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2008 Remediation Effectiveness Report for the U. S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee

Volume 2: Data and Evaluations

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Prepared by the
Water Resources Restoration Program
Bechtel Jacobs Company LLC

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
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U. S. DEPARTMENT OF ENERGY

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TABLES

FIGURES

ACRONYMS

µg/g	micrograms per gram
µg/L	micrograms per liter
ACB	auxiliary charcoal bed
AM	Action Memorandum
ARAP	Aquatic Resource Alteration Permit
ARAR	applicable or relevant and appropriate requirements
ASA	Auditable Safety Analysis
ASER	Annual Site Environmental Report
AWQC	ambient water quality criteria
BCBG	Bear Creek Burial Ground
BCK	Bear Creek kilometer
BCV	Bear Creek Valley
BFK	Brushy Fork kilometer
bgs	below ground surface
BJC	Bechtel Jacobs Company LLC
BMAP	Biological Monitoring and Abatement Program
BMP	best management practice
BSWTS	Big Spring Water Treatment System
BV	Bethel Valley
B&W	B&W Technical Services Y-12 LLC
BYBY	Boneyard/Burnyard
CA	Characterization Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulatio*ns*
Ci	curie
CMTS	Central Mercury Treatment System
COC	contaminant of concern
COE	Corp of Engineers
Cr	chromium
ChR	Chestnut Ridge
CRM	Clinch River mile
CR/PC	Clinch River/Poplar Creek
CR	Clinch River
CROET	Community Reuse Organization of East Tennessee
CVOC	chlorinated volatile organic compound
D&D	decontamination and decommissioning
DARA	Disposal Area Remedial Action
DCA	dichloroethane
DCG	derived concentration guidelines
DGT	downgradient trench
DNAPL	dense non-aqueous-phase liquid
DOE	U. S. Department of Energy
DSWM	Division of Solid Waste Management
DVS	Dynamic Verification Strategy
EC	Environmental Compliance
ECP	Environmental Compliance Plan
EE/CA	Engineering Evaluation/Cost Analysis
EEMTS	East End Mercury Treatment System

EEVOC	East End Volatile Organic Compound
EFPC	East Fork Poplar Creek
ELCR	excess lifetime cancer risk
EMP	Environmental Monitoring Plan
EMWMF	Environmental Management Waste Management Facility
EPA	U. S. Environmental Protection Agency
EPP	excavation/penetration permit
ESD	Explanation of Significant Difference
ETTP	East Tennessee Technology Park
EU	exposure unit
FCA	fixed contamination area
FCAP	Filled Coal Ash Pond
FFA	Federal Facility Agreement
FIT	Facility Inspection and Training Manual
FS	feasibility study
FUSRAP	Formerly Utilized Sites Remedial Action Program
FY	fiscal year
FYR	Five-Year Review
GHK	Gum Hollow Branch kilometer
HFIR	High Flux Isotope Reactor
Hg	mercury
HI	hazard index
HRE	Homogeneous Reactor Experiment
HRT	Homogeneous Reactor Test
IHP	Intermediate Holding Pond
IP	integration point
IROD	Interim Record of Decision
ISG	*in situ* grouting
IWMF	Interim Waste Management Facility
KHQ	Kerr Hollow Quarry
LEFPC	Lower East Fork Poplar Creek
LLW	low level (radioactive) waste
LLLW	liquid low-level waste
LTS	long-term stewardship
LUC	land use control
LUCAP	Land Use Control Assurance Plan
LUCIP	Land Use Control Implementation Plan
LWBR	Lower Watts Bar Reservoir
MB	Melton Branch
MBK	Mill Branch kilometer
MCK	McCoy Branch kilometer
MCL	maximum contaminant level
MEK	Melton Branch kilometer
mgd	million gallons per day
mg/kg	milligrams per kilogram
MIK	Mitchell Branch kilometer
MNA	Monitored Natural Attenuation
MRF	Metal Recovery Facility
MSRE	Molten Salt Reactor Experiment
MV	Melton Valley
NEPA	National Environmental Policy Act

NESHAP	National Emission Standards for Hazardous Air Pollutants
NFA	No Further Action
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
NSC	Non-Significant Change
NT-3	North Tributary 3
NTF	North Tank Farm
OLFSCP	Oil Landfarm Soil Containment Pad
ORAU	Oak Ridge Associated Universities
OREIS	Oak Ridge Environmental Information System
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OU	operable unit
P&A	plugging and abandonment
PC	Poplar Creek
PCB	polychlorinated biphenyl
PCCR	Phased Construction Completion Report
PCE	tetrachloroethene
pCi/L	picoCuries per liter
PCM	Poplar Creek mile
PCR	Post-Construction Report
PPA	property protection area
ppt	parts per trillion
PQL	project quantitation level
psig	pounds per square inch gauge
PWTC	Process Waste Treatment Complex
QA	quality assurance
RA	remedial action
RAER	Remedial Action Effectiveness Report
RAO	remedial action objective
RAR	Remedial Action Report
RAWP	Remedial Action Work Plan
RBC	risk-based screening criteria
RCRA	Resource Conservation and Recovery Act of 1976
RDR	Remedial Design Report
RER	Remediation Effectiveness Report
RI	remedial investigation
RI/FS	Remedial Investigation/Feasibility Study
RL	remediation level
RMA	Radioactive Materials Areas
RmAR	Removal Action Report
RMPE	Reduction of Mercury in Plant Effluents
RPP	Radiation Protection Plan
ROD	Record of Decision
SAP	Sampling and Analysis Plan
S&M	surveillance and maintenance
SCF	South Campus Facility
SDWA	Safe Drinking Water Act of 1974
SIOU	Surface Impoundments Operable Unit
SRS	Sediment Retention Structure
STT	Shielded Transfer Tanks

SVOC	semivolatile organic compound
SWSA	Solid Waste Storage Area
TCA	trichloroethane
TCE	trichloroethene
TC RmA	time-critical removal action
TDEC	Tennessee Department of Environment and Conservation
TMDL	Total Maximum Daily Load
TRM	Tennessee River mile
TRU	transuranic
TSCA	Toxic Substances Control Act of 1976
TVA	Tennessee Valley Authority
TV	threshold value
TWRA	Tennessee Wildlife Resources Agency
UEFPC	Upper East Fork Poplar Creek
UGT	upgradient trench
UNC	United Nuclear Corporation
UT-B	University of Tennessee-Battelle
UV	Union Valley
VOC	volatile organic compound
WAC	waste acceptance criteria
WAG	Waste Area Grouping
WBIWG	Watts Bar Interagency Working Group
WCK	White Oak Creek kilometer
WEMA	West End Mercury Area
WIR	waste incidental to reprocessing
WOC	White Oak Creek
WOCC	Waste Operations Control Center
WOCE	White Oak Creek Embayment
WOD	White Oak Dam
WOL	White Oak Lake
WRRP	Water Resources Restoration Program
WTS	Water Treatment System
WWSY	White Wing Scrap Yard
Y-12 Complex	Y-12 National Security Complex
ZVI	zero valent iron

ACKNOWLEDGEMENTS

Primary tasks of the U.S. Department of Energy Oak Ridge Operations (DOE-ORO) are contracted to various entities (public and non-profit companies, as well as educational institutions). Bechtel Jacobs Company, LLC (BJC) conducts environmental cleanup and long-term stewardship at sites with Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as the primary regulatory authority on the Oak Ridge Reservation (ORR) and impacted sites off the reservation (e.g., Lower East Fork Poplar Creek). Bechtel Jacobs Company's Water Resources Restoration Program (WRRP) implements a comprehensive, integrated environmental monitoring program for the ORR and prepares the annual Remediation Effectiveness Report (RER). Babcock & Wilcox Technical Services Y-12 (formerly BWXT Y-12) operates the Y-12 National Security Complex, which manages the production and refurbishment of nuclear weapon components for the DOE and the National Nuclear Security Administration. A partnership between the University of Tennessee and Battelle, UT-Battelle, manages and operates the Oak Ridge National Laboratory (ORNL) for the DOE.

The BJC WRRP gratefully acknowledges the contributions and efforts of many organizations and individuals on the ORR for providing support in preparation of the 2008 RER. Particular thanks are due to the Ecological Assessment Group of the Environmental Sciences Division (ESD) (UT-Battelle) at the ORNL for providing field support, biological data, and technical interpretations included in the biological monitoring sections of this report. Where applicable, ORR monitoring data collected by other programs were used to augment the WRRP sampling results. Considerable thanks are due to UT-Battelle's Environmental Protection and Waste Services Division; Babcock & Wilcox Technical Services Y-12's Environment, Safety and Health Organization and Groundwater Protection programs; BJC's Environmental Compliance and Protection (EC&P) organization (East Tennessee Technology Park) for providing National Pollution Discharge Elimination System (NPDES) Clean Water Act data; and BJC's Radiation Protection Organization for providing Radiological Surveillance data for sites with residual contamination. Long-term stewardship information used in the RER is collected and compiled in conjunction with the BJC Surveillance and Maintenance (S&M) programs. The Tennessee Valley Authority generously provided historical sampling results that were used to construct some graphs depicting off-site data. A sincere note of thanks is due to Commodore Advanced Sciences Inc. sampling and support personnel for their diligent efforts in completing much of the field work for the WRRP monitoring program.

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EXECUTIVE SUMMARY

Under the requirements of the Oak Ridge Reservation (ORR) Federal Facility Agreement (FFA) established between the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Tennessee Department of Environment and Conservation (TDEC) in 1992, all environmental restoration activities on the ORR will be performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Since 1990, the environmental restoration activities have experienced a gradual shift from characterization to remediation. As this has occurred, it has been determined that the assessment of the individual and cumulative performance of all ORR CERCLA remedial actions is most effectively tracked in a single document. The Remediation Effectiveness Report (RER) is an FFA document intended to collate all ORR CERCLA decision requirements, compare pre- and post-remediation conditions at CERCLA sites, and present the results of any required post-decision remediation effectiveness monitoring. First issued in 1997, the RER has been reissued annually to update the performance histories of completed actions and to add descriptions of new CERCLA actions.

This year only one 2008 Remediation Effectiveness Report document is issued and it is identified as Volume 2: Data and Evaluations. The 2007 RER Volume 1 (issued August 2007) is the reference document to this 2008 RER Volume 2, and to the next 3 subsequent years' RER Volume 2 documents.

The 2007 RER Volume 1, a compendium of the details and background on all CERCLA decisions made as of September 30, 2006, will be updated every 5 years to provide the additional information necessary for the Oak Ridge Reservation CERCLA Five-Year Review (FYR). You may request a copy at the DOE Information Center, 475 Oak Ridge Turnpike, Oak Ridge, Tennessee. The 2007 RER Volume 1 can also be accessed online under the document request link at:
http://www.oakridge.doe.Gov/external/Home/PublicActivities/DOEInformationCenter/tabid/126/Default.aspx

The RER Volume 2 report, generated annually, will contain the required monitoring data evaluation and effectiveness assessment for the completed CERCLA remediation activities, as well as the compliance assessment with LTS requirements. This greatly streamlines the RER document process and focuses the annual review on the sampling data gathered and results at those sites where the work has been completed.

Monitoring information used in Volume 2 to assess remedy performance was collected and/or compiled by DOE's Water Resources Restoration Program (WRRP). Only data used to assess performance of completed actions are provided in Volume 2. In addition to collecting CERCLA performance assessment data, the WRRP also collects baseline data to be used to gauge the effectiveness of future actions once implemented. These baseline data are maintained in the Oak Ridge Environmental Information System (OREIS) and will be reported in future RERs, as required, once the respective actions are completed. However, when insufficient data exist to assess the impact of the remedial action(s), e.g., when the remedial action was only recently completed, a brief preliminary evaluation is made of early indicators of effectiveness at the watershed scale, such as contaminant trends at surface water integration points.

REPORT ORGANIZATION

Within the 2008 RER (i.e., Volume 2), a chapter is devoted to each of the ORR administrative watersheds, as well as a chapter each to Chestnut Ridge, East Tennessee Technology Park, and a single chapter to all off-site actions. Each chapter of Volume 2 identifies single actions and, if applicable, watershed-scale Record of Decision (ROD) actions with on-going monitoring and/or LTS activities. The remedial action objectives (RAO) and performance monitoring criteria are provided, followed by an evaluation of the monitoring results with a comparison to stated performance metrics. Each chapter concludes with a summary of the watershed condition and any notable trends, as well as any monitoring changes and recommendations.

REMEDIATION EFFECTIVENESS SUMMARY

Variations in annual rainfall affect contaminant concentrations in groundwater, surface water, and contaminant discharge fluxes measured in surface water across the ORR. Because of this, rainfall trends for FY 2001 through FY 2007 are often used in evaluation of contaminant concentrations and discharge fluxes in Volume 2. Mean annual rainfall for FY 2007 (approximately 35.6 inches) was significantly below the long-term mean for the ORR (approximately 54 inches), and is the driest year on record for the ORR. The impact of the extremely dry year on contaminant concentrations is consistent with the effects observed in previous dry years and confirms the site conceptual models and data evaluations presented in previous RERs concerning surface water and subsurface systems.

Highlights of the effectiveness of completed remedial actions are provided below. Issues and recommendations identified since the 2006 RER/FYR including current year evaluations of performance monitoring data are summarized in Chapter 1 of Volume 2 of this 2008 RER. A more detailed discussion of the issue(s) resulting from the 2008 RER evaluations is provided in the appropriate chapter.

Bethel Valley

The predominant factor that affected the hydrologic system in Bethel Valley during FY 2007 was the extreme drought. The drought caused minimal rainfall percolation through soils, minimal groundwater recharge, and minimal surface water discharge in addition to treated ORNL facilities effluent. Consequently, concentrations of ^{90}Sr and ^{137}Cs in surface water at the watershed exit point were the lowest on record. The low ^{137}Cs concentrations and flux at the 7500 Bridge are attributed to low surface water flow volumes that caused a decrease in mobilization of cesium-contaminated sediment. The low ^{90}Sr concentrations and flux at the 7500 Bridge is attributed to little percolation of rainfall through contaminated soils and low contaminated groundwater seepage volume to White Oak Creek and its tributaries. Groundwater contaminant concentrations in the Corehole 8 Plume were observed to increase slightly during FY 2007 as a result of diminished recharge to the groundwater system. At shallow depths in fractured rock groundwater systems, contaminant concentrations are sensitive to rain-induced recharge events which can dilute plume water in the fractures.

Fish and benthic communities are degraded relative to reference sites, although improvements have occurred since the mid-1980s. The fish communities in WOC have been fairly stable in terms of overall numbers of species in recent samples, but despite increased species richness values during the past year at WCK 3.9, they are generally below that of comparable reference fish communities. The benthic macroinvertebrate community just downstream of most major effluent discharges from ORNL continued to indicate that ecological condition of WOC is degraded relative to comparable reference streams and that the extent of recovery observed after 1998 has basically stabilized.

Melton Valley

Monitoring during FY 2007 showed the combined influences of remedial actions and extreme drought. The affects of hydrologic isolation caps and groundwater collection systems are demonstrated by suppression of groundwater levels within capped areas, reduced groundwater level fluctuations inside hydrologically isolated areas compared to those outside the remediated areas, and significant reductions in both contaminant concentrations and discharge fluxes in surface water. Surface water radiological contaminant fluxes measured in Melton Valley were the lowest on record since the onset of such monitoring in the early 1990s. Most of the groundwater levels in the hydrologically isolated areas in Melton Valley met the performance targets for effectiveness. Additionally, contaminant concentrations in most wells in the vicinity of the Liquid Low-Level Waste (LLLW) Seepage Pits and Trenches showed decreasing contaminant concentrations. These decreases are attributed primarily to the effects of remedial actions. Although flow volumes in the Melton Valley groundwater collection systems declined during summer because of the drought and continuing drain-down of groundwater beneath capped areas, analysis of the collected groundwater shows beneficial contaminant mass removal due to treatment. The extreme drought was evident as a number of surface water monitoring stations on tributaries to White Oak Creek became dry during the summer months and some reaches of Melton Branch were dry through much of the late spring and summer. It is expected that a return to normal precipitation patterns may produce some increases in groundwater levels in remediated areas and overall surface water flows will increase.

Monitoring was conducted on 29 of the 36 groundwater sampling zones in the Melton Valley exit pathway wells during FY 2007. Strontium-90 was detected in four of the sampling zones in 2007 with a maximum measured concentration of 12.4 pCi/L. Low (< 5 µg/L) concentrations of the following VOCs were detected -- TCE in 4 sampling zones, 1,2-DCE in one sampling zone, and acetone and chloromethane were both detected once in separate sample zones. Alpha and beta activity levels showed elevated values in several sample zones that typically also contained elevated suspended solids. Detection of elevated alpha and beta activity in the exit pathway wells is identified as an issue in this RER to be addressed by the ORNL CERCLA Core Team.

Bear Creek Valley

Contaminant discharges in Bear Creek Valley were low during FY 2007 largely because of the extreme drought conditions. The uranium fluxes measured at BCK 9.2 and BCK 12.34 were the lowest on record. The Phase I ROD goal for uranium flux at BCK 12.34 (< 27.2 kg/yr) was attained in FY 2007 as it was during FY 2006. Although the uranium flux of 59.5 kg was the lowest on record at BCK 9.2, the discharge was significantly greater than the Phase I ROD goal of = 34 kg/yr. Much of the uranium flux measured at BCK 9.2 originated from ungauged sources that are suspected to include discharges from NT-8 and groundwater in the Maynardville Limestone karst aquifer. To further define the role of the western portion of the Bear Creek Burial Grounds in watershed uranium discharge, continuous flow-paced sampling will be initiated at Bear Creek tributary NT-8 in FY 2008.

The fifth year of stream stability monitoring of the restored NT-3 was completed. Stream morphological conditions are stable and concurrence is requested to discontinue formal monitoring.

Aquatic biota monitoring during FY 2007 shows continuing impact to the aquatic ecosystem related to contaminant discharge and residual contamination in the Bear Creek environment. PCBs and a number of metals, including mercury, nickel, uranium, and cadmium, accumulate in Bear Creek fish. Fish species richness in the most downstream portion of Bear Creek (BCK 3.3) is in the range of the reference sites. Fish species richness in the headwater region (NT-3 and BCK 12.4) are in the lower range of reference streams while at BCK 9.9, near the Zone 3 integration point, a gradual increase in species richness has been observed from 2000 through 2007. Benthic macroinvertibrate community richness in Bear Creek is also similar to reference streams at the lowermost sites, but in Upper Bear Creek and the mid-valley area remain well below reference stream values.

Chestnut Ridge

Filled Coal Ash Pond—Surface water quality data directly above and below the wetland at FCAP are consistent with monitoring results from previous years since implementation of the remedial action. Elevated results obtained for COCs during July 2007 indicate the presence of oxyhydroxide precipitate particles contained in the FCAP leachate, consistent with below average rainfall during the year.

Communities of fish and invertebrates in McCoy Branch exhibit small differences from reference sites that suggest only slight impacts from the FCAP.

Kerr Hollow Quarry—Results of statistical analyses of target constituents in accordance with the RCRA post-closure permit for Kerr Hollow Quarry were conducted for FY 2007 data. Results of these evaluations do not indicate a contaminant release to the uppermost aquifer and do not warrant any response action specified in the post-closure permit.

United Nuclear Corporation—During FY 2007, beta activity was detected in groundwater above the MCL of 50 pCi/L downgradient of the site. Chemical analysis confirms that potassium-40, a naturally occurring radionuclide was the likely cause of the beta activity. Strontium-90, another beta-emitting radionuclide present in waste at the UNC site was not detected in any of the groundwater samples collected in FY 2007. Recent years' groundwater monitoring data were reviewed with the Upper East Fork Poplar Creek CERCLA Core Team. A decision was reached to continue existing groundwater monitoring and to add a surface water sampling location at the nearest downgradient seep in the headwater of McCoy Branch. Sampling at the seep will be conducted contemporaneous with future groundwater sampling events based on the availability of surface water flow at the location.

Upper East Fork Poplar Creek

Surface water contaminant discharge conditions in UEFPC during FY 2007 were stable and consistent with the conditions observed during FY 2006. The extreme drought condition continued to minimize the mobilization and transport of mercury via groundwater and storm flows. During FY 2007 mercury discharges measured at the WEMA integration point (Outfall 200A6) and at the watershed integration point (Station 17) were about 2 and 4 kg respectively. The 4 kg watershed discharge of mercury is essentially identical with the FY 2006 value. The Big Springs Water Treatment System operated with a > 97% mercury removal efficiency despite receiving influent mercury concentrations in excess of the system design criteria. The East End VOC Plume groundwater pump and treat system continued to contain the plume, protecting groundwater and surface water offsite in Union Valley.

Aquatic biological monitoring shows that mercury concentrations remain stable in fish tissue at EFK 23.4 near the watershed integration point although surface water mercury concentrations have decreased by nearly 30% as a result of BSWTS operation. PCB concentrations in fish tissue have apparently stabilized at about 0.2 ppm which is a significant decrease from levels above 1 ppm measured in 1999. Although fish and benthic communities in UEFPC are relatively stable, they continue to show impairment compared to the reference streams.

CERCLA Off-Site Actions

The implementation of the fish advisory in LWBR was deemed protective as a ROD institutional control action in the early 1990s when PCBs in fish were approximately 1.5 mg/kg. The current PCB concentrations in fish from LWBR are substantially lower than the early 1990s. Based on the current levels in fish, the fish advisory in LWBR would seem to be protective. Mercury concentrations in LWBR fish are also below EPA and TDEC guidelines.

East Tennessee Technology Park

Surface water and groundwater contaminant trends at ETTP reflect relatively stable conditions. The extreme drought of FY 2007 may have contributed to an observed slight increase in VOC concentrations in Mitchell Branch although effects of remedial actions may also have contributed to the increase. The notable observation at ETTP concerning surface water contamination during FY 2007 was the detection of hexavalent chromium in Mitchell Branch. The chromium was found to emanate from Outfall 170 and was found to be tied to contaminated groundwater seepage. Investigations were initiated to determine the source of contamination and to prevent impacts to surface water quality in Mitchell Branch.

Groundwater quality data reflect generally decreasing concentrations of VOCs in most monitored areas and the continuing presence of low concentrations of VOCs in groundwater exit pathways was similar to previous observations reported from FY 2006. Metals contamination, particularly chromium, largely associated with suspended solids in shallow groundwater wells continued to affect water quality in several areas. Redevelopment of selected monitoring wells is planned to enable collection of more representative groundwater samples.

Aquatic biota monitoring also shows that conditions are fairly stable in surface water bodies at ETTP. PCB levels remain elevated in fish in the K-1007-P1 Pond. When implemented, the ecological enhancement of the P1 Pond is expected to reduce PCB uptake from pond sediment into the aquatic foodchain. PCB levels in sunfish in Mitchell Branch downstream of Outfall 190 remain elevated although concentrations have decreased in recent years. The number of fish and benthic macroinvertebrate species in Mitchell Branch appears to have stabilized at a level below that observed in reference streams.

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ACRONYMS

AM	Action Memorandum
BCV	Bear Creek Valley
BV	Bethel Valley
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CR	Clinch River
DOE	U. S. Department of Energy
EMWMF	Environmental Management Waste Management Facility
EPA	U. S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
FFA	Federal Facility Agreement
FY	fiscal year
FYR	Five-Year Review
IP	integration point
LEFPC	Lower East Fork Poplar Creek
LTS	Long-term stewardship
LUCAP	Land Use Control Assurance Plan
LUCIP	Land Use Control Implementation Plan
MV	Melton Valley
OREIS	Oak Ridge Environmental Information System
ORR	Oak Ridge Reservation
PC	Poplar Creek
PCCR	phased construction completion report
PCR	post-construction report
RAR	remedial action report
RAO	remedial action objective
RAWP	remedial action work plan
RER	Remediation Effectiveness Report
RmAR	removal action report
ROD	Record of Decision
SCF	South Campus Facility
TDEC	Tennessee Department of Environment and Conservation
UEFPC	Upper East Fork Poplar Creek
UV	Union Valley
WRRP	Water Resources Restoration Program

1. INTRODUCTION

1.1 OBJECTIVES OF VOLUME 2 REMEDIATION EFFECTIVENESS REPORT

The objective of the annual Remediation Effectiveness Report (RER) is to assess and document effectiveness, or progress toward a stated goal, of each completed remedy performed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) on and around the U. S. Department of Energy (DOE) Oak Ridge Reservation (ORR). As part of this assessment, compliance with long-term stewardship (LTS) requirements of CERCLA decisions is also evaluated. This is the second year that the RER has been issued with a revised format.

The revised format is streamlined to facilitate annual reviews and to focus on data evaluations to assess performance of completed actions and compliance with LTS requirements. The RER consists of two volumes: Volume 1, which is updated and published in its entirety every fifth year, acts as a reference volume for the CERCLA Five-Year Review (FYR) and a Volume 2 RER updated annually, which focuses on performance evaluations where the CERCLA activities have been completed.

Volume 1 of the 2007 RER is a compendium of all CERCLA decisions finalized through September 30, 2006. It contains a concise description of each remedial action in the context of a conceptual contaminant fate and transport model for each watershed, and summarizes the goals of the remedy. Section 1.4 of Volume 1 of the 2007 RER provides the physical context with which to better understand the CERCLA decision and activities to date, including a summary of the contaminant source areas and surface water, groundwater, and biological resources. Volume 1 also includes CERCLA decisions that include future actions and any ongoing actions. This compendium summarizes all monitoring, LTS, and applicable land-use control requirements for each CERCLA decision, as well as the associated metrics against which performance is measured.

The 2008 RER (i.e., Volume 2) provides the current status and updates to completed CERCLA actions on the ORR, as well as the technical evaluation of effectiveness for each remedy that includes monitoring and/or LTS requirements. For each of these actions, Volume 2 provides: (1) a summary of performance goals and objectives; (2) specific monitoring locations and parameters that fulfill the requirements contained in the respective decision document(s); and (3) a comparison of monitoring results to stated goals or metrics to evaluate the performance of the remedy. Based on this evaluation, changes and recommendations to the monitoring program may be proposed, as appropriate. Lastly, Appendix B provides the applicable compliance certification for the approved Melton Valley land use controls.

Various CERCLA instruments are used to document remedial decisions on the ORR. Typically, either a Record of Decision (ROD) for a remedial action or Action Memorandum (AM) for a removal action defines the selected remedy for a site. These instruments serve as the statutory decision guiding the performance of site remediation activities and may also specify monitoring and LTS requirements. However, because most decision documents generally lack monitoring specifics, additional details are typically found in post-ROD documents, such as remedial action work plans (RAWPs), post-construction reports (PCRs), remedial action reports (RARs), removal action reports (RmARs), phased-construction completion reports (PCCRs), or ROD monitoring plans.

Monitoring information used in the 2008 RER to assess performance of completed CERCLA actions was collected and/or compiled under DOE's Water Resources Restoration Program (WRRP). The WRRP was established to implement a comprehensive, integrated environmental monitoring and assessment program for the DOE ORR and to minimize duplication of field, analytical, and reporting efforts. Groundwater, surface water, sediment, and biota are monitored and evaluated as part of this assessment program. In addition to collecting CERCLA performance assessment data, the WRRP also collects baseline data to be used to gauge the effectiveness of future actions once implemented. Such baseline data that are relevant to future actions are collected in accordance with the annual WRRP Sampling and Analysis Plan (SAP), and are maintained in the Oak Ridge Environmental Information System (OREIS). The data will be reported in future RERs, as required, once the respective actions are completed.

Select biomonitoring data collected by the WRRP provide a usable measure of overall improvements in aquatic conditions. However, these data are not intended to imply any conclusions regarding the current status of ecological risk. The risk to ecological receptors will be evaluated in future studies, such as Remedial Investigations (RIs), and addressed by final decisions for each of the watersheds or Operable Units (OUs).

When remediation is complete, selected sites will require some level of LTS to ensure protection of human health and the environment from the remaining hazards, or residual contamination. LTS ensures that remediation remains effective for an extended, or possibly indefinite, period of time until residual hazards are reduced sufficiently to permit unrestricted use and unlimited access (DOE 2003a). LTS is designed to:

- Prevent the residual hazard from migrating to the receptor (generally through engineering controls), and
- Prevent the receptor from encountering the residual hazard (generally through land use controls).

Engineering controls include actions to stabilize and/or physically contain or isolate waste, contamination, or other residual hazards. Engineered controls include *in-situ* stabilization; caps on residual contamination; groundwater extraction and treatment systems; and vaults, repositories, or engineered landfills designed to isolate waste or materials.

Land use controls are legal and other non-engineering measures intended to prevent the public from coming into contact with contamination left in place. Land use controls include administrative controls such as property record restrictions, property record notices, zoning notices, and excavation/penetration permit program, as well as physical controls, such as state advisories/postings, fences, signs, and surveillance patrols.

Long-term stewardship encompasses both engineering controls and land use controls. The RER evaluates the performance of engineering controls and land use controls that are required by CERCLA decision documents (e.g., RODs, RAWPs, PCCRs, RARs, RmARs) to protect human health and the environment. The definitions encompassing LTS have evolved over time and earlier decision documents used the term "institutional controls" loosely instead of LUCs and engineering controls. This term "institutional controls" is used throughout the RER when using citations directly from these earlier decision documents.

Long-term stewardship information used in this report was collected and/or compiled under the WRRP in conjunction with the Surveillance and Maintenance (S&M) Programs and the BJC Radiation Protection Organization at ETTP.

1.2 ORGANIZATION OF THE REPORT

Volume 1 of the 2007 RER (DOE 2007a) includes information that is current as of September 30, 2006. Volume 1 is a compendium of background information and a description of completed, ongoing, and future actions. To continue to streamline and facilitate annual document reviews, Volume 1 of the 2007

RER is intended to serve as a reference volume for site background information and contaminant transport models for the remedial actions completed on the ORR. This information will be updated and reissued every 5 years for the FYR.

The 2008 RER (i.e., Volume 2) provides the technical evaluation of effectiveness of each completed remedy. All data analyses, interpretations, and conclusions regarding effectiveness of a specific action are contained in this volume, along with any recommendations regarding the remedy or monitoring conducted to evaluate the remedy. Actions that do not have LTS or monitoring requirements, or have been terminated or superseded by watershed-scale actions are not discussed in the 2008 RER.

Within the 2008 RER, a chapter is devoted to each of the watersheds, as well as a chapter each to Chestnut Ridge (ChR), East Tennessee Technology Park (ETTP), and a single chapter to all offsite actions. Rather than forming a single defined hydrologic watershed, ChR and the ETTP comprise several individual sub-watersheds, but are treated as a single unit for planning and administrative purposes (Fig. 1.1). Each chapter identifies completed single actions and, as applicable, completed watershed-scale ROD actions with ongoing monitoring and/or LTS activities. The remedial action objective (RAO) and performance monitoring criteria are provided, followed by an evaluation of the monitoring results with a comparison to stated performance metrics. When insufficient data exist to assess the impact of the remedial action(s), e.g., when the remedial action was only recently completed, a brief preliminary evaluation is made of early indicators of effectiveness at the watershed scale, such as contaminant trends at surface water integration points (IPs).

