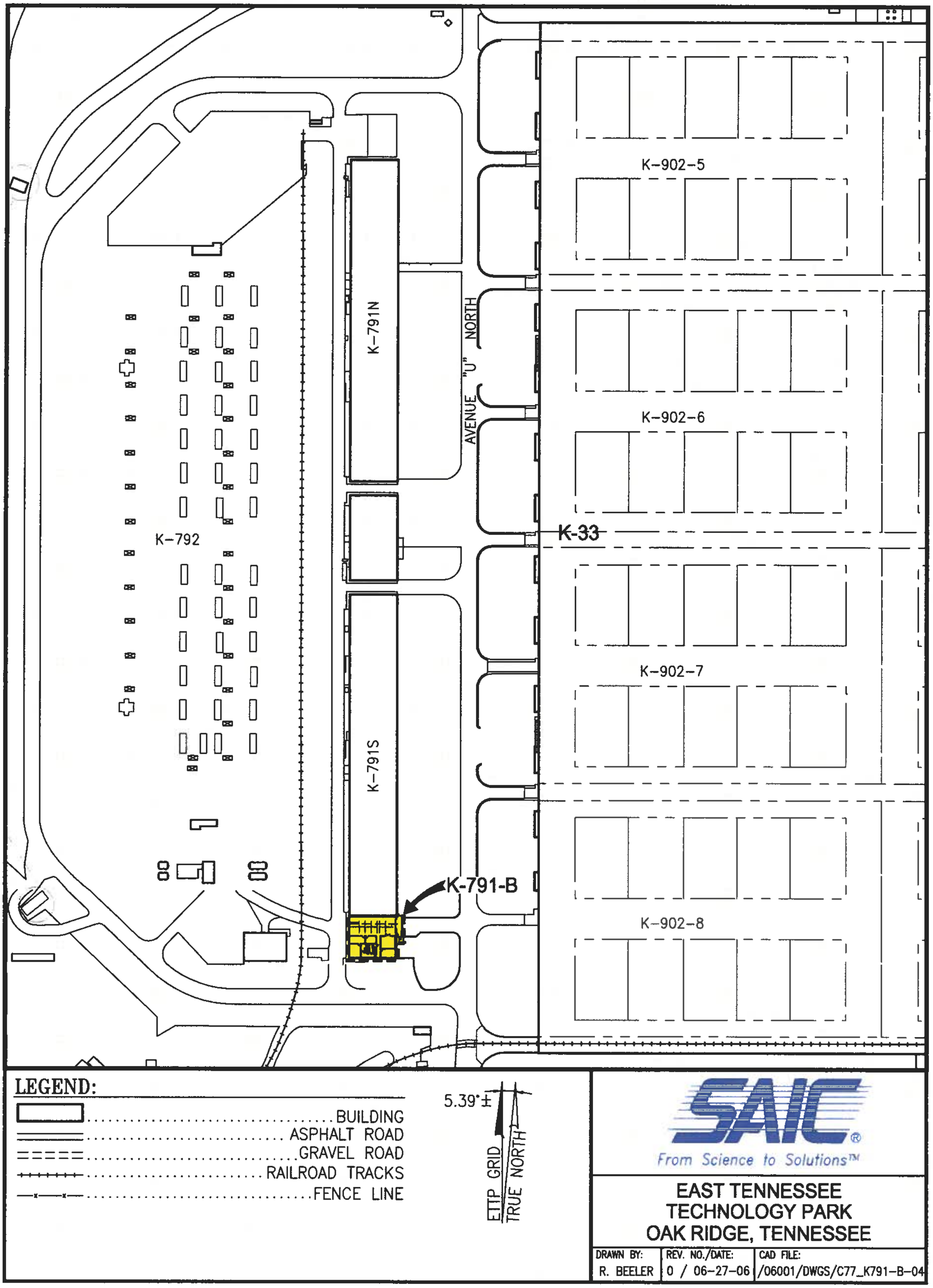

Fig. E.1. K-791-B building footprint.

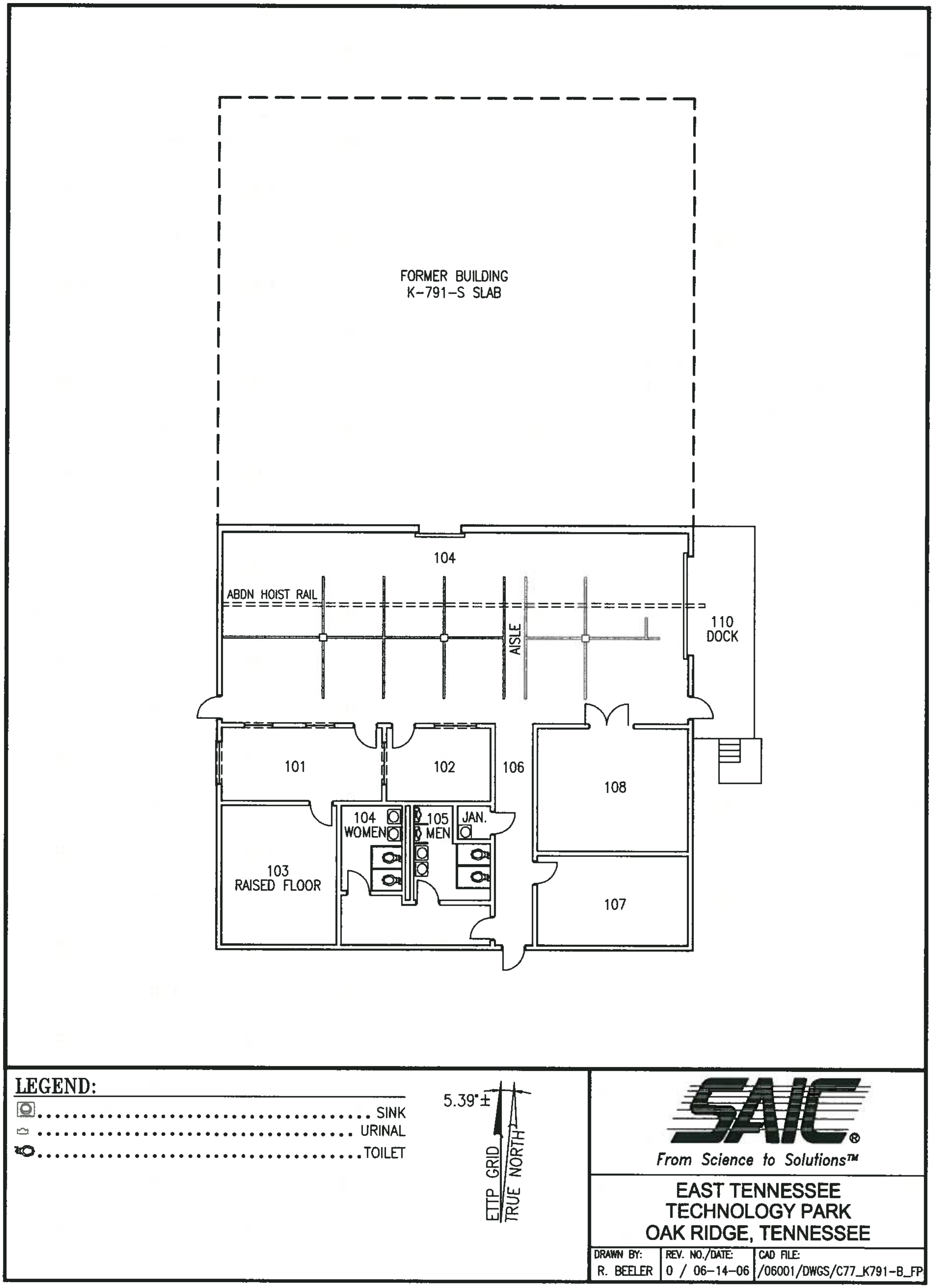

Fig. E.2. K-791-B floor plan.

E.3 EXISTING SURVEY DATA SUMMARY

A search of the Bechtel Jacobs Company LLC (BJC) Radiation Control (RADCON) electronic survey data collected between 1996 and 2006 showed twenty-four various surveys, including characterization and equipment release performed during this time frame, associated with the K-791 area. However, only one survey, 19970326KA36182001, was associated with the K-791-B building. This survey was performed for off-site release of equipment (four oil gauges with thermocouples and two electric relays). Survey results revealed both fixed and removable contamination were less than plant off-site release limits [Table E.1 derived concentration guideline level (DCGL) values] for unrestrictive use. Alpha results were less than 24.5 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) with beta/gamma results at less than 57.6 dpm/100 cm^2 for removable contamination. Total results for both alpha and beta/gamma were less than the instruments' lower limit of detection at 339.2 dpm/100 cm^2 and 74.5 dpm/100 cm^2, respectively. All other surveys identified during the data search were associated with the K-791 Switchyard area, which is not part of this survey plan. No other radiological survey data were found.

The U. S. Department of Energy (DOE) DCGLs for uranium are given in Table E.1. Uranium is the dominant contaminant present on-site as described in Chap. E.5 of this survey plan.

Table E.1. Contamination limits (DCGLs) for all survey units

	DCGL (dpm/100 cm^2)	$DCGL_{EMC}$ (dpm/area)
Total alpha	5,000	15,000
Removable alpha	1,000	N/A
Total beta-gamma	5,000	15,000
Removable beta-gamma	1,000	N/A

DCGL = derived concentration guideline level.
$DCGL_{EMC}$ = derived concentration guideline level elevated measurement comparison.
dpm = disintegrations per minute.
N/A = not applicable.

E.4 DATA QUALITY OBJECTIVES PURPOSE

The purpose of this survey plan is to obtain radiological survey data to determine the presence of residual contamination in the K-791-B building through the use of a scoping survey and a final status survey. The data gathered, combined with process knowledge, will be used to either lease the facility or transfer title of the K-791-B building. The data quality objectives (DQOs) have been detailed in the Design of Radiological Surveys documents (hereafter referred to as the "design documents"[1] with one attached as Appendix A to this document).

[1] *Design of Radiological Surveys of Potential Lease Space at East Tennessee Technology Park, Oak Ridge, Tennessee*, BJC/OR-554, Bechtel Jacobs Company LLC, Oak Ridge, TN, March 2000, and *Design of Radiological Survey and Sampling to Support Title Transfer or Lease of Property on the Department of Energy Oak Ridge Reservation*, BJC/OR-554-R1, Bechtel Jacobs Company LLC, Oak Ridge, TN, August 2006.

E.5 MEASUREMENT TECHNIQUES/SURVEY APPROACH

E.5.1 RADIONUCLIDES OF CONCERN

Process history of the ETTP Site indicates that uranium (natural, depleted, and/or enriched) would be the most prominent radiological contaminant potentially present in the K-791-B building due to tracking of contamination from other on-site buildings or from past activities when the building was associated with the K-33 gaseous diffusion building. Uranium-235 enrichment levels expected from operations since the early 1960s would be anticipated to be between 0.2 to 5.5%. Most facilities would be potentially contaminated via tracking from enrichments of less than 3%.[2]

Other radionuclides (^{60}Co, ^{137}Cs, $^{89/90}$Sr, ^{237}Np, ^{99}Tc, and $^{238/239/240}$Pu) have also been detected on-site at ETTP. These other radionuclides originated from the introduction of contaminated materials from the ORNL and/or from the Hanford and Savannah River Reactor Returns Uranium Reprocessing Program. These radionuclides, however, are expected to be found in much lower quantities than uranium and be undetectable in this area, based upon its operational history. If radionuclides were present, it is assumed that they would be present at ratios of 1140:1 for uranium to transuranic (U:TRU) and 350:1 for uranium to technetium-99 (U:^{99}Tc) [both ratios are process buildings weighted averages].[3]

E.5.2 DETERMINATION OF THE RESIDUAL RADIOACTIVITY LIMITS

The overall goal of this survey is to show that residual contamination exceeding the release criteria is not present in any of the survey units (SUs). As shown by modeling, the dose and risk obtained from exposure to radioactivity at the DOE surface contamination limits, as set forth in Title 10 *Code of Federal Regulations* 835[4] and also in DOE Order 5400.5,[5] is less than that from the dose and risk criteria, as explained in the design documents. As a result of this modeling, the DCGLs for this survey will be set at the DOE contamination limits for uranium (see Table E.1), which is the dominant contaminant present on-site. A separate limit for the maximum allowable contamination that is concentrated in a smaller area, the derived concentration guideline level$_{\text{elevated measurement comparison}}$ ($DCGL_{EMC}$), is normally calculated based upon modeling the dose obtained from an area determined by the number of samples taken in the SU and the spacing between them. However, the $DCGL_{EMC}$ will be set to three times the appropriate contamination limit, which equates to the contamination-averaging criteria as set forth by DOE in 5400.5 for an elevated reading within a 1-m^2 maximum size area.

E.5.3 IDENTIFICATION OF SURVEY UNITS AND CLASSIFICATIONS

E.5.3.1 Lease Survey

Areas are classified as either Class 3, 2, or 1 based upon historical data and process knowledge. SUs must be of the same or similar material type. For example, an SU cannot contain both asphalt and soil; it would be divided into an SU of asphalt and another SU of soil. Refer to the design documents for complete descriptions of the different classifications of SUs. An area will be considered to be a Class 3

[2] Contracted Health Physics Technician Training handouts, K-25 Site, 1993.
[3] (BJC 1999). *Isotopic Distribution of Contamination Found at the U. S. Department of Energy Gaseous Diffusion Plants*, BJC/OR-2537, Bechtel Jacobs LLC, October.
[4] (*CFR* 1999). *Occupational Radiation Protection*; 10 *CFR 835,* Appendix D, "Surface Radioactivity Values."
[5] (DOE 1990). *Radiation Protection of the Public and Environment*; DOE Order 5400.5, Fig. IV-1, "Surface Contamination Guidelines," p. IV-6, U.S. Department of Energy, February.

SU if it is not expected to have residual radioactivity levels above 25% of the DCGL (1250 dpm/100 cm^2 total activity or 250 dpm/100 cm^2 removable activity). A Class 2 SU is expected to have, or has had, residual radioactivity levels less than the DCGL. A Class 1 SU is expected to have, or has had, residual radioactivity levels above the DCGL.

The interior of the building is divided into SUs based on the physical layout of the facility, historical usage of the facility rooms, the type of flooring material, and the natural barriers for traffic. Based upon the limited existing building survey data and the facility's association with K-33, interior survey units (ISUs) associated with machine shop operations will be initially classified as Class 2 areas. ISUs associated with the change houses and administrative activities will be initially classified as Class 3. The K-791-B facility will be composed of a total of four ISUs, as shown in Table E.2 and Fig. E.3. SU 1 is composed of the machine shop operations area and an office, which has the same carpeted flooring as in the machine shop. SU 2 is composed of those areas and rooms with tile covering the floors, such as the lunchroom and janitor's closet. SU 3 is composed of the rooms and areas with clay tile flooring. SU 4 is composed of the computer room with the raised wooden floor.

The survey of equipment and furnishings will be performed along the lines of the survey protocol developed by Safety and Ecology Corporation (SEC) for the release of materials from the K-1001-A, -B, -C, and -D buildings prior to their demolition.[6] Each building ISU (Table E.2) is to be the basis for the furnishings survey unit (FSU). All newer furnishings will be grouped together in batches (SUs) and classified as Class 3 because they have a very low potential for having been used in other facilities or areas that are potentially contaminated. Older furnishings, which could have been used in other buildings or areas, will be grouped into SUs and classified as Class 2. Only furnishings belonging to DOE or that appear to have been DOE property will be surveyed. Any furnishings belonging to lessees will not be surveyed because they are not being released. However, any furnishings that have been previously transferred to lessees as property with the lease from DOE will be surveyed.

Table E.2. Lease survey unit classifications

Interior survey units	Class
K-791-B Rooms 102, 104 (ISU 1)	Class 2
K-791-B Rooms 101, 106, 107, 108, janitor's closet (ISU 2)	Class 3
K-791-B Rooms 104, 105 (ISU 3)	Class 3
K-791-B Room 103 (ISU 4)	Class 3

ISU = interior survey unit.

E.5.3.2 Transfer Survey

As discussed in Sect. E.5.3.1, areas are classified as either Class 3, 2, or 1 based upon historical data and process knowledge. As with the requirements of the lease survey, an area will be considered a Class 3 SU if it is not expected to have residual radioactivity levels above 25% of the DCGL (1250 dpm/100 cm^2 total activity or 250 dpm/100 cm^2 removable activity). A Class 2 SU is expected to have, or has had, residual radioactivity levels less than the DCGL. A Class 1 SU is expected to have, or has had, residual radioactivity levels above the DCGL. The interior of the building is divided into SUs similar to the SUs discussed in Sect. E.5.3.1. Based upon the limited existing survey data for the facility, ISUs directly associated

[6] *Survey Protocol Unrestricted Release of Building Furnishings*, prepared by Safety and Ecology Corporation for Bechtel Jacobs Company LLC Radiation Control.

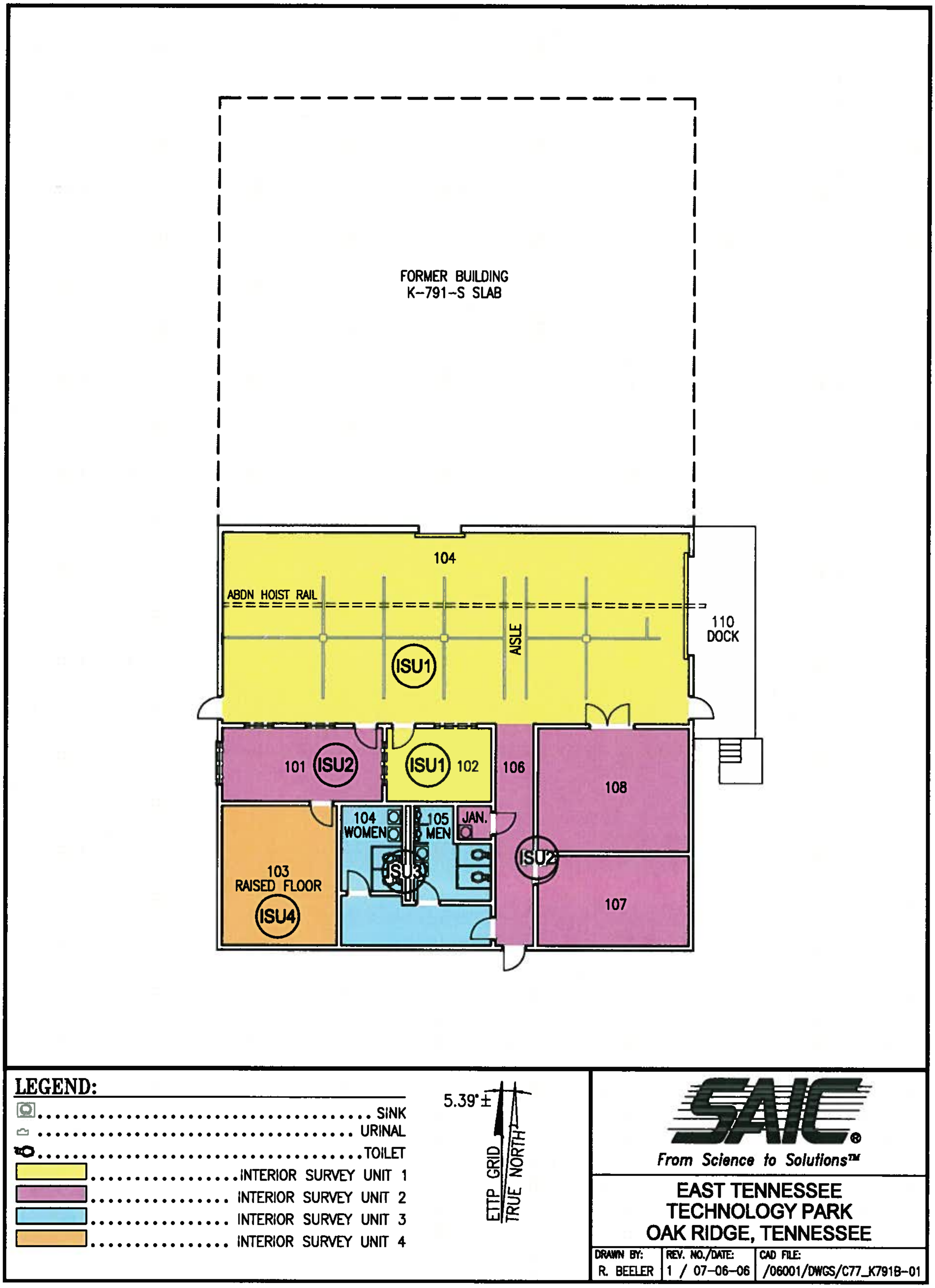

Fig. E.3. K-791-B lease survey units.

with machine shop activities will be initially classified as Class 2 areas. Other ISUs not directly associated with machine shop activities, such as the lunchroom and change houses, will be initially classified as Class 3 areas. For transfer purposes, the internal portions of the K-791-B facility will be composed of a total of three ISUs, as shown in Table E.3 and Fig. E.4.

Table E.3. Transfer survey unit classifications

Interior survey units	**Class**
K-791-B Rooms 102, 104 (ISU 1)	Class 2
K-791-B Rooms 101, 106, 107, 108, janitors closet (ISU 2)	Class 3
K-791-B Rooms 103, 104, 105 (ISU 3)	Class 3
Exterior survey units	
K-791-B Loading dock (ESU 1)	Class 3
K-791-B Roof, B HVAC unit and associated ducts (ESU 2)	Class 3
K-791-B Exterior walls, fan, and through-the-wall heating/cooling units, and drain spouts (ESU 3)	Class 3

ESU = exterior survey unit.
HVAC = heating, ventilating, and air-conditioning.
ISU = interior survey unit.

The exterior of the K-791-B building will be divided into three Class 3 exterior survey units (ESUs): one for the dock of the K-791-B facility (ESU 1); one for the roof and the heating, ventilating, and air-conditioning (HVAC) unit and ducts on the roof (ESU 2); and one for the exterior walls, abandoned fan on the north side of the building, and through-the-wall heating/cooling units exterior walls, and drain spouts (ESU 3 as shown in Table E.3). Although there is no prior survey history of the K-791-B exterior area, previous surrounding area characterization, such as the K-25 Site cooling towers (SAIC Report 01-0143-03-5812-009, July 1994), does not indicate a potential for the ESUs to exceed 25% of the DCGL.

The survey of equipment and furnishings will be performed along the lines of the survey protocol developed by SEC as discussed in Sect. E.5.3.1. Each building ISU (Table E.4) is to be the basis for the FSU. All newer furnishings will be grouped together in batches (SUs) and classified as Class 3 because they have a very low potential for having been used in other facilities or areas that are potentially contaminated. Older furnishings, which could have been used in other buildings or areas, will be grouped into SUs and classified as Class 2. Only furnishings belonging to DOE or that appear to have been DOE property will be surveyed. Any furnishings belonging to lessees will not be surveyed because they are not being released. However, any furnishings that have been previously transferred to lessees as property with the lease from DOE will be surveyed.

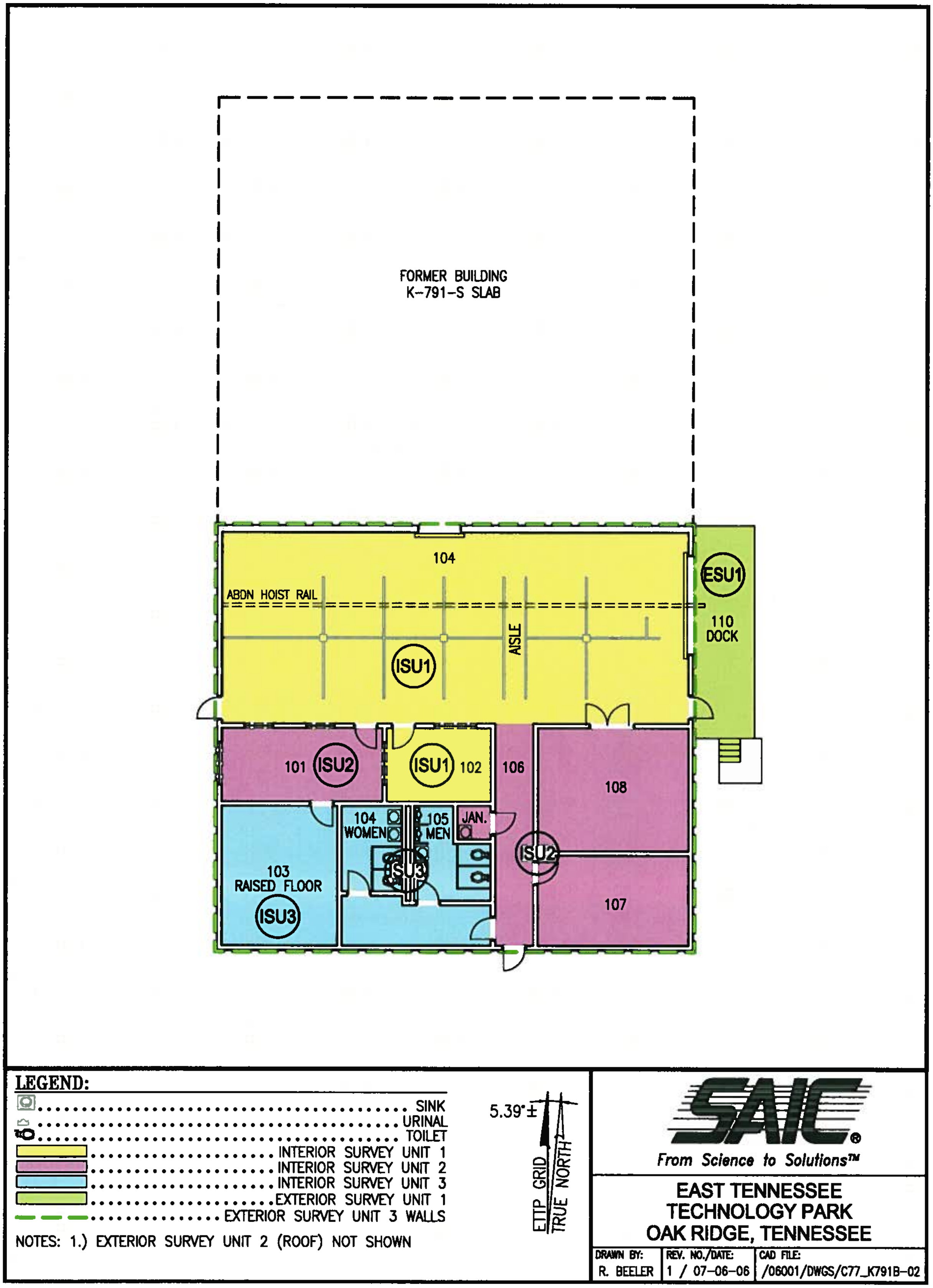

Fig. E.4. K-791-B transfer survey units.

Table E.4. Comparison of parameters for computing number of samples

Parameter	SEC K-1001-A, -B, -C, and -D furnishings survey plan	Survey design document
Type I error rate (α)	0.05	0.05
Type II error rate (β)	0.05	0.10
Non-parametrical statistical test	Wilcoxon-Rank Sum	Sign[7]
LBGR	2500 dpm/100 cm^2	2500 dpm/100 cm^2
Number of data points per survey unit	20 (10 in each survey unit, 10 in each reference background survey unit)	11

dpm = disintegrations per minute.
LBGR = Lower Bound of the Gray Region.
SEC = Safety and Ecology Corporation.

E.5.4 INSTRUMENTATION SELECTION AND SURVEY TECHNIQUES FOR LEASE AND TRANSFER

Refer to the design documents in Appendix A for details on instrumentation selection. In general, for both the lease and transfer surveys, alpha scintillation and beta-gamma Geiger-Müeller (GM) detectors will be attached to scalar rate meters and will have minimum detectable activities less than 25% of the DCGL. Gas-proportional floor monitors or floor monitors with the probe detached from the monitor cart for usage as a hand-held probe, calibrated to detect both alpha and beta-gamma radiations, will be used for as much of the scan surveys as possible, including the primary work surfaces, walls, and ceilings. Sodium iodide (NaI) meters and Bicron MicroRem® meters[8] will also be used, as specified in this survey plan. Removable contamination surveys (i.e., smear surveys) will be conducted at all locations where fixed/total measurements are taken. All removable contamination survey smears will be counted on a gas-proportional counter calibrated to detect both alpha and beta-gamma radiations.

For Class 3 areas, 10% surface scan surveys will be performed over the primary traffic and work surfaces of the entire SU, as accessible. Scanning of walls and ceilings will be based on visual inspection and professional judgment. One hundred percent of the floor area (underneath the carpet) will be scanned in Class 2 areas. Other surfaces that are classified as Class 2 areas, such as walls, ceilings, overhead areas, etc., will have a scan coverage that varies in accordance with how close the expected activity levels are to the DCGLs. (This is a deviation from the current design documents but is in accordance with the proposed revision that has been submitted for approval.) Although there are currently no Class 1 SUs, if found, Class 1 SUs will have a 100% scan of all surfaces performed. Emphasis will be placed upon entrances/high-traffic areas, suspect areas, and professional judgment for all scan surveys.

All surveys will be performed in accordance with established BJC RADCON procedures (e.g., scan rate, probe distance, source checks).

All areas will be surveyed in an "as-found" condition. Materials may be rearranged or moved to allow for survey access to areas covered by material and/or equipment.

[7] The Wilcoxon-Rank Sum statistical test is for use when the primary contaminants are found in background. The Sign test is to be used when the contaminant is not found in background or when the contaminants are in background, but at a small fraction of the DCGL. The Sign test will be used for this survey.

[8] Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof.

E.5.5 REFERENCE COORDINATE SYSTEM FOR LEASE AND TRANSER SURVEYS

Class 3 areas do not require a sample grid. A reference coordinate system will be used in each SU to reference measurements so they can be relocated/verified as needed, unless the measurement is at an easily identifiable location, such as "Room A, 4 ft up on west wall, approximately 2 ft from south wall." The starting point of the reference grid, if needed, will be the southwest corner of each SU, with the distance north being Y and the distance east being X in an X–Y coordinate system [i.e., (X,Y)], with the units in feet.

Class 2 and Class 1 SUs require a sample grid with systematic measurements taken based upon a random starting point. These survey grids are based upon the SU's area and number of systematic sample measurements required in each.

If an SU has to be reclassified to a higher classification and survey requirements, an addendum to this survey plan that contains the sample grids of the reclassified SUs or sections will be issued and included in the survey report and in the Environmental Baseline Survey (EBS) Chap. 6, "Survey Results."

E.6 SURVEY DESIGN

E.6.1 QUANTIFY DATA QUALITY OBJECTIVES

The null hypothesis (H_o) for each SU is that the residual contamination exceeds the DCGL. The alternative hypothesis (H_a) is that the SU meets the DCGL. Decision error levels, as set forth in the design documents, are 0.05 for Type I (α) errors and 0.10 for Type II (β) errors in all SUs. The Lower Bound of the Gray Region (LBGR) is initially set to one-half of the DCGL. These parameters apply to all transfer SUs, regardless of their classification. The design documents discuss the DQO process in greater detail.

B.6.2 DETERMINATION OF THE NUMBER OF DATA POINTS

Using the prescribed statistical testing methodology found in the design documents (Sign test), a Δ/σ value (also known as the "relative shift") greater than 3 is estimated for all Class 2 areas, where Δ is the DCGL – LBGR, the LBGR is 50% of the DCGL, and σ is the standard deviation of the data. (Note: This is true for survey data but does not apply to sample results from soil.) However, the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM)[9] recommends that the relative shift be between 1 and 3. Due to the lack of sampling data associated with the K-791-B facility, a relative shift of 3 was assumed. The Sign test was used because the residual contamination present within the SUs should be at a very small fraction of the DCGL. Using a relative shift of 3 with the DQO parameters listed in Table E.4, 11 survey data points (fixed and removable readings) are needed for all SUs, at a minimum, not including any tool, furniture, or equipment surveys.

B.6.3 LEASE SURVEY PROCEDURES

In any area in which the survey indicates activity exceeding 5000 dpm/100 cm^2, direct alpha and beta-gamma measurements will be made following the establishment of a 1-m^2 grid to obtain data applicable to the DOE Order 5400.5 release criteria. BJC RADCON procedures will be followed for

[9] (NRC 1997). *Multi-Agency Radiation Survey and Site Investigation Manual, Final Edition*, NUREG-1575, Nuclear Regulatory Commission, December 1997.

posting of the immediate area. In addition, any contamination survey location found in excess of two times the DCGL will also have a dose-rate measurement taken at a distance of 3 ft.

Any activity in excess of 25% of the DCGL (when averaged over 1 m^2) will require that a Class 3 SU, or sections thereof, be reclassified as Class 2 and surveyed appropriately. Any activity in excess of the DCGL will require that a Class 3 or 2 SU, or sections thereof, be reclassified as Class 1 and surveyed appropriately.

Many of the radionuclides found on the Oak Ridge Reservation have natural background concentrations. Therefore, background subtraction will be required for all direct field measurements. Some comparison to background levels will also be required for the scanning because only a gross signal will be measured. Material-specific backgrounds might be necessary for materials such as tile, brick, and cinderblock because these materials contain elevated levels of naturally occurring radionuclides. For example, the background is 1716 dpm/100 cm^2 total beta-gamma above ambient background for a glazed clay-tile floor, 1103 dpm/100 cm^2 total beta-gamma above ambient background for a red-clay brick, and 142 dpm/100 cm^2 total beta-gamma above ambient background for a concrete block using a GM detector.[10] This level of radioactivity is within that of the naturally occurring radioactive material (NORM) contained in the glazed clay-tile/brick/concrete block matrix and will be subtracted from the net ambient readings for these materials before determining if the result is greater than 25% of the DCGL or the DCGL.

A summary of the requirements for each type of SU is found in Table E.5, and a survey technician summary is found in Table E.6.

E.6.3.1 Interior Survey Units

Any asbestos-controlled areas will be identified with any pertinent information on whether radiological contamination is suspected (e.g., ventilation hood, exhaust vents, posted radiological area) but not entered as part of this survey. Any ventilation exhausts and air intakes in the survey footprint will be surveyed for contamination.

E.6.3.2 Class 3 interior survey units

The K-791-B building interior survey units not directly associated with machine shop operations are currently classified as Class 3. The survey protocols are as follows: Ten percent of the primary traffic areas and work surfaces will be scanned with floor monitors, NaI meters, and hand-held meters (including use of a floor monitor probe set up as a hand-held probe and calibrated to detect alpha and beta-gamma contamination for large-area scans of non-floor surfaces), as appropriate. NaI scans will be performed for areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans (e.g., drains, floor cracks/joints/penetrations, wall/floor interfaces). Any location on the walls or ceiling that, using professional judgment, could potentially have residual radioactivity present will also be scanned over the suspected area and documented on the survey. Room 103 was previously constructed as a change house but was refurbished into a computer room. The room, therefore, contains a raised wooden floor on top and several inches above the clay tiled floor, such as found in the men's change house. The clay tile floor is not accessible except through mechanical means. For leasing purposes, the wooden floor will be surveyed intact. Tools, office furniture, and equipment will be a separate SU and surveyed per the

[10] Values computed based upon the beta-gamma background levels for brick, ceramic tile, and ambient found in Table 5.1 of NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, December 1997 (NRC 1997b), and an average beta-gamma Geiger-Müeller correction factor of 34 (dpm/100 cm^2)/cpm for a planar radiation source.