The order of presentation follows:

- Chapter 2–Bethel Valley (BV) Watershed
- Chapter 3–Melton Valley (MV) Watershed
- Chapter 4–Bear Creek Valley (BCV) Watershed
- Chapter 5–Chestnut Ridge (ChR)
- Chapter 6–Upper East Fork Poplar Creek (UEFPC)
- Chapter 7–Off-Site Actions, including Lower East Fork Poplar Creek (LEFPC), Clinch River/Poplar Creek (CR/PC), Lower Watts Bar Reservoir (LWBR), South Campus Facility (SCF), and Union Valley (UV)
- Chapter 8–East Tennessee Technology Park (ETTP)
- Chapter 9–Other Sites

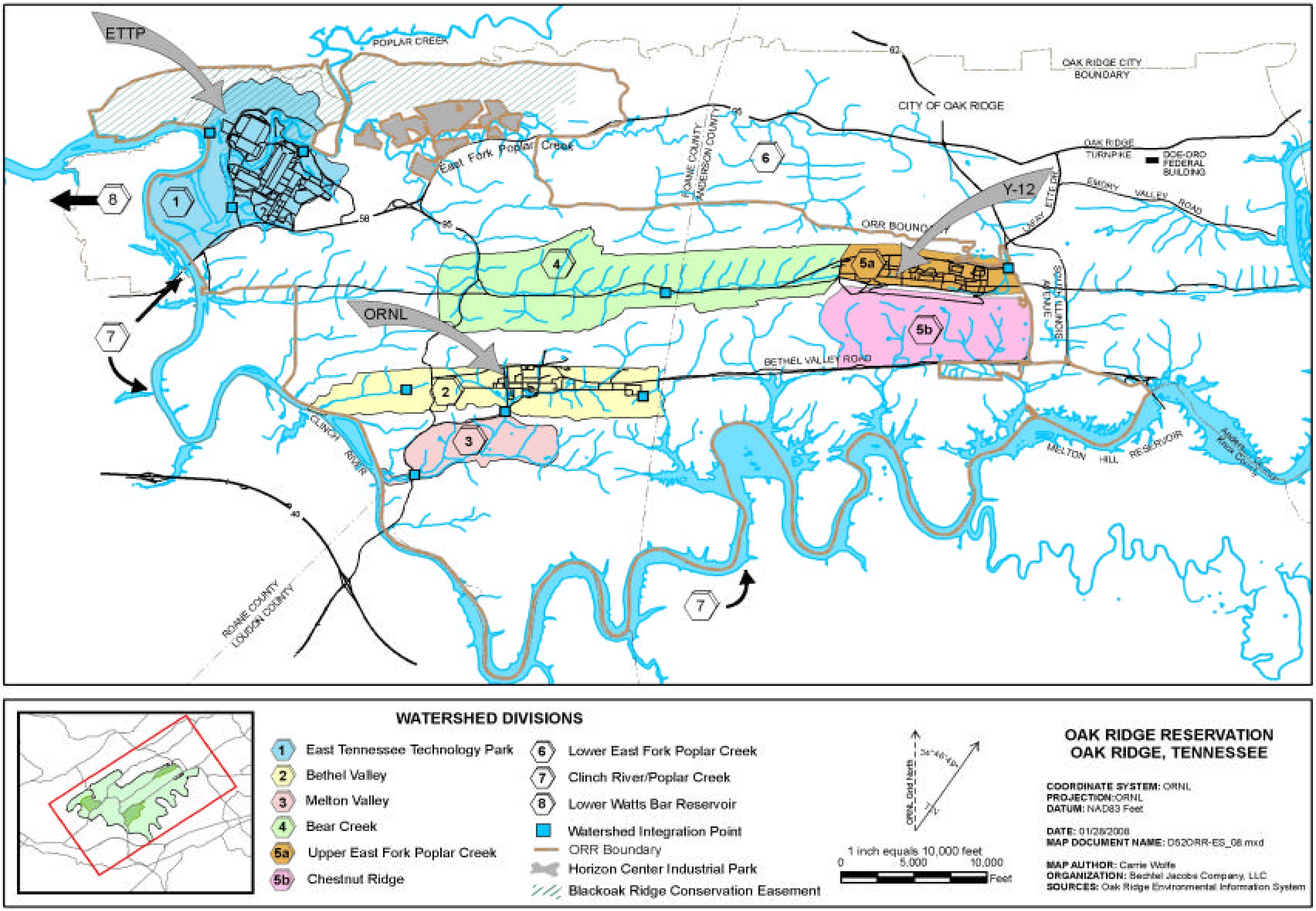

Fig. 1.1. Watersheds on the ORR and adjacent impacted watersheds.

Chapter 10 includes a complete bibliography of relevant information for each watershed, and Chapter 11 provides a list of references used in preparation of this report. Appendix A includes the annual report for the Environmental Management Waste Management Facility (EMWMF), and Appendix B provides the required DOE certification that relevant LUCIP requirements were implemented in accordance with the LUCAP. Appendix C of this report includes the Appendix E of the Federal Facility Agreement (FFA), FY 2007–2009 Enforceable Milestones.

1.3 ORR-WIDE RAINFALL

The quantity, duration, and intensity of rainfall affect contaminant concentrations in groundwater and surface water across the ORR (DOE 2006a). Because of this, general rainfall trends for FY 2007 are summarized in this section to provide a general context for the remainder of this report.

Details of rainfall distribution within FY 2007 are illustrated in Fig. 1.2. Mean monthly rainfall values for FY 2007 for the ORR vary from ~1 in/month to >5 in/month. During FY 2007, the greatest monthly rainfall occurred in April 2007 and the lowest monthly rainfall occurred during August 2007.

FY 2007 was the driest year on record for the ORR, with a total of 35.6 inches based on a composite of six rain-gauge stations located throughout the reservation (Fig. 1.3). The total rainfall for FY 2007 was significantly below the long-term mean for the ORR of 54 inches/year. Much of the spring and summer of FY 2007 on the ORR were classified as "exceptional intensity" of drought, which is the most severe category used by the U. S. Drought Monitor, produced and maintained by the U.S. Department of Agriculture and the National Oceanic and Atmospheric Administration. This information can be accessed at the following: www.drought.unl.edu/dm/MONITOR.html.

1.4 ISSUES AND RECOMMENDATIONS

Table 1.1 summarizes issues identified through evaluation of performance monitoring data and provides recommendations, as appropriate. To track issues through their resolution, the table includes those issues that are carried forward from the previous annual RER and/or FYR that are relevant to the annual report (i.e., issues relevant to the 2011 FYR are not included), as well as any issues identified from data evaluations provided in the 2008 RER. As a particular issue is resolved from last year's 2007 RER, it will be included in the last section of the table and no longer carried in subsequent RERs.

An issue that is "carried forward" is only discussed in the respective chapter of the text if FY 2007 monitoring data clarifies, modifies, or otherwise impacts the issue in any way. For example, because many of the issues currently included in Table 1.1 require completion of future actions within the watershed, those particular issues will remain in the table for tracking purposes, but generally will not be discussed in any detail in the respective chapter.

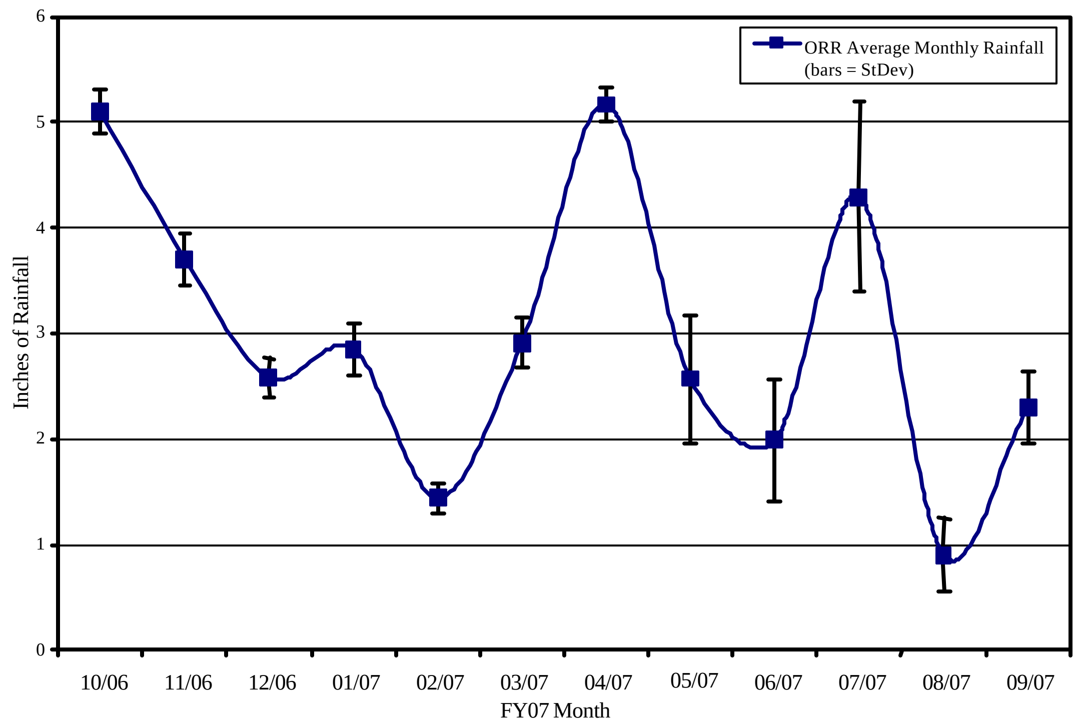

Fig. 1.2. FY 2007 monthly average rainfall from six rain gauges on the ORR.

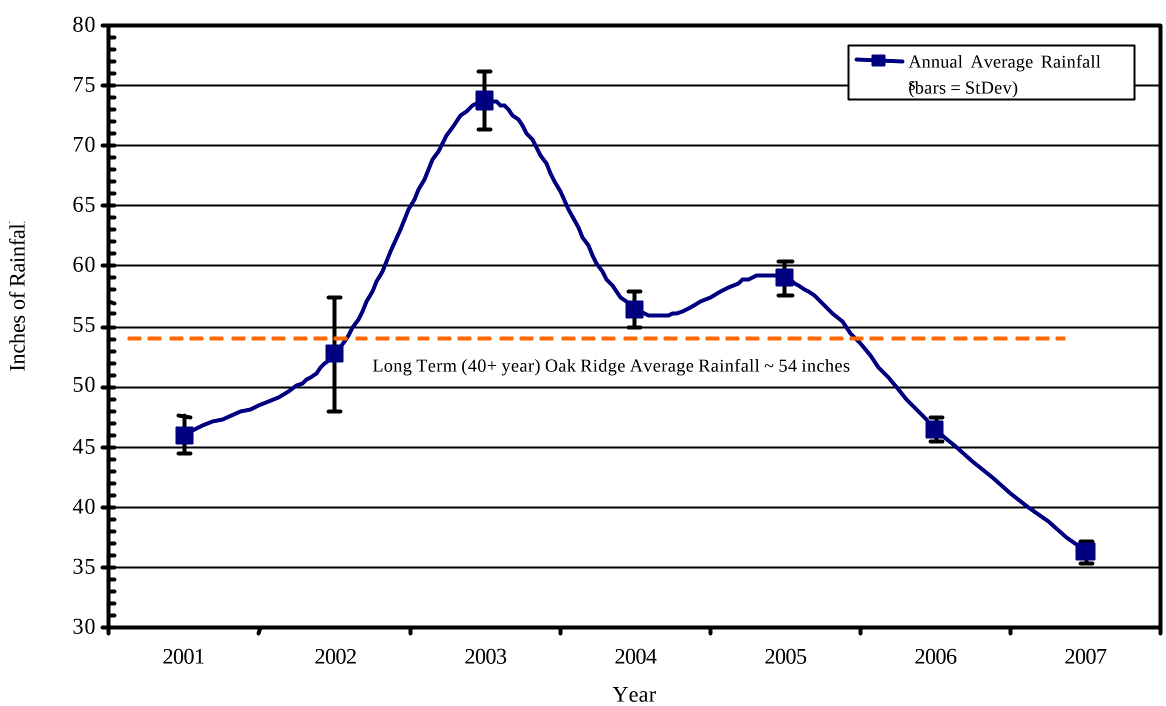

Fig. 1.3. Mean annual rainfall from six rain gauges on the ORR, 2001-2007.

Table 1.1. 2008 summary of technical issues, recommendations, and follow-up actions

ISSUE [(1)]	ACTION/ RECOMMENDATION	RESPONSIBLE PARTY(IES) Primary/Support	TARGET RESPONSE DATE
MELTON VALLEY			
<u>2008 ISSUES:</u> 1. The groundwater level fluctuation metric for hydrologic isolation effectiveness evaluation is applicable only in cases where wells do not extend into bedrock beneath buried waste units.	1. In several instances in which wells completed in bedrock were selected for hydrologic isolation effectiveness evaluation, the actual fluctuation range remains greater than the stated ROD fluctuation metric although the groundwater level is far below the buried waste. The intent of the fluctuation range metric was to limit interaction of a fluctuating groundwater with buried waste which would cause continuing waste leaching. In cases where the groundwater level remains below the waste unit, the fluctuation range metric should be disregarded. In cases where groundwater level fluctuations rise to levels equivalent to the base of waste in nearby trenches, the metric should be interpreted as 75% reduction of water level fluctuation in the buried waste elevation zone compared to pre-remediation fluctuations.	DOE/ EPA & TDEC	To be addressed by the ORNL Core Team in FY 2008. As appropriate, a letter in accordance with FFA App. I-12 to document resolution will be completed
2. Monitoring results for some zones in the Melton Valley exit pathway wells yield elevated alpha and beta activity results that are apparently the result of elevated suspended and/or dissolved solids. These results raise concern over possible migration of contamination across the DOE property boundary in western Melton Valley.	2. Issues related to Melton Valley exit pathway groundwater monitoring will be addressed in the ORNL CERCLA Core Team. The issues will be compiled and a path forward concerning modification or enhancement of this monitoring will be prepared.	DOE/ EPA & TDEC	To be addressed by the ORNL Core Team in FY 2008 and a path forward documented.
BETHEL VALLEY			
<u>ISSUE CARRIED FORWARD:</u> 1. The ^{90}Sr contamination from non-point sources has become the dominant contributor to ^{90}Sr flux at the 7500 Bridge location. SWSA 3 may also be contributing to increased flux seen at Raccoon Creek.	1. Increased ^{90}Sr flux was not observed in FY 2007 because of extreme drought conditions. Ungauged ^{90}Sr flux comprised ~32% of the total flux measured at 7500 Bridge during FY 2007. Potential source areas were identified during focused investigations conducted during winter 2006 as summarized in the 2007 RER. When completed, remedial actions required by the BV ROD are expected to reduce strontium releases into the Bethel Valley Watershed. These measures will include contaminated soil removal, hydrologic isolation of SWSA 3, and other actions associated with potential sources of surface water contamination. A continuation of the increasing ^{90}Sr trend will be addressed in	DOE/ EPA & TDEC	BV ROD, refer to the FFA App. E and J for planned implementation schedules.

Table 1.1. FY 2008 summary of technical issues, recommendations, and follow-up actions (continued)

ISSUE (1)	ACTION/ RECOMMENDATION	RESPONSIBLE PARTY(IES) Primary/Support	TARGET RESPONSE DATE
	the context of the BV remedial actions.		
UPPER EAST FORK POPLAR CREEK			
ISSUES CARRIED FORWARD: 1. Mercury concentrations in fish within the EFPC system remain elevated, despite decreasing concentrations in aqueous mercury levels.	1. A team consisting of DOE EM, NNSA, and Office of Science is being brought together to develop a conceptual model(s) for mercury fate and transport relevant to methyl mercury concentrations in the EFPC ecosystem. The effort will be coordinated with the UEFPC Core Team.	DOE/ EPA & TDEC	Summary of results in 2009 RER.
2. FY 2005 pre-action Hg concentrations at Station 17 are above the 200-ppt performance goal. Hg concentrations in fish in UEFPC have yet to respond to commensurate reductions of Hg from historical RMPE actions. Biota monitoring in UEFPC shows impaired diversity and density of pollution-intolerant species.	2. Remedial measures required by the UEFPC Phase I ROD are expected to reduce Hg concentrations at Station 17, as well as in fish in UEFPC (see Action/Recommendation #1 above). These measures include Hg source removal and surface water treatment. The Big Spring Water Treatment System was fully operational during FY 2007 and a corresponding 50% decrease in Hg flux was observed at Station 17. Also, FY 2007 Hg levels in LEFPC fish remain above federal ambient water quality criteria, but are less than peak levels observed in 2001-2002. Below-average rainfall likely contributed somewhat to the decrease. It is anticipated that implementation of the Hg-source removal actions will result in a similar decrease in flux at the IP.	DOE/ EPA & TDEC	UEFPC Phase I ROD, refer to the FFA App. E and J for planned implementation schedules.
CHESTNUT RIDGE			
2008 RER ISSUE: 1. Elevated gross beta activity observed in downgradient well GW-205 at the UNC site on Chestnut Ridge suggests a potential contaminant release from the site.	1. The issue was discussed by the UEFPC Core Team in FY 2007. The UEFPC Core Team agreed to continue monitoring in existing wells and add a downgradient spring to the monitoring network to better understand shallow groundwater flow dynamics at the site. Spring (UNC SW-1) was added to the WRRP FY 2008 SAP.	DOE/ EPA & TDEC	Results to be included in the 2009 RER.
BEAR CREEK VALLEY			
2008 RER ISSUE: 1. In addition to surface water monitoring at the BYBY, the PCCR (DOE 2003e) specifies 5 years of monitoring benthic macroinvertebrate and fish communities in NT-3, and stream channel stability and riparian	1. DOE will complete the post construction monitoring at BYBY in FY 2008 to confirm riparian stream and vegetation was successfully established and is now stable.	DOE/ EPA & TDEC	Results reported in the 2009 RER.

Table 1.1. FY 2008 summary of technical issues, recommendations, and follow-up actions (continued)

ISSUE [1]	ACTION/ RECOMMENDATION	RESPONSIBLE PARTY(IES) Primary/Support	TARGET RESPONSE DATE
vegetation monitoring of the restored NT-3 channel.			
ISSUES CARRIED FORWARD:			
2. Ungauged total-uranium flux at the watershed IP (BCK 9.2) represents more than half of the uranium measured during FY 2006 in Bear Creek Valley (see Issue/Recommendation #4 below).	2. DOE is monitoring potential sources of uranium, e.g., NT-8, to determine and quantify the total uranium contributing to the uranium flux measured at the IP BCK 9.2.	DOE/ EPA & TDEC	Results reported in FY 2009 RER; Bear Creek Valley Groundwater ROD, refer to FFA App. E and J for planned implementation schedule.
3. Results for BCK 9.2 show an increase in the proportion of ungauged uranium flux beginning in FY 2002. Increasing uranium trends are not observed at gauged monitoring stations, or in principal groundwater exit points contributing to Bear Creek surface flow.	3. Evaluation of FY 2007 data indicates a significant decrease in uranium flux results at BCK 9.2. As remaining actions of the BCV Phase 1 ROD are completed, as well as any actions required by additional CERCLA decisions in BCV, corresponding decreases in uranium flux are anticipated.	DOE/ EPA & TDEC	BCV Phase I & 2 RODs, BCV Groundwater ROD; refer to FFA App. E and J for planned implementation schedule.
4. Multiple large scale construction activities have occurred in the eastern portion of the watershed (e.g., EMWMF and the capping at BYBY). This has resulted in large-scale clearing of mature woodland-forested areas, extensive cut-and-fill construction, complete diversion of NT-4, and regrading most the NT-3 drainage basin. This may have altered runoff and infiltration patterns and evapotranspiration rates. Additionally, uranium flux attributable to NT-7 and NT-8 has not been quantified since the RI.	4. Evaluate water and contaminant mass balance for Bear Creek Valley upstream of the IP to evaluate the effect of substantial construction and physical changes that have occurred since the RI, and to help determine causes for the observed ungauged flux at the IP.	DOE/ EPA & TDEC	Final BCV ROD (Groundwater), refer to FFA App. E and J for planned implementation schedule.

Table 1.1. FY 2008 summary of technical issues, recommendations, and follow-up actions (continued)

ISSUE (1)	ACTION/ RECOMMENDATION	RESPONSIBLE PARTY(IES) Primary/Support	TARGET RESPONSE DATE
CLOSED OUT ISSUES			
MELTON VALLEY: 1. During FY 2003 through 2005 there was a flux imbalance noted with respect to ^{90}Sr, ^{3}H, and ^{137}Cs between contaminant inflows at the 7500 Bridge and those measured at the White Oak Creek Weir.	1. The mass imbalance noted previously for ^{90}Sr and ^{3}H was not observed during FY 2006 or FY 2007. The mass balance of ^{137}Cs in the WOC surface water system has always been difficult to reconcile because this contaminant is transported with sediment as a result of the strong adsorption of cesium to soil particles. Consistent with the recommendation from previous years' RERs, to increase the accuracy of flow measurements used in flux calculation, field work was completed during FY 2007 to remove excess sediment from four weirs in MV: White Oak Creek weir, 7500 Bridge weir, Melton Branch weir, and MB2 weir. The ORNL CERCLA Core Team discussed the weir cleanout and EPA/TDEC approved the RDR/RAWP Addendum (DOE 2006b), which identified the waste cleanout activities. Data collected after the weir cleanout was discussed by the Core Team and will be reported in subsequent RERs.	DOE/ EPA & TDEC	Results reported in future RERs.
EAST TENNESSEE TECHNOLOGY PARK: 1. PCB concentrations in fish within the K-1007-P1 and K-901-A holding ponds remain above acceptable risk levels.	1. The identified PCB risks are addressed through an AM, approved March 2007, requiring a non-TC RmA that targets the sediment and fish contamination in the K-1007-P1 Holding Pond by restoring the pond to natural conditions less conducive to PCB uptake in fish. Monitoring and institutional controls will be implemented at the K-1007-P1 Holding Pond, as well as the K-901-A Holding Pond, and K-720 Slough.	DOE/ EPA & TDEC	ETTP Ponds AM approved March 2007. Refer to the FFA App. E and J for planned implementation schedules.
UPPER EAST FORK POPLAR CREEK: 1. The FY 2006 RER/CERCLA FYR demonstrated that the EEVOC Plume removal action is achieving its performance goal of reducing VOC concentrations within the off-site exit pathway along the eastern boundary of the ORR.	1. Based on 5 years of analytical data, a number of changes to performance monitoring for the EEVOC Plume Removal Action were recommended in the FY 2006 RER/CERCLA FYR and approved with the acceptance of the RmAR in June 2006. The changes that were implemented in FY 2007 include: (a) semiannual monitoring of GW-169, GW-170, and Westbay well GW-722 for VOCs only, and (b) discontinue monitoring of GW-232.	DOE/ EPA & TDEC	Action completed. RmAR approved June 2006. FY 2007 results included in the FY 2008 RER.

Table 1.1. FY 2008 summary of technical issues, recommendations, and follow-up actions (continued)

ISSUE [1]	ACTION/ RECOMMENDATION	RESPONSIBLE PARTY(IES) Primary/Support	TARGET RESPONSE DATE
2. Pre-action data do not definitively indicate whether there is a net gain or loss of Hg mass between source areas in the western portion of Y-12 and Station 200A6. Substantial fluctuations in Hg mass balance (flux) have been observed the past 3 years.	2. At the beginning of FY 2007, DOE implemented a revised monitoring approach for measuring the Hg mass discharged from the West End Mercury Area (WEMA), as approved by both EPA (9/29/06) and TDEC (10/04/06). This monitoring is required by the UEFPC Phase I Interim Source Control Actions ROD (DOE 2007f). The modified monitoring approach includes (a) upgrading sampling equipment at Station 200A6 for continuous Hg flux measurement on 7-day (full week) composites to provide baseline Hg flux data for the WEMA actions, (b) changing monitoring at Station 8 to weekly grab samples to evaluate ungauged Hg influx to UEFPC, and (c) discontinuing monitoring at outfalls 150, 160, 163, and 169 until 1 year prior to implementation of the WEMA actions. This change has been incorporated into the WRRP Sampling and Analysis Plan (SAP).	DOE/ EPA & TDEC	Action completed. Letter per FFA Appendix I-12, October 2006.
<u>BEAR CREEK VALLEY:</u> 1. Although the data confirm that the treatment technology is effective in removing uranium from groundwater, the Pathway 1 & 2 treatment systems (i.e., the S-3 Site Tributary Interception removal action) have not removed a sufficient uranium mass from groundwater to benefit water quality in Bear Creek commensurate with the associated operations and maintenance costs.	1. DOE recommended discontinuation of the Pathways 1 and 2 groundwater collection systems and all monitoring associated with the early action. An addendum to the RmAR for the S-3 was approved by EPA and TDEC in June 2007 that authorized the treatment system to remain in shutdown mode. The ultimate disposition of the Pathways 1 and 2 systems will be included in future design consideration for Pathway 3 or in the final groundwater decision for BCV. (Note: Weekly flow-paced composite samples at BCK 12.34 will continue to be analyzed for nitrate and uranium isotopes. In the year prior to the CERCLA FYR, quarterly grab samples will be analyzed for metals, including mercury and total uranium).	DOE/ EPA & TDEC	RmAR addendum approved per FFA App. I-12, June 2007.
2. Performance monitoring for the BYBY action has shown that annual uranium flux has remained below the goal of 4.3 kg/year every since FY 2003.	2. DOE requested concurrence (December 2006) from EPA and TDEC to make the following changes to monitoring in BCV: (a) discontinue flow-paced composite sampling at NT-3 and replace with monthly grab samples for isotopic uranium, (b) discontinue monitoring at BCK 11.84, upstream of the confluence of BC with NT-3, (c) upgrade BCK 11.54 for more accurate flow measurements to use as the upstream IP for the Bear Creek Burial Grounds, and (d) reduce the frequency of AWQC monitoring at NT-3 to every 5 years corresponding to the FYR.	DOE/ EPA & TDEC	Letter per FFA App. I-12, December 2006. EPA approval received 3/14/07; TDEC concurrence received 4/4/07.

Table 1.1. FY 2008 summary of technical issues, recommendations, and follow-up actions (continued)

[1] Issues resulting from evaluations of FY 2007 data are identified in the table as 2008 RER ISSUES. Issues are also identified in the table as either "ISSUE(S) CARRIED FORWARD" to indicate that the issue is carried over from the previous year's RER to track the issue through resolution, or as "CLOSED OUT ISSUES" to indicate that issue has been resolved and will not be tracked in subsequent RERs.

AWQC = ambient water quality criteria
BCV = Bear Creek Valley
BCK = Bear Creek kilometer
BV = Bethel Valley
BYBY = Boneyard/Burnyard
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DOE = U.S. Department of Energy
EEVOC = East End Volatile Organic Compound
EMWMF = Environmental Management Waste Management Facility
EPA = Environmental Protection Agency
FFA = Federal Facilities Agreement
FY = fiscal year
FYR = Five-Year Review
GW = groundwater
IP = integration point
MV = Melton Valley
NT = North Tributary
ORR = Oak Ridge Reservation
ppt = part per trillion
RAWP = Remedial Action Work Plan
RDR = Remedial Design Report
RER = Remediation Effectiveness Report
RI = remedial investigation
RmAR = Removal Action Report
RMPE = Reduction of Mercury in Plant Effluents
ROD = Record of Decision
SAP = Sampling and Analysis Plan
SIOU = Surface Impoundments Operable Unit
SNS = Spallation Neutron Source
SWSA = Solid Waste Storage Area
TDEC = Tennessee Department of Environment and Conservation
UEFPC = Upper East Fork Poplar Creek
VOC = volatile organic compound
WEMA = West End Mercury Area
WOC = White Oak Creek
WRRP = Water Resources Restoration Program

2. CERCLA ACTIONS IN BETHEL VALLEY WATERSHED

2.1 INTRODUCTION AND OVERVIEW

The BV Watershed contains most of the Oak Ridge National Laboratory (ORNL) active facilities and a considerable fraction of the CERCLA facilities and contaminated sites at ORNL. Figure 2.1 shows the location of key CERCLA sites and actions in the watershed. Single actions (i.e., major actions completed as stand-alone projects) in BV include remediation of dozens of low level liquid waste (LLLW) tanks including steel and gunite tanks, remediation of the 4 former process wastewater ponds that constituted the Surface Impoundments Operable Unit (SIOU), installation and operation of the Corehole 8 plume containment system, and partial completion of contaminated soil excavation in the North Tank Farm (NTF) related to the Corehole 8 plume source near Tank W-1A. In 2002 the *Record of Decision for Interim Actions at Bethel Valley, Oak Ridge, Tennessee* (DOE 2002a) was signed. This ROD specifies RAs for CERCLA facilities and establishes protectiveness and cleanup levels for the watershed. Remedial actions specified by the BV ROD have not yet been implemented.

This section provides an update to CERCLA activities completed in BV during FY 2007, and includes discussion of the watershed RAO and performance metrics, evaluation of performance of stand-alone CERCLA actions for which monitoring and performance metrics were stipulated in decision documents, and summarizes the watershed conditions with respect to the ROD goals. Table 2.1 summarizes the CERCLA actions completed in BV. Table 2.2 provides a summary of LTS requirements, and Fig. 2.2 shows anticipated land uses for BV.

For a complete discussion of background information and performance metrics for each remedy, a compendium is provided in Chapter 2 of Volume 1 of the FY 2007 RER (DOE 2007a). This information will be updated in the annual RER and republished every fifth year at the time of the CERCLA FYR.

2.1.1 Status and Updates

During FY 2007, University of Tennessee-Battelle (UT-B) implemented a project to reconfigure the piping and reroute mercury-contaminated sump water from Bldg. 4501 to a treatment system. The action is expected to be completed in early 2008 and will significantly reduce the mercury impacts to White Oak Creek (WOC), as well as fulfill a requirement of the BV ROD for Interim Actions (DOE 2002a). Although several locations in the ORNL main plant area are mercury contaminated, the principal source of mercury that impacts WOC is at Bldg. 4501 where a spill of approximately 20,000 lbs. occurred in the 1950s. Mercury is captured in the basement foundation dewatering sumps and some of the sump water is discharged to WOC.

No other CERCLA actions were completed in BV during FY 2007. Monitoring in support of performance assessments and evaluations of future RAs are ongoing.