Table E.5. Summary of survey unit requirements

Survey unit type	Class 3	Class 2	Class 1
Interior	• Ten percent scan of primary traffic and work spaces. • Use of professional judgment for wall scans. • Eleven total and removable reading(s), at a minimum, per SU and at least one per office, room, or open space. • Reading locations based on professional judgment and scan survey. • Dose-rate walkover survey in each SU. • Minimum of one dose-rate reading per office or open space. • One dose-rate reading per every 20 ft of hallway. • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans. • Upgrading to Class 2 if activity > 25% DCGL. • Upgrading to Class 1 if activity > DCGL.	• One hundred percent scan of floors/primary work areas underneath carpet. • Thirty percent scan of walls and overhead areas. • Eleven total and removable readings, at a minimum, per SU • Reading locations based upon a grid to be determined, as needed. • Smears and direct readings to be obtained from locations of the highest contamination with results greater than 25% of the DCGL, as indicated by the scanning surveys for each horizontal and vertical surface. • Dose-rate walkover survey in each SU. • Minimum of one dose-rate reading per office or open space. • One dose-rate reading per every 20 ft of hallway. • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans. • Upgrading to Class 1 if activity > DCGL.	• One hundred percent scan of all surfaces. • Eleven total and removable readings, at a minimum, per SU. • Reading locations based upon a grid to be determined, as needed. • Smears and direct readings to also be obtained from locations of the highest contamination with results greater than the DCGL, as indicated by the scanning surveys for each horizontal and vertical surface. • Dose-rate walkover survey in each SU. • Minimum of one dose-rate reading per office or open space. • One dose-rate reading per every 20 ft of hallway. • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans.
Furnishings	• Ten percent scan of all accessible surfaces. • Maximum total surface area < 5000 m^2. • Removal of item and all other similar items to be placed in a new Class 2 SU if activity > 25% of DCGL.	• Twenty-five percent scan of all accessible surfaces. • Maximum total surface area < 1000 m^2. • Removal of item and all other similar items to be placed in a new Class 1 SU if activity > DCGL.	• One hundred percent scan of all accessible surfaces. • Maximum total surface area < 100 m^2.

DCGL = derived concentration guideline level.
NaI = sodium iodide.
SU = survey unit.

Table E.6. Survey technician summary of survey requirements

Class 3	Class 2	Class 1
• Ten percent scan of interior floor/primary work areas, 10% of exterior accessible surfaces, and 10% of furnishings accessible surfaces. • Professional judgment for wall scans. • Scan of exterior walls up to at least 8 ft. • Eleven total and removable reading(s), at a minimum, per SU and at least one per office, room or open area. • Dose-rate walkover survey in each SU (minimum of one reading/office or open space or 1/20 ft of hallway). • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans based on professional judgement. • Removal of item and all other similar items to be placed in a new Class 2 SU if furnishings activity > 25% of DCGL. • Notification of supervisor if activity > 25% DCGL.	• One hundred percent scan of interior floor/primary work areas. • Thirty percent scan of walls and overhead areas. • Furnishings scan of 25% of accessible surfaces. • Eleven (minimum) total and removable readings. • Reading locations based upon a grid. • Dose-rate walkover survey in each SU (minimum of one reading/office or open space, 1/20 ft of hallway). • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans with coverage equal to % of DCGL. • Notification of supervisor if activity > DCGL. • Removal of item and all other similar items to be placed in a new Class 1 SU if furnishings activity > DCGL.	• One hundred percent scan of all surfaces. • Eleven (minimum) total and removable readings. • Reading locations based upon a grid to be determined. • Dose-rate walkover survey in each SU (minimum of one reading/office or open space, 1/20 ft of hallway). • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans based on professional judgment.

DCGL = derived concentration guideline level.
NaI = sodium iodide.
SU = survey unit.

guidance found in Sect. E.6.3.3. One total and removable contamination measurement, at a minimum, will be recorded in each room, hallway, or open space at locations determined during the scan survey to have the highest activity. Any Class 3 areas that exceed 25% of the DCGL will be reclassified as Class 2 areas and surveyed accordingly. All reclassified areas will be discussed in the survey report and in the EBS Chap. 6, "Survey Results."

A general dose-rate walkover survey of each SU, using a Bicron MicroRem® meter, will be performed to determine if any variations exist in the penetrating radiation dose rate. If variations exist, then the location will be recorded. Dose-rate measurements will be obtained at a minimum of 1 per room and every 20 ft in hallways and large rooms.

E.6.3.3 Class 2 interior survey units

The K-791-B building ISUs directly associated with machine shop operations, or contain carpeted flooring similar to the machine shop, are currently classified as Class 2 due to the limited survey history and history of machine shop activities, and the close proximity to the K-31 and K-33 gaseous diffusion buildings. The Class 2 survey protocols are as follows: 100% of the floor surface will be scan-surveyed using a floor monitor, NaI meter, or hand-held meters, as appropriate, with the carpet removed. Due to the lack of historical information associated with the K-791-B facility, 30% of the walls up to 8 ft and overhead areas will be scanned according to Table E.7. It is not expected for 30% or greater of the walls and overhead areas to be greater than 50% of the DCGL. Five (minimum) total and removable measurements per vertical and horizontal surface in each room will be recorded from locations of the highest contamination as indicated by the scanning surveys. Any Class 2 areas that exceed the DCGL will be reclassified as Class 1 areas and surveyed accordingly. All reclassified areas will be discussed in the addendum to this survey plan that will be issued and included in the survey report and in the EBS Chap. 6, "Survey Results."

Table E.7. Class 2 survey unit scan percentage versus percent of DCGL

% DCGL	Activity (dpm/100 cm^2)	Scan %
<30	<1500	10
<50	<2500	30
<70	<3500	50
>=70	<5000	100

DCGL = derived concentration guideline level.
dpm = disintegrations per minute (activity as observed from historical data).

Although there are currently no Class 1 SUs, the potential exists for having a Class 3 or 2 area upgraded to a Class 1. Class 1 SUs follow the Class 2 survey protocols, with the exception that walls and ceilings will be classified separately and, if Class 1, will have 100% of surfaces scanned.

E.6.3.4 Equipment and Furniture (Furnishings) Surveys

The survey of equipment and furnishings will be performed along the lines of the survey protocol developed by SEC for the release of materials from the K-1001-A, -B, -C, and -D buildings prior to their demolition.[11] The K-1001-A, -B, -C, and -D and design documents requirements that affect the number of survey data points are listed in Table E.3.

As stated in Sect. E.5.3, SUs are classified as either Class 1, 2, or 3 based upon historical data and process knowledge providing information on the contamination potential for the unit. Furnishings (which include all furniture, equipment racks, equipment, tools, etc., for the purposes of this portion of the survey) are considered to have a low potential for residual contamination being present (there have been several tool survey "sweeps" throughout the plant over recent years which should have captured the vast majority of contaminated tools on-site). All SUs will have alpha and beta-gamma scan surveys performed on them, with the areas covered by the scans determined by professional judgment. In addition, direct and removable alpha and beta-gamma measurements will be taken, with the locations being the areas with the highest readings, as determined during the scan surveys. A detailed listing of all the items within the SU is not required; a generalized item listing of SU classification and number, NaI scan results, and the individual survey data points is the minimum data reporting requirement.

The building ISU (Table E.2) is to be the basis for the FSU. The individual FSUs will be designated in a manner similar to the following example to identify the ISU and the FSU (e.g., ISU 4 FSU C3, which designates that the data are from the ISU 4 FSU Class 3). If removable equipment or furnishings are found in ESUs, they will also make up an FSU identified with the ESU number.

[11] *Survey Protocol Unrestricted Release of Building Furnishings*, prepared by Safety and Ecology Corporation for Bechtel Jacobs Company LLC Radiation Control.

E.6.3.5 Furnishings – survey unit survey procedures

Class 3 Furnishings Survey Units

The K-791-B facility currently contains minimum furnishings. All newer furnishings will be grouped together in batches (SUs) and classified as Class 3, as they have a very low potential for having been used in other facilities or areas that are potentially contaminated. The total surface area of each Class 3 SU will not exceed 5000 m^2. The surface scan surveys will cover 10% of all accessible areas. If residual radioactive activity is found in excess of 25% of the DCGL, the item with the residual activity, and all items of a similar type and history in that SU, will be removed from that SU, reclassified as a separate Class 2 SU, and resurveyed accordingly.

Class 2 Furnishings Survey Units

Older furnishings, which could have been used in other buildings or areas, will be grouped into SUs and classified as Class 2. The total surface area of a Class 2 FSU will not exceed 1000 m^2. The surface scan surveys will cover 10% of all accessible areas. If residual radioactive activity is found in excess of the DCGL, the item with the residual activity, and all items of a similar type and history in that SU, will be removed from that SU, reclassified as a separate Class 1 SU, and resurveyed accordingly.

Class 1 Furnishings Survey Units

Only furnishings that have exceeded the DCGL during the Class 2 survey, above, will be classified and surveyed as a Class 1 SU. The total surface area of a Class 1 FSU will not exceed 100 m^2. The surface scan surveys will cover 100% of all accessible areas.

All furnishings survey data results (in each SU) that meet the above criteria will be evaluated against the Sign test criteria to determine if the items can be released. The null hypothesis (H_o) to be tested is that the residual radioactivity in the SU exceeds the DCGL. If the null hypothesis is rejected based upon the non-parametrical statistical test, then the alternative hypothesis (H_a) is accepted, which states that the residual radioactivity in the SU does not exceed the DCGL and, therefore, can be released.

E.6.4 TRANSFER SURVEY PROCEDURES

All surveys are to be performed in accordance with this survey plan, the design documents, and BJC RADCON procedures as discussed in Sect. E.6.3.

In any area in which the survey indicates activity exceeding 5000 dpm/100 cm^2, direct alpha and beta-gamma measurements will be made following the establishment of a 1-m^2 grid to obtain data applicable to the DOE Order 5400.5 release criteria. BJC RADCON procedures will be followed for posting of the immediate area. In addition, any contamination survey location found in excess of two times the DCGL will also have a dose-rate measurement taken at a distance of 3 ft.

Any activity in excess of 25% of the DCGL (when averaged over 1 m^2) will require that a Class 3 SU, or sections thereof, be reclassified as Class 2 and surveyed appropriately. Any activity in excess of the DCGL will require that a Class 3 or 2 SU, or sections thereof, be reclassified as Class 1 and surveyed appropriately.

As discussed in Sect. E.5.3, background subtraction will be required for all direct field measurements. Some comparison to background levels will also be required for the scanning because only a gross signal will be measured. Material-specific backgrounds might be necessary for some materials such as tile, due to the material containing elevated levels of naturally occurring radionuclides. Where the level of radioactivity is within that of the NORM contained in the tile matrix, background will be subtracted from the net ambient readings for these materials before determining if the result is greater than 25% of the DCGL or the DCGL.

A summary of the requirements for each type of SU is found in Table E.8, and a survey technician summary is found in Table E.9.

E.6.4.1 Interior Survey Units

Any asbestos-controlled areas will be identified with any pertinent information on whether radiological contamination is suspected (e.g., ventilation hood, exhaust vents, posted radiological area) but not entered as part of this survey. Any ventilation exhausts and air intakes in the survey footprint will be surveyed for contamination.

E.6.4.1.1 Class 3 interior survey units

The K-791-B building ISUs not directly associated with machine shop are currently classified as Class 3. The survey protocols are as follows: a minimum of 10% of the primary traffic areas and work surfaces will be scanned with floor monitors, NaI meters, and hand-held meters (including use of a floor monitor probe set up as a hand-held probe and calibrated to detect alpha and beta-gamma contamination for large-area scans of non-floor surfaces), as appropriate. NaI scans will be performed for areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans (e.g., drains, floor cracks/joints/penetrations, wall/floor interfaces). Room 103 was previously constructed as a change house but was refurbished into a computer room. The room, therefore, contains a raised wooden floor on top and several inches above the clay tiled floor, such as found in the men's change house. The clay tile floor is not accessible except through mechanical means. For transfer purposes, a 4 foot by 8 foot section of the wooden floor will be removed exposing the lower tile floor. The tile floor below will be scanned with floor monitors, NaI meters, and hand-held meters, as appropriate. Any location on the walls or ceiling that, using professional judgment, could potentially have residual radioactivity present will also be scanned over the suspected area and documented on the survey. Tools, office furniture, and equipment will be a separate SU and surveyed per the guidance found in Sect. E.6.4.3. Eleven measurements of total and removable contamination, at a minimum, will be recorded within each SU at locations determined during the scan survey to have the highest activity. However, at least one reading will be made in each room. Any Class 3 areas that exceed 25% of the DCGL will be reclassified as Class 2 areas and surveyed accordingly. All reclassified areas will be discussed in the survey report and in the EBS Chap. 6, "Survey Results."

A general dose-rate walkover survey of each SU, using a Bicron MicroRem® meter, will be performed to determine if any variations exist in the penetrating radiation dose rate. If variations exist, then the location will be recorded. Dose-rate measurements will be recorded at a minimum of 1 per room and every 20 ft in hallways and large rooms.

E.6.4.1.2 Class 2 interior survey units

The K-791-B building ISUs directly associated with machine shop operations, or contain carpeted flooring similar to the machine shop, are currently classified as Class 2 due to the limited survey history and history of machine shop activities and the close proximity to the K-31 and K-33 gaseous

Table E.8. Summary of survey unit requirements

Survey unit type	Class 3	Class 2	Class 1
Interior	• Ten percent scan of primary traffic and work spaces. • Use of professional judgment for wall scans. • Remove a 4 ft x 8 ft section of upper flooring and scan flooring underneath. • Eleven total and removable reading(s), at a minimum, per SU and at least one per office, room, or open space. • Reading locations based on professional judgment and scan survey. • Dose-rate walkover survey in each SU. • Minimum of one dose-rate reading per office or open space. • One dose-rate reading per every 20 ft of hallway. • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans. • Upgrading to Class 2 if activity > 25% DCGL. • Upgrading to Class 1 if activity > DCGL.	• One hundred percent scan of floors/primary work areas with carpet removed. • Thirty percent scan of walls and overhead areas. • Eleven total and removable readings, at a minimum, per SU. • Reading locations based upon a grid to be determined, as needed. • Smears and direct readings to also be obtained from locations of the highest contamination with results greater than 25% of the DCGL, as indicated by the scanning surveys for each horizontal and vertical surface. • Dose-rate walkover survey in each SU. • Minimum of one dose-rate reading per office or open space. • One dose-rate reading per every 20 ft of hallway. • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans. • Upgrading to Class 1 if activity > DCGL.	• One hundred percent scan of all surfaces. • Eleven total and removable readings, at a minimum, per SU. • Reading locations based upon a grid to be determined, as needed. • Smears and direct readings to also be obtained from locations of the highest contamination with results greater than the DCGL, as indicated by the scanning surveys for each horizontal and vertical surface. • Dose-rate walkover survey in each SU. • Minimum of one dose-rate reading per office or open space. • One dose-rate reading per every 20 ft of hallway. • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans.
Exterior	• Ten percent scan of accessible surfaces. • Scan of walls up to at least 8 ft. • Eleven total and removable readings, at a minimum, per SU. • Reading locations based on professional judgment and scan survey; at least one timed measurement on each piece of exterior equipment and on each facing and roof for buildings. • Dose-rate reading for each static measurement location. • NaI scan of areas such as area directly under drain spouts that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans. • Upgrading to Class 2 if activity > 25% DCGL. • Upgrading to Class 1 if activity > DCGL.	• Thirty percent scan of surfaces. • Scan of walls up to at least 8 ft. • Eleven total and removable readings, at a minimum, per SU. • Reading locations based upon a grid. • Dose-rate walkover survey in/on each SU. • One dose-rate reading per every 20 ft. • NaI scan of areas such as area directly under drain spouts that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans. • Upgrading to Class 1 if activity > DCGL.	• One hundred percent scan of all surfaces. • Scan of walls up to at least 8 ft. • Eleven total and removable readings, at a minimum, per SU. • Reading locations based upon a grid to be determined, as needed. • Dose-rate walkover survey in/on each SU. • One dose-rate reading per every 20 ft. • NaI scan of areas such as area directly under drain spouts that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans.

Table E.8. Summary of survey unit requirements (continued)

Survey unit type	Class 3	Class 2	Class 1
Furnishings	• Ten percent scan of all accessible surfaces. • Maximum total surface area < 5000 m^2. • Removal of item and all other similar items to be placed in a new Class 2 SU if activity > 25% of DCGL.	• Twenty-five percent scan of all accessible surfaces. • Maximum total surface area < 1000 m^2. • Removal of item and all other similar items to be placed in a new Class 1 SU if activity > DCGL.	• One hundred percent scan of all accessible surfaces. • Maximum total surface area < 100 m^2.

DCGL = derived concentration guideline level.
NaI = sodium iodide.
SU = survey unit.

Table E.9. Survey technician summary of survey requirements

Class 3	Class 2	Class 1
• Ten percent scan of interior floor/primary work areas, 10% of exterior accessible surfaces, and 10% of furnishings accessible surfaces. • Remove a 4 ft x 8 ft section of upper flooring and scan flooring underneath. • Professional judgment for wall scans. • Scan of exterior walls up to at least 8 ft. • Eleven (minimum) total and removable readings and at least one per room or open area.	• One hundred percent scan of interior floor/primary work areas underneath carpet. • Thirty percent scan of walls and overhead areas. • Furnishings scan of 25% of accessible surfaces. • Scan of exterior walls up to at least 8 ft. • Eleven (minimum) total and removable readings.	• One hundred percent scan of all surfaces. • Scan of exterior walls up to at least 8 ft. • Eleven (minimum) total and removable readings. • Reading locations based upon a grid to be determined. • Dose-rate walkover survey in each SU (minimum of one reading/office or open space, 1/20 ft of hallway or exterior).
• Dose-rate walkover survey in each SU (minimum of one reading/office or open space, 1/20 ft of hallway or exterior). • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans based on professional judgment. • Removal of item and all other similar items to be placed in a new Class 2 SU if furnishings activity > 25% of DCGL. • Notification of supervisor if activity > 25% DCGL.	• Reading locations based upon a grid. • Dose-rate walkover survey in each SU (minimum of one reading/office or open space, 1/20 ft of hallway or exterior). • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans with coverage equal to % of DCGL. • Notification of supervisor if activity > DCGL. • Removal of item and all other similar items to be placed in a new Class 1 SU if furnishings activity > DCGL.	• NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans based on professional judgment.

DCGL = derived concentration guideline level.
NaI = sodium iodide.
SU = survey unit.

diffusion buildings. The Class 2 survey protocols are as follows: 100% of the floor surface will be scan-surveyed using a floor monitor, NaI meter, or hand-held meters, as appropriate, underneath the existing carpet. Thirty percent of the walls up to 8 ft and overhead areas will be scanned. The static measurement locations will be systematically chosen per the survey grid for the floor only. In addition, smears and direct readings will be obtained from locations of the highest contamination with results greater than 25% of the DCGL, as indicated by the scanning surveys for each horizontal and vertical surface. Any Class 2 areas that exceed the DCGL will be reclassified as Class 1 areas and surveyed accordingly. All reclassified areas will be discussed in the addendum to this survey plan that will be issued and included in the survey report and in the EBS Chap. 6, "Survey Results."

E.6.4.1.3 Class 1 interior survey units

Although there are currently no Class 1 SUs, the potential exists for having a Class 3 or 2 area upgraded to a Class 1. Class 1 SUs follow the Class 2 survey protocols, with the exception that walls and ceilings will be classified separately and, if Class 1, will have 100% of surfaces scanned.

E.6.4.2 Exterior Survey Units

All exterior areas will be surveyed with hand-held meters or with a gas-proportional probe and with an NaI meter up to a minimum height of 8 ft. Exterior areas, other than the building exterior walls and roof, that are covered under this survey plan include the porch with crane track protrusions, drain spouts, HVAC unit and ducts, and the abandoned fan on the north wall of the building. Emphasis is to be placed upon air vents/intakes, windowsills, gutter downspouts, valve handles, and wherever professional judgment would indicate a higher probability of finding elevated readings.

E.6.4.2.1 Class 3 exterior survey units

There are three Class 3 ESUs. The Class 3 survey protocols are as follows: Exterior surveys will have 10% of the surfaces scanned with hand-held meters or with gas-proportional probes, as appropriate. For exterior areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans (e.g., drain spouts, wall/floor interfaces), a scan will be performed using a NaI meter. Eleven measurements of total and removable contamination, at a minimum, will be recorded within each SU at locations determined during the scan survey to have the highest activity. At least one timed measurement will be made on each piece of exterior equipment and on each facing and roof of the building. Any Class 3 or 2 areas that exceed the DCGL will be reclassified as Class 1 areas and surveyed accordingly. All reclassified areas will be discussed in an addendum to this survey plan that will be issued and included in the survey report and in the EBS Chap. 6, "Survey Results."

E.6.4.2.2 Class 2 exterior survey units

Although there are currently no Class 2 exterior survey units, the potential exists for Class 3 areas to be upgraded to Class 2; therefore, the Class 2 survey protocols are as follows. Surfaces such as the roof and walls up to 8 ft, will be scan-surveyed using hand-held meters and/or gas-proportional meters (if possible) and with an NaI meter according to the percentages listed in Table E.7. The survey measurement locations will be systematically chosen per survey grid. In addition, smears and direct readings will be obtained from locations of the highest contamination with results greater than 25% of the DCGL, as indicated by the scanning surveys for each horizontal and vertical surface. Any Class 3 or 2 areas that exceed the DCGL will be reclassified as Class 1 areas and surveyed accordingly. All reclassified areas will be discussed in an addendum to this survey plan that will be issued and included in the survey report and in the EBS Chap. 6, "Survey Results."

E.6.4.2.3 Class 1 exterior survey units

Although there are currently no Class 1 exterior areas, the potential exists for having a Class 3 or 2 area upgraded to a Class 1. Class 1 SUs follow the Class 2 survey protocols, with the exception that 100% of the surfaces will be scanned.

E.6.4.3 Equipment and Furniture (Furnishings) Surveys

Equipment surveys will be performed in the same manner as for lease as described in Sect. E.6.3.3.

E.6.5 SPECIFICATION OF SAMPLING LOCATIONS

All recorded survey measurement locations are to be on a random basis for Class 3 internal and external SUs. For Class 3 ISUs and ESUs, the random points will be chosen on a judgmental basis and should include entrances, primary traffic areas, air vents, and primary workspaces; these are the areas that would be expected to have the highest probability of having elevated readings. Survey locations for Class 2 or 1 ISUs and ESUs will be based on a survey grid plus measurements from the highest point of each surface determined from the scan. The gridded survey locations for ISU 1 are given on Fig. E.5. If needed, further survey locations for Class 2 or 1 will be based on systematic points on the survey grid plus measurements from the highest point of each surface determined from the scan.

E.7 DOCUMENTATION

Survey data will be documented in accordance with the procedures and reviews required by the DOE contractor. A report will be prepared describing the survey methods, results, and evaluation. The report will include the findings of the assessment, describe the materials surveyed and their condition, and justify the contamination potential classification assigned. The data evaluation will be included, along with the assessment of the quality assurance (QA)/quality control (QC) documentation. This report, or a summary of the report, will also be included and referenced in the facility's baseline environmental conditions documentation. It should be noted that the transfer of K-791-B cannot occur without the concurrence of both U. S. Environmental Protection Agency Region 4 and the Tennessee Department of Environment and Conservation.

E.8 QUALITY ASSURANCE

All appropriate QA/QC reviews to ensure the quality of the data gathered will be performed and documented.

Survey instruments and methods specified in applicable RADCON operating and technical procedures have been documented as to their ability to provide a 95% confidence level in detection of surface contamination at levels that meet the requirements of this protocol. Supporting data are provided on each survey form. RADCON technicians not involved in the execution of this protocol will repeat approximately 5% of the direct and removable activity measurements on items destined for unrestricted release for verification. The results must confirm the initial findings for acceptance as satisfying release criteria.

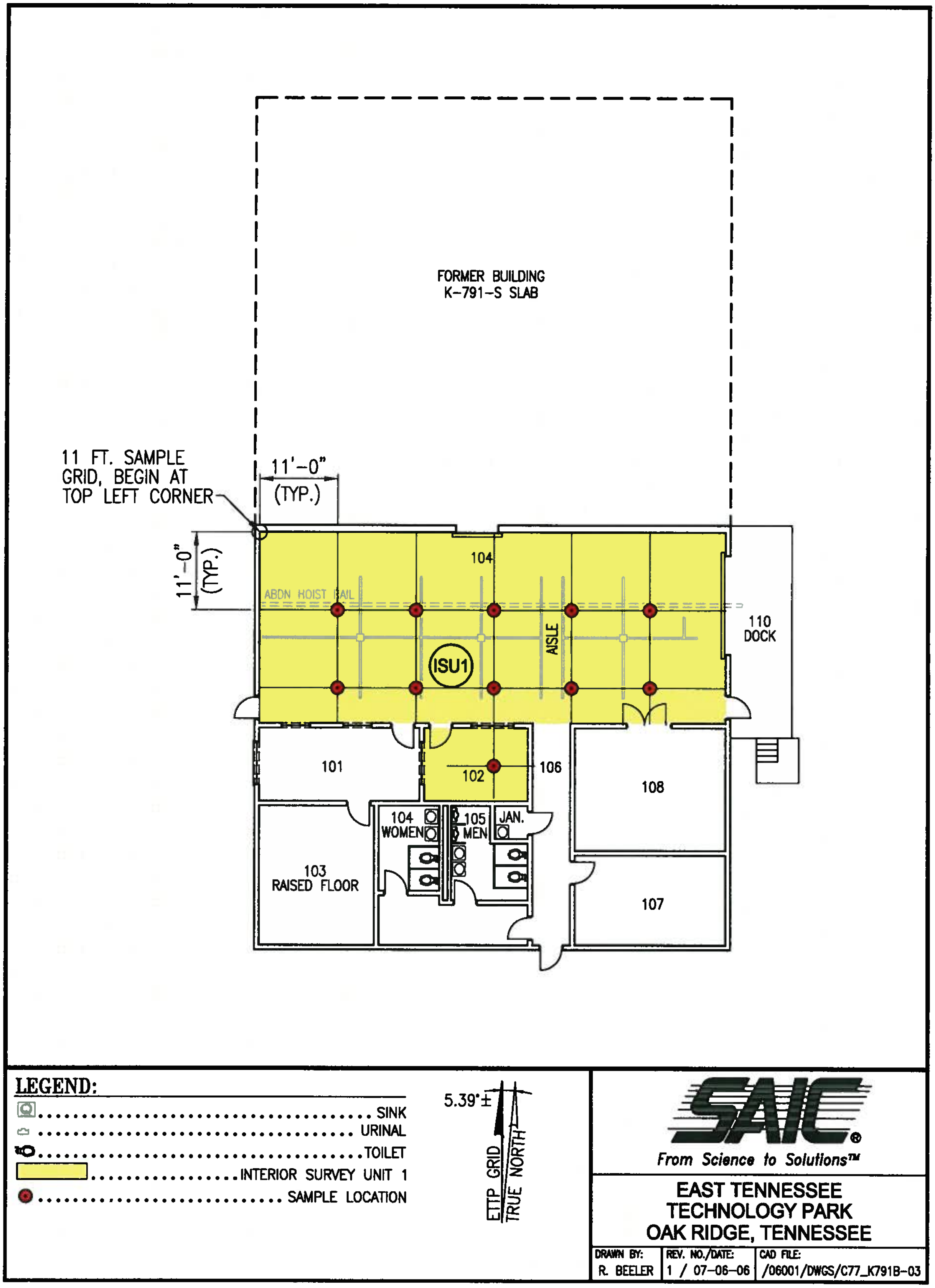

Fig. E.5. Sample locations for the machine shop operations floor (ISU 1).

A DOE contractor, RADCON-certified health physicist, or another designated health physicist, will review, evaluate, and validate the survey results, including assessment of the QA/QC information and data, prior to generation of the radiological survey report. The final radiological survey report will include the details of this assessment. It will be provided to the DOE contractor project QA manager, project manager, and site project health physicist for approval prior to its inclusion into the EBS.

ADDENDUM

CHANGES AND UPGRADES DUE TO CONDITIONS FOUND IN BUILDING K-791-B

The initial survey results of Bldg. K-791-B performed in July 2006, revealed fixed contamination greater than 25% of the derived concentration guideline level (DCGL) was found on the exterior walls of the building. A summary of the fixed contamination results is listed in Table Addendum.1. In Exterior Survey Unit (ESU) 3, four out of four survey locations on the west side of Bldg. K-791-B were found to contain contamination greater than 25% of the DCGL. Additionally, three out of four locations on the south wall, three out of four locations on the north wall, and three out of four locations on the east wall contained contamination greater than 25% of the DCGL. In accordance with the survey plan, these conditions warrant a revision of the classification of this survey unit (SU) and resurvey. This addendum documents the changes required as a result of the conditions found.

Table Addendum.1. ESU 3 contamination summaries

Survey location	Alpha fixed (dpm/100 cm^2)	Beta-gamma fixed (dpm/100 cm^2)
North wall-1	35.76	2267.94
North wall-2	17.88	2495.18
North wall-3	44.7	2297.84
North wall-4	<13.41	103.18
South wall-1	31.29	1962.96
South wall-2	44.7	1329.08
South wall-3	31.29	1771.6
South wall-4	22.35	1239.38
East wall-1	35.76	1460.64
East wall-2	0	1669.94
East wall-3	13.41	1586.22
East wall-4	8.94	<-275.08
West wall-1	4.47	1407.07
West wall-2	53.64	1370.94
West wall-3	17.88	1293.2
West wall-4	13.41	1891.2

Note: DCGL: 5000 dpm/100 cm^2 alpha and beta-gamma fixed.
25% DCGL: 1250 dpm/100 cm^2 alpha and beta-gamma fixed.
dpm = disintegrations per minute.
ESU = exterior survey unit.

Because contamination levels in excess of 25% of the DCGL were found on all four building walls in ESU 3, all four walls will be considered Class 2 and scanned according to the design document. Each wall is considered its own SU (see Table Addendum.2) with sampling location grids as shown in Figs. Addendum.1 and Addendum.2. Each SU will be surveyed according to the survey protocols stated in Sect. E.6.4.2.2, "Class 2 Exterior Survey Units," of this survey plan. The survey summary requirements are found in Tables E.8 and E.9 of this survey plan.

Table Addendum.2. Survey unit designations

Area	Survey unit
North Wall	ESU 4
South Wall	ESU 5
West Wall	ESU 6
East Wall	ESU 7

ESU = exterior survey unit.

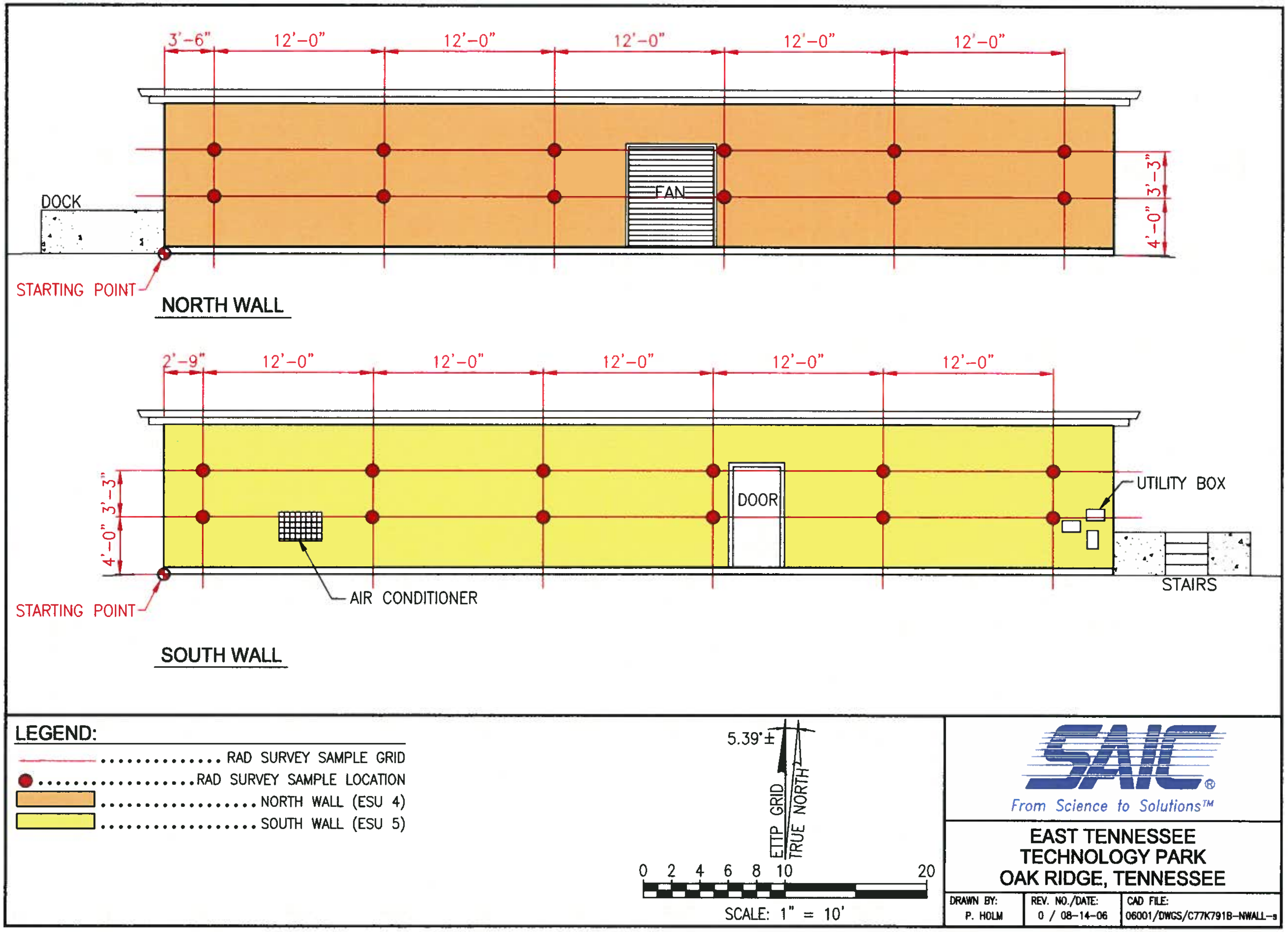

Fig. Addendum.1. Building K-971-B North and South Wall.

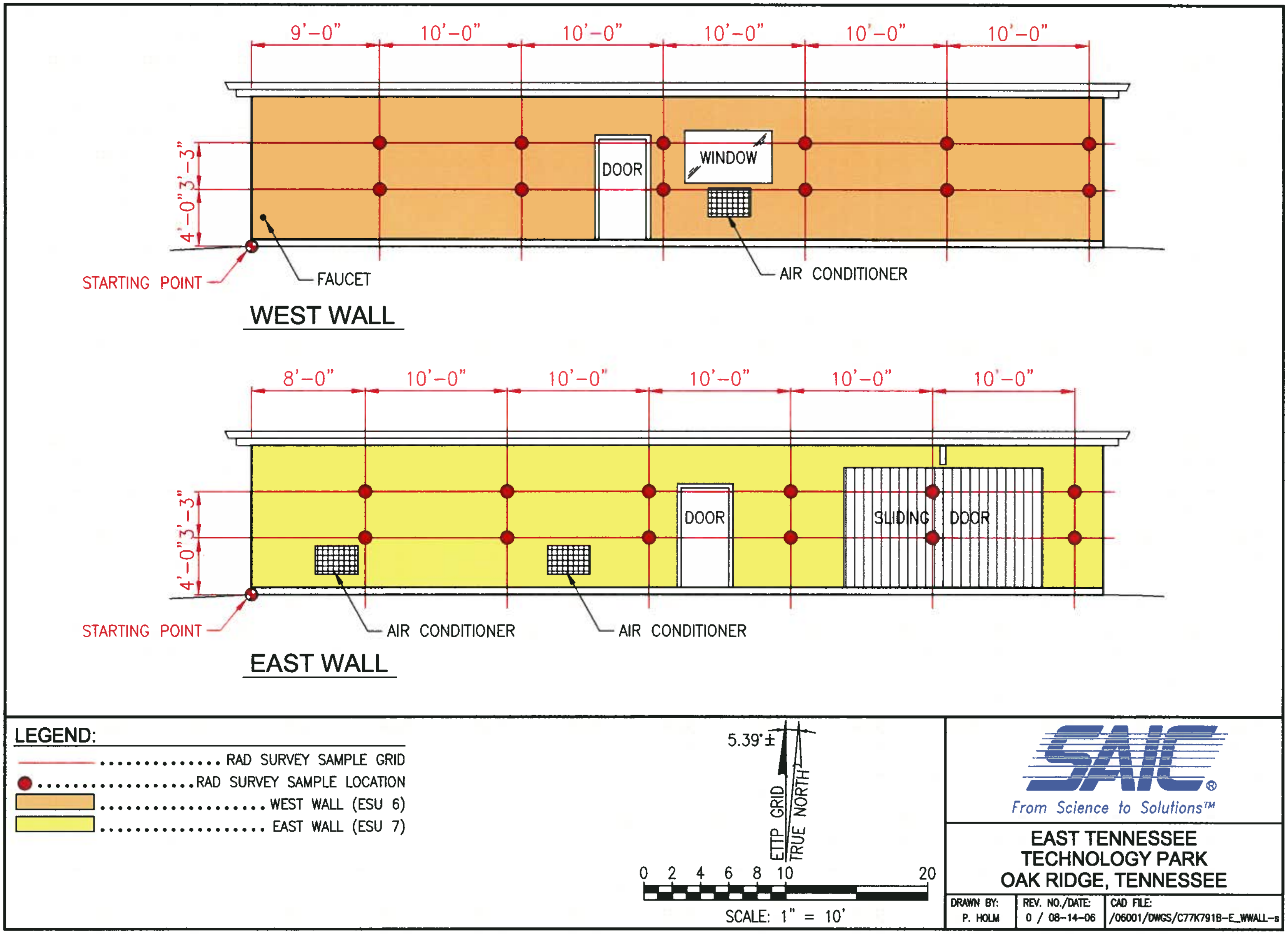

Fig. Addendum.2. Building K-971-B East and West Wall.