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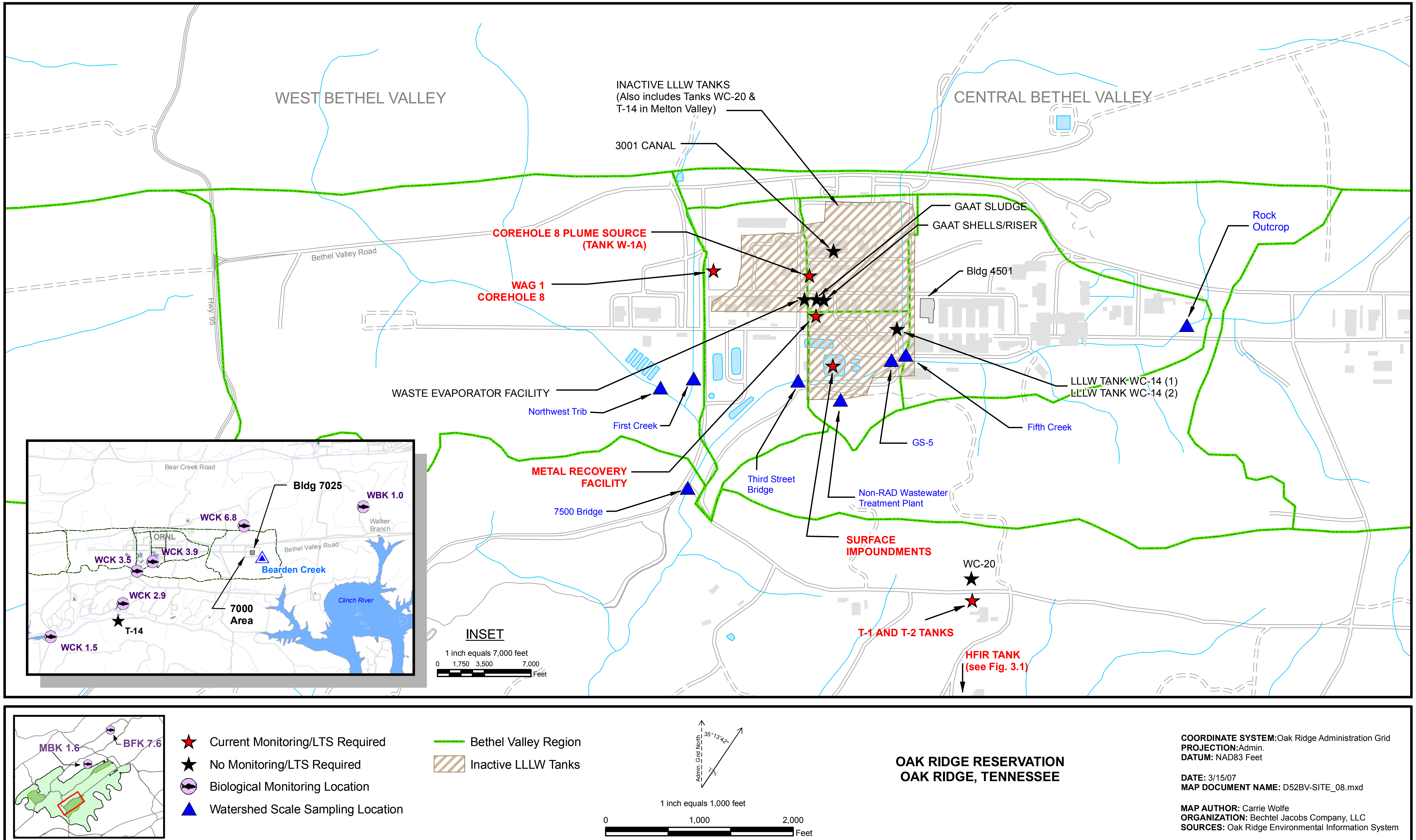

Fig. 2.1. Bethel Valley Watershed site map.

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Table 2.1. CERCLA actions in Bethel Valley

CERCLA action	Decision document, date signed	Action status [a]	Monitoring/ LTS required	RER section
Watershed-scale actions				
BV Interim Actions	ROD: 5/2/02	Actions ongoing;[b] PCCR for Tanks T-1, T-2, and HFIR (11/16/05)[c] LUCIP submitted, September, 2006	Yes/Yes No/Yes	2.2 2.2.3
Completed single-project actions				
WAG 1 Corehole 8 Removal Action (Plume Collection)	AM: 11/10/94 AM Addendum: 4/22/98 AM Addendum: 9/30/99	Actions completed; RmAR approved (8/2/95) Phase II Operations Report approved (6/9/00)	Yes/No	2.3.1
Bldg. 3001 Canal Removal Action	AM: 11/18/96	Action completed; RmAR approved (7/11/97)	No/No[d]	2.3.3
SIOU Remedial Action	ROD: 9/25/97	Action completed; RAR for Impoundments A and B approved (5/17/04) RAR for Impoundments C and D approved (4/18/99)	No/Yes	2.3.4
MRF Removal Action	AM: 3/3/00	Action completed; RmAR issued (9/25/03)	No/Yes	2.3.5
WAG 1 Tank WC-14 Time-Critical Removal Action (1) Liquid removal	AM: 2/16/95	Action completed; RmAR approved (8/2/95)	Discontinued/ No	--
WAG 1 Tank WC-14 Time-Critical Removal Action (2) Sludge removal	AM: 9/3/97	Action completed; RmAR approved (10/5/98)	No/No	--
Waste Evaporator Facility Removal Action	AM: 7/28/95	Action completed; RmAR approved (12/2/96)	No/No	--
GAAT OU Interim Removal Action	ROD: 9/2/97	Action completed; RAR approved (10/2/01)	No/No	--
Inactive LLLW Tanks Removal Action	AM: 5/14/99 AM Addendum: 9/30/99	Action completed; RmAR approved (10/2/01)	No/No	--
GAAT Stabilization Removal Action (Shells/Risers)	AM: 7/13/01	Action completed; RmAR approved (8/21/02)	No/No	--
Completed single-project action; pending additional action				
Corehole 8 Plume Source (Tank W-1A) Removal Action	AM: 9/18/98 Amended in 1999	Complete; RmAR issued August 2001	No/Yes	2.3.2

[a] Detailed information of the status of ongoing actions is from Appendix E of the FFA and is available at http://www.bechteljacobs.com/ettp-ffa-appendices.html
[b]During FY 2007 basement piping in Bldg. 4501 was modified to reduce mercury discharges to the environment and send a portion of mercury contaminated sump water to treatment. A completion report for this action is pending.
[c]The T-1 and T-2 Tanks are located on the BV Watershed map (Fig. 2.1) and HFIR Tank is located on the MV Watershed map (Fig. 3.1).
[d]The RmAR for the Bldg. 3001 Canal requires monthly inspections of the grout and paint for 1 year only; all subsequent inspections are conducted as a BMP and will not be reported after this RER.

Table 2.1. CERCLA actions in Bethel Valley (continued)

AM = Action Memorandum
BMP = best management practice
BV = Bethel Valley
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
FFA = Federal Facility Agreement
GAAT = Gunite and Associated Tanks
HFIR = High Flux Isotope Reactor
LLLW = liquid low-level (radioactive) waste
LTS = long-term stewardship
LUCIP = Land Use Control Implementation Plan
MRF = Metal Recovery Facility
OU = operable unit
PCCR = Phased Construction Completion Report
RAR = Remedial Action Report
RER = Remediation Effectiveness Report
RmAR =Removal Action Report
ROD = Record of Decision
SIOU = Surface Impoundments Operable Unit
WAG = Waste Area Grouping

Table 2.2. Long-term stewardship requirements for CERCLA actions in Bethel Valley Watershed

Site/Project	LTS Requirements		Status	RER Section
	Land Use Controls	Engineering Controls		
Watershed-scale actions				
ROD for Interim Actions in Bethel Valley[a] ▪ Tanks T1, T2, and HFIR Tanks PCCR[b]	Watershed LUCs Administrative: ▪ land use and groundwater deed restrictions ▪ property record notices ▪ zoning notices ▪ permits program Physical: ▪ access controls ▪ signs ▪ security patrols	PCCR specific ▪ Maintain above-ground areas ▪ Radiological surveys	LUCs in place ▪ Physical LUCs in place. ▪ Administrative LUCs required at completion of actions. PCCR Specific ▪ Engineering Controls remain protective.	2.2.3
Completed single project actions				
WAG 1 Corehole 8 Removal Action (Plume Collection)[c]	None specified		N/A	2.3.1.3
Bldg. 3001 Canal Removal Action		No longer a requirement after 1998.	N/A	2.3.3.1
SIOU Remedial Action	▪ Maintain existing EPP program		▪ LUCs in place.	2.3.4.1
MRF Removal Action	▪ Signs	▪ Maintain gravel cover	▪ LUCs in place. ▪ Engineering Controls remain protective.	2.3.5.1
Completed single project actions—pending additional action				
Corehole 8 Plume Source (Tank W-1A) Removal Action	▪ Signs	▪ Maintain backfill	▪ LUCs in place. ▪ Engineering Controls remain protective.	2.3.2.1

(a) Remaining actions have not been implemented.
(b) This action was completed under the BV ROD, however, implementation of it's LUCs is specified in the MV LUCIP and is documented in the MV RAR. The T-1 and T-2 Tanks are located on the BV Watershed map (Fig. 2.1) and HFIR Tank is located on the MV Watershed map (Fig. 3.1).
(c) Extraction system is maintained.

BV = Bethel Valley
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
EPP = excavation/penetration permit
N/A = not applicable
PCCR = Phased Construction Completion Report
RAR = Remedial Action Report
RER = Remediation Effectiveness Report

Table 2.2. Long-term stewardship requirements for CERCLA actions in Bethel Valley Watershed (continued)

HFIR = High Flux Isotope Reactor
LTS = long-term stewardship
LUCs = land use controls
LUCIP = Land Use Control Implementation Plan
MRF = Metal Recovery Facility
MV = Melton Valley
ROD = Record of Decision
SIOU = Surface Impoundments Operable Unit
WAG =Waste Area Grouping

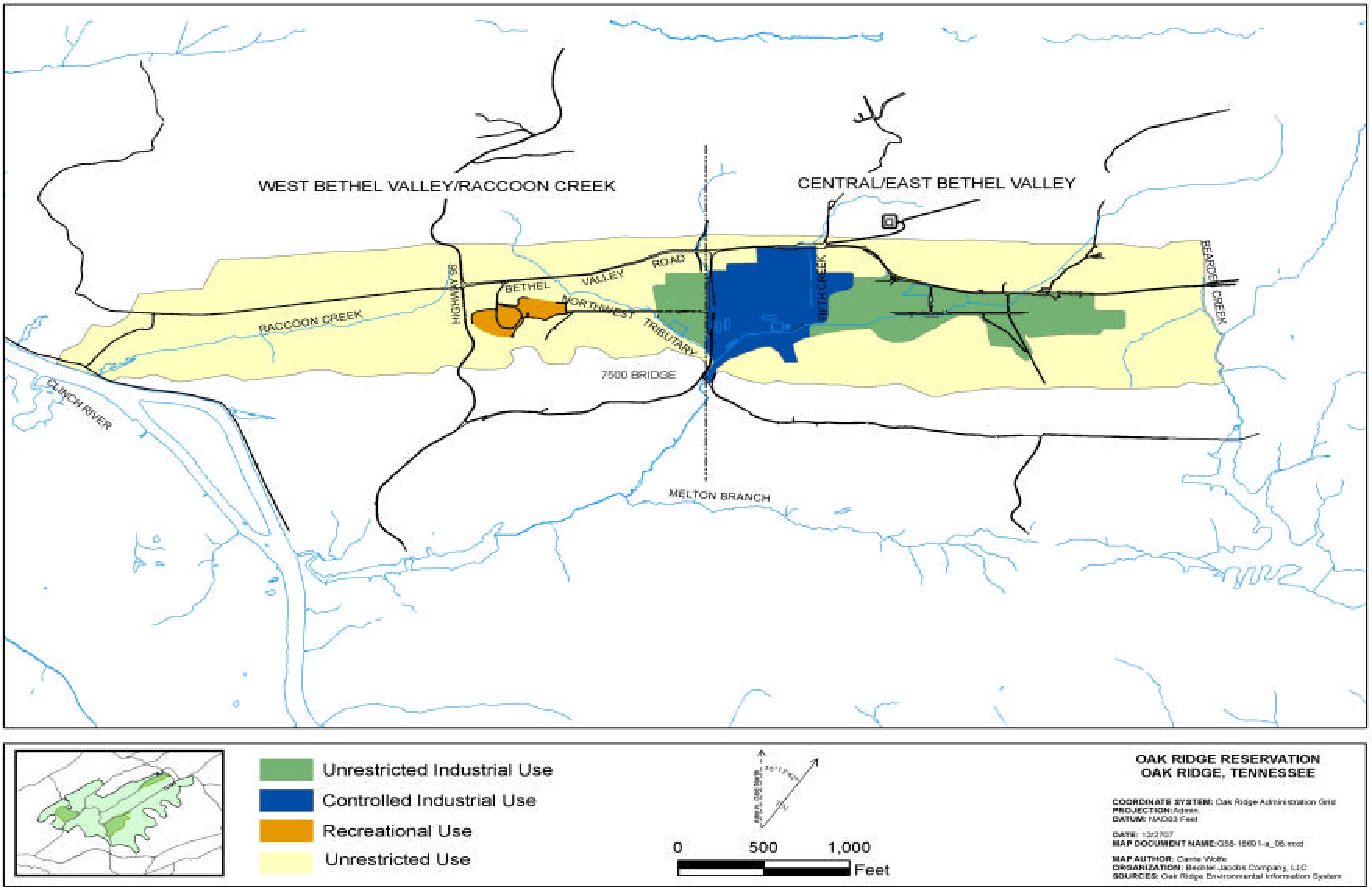

Fig. 2.2. Anticipated land uses for Bethel Valley.

2.2 RECORD OF DECISION FOR INTERIM ACTIONS FOR THE BETHEL VALLEY WATERSHED

The BV ROD (DOE 2002a) specifies RAs to be completed in BV to protect human health and the environment. The anticipated future activities and land use in BV center around continued operation of ORNL with its associated facilities. Much of the RA in BV is demolition of buildings and process equipment, as well as capping two low-level solid waste burial grounds, remediation of contaminated soil that contributes to groundwater contamination, grouting of inactive waste transfer pipelines, and remediation of a volatile organic compound (VOC) contaminated groundwater plume. Figure 2.1 shows the BV area, locations of completed CERCLA actions, and elements of the BV remedy.

2.2.1 Performance Goals and Monitoring Objectives

The BV ROD RAO, requirements to demonstrate effectiveness of RAs, and monitoring actions to measure remedy effectiveness are summarized in Table 2.3. RA objectives for surface water include attainment of a 45% risk reduction from baseline levels of 1994 at the 7500 Bridge, attainment of ambient water quality criteria (AWQC) for organisms, and attainment and maintenance of water quality and sediment contaminant levels of 1×10^{-4} for a hypothetical recreational use scenario. The RAO for groundwater is to prevent further degradation of water quality by remediation of soils that contribute to groundwater contamination above a 1×10^{-4} risk level for a hypothetical industrial use scenario, to protect surface water by continued collection and treatment of groundwater that causes surface water exceedances, and to reduce surface water risk from contaminated groundwater discharge. The ROD also includes the requirements to monitor groundwater exit pathway wells and to monitor groundwater in the vicinity of contaminant source control areas to measure effectiveness of contaminant source control actions.

Until major remedial actions are completed in Bethel Valley little change in contaminant release concentrations are expected.

Remedial actions in BV specified by the ROD have not yet been initiated. Therefore, remediation effectiveness monitoring identified in Table 2.3 has not been initiated. An investigation of subsurface soil and groundwater contamination was conducted in FY 2004–2005 [the *BV Groundwater Engineering Study* (DOE 2005a)] that provided information concerning soil RA to protect groundwater consistent with the RAO and to further delineate groundwater contamination in portions of BV. The groundwater engineering study included installation of a multi-zone well located in western BV to sample groundwater between the Solid Waste Storage Area (SWSA) 3 area and the headwaters of Raccoon Creek. Until major RAs are completed in BV little change in surface water or groundwater contaminant conditions is expected to occur. Surface water, groundwater, and biological monitoring in BV continue to be conducted to document conditions and trends relevant to the BV RAOs.

2.2.2 Evaluation of Performance Monitoring Data

No RAs requiring monitoring specified by the ROD have yet been completed in BV. General water quality monitoring information for BV is presented in Sect. 2.4 Watershed Conditions and Trends.

Table 2.3. Bethel Valley ROD Remedial Action Objectives, effectiveness measures, and monitoring actions

RAO	Requirement to Demonstrate Effectiveness[a]	Monitoring Action
RAOs for selected remedy for BV (ROD, Table 1.1, P. 1-6 and Table 2.24, P. 2-92) • Future Land Use – Protect human health to risk level of 1 X 10^{-4}: - ORNL main plant area: controlled industrial use - Remainder of ORNL developed areas: unrestricted industrial - Selected Burial Grounds: recreational use - Undeveloped areas: unrestricted use • Protection of surface water: - AWQC for designated stream uses in all waters of the state - Achieve 45% risk reduction from 1994 levels at 7500 Bridge (based on combined risk from ^{90}Sr and ^{137}Cs, as per P. 2-162 of ROD) - Maintain surface water and achieve sediment recreational risk-based limits to goal of 1 X 10^{-4} • Groundwater protection: - Minimize further impacts to groundwater - Prevent groundwater from causing surface water exceedances in all waters of the state • Protection of ecological receptors: - Maintain protection for area populations of terrestrial organisms - Protect reach-level populations of aquatic organisms	Table 2.30, P. 2-127 of the ROD defines a large variety of principal actions for the selected remedy in Bethel Valley. Table 2.37, P. 2-158 of the ROD provides performance objectives and measures for each action: • Buried Waste – install cap and/or maintain soil cover; upgradient diversion ditch at SWSA 3 • Inactive LLLW pipelines – stabilize or remove; some trench barriers • Contaminated soil impacting worker protection - Main Plant – remove up to 2 ft; cover as determined acceptable - Outside Main Plant – remove up to 10 ft - SWSA 3 vicinity – remove soil to meet remediation levels • Contaminated soil inside Main Plant area impacting groundwater – remove soil contributing to levels above 10^{-4} industrial risk from groundwater • Sediments – remove to depth of deposition to achieve: - AWQC for Hg in surface water - achieve 45% risk reduction at 7500 Bridge - achieve recreational risk-based limits in sediment - protect benthic invertebrates in sediment • Floodplain soils – remove to maximum depth of 2 ft; backfill to protect industrial worker and minimize migration of contaminants downstream • Groundwater extraction – to minimize further impacts to groundwater, to prevent surface water exceedances and achieve 45% risk reduction at 7500 Bridge; to protect benthic invertebrate populations: - Corehole 8 Plume[b] – extract groundwater from 4 wells and sumps at 7 stormwater junction boxes - ^{90}Sr-contaminated sumps – pump from 27 existing sumps - Hg-contaminated sumps – pump from 4 existing sumps (pretreatment for Hg if necessary) - VOC Plume – enhanced in situ anaerobic bioremediation - Well P&A – grout ~229 obsolete or poor-quality wells and abandon in place.	"Details of surface water monitoring will be developed and approved during the remedial design process. Results of monitoring will be included in the annual RER for the ORR." (ROD, P. 2-142) "…the details of groundwater monitoring will be developed and approved during the remedial design process. Results of monitoring will be included in the annual RER." (ROD, P. 2-144) ROD, Sect. 2.12.3 Maintenance Activities and Environmental Monitoring (P. 2-142) • SW Monitoring will be used to verify compliance with AWQC and to verify reduction of off-site contaminant releases to acceptable levels (ROD Fig. 2.36 shows locations): - System of flow volume and contaminant measurement stations…on the main stem of WOC (e.g., 7500 Bridge), NWT, First Creek, and Raccoon Creek will be maintained and operated to measure concentrations and release fluxes of contaminants from BV source areas - Additional established SW sampling sites are located on WOC and its tributaries in BV and these sites may be sampled as remedial actions are completed to document contaminant releases from tributary areas. - Continuous measurement of flow volume with flow-proportional sampling for contaminant measurement will occur at the 4 main stations in BV (7500 Bridge Weir, First Creek Weir, NWT Weir, and Raccoon Creek Weir) and other stations as needed. • Groundwater Monitoring objectives in BV include two aspects of site surveillance: - Exit Pathway groundwater monitoring in West BV/Raccoon Creek to determine if contaminants are leaving known contaminated areas - Source control area groundwater will be monitored to measure effectiveness of contaminant source control actions • Sediment Sampling in WOC, First Creek, Fifth Creek; frequency determined in post-ROD monitoring plan • Biological Monitoring – fish and benthic

Table 2.3. Bethel Valley ROD Remedial Action Objectives, effectiveness measures, and monitoring actions (continued)

RAO	Requirement to Demonstrate Effectiveness[a]	Monitoring Action
		macroinvertibrate surveys will be conducted in WOC, First Creek, and Fifth Creek; frequency determined in post-ROD monitoring plan.

[a] Actions that have direct effect on contaminated soil, sediment, or groundwater and have environmental performance measures only are identified in Volume I.
[b] The Bethel Valley Groundwater Engineering Study identified three options for managing the Core Hole 8 Plume to be evaluated during a final remedial design phase.

AWQC = ambient water quality criteria
BV = Bethel Valley
Cs= cesium
D&D = decontamination & decommissioning
Hg = mercury
LLLW= low level liquid waste
NWT = North West Tributary
ORNL = Oak Ridge National Laboratory
ORR = Oak Ridge Reservation
P&A = plugging and abandonment
RAO = remedial action objective
RER = Remediation Effectiveness Report
ROD = Record of Decision
S&M = surveillance and maintenance
Sr = strontium
SWSA = Solid Waste Storage Unit
SW = solid waste
VOC = volatile organic contaminants
WOC = White Oak Creek

2.2.3 Compliance with LTS Requirements

2.2.3.1 Requirements

The ROD requires implementation of land use controls (LUCs) to protect against unacceptable exposures to contamination during the RAs as well as after completion of all RAs in BV. During RAs, interim LUCs are being imposed and will remain until permanent LUCs are established in future remedial decisions for this area. Because the final groundwater decision is being deferred, groundwater use restrictions in contaminated areas will be required regardless of land use. Other objectives of the LUCs are as follows:

- Controlled industrial area: Restrict excavations or penetrations deeper than 0.6 m (2 ft) and prevent uses of the land more intrusive than industrial use above 0.6 m (2 ft).

- Unrestricted industrial area: No restrictions on excavations or penetrations shallower than 3 m (10 ft) and prevent uses of the land more intrusive than industrial use deeper than 3 m (10 ft).

- Recreational area (as applied to the SWSA 3 burial ground and the Contractor's Landfill): Restrict recreational activity to passive surface use of disposal areas; prevent unauthorized contact, removal, or excavation of waste material; prevent unauthorized destruction or modification of engineered controls; and preclude use of the areas for additional future waste disposals or alternate uses inconsistent with the management of currently disposed waste.

Additionally, the Tanks T-1, T-2, and the High Flux Isotope Reactor (HFIR) Tank PCCR (DOE 2005b) states that the above-ground areas of these sites are subject to routine maintenance and radiological surveys. Although remediated under the BV ROD, these three tanks are located in the MV Watershed. The location of the T-1 and T-2 Tanks is shown on the BV Watershed map (Fig. 2.1) and HFIR Tank is located on the MV Watershed map (Fig. 3.1). The results of the remediation of these tanks are documented in the MV RAR.

There are no additional project-specific LUCs identified for closure at this time.

2.2.3.2 Status of Requirements for FY 2007

Interim LUCs were maintained for the specified land use areas. Signs were maintained to control access, and surveillance patrols conducted as part of routine S&M inspections were effective in preventing access by unauthorized personnel. The excavation/penetration permit (EPP) program functioned according to established procedures and plans for the site.

The Tanks T-1, T-2, and HFIR Tank were inspected by the MV S&M Program in FY 2007. Monthly and weekly site walk downs ensured that the above-ground areas remained protective and signs are in place. The sites also underwent routine radiological surveys. Routine maintenance was performed including repairing areas of erosion and fixing a sink hole in the area around the tanks. These sites are covered under the existing DOE and contractor EPP program which remains in effect to provide protection to workers in the areas surrounding the tanks.

2.3 COMPLETED SINGLE ACTIONS IN BETHEL VALLEY WITH MONITORING AND/OR LTS REQUIREMENTS

2.3.1 WAG 1 Corehole 8 Removal Action (Plume Collections)

In 1991, CERCLA characterization efforts identified a plume of ^{90}Sr-contaminated groundwater, referred to since that time as the Corehole 8 Plume (Fig. 2.3). A removal site evaluation performed in 1994 concluded that contaminated groundwater seeping into the ORNL storm drain system was being discharged into First Creek at storm drain Outfall 342. First Creek is a tributary to WOC and ultimately to the Clinch River. Further investigation showed that contaminated groundwater entered the storm water collection system by in-leakage to three catch basins in the western part of ORNL.

The AM for the project was approved in November 1994 (DOE 1994a). Installation of a groundwater collection and transmission system began in December. Water collected in the two porous sumps is pumped into the Corehole 8 sump and then on to a process waste system manhole in the NTF. Startup of the system occurred on March 31, 1995. Collected groundwater is piped to the ORNL Process Waste Treatment Complex (PWTC) for treatment and is discharged through an existing National Pollutant Discharge Elimination System (NPDES) outfall (X12).

In October 1997, monitoring of surface water in First Creek identified elevated levels of ^{90}Sr and ^{233}U, an isotope associated with the reactor waste placed in Tank W-1A in the NTF and now known to be the source of the Corehole 8 Plume. Additional sampling conducted in December 1997 identified two unlined storm drain manholes as the point of entry for the contamination. In March 1998, an additional groundwater interceptor trench was installed that connects to one of the Corehole 8 Plume collection sumps.

In September 1999, an addendum to the AM (DOE 1999a) authorized additional groundwater extraction and treatment actions expected to enhance the effectiveness of the original removal action. The additional actions involved pumping contaminated groundwater out of well 4411 and discharging it into the PWTC for further treatment. Well 4411 is located downgradient and down-dip from Tank W-1A and intersects a thin limestone bedrock layer determined to be the preferential flow pathway for the Corehole 8 Plume.

2.3.1.1 Performance Goals and Monitoring Objectives

The AM (DOE 1994a) estimated that the plume collection system would intercept between 20 and 50% of the Corehole 8 plume water prior to its entering First Creek. Evaluation of the ^{90}Sr flux measured at First Creek monitoring station is used as the performance metric for remedy effectiveness evaluation.

2.3.1.2 Evaluation of Performance Monitoring Data

Figure 2.4 shows the historical ^{90}Sr and $^{233/234}$U concentrations measured in groundwater at well 4411 and Corehole 8 Zone 2. Well 4411 is a plume extraction well that intersects the plume at a depth of approximately 90 ft below ground surface (bgs) in a location approximately 120 ft south of Tank W-1A, where leakage from a broken LLLW pipeline created the plume source. Samples from well 4411 are taken at the wellhead and represent contaminant concentrations in extracted groundwater that is

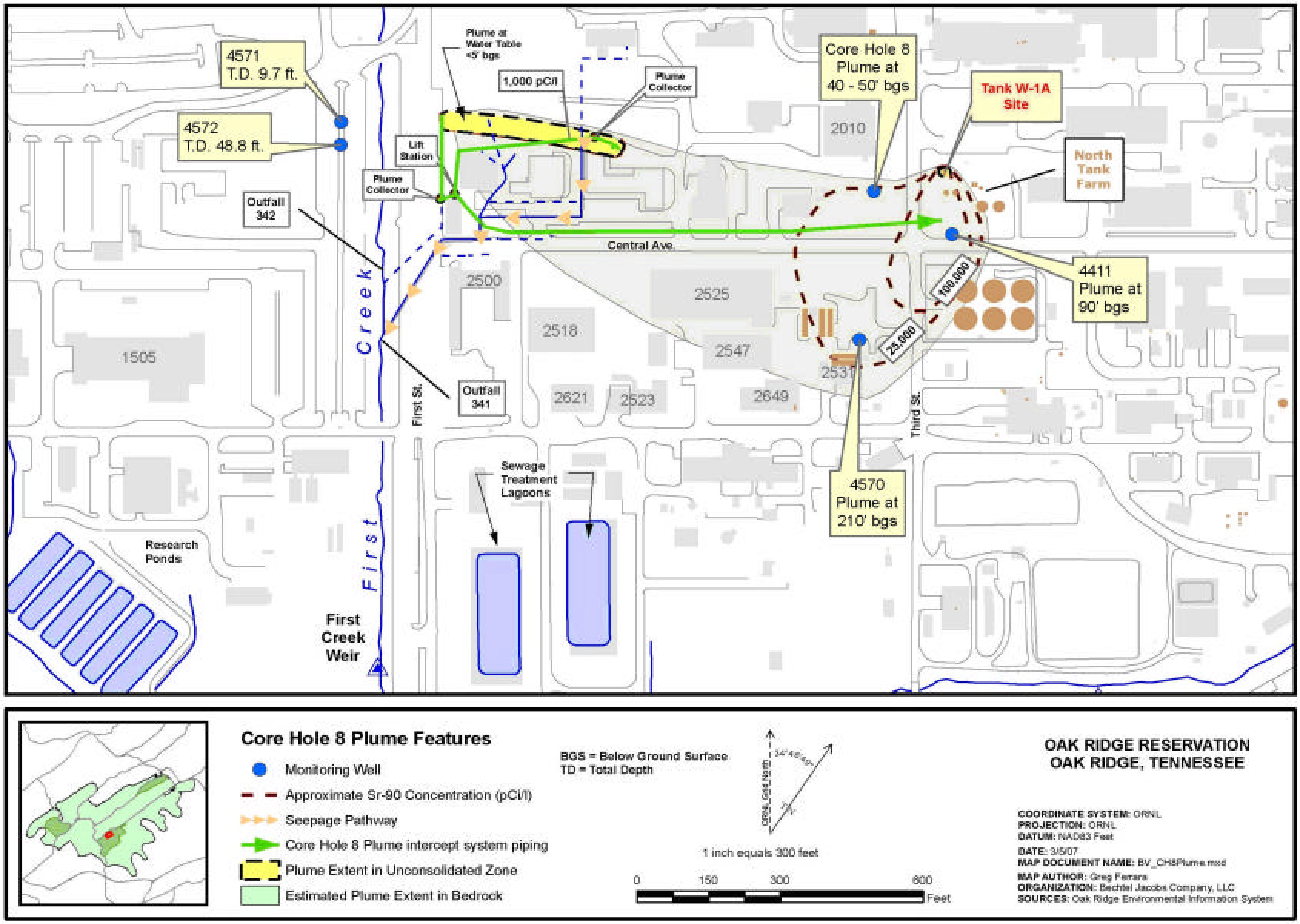

Fig. 2.3. Location and features of the Core Hole 8 Plume.