APPENDIX F

RADIOLOGICAL SURVEY PLAN FOR BUILDING K-796-A

F.1 AREA TO BE SURVEYED

The area to be surveyed is the K-796-A building. The building is to have the title transferred to the Community Reuse Organization of East Tennessee (CROET). The K-796-A building is located in the northwest section of the East Tennessee Technology Park (ETTP), west of the K-33 and K-791-B buildings, north of Bldg. K-761, and south of the K-792 Switchyard. For a detailed depiction of the footprint, refer to Fig. F.1.

Building K-796-A is a single-story, pre-engineered, steel-framed, corrugated metal skin building. The facility measures approximately 60 ft long by 40 ft wide and has a floor area of 2780 ft^2. Heating/cooling wall units are located on the south and west walls. See Fig. F.2 for the floor plan of Bldg. K-796-A.

F.2 HISTORY OF THE AREA

The 2780-ft^2 K-796-A building was constructed in 1978. From its construction until 1998, Bldg. K-796-A was historically used for storage of electrical maintenance supplies and tools that were used to support power transmission and switchyard operations at the three plants on the Oak Ridge Reservation (ORR). During this time, various items of electrical equipment (such as small transformers, oil-filled circuit breakers, and oil-filled transformer bushings) were temporarily stored at Bldg. K-796-A. During active operations at the Oak Ridge Gaseous Diffusion Plant, Bldg. K-796-A was also used to conduct overflow maintenance from Bldg. K-791-B, which had the potential to include equipment that contained polychlorinated biphenyl (PCB) dielectric fluids. The facility was also used for fabrication of conduit runs. Equipment used in those activities included conduit benders, pipe-threading equipment, and band saws.

Between 2000 and 2005, Bldg. K-796-A was used by the U. S. Department of Energy (DOE) contractor performing decontamination activities in the K-29, K-31, and K-33 process buildings for conference space. The interior walls indicated in Fig. F.2 were constructed during that time.

There are no floor drains, potable water, fire water, or sanitary sewer connections, including underground service lines, present in the building. Electrical service is provided by an overhead 220-V line.

F.3 EXISTING SURVEY DATA SUMMARY

A search of the Bechtel Jacobs Company LLC (BJC) Radiation Control (RADCON) electronic survey data collected between 1996 and 2006 showed two characterization surveys, performed during this time frame, associated with the K-796-A building. The first survey, performed in 1997 (19970721KA36193001), consisted of both total and removable contamination. The second survey, taken in 2006 (20060804EBVDESK003), consisted of only area dose rates. The 1997 survey results revealed both fixed and removable contamination were less than plant off-site release limits [Table F.1 derived concentration guideline level (DCGL) values] for unrestrictive use. Only two locations were surveyed. Alpha results were less than 27.2 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) with beta/gamma results at less than 50.4 dpm/100 cm^2 for removable contamination. Total results for both alpha and beta/gamma were less than the instruments' critical levels of detection at 78.9 dpm/100 cm^2 and 548 dpm/100 cm^2, respectively. No other radiological survey data were found. The two surveys were utilized in the preparation of this survey plan.

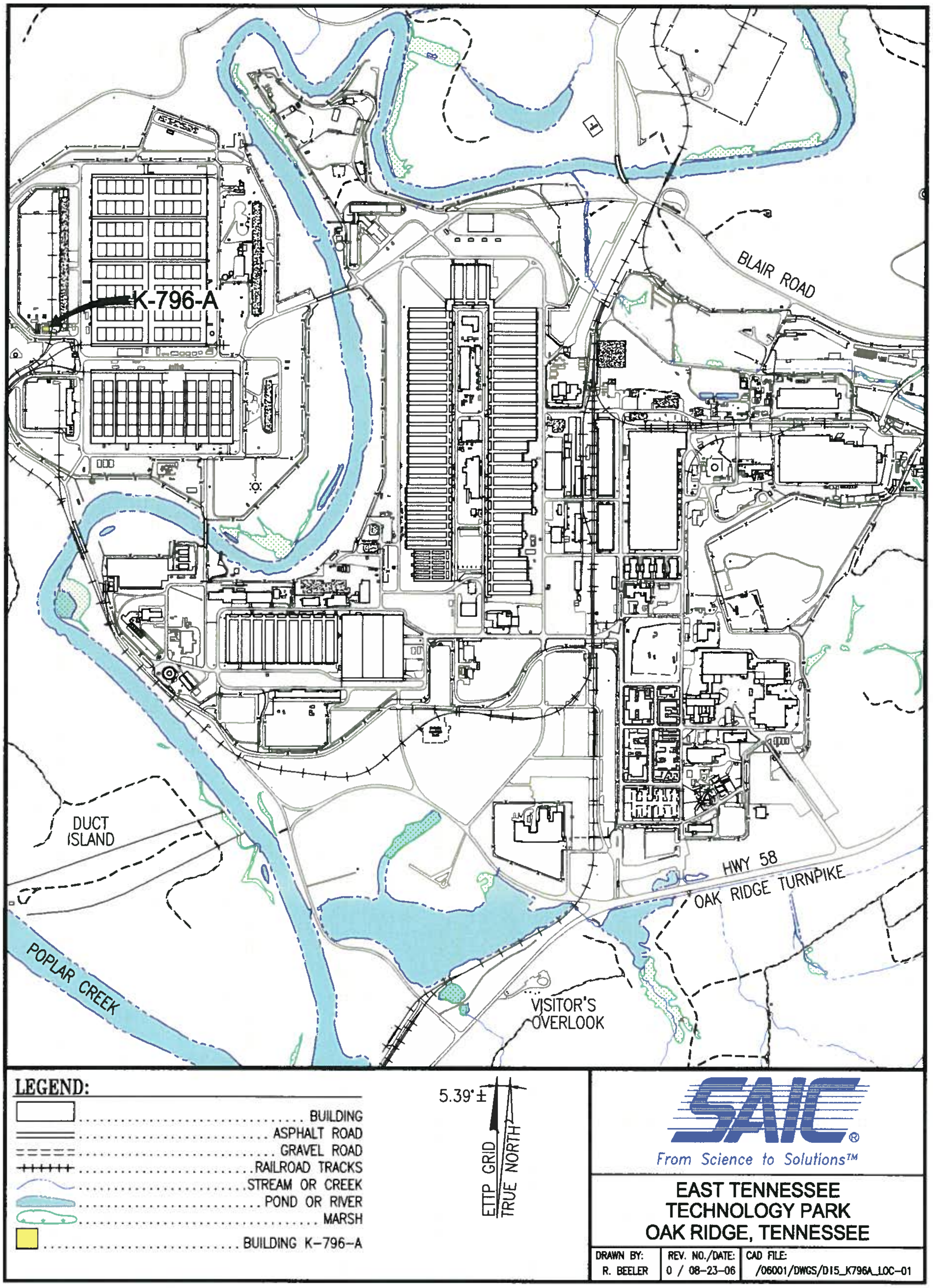

Fig. F.1. Footprint and location of K-796-A building within ETTP.

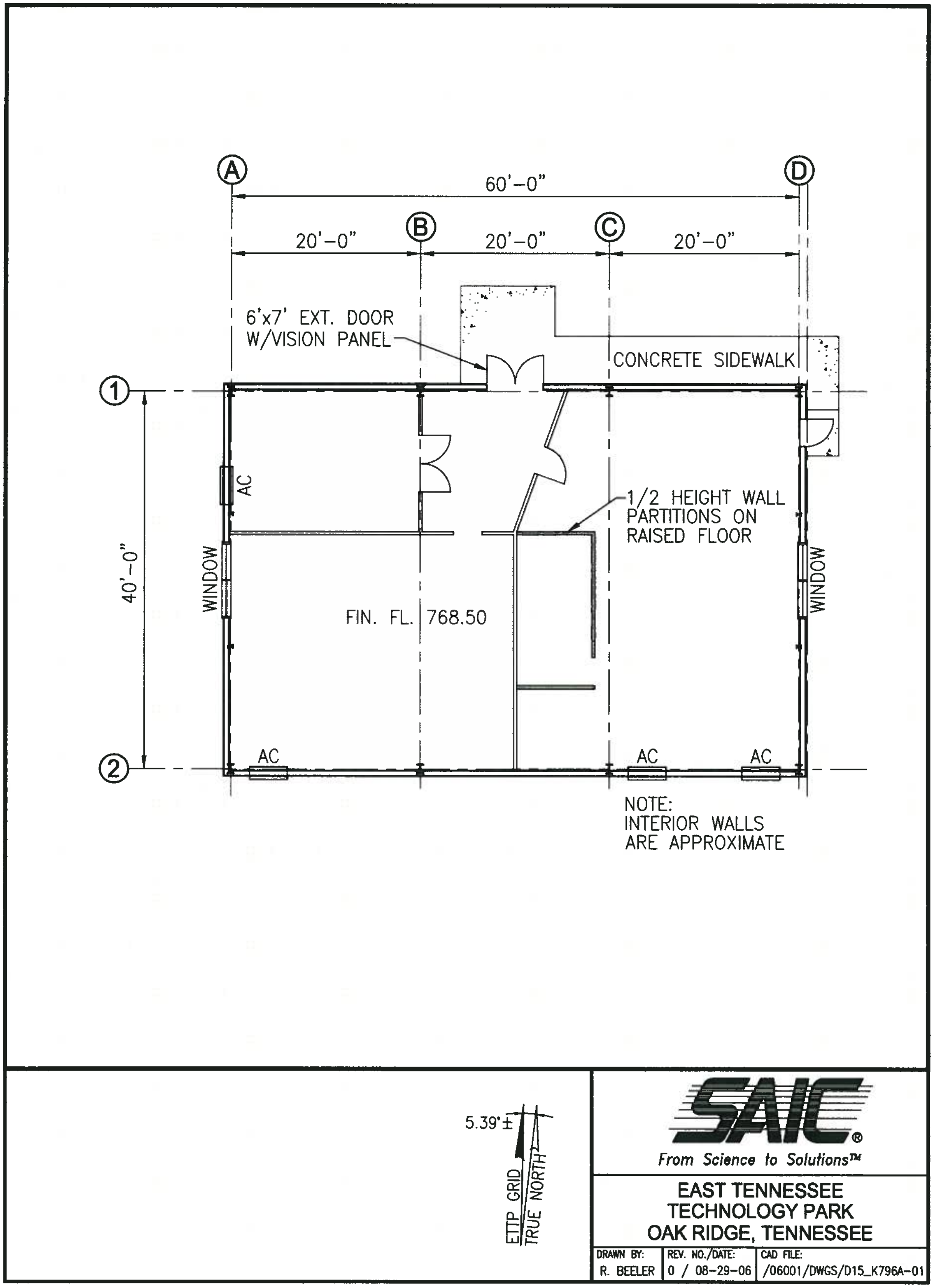

Fig. F.2. K-796-A floor plan.

The DOE DCGLs for uranium are given in Table F.1. Uranium is the dominant contaminant present on-site as described in Chap. F.5 of this survey plan.

Table F.1. Contamination limits (DCGLs) for all survey units

	DCGL (dpm/100 cm^2)	$DCGL_{EMC}$ (dpm/area)
Total alpha	5,000	15,000
Removable alpha	1,000	N/A
Total beta-gamma	5,000	15,000
Removable beta-gamma	1,000	N/A

DCGL = derived concentration guideline level.
$DCGL_{EMC}$ = derived concentration guideline level elevated measurement comparison.
dpm = disintegrations per minute.
N/A = not applicable.

F.4 DATA QUALITY OBJECTIVES PURPOSE

The purpose of this survey plan is to obtain radiological survey data to determine the presence of residual contamination in the K-796-A building through the use of a final status survey. The data gathered, combined with process knowledge, will be used to transfer title of the K-796-A building. The data quality objectives (DQOs) have been detailed in the Design of Radiological Surveys document (hereafter referred to as the "design document"[1] and attached as Appendix A to this document).

F.5 MEASUREMENT TECHNIQUES/SURVEY APPROACH

F.5.1 RADIONUCLIDES OF CONCERN

Process history of the ETTP Site indicates that uranium (natural, depleted, and/or enriched) would be the most prominent radiological contaminant potentially present in the K-796-A building due to tracking of contamination from other on-site buildings or from past activities since the building is in close proximity to the K-33 gaseous diffusion building. Uranium-235 enrichment levels expected from operations since the early 1960s would be anticipated to be between 0.2 to 6.2%. Most facilities would be potentially contaminated via tracking from enrichments of less than 3%.[2]

Other radionuclides (^{60}Co, ^{137}Cs, $^{89/90}$Sr, ^{237}Np, ^{99}Tc, and $^{238/239/240}$Pu) have also been detected on-site at ETTP. These other radionuclides originated from the introduction of contaminated materials from the Oak Ridge National Laboratory and/or from the Hanford and Savannah River Reactor Returns Uranium Reprocessing Program. These radionuclides, however, are expected to be found in much lower quantities than uranium and be undetectable in this area, based upon its operational history. If radionuclides were present, it is assumed that they would be present at ratios of 1140:1 for uranium to transuranic (U:TRU) and 350:1 for uranium to technetium-99 (U:^{99}Tc) [both ratios are process buildings weighted averages].[3]

[1] *Design of Radiological Survey and Sampling to Support Title Transfer or Lease of Property on the Department of Energy Oak Ridge Reservation*, BJC/OR-554-R1, Bechtel Jacobs Company LLC, Oak Ridge, TN, August 2006.
[2] Contracted Health Physics Technician Training handouts, K-25 Site, 1993.
[3] *Isotopic Distribution of Contamination Found at the U. S. Department of Energy Gaseous Diffusion Plants*, BJC/OR-407, Bechtel Jacobs Company LLC, Oak Ridge, TN, October 1999.

F.5.2 DETERMINATION OF THE RESIDUAL RADIOACTIVITY LIMITS

The overall goal of this survey is to show that residual contamination exceeding the release criteria is not present in any of the survey units (SUs). As shown by modeling, the dose and risk obtained from exposure to radioactivity at the DOE surface contamination limits, as set forth in Title 10 *Code of Federal Regulations* 835[4] and also in DOE Order 5400.5,[5] is less than that from the dose and risk criteria, as explained in the design documents. As a result of this modeling, the DCGLs for this survey will be set at the DOE contamination limits for uranium (see Table F.1), which is the dominant contaminant present on-site. A separate limit for the maximum allowable contamination that is concentrated in a smaller area, the derived concentration guideline level$_{\text{elevated measurement comparison}}$ ($DCGL_{EMC}$), is normally calculated based upon modeling the dose obtained from an area determined by the number of samples taken in the SU and the spacing between them. However, the $DCGL_{EMC}$ will be set to three times the appropriate contamination limit, which equates to the contamination-averaging criteria as set forth by DOE in 5400.5 for an elevated reading within a 1-m^2 maximum size area.

F.5.3 IDENTIFICATION OF SURVEY UNITS AND CLASSIFICATIONS

F.5.3.1 Transfer Survey

Areas are classified as either Class 3, 2, or 1 based upon historical data and process knowledge. SUs must be of the same or similar material type. For example, an SU cannot contain both asphalt and soil; it would be divided into an SU of asphalt and another SU of soil. Refer to the design document for complete descriptions of the different classifications of SUs. An area will be considered to be a Class 3 SU if it is not expected to have residual radioactivity levels above 25% of the DCGL (1250 dpm/100 cm^2 total activity or 250 dpm/100 cm^2 removable activity). A Class 2 SU is expected to have, or has had, residual radioactivity levels less than the DCGL. A Class 1 SU is expected to have, or has had, residual radioactivity levels above the DCGL.

The interior of the building is divided into SUs based on the physical layout of the facility, historical usage of the facility rooms, the type of flooring material, and the natural barriers for traffic. Interior survey units (ISUs) will be initially classified as Class 3 areas. The flooring material is consistent, along with the historical usage of the facility rooms, throughout the K-796-A facility; therefore, the building will be composed of one ISU, as shown in Table F.2 and Fig. F.3. The building contains no furnishings or equipment.

Table F.2. Transfer survey unit classifications

Interior survey unit	**Class**
K-796-A interior rooms (ISU 1)	Class 3
Exterior survey unit	
K-796-A north wall, including any HVACs and support equipment (ESU 1)	Class 2
K-796-A south wall, including any HVACs and support equipment (ESU 2)	Class 2
K-796-A east wall, including any HVACs and support equipment (ESU 3)	Class 2
K-796-A west wall, including any HVACs and support equipment (ESU 4)	Class 2
K-796-A roof (ESU 5)	Class 3

ESU = exterior survey unit.
HVAC = heating, ventilating, and air-conditioning.
ISU = interior survey unit.

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[4] (*CFR* 1999). *Occupational Radiation Protection*, 10 *CFR* 835, Appendix D, "Surface Radioactivity Values."

[5] DOE Order 5400.5 is entitled *Radiation Protection of the Public and the Environment*; the values are taken from Fig. IV-1, "Surface Contamination Guidelines."