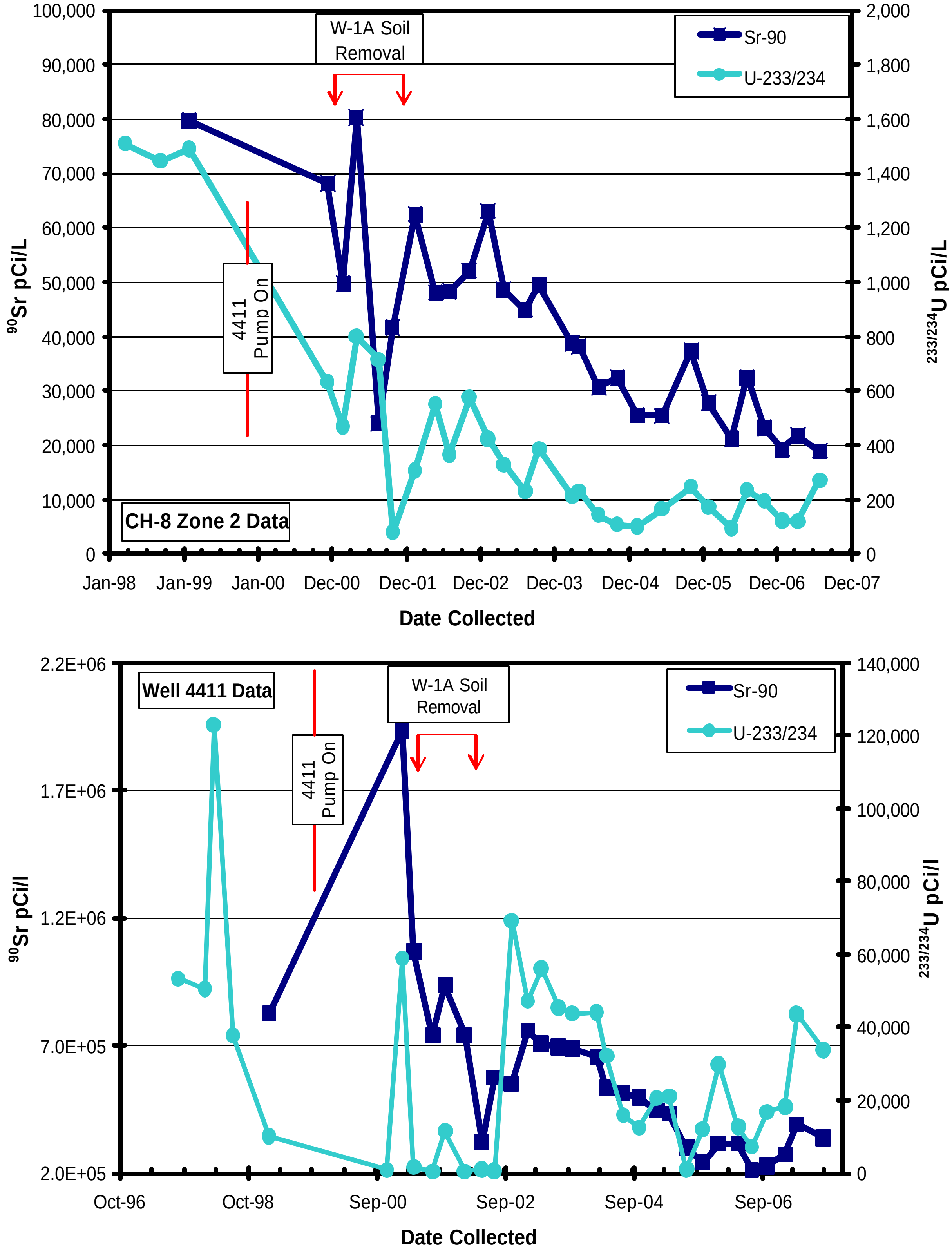

Fig. 2.4. Contaminant concentrations in well 4411 and Corehole 8 Zone 2.

being pumped to the PWTC for treatment. Corehole 8 is a 50 ft deep well in which a WestBay® multizone sampling system was installed to allow sampling of discrete intervals in the well. Zone 2 is the second zone from the bottom of the well and its sampling interval spans the depth of 41.2–43.2 ft bgs. During well installation and initial sampling this zone was found to produce the highest concentrations of contaminants in the well and for that reason it has become the focal point for ongoing monitoring at that location. Data presented in Fig. 2.4 show that during FY 2007 groundwater contaminant concentrations at both well 4411 and Corehole 8 varied somewhat. Strontium-90 showed continuing decreasing concentrations at well 4411 although a slight increase was observed in Corehole 8. Uranium 233/234 increased slightly in both wells in 2007. The slight increases in groundwater concentrations are attributed to the record low rainfall that occurred during FY 2007 which resulted in much below normal groundwater recharge which would normally cause some plume concentration dilution. However, at both wells the concentrations remained near the low levels of the decreasing trends that followed excavation of contaminated soils in the NTF.

Figure 2.5 shows the Corehole 8 groundwater collection sump ^{90}Sr and alpha activity concentration data from system startup in 1995 through FY 2007. Notations on the figure show approximate dates when extraction of contaminated groundwater via well 4411 started, as well as the approximate dates during which contaminated soil was excavated from the NTF. The data demonstrate that both actions had visible benefits in reducing contaminant concentrations in the plume collection system that is located in the western end of the plume. Concentrations of ^{90}Sr and $^{233/234}$U in the Corehole 8 collection system increased in the latter half of FY 2007 in response to the absence of groundwater recharge during the extreme drought. Table 2.4 includes Corehole 8 collection system monthly and annual total flow volumes collected and ^{90}Sr flux captured and sent to the PWTC for FY 1997 and FY 2007. Table 2.4 shows that the flux of ^{90}Sr that reaches the groundwater collection system has been reduced by a factor of 10 in the 10 years between 1997 and 2007 by the combined effects of NTF soil cleanup and plume extraction at well 4411. Figure 2.6 shows the annual flux of ^{90}Sr collected by the Corehole 8 groundwater collection system along with total annual rainfall measured at the ORNL site. The long term average annual rainfall for Oak Ridge is approximately 54 inches per year. As shown on Fig. 2.6, FY 2003–FY 2005 were years of above average rainfall. FY 2003 was an especially unusual year in that the annual rainfall was approximately 35% above the long term average. The impact of the 3 years of above average rainfall and the extreme rainfall of FY 2003 on strontium flux is apparent in Fig. 2.6.

Figure 2.7 shows ^{90}Sr and $^{233/234}$U concentrations measured at well 4570 since its installation as part of the BV Groundwater Engineering Study. Contaminant concentrations show a declining behavior during the monitoring period. Wells 4571 and 4572 are also monitored to evaluate the potential extension of the plume west of First Creek. Strontium-90 was not detected in wells 4571 (9.7 ft deep) and 4572 (48.8 ft deep) in either of two sampling events during FY 2007.

First Creek is the receiving surface water body for discharge of contaminated groundwater in the Corehole 8 plume. Continuous flow-paced monitoring of First Creek has been ongoing since before the Corehole 8 Plume removal action was conducted. Table 2.5 includes the FY 2007 monthly flow volumes, ^{90}Sr concentrations, and ^{90}Sr fluxes, as well as similar data from 1994 prior to the removal action. The flux of ^{90}Sr measured in First Creek in FY 2007 was approximately 8% of the flux measured during calendar year 1994 prior to startup of the Corehole 8 Groundwater collection system. Table 2.6 shows the history of ^{90}Sr fluxes in First Creek from FY 1993 through 2007.

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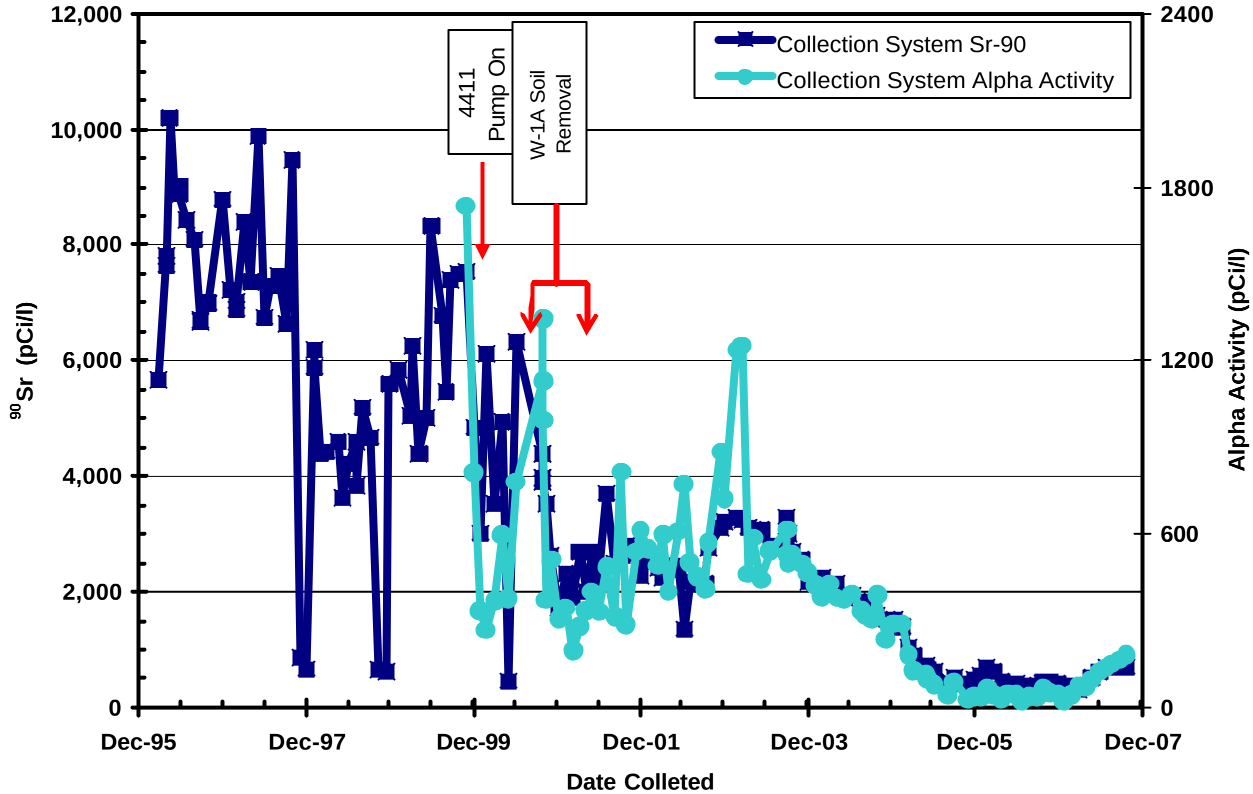

Fig. 2.5. ^{90}Sr and alpha activity concentration in collected Corehole 8 plume groundwater.

Table 2.4. Corehole 8 groundwater collection system ^{90}Sr flux

Month	FY 1997			Month	FY 2007		
	^{90}Sr (pCi/L)	Flow Volume (liters)	^{90}Sr Flux (Ci)		^{90}Sr (pCi/l)	Flow Volume (liters)	^{90}Sr Flux (Ci)
October 1996	8700	933,000	0.0081	October 2006	434	2,183,371	0.0009
November 1996	8800	1,845,000	0.0162	November 2006	423	3,391,027	0.0014
December 1996	7230	2,595,000	0.0188	December 2006	302	2,230,099	0.0007
January 1997	6890	1,711,000	0.0118	January 2007	370	3,094,272	0.0011
February 1997	8390	1,858,000	0.0156	February 2007	317	2,742,134	0.0009
March 1997	7350	2,162,000	0.0159	March 2007	387	4,852,440	0.0019
April 1997	9870	1,946,000	0.0192	April 2007	516	3,245,933	0.0017
May 1997	6750	1,697,000	0.0115	May 2007	609	3,030,610	0.0018
June 1997	7280	2,631,000	0.0192	June 2007	700	2,260,426	0.0016
July 1997	7463	1,705,000	0.0127	July 2007	702	2,250,878	0.0016
August 1997	6647	1,131,000	0.0075	August 2007	756	2,918,160	0.0022
September 1997	9465	953,000	0.009	September 2007	702	1,779,984	0.0012
Total		21,167,000	0.1655	Total		34,754,281	0.017

Ci = Curie
Sr = strontium
FY = fiscal year
pCi/L= picoCuries per liter

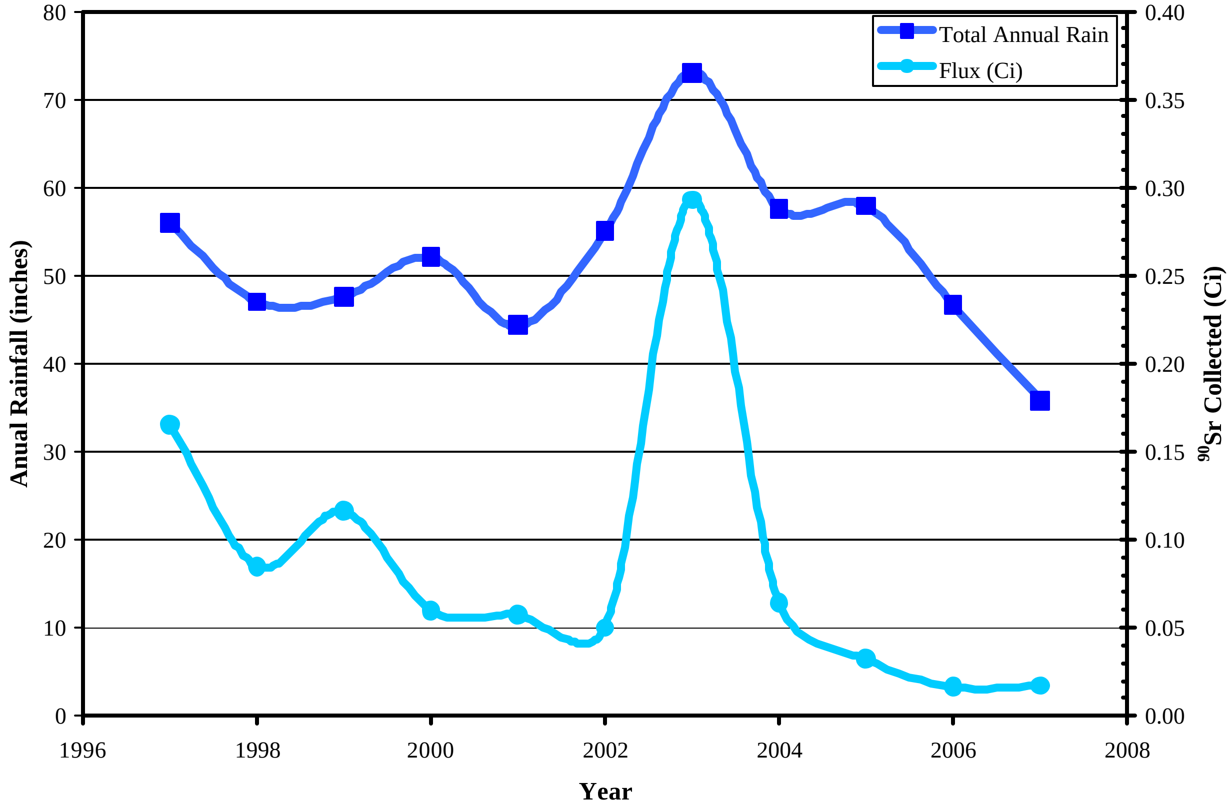

Fig. 2.6. Corehole 8 plume groundwater collector annual intercepted ^{90}Sr flux and rainfall.

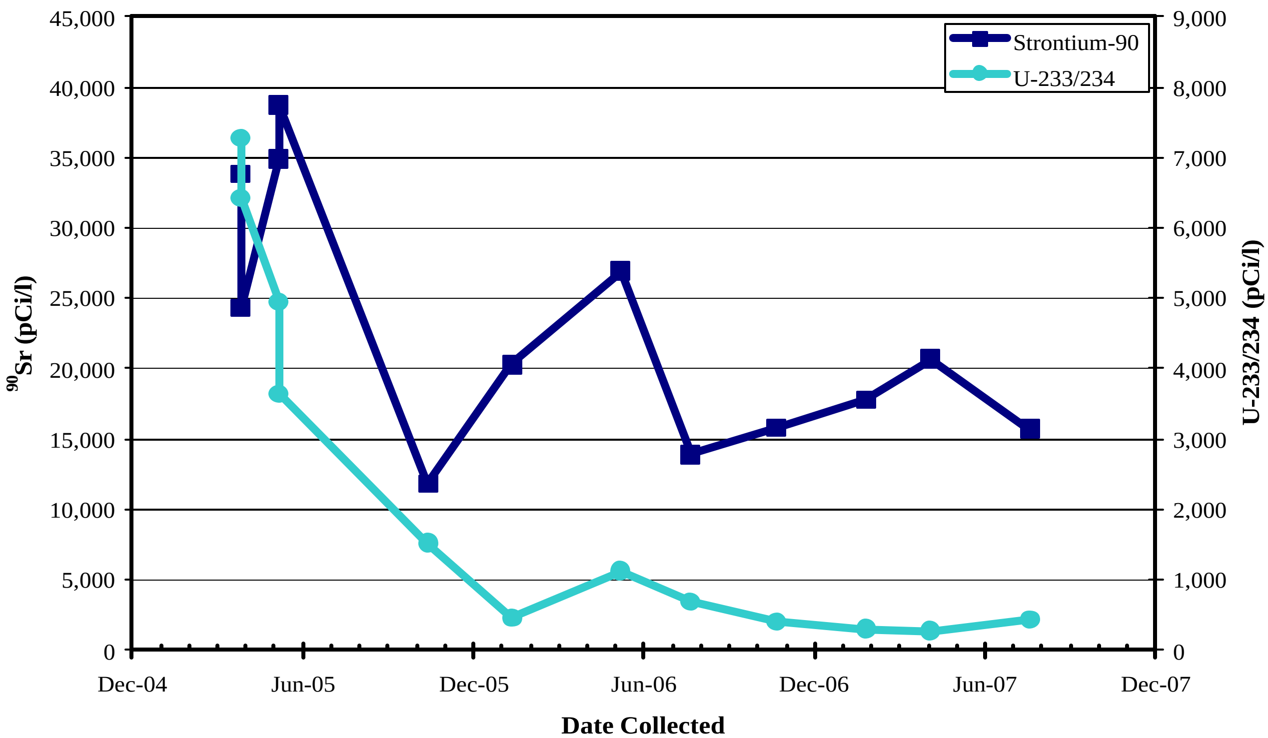

Fig. 2.7. ^{90}Sr and $^{233/234}$U concentrations in well 4570.

Performance evaluation data summarized above demonstrate that the Waste Area Grouping (WAG) 1 Corehole 8 Removal Action has effectively reduced contaminant discharge to First Creek as shown by the low flux of ^{90}Sr measured in First Creek. The effects of NTF soil removal are apparent from the declining concentrations and flux in the groundwater collection system, and variable but stable concentrations in groundwater near the source area.

Table 2.5. First Creek ^{90}Sr fluxes pre-action and in FY 2007

Month	CY 1994 (pre-action)			Month	FY 2007		
	^{90}Sr (pCi/L)	Flow volume (liters)	^{90}Sr Flux (Ci)		^{90}Sr (pCi/l)	Flow volume (liters)	^{90}Sr Flux (Ci)
January 1994	124.4	102,893,891	0.0128	October 2006	20.3	27,207,353	0.000552
February 1994	95.6	126,569,038	0.0121	November 2006	14.6	80,457,494	0.00118
March 1994	89.2	228,699,552	0.0204	December 2006	23.5	22,402,915	0.000526
April 1994	105.4	166,982,922	0.0176	January 2007	14.7	81,584,035	0.00112
May 1994	236.5	41,437,632	0.0098	February 2007	25.1	28,119,946	0.00071
June 1994	297.3	32,963,337	0.0098	March 2007	19.3	67,374,432	0.0013
July 1994	324.4	25,585,697	0.0083	April 2007	19.1	98,337,744	0.00188
August 1994	378.4	30,919,662	0.0117	May 2007	27	51,084,288	0.00138
September 1994	364.9	26,586,673	0.0097	June 2007	50.2	22,867,402	0.00115
October 1994	133.6	24,700,599	0.0033	July 2007	61.9	20,031,854	0.00124
November 1994	260.9	37,178,996	0.0097	August 2007	65.4	21,451,392	0.00141
December 1994	179.8	66,740,823	0.012	September 2007	70.9	16,957,627	0.00121
Total		911,258,822	0.137	Total		537,876,482	0.0137

Ci = Curie
CY = calendar year
FY = fiscal year
pCi/L= picoCuries per liter
Sr = strontium

Table 2.6. Strontium-90 flux changes at First Creek Weir, 1993–2007

Year	^{90}Sr flux (Ci)	Percent reduction from CY 1994[a]
CY 1993	0.13	
CY 1994	0.137	
CY 1995	0.067	51.1
FY 1996	NA	NA
FY 1997	0.036[b]	73.7
FY 1998	0.044[c]	67.9
FY 1999	0.044[c]	67.9
FY 2000	0.026	81.0
FY 2001	0.035	74.8
FY 2002	0.034	75.0
FY 2003	0.016	88.0
FY 2004	0.016	88.5
FY 2005	0.019	86.2
FY 2006	0.011	92.0
FY 2007	0.014	89.2

[a]Remedy effectiveness (20—50% reduction from 1994 flux) has been attained continuously from startup through FY 2007.
[b]Represents 10 months of data.
[c]Represents 11 months of data.
Ci = Curie.
CY = calendar year.
FY = fiscal year.
NA = not applicable.

2.3.1.3 Compliance with LTS Requirements

2.3.1.3.1 Requirements

Long-term stewardship requirements are not specified in the decision document pertaining to this site.

2.3.1.3.2 Status of Requirements for FY 2007

Although no LTS requirements are specified, operational checks of the pumping and treatment system were conducted by Energy*Solutions*, maintenance was performed as required, and the system was monitored by the Bechtel Jacobs Company LLC (BJC) Waste Operations Control Center (WOCC) via the automated alarm for pump malfunctions. Malfunctions were reported to the BJC Facility Manager and a work package was developed for Energy*Solutions* to perform repairs. Additionally, the ORNL site was subject to access controls (badge required to pass through security checkpoints), and "Contamination Area" signs were clearly in place.

2.3.2 Tank W-1A Removal Action

Location of the Corehole 8 Plume Source (Tank W-1A) Removal Action is shown on Fig. 2.1. The scope of this action included removal of contaminated soils, along with associated piping, valve pits, and appurtenances within the area of excavation; backfilling; and site restoration. Some soils and the tank have been left in place due to potential transuranic (TRU) waste that would require special handling and disposition. The tank interior was cleaned; however, excavation of the contaminated soil from around the tank and tank removal require completion. This site has only LTS requirements. A review of compliance with these LTS requirements is included in Sect. 2.3.2.1. Background information on this remedy and performance standards are provided in Chapter 2 of Volume 1 of the 2007 RER.

No surface water or groundwater monitoring is required to verify the effectiveness of the removal action; however, the Corehole 8 plume groundwater recovery and monitoring continue at well 4411 and the Corehole 8 sump (Sect. 2.3.1).

2.3.2.1 Compliance with LTS Requirements

2.3.2.1.1 Requirements

Long-term stewardship requirements specified in the RmAR (DOE 2002b) include S&M activities to be performed routinely to ensure that the clean backfill is not undergoing excessive subsidence or erosion. The RmAR also requires that the area be posted as “Soil Contamination Area–Contact Radiation Protection before disturbing surfaces.” In it’s current condition, the area does not require fencing to protect personnel.

2.3.2.1.2 Status of Requirements for FY 2007

The site underwent annual inspections by the ORNL S&M Program to monitor the condition of the backfill to note excessive subsidence or erosion. Site access controls, general housekeeping, and condition of the signs were also inspected. There were no deficiencies noted on the inspection checksheets.

2.3.3 Building 3001 Canal Removal Action

Location of the Bldg. 3001 Canal Removal Action is shown on Fig. 2.1. The scope of this action included displacing water from the canal with a specific grout formulation to provide stable shielding for residual contamination, and to eliminate further leakage and hydraulic transport, and painting of the canal and vault walls to isolate contact-smearable contamination. This site has only LTS requirements. A review of compliance with these LTS requirements is included in Sect. 2.3.3.1. Background information on this remedy and performance standards are provided in Chapter 2 of Volume 1 of the 2007 RER.

No surface water or groundwater monitoring is required to verify the effectiveness of the removal action.

2.3.3.1 Compliance with LTS Requirements

2.3.3.1.1 Requirements

The RmAR (DOE 1997a) stipulates that the condition of the grout and paint will be inspected monthly for 1 year to check for significant cracks and chipping that could cause increased risk of exposure.

2.3.3.1.2 Status of Requirements for FY 2007

The monthly checks were conducted through 2006 and are no longer reported in the RER.

2.3.4 Surface Impoundments Remedial Action

The location of the SIOU RA is shown on Fig. 2.1. The scope of this action involved the removal of contaminated water, sediment, and the upper 0.1 to 0.2 ft of sub-impoundment soil (clay) and was implemented in two phases. The first phase involved contaminated water and sediment removal and backfilling of Impoundments C and D, which were small, lined impoundments. The second phase involved removal and treatment of discrete batches of contaminated sediment and backfilling of Impoundments A and B, which were larger, unlined impoundments. Upon completion of RA, all four impoundments were covered with gravel and asphalt and are currently used as parking areas. This site has only LTS requirements. A review of compliance with these LTS requirements is included in Sect. 2.3.4.1. Background information on this remedy and performance standards are provided in Chapter 2 of Volume 1 of the 2007 RER.

No post-action performance monitoring of groundwater or surface water was specified in the decision documents.

2.3.4.1 Compliance with LTS Requirements

2.3.4.1.1 Requirements

The RAR (DOE 2003c) states that no institutional controls are needed at the site. However, it does state that institutional controls that limit excavation will remain in place for potential residual subsurface contamination around the site.

2.3.4.1.2 Status of Requirements for FY 2007

Site inspections are performed annually by the ORNL S&M Program to check for evidence at the site of unauthorized excavation/penetrations without a valid permit. During FY 2007, there were no deficiencies noted on the inspection checksheets.

In addition both primary workgroups of this area, UT-B and BJC, have an EPP program with procedures that do not allow for unauthorized excavations/penetrations in this area.

2.3.5 Metal Recovery Facility Removal Action

Location of the Metal Recovery Facility (MRF) Removal Action is shown on Fig. 2.1. The scope of this action included removal of surface structures to slab, leaving in place the concrete floor slab, foundation, and other subsurface structures. The floor slab area was sealed and the slab and surrounding yard areas were covered with a minimum 2 in. of gravel. Final disposition of the slab and surface structures has been deferred to the BV ROD. This site has only LTS requirements. A review of compliance with these LTS requirements is included in Sect. 2.3.5.1. Background information on this remedy and performance standards are provided in Chapter 2 of Volume 1 of the 2007 RER.

No surface water or groundwater monitoring is required to verify the effectiveness of the removal action.

2.3.5.1 Compliance with LTS Requirements

2.3.5.1.1 Requirements

Long-term stewardship requirements specified in the RmAR (DOE 2003d) include S&M activities to ensure that the gravel cover is not grossly disturbed in a manner that might expose subsurface contamination. In the event that the gravel cover is disturbed, the minimum 2-in. gravel protective cover over the epoxy barrier coating will be restored. The RmAR also requires that the site be posted as an underground contamination area.

2.3.5.1.2 Status of Requirements for FY 2007

The site underwent annual inspections performed by the ORNL S&M Program to monitor the condition of the gravel cover and ensure that the signs denoting that the area has underground contamination are present and visible and firmly in place. No deficiencies were noted on the inspection checksheets and no maintenance was required.

2.4 BETHEL VALLEY WATERSHED CONDITION AND TRENDS

There are three key criteria to evaluating conditions and trends relevant to the overall surface water goals for BV as stipulated in the ROD: (1) contaminant fluxes in WOC and contributing tributaries and outfalls, (2) contaminants measured in exit pathways, and (3) status of aquatic biota.

2.4.1 Surface Water Contaminant Fluxes

FY 2007 Bethel Valley ^{90}Sr and ^{137}Cs discharges are the lowest ever measured. Much below-average rainfall is the likely cause.

Historic and ongoing discharges of ^{90}Sr, ^{137}Cs, and mercury in surface water in BV are principal contamination issues that directly reflect condition of the watershed and are performance metrics for the BV ROD. While ROD actions that will directly address several known source areas of these contaminants have not yet been initiated, ongoing measurement of these contaminants is conducted to track baseline discharge conditions. As summarized in Sect. 2.2.1, surface water goals include 45% reduction of risk levels associated with COCs at the 7500 Bridge monitoring station compared to FY 2004 levels, as well as attainment of AWQC for organisms. The principal COCs discharged from BV in 1994 were ^{90}Sr and ^{137}Cs. Evaluation of the annual average ^{90}Sr and ^{137}Cs discharge concentrations compared to the FY 1994 baseline year is presented later in this section.

Figure 2.8 shows locations in the ORNL main plant area in BV where contaminant concentration and flows are measured to estimate the discharge fluxes from various contributing areas or outfalls. Strontium-90 is the principal radiological contaminant of concern in surface water in BV because it is a fairly widely distributed contaminant in buried waste, in contaminated soils related to LLLW pipeline leaks, and in groundwater. Cesium-137 is a significant surface water contaminant in WOC and its sources include discharges from the PWTC effluent and contaminated soils on the WOC floodplain from the former SIOU area downstream to 7500 Bridge Weir. Table 2.7 includes the FY 2007 flux estimates for ^{90}Sr, ^{137}Cs, and tritium at the relevant BV surface water monitoring locations. Table 2.8 includes annual ^{90}Sr, ^{137}Cs, and tritium fluxes in BV for the baseline year (1994) and for most monitoring stations from FY 1998 through FY 2007. During January 2007 excess sediment accumulated upstream of the 7500 Bridge Weir was removed to allow more accurate measurement of stream flow volume. This problem was identified as an issue during preceding years and was resolved by completion of the weir pool sediment removal.

During FY 2007 the total contaminant fluxes for ^{90}Sr and ^{137}Cs were the lowest measured since the CERCLA program started tracking the BV discharge flux in 1993. During FY 2007 tritium flux in BV increased compared to FY 2006 and previous years as a result of operation of the MV groundwater collection systems that transport tritium contaminated groundwater from the hydrologic isolation areas to the ORNL PWTC. As shown in Tables 2.7 and 2.8, the source of tritium measured at the 7500 Bridge weir is from the PWTC effluent. The relocation of tritium discharge from the pre-remedial action seepage into Melton Branch (MB) to discharge at the ORNL PWTC outfall does not significantly affect the facility permitted discharge limit of radiological contaminants.

Figure 2.9 shows the annual ^{90}Sr flux from gauged areas and the estimated ungauged flux along with total annual rainfall at the ORNL site for FY 2000 through FY 2007. In contrast to FY 2003 through FY 2005 when annual rainfalls were above average, during FY 2007 the total and ungauged ^{90}Sr fluxes decreased to the lowest levels measured since the CERCLA program started tracking BV contaminant discharge.

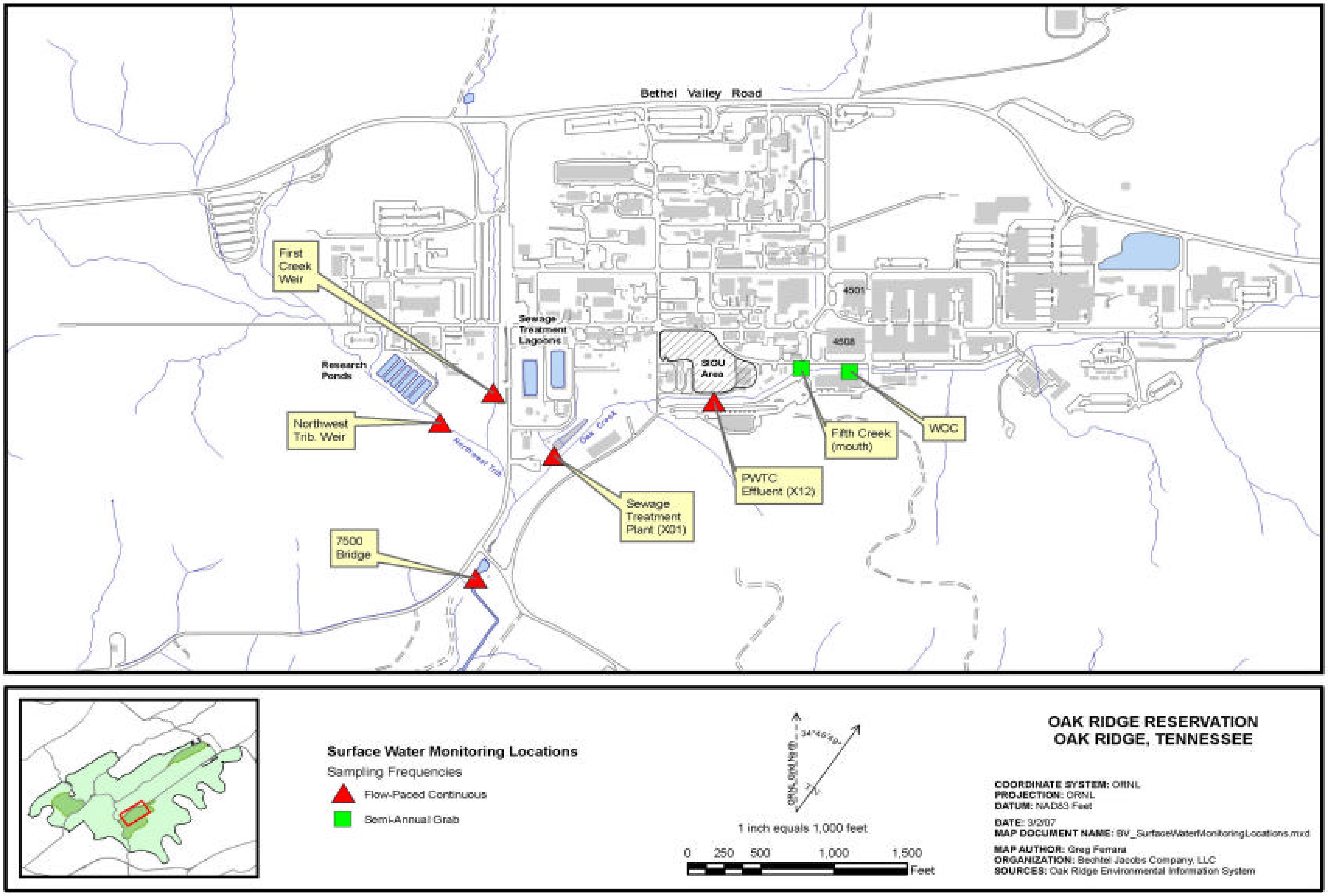

Fig. 2.8. Surface water monitoring locations in ORNL main plant area.

Table 2.7. FY 2007 radiological contaminant fluxes from Bethel Valley areas

Month	^{90}Sr Flux (Ci)						^{137}Cs Flux (Ci)		Tritium Flux (Ci)	
	7500 Bridge	First Creek	NWT	PWTC (X12)	STP (X01)	Un-gauged	7500 Bridge	PWTC (X12)	7500 Bridge	PWTC (X12)
October 2006	0.013	0.0006	0.0015	0.0035	0.0031	0.004	0.0049	0.0151	12.0	15.5
November 2006	0.025	0.0012	0.0040	0.0035	0.0044	0.012	0.0097	0.0258	20.1	16.8
December 2006	0.008	0.0005	0.0017	0.0027	0.0021	0.001	0.0038	0.0137	8.75	10.8
January 2007	0.009[b]	0.0012	0.0051	0.0024	0.0034	--[a]	0.0061[b]	0.0254	6.89[b]	17.2
February 2007	0.008	0.0007	0.0023	0.0028	0.0015	0.001	0.0052	0.0160	7.87	9.69
March 2007	0.011	0.0013	0.0031	0.0029	0.0016	0.002	0.0083	0.0227	9.14	11.2
April 2007	0.022	0.0019	0.0041	0.0032	0.0023	0.010	0.0162	0.0235	15.5	13.2
May 2007	0.015	0.0014	0.0021	0.0041	0.0030	0.005	0.0093	0.0360	10.4	14.4
June 2007	0.007	0.0011	0.0001	0.0026	0.0019	0.001	0.0061	0.0309	7.71	9.95
July 2007	0.007	0.0012	0.0001	0.0025	0.0017	0.002	0.0072	0.0188	5.58	10.9
August 2007	0.009	0.0014	0.0001	0.0020	0.0020	0.003	0.0036	0.0059	10.5	12.9
September 2007	0.006	0.0012	0.0001	0.0006	0.0014	0.003	--[a]	0.0025	7.59	8.45
Total	0.140	0.014	0.024	0.033	0.028	0.044	0.080	0.236	122	151

[a]Contaminant concentration below detection limit.
[b]Station was out of service January 3 – 13, 2007 for maintenance..

Ci = Curie
Cs = cesium
NWT= North West Tributary
PWTC = Process Waste Treatment Complex
STP = Sewage Treatment Plant
Sr = strontium
(X12) = denotes outfall

Table 2.8. Annual radionuclide fluxes at key Bethel Valley surface water monitoring locations

Year	^{90}Sr Flux (Ci)						Tritium Flux (Ci)		^{137}Cs Flux (Ci)	
	7500 Bridge	First Creek	NWT	STP (X01)	PWTC (X12)	Ungauged BV ^{90}Sr	7500 Bridge	PWTC (X12)	7500 Bridge	PWTC (X12)
1993	0.61	0.13	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]	0.99	--[a]
1994	0.75	0.137	--[a]	--[a]	--[a]	--[a]	--[a]	--[a]	0.66	--[a]
1998	0.22	0.044	--[a]	0.048	0.038	0.09[b]	--[a]	52.8	--[a]	0.38
1999	0.19	0.044	--[a]	0.087	0.050	0.01[b]	30.8	50.8	0.34	0.82
2000	0.15	0.026	0.039	0.033	0.056	0.03	81.1	83.4	0.98	0.92
2001	0.22	0.035	0.035	0.031	0.078	0.08	26.9	29.2	1.4	0.54
2002	0.25	0.034	0.036	0.031	0.057	0.13	61.4	63.3	0.74	0.90
2003	0.41	0.016	0.063	0.046	0.062	0.27	96.1	70.8	0.43	0.32
2004	0.64	0.016	0.063	0.040	0.067	0.45	60.3	63.9	0.37	0.50
2005	0.69	0.019	0.068	0.036	0.071	0.51	26.6	33.5	0.82	0.58
2006	0.20	0.011	0.037	0.026	0.049	0.08	87.7	94.4	0.15	0.19
2007	0.14	0.014	0.024	0.028	0.033	0.04	122	151	0.08	0.24

[a]Flow and/or concentration data not available for flux calculation.
[b]Ungauged ^{90}Sr flux includes Northwest Tributary contribution.

Ci = Curie
Cs = cesium
BV = Bethel Valley
NWT= North West Tributary
PWTC = Process Waste Treatment Complex
STP = Sewage Treatment Plant
Sr = strontium
(X12) = denotes outfall

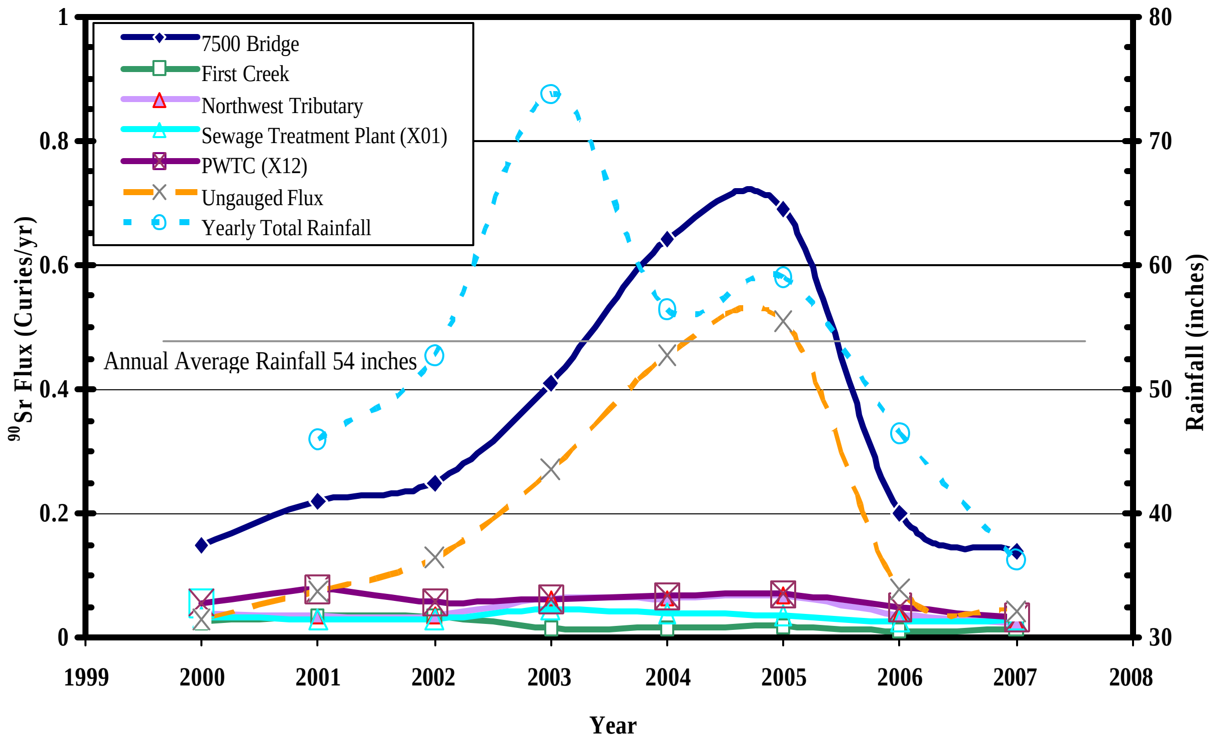

Fig. 2.9. Annual ^{90}Sr flux from gauged and ungauged Bethel Valley areas and total annual rainfall.

As shown in Fig. 2.10, during FY 2007 slightly more than 30% of the ^{90}Sr flux measured at the 7500 Bridge station is attributed to ungauged contributions to the stream. Since FY 2000 this percentage has ranged from a low of 20% (FY 2000) to a high of nearly 74% (FY 2005). As discussed in prior year RERs, causes of the variability of ungauged ^{90}Sr contributions to WOC are under continuing investigation. Periods of extended above-average rainfall are apparently responsible for mobilizing ^{90}Sr from unknown sources in BV contributing to increased contaminant loading in WOC. During winter of FY 2006, a focused investigation of ^{90}Sr in WOC in BV identified several groundwater seeps, residual groundwater contamination around the SIOU, and contaminated groundwater associated with the former LLLW system that may contribute to ungauged ^{90}Sr in the stream. A contaminated soil area upstream of the 7500 Bridge was remediated in FY 2005 as part of the MV Soil and Sediment RA. It is possible that this contaminated area that was associated with a LLLW leak site was a key source of the excess ^{90}Sr that was transported under extremely wet climatic conditions. Additional sampling is planned to more precisely locate specific sources of the ungauged ^{90}Sr in WOC in BV pending sufficient rainfall to cause increased discharge. This issue was identified in the 2007 RER and is being "tracked" as a recommendation (see Sect. 2.5). When completed, the BV ROD actions are expected to reduce ^{90}Sr releases from the watershed.

During FY 2007, the annual ^{137}Cs flux measured at the 7500 Bridge was the lowest on record (Table 2.8). Low rainfall during 2007 reduced the transport of cesium which tends to adsorb to stream sediment upon contact.

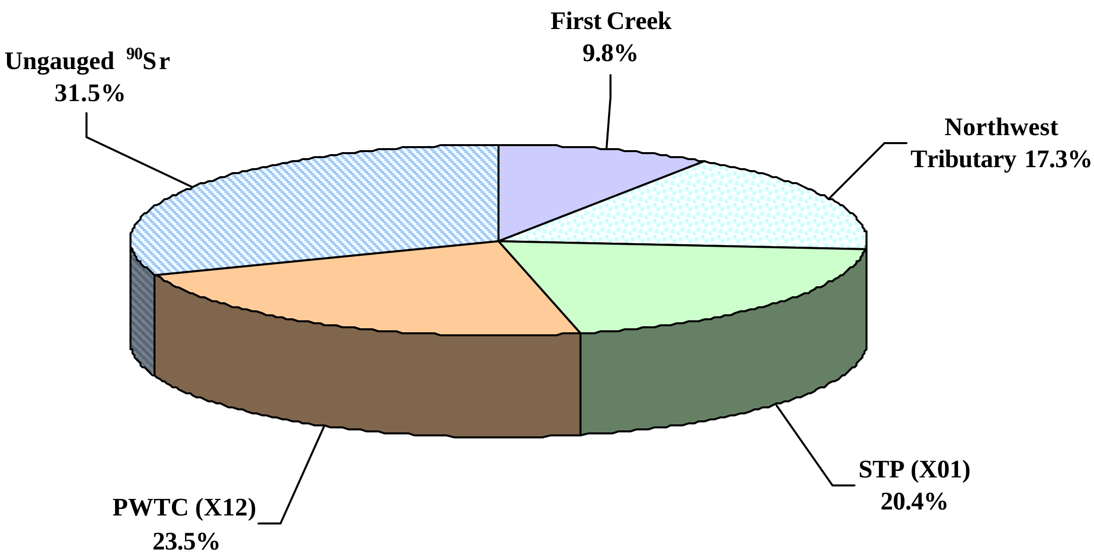

Fig. 2.10. Proportions of ^{90}Sr flux from gauged and ungauged contributions measured at 7500 Bridge station during FY 2007.

The BV ROD includes a requirement for RAs to achieve 45% reduction of risk associated with ^{90}Sr and ^{137}Cs discharges in surface water measured at the 7500 Bridge compared to levels measured in 1994 which as established as the baseline year for the ROD. Reporting this ROD metric for BV is new to this RER and DOE will continue to track and report the 7500 Bridge risk-reduction goal in future reports. Table 2.9 includes the average annual ^{90}Sr and ^{137}Cs concentrations calculated from the flow-paced composite samples collected at the 7500 Bridge for FY 1994 and FY 2001 through FY 2007. Also included are the concentration goals for ^{90}Sr and ^{137}Cs based on the 45% risk reduction requirement. As shown in Table 2.9, ^{90}Sr concentrations exceeded the risk-based goal in 1994, 2004, and 2005, while ^{137}Cs exceeded the goal in each year except 2006 and 2007. The elevated ^{90}Sr concentrations of 2004 and 2005 have been noted in previous RER's and were the consequence of prolonged above normal rainfall patterns. The very low average concentration values for both ^{90}Sr and ^{137}Cs during 2006 and 2007 are indicative of the impact the extreme drought has had on percolation and groundwater recharge (consequently low ^{90}Sr mobilization) and surface water flow volumes (consequently low sediment-bound ^{137}Cs mobility).

Table 2.9. 7500 Bridge risk-reduction goal evaluation

Year	Average ^{90}Sr (Goal = 37 pCi/L)	Average ^{137}Cs (Goal = 33 pCi/L)
1994	67	59
2001	37	**219**
2002	37	**116**
2003	37	**41**
2004	**78**	**47**
2005	**70**	**78**
2006	35	33
2007	27	17

Bold values indicate years during which annual average concentration exceeded the ROD risk goal
Cs= cesium   pCi/L = picoCuries per liter   ROD = Record of Decision   Sr = strontium

Mercury is the most significant non-radiological contaminant in WOC in BV. Sampling and analysis for mercury is conducted at the 7500 Bridge station, at the mouth of Fifth Creek, and at a location in WOC south of Bldg. 4508. During FY 2007, grab samples were collected monthly at the 7500 Bridge weir to evaluate mercury discharges. Mercury concentrations in these samples ranged from about 31 to about 92 ng/L with an average of 57 ng/L. Based on the daily flows at the 7500 Bridge for grab sampling dates, the daily loading of total mercury averaged about 0.07 g/d with minimum and maximum of 0.03 and 0.17 g/d, respectively.

Data from monthly sampling at 7500 Bridge show that during FY 2007 mercury concentrations were less than the recreation—organisms only AWQC of 51 ng/L in samples collected in October, March, April, and July. Table 2.10 summarizes average and maximum detected mercury concentration at the 7500 Bridge. Mercury concentrations at 7500 Bridge have varied significantly since routine sampling commenced in FY 2001. The highest average and maximum concentrations were measured in FY 2001 followed by results of FY 2005. During FY 2003 the high runoff from record high rainfall apparently caused the average and maximum mercury concentrations at 7500 Bridge to be lower than typical. Semiannual sampling during winter and summer at the mouth of Fifth Creek (66 and 44 ng/L respectively) and at a location in WOC south of Bldg. 4508 (147 and 59 ng/L respectively) show that although some contamination continues to affect Fifth Creek, the principal source affecting WOC reaches the stream to the south of Bldg. 4501.

Table 2.10. 7500 Bridge mercury concentration

Fiscal Year	Average (ng/L)	Maximum (ng/L)	Annual Rainfall (in.)
2001	291	777	44.3
2002	89	264	55.0
2003	29	63	73.0
2004	53	241	57.6
2005	111	616	57.9
2006	67	515	46.7
2007	57	92	36.3

ng/L = nanograms per liter

Although several locations in the ORNL main plant area are mercury contaminated, the principal source of mercury that impacts WOC is at Bldg. 4501 where a spill of approximately 20,000 pounds occurred in the 1950s. Mercury is captured in the basement foundation dewatering sumps and some of the sump water is discharged to WOC. The BV ROD includes reconfiguration of piping and treatment of all contaminated Bldg. 4501 sump water to eliminate the discharge of mercury contaminated groundwater to WOC. During FY 2007 UT-B implemented a project to reconfigure the piping and the Bldg. 4501 sump water is expected to be re-routed to the treatment system early in 2008. Completion of that action will significantly reduce mercury inputs to WOC.

2.4.2 Exit Pathway Groundwater and Surface Water Monitoring

Groundwater and surface water monitoring is conducted at the western end of BV to determine if contaminants discharge to Raccoon Creek and the Clinch River via a western exit pathway. Figure 2.11 shows locations where BV exit pathway sampling is conducted. Contaminated groundwater that originates from SWSA 3 seeps to the headwaters of Raccoon Creek, a short distance to the west of Tennessee Highway 95. This seepage pathway was discovered in the early 1980s and monitoring has been conducted at the Raccoon Creek Weir intermittently since the 1990s. The principal contaminant detected in the Raccoon Creek headwaters is ^{90}Sr. The annual flux of ^{90}Sr discharging via Raccoon Creek has been measured from 1999 through 2004. However, problems with flow measurements at the site prevented the

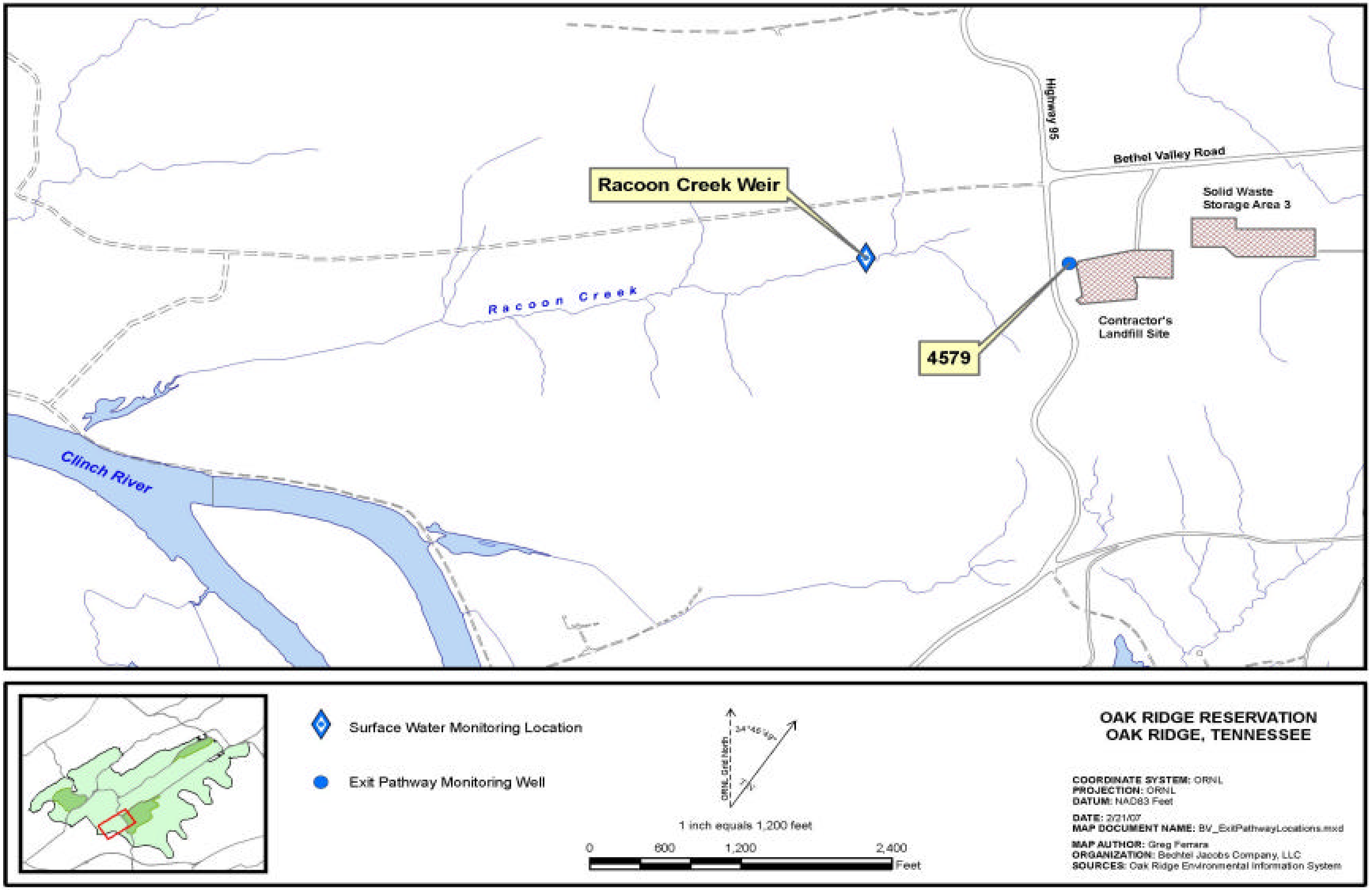

Fig. 2.11. Bethel Valley exit pathway monitoring locations.

ability to estimate flux for FY 2005 and 2006. Station repairs were completed in January 2007 to enable flux estimates for the remainder of FY 2007. Table 2.11 includes the FY 2006 and FY 2007 ^{90}Sr concentration data from samples collected at the weir and estimated flux for periods when reliable station flow data were available. The ^{90}Sr concentrations at the Raccoon Creek weir have historically fluctuated inversely to the amount of flow at the station because the seepage pathway from the source is in bedrock and groundwater seepage constitutes a higher proportion of baseflow during dry seasons than it does during wet seasons. Historically, during 1998, the highest ^{90}Sr concentrations measured at Raccoon Creek were nearly 100 pCi/L.

During the BV Groundwater Engineering Study in 2005, a multi-zone monitoring well (well 4579) was constructed near Highway 95 to determine if contaminated groundwater from SWSA 3 seeps downward and may flow to the Clinch River beneath the known seep that discharges to Raccoon Creek. A Westbay® multi-zone sampling system was installed in the well with three separate sampling zones at depths of nominally 152 – 172, 80 – 90, and 35 – 45 ft bgs. During 2007, ^{90}Sr was not detected in the deepest zone during either of the two sampling events. Strontium-90 was detected in the intermediate and shallow zones during 2007. In the intermediate zone two samples collected in January contained 77 and 14 pCi/L of ^{90}Sr, while ^{90}Sr was not detected in the two samples collected from this zone in July. Sampling of the shallowest zone showed ^{90}Sr to be present at concentrations of about 36 and 2.6 pCi/L in January and July, respectively. The detected concentrations of ^{90}Sr are similar to those detected in surface water at the Raccoon Creek Weir which is the surface water integration monitoring location for westward seeping groundwater from the SWSA 3 source area. These results suggest that contaminant seepage westward from the SWSA 3 area toward the CR is adequately monitored in the surface water in Raccoon Creek. Monitoring of well 4579 will be continued on an annual basis.

Surface water is sampled in a tributary to Bearden Creek at the eastern end of BV to evaluate contaminant discharges from the 7000 Services Area to surface water. Historically, tritium has been detected at this monitoring location. The source of tritium in the Services Area was a former tritium handling facility at Bldg. 7025. During FY 2007, surface water flow was not present in the tributary on-site visits to attempt sampling because of the abnormally dry conditions.

2.4.3 Aquatic Biological Monitoring

Biomonitoring data are available for WOC near the exit point of the BV watershed (Fig. 2.1 inset), and this information can be useful in evaluating watershed trends and the effectiveness of watershed-scale decisions defined in the ROD for Interim Actions in BV. As is the case for most watershed units, biological monitoring data in the WOC watershed includes: (1) contaminant accumulation in fish; (2) fish community survey; and (3) benthic macroinvertebrate surveys. Fish bioaccumulation results from all of WOC, including stream sections downstream of the MB confluence, are presented in this chapter.

In WOC, mercury and polychlorinated biphenyl (PCB) concentrations in fish are at or near human health risk thresholds (e.g. EPA AWQC, TDEC fish advisory limits). Mercury concentrations in fish collected in the WOC system (WCK 2.9, WCK 1.5) in 2007 remained within historical ranges (Fig. 2.12). Mercury concentrations in sunfish at WCK 3.9 (a site collected for the first time in 2007) averaged 0.45 µg/g. Mean PCB concentrations in fish continued to indicate the presence of upstream sources, with the redbreast sunfish samples from WOC (WCK 3.9) averaging 0.26 ± 0.03 µg/g PCBs, slightly higher than the mean concentration (0.17 µg/g) observed a kilometer downstream at WCK 1.5 (Fig. 2.13). However, stonerollers collected at WCK 3.9 contained much higher PCB concentrations, averaging 2.1 ± 0.13 µg/g.

Fish and benthic communities are degraded relative to reference sites, although improvements have occurred since the mid-1980s. The fish communities in WOC have been fairly stable in terms of overall

Table 2.11. Strontium-90 data from Raccoon Creek Weir

Month/Year	Flow volume[a] (L)	^{90}Sr Qualifier[b]	^{90}Sr Result (pCi/L)	^{90}Sr Flux (Ci)
October 2005	NA	=	77.2	
November 2005	NA	=	35.7	
December 2005	NA	=	16.1	
January 2006	NA	=	11.5	
February 2006	NA	=	10.1	
March 2006	NA	=	6.02	
April 2006	NA	=	2.64	
May 2006	NA	=	23.4	
June 2006	NA	=	50.2	
July 2006	NA	=	54.4	
August 2006	NA	=	55.4	
September 2006	NA	=	9.27	
October 2006	NA	=	9.67	
November 2006	NA	=	44.6	
December 2006	NA	=	9.55	
January 2007	NA	=	5.0	
February 2007	28,135,037	=	5.86	0.00003
March 2007	5,216,357	=	4.32	0.00009
April 2007	20,777,458	=	4.16	0.00018
May 2007	43,587,475	=	4.19	0.00007
June 2007	16,609,334	=	25.2	0.00002
July 2007	732,874	=	32.4	0.0000022
August 2007	Dry		--	
September 2007	Dry		--	
FY 2007 (Feb. – Jul.)	86,992,200[c]		14.5[d]	3.9E-04[c]
FY 2006	NA		29.3[d]	--
FY 2005	NA		16.8[d]	--
FY 2004 Total	254,073,296		9.6[d]	1.68E-03
FY 2003 Total	380,747,035		5.9[d]	1.07E-03
FY 2002 Total	318,825,472		8.7[d]	9.35E-04
FY 2001 (11 months)	315,555,053		6.7[d]	6.10E-04
FY 2000 Total	201,623,294			5.90E-04
FY 1999 Total	244,698,985			4.40E-04[e]

[a] The FY 2005 and 2006 flow data are not reported as the data have been deemed unusable due to problems associated with the weir.
[b] "=" is a validated result, detected and unqualified.
[c] Station was returned to full operation at end of January 2007. Reported flows and fluxes are calculated for the months when flow was present after station maintenance.
[d] Concentration value represents average concentration for all monthly flow composite samples at the station.
[e] Flux for FY 1999 was reported at 0.37 mCi in the 2000 Remediation Effectiveness Report (see DOE 2000f). The flux was subsequently recalculated to include "nondetected" concentrations omitted from the original calculation.

Ci = Curie
FY = fiscal year
L = liter
mCi = milliCurie
N/A = not applicable
pCi = picoCurie
Sr = strontium

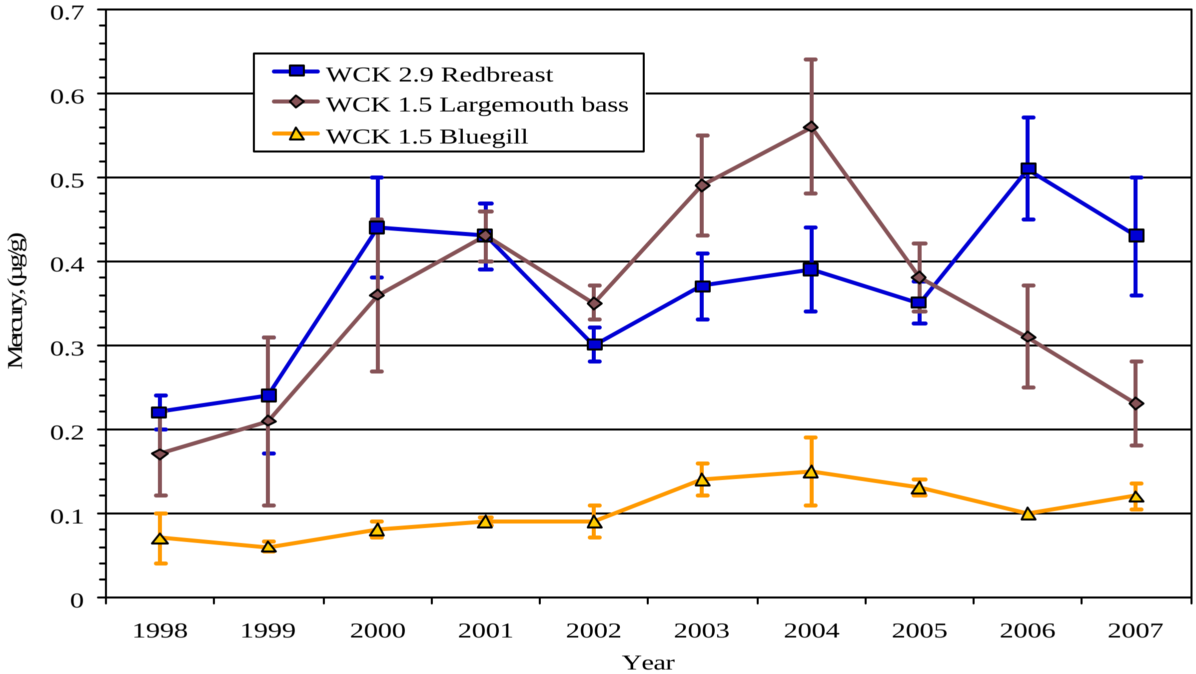

Fig. 2.12. Mean concentrations of mercury (µg/g, ± SE, N = 6) in muscle tissue of sunfish and bass from White Oak Creek (WCK 2.9) and White Oak Lake (WCK 1.5), 1998–2007.