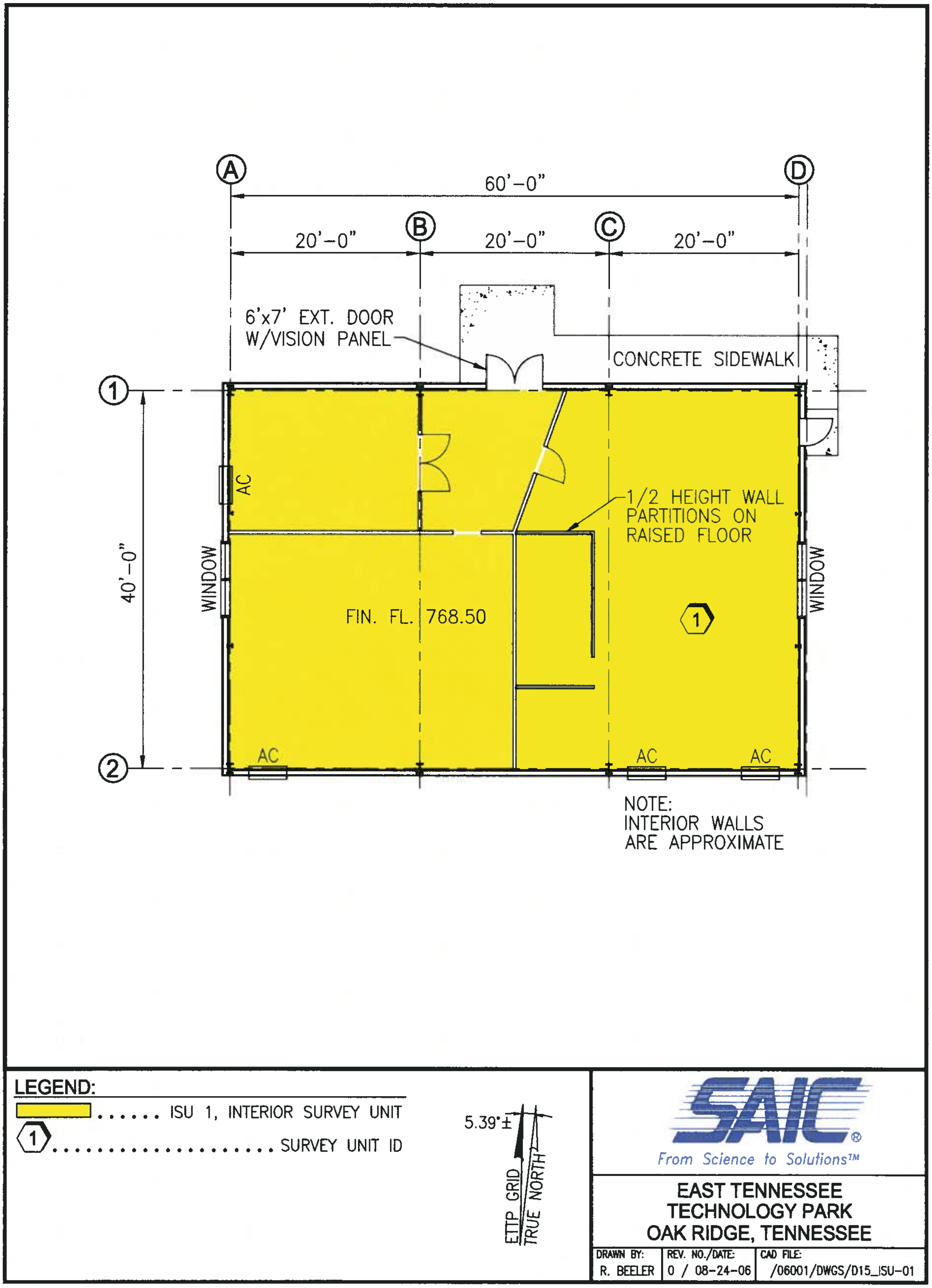

Fig. F.3. K-796-A interior survey unit.

The facility is physically located within close proximity to the K-31 and K-33 gaseous diffusion buildings with building K-791-B between the K-33 building and K-796-A. Radiological survey results of the K-791-B building revealed contamination on the exterior walls in excess of 25% of the DCGL. Based upon the K-791-B survey results, there is considered a potential for the exterior walls of the K-796-A building to exceed 25% of the DCGL as well. The exterior walls of the K-796-A building, therefore, will be divided into four Class 2 exterior survey units (ESUs): one for the north wall (ESU 1), one for the south wall (ESU 2), one for the east wall (ESU 3), and one for the west wall (ESU 4) [see Fig. F.4].

The results of the K-791-B survey do not indicate a potential for the K-796-A roof to exceed 25% of the DCGL; the K-796-A roof, therefore, will be classified as Class 3 and is designated as ESU 5.

F.5.4 INSTRUMENTATION SELECTION AND SURVEY TECHNIQUES FOR TRANSFER

Refer to the design document for details on instrumentation selection. In general, for the transfer survey, alpha scintillation and beta-gamma Geiger-Müeller (GM) detectors will be attached to scalar rate meters and have minimum detectable activities less than 25% of the DCGL. Gas-proportional floor monitors or floor monitors with the probe detached from the monitor cart for usage as a hand-held probe (e.g., PDA data-loggers), calibrated to detect both alpha and beta-gamma radiations, will be used for as much of the scan surveys as possible, including the primary horizontal surfaces (i.e. primary work surfaces, walls, ceilings, and roof). Sodium iodide (NaI) meters and Bicron MicroRem® meters[6] will also be used, as specified in this survey plan. Removable contamination surveys (i.e., smear surveys) will be conducted at all locations where fixed/total measurements are taken. All removable contamination survey smears will be counted on a gas-proportional counter calibrated to detect both alpha and beta-gamma radiations.

For Class 3 areas, 10% surface scan surveys will be performed over the primary traffic and work surfaces of the entire SU, as accessible. Scanning of walls and ceilings will be based on visual inspection and professional judgment. Surfaces classified as Class 2 areas, such as walls, ceilings, overhead areas, etc., will have a scan coverage that varies in accordance with how close the expected activity levels are to the DCGLs. (This is a deviation from the current design documents but is in accordance with the proposed revision that has been submitted for approval.) Although there are currently no Class 1 SUs, if found, Class 1 SUs will have a 100% scan of all surfaces performed. Emphasis will be placed upon entrances/high-traffic areas, suspect areas, and professional judgment for all scan surveys.

All surveys will be performed in accordance with established BJC RADCON procedures (e.g., scan rate, probe distance, source checks). All areas will be surveyed in an "as-found" condition. Materials may be rearranged or moved to allow for survey access to areas covered by material and/or equipment.

F.5.5 REFERENCE COORDINATE SYSTEM FOR LEASE AND TRANSER SURVEYS

Class 3 areas do not require a sample grid. A reference coordinate system will be used in each SU to reference measurements so they can be relocated/verified as needed, unless the measurement is at an easily identifiable location, such as "Room A, 4 ft up on west wall, approximately 2 ft from south wall." The starting point of the reference grid, if needed, will be the southwest corner of each SU, with the distance north being Y and the distance east being X in an X–Y coordinate system [i.e., (X,Y)], with the units in feet.

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[6] Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof.

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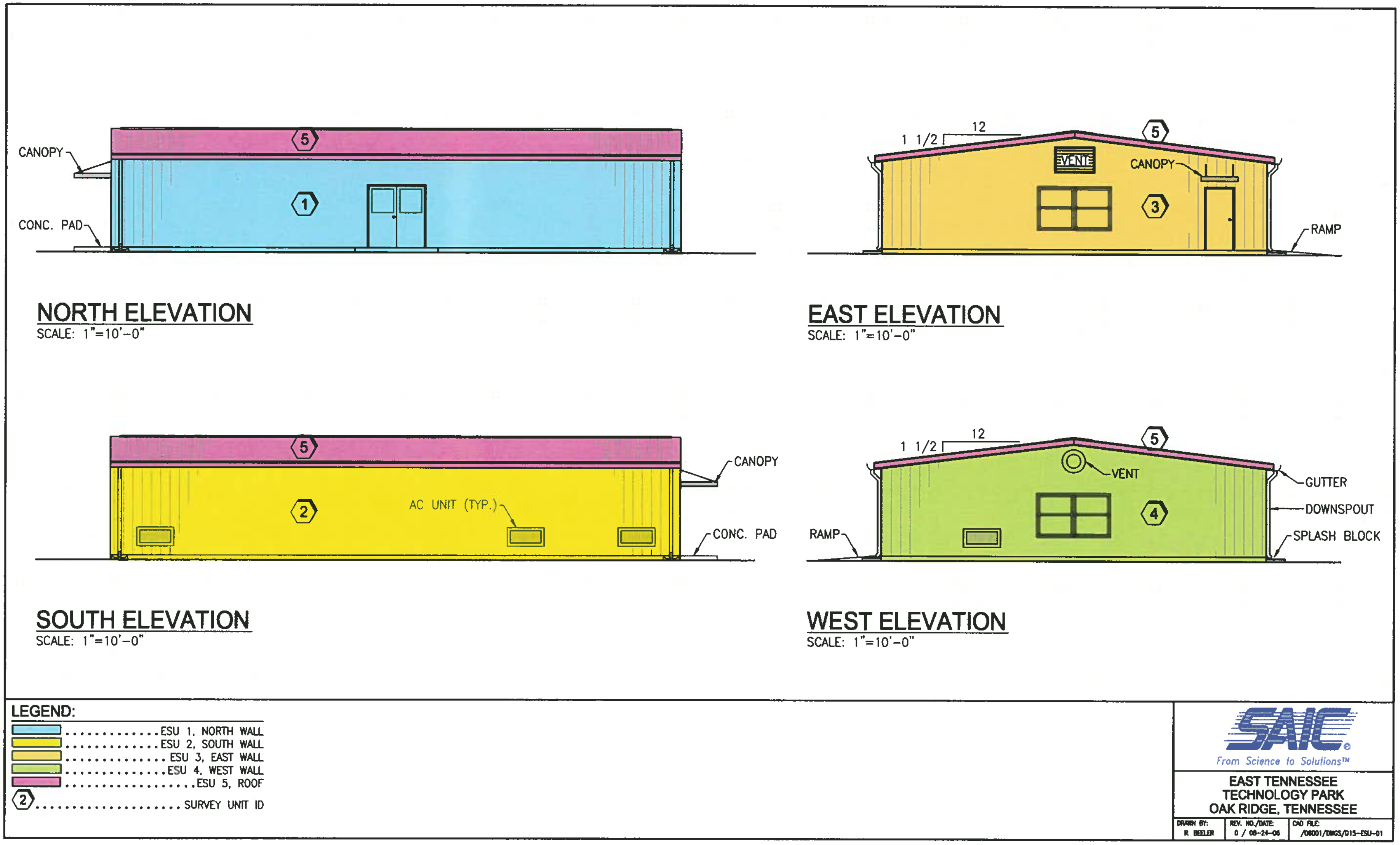

Fig. F.4. K-796-A exterior survey units.

Class 2 and Class 1 SUs require a sample grid with systematic measurements taken based upon a random starting point. These survey grids are based upon the SU's area and number of systematic sample measurements required in each.

If an SU has to be reclassified to a higher classification and survey requirements, an addendum to this survey plan that contains the sample grids of the reclassified SUs or sections will be issued and included in this report, or a summary of the report, will also be included and referenced in the facility's baseline environmental condition documentation.

F.6 SURVEY DESIGN

F.6.1 QUANTIFY DATA QUALITY OBJECTIVES

The null hypothesis (H_o) for each SU is that the residual contamination exceeds the DCGL. The alternative hypothesis (H_a) is that the SU meets the DCGL. Decision error levels, as set forth in the design documents, are 0.05 for Type I (α) errors and 0.10 for Type II (β) errors in all SUs. The Lower Bound of the Gray Region (LBGR) is initially set to one-half of the DCGL. These parameters apply to all transfer SUs, regardless of their classification. The design documents discuss the DQO process in greater detail.

F.6.2 DETERMINATION OF THE NUMBER OF DATA POINTS

Using the prescribed statistical testing methodology found in the design documents (Sign test), a Δ/σ value (also known as the "relative shift") greater than 3 is estimated for all Class 3 and Class 2 areas, where Δ is the DCGL – LBGR, the LBGR is 50% of the DCGL, and σ is the standard deviation of the data. (Note: This is true for survey data but does not apply to sample results from soil.) However, the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM)[7] recommends that the relative shift be between 1 and 3. Due to the lack of sampling data associated with the K-796-A facility, a relative shift of 3 was assumed. The Sign test was used because the residual contamination present within the SUs should be at a very small fraction of the DCGL. Using a relative shift of 3 with the DQO parameters listed in Table F.3, 11 survey data points (fixed and removable readings) are needed for all SUs, at a minimum, not including any tool, furniture, or equipment surveys.

F.6.3 TRANSFER SURVEY PROCEDURES

In any area in which the survey indicates activity exceeding 5000 dpm/100 cm^2, direct alpha and beta-gamma measurements will be made following the establishment of a 1-m^2 grid to obtain data applicable to the DOE Order 5400.5 release criteria. BJC RADCON procedures will be followed for posting of the immediate area. In addition, any contamination survey location found in excess of two times the DCGL will also have a dose-rate measurement taken at a distance of 3 ft.

Any activity in excess of 25% of the DCGL (when averaged over 1 m^2) will require that a Class 3 SU, or sections thereof, be reclassified as Class 2 and surveyed appropriately. Any activity in excess of the DCGL will require that a Class 3 or 2 SU, or sections thereof, be reclassified as Class 1 and surveyed appropriately.

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[7] (NRC 1997). *Multi-Agency Radiation Survey and Site Investigation Manual, Final Edition*, NUREG-1575, Nuclear Regulatory Commission, December.

Table F.3. Comparison of parameters for computing number of samples

Parameter	SEC K-1001-A, -B, -C, and -D furnishings survey plan	Survey design document
Type I error rate (α)	0.05	0.05
Type II error rate (β)	0.05	0.10
Non-parametrical statistical test	Wilcoxon-Rank Sum	Sign[8]
LBGR	2500 dpm/100 cm^2	2500 dpm/100 cm^2
Number of data points per survey unit	20 (10 in each survey unit, 10 in each reference background survey unit)	11

dpm = disintegrations per minute.
LBGR = Lower Bound of the Gray Region.
SEC = Safety and Ecology Corporation.

Many of the radionuclides found on the Oak Ridge Reservation have natural background concentrations. Therefore, background subtraction will be required for all direct field measurements. Some comparison to background levels will also be required for the scanning because only a gross signal will be measured. Material-specific backgrounds might be necessary for materials such as tile, brick, and cinderblock because these materials contain elevated levels of naturally occurring radionuclides. For example, the background is 1716 dpm/100 cm^2 total beta-gamma above ambient background for a glazed clay-tile floor, 1103 dpm/100 cm^2 total beta-gamma above ambient background for a red-clay brick, and 142 dpm/100 cm^2 total beta-gamma above ambient background for a concrete block using a GM detector.[9] This level of radioactivity is within that of the naturally occurring radioactive material (NORM) contained in the glazed clay-tile/brick/concrete block matrix and will be subtracted from the net ambient readings for these materials before determining if the result is greater than 25% of the DCGL or the DCGL.

A summary of the requirements for each type of SU is found in Table F.4, and a survey technician summary is found in Table F.5.

F.6.3.1 Interior Survey Units

Any asbestos-controlled areas will be identified with any pertinent information on whether radiological contamination is suspected (e.g., ventilation hood, exhaust vents, posted radiological area) but not entered as part of this survey. Any ventilation exhausts and air intakes in the survey footprint will be surveyed for contamination.

F.6.3.1.1 Class 3 interior survey units

The K-796-A building ISU is currently classified as Class 3. The survey protocols are as follows: a minimum of 10% of the primary traffic areas and work surfaces will be scanned with floor monitors, NaI meters, and hand-held meters (including use of a floor monitor probe set up as a hand-held probe and calibrated to detect alpha and beta-gamma contamination for large-area scans of non-floor surfaces), as appropriate. NaI scans will be performed for areas that have a potential for holding activity that would be

[8] The Wilcoxon-Rank Sum statistical test is for use when the primary contaminants are found in background. The Sign test is to be used when the contaminant is not found in background or when the contaminants are in background, but at a small fraction of the DCGL. The Sign test will be used for this survey.

[9] Values computed based upon the beta-gamma background levels for brick, ceramic tile, and ambient found in Table 5.1 of NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, December 1997 (NRC 1997b), and an average beta-gamma Geiger-Müeller correction factor of 34 (dpm/100 cm^2)/cpm for a planar radiation source.

Table F.4. Summary of survey unit requirements

Survey unit type	Class 3	Class 2	Class 1
Interior	• Ten percent scan of primary traffic and work spaces. • Use of professional judgment for wall scans. • Eleven total and removable reading(s), at a minimum, per SU and at least one per office, room, or open space. • Reading locations based on professional judgment and scan survey. • Dose-rate walkover survey in each SU. • Minimum of one dose-rate reading per office or open space. • One dose-rate reading per every 20 ft of hallway. • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans. • Upgrading to Class 2 if activity > 25% DCGL. • Upgrading to Class 1 if activity > DCGL.	• One hundred percent scan of floors/primary work areas. • Thirty percent scan of walls and overhead areas. • Eleven total and removable readings, at a minimum, per SU. • Reading locations based upon a grid to be determined, as needed. • Smears and direct readings to also be obtained from locations of the highest contamination with results greater than 25% of the DCGL, as indicated by the scanning surveys for each horizontal and vertical surface. • Dose-rate walkover survey in each SU. • Minimum of one dose-rate reading per office or open space. • One dose-rate reading per every 20 ft of hallway. • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans. • Upgrading to Class 1 if activity > DCGL.	• One hundred percent scan of all surfaces. • Eleven total and removable readings, at a minimum, per SU. • Reading locations based upon a grid to be determined, as needed. • Smears and direct readings to also be obtained from locations of the highest contamination with results greater than the DCGL, as indicated by the scanning surveys for each horizontal and vertical surface. • Dose-rate walkover survey in each SU. • Minimum of one dose-rate reading per office or open space. • One dose-rate reading per every 20 ft of hallway. • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans.
Exterior	• Ten percent scan of accessible surfaces. • Scan of walls up to at least 8 ft. • Eleven total and removable readings, at a minimum, per SU. • Reading locations based on professional judgment and scan survey; at least one timed measurement on each piece of exterior equipment and on each facing and roof for buildings. • Dose-rate reading for each static measurement location. • NaI scan of areas such as area directly under drain spouts that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans. • Upgrading to Class 2 if activity > 25% DCGL. • Upgrading to Class 1 if activity > DCGL.	• Thirty percent scan of surfaces. • Scan of walls up to at least 8 ft. • Eleven total and removable readings, at a minimum, per SU. • Reading locations based upon a grid. • Dose-rate walkover survey in/on each SU. • One dose-rate reading per every 20 ft. • NaI scan of areas such as area directly under drain spouts that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans. • Upgrading to Class 1 if activity > DCGL.	• One hundred percent scan of all surfaces. • Scan of walls up to at least 8 ft. • Eleven total and removable readings, at a minimum, per SU. • Reading locations based upon a grid to be determined, as needed. • Dose-rate walkover survey in/on each SU. • One dose-rate reading per every 20 ft. • NaI scan of areas such as area directly under drain spouts that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans.

DCGL = derived concentration guideline level.
NaI = sodium iodide.
SU = survey unit.

Table F.5. Survey technician summary of survey requirements

Class 3	Class 2	Class 1
• Ten percent scan of interior floor/primary work areas, and 10% of exterior accessible surfaces. • Professional judgment for wall scans. • Scan of exterior walls up to at least 8 ft. • Eleven total and removable reading(s), at a minimum, per SU and at least one per office, room or open area. • Dose-rate walkover survey in each SU (minimum of one reading/office or open space or 1/20 ft of hallway). • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans based on professional judgment. • Notification of supervisor if activity > 25% DCGL.	• One hundred percent scan of interior floor/primary work areas. • Thirty percent scan of walls and overhead areas. • Eleven (minimum) total and removable readings. • Reading locations based upon a grid. • Dose-rate walkover survey in each SU (minimum of one reading/office or open space, 1/20 ft of hallway). • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans with coverage equal to % of DCGL. • Notification of supervisor if activity > DCGL.	• One hundred percent scan of all surfaces. • Eleven (minimum) total and removable readings. • Reading locations based upon a grid to be determined. • Dose-rate walkover survey in each SU (minimum of one reading/office or open space, 1/20 ft of hallway). • NaI scan of areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans based on professional judgment.

DCGL = derived concentration guideline level.
NaI = sodium iodide.
SU = survey unit.

difficult to detect by alpha and beta-gamma scans (e.g., drains, floor cracks/joints/penetrations, wall/floor interfaces). Any location on the walls or ceiling that, using professional judgment, could potentially have residual radioactivity present will also be scanned over the suspected area and documented on the survey. Eleven measurements of total and removable contamination, at a minimum, will be recorded within each SU at locations determined during the scan survey to have the highest activity. However, at least one reading will be made in each room. Any Class 3 areas that exceed 25% of the DCGL will be reclassified as Class 2 or Class 1 areas and surveyed accordingly. All reclassified areas will be discussed in the survey report and in the facility's baseline environmental condition documentation.

A general dose-rate walkover survey of each SU, using a Bicron MicroRem® meter, will be performed to determine if any variations exist in the penetrating radiation dose rate. If variations exist, then the location will be recorded. Dose-rate measurements will be recorded at a minimum of 1 per room and every 20 ft in hallways and large rooms.

F.6.3.1.2 Class 2 interior survey units

There are currently no ISUs classified as Class 2; however, the Class 2 survey protocols are as follows: 100% of the floor surface will be scan-surveyed using a floor monitor, NaI meter, or hand-held meters, as appropriate. Thirty percent of the walls up to 8 ft and overhead areas will be scanned according to Table F.6. Five (minimum) total and removable measurements per vertical and horizontal surface in each room will be recorded from locations of the highest contamination as indicated by the scanning surveys. Any Class 2 areas that exceed the DCGL will be reclassified as Class 1 areas and surveyed accordingly. All reclassified areas will be discussed in the addendum to this survey plan that will be issued and included in the survey report and in the facility's baseline environmental condition documentation.

Table F.6. Class 2 survey unit scan percentage versus percent of DCGL

% DCGL	Activity (dpm/100 cm^2)	Scan %
<30	<1500	10
<50	<2500	30
<70	<3500	50
>=70	<5000	100

DCGL = derived concentration guideline level.
dpm = disintegrations per minute (activity as observed from historical data).

F.6.3.1.3 Class 1 interior survey units

Although there are currently no Class 1 SUs, the potential exists for having a Class 3 or 2 area upgraded to a Class 1. Class 1 SUs follow the Class 2 survey protocols, with the exception that walls and ceilings will be classified separately and, if Class 1, will have 100% of surfaces scanned.

F.6.3.2 Exterior Survey Units

All exterior areas will be surveyed with hand-held meters or with a gas-proportional probe and with an NaI meter up to a minimum height of 8 ft. Exterior areas, other than the building exterior walls and roof, that are covered under this survey plan include the concrete sidewalk, drain spouts, and HVAC units and ducts. Emphasis is to be placed upon air vents/intakes, windowsills, gutter downspouts, valve handles, and wherever professional judgment would indicate a higher probability of finding elevated readings.

F.6.3.2.1 Class 3 exterior survey units

There is one Class 3 ESU, the roof. The Class 3 survey protocols are as follows: Exterior surveys will have 10% of the surfaces scanned with hand-held meters or with gas-proportional probes, as appropriate. For exterior areas that have a potential for holding activity that would be difficult to detect by alpha and beta-gamma scans (e.g., drain spouts, wall/floor interfaces), a scan will be performed using an NaI meter. Eleven measurements of total and removable contamination, at a minimum, will be recorded within each SU at locations determined during the scan survey to have the highest activity. At least one timed measurement will be made on each piece of exterior equipment and on each facing of the roof. Any Class 3 or 2 areas that exceed the DCGL will be reclassified as Class 1 areas and surveyed accordingly. All reclassified areas will be discussed in an addendum to this survey plan that will be issued and included in the survey report and in the facility's baseline environmental condition documentation.

F.6.3.2.2 Class 2 exterior survey units

The four exterior walls are classified as Class 2 ESUs. The Class 2 survey protocols are as follows: The walls, up to 8 ft, will be scan-surveyed using hand-held meters and/or gas-proportional meters (if possible) and with an NaI meter according to the percentages listed in Table F.6. The survey measurement locations will be systematically chosen per survey grid (see Fig. F.5). In addition, smears and direct readings will be obtained from locations of the highest contamination with results greater than 25% of the DCGL, as indicated by the scanning surveys for each horizontal and vertical surface. Any Class 3 or 2 areas that exceed the DCGL will be reclassified as Class 1 areas and surveyed accordingly. All reclassified areas will be discussed in an addendum to this survey plan that will be issued and included in the survey report and in the facility's baseline environmental condition documentation.

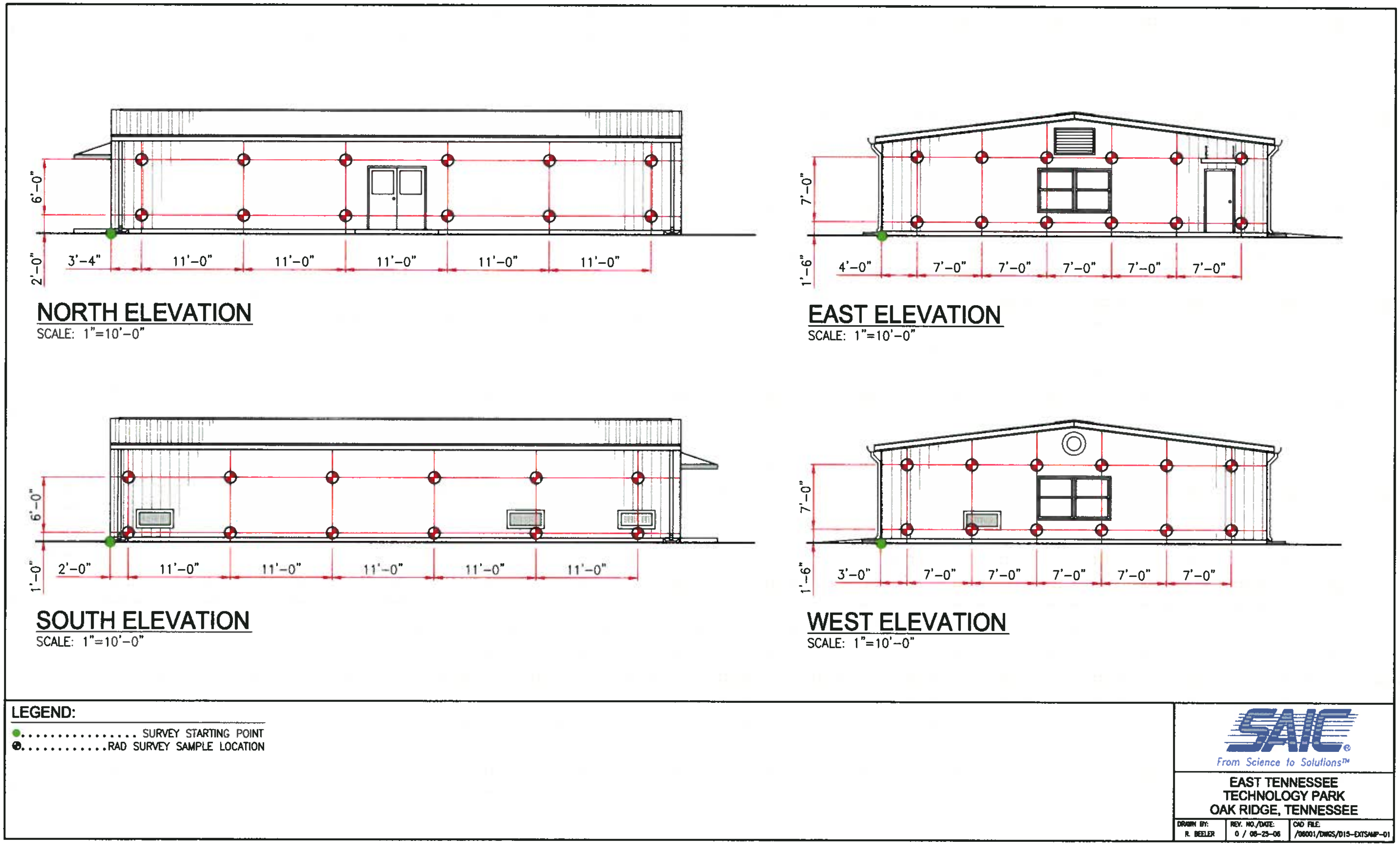

Fig. F.5. K-796-A Class 2 exterior sampling locations.

F.6.3.2.3 Class 1 exterior survey units

Although there are currently no Class 1 exterior areas, the potential exists for having a Class 3 or 2 area upgraded to a Class 1. Class 1 SUs follow the Class 2 survey protocols, with the exception that 100% of the surfaces will be scanned.

F.6.4 SPECIFICATION OF SAMPLING LOCATIONS

All recorded survey measurement locations are to be on a random basis for Class 3 internal and external SUs. For Class 3 ISUs and ESUs, the random points will be chosen on a judgmental basis and should include entrances, primary traffic areas, air vents, and primary workspaces; these are the areas that would be expected to have the highest probability of having elevated readings. Survey locations for Class 2 or 1 ISUs and ESUs will be based on a survey grid plus measurements from the highest point of each surface determined from the scan. The gridded survey locations for ISU 1 are given on Fig. F.5. If needed, further survey locations for Class 2 or 1 will be based on systematic points on the survey grid plus measurements from the highest point of each surface determined from the scan.

F.7 DOCUMENTATION

Survey data will be documented in accordance with the procedures and reviews required by the DOE contractor. A report will be prepared describing the survey methods, results, and evaluation. The report will include the findings of the assessment, describe the materials surveyed and their condition, and justify the contamination potential classification assigned. The data evaluation will be included, along with the assessment of the quality assurance (QA)/quality control (QC) documentation. This report, or a summary of the report, will also be included and referenced in the facility's baseline environmental conditions documentation. It should be noted that the transfer of K-796-A cannot occur without the concurrence of both U. S. Environmental Protection Agency Region 4 and the Tennessee Department of Environment and Conservation.

F.8 QUALITY ASSURANCE

All appropriate QA/QC reviews to ensure the quality of the data gathered will be performed and documented.

Survey instruments and methods specified in applicable RADCON operating and technical procedures have been documented as to their ability to provide a 95% confidence level in detection of surface contamination at levels that meet the requirements of this protocol. Supporting data are provided on each survey form.

RADCON technicians not involved in the execution of this protocol will repeat approximately 5% of the direct and removable activity measurements on items destined for unrestricted release for verification. The results must confirm the initial findings for acceptance as satisfying release criteria.

A DOE contractor, RADCON-certified health physicist, or another designated health physicist, will review, evaluate, and validate the survey results, including assessment of the QA/QC information and data, prior to generation of the radiological survey report. The final radiological survey report will include the details of this assessment. It will be provided to the DOE contractor project QA manager, project manager, and site project health physicist for approval prior to its inclusion into the transfer documentation.

APPENDIX G

RISK SCREEN FOR THE K-792 SWITCHYARD COMPLEX

CONTENTS

TABLES

ACRONYMS

BEAR	Baseline Environmental Analysis Report
bgs	below ground surface
COPC	contaminant of potential concern
DOE	U. S. Department of Energy
EPA	U. S. Environmental Protection Agency
ESU	exterior survey unit
ETTP	East Tennessee Technology Park
HI	hazard index
HQ	hazard quotient
ISU	interior survey unit
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
PRG	preliminary remediation goal
RAGS	*Risk Assessment Guidance for Superfund*
RL	remediation level
ROD	Record of Decision
SU	survey unit

EXECUTIVE SUMMARY

The goal of this risk screen is to determine the potential for adverse health effects associated with the use of the K-792 Complex as an office complex.

The representative exposure scenarios considered for the risk screen are for an industrial/office worker. The workers are defined by individuals who spend time doing office work within a building. Two exposure scenarios were analyzed for this risk screen: (1) an office/industrial worker who works in K-791-B, and (2) an office/industrial worker who works in K-796-A. The evaluation of the industrial worker who is exposed to soils in the K-792 Switchyard Complex is presented in the two Phased Construction Completion Reports (PCCRs) that cover the two exposure units (EUs) within which the K-792 Switchyard Complex is located (DOE 2006 and 2007a). Both of the EUs have been approved for no further action by the U. S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation.

The process followed in performing this risk screen includes screening the site data against nationally available preliminary remediation goals (PRGs) to provide screening-level risk estimates and determine if there is a need for a full risk calculation. The full risk calculation is conducted only when the screening-level risk estimates of constituents exceeding PRGs indicate the potential for elevated risks [i.e., cumulative screening-level risks exceeding the generally acceptable target risk range of E-04 to E-06 or a hazard index (HI) above 1], or where no nationally recognized PRGs were available for the exposure scenario being considered. Available data for the K-792 Complex included building radiological surveys and polychlorinated biphenyl swipe samples results from building surfaces. Because no PRG screening values are available for building surfaces, a risk calculation was performed to evaluate exposures associated with the building.

The EPA has established a generally acceptable target risk range of E-04 to E-06 and a generally acceptable HI of 1. The risk estimate is a value that represents the excess cancer incidence that might be expected due to the exposure scenario evaluated. The HI is a value that represents the potential for toxic effects to an exposed individual. The results of the risk evaluation are as follows:

- the risk calculation for the building survey units for both K-791-B and K-796-A resulted in a risk below EPA's generally acceptable target risk range of E-04 to E-06 and an HI below 1.

The risk screening was considered indicative of the low likelihood of adverse health effects associated with worker exposure. The K-792 Switchyard Complex is, therefore, considered suitable for transfer.

G.1. INTRODUCTION

The goal of this risk screen is to determine the potential for adverse health effects associated with Bldgs. K-791-B and K-796-A located within the K-792 Switchyard Complex, which is proposed for transfer by the U. S. Department of Energy (DOE) to the Heritage Center, LLC (Heritage Center), a subsidiary corporation of the Community Reuse Organization of East Tennessee. Specifically, the objectives of this evaluation are (1) to determine exposure to constituents based on available data for the buildings and (2) to use these data to provide an estimate of the potential for adverse effects to human health. The risk calculations utilized in this evaluation are based on the document *Risk Assessment Guidance for Superfund* (RAGS) [EPA 1989]. The following sections describe the process used to provide a quantitative analysis of the risks to human health from exposure to the K-792 Switchyard Complex buildings.

The East Tennessee Technology Park (ETTP) Reindustrialization Program process for conducting risk screens includes screening the site data against nationally available preliminary remediation goals (PRGs) as well as remediation levels (RLs) [where applicable] to determine the need for a full risk calculation. The calculation of risk is only conducted where a constituent, or several constituents, exceeds PRGs, indicating the potential for elevated risks, or where no nationally recognized PRGs are available for the exposure scenario being considered. For this subject study area, the representative exposure scenario includes the industrial/office worker, defined by an individual who spends time doing office work within one of the buildings.

Because no nationally recognized PRGs are available for a building, a risk calculation was performed for the industrial/office worker exposed to the surfaces of the building assuming exposure by the inhalation, ingestion, dermal contact with chemicals, and external exposure to ionizing radiation pathways. The risk calculations for Bldgs. K-791-B and K-796-A were based on the most recent radiological survey data and polychlorinated biphenyl (PCB) swipe sample results. For the risk screen, it was assumed that furnishings remain in place and, thus, each survey unit (SU) was assumed to include any furnishings. Each SU was evaluated individually, and an average exposure for all SUs was developed to represent a receptor exposed to all SUs. Similarly, the average PCB swipe result was used to evaluate a receptor exposed to the building as a whole.

Results of the risk estimates are compared with the U. S. Environmental Protection Agency (EPA)-established generally acceptable target risk range of E-04 to E-06 and a generally acceptable hazard index (HI) of 1. The risk estimate is a value that represents the excess cancer incidence that might be expected due to the particular exposure scenario evaluated. The HI is a value that represents the potential for toxic effects to an exposed individual. Results of the PRG screen and screening-level risk calculations were compared to the EPA range to determine the potential for adverse health effects.

The following sections describe the process used to provide a quantitative analysis of the risks to human health from exposure to K-792 Complex buildings.

G.2. DESCRIPTION AND HISTORY

A full description and history of the K-792 Switchyard Complex, as well as site maps, are presented in Chaps. 1 through 5 of the Environmental Baseline Survey (EBS) for the subject site. In the EBS, Fig. 1.1 shows the location of the K-792 Switchyard Complex within the ETTP, and Fig. 1.2 shows the location of Bldgs. K-791-B and K-796-A within the Switchyard.