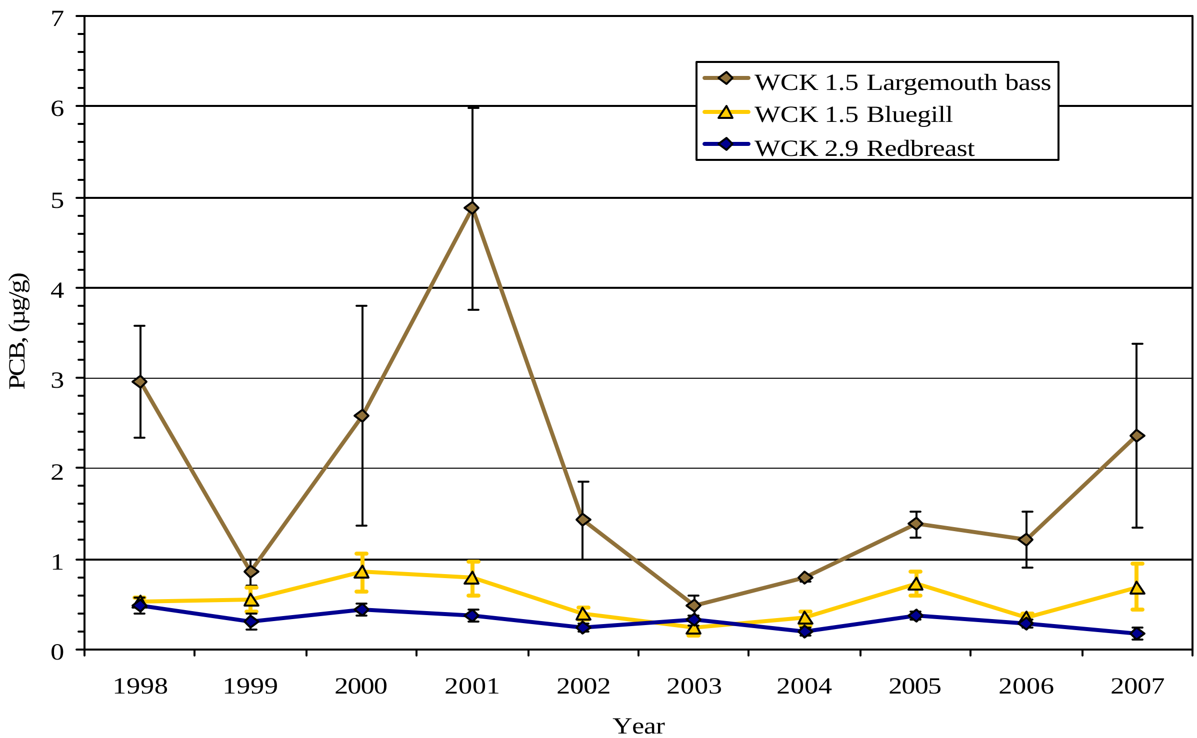

Fig. 2.13. Mean PCB concentrations (µg/g, ± SEN=6) in fish fillet collected from the WOC watershed, 1998–2007. WCK = White Oak Creek kilometer.

numbers of species in recent samples, but despite increased species richness values during the past year at WCK 3.9, they are generally below that of comparable reference fish communities (Fig. 2.14), Brushy Fork (BFK) and Mill Branch (MBK). The benthic macroinvertebrate community just downstream of most major effluent discharges from ORNL continued to indicate that ecological condition of WOC is degraded, and that the extent of recovery observed after 1998 has basically stabilized (Fig. 2.15).

2.4.4 Summary: Watershed Conditions and Trends

The predominant factor that affected the hydrologic system in BV during FY 2007 was the extreme drought. The drought caused minimal rainfall percolation through soils, minimal groundwater recharge, and minimal surface water discharge in addition to treated ORNL facilities effluent. Consequently, concentrations of ^{90}Sr and ^{137}Cs in surface water at the watershed exit point were the lowest on record. The low ^{137}Cs concentrations and flux at the 7500 Bridge are attributed to low surface water flow volumes that caused a decrease in mobilization of cesium-contaminated sediment. The low ^{90}Sr concentrations and flux at the 7500 Bridge is attributed to little percolation of rainfall through contaminated soils and low contaminated groundwater seepage volume to WOC and its tributaries. Groundwater contaminant concentrations in the Corehole 8 Plume were observed to increase slightly during FY 2007 as a result of diminished recharge to the groundwater system. In fractured rock groundwater systems, contaminant concentrations are sensitive to rain-induced recharge events which can dilute plume water in the fractures.

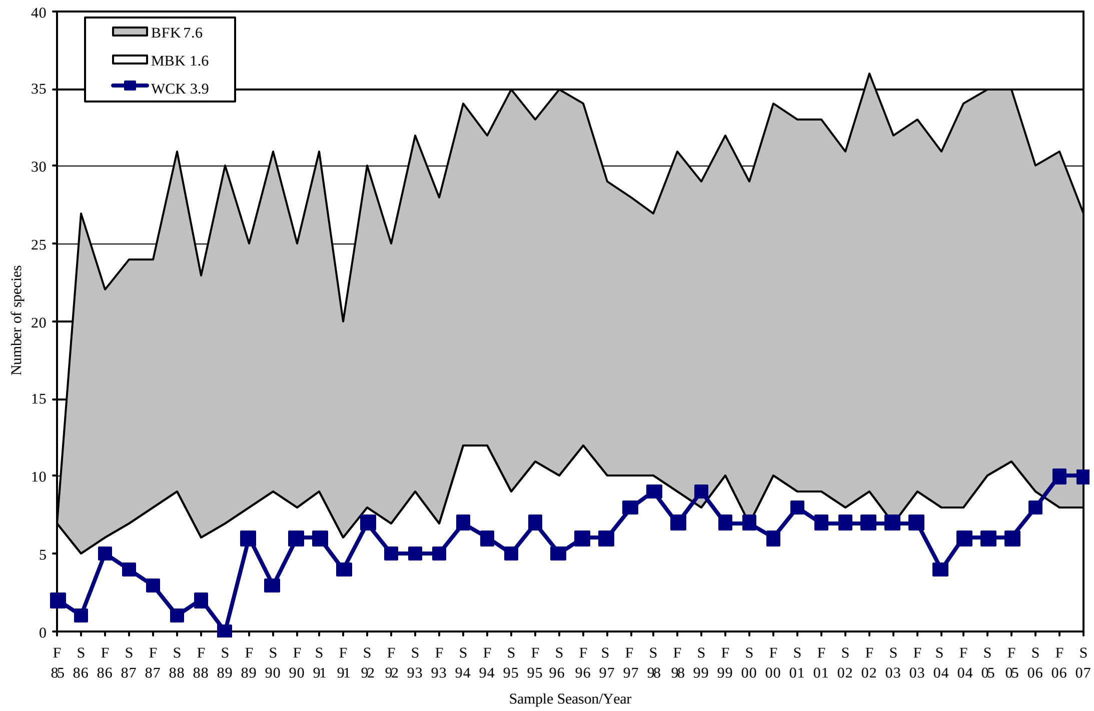

Fig. 2.14. Species richness (number of species) in samples of the fish community in upper White Oak Creek (WCK 3.9) and reference streams, Brushy Fork (BFK) and Mill Branch (MBK), 1985 to 2007.

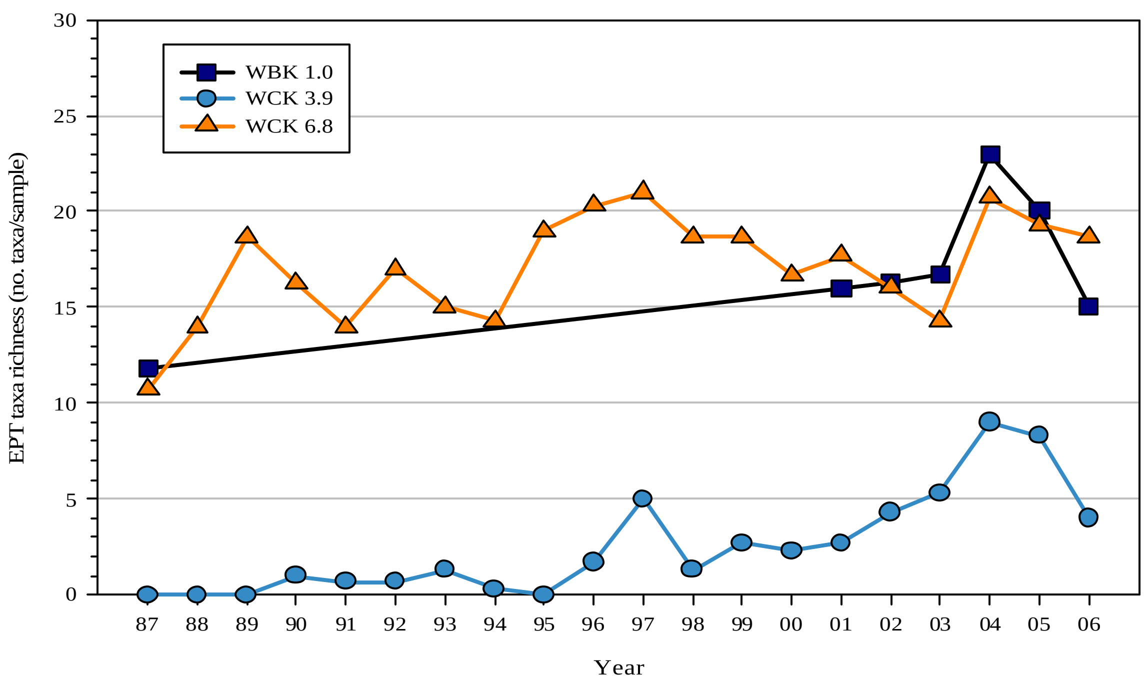

Fig. 2.15. Mean (n = 3) taxonomic richness of the pollution-intolerant taxa for the benthic macroinvertebrate community at sites in upper White Oak Creek (WCK) and Walker Branch (WBK), April sampling periods, 1987–2007.

2.5 BETHEL VALLEY MONITORING CHANGES AND RECOMMENDATIONS

Table 2.12 summarizes recommendations for the BV Watershed and carries forward the issue of ungauged flux in BV from the 2006 RER/CERCLA FYR (DOE 2007b) for tracking purposes until final resolution.

During FY 2007, ungauged ^{90}Sr flux comprised 32% of the total flux measured at the 7500 Bridge weir. Potential source areas identified during a focused investigation conducted during the winter of 2006 (see Sect. 2.4.1) include several groundwater seeps, residual groundwater contamination around the SIOU, and contaminated groundwater associated with the former LLLW system. A collection of remedial measures required by the BV ROD is ultimately expected to reduce ^{90}Sr releases into the watershed. Until such measures have been completed, baseline monitoring will continue during FY 2008 to more precisely locate specific contributors to the ungauged ^{90}Sr flux in WOC. No changes to monitoring in BV are recommended at this time.

Table 2.12. Summary of Bethel Valley Watershed technical issues and recommendations

ISSUE [(1)]	ACTION/ RECOMMENDATION
ISSUE CARRIED FORWARD: 1. The ^{90}Sr contamination from non-point sources has become the dominant contributor to ^{90}Sr flux at the 7500 Bridge location. SWSA 3 may also be contributing to increased flux seen at Raccoon Creek.	1. Increased ^{90}Sr flux was not observed in FY 2007 because or extreme drought conditions. Ungauged ^{90}Sr flux comprised ~32% of the total flux measured at 7500 Bridge during FY 2007. Potential source areas were identified during focused investigations conducted during winter 2006 as summarized in the FY 2007 RER. When completed, remedial actions required by the BV ROD are expected to reduce strontium releases into the Bethel Valley Watershed. These measures will include contaminated soil removal, hydrologic isolation of SWSA 3, and other actions associated with potential sources of surface water contamination. A continuation of the increasing ^{90}Sr trend will be addressed in the context of the BV remedial actions.

[(1)] Issues are identified in the table as “ISSUE(S) CARRIED FORWARD” to indicate that the issue is carried forward from a previous year’s RER so as to track the issue through resolution.

BV = Bethel Valley
FY = fiscal year
RER = Remediation Effectiveness ReportS
ROD = Record of Decision
Sr = strontium
SWSA = Solid Waste Storage Area

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3. CERCLA ACTIONS IN MELTON VALLEY WATERSHED

3.1 INTRODUCTION AND OVERVIEW

This chapter provides an update of the effectiveness of ongoing and completed CERCLA actions in MV watershed during FY 2007. Table 3.1 lists CERCLA actions within the watershed and Fig. 3.1 shows the locations of those actions. Only sites that have performance monitoring and LTS requirements, as noted in Table 3.1, are included in the performance evaluations provided herein. In subsequent sections, performance goals and objectives, monitoring results, and an assessment of the effectiveness of each completed action are presented. Remedial action objectives that form the basis for the interim remedial actions conducted as part of the MV ROD are based on future land uses outlined on Fig. 3.2. These future land uses require certain restrictions regarding site access and allowable activities within the area as summarized in the LTS requirements.

A summary of LTS requirements is provided in Table 3.2, and a review of compliance with these requirements is included in Sect. 3.2.3, Sect. 3.3.1.1, Sect. 3.3.2.1, and Sect. 3.3.3.1.

For background information on each remedy and performance standards, a compendium of all CERCLA decisions in the watershed within the context of a contaminant release conceptual model is provided in Chapter 3 of Volume 1 of the 2007 RER (DOE 2007a). This information will be updated in the annual RER and republished every fifth year at the time of the CERCLA FYR.

3.1.1 Status and Updates

Implementation of remedial activities associated with the ROD for Interim Actions for the MV Watershed (DOE 2006d) was completed in September 2006. The last few of the PCCRs were approved in FY 2007: (1) Hydrologic Isolation at Seepage Pits and Trenches (DOE 2006e) was approved October 2, 2006; (2) Soils and Sediments (DOE 2006f) was approved October 2, 2006; (3) Homogenous Reactor Experiment (HRE) Ancillary Facilities Decontamination and Decommissioning (D&D) (DOE 2006g) was approved October 4, 2006; and (4) Hydrologic Isolation at SWSA 5 (DOE 2006h was approved November 6, 2006. The RAR (DOE 2007e) was prepared to document compliance with requirements of the ROD and was approved in September 2007. The RAR includes the most recent MV Monitoring Plan and supersedes all requirements included in previous PCCRs. Performance metrics included in the ROD and the MV Monitoring Plan are summarized in Sect. 3.2.1.

The CERCLA activities that occurred in Melton Valley during FY 2007 did not have an impact on performance monitoring requirements. An Explanation of Significant Difference (ESD) was approved in December 2006 to remove five Shielded Transfer Tanks (STTs) from the MV D&D scope of work included in the MV ROD. DOE Order 435.1, *Radioactive Waste Management*, requires that DOE classify wastes from reprocessing of spent nuclear fuel as either high-level radioactive or waste incidental to reprocessing (WIR), depending upon the degree of hazard presented by the waste. Wastes determined to be WIR are managed as transuranic, mixed low-level, or low-level wastes. It was determined that a WIR determination was required by DOE Order 435.1 prior to disposal of the STTs. Due to the extensive documentation and extended review period associated with the WIR process, an ESD was approved to remove the five STTs from the MV ROD and address the disposal of the grouted tanks and contents under a National Environmental Policy Act (NEPA) process following completion of the WIR determination.

Table 3.1. CERCLA actions in Melton Valley Watershed

CERCLA action	Decision document, date signed	Action status[a]	Monitoring/ LTS required	RER section
Watershed Scale Actions				
Melton Valley Interim Actions	ROD: 9/21/00 ROD: 9/7/04 – Amendment to change remediation approach for Trenches 5 & 7 to ISG ESD: 3/12/04 – Add Tumulus to SWSA 6 Cap. ESD: 9/7/04 – Modify requirements for 11 waste units. ESD: 9/13/05 – Remove 7 facilities from MSRE D&D. ESD: 12/27/06 – Remove 5 STT from D&D scope. LUCIP: 5/24/06	RAR (9/5/07) PCCRs approved: Hydrofracture Well Plugging & Abandonment (7/14/06) New Hydrofracture Facility D&D (7/31/06) Trenches 5 and 7 and HRE Fuel Wells In Situ Grouting (8/14/06) Hydrologic Isolation at SWSA 6 (9/6/06) SWSA 4 and Intermediate Holding Pond (9/11/06) Old Hydrofracture Facility D&D (9/26/06) Hydrologic Isolation at Seepage Pits and Trenches (10/2/06) Soils and Sediments (10/2/06) HRE Ancillary Facilities D&D (10/4/06) 7841 Equipment Storage Area and 7802F Storage Shed D&D (10/5/06) Hydrologic Isolation at SWSA 5 (11/6/06)	Yes/Yes	3.2
Single Project Actions				
WOCE	Decision November 9, 1990	RmAR approved September 30, 1992	No/Yes	3.3.1
WAG 13 Cesium Plots	IROD October 30, 1992	RmAR approved August 25, 1994	No/Yes	3.3.2
WAG 5 Seep C	AM April 25, 1994	RmAR approved June 22, 1995. System shutdown prior to capping.	Discontinued	--
WAG 5 Seep D	AM August 19, 1994	RmAR approved June 22, 1995. Collection of contaminated groundwater ongoing.	Superseded	--
WAG 4 Seep Control	AM February 12, 1996	RmAR approved January 16, 1997	Discontinued	--
MSRE D&D Reactive Gas	AM June 12, 1995	RmAR approved February 12, 1998	No/No	--
MSRE D&D Uranium Deposit Removal	AM July 16, 1996	RmAR approved December 18, 2001	No/Yes	3.3.3
OHF Tanks Sludges	AM September 12, 1996	RmAR approved December 15, 1998	No/No	--

Table 3.1. CERCLA actions in Melton Valley Watershed (continued)

OHF Tanks and Impoundment	AM May 28, 1999 AM Addendum March 03, 2000	RmAR approved May 11, 2001	Discontinued	--
MSRE D&D Fuel Salt Removal	ROD July 8, 1998 ESD approved January 19, 2007 – Delete requirement to convert MSRE ^{233}U to an oxide.	Ongoing	TBD	--

[a] Detailed information on the status of ongoing actions is from Appendix E of the FFA and is available in Appendix C of this report. The most up-to-date status of schedule information is available at **www.bechteljacobs.com/ettp-ffa-appendicies.shtml**.
[b] The Seep D treatment system was dismantled during MV ROD remedial actions. The groundwater collection sump was incorporated into the MV ROD groundwater collection system.

AM = Action Memorandum
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
D&D = decontamination and decommissioning
ESD = Explanation of Significant Differences
FFA = Federal Facility Agreement
FY = fiscal year
IROD = Interim Record of Decision
LTS = long-term stewardship
LUCIP = Land Use Control Implementation Plan
MSRE = Molten Salt Reactor Experiment
OHF = Old Hydrofracture Facility
RAR = Remedial Action Report
RER = Remediation Effectiveness Report
RmAR = Removal Action Report
ROD = Record of Decision
TBD = to be determined
WAG = Waste Area Grouping
WOCE = White Oak Creek Embayment

In addition, an ESD was approved in January 2007 for the Molten Salt Reactor Experiment (MSRE) D&D Fuel Salt Removal ROD that deletes the requirement to convert the MSRE-separated ^{233}U to an oxide. The ^{233}U recovered from MSRE is a small percentage of the total amount of ^{233}U inventory stored in Bldg. 3019 at ORNL. Based on preliminary planning, DOE determined that processing of the MSRE ^{233}U materials as an integral part of the total Bldg. 3019 inventory would be more cost effective than the originally planned conversion of the materials to a stable oxide as prescribed in the MSRE ROD. Accordingly, DOE, with approval of the FFA regulators, deleted conversion of the ^{233}U from the MSRE D&D Fuel Salt Removal ROD. Storage of the ^{233}U from the MSRE in Bldg. 3019 completes all ROD obligations for the material. The MSRE ^{233}U would then be managed under the same authority as the remainder of the Bldg. 3019 material, which is not part of the MSRE ROD remedy.

Because these CERCLA actions do not have monitoring or LTS requirements, they are not discussed further in this report.

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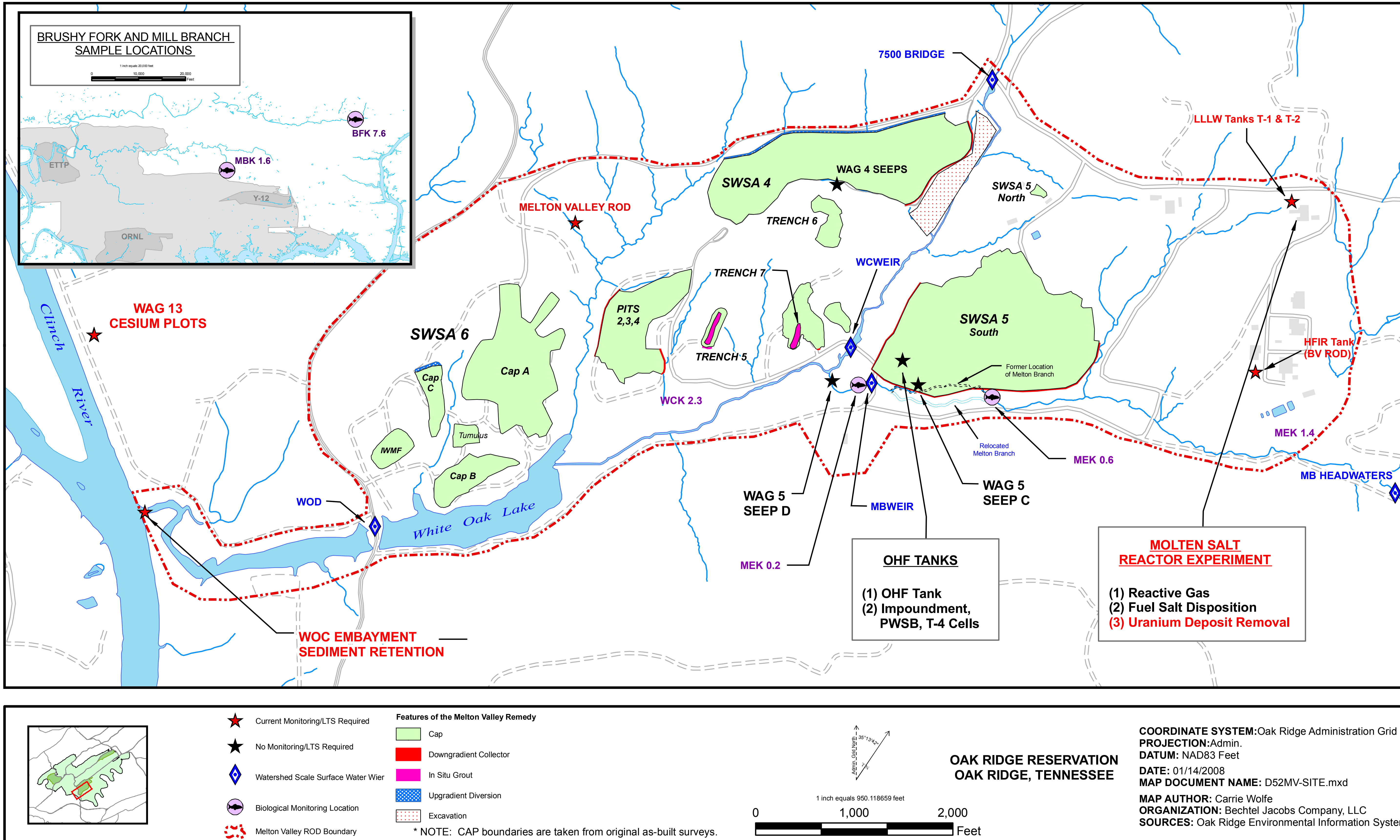

Fig. 3.1. Melton Valley Watershed site map.

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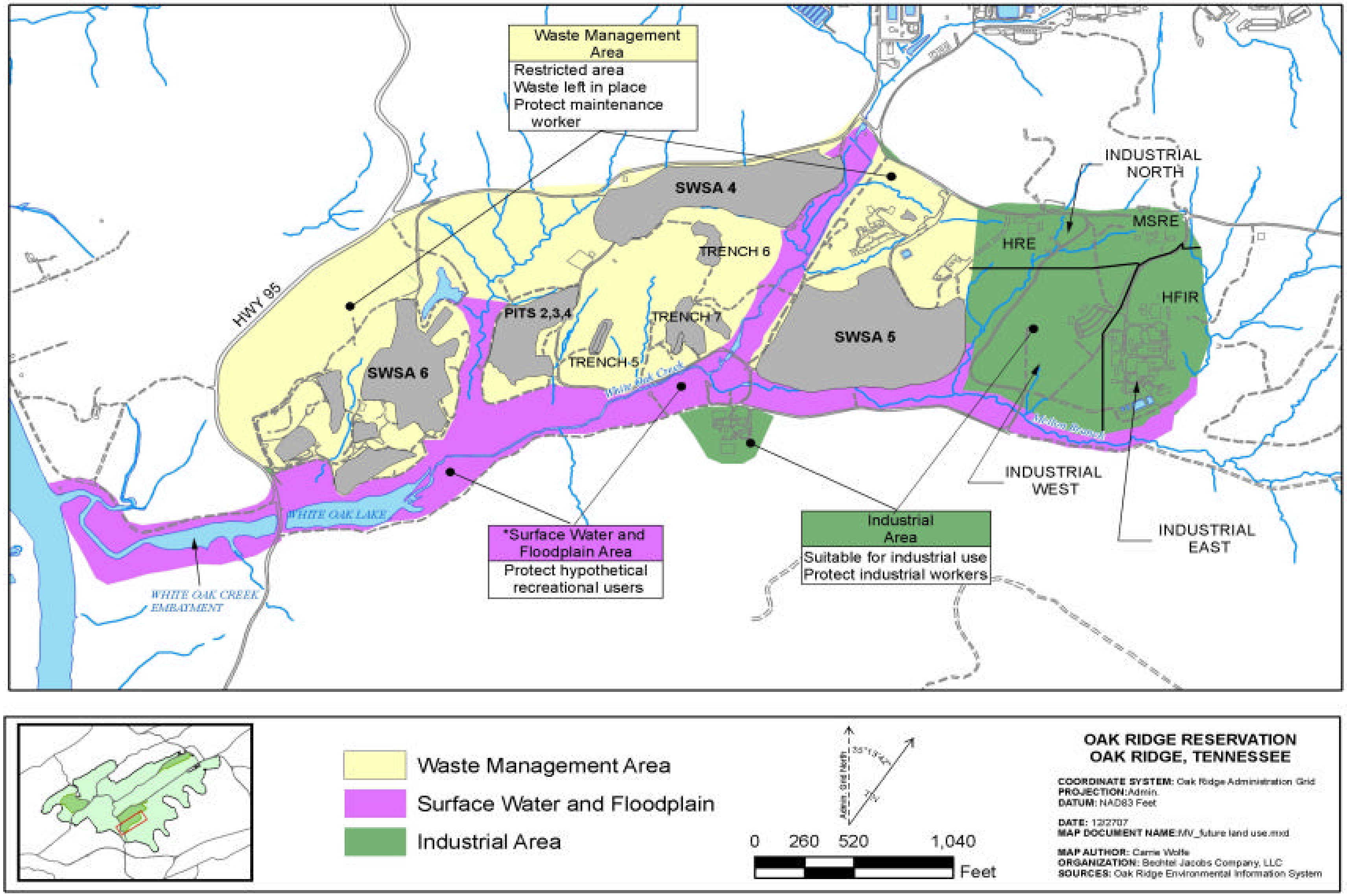


Fig. 3.2. Melton Valley future land use.

Table 3.2 Long-term stewardship requirements for CERCLA actions in Melton Valley Watershed

<table>
<tr><th rowspan="2">Site/Project</th><th colspan="2">LTS Requirements</th><th rowspan="2">Status</th><th rowspan="2">RER Section</th></tr>
<tr><th>Land Use Controls</th><th>Engineering Controls</th></tr>
<tr><td colspan="5">Watershed-scale actions</td></tr>
<tr><td>ROD for Interim Actions for the MV Watershed
▪ SWSA 4 and IHP PCCR
▪ SWSA 5 PCCR
▪ SWSA 6 PCCR
▪ Seepage Pits and Trenches PCCR
▪ Trenches 5 and 7 PCCR
▪ Soils and Sediments PCCR
▪ Hydrofracture Well P&A PCCR
▪ NHF D&D PCCR
▪ OHF D&D PCCR
▪ HRE Ancillary Facilities D&D PCCR
▪ 7841 Equipment Storage Area and 7802F Storage Shed D&D PCCR</td><td>Watershed LUCs
Administrative:
▪ land use and groundwater deed restrictions
▪ property record notices
▪ zoning notices
▪ permits program

Physical:
▪ state advisory / postings
▪ access controls
▪ signs
▪ security patrols</td><td>Hydrologic Isolation Projects[(a)] PCCRs specific:
▪ Maintain caps</td><td>Watershed LUCs Implemented under LUCIP:
▪ Physical LUCs in place.
▪ Administrative LUCs in place.
▪ RCRA required notices complete.

Hydrologic Isolation Projects[(a)] PCCRs specific:
▪ Engineering Controls remain protective.</td><td>3.2.3</td></tr>
<tr><td colspan="5">Completed single project actions</td></tr>
<tr><td>White Oak Creek Embayment Sediment Retention Structure</td><td></td><td>▪ Inspection and maintenance of SRS</td><td>▪ Engineering Controls remain protective.</td><td>3.3.1.1</td></tr>
<tr><td>WAG 13 Cesium Plots Interim Remedial Action</td><td>▪ Long term S&M of the fenced enclosure</td><td></td><td>▪ LUCs in place.</td><td>3.3.2.1</td></tr>
<tr><td>MSRE D&D (Uranium Deposit) Removal Action</td><td></td><td>▪ Ongoing S&M</td><td>▪ Engineering Controls remain protective.</td><td>3.3.3.1</td></tr>
</table>

[(a)]Hydrologic Isolation Projects include SWSA 4, SWSA 5, SWSA 6, and Seepage Pits and Trenches area.

CERCLA = Comprehensive Environmental Response, Compensation and Liability Act of 1980
D&D = decontamination & decommissioning
HRE = Homogeneous Reactor Experiment
IHP = Intermediate Holding Pond
LTS = long-term stewardship
LUCs = land use controls
LUCIP = Land Use Control Implementation Plan
MSRE = Molten Salt Reactor Experiment
MV = Melton Valley
NHF = New Hydrofracture Facility
OHF = Old Hydrofracture Facility
P&A = plugging and abandonment
PCCR = Phased Construction Completion Report
RAR = Remedial Action Report
RCRA = Resource Conservation and Recovery Act of 1976
RER = Remediation Effectiveness Report
ROD = Record of Decision
S&M = surveillance and maintenance
SRS = Sediment Retention Structure
SWSA = Solid Waste Storage Area
WAG = Waste Area Grouping

3.2 RECORD OF DECISION FOR INTERIM ACTIONS IN MELTON VALLEY WATERSHED

In FY 2006, a multi-year project was completed to conduct remedial actions specified by the MV ROD. Figure 3.1 shows the locations of CERCLA actions in the MV watershed. Remedial actions conducted as part of the MV Interim Actions included hydrologic isolation of approximately 140 acres of shallow land burial areas, plugging and abandonment of 111 deep wells associated with the hydrofracture disposal of radioactive liquids and sludges, demolition and disposal of small facilities, remediation of 6 surface wastewater impoundments, remediation of contaminated soils throughout approximately 800 acres of MV, grouting of thousands of feet of abandoned liquid waste transfer pipelines, and plugging and abandonment (P&A) of hundreds of unneeded shallow wells and piezometers. Volume 1 of the 2007 RER (DOE 2007a), PCCRs for the MV Project, and the MV RAR completed in FY 2007 document the details of the remedial actions conducted.

Completion of these remedial actions effectively supersedes the ongoing operation and monitoring required for two removal actions–the WAG 4 Seeps RmAR (DOE 1996a) and the WAG 5 Seeps Removal Action that addressed seeps C&D (DOE 1995a). Although groundwater at Seep D is still being pumped for treatment, the former onsite treatment system was dismantled and the Seep D groundwater is delivered to the MV groundwater collection system for treatment at the ORNL PWTC.

Environmental monitoring to document conditions in MV has been ongoing for decades and monitoring is tailored to evaluate the environmental response to the remedial actions. The MV Monitoring Plan, Oak Ridge, Tennessee (DOE 2002c) was prepared to provide an integrated plan that incorporates a wide range of monitoring objectives in MV focusing principally on remediation effectiveness monitoring. Although the post-remediation effectiveness metrics and monitoring locations were developed in large part during the remedial design, environmental monitoring of those metrics was initiated during FY 2006 while construction was ongoing in most of MV. Continuation of monitoring during FY 2007 demonstrates the shift in the environmental response to the remedial actions as this monitoring documents the changes in groundwater levels and contaminant concentrations following full remedy implementation.

Remediation effectiveness evaluations included in this RER report the results of monitoring the first full year of remedy operation. FY 2007 was the driest year on record for Oak Ridge with a total rainfall of 35.6 inches based on the average from 6 rain gages located throughout the ORR. Normal annual rainfall for Oak Ridge has been 54 inches. As documented in previous RERs, contaminant discharges tend to correlate with rainfall amounts.

3.2.1 Performance Goals and Monitoring Objectives

The MV ROD specified surface water quality, surface water risk targets, and groundwater controls to be achieved within specified periods after completion of the remedial actions. The ROD also included specific performance objectives that would be used as the metrics to evaluate the effectiveness of the remediation. These goals and metrics are presented below. The evaluation of performance during FY 2007 is presented in Sect. 3.2.2.

3.2.1.1 Surface Water Quality Goals and Monitoring Requirements

Surface water goals include protection of the CR to meet its stream use classification (e.g. as a domestic water supply), and to achieve AWQC in on-site waters of the state. The ROD included specific surface water remediation levels (RLs), as outlined in Table 3.3. Locations where surface water monitoring occurs to evaluate the remedy performance are shown on Fig. 3.3. The following excerpts from the MV ROD (2.11.7.3.1 Remediation Levels for Surface Water) include the specific concentration goals for the principal surface water contaminants of concern (COC) in MV.

Table 3.3. Surface water remediation levels for the Melton Valley Watershed, ORNL, Oak Ridge, Tennessee[a]

Melton Valley watershed	Goal: AWQC in waters of the state		Residential Risk
	Numeric AWQC	Narrative AWQC/ recreational risk	
Receptor	Hypothetical recreational user; fish and aquatic life	Hypothetical recreational user	Hypothetical off-site resident
Areas affected	All waters of the state	All waters of the state	Confluence of White Oak Creek with Clinch River
Anticipated compliance locations	See Fig. 3.3 of RER	See Fig. 3.3 of RER	Confluence of White Oak Creek with Clinch River
Remediation level	Levels established in Rules of the TDEC Chapter 1200-4-3-.03	See Table 3.5 of RER	See Table 3.4 of RER
Exposure scenarios	N/A (numeric criteria tabulated in regulation; no separate calculation using exposure scenarios needed)	Hypothetical recreational swimming for White Oak Lake and White Oak Creek Embayment; recreational wading for White Oak Creek, Melton Branch, and other waters of the state. The exposure scenarios do not take into account fish ingestion and sediment contact	Hypothetical residential (i.e., general household use)

[a]Source: Melton Valley ROD Table 2.18
AWQC = ambient water quality criteria
N/A = not applicable
ORNL = Oak Ridge National Laboratory
RER = Remediation Effectiveness Report
TDEC = Tennessee Department of Environment and Conservation

Protect Clinch River to meet its stream use classification

"This goal protects Clinch River as a domestic water supply meet SDWA MCLs[*] from contaminated surface water coming from MV. This goal provides residential risk-based limits for surface water at the confluence of WOC with Clinch River. This goal will be met within 10 years from completion of actions in MV and Bethel Valley. Remediation levels at the confluence of WOC with Clinch River will achieve an annual average excess lifetime cancer risk (ELCR) less than 1 X 10^{-4} and an HI less than 1 for a residential exposure scenario (i.e., general household use). Samples to demonstrate compliance with

[*] MCLs refer to the Safe Water Drinking Act of 1974 maximum contaminant levels for drinking water.

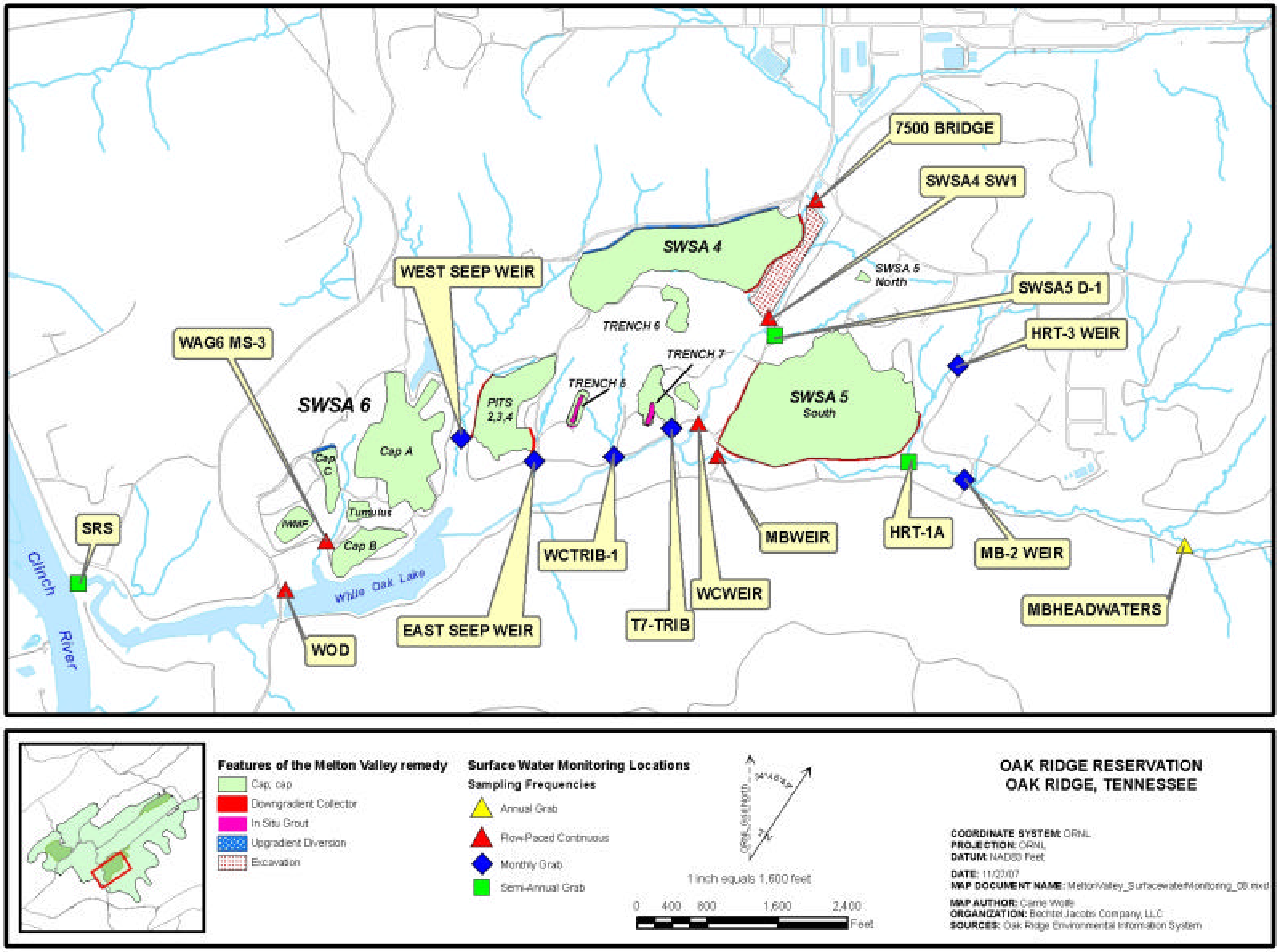


Fig. 3.3. Melton Valley surface water monitoring locations.

these remediation levels may be taken from the White Oak Creek Embayment (WOCE) and/or White Oak Dam (WOD). Table 3.4 [sic] lists the remediation levels for the contaminants contributing to residential risk at WOD.

Table 3.4. Residential risk-based surface water remediation concentrations for the Melton Valley Watershed, ORNL, Oak Ridge, Tennessee[a]

Contaminants at White Oak Dam[b]	Units	Reference Concentration[c]	Minimum Detection Limit[d]	Concentrations based on a residential scenario[e] (for White Oak Creek Embayment and/or White Oak Dam)
Arsenic	mg/L	ND	0.003	0.0056
Chloroform	mg/L	ND	0.001	0.021
1,2-dichloroethane	mg/L	ND	0.001	0.016
PCBs	mg/L	ND	0.001	0.011
Cesium-137+D	pCi/L	40	10.0	150
Cobalt-60	pCi/L	ND	10.0	250
Strontium-90+D	pCi/L	ND	2.0	85
Tritium	pCi/L	1626	300	58,000

Note: The remediation levels are calculated at 1 X 10^{-4} ELCR or HI of 1 using standard risk assessment protocols for a general household use scenario. These values apply to single contaminants only. To account for the total risk from multiple contaminants, sum of ratios calculations may be applied to all contaminants that are present above background. Actual remediation concentrations when multiple contaminants are present will therefore likely be lower than the single contaminant concentrations listed in the table. Concentrations for other contaminants not listed in the table will be determined as necessary and in a manner similar to that followed above.

[a] Source: MV ROD Table 2.20.

[b] Beryllium was identified as a COC in the FS but was not included here because EPA has since revised its position on the carcinogenicity of beryllium (see MV ROD Table 2.5). Also, some of these contaminants have SDWA MCLs. The selected remedy will make progress toward protecting Clinch River as a drinking water source (i.e., meet SDWA MCLs).

[c] Reference concentrations equal twice the arithmetic mean of the background; these concentrations were used for surface water analyte screening in the MV watershed risk assessment.

[d] The minimum detection limits are based on existing regulatory methodology and current laboratory instrument capabilities.

[e] The residential scenario assumes a 70-kg adult receptor, an exposure frequency of 350 days/year, an exposure duration of 30 years, an ingestion rate of 2 L/day, and a skin surface area (for dermal exposure) of 1.94 m^2.

COC = contaminant of concern
ELCR = excess lifetime cancer risk
EPA = Environmental Protection Agency
FS = feasibility study
HI = hazard index
kg = kilogram
L = liter
m =meter
MCL = maximum contamination level
mg/L = milligrams per liter
MV = Melton Valley
ND = not detected or analyzed
PCB = polychlorinated biphenyl
pCi/L = picoCurie per liter
ROD = Record of Decision
SDWA = Safe Drinking Water Act of 1974

Achieve AWQC in waters of the state

White Oak Creek and Melton Branch (MB) are classified for Fish and Aquatic Life, Recreation, and Livestock Watering and Wildlife uses, but not for Domestic or Industrial Water Supply or Irrigation. All other named and unnamed surface waters in the watershed are also classified for Irrigation by default under the Rules of the TDEC Chapter 1200-4-4. Numeric AWQC and narrative criteria for the protection of human health (based on ELCR of 1 X 10^{-4} and HI less than 1 for recreational exposure scenario) and aquatic organisms will be met for site-related contaminants in all waters of the state in MV in ~10 years from completion of source actions in MV. Numeric AWQC exists for selected compounds under the Recreation and Fish and Aquatic Life Classifications. Consistent with EPA guidance, compliance with numeric AWQC for Recreation and Fish and Aquatic Life Classifications is sufficiently stringent to ensure protection of other uses for which there are narrative, but not numeric, criteria (i.e., Irrigation or Livestock Watering and Wildlife). A recreational risk scenario considered representative of the surface water classifications is used to calculate cumulative risk from measured concentrations of surface water contaminants or conversely to derive allowable concentrations from risk-based limits.

AWQC in Waters of the State—Numeric AWQC

The numeric AWQC for (1) Fish and Aquatic life and (2) Recreation (organisms only) apply to waters of the state in MV and are tabulated in Rules of the TDEC Chapter 1200-4-3-.03 for most of the COCs. Compliance will be based on statistically valid data assessments, and take into account frequency of detection and data trends. The sampling locations for the selected remedy will be finalized in a post-ROD sampling plan. The locations are generally at the downstream end of individual reaches but upstream of any confluence with other major streams. Samples taken from such locations would essentially integrate contamination entering the reach from any sources upstream of the sampling location.

AWQC in Waters of the State ¾ Narrative Criteria

In accordance with EPA guidance, the CERCLA risk assessment process is used to address the narrative criteria for waters of the state. A recreational risk scenario considered representative of the surface water classifications is used to calculate cumulative risk from measured concentrations of surface water contaminants or conversely to derive allowable concentrations from risk-based limits. However, DOE does not reasonably foresee actual recreational use of MV surface water in the future.

Waters of the state containing COCs that do not have numeric AWQC will achieve an annual average ELCR less than 1 X 10^{-4} and an HI less than 1 for a recreational exposure scenario. This goal applies only to surface water and only to those contaminants of concern that do not have numeric AWQC, such as radionuclides. The numeric AWQC for individual contaminants is generally equivalent to risk levels ranging up to 10^{-5}. The annual average risk goal of 1 X 10^{-4} meets the intent of the AWQC because when multiple contaminants are present in the surface water, as is likely, their individual risk levels would be roughly equivalent to the AWQC-equivalent risk of 10^{-5}. A lower risk goal could routinely require individual contaminant risks to be below the AWQC-equivalent risk of 10^{-5}.

Under this ROD, the recreational scenario is defined as a swimming scenario for the impounded water bodies, such as White Oak Lake and the WOCE, and a wading scenario for streams such as WOC and MB. Since contaminated sediments are left in place under the remedy in this ROD, the swimming or wading scenarios do not include external exposure to or contact with sediment. Also, the scenarios do not include fish consumption because some contaminants in fish may be linked to contaminated *sediments. Table 3.5 [sic] lists the remediation levels for the recreational surface water COCs identified in the FS. The sampling locations for the selected remedy will be finalized in a post-ROD sampling plan."*

Table 3.5. Recreational risk-based surface water remediation concentrations for the Melton Valley Watershed, ORNL, Oak Ridge, Tennessee[a]

COCs identified in the FS[b]	Units	Reference Concentration	Minimum Detection Limit[d]	Concentrations based on a recreational swimming scenario[e] (for White Oak Lake and White Oak Creek Embayment)	Concentrations based on a recreational wading scenario[f] (for White Oak Creek, Melton Branch, and other waters of the state)
Arsenic	mg/L	ND	0.003	NA[g]	NA[g]
Tetrachloroethylene	mg/L	ND	0.001	NA[g]	NA[g]
Vinyl chloride	mg/L	ND	0.001	NA[g]	NA[g]
Cesium-137+D	pCi/L	40	10.0	4.69E+04	2.37E+05
Cobalt-60	pCi/L	ND	10.0	7.84E+04	3.92E+05
Radium-228+D	pCi/L	ND	0.5	5.97E+03	2.99E+04
Strontium-90+D	pCi/L	ND	2.0	2.65E+04	1.33E+05
Tritium	pCi/L	1,626	300	2.07E+07	1.04E+08
Uranium-234	pCi/L	ND	0.5	3.34E+04	1.67E+05

Note: The remediation levels are calculated at 1 X 10^{-4} ELCR or HI of 1 using standard risk assessment protocols for a swimming or wading scenario. These values apply to single contaminants only. To account for the total risk from multiple contaminants, sum of ratios calculations may be applied to all contaminants that are present above background. Actual remediation concentrations when multiple contaminants are present will therefore likely be lower than the single contaminant concentrations listed in the table. Concentrations for other site-related contaminants not listed in the table will be determined as necessary and in a manner similar to that followed above.

[a] Source: MV ROD Table 2.19.

[b] Beryllium was identified as a COC in the FS but was not included here because EPA has since revised its position on the carcinogenicity of beryllium (see Table 2.5).

[c] Reference concentrations equal twice the arithmetic mean of the background; these concentrations were used for surface water analyte screening in the MV watershed risk assessment.

[d] The minimum detection limits are based on existing regulatory methodology and current laboratory instrument capabilities.

[e] The recreational swimming scenario assumes a 70-kg adult receptor, an exposure frequency of 45 hours/year, an exposure duration of 30 years, an ingestion rate of 0.05 L/hour, and a skin surface area (for dermal exposure) of 1.94 m^2.

[f] The recreational wading scenario assumes a 70-kg adult receptor, an exposure frequency of 45 hrs/yr, an exposure duration of 30 years, an ingestion rate of 0.01 L/hour, and a skin surface area (for dermal exposure) of 0.632 m^2.

[g] Risk-based concentrations to meet the narrative criteria were not derived for these COCs since numeric AWQC exists for them.

AWQC = ambient water quality criteria
COCs = contaminants of concern
D = daughter products
ELCR = excess lifetime cancer risk
EPA = Environmental Protection Agency
FS = feasibility study
HI = hazard index
kg = kilogram
mg/L = milligrams per liter
m^2 = square meter
MV = Melton Valley
NA = not applicable
ND = not detected or analyzed
ORNL = Oak Ridge National Laboratory
pCi/L = picoCuries per liter
ROD = Record of Decision

3.2.1.2 Performance Objectives and Performance Measurement

In addition to the ROD surface water quality remediation goals stated above, the MV ROD included specific performance objectives and performance measures that form the basis of remediation effectiveness monitoring. These performance objectives provide a quantitative basis to evaluate the effectiveness of hydrologic isolation at limiting contaminant releases from buried waste by monitoring groundwater fluctuation within hydrologic isolation areas. Additionally, the performance measure for surface water quality is to achieve the AWQC numeric and narrative goals related to contaminant discharges originating from MV areas within 2 years after completion of remedial actions. Table 3.6 includes the ROD performance objectives and performance measures for those elements of the remedy that specified post-remediation monitoring. Also, included in Table 3.6 are goal attainment dates and references to sections in this RER where the annual status of performance for each metric are discussed.

3.2.1.3 Groundwater Quality Goals and Monitoring Requirements

The MV ROD goal for groundwater is to mitigate further impact to groundwater. The combined elements of the remedy including hydrologic isolation of buried waste, *in situ* grouting (ISG) of Liquid Waste Seepage Trenches 5 and 7, and excavation of contaminated soils and pond sediment per ROD cleanup levels are the measures taken to mitigate further groundwater impacts from the MV CERCLA units. The ROD stipulates that groundwater be monitored in the exit pathway along the western edge of the valley, in the vicinity of the hydrofracture waste injection sites, and in the vicinity of contaminant source control areas. Monitoring results obtained to date in these areas are discussed later in this chapter. Monitoring of groundwater at SWSA 6 is conducted under the requirements of the SWSA 6 Post-Closure Permit Application [pending approval by TDEC–Division of Solid Waste Management (DSWM)]. Data obtained from the SWSA 6 Resource Conservation and Recovery Act of 1976 (RCRA) monitoring is used to evaluate the post-remediation groundwater quality conditions at the site perimeter.

Minimization of surface water infiltration and groundwater inflows into buried waste to reduce contaminant releases is key to the concept of hydrologic isolation. The MV remedy utilizes multi-layer caps to prevent vertical infiltration of rainwater into buried waste or other hydrologic isolation units as well as upgradient storm flow interceptor trenches, where necessary, to prevent shallow subsurface seepage from entering the areas laterally. The MV ROD included the performance goal of reducing groundwater level fluctuations within hydrologically isolated areas by >75% from pre-construction fluctuation ranges (Table 3.6). Prior to remediation, groundwater levels were observed to rise into waste burial trenches in many areas of MV. In some areas waste trenches were known to fill with water completely during winter months. Contact of this water with buried waste materials was the source of contaminated leachate that subsequently seeped downward and laterally to adjacent seeps, springs, and streams. The performance goal of attaining a >75% reduction in groundwater level fluctuations created a design requirement to minimize, as much as possible, the contact of groundwater with buried waste to reduce the contaminated leachate formation process. As such, the fluctuation range is most relevant in cases where groundwater levels rise into the waste burial elevation ranges. Groundwater level fluctuations at elevations below the contaminant sources have less importance to the overall remedy effectiveness. During the remedial design of each hydrologic isolation area wells were selected for monitoring post-remediation groundwater level fluctuations, baseline fluctuation ranges were evaluated, and target post-remediation groundwater elevations were determined to indicate that groundwater levels had dropped to below the 75% fluctuation range elevation. Target groundwater elevations and fluctuation ranges for wells within hydrologically isolated areas are presented in Sect. 3.2.2.2 (Tables 3.11–3.13) along with a summary of the FY 2007 monitoring results. Figure 3.4 shows well locations where groundwater levels are monitored to evaluate remedy performance.

Table 3.6. Performance measures for major actions in the Melton Valley Watershed, ORNL, Oak Ridge, Tennessee[a]

Unit type/ unit names project scope	Performance objectives	Performance measure, [b,c] Attainment schedule and RER section
• SWSA 4 • SWSA 4 • Liquid Seepage Pit 1 & Secondary Media • Inactive Waste Transfer Lines @ Lagoon Rd. • Pilot Pits Area • Shallow Well P&A	• Contain disposed & contaminated materials • Meet RAO for the waste management use area [soil]	• Prevent releases from SWSA 4 from causing AWQC exceedances in waters of the state within 2 years after SWSA 4 construction is complete. (Fall 2008). [See Sect. 3.2.2.1.3] ▪ Reduce SWSA 4 contaminant releases to surface water by approximately 80% to meet computed 1 X 10-4 total residential risk at the confluence of White Oak Creek with Clinch River in ~10 years after all ROD actions are complete (2016). [See Sect. 3.2.2.1] ▪ Reduce groundwater through flow in buried waste units by >75% as measured by >75% decrease in water level fluctuations in selected monitoring locations inside the contained area. [See Sect. 3.2.2.2]
• SWSA 5 South • SWSA 5 South • Stabilized OHF Pond and Tanks • Stabilized subsurface OHF facilities • Contaminated soils at OHF site • Shallow Well P&A	• Contain disposed materials • Meet RAO for the waste management use area [soil]	• Prevent releases from SW 5 South from causing AWQC exceedances in waters of the state in Melton Branch, Lower HRE Tributary, and SWSA 5 D1 within 2 years after SWSA 5 South construction is complete. (Fall 2008). [See Sect. 3.2.2.1.3] • Reduce SWSA 5 contaminant releases to surface water by approximately 80% to meet computed 1 X 10-4 total residential risk at the confluence of White Oak Creek with Clinch River in ~10 years after all ROD actions are complete (2016). [See Sect. 3.2.2.1] • Reduce groundwater through flow in buried waste units by >75% as measured by >75% decrease in water level fluctuations in selected monitoring locations inside the contained area. [See Sect. 3.2.2.2]
• SWSA 5 North 4 Trenches	• Contain disposed materials • Meet RAO for the waste management use area [soil]	• Verify that groundwater does not contact the buried waste through water level. • monitoring in and adjacent to the trenches after capping. [See Sect. 3.2.2.2]
• SWSA 6 • SWSA 6 • Shallow Well P&A	• Contain disposed materials • Meet RAO for the waste management area [soil]	• Prevent releases from SWSA 6 from causing AWQC exceedances in waters of the state within 2 years after SWSA 6 construction is complete (Fall 2008). [See Sect. 3.2.2.1.3] • Comply with RCRA post-closure requirements for designated RCRA areas (Ongoing). • Reduce groundwater through flow in buried waste units by >75% as measured by >75% decrease in water level fluctuations in selected monitoring locations inside the contained area. [See Sect. 3.2.2.2]

Table 3.6. Performance measures for major actions in the Melton Valley Watershed, ORNL, Oak Ridge, Tennessee[a] (continued)

Unit type/ unit names project scope	Performance objectives	Performance measure, [b,c] Attainment schedule and RER section
• Pits 2, 3, and 4 and Trench 6 • Liquid seepage pits • Inactive waste pipelines • Shallow well P&A	• Contain disposed materials • Meet RAO for the waste management use area [soil]	• Prevent releases from Liquid Waste Seepage Pits 2, 3, and 4, and Trench 6 from causing AWQC exceedances in waters of the state within 2 years after construction is complete (Fall 2008). [See Sect. 3.2.2.1.3] • Reduce groundwater through flow in the contained area by >75% as measured by >75% decrease in water level fluctuations in selected monitoring locations inside the contained area. [See Sect. 3.2.2.2]
• Trenches 5 and 7 • Liquid seepage trenches • Inactive waste pipelines • Shallow well P&A	• Immobilize disposed materials. • Meet RAO for the waste management use area. [soil]	• Prevent releases from Seepage Trenches 5 and 7 from causing AWQC exceedances in waters of the state within 2 years after ISG is complete (Fall 2008). [See Sect. 3.2.2.1.3] • Grout any additional contaminated soils that cause contamination of groundwater leading to surface water exceedances.
• Surface water quality	• Meet TDEC numeric AWQC and narrative (risk-based) water quality criteria in all waters of the state for specified uses. • Meet risk levels for hypothetical recreational water use (contact and consumption under the recreational exposure scenario).	• Achieve numeric AWQC and narrative (risk-based) water quality criteria in waters of the state within 2 years after completion of all actions that are part of the selected remedy. Meet recreation use criteria for water contact and consumption, excluding fish consumption (Fall 2008). [See Sect. 3.2.2.1.3] • Reduce contaminant releases to meet water quality conditions that would allow hypothetical residential use (risk level of 1 X 10-4 for water only – no fish consumption or sediment contact scenarios) at confluence with the Clinch River in ~10 years after completion of all ROD actions. Reductions in ^{90}Sr and tritium of 75-80% are required. [See Sect. 3.2.2.1]

[a] Source: Melton Valley ROD Table 2.17.

[b] To meet a target post-remediation risk level of 1 X 10^{-4} for surface water under the residential scenario at the mouth of White Oak Creek an 80% reduction of risk from the sum of individual contaminants from combined sources in Melton Valley is required. This calculation includes anticipated reductions in surface water contaminant risk that originate in Bethel Valley. Reduction of releases from individual source areas in MV as a result of remedial actions may vary somewhat. For all remediated areas, post-construction surveillance and maintenance monitoring will be implemented, which includes inspection of cap integrity, proper functioning and maintenance of surface water and groundwater flow control features, and conformance with land use control requirements.

AWQC = ambient water quality criteria
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
> = greater than
HRE = Homogeneous Reactor Experiment
ISG = *in situ* grouting
MV = Melton Valley
OHF = Old Hydrofracture Facility
ORNL = Oak Ridge National Laboratory
% = percent
P&A = plugging and abandonment
RAO = remedial action objective
RCRA = Resource Conservation and Recovery Act of 1976
ROD = Record of Decision
Sr = strontium
SWSA = Solid Waste Storage Area
TDEC = Tennessee Department of Environment and Conservation

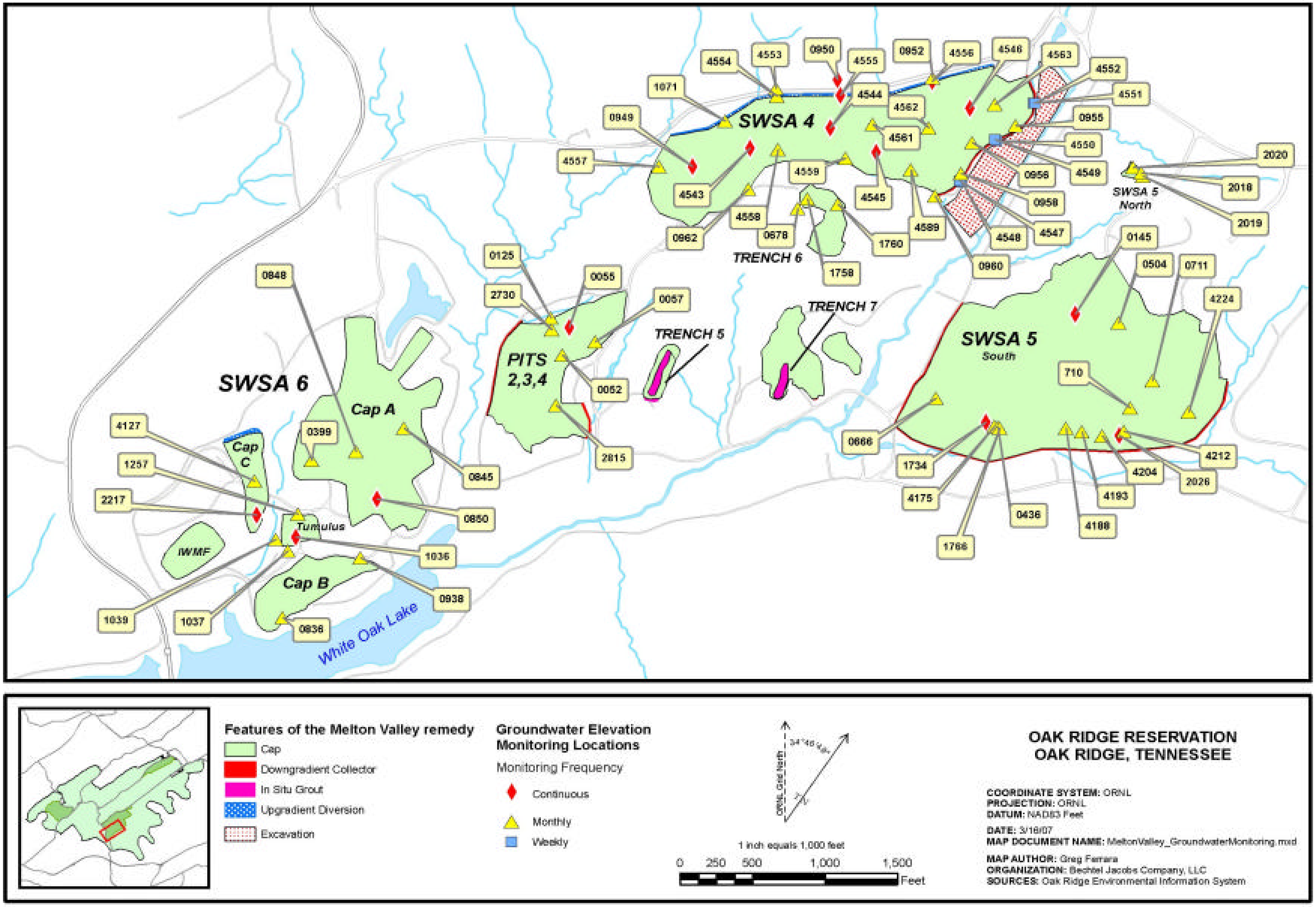


Fig. 3.4. Locations of Melton Valley groundwater elevation monitoring wells and monitoring frequencies.

During the design process for ISG of Liquid Waste Seepage Trenches 5 and 7 a groundwater quality monitoring plan was prepared and implemented to monitor 13 wells in the vicinity of those two units for water quality evaluation. Results of that sampling and analyses are included in Sect. 3.2.2.2.2.

Groundwater emanating from capped waste areas is collected by downgradient interceptor trenches at SWSA 5; along the eastern edge of SWSA 4; southeast of Trench 7; along the eastern and western sides of Pits 2, 3, and 4; and at Seep D. The system includes some 30+ pumps that are operated based on automated level controls in the groundwater collection areas. The collected groundwater is all routed to an equalization tank located at SWSA 4 before transfer to the ORNL PWTC in BV. Water at the equalization tank is sampled to verify that the wastewater meets the facility waste acceptance criteria (WAC).