G.3. AVAILABLE DATA

Building data included radiological surveys of the K-791-B and K-796-A building interiors, furniture, and exterior units, as well as PCB swipes of interior building surfaces (see Figs. E.4, F.3, and F.4 for SU locations). For this evaluation, it was assumed that any furniture would remain in the SU. A detailed discussion of the available data is presented in Chap. 6 of the EBS. Data for soils in the K-792 Switchyard are presented in the two PCCRs (DOE 2006 and 2007a) that cover the K-792 Switchyard Complex. The evaluation of the soils data for the EUs in which the K-792 Switchyard Complex is located is also presented in the PCCRs. The two EUs that include the K-792 Switchyard Complex have approved no further actions (NFAs) based on the results of the Dynamic Verification Strategy (DOE 2007b) used for evaluation of the EU soils.

G.4. EXPOSURE ASSESSMENT

An exposure assessment combines information about site characteristics and site-related data with exposure assumptions in order to quantify the intake of contaminants by a hypothetically exposed individual. The estimated exposure is based on the following:

- characterizing the exposure scenario based on site surveys and anticipated future property use,
- identifying complete exposure pathways based on assumed receptor activities and site-specific information, and
- quantifying receptor exposure based on exposure assumptions and chemical-specific data.

The steps in the exposure assessment are discussed in detail in the following sections.

G.4.1 EXPOSURE SCENARIO EVALUATION

Exposure scenarios are selected based on site surveys and anticipated uses of the K-792 Switchyard Complex and Bldgs. K-791-B and K-796-A. The ETTP area is being evaluated for industrial uses ranging from light to heavy industrial applications. The anticipated use scenario for the subject site is for light industrial and office activity; therefore, the likely exposure scenario is an industrial/office worker exposed to contamination associated with the building SUs. The industrial worker exposures associated with switchyard soils have been evaluated in the two respective PCCRs (DOE 2006 and 2007) that cover the K-792 Switchyard Complex.

Exposures to the industrial/office worker at the buildings were evaluated using available radiological survey data. In addition, PCB swipe data were also evaluated. Groundwater is not a pathway for exposure to workers via deed restrictions. Therefore, groundwater is not included in this risk screen. Uncertainties associated with the exposure scenario evaluation are presented in Chap. G.6.

G.4.1.1 Industrial/Office Worker Scenario

An industrial/office worker is anticipated to be present at the subject site in the future, and be exposed to building SUs. It is assumed that two separate industrial/office workers exposures exist: (1) a worker who works in K-791-B, and (2) a worker who works in K-796-A.

G.4.2 EXPOSURE PATHWAY IDENTIFICATION

Evaluating the exposure pathways requires describing the mechanism by which an individual may become exposed to contaminants associated with soils and building surfaces in the subject site. A complete exposure pathway requires the following:

- a source of contamination,
- a pathway of migration from the source of contamination to the exposure point,
- a receptor present at the exposure point, and
- an exposure mechanism at the exposure point.

If any one component of a complete exposure pathway is missing, then the pathway is considered incomplete. Only complete exposure pathways were quantified in the risk screen.

Complete exposure pathways associated with the site buildings and soils include ingestion, inhalation, dermal contact with chemicals, and external exposure to ionizing radiation. The ingestion pathway is complete because contamination may be present, a receptor may be present in the buildings or study area, and a receptor may contact and ingest contaminants. The inhalation pathway is complete because contamination may be present, contaminants may become airborne, a receptor may be present in the buildings or study area, and an individual may inhale contaminants in the air. The dermal pathway is complete because chemical contamination may be present, a receptor may be present in or around the transfer area, and a receptor may contact and dermally absorb contaminants. External exposure to ionizing radiation is a complete exposure pathway because radionuclides may be present, ionizing radiation may be emitted, and a receptor may be present to absorb the radiation. The following section describes how each of the complete exposure pathways was quantified in the risk screen.

G.4.2.1 Vapor Intrusion Pathway Evaluation

Sub-slab soil vapor was collected in September 2006 and February 2007 to determine if a potential source for volatile organic compounds (VOCs) exists under the buildings. The results were validated, and the average concentration for each VOC was calculated and compared to its respective soil vapor trigger level (TL), a concentration calculated to be health protective. In addition, to ensure that the VOCs did not cumulatively exceed TLs, the average concentration for each VOC was divided by its respective TL to determine what fraction the concentration represented. The resulting fractions were then added for all VOCs that had at least one detection. If, collectively, the VOC concentrations had exceeded the TLs, the resulting value would be above 1.0 (i.e., the fractions would add up to over 1.0).

None of the VOCs detected in either sampling event exceeded TLs for Bldg. K-791-A or K-796-B, and the sum of TL fractions was below 1.0 (see Chap. G.6). Therefore, based on the soil vapor sampling results, the vapor intrusion pathway is not considered complete beneath the buildings.

G.4.3 QUANTIFICATION OF EXPOSURE

Quantifying the exposure to the receptor requires the following:

- statistical evaluation of the representative dataset;
- selection of contaminants of potential concern (COPCs), based on comparison to PRGs;
- identification of the COPCs that have available toxicity data and can be quantitatively evaluated;

- estimation of the exposure parameters appropriate to the exposure scenarios;
- selection of toxicity data appropriate for the receptor and exposure pathways; and
- calculation of the intake based on the calculated exposure concentrations (Chap. G.5).

The ingestion, inhalation, dermal contact with chemicals, and external exposure to ionizing radiation pathways were quantified using available radiological survey data. The purpose of the quantification of exposures is to provide a conservative estimate of exposures related to the exposure scenarios evaluated. At each step in the quantification process, assumptions are made in order to provide an upper-bound estimate of risk that is protective of exposures associated with the study area.

G.4.3.1 Building Surfaces

The industrial/office worker exposure scenario was evaluated based on the following assumptions (see Table G.4.1):

- the worker is present at the site for 25 years,
- the worker is on-site for 250 days/year for 8 hrs/day,
- the worker ingests 50 mg/day of contaminated material, and
- the worker inhales air at a rate of 20 m^3/day.

The ingestion and inhalation pathways associated with the building surfaces were quantified for the industrial/office worker using the sampling data for removable contamination, as well as fixed contamination for the SUs. Furniture was assumed to remain in the SU, and external exposure was evaluated using measured dose rates. Building interior survey data indicated that approximately 10% of the fixed contamination is removable; therefore, it was assumed that 10% of the detected fixed contamination is available for ingestion and inhalation each workday. For Bldgs. K-791-B and K-796-A, all SUs have removable contamination and were included in the evaluation of exposure to removable contamination. Consistent with standard EPA risk assumptions, it is assumed that there is no depletion of the source material over time and 100% of removable contamination is available.

Table G.4.1. Parameters for evaluation of exposures to the K-791-B and K-796-A building survey units

Pathway	EF (d/year)	ED (year)	BW (kg)	CF[a]	IR_{soil} (kg/d)	FI (unitless)	IR_{air} (m^3/d)	SA (m^2/d)	AF (mg/cm^2)	ABS (unitless)
					Industrial worker					
Ingestion	250	25	70	1000	0.000050	1.0	—	—	—	—
Inhalation	250	25	70	1000	—	—	20	—	—	—
Dermal (PCBs only)	250	25	70	0.01	—	—	—	0.33	0.2	0.14

[a] Units are g/kg for the ingestion and inhalation pathways; units are kg-cm^2/mg-m^2 for the dermal exposure pathway.
Other factors used:
ABS = dermal absorption factor.
AF = adherence factor.
BW = body weight.
CF = conversion factor.
ED = exposure duration.
EF = exposure frequency.
FI = fraction ingested from contaminated source.
IR = intake rate.
SA = skin area.

G.5. RISK RESULTS

The risk estimate is a value that represents the excess cancer incidence that might be expected due to the exposure scenario evaluated. The HI is a value that represents the potential for toxic effects to an exposed individual. The EPA has established a target risk range of E-04 to E-06 and a target HI of 1. The following section presents the risk results for the subject site.

G.5.1 INDUSTRIAL/OFFICE WORKERS

The evaluation of the Bldg. K-791-B and K-796-A SUs and PCB swipes indicated that all risks were below 1E-06, all hazards were below 0.1, and all measured external doses were below the background level of 0.007 mrem/year (see Tables G.5.1 through G.5.4), indicating a low likelihood of adverse health effects from the building SUs. The results were within the generally acceptable target risk range of E-04 to E-06 and below the generally acceptable HI of 1.

G.5.2 CONCLUSION

The screening was considered indicative of the low likelihood of adverse health effects associated with industrial/office worker exposure to building SUs. The K-792 Complex is, therefore, considered suitable for transfer.

Table G.5.1. Carcinogenic risk and radiological dose estimates for Bldg. K-791-B interior/exterior survey units[a]

Carcinogenic risk (risk/lifetime)	Removable activity			10% of Total activity			Overall total
Interior survey unit	Ingestion risk	Inhalation risk	Total risk	Ingestion risk	Inhalation risk	Total risk	
ISU1	7.35E-09	3.35E-11	7.39E-09	8.65E-08	3.94E-10	8.69E-08	9.43E-08
ISU2	7.35E-09	3.35E-11	7.39E-09	4.11E-08	1.88E-10	4.13E-08	4.87E-08
ISU3	1.05E-08	4.77E-11	1.05E-08	5.57E-08	2.54E-10	5.60E-08	6.65E-08
ISU4	7.35E-09	3.35E-11	7.39E-09	8.38E-08	3.82E-10	8.42E-08	9.16E-08
ESU1	4.09E-09	1.86E-11	4.10E-09	2.82E-08	1.29E-11	2.83E-08	3.24E-08
ESU2	7.35E-09	3.35E-11	7.39E-09	1.59E-08	7.23E-11	1.59E-08	2.33E-08
ESU3	3.76E-09	1.71E-11	3.78E-09	1.44E-07	6.58E-10	1.45E-07	1.49E-07
Average[b]	**6.82E-09**	**3.11E-11**	**6.85E-09**	**6.51E-08**	**2.97E-10**	**6.54E-08**	**7.22E-08**
Radiological dose (mrem/year)	**Removable activity**			**10% of Total activity**			**Overall total**
Interior survey unit	**Ingestion dose**	**Inhalation dose**	**Total dose**	**Ingestion dose**	**Inhalation dose**	**Total dose**	
ISU1	5.09E-04	2.49E-06	5.11E-04	5.98E-03	2.93E-05	6.01E-03	6.52E-03
ISU2	5.09E-04	2.49E-06	5.11E-04	2.84E-03	1.39E-05	2.86E-03	3.37E-03
ISU3	7.24E-04	3.54E-06	7.27E-04	3.85E-03	1.89E-05	3.87E-03	4.60E-03
ISU4	5.09E-04	2.49E-06	5.11E-04	5.80E-03	2.84E-05	5.83E-03	6.34E-03
ESU1	2.83E-04	1.38E-06	2.84E-04	1.95E-03	9.55E-06	1.96E-03	2.24E-03
ESU2	5.09E-04	2.49E-06	5.11E-04	1.10E-03	5.37E-06	1.10E-03	1.61E-03
ESU3	2.60E-04	1.27E-06	2.61E-04	9.99E-03	4.89E-05	1.00E-02	1.03E-02
Average[b]	**4.72E-04**	**2.31E-06**	**4.74E-04**	**4.50E-03**	**2.20E-05**	**4.52E-03**	**5.00E-03**

[a] Uses exposure concentration = lesser of max and UCL-95 (UCL-95 may be larger than max if data are limited).
[b] Assumes receptor is equally exposed to each interior survey unit throughout the workday.
ISU = Interior Survey Unit.
ESU = Exterior Survey Unit.

Table G.5.2. Building K-791-B interior PCB risk results

	Average swipe ($\mu g/100\ cm^2$)	Ingestion risk	Inhalation risk	Dermal risk	Ingestion hazard	Inhalation hazard	Dermal hazard
PCBs	2.60E-01	6.06E-10	1.80E-07	1.24E-09	4.24E-05	NA	8.71E-05

NA = not applicable.
PCB = polychlorinated biphenyl.

Table G.5.3. Carcinogenic risk and radiological dose estimates for Bldg. K-796-A interior/exterior survey units[a]

Carcinogenic risk (risk/lifetime)	Removable activity			10% of Total activity			Overall total
Interior survey unit	**Ingestion risk**	**Inhalation risk**	**Total risk**	**Ingestion risk**	**Inhalation risk**	**Total risk**	
ISU1	0.00E+00	0.00E+00	0.00E+00	2.00E-09	9.10E-12	2.01E-09	2.01E-09
ISU2	0.00E+00	0.00E+00	0.00E+00	2.17E-09	9.88E-12	2.18E-09	2.18E-09
ISU3	0.00E+00	0.00E+00	0.00E+00	6.51E-09	2.97E-11	6.54E-08	6.54E-08
ESU1	9.55E-09	4.35E-11	9.59E-09	1.56E-09	7.10E-12	1.57E-09	1.12E-08
ESU2	2.75E-09	1.26E-11	2.77E-09	1.78E-09	8.09E-12	1.78E-09	4.55E-09
Average[b]	**2.46E-09**	**1.12E-11**	**2.47E-09**	**2.80E-09**	**1.28E-11**	**2.81E-09**	**5.29E-08**
Radiological dose (mrem/year)	**Removable activity**			**10% of Total activity**			**Overall total**
Interior survey unit	**Ingestion dose**	**Inhalation dose**	**Total dose**	**Ingestion dose**	**Inhalation dose**	**Total dose**	
ISU1	0.00E+00	0.00E+00	0.00E+00	6.91E-04	3.38E-06	6.94E-04	6.94E-04
ISU2	0.00E+00	0.00E+00	0.00E+00	7.49E-04	3.67E-06	7.53E-04	7.53E-04
ISU3	0.00E+00	0.00E+00	0.00E+00	2.25E-03	1.10E-05	2.26E-03	2.26E-03
ESU1	3.30E-03	1.62E-05	3.32E-03	5.39E-04	2.64E-06	5.41E-04	3.86E-03
ESU2	9.52E-04	4.66E-06	9.57E-04	6.14E-04	3.01E-06	6.17E-04	1.57E-03
Average[b]	**8.51E-04**	**4.17E-06**	**8.55E-04**	**9.69E-04**	**4.74E-06**	**9.73E-04**	**1.83E-03**

[a] Uses exposure concentration = lesser of max and UCL-95 (UCL-95 may be larger than max if data are limited).
[b] Assumes receptor is equally exposed to each interior survey unit throughout the workday.
ISU = Interior Survey Unit.
ESU = Exterior Survey Unit.

Table G.5.4. Building K-796-A interior PCB risk results

	Average swipe (μg/100 cm^2)	Ingestion risk	Inhalation risk	Dermal risk	Ingestion hazard	Inhalation hazard	Dermal hazard
PCBs	3.20E-01	7.46E-10	2.21E-07	1.53E-09	5.22E-05	NA	1.07E-04

NA = not applicable.
PCB = polychlorinated biphenyl.

G.6. EVALUATION OF UNCERTAINTIES

The estimation of uncertainty, whether quantitative or qualitative, is fundamental to scientific activities that involve measured or assessed quantities. Estimates of risk are conditional based on a number of assumptions concerning exposure. Generation of a point estimate of risk, as has been done in this screening-level assessment, has the potential to yield under- or overestimates of the actual value and can lead to improper decisions. Therefore, it is necessary to specify the assumptions and uncertainties inherent in the screening-level evaluation process to place the risk estimates in perspective and ensure that anyone making risk-management decisions is well informed.

Uncertainty about environmental risk estimates is known to be at least an order of magnitude or greater (EPA 1989). The evaluation of uncertainties for the assessment is qualitative, since the resource requirements necessary to provide a quantitative statistical uncertainty analysis for this study area would generally outweigh the benefits. The focus of the discussion in this section will be on the important variables and assumptions that contribute most to the overall uncertainty.

G.6.1 UNCERTAINTY IN THE SOURCE TERM

Several uncertainties are associated with the data set and the data evaluation process. These uncertainties include the selection of COPCs and the determination of the exposure point concentration.

Although the data evaluation process used to select COPCs adheres to established procedures and guidance, it also requires making decisions and developing assumptions on the basis of historical information, process knowledge, and best professional judgment about the data. Uncertainties are associated with all such assumptions. The toxicity values used in the derivation of PRGs are subject to change; as additional information (from scientific research) becomes available, these periodic changes in toxicity values may cause the PRG values to change as well, causing increased uncertainty in the data screening process.

Representative concentrations and other statistics are calculated in this risk screen based on the assumption that the samples collected are truly random samples. Some of the data may not have been taken randomly, but rather may have come from biased sampling, aimed at identifying high contaminant concentration locations.

G.6.2 UNCERTAINTY IN THE EXPOSURE ASSESSMENT

For each exposure pathway, assumptions are made concerning the parameters, the routes of exposure, the amount of contaminated media an individual can be exposed to, and intake rates for different routes of exposure. In the absence of site-specific data, the assumptions used in this assessment are consistent with EPA-approved parameters and default values. When several of these upper-bound values are combined in estimating exposure for any one pathway, the resulting risks can be in excess of the 99th percentile and, therefore, outside the range that may be reasonably expected.

The guidance values for intake rates and exposure parameters are assumed to be representative of the hypothetical populations evaluated. All contaminant exposures and intakes are assumed to be from the site-related exposure media (i.e., no other sources contribute to the receptor's risk). Even if these assumptions are true, other areas of uncertainty may apply. Selected intake rates and population characteristics (i.e., weight, life span, and activities) are assumed to be representative of the exposed population. The consistent conservatism used in the estimation of these parameters generally leads to overestimation of the potential risk to the postulated receptors.

G.6.3 UNCERTAINTY IN TOXICITY VALUES AND RISK PREDICTIONS

Uncertainty in the values used to represent the dose-response relationship will highly impact the risk estimates. These uncertainties are contaminant-specific and are embedded in the toxicity value. The factors that are incorporated to represent sources of uncertainty include the source of the data, duration of the study, extrapolations from short- to long-term exposures, intrahuman or interspecies variability, and other special considerations. In addition, toxicity varies with the chemical form.

Uncertainties related to the summation of carcinogenic risk and non-carcinogenic HI estimates across contaminants and pathways are a primary uncertainty in the risk characterization process. In the absence of information on the toxicity of specific chemical mixtures, additive (cumulative) risks are assumed (EPA 1989).

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