3.2.2 Evaluation of Performance Monitoring Data

3.2.2.1 Surface Water Monitoring Data

This section provides an evaluation of the surface water quality data collected during FY 2007 compared to the MV ROD (DOE 2000a) goals and performance metrics. Surface water monitoring station locations are shown on Fig. 3.3. Section 3.2.2.1.1 presents information concerning major radionuclide concentrations and fluxes at the surface water IP monitoring stations. Section 3.2.2.1.2 presents data obtained at the tributary sampling locations. Section 3.2.2.1.3 provides a discussion of AWQC and aquatic biota monitoring in MV. Comparison of surface water quality conditions to historic conditions is included in Sect. 3.4.

3.2.2.1.1 Integration Point Monitoring Results

Table 3.7 includes the concentrations of ^{90}Sr, ^{3}H, and ^{137}Cs from the monthly flow-paced composite samples obtained at main stem integration points including 7500 Bridge, WCWeir, MBWeir, and WOD. Flow-paced composite samples are also collected at SWSA4 SW1 and at WAG6 MS3. The monthly flow-paced sampling provides continuous sampling of surface water at each sample station, thus providing a reliable measure of the time-averaged contaminant concentration. During 2005 and 2006 contaminant flux estimates showed an imbalance between the 7500 Bridge and the WOC weirs possibly related to flow measurement inaccuracies. During FY 2007 sediment accumulations were removed from areas upstream of the 7500 Bridge weir and from the MB and WOC weirs to improve the flow volume measurement accuracy through all stages of flow.

Table 3.7. Summary of FY 2007 radiological contaminant levels in surface water in Melton Valley

Monthly FPC Date	7500 Bridge			WCWeir			MBWeir			White Oak Dam		
	^{90}Sr	^{3}H	^{137}Cs	^{90}Sr	^{3}H	^{137}Cs	^{90}Sr	^{3}H	^{137}Cs	^{90}Sr	^{3}H	^{137}Cs
25-Oct-06	33.1	30,200	12.3	34	26,000	9.5	110	42,000	4.8 (U)	72	55,000	120
29-Nov-06	33.2	26,400	12.7	37	31,000	16	77	20,000	5.1 (U)	73	23,000	29
27-Dec-06	25.3	28,700	12.5	26	31,000	21	41	25,000	3.4 (U)	59	31,000	24
31-Jan-07	25.5	20,500	18.2	29	23,000	11	38	18,000	3.8 (U)	59	26,000	9.4
28-Feb-07	26.7	26,400	17.4	28	32,000	17	27	19,000	5.1 (U)	45	27,000	22
28-Mar-07	23	18,600	16.8	24	22,000	25	32	18,000	4.5 (U)	47	21,000	36
25-Apr-07	25	17,900	18.7	28	18,000	19	30	14,000	5.5 (U)	44	17,000	43
30-May-07	30.9	20,900	18.7	30	24,000	12	22	14,000	5.4 (U)	53	19,000	26
27-Jun-07	22.8	25,900	20.5	32	30,000	16	28	15,000	5.3 (U)	52	25,000	21
25-Jul-07	28.1	22,000	28.3	32	30,000	42	38	15,000	5.1 (U)	52	29,000	**170**
29-Aug-07	25.3	30,700	10.6	27	22,000	22	36	16,000	4.3 (U)	44	30,000	32
26-Sep-07	22.6	28,600	-0.8(U)	27	41,000	12	27	11,000	5.4	40	29,000	20
Average Concentration (pCi/L)	26.89	24,733	16.9	29.5	27,500	18.5	42.2	18,917	-	53.3	27,667	46.0
Flux (Curies)	0.139	122	0.08	0.172	151	0.10	0.06	25.6	0.003	0.48	225	0.33

Concentration values are pCi/L.
Flux values are curies.
Cs = cesium
DGT = downgradient trench
FPC = flow-paced composite sample
FY = fiscal year
MB = Melton Branch
pCi/L = picoCuries per liter
P&T = pits and trenches
SWSA = Solid Waste Storage Area
WC Weir = White Oak Creek Weir
U = reported concentration was below the minimum detectable activity – analyte was not detected.
Bold font values at White Oak Dam were greater than the MV ROD water quality goal (^{137}Cs = 150 pCi/L, ^{90}Sr = 85 pCi/L, tritium = 58,000 pCi/L) for protection of the Clinch River. MVROD radiological contaminant concentrations are met at all locations except where bold font indicates and exceedance.

Key observations from data presented in Table 3.7 include the following:

Strontium-90

Principal historic sources of ^{90}Sr that affect surface water in MV include discharges from BV, SWSA 4, and SWSA 5 South. During FY 2007 the ^{90}Sr concentration for water entering MV at the 7500 Bridge was fairly stable with an average concentration of about 27 pCi/L, and a maximum of 33.2 pCi/L was measured in November 2006. The ^{90}Sr concentration downstream at the WCWeir averaged 29.5 pCi/L indicating a fairly steady concentration regime in the reach between the two stations. Strontium-90 concentrations measured at the MBWeir decreased following the first quarter of the year from a maximum concentration of 110 pCi/L measured in October 2006 to concentrations that varied between about 25 to 40 pCi/L during the latter half of the FY. The MB average ^{90}Sr concentration for the year was about 42 pCi/L. At White Oak Dam (WOD) the ^{90}Sr concentration exhibited a gradual decrease from the first quarter with a maximum of 73 pCi/L in November 2006 to concentrations in the 40's to 50's pCi/L throughout the remainder of the year. The 2007 average ^{90}Sr concentration at WOD was 53.3 pCi/L.

All ^{90}Sr concentrations in surface water during FY 2007 were less than the MV ROD remediation goal.

An estimated 0.14 Ci of ^{90}Sr entered MV in WOC at the 7500 Bridge. At WCWeir about 0.17 Ci was measured. Monitoring at SWSA4 SW1 measured approximately 0.003 Ci of ^{90}Sr that discharged from the SWSA 4 and Intermediate Holding Pond (IHP) areas into WOC during the 65 days throughout FY 2007 when surface water flow occurred at the monitoring station. Monitoring at WAG6 MS3 measured a flux of 0.008 Ci of ^{90}Sr that discharged from the western portion of SWSA 6 into White Oak Lake (WOL). The ^{90}Sr flux at MBWeir and WOD were 0.06 Ci and 0.48 Ci, respectively.

During FY 2007 all the ^{90}Sr concentrations measured at WOD were less than the MV ROD remediation goal (85 pCi/L) for surface water quality to protect water quality in the CR. The ROD expectation was to attain this goal within 10 years of completion of RAs. Strontium-90 concentrations in surface water at the integration point sampling locations were well below the on-site recreational remediation goal (see Table 3.5) for all sample periods during FY 2007. Comparison of the FY 2007 ^{90}Sr discharges to historic conditions is included in Sect. 3.4.

Tritium

Historically, the major source areas of ^{3}H discharges to surface water in MV were SWSA 5 South, SWSA 6, and SWSA 4. The result of MV remedial action has been a substantial reduction of ^{3}H discharge to surface water in MV and relocation of ^{3}H discharge to the PWTC Outfall (X12) in BV because of groundwater collection and treatment. During FY 2007, the monthly composite sample ^{3}H concentrations measured in WOC as it enters MV at the 7500 Bridge averaged about 24,700 pCi/L with a maximum detected concentration of 30,700 pCi/L in August 2007. Tritium concentrations downstream at the WCWeir averaged 27,500 pCi/L with a maximum concentration of 41,000 pCi/L measured in September 2007. Sources of tritium in the stream reach between these two stations include SWSA 4 and the western slope of SWSA 5. Surface water flow from SWSA 4 into WOC via the former IHP area contained an average tritium concentration of slightly more than 11,000 pCi/L. Groundwater seepage directly into the WOC streambed from the western slope of SWSA 5 may be a source of the tritium increase in this reach. Tritium concentrations in monthly composite samples from the MBWeir decreased steadily from a maximum of 42,000 pCi/L in October 2006 to 11,000 pCi/L measured in September 2007, and the average tritium concentration was

All monthly composite tritium concentrations in surface water during FY 2007 were less than the MV ROD remediation goal.

slightly below 19,000 pCi/L. At WOD the monthly composite tritium concentrations varied throughout the year with a maximum of 55,000 pCi/L in October 2006 and an average concentration of about 27,700 pCi/L for the year. All of the monthly flow composite samples from WOD were less than the MV ROD goal of 58,000 pCi/L for tritium concentration.

The FY 2007 flux of tritium that entered MV at the 7500 Bridge was 122 Ci. At the WCWeir, 151 Ci of tritium was measured. Monitoring at SWSA4 SW1 measured a flux of approximately 0.14 Ci of ^{3}H that discharged from the SWSA 4 and IHP area into WOC. The measured tritium flux at MBWeir for FY 2007 was 25.6 Ci. WAG6 MS3 measured approximately 10.7 Ci of ^{3}H discharged from the western portion of SWSA 6 to WOL. The ^{3}H flux measured at WOD during FY 2007 was 225 Ci. Additional discussion of the FY 2007 surface water contaminant discharges is presented in Sect. 3.4.

Cesium-137

Sources of ^{137}Cs in surface water in MV include stream channel sediment and floodplain soils throughout WOC and its floodplain in MV, lakebed sediment in WOL and the White Oak Creek Embayment (WOCE) (downstream of WOD to the sediment retention structure at CR), as well as a variable influx from BV that enters via WOC at the 7500 Bridge. As shown in Table 3.7, the influx concentrations of ^{137}Cs at 7500 Bridge averaged about 17 pCi/L, with a maximum concentration of 28.3 pCi/L that was measured in the July 2007 flow-paced sample. As reported in previous RERs, episodic ^{137}Cs spikes are occasionally detected at 7500 Bridge, WCWeir, and at WOD. These spikes are often attributable to high rainfall events, especially after periods of low flow during which cesium discharged from the ORNL PWTC tends to bind to fine-grained stream channel sediment. Strong storms mobilize and flush these sediments down the stream system causing the episodic pulses of elevated cesium table detected in monitoring data. The much below-average rainfall during FY 2007 and the absence of strong storms that cause stream channel scour minimized the transport of ^{137}Cs from BV.

The average ^{137}Cs concentration in surface water during FY 2007 was less than the MV ROD remediation goal.

Cesium-137 measured at the WCWeir averaged about 19 pCi/L with a maximum of 42 pCi/L measured in the July 2007 composite sample. MB has not been a significant source of historic ^{137}Cs discharge and during FY 2007 this radionuclide was measured above its detection limit in only one of the 12 monthly composite samples. Cesium-137 was not detected in the flow composite samples collected at the SWSA4 SW1 sampling site where surface water contaminants from the SWSA 4 area are monitored. At WOD the average concentration of ^{137}Cs was 46 pCi/L with a maximum of 170 pCi/L measured in the July 2007 composite sample. Cesium-137 was not detected in the composite samples from WAG6 MS3. The flux measurements of ^{137}Cs in MV surface water during FY 2007 indicate that approximately 0.08 Ci entered the system at 7500 Bridge, approximately 0.10 Ci was measured at WCWeir, MBWeir measured approximately 0.003 Ci during September 2007 which was the only month ^{137}Cs was detected. Monitoring at WOD indicates 0.33 Ci was discharged to the WOCE at WOD.

Although the maximum monthly composite sample ^{137}Cs concentration of 170 pCi/L, which occurred in July 2007, exceeded the remediation goal for protection of the CR as a domestic water supply, the 46 pCi/L average ^{137}Cs concentration at WOD was less than the remediation level (150 pCi/L) for protection of the CR, as provided in Table 3.4. The ROD expectation was to attain this goal within 10 years of completion of remedial actions. Cesium-137 concentrations in surface water at the IP sampling locations were well below the on-site recreational remediation goal (see Table 3.5) for all sample periods during FY 2007. Additional discussion of the FY 2007 surface water contaminant discharges is presented in Sect. 3.4.

3.2.2.1.2 Tributary Surface Water Monitoring Results

Tributary monitoring locations are sampled to evaluate the effect of remedial actions on water quality in tributaries to WOC and MB. Tributary sample locations are shown on Fig. 3.3 and samples are obtained by the grab method. Tributary sampling results are presented by geographic areas, generally from west to east, throughout MV.

Table 3.8 presents a summary of radiological analyses conducted on samples from tributary monitoring locations in the MV Seepage Pits and Trenches area during FY 2007. WEST SEEP is the stream that drains the eastern slope of SWSA 6; the western side of Seepage Pits 2, 3, and 4; and receives drainage from the western end of the SWSA 4 cap. EAST SEEP is the drainage area for the eastern side of Seepage Pits 2, 3, and 4 and the western side of Trench 5. WCTRIB-1 is the drainage area that receives groundwater seepage from the eastern side of Trench 5, the western side of Trench 7, and Trench 6. T7-TRIB is a seep on the eastern side of Trench 7 that has been intercepted by a downgradient drain related to Trench 7. Because of drought conditions during 2007 samples were not available from WCTRIB-1 or T7-TRIB.

Significant alpha and beta activity levels are routinely detected at the East and West Seep sampling locations in 2007. Carbon-14 is detected in surface water at EAST SEEP location. The source of ^{14}C was the LLLW that was disposed in the Seepage Pits and Trenches. Although the pH treatment of the liquid wastes chemically immobilized most of the radiological constituents, carbon was less affected than other cationic contaminants. Cesium-137 is not a significant surface water contaminant in the Seepage Pits and Trenches area and this contaminant was not detected in any samples from EAST SEEP and WEST SEEP during FY 2007. Cobalt-60 has long been known to be mobile in groundwater that discharges to surface water in the Seepage Pits and Trenches and although this radionuclide was detected in surface water at the EAST SEEP in FY 2006 this contaminant was not detected in any of the 9 samples collected during FY 2007. Strontium-90 was detected at low concentrations in surface water at EAST SEEP and WEST SEEP during FY 2007. Low concentrations of ^{3}H are detected at EAST SEEP and WEST SEEP. Uranium-233/234 dominates the uranium isotopes that are all detected routinely at the EAST SEEP location. All FY 2007 surface water radiological analyses indicate that water quality in the Seepage Pits and Trenches area meets the on-site recreational RLs for wading (see Table 3.5).

FY 2007 Water quality in the Seepage Pits and Trenches area met the MV ROD radiological goal.

Table 3.8. Summary of FY 2007 Seepage Pits and Trenches area surface water radiological results

Chemical Name	Location ID	Average Value[a] (pCi/L)	Maximum concentration[a] (pCi/L)	Number Detects[b]	Number of results[c]
Alpha activity	EAST SEEP	18	29.5	10	10
	WEST SEEP	40.9	77.2	13	13
Beta activity	EAST SEEP	123	213	10	10
	WEST SEEP	82	219	13	13
Carbon-14	EAST SEEP		3,140	1	1
	WEST SEEP		407 U	0	2
Cesium-137	EAST SEEP		<9.38	0	10
	WEST SEEP		5.87 U	0	13

Table 3.8. Summary of FY 2007 Seepage Pits and Trenches area surface water radiological results (continued)

Chemical Name	Location ID	Average Value[a] (pCi/L)	Maximum concentration[a] (pCi/L)	Number Detects[b]	Number of results[c]
	EAST SEEP	41.1[d]	333[d]	10	10
Strontium-90	WEST SEEP	29.4	39.8	13	13
Tritium	EAST SEEP	4,370	4,430	10	10
	WEST SEEP	10,200	19,400	13	13
Uranium-233/234	EAST SEEP	16.2	26.1	9	9
Uranium-235/236	EAST SEEP	<0.34	0.67	4	9
Uranium-238	EAST SEEP	1.19	1.82	9	9

[a]All results met radiological risk-based goals of MV ROD (Table 3.5)
[b] Detects include only results positively quantified – not J or U qualified
[c] Number includes results of all analyses regardless of qualification.
[d] includes maximum value that is likely an outlier based on site history.
ID = identification U = not detected
MV = Melton Valley ROD = Record of Decision
pCi/L = picoCuries per liter

Table 3.9 presents radiological monitoring results for surface water stations around SWSA 5 and sampling locations are shown on Fig. 3.3. The SWSA5 D-1 is the stream that drains the area between SWSA 5 North and South. Homogeneous Reactor Test (HRT)-1A is a sampling location at the southeast corner of SWSA 5 on the HRE Tributary of MB. MBWeir is the principal monitoring station on MB on the south side of SWSA 5 South. Table 3.9 includes summary results from grab samples collected at HRT-1A, SWSA5 D1, and MBWeir and also includes summary results from the monthly flow-paced composite samples obtained by UT-B at the MBWeir monitoring station. The SWSA5 D-1 stream contained both alpha and beta activity in all samples. Cesium-137 and ^{60}Co were not detected at HRT-1A or at SWSA 5 D-1. Strontium-90 and ^{3}H are detected routinely at all sampling locations around SWSA 5 South, as shown in Table 3.9. Low concentrations of $^{233/234}$U were detectable at all 3 surface water monitoring stations around SWSA 5 during FY 2007. All FY 2007 surface water radiological analyses indicate that water quality in the SWSA 5 area meets the on-site recreational remediation levels for wading (Table 3.5).

FY 2007 water quality in the SWSA 5 area met the MV ROD radiological goal.

The portion of MV east of SWSA 5 South to the eastern edge of the HFIR facility is designated and remediated to allow government-controlled industrial land use. Surface water sample locations in this portion of MV include HRT-3, which samples surface water downstream of the MSRE and HRE facilities; MB2, which samples surface water downstream of the HFIR area; and MB HEADWATERS, which samples surface water in the headwaters of MB upstream of HFIR. Because of the extreme drought during FY 2007, no samples were obtained from the MB-HEADWATERS site.

FY 2007 water quality in the industrial and headwater area met the MV ROD radiological goal.

Table 3.10 presents the FY 2007 radiological data summary for sampling at these locations. At HRT-3, beta activity is attributable to contaminant discharges related to the remediated LLLW tanks, pipelines, and leaks associated with Tanks T-1 and T-2 and the pump station, as well as residual contamination from the HRE site. At MB2, ^{3}H is detected that originates from releases associated with the HFIR site and the remediated HFIR wastewater ponds. All FY 2007 surface water radiological analyses indicate that water quality in the Industrial Area and headwaters meets the on-site recreational RLs for wading (Table 3.5).

Table 3.9. Summary of FY 2007 SWSA 5 area surface water radiological results

Chemical Name	Location ID	Average Detected Value[a] (pCi/L)	Maximum Concentration[a] (pCi/L)	Number of Detects[b]	Number of Results[c]
Alpha Activity	HRT-1A	--	2.32 U	0	2
	MBWeir	< 3.8	4.2	2	14[d]
	SWSA5 D1	35.8	62.8	9	9
Beta Activity	HRT-1A	288	348	2	2
	MBWeir	86.9	230	14	14[d]
	SWSA5 D1	45.7	207	9	9
^{90}Sr	HRT-1A	131	156	2	2
	MBWeir	34.2	110	14	14[d]
	SWSA5 D1	8	16.9	9	9
^{137}Cs	HRT-1A	--	<4.5	0	2
	MBWeir	--	<5.5	0	14[d]
	SWSA5 D1	--	<9.6	0	9
^{3}H	HRT-1A	<1,000	1,000	1	2
	MBWeir	16,200	20,200	14	14[d]
	SWSA5 D1	11,800	28,600	9	9
$^{233/234}U$	HRT-1A	0.41	0.54	2	2
	MBWeir	< 0.12	0.11	1	2
	SWSA5 D1	14.9	14.9	1	1[e]

[a] All results met radiological risk-based goals of MV ROD (Table 3.5).
[b] Detects include only results positively quantified – not J or U qualified
[c] Number of results includes results of all analyses regardless of qualification.
[d] Includes 12 monthly flow paced composite samples and 2 semi-annual grab samples.
[e] No flow was present at the time of 4th quarter sampling for this parameter
HRT = Homogeneous Reactor Test
ID = identification
MB = Melton Branch
pCi/L = picoCuries per liter
SWSA = Solid Waste Storage Area
U = not detected

3.2.2.1.3 Ambient Water Quality Criteria Results

During 2002 a broad suite of AWQC parameters were analyzed at MV main stream and tributary monitoring stations and the results were published in the 2003 RER. The results indicated that mercury was the principal AWQC contaminant in surface water that exceeds the protectiveness criterion in MV and its distribution in surface water is primarily in the main stem of WOC. Although mercury is detected in collected groundwater in MV (Sect. 3.2.2.2.2), the principal source of mercury contamination to WOC is from facility discharges associated with Bldg. 4501 in BV. During FY 2008 surface water locations will be sampled for the numeric AWQC parameters to evaluate remedy effectiveness at 2-years post-completion which was the ROD goal for attainment of AWQC. Sampling results and evaluations will be reported in the 2009 RER.

Biological monitoring results for MV demonstrate progress toward meeting the goals of the MV ROD, which includes: (1) achieving numeric and narrative Tennessee AWQC, including protection of fish and aquatic life, in a reasonable amount of time, and (2) protecting ecological populations. To date, MV remedial actions have focused on waste capping and improvement to groundwater and surface water releases of radionuclides and were not specifically designed to address the ecological goals. However, MV remedial actions have improved aquatic communities since the 1980s (see Sect. 3.4.2), and it is expected that the cumulative actions in the watershed will, in time, further improve aquatic ecological communities and reduce overall ecological risks in the watershed.

Table 3.10. Summary of FY 2007 MV Industrial Area surface water radiological results

Chemical Name	Location ID	Average Value[a] (pCi/L)	Maximum Concentration[a] (pCi/L)	Number of Detects[b]	Number of Results[c]
Alpha activity	HRT-3	<3.0	8.9	6	13
	MB2	--	3.55 U	0	8
	MB-HEADWATERS[d]	--	--	--	--
Beta activity	HRT-3	254	414	13	13
	MB2	<17	90.1	12	13
	MB-HEADWATERS[d]	--	--	--	--
Cesium-137	HRT-3	--	9.97 U	0	13
	MB2	--	9.91 U	0	13
	MB-HEADWATERS[d]	--	--	--	--
Strontium-90	HRT-3	114	199	13	13
	MB2	<25	5.94	7	13
	MB-HEADWATERS[d]	--	--	--	--
Tritium	HRT-3	--	355 U	0	13
	MB2	<461	649	8	13
	MB-HEADWATERS[d]	--	--	--	--

[a] All results met radiological risk-based goals for MV ROD (Table 3.5).
[b]Detects include only results positively quantified – not J or U qualified.
[c] Number of results of all analyses regardless of qualification.
[d] No flow was present at the time of 4th quarter sampling for this parameter.

HRT = Homogeneous Reactor Test
ID = identification
MB = Melton Branch
MV = Melton Valley
pCi/L = picoCuries per liter
U = not detected

3.2.2.2 Groundwater Monitoring Data

This section includes discussions of the effectiveness of MV hydrologic isolation at controlling groundwater level fluctuations in contained areas (Sect. 3.2.2.2.1); groundwater quality monitoring results from the Seepage Pits and Trenches 5 and 7 areas and exit pathway wells (Sect. 3.2.2.2.2); and comparison of the FY 2007 collected groundwater quality to the PWTC WAC (Sect. 3.2.2.2.3).

3.2.2.2.1 Groundwater Level Control in Hydrologic Isolation Units

Hydrologic isolation systems in Melton Valley meet performance expectations.

As summarized in Sect. 3.2, a key component of the MV remedy is construction of caps and other hydrologic isolation features to reduce the volume of groundwater that comes in contact with buried waste and associated contaminated soils to form leachate. Each of the hydrologic isolation areas (SWSA 6, SWSA 4, SWSA 5 South and North, SWSA 6, and portions of the Seepage Pits and Trenches) have wells designated to measure the groundwater elevation within, and sometimes at the edge or outside, contained waste units. This section summarizes the results of FY 2007 groundwater level monitoring by area. Areas are discussed generally from west to east beginning with SWSA 6 and Pits 2, 3, and 4; followed by a discussion of Trench 6 and SWSA 4; and ending with SWSA 5.

SWSA 6 and Pits 2, 3, and 4 Groundwater Elevation Monitoring

Figure 3.5 shows well locations at SWSA 6 and Pits 2, 3, and 4 where groundwater elevations are monitored to evaluate hydrologic isolation effectiveness. Table 3.11 lists the wells and provides a data summary for FY 2007 results.

Groundwater levels in the SWSA 6 and Pits 2, 3, and 4 hydrologically isolated areas remained below target elevations throughout FY 2007.

As indicated in Table 3.11, 7 of the 12 wells at SWSA 6 lie within hydrologically isolated areas, had specified target elevations, and each well, except well 1036, also had specified post-remediation groundwater level fluctuation targets. During FY 2007, the monitoring data show that the remedy is having the desired effect on groundwater level control within hydrologically isolated areas. At each location where target elevations were specified for groundwater levels all data obtained during FY 2007 were below those elevations. Although groundwater fluctuation ranges remain greater than 25% of pre-remediation fluctuations the water table has dropped to levels lower than the targets indicating that hydrologic isolation has had the desired effect of reducing water contact with buried wastes.

The Interim Waste Management Facility (IWMF) is an engineered waste disposal system with seepage detection and monitoring features and, therefore, no groundwater level monitoring is required for that facility. As discussed in Sect. 3.2.1.2, the intent of the fluctuation range metric was to limit interaction of a fluctuating groundwater table with buried waste which would cause continuing waste leaching. Several wells at SWSA 6 show that groundwater levels have dropped below the target elevation that indicates the performance goal is met although the fluctuation range remains greater than the pre-remediation range. This condition is identified in this RER as an issue to be addressed by the ORNL CERCLA Core Team to consider refinement of this ROD performance metric. One well (2217) was dry on all dates measurements were made. Overall, the groundwater response inside the hydrologically isolated areas has responded as desired, with a general decline in groundwater elevations and dampening of the historic groundwater fluctuations.

At the Seepage Pits 2, 3, and 4 area, 5 wells that lie within the hydrologically isolated area were specified during the design process for groundwater elevation monitoring. The target groundwater elevations for wells at this area were based on the bottom elevation of the seepage pit waste units. During FY 2007, all the wells monitored in the area had average and maximum groundwater levels several feet below the former pit floor elevations and one well, 0052, was dry at all monitoring visits and below the target elevation.

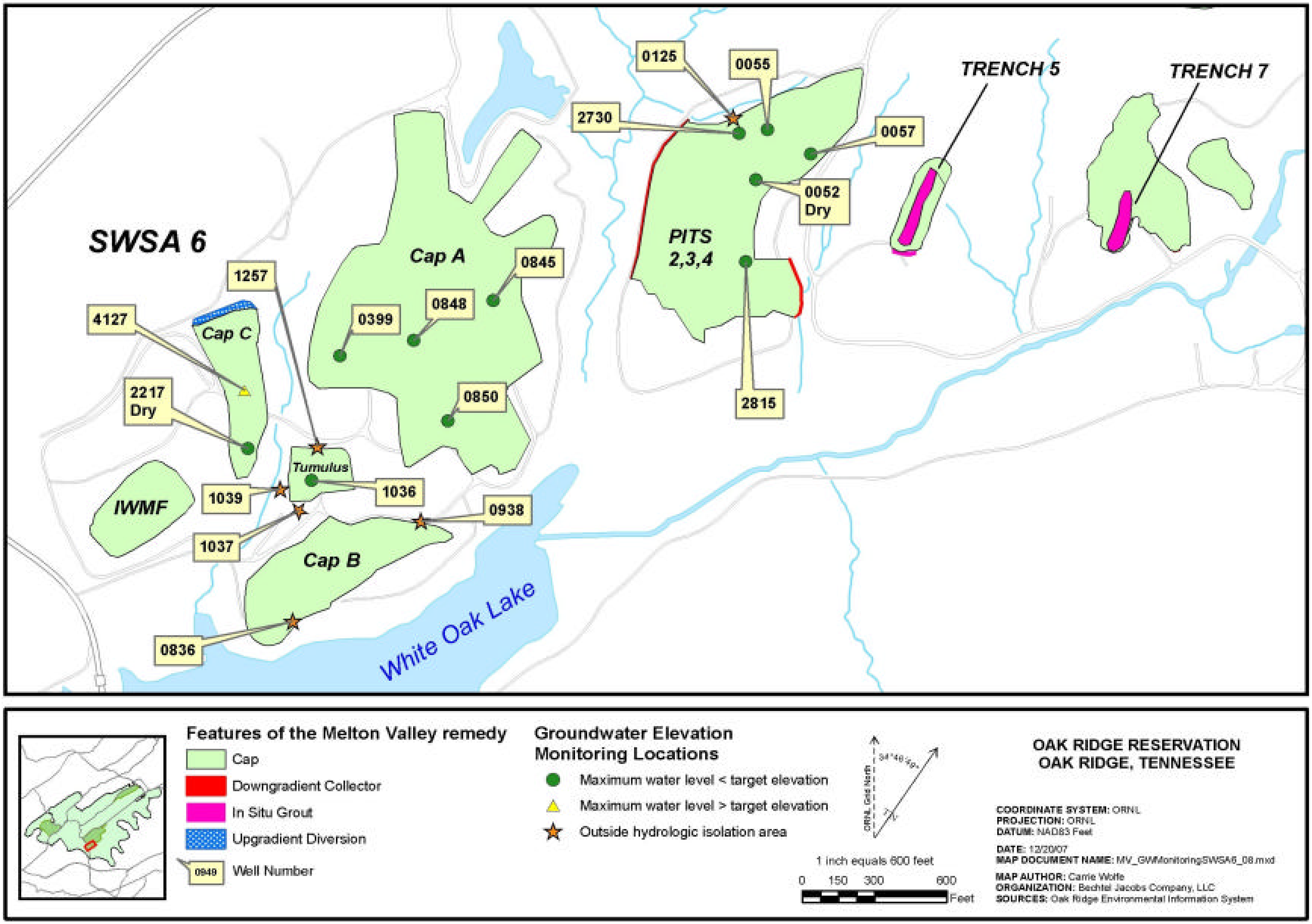


Fig. 3.5. SWSA 6 and Seepage Pits 2, 3, and 4 wells used to monitor groundwater elevations.

Table 3.11. Summary of FY 2007 groundwater elevation monitoring at SWSA 6 and Seepage Pits 2, 3, and 4

Well	Area	No. of Meas.	Min. Elev.	Avg Elev.	Max. Elev.	Obs. Range	Target Elevation (TE)[1]	Target Range (TR)[1]	Avg. Meets TE	Max. meets TE	Meets Fluct. TR	Comment
0399	SWSA 6	12	771.86	775.8	776.57	4.71	782.90	1.36	Y	Y	N	WL below TE
0836	SWSA 6	8	744.82	745.58	745.98	1.16	NA[2]	NA[2]	—	—	—	Outside cap edge
0845	SWSA 6	12	781.31	781.91	782.53	1.22	784.1	0.82	Y	Y	N	WL below waste
0848	SWSA 6	12	778.44	778.85	779.11	0.67	779.2	0.27	Y	Y	N	Steadily declining
0850	SWSA 6	359	764.57	765.63	766.72	2.15	765.9	2.1	Y	Y	N	Declining trend
0938	SWSA 6	12	752.59	754.325	756.19	3.6	NA[2]	NA[2]	—	—	—	Outside cap edge
1036	SWSA 6	359	758.44	760.69	762.73	4.29	768	NA[3]	Y	Y	—	
1037	SWSA 6	11	752.73	755.12	758	5.27	NA[2]	NA[2]	—	—	—	Outside cap edge
1039	SWSA 6	12	758.22	760.68	762.72	4.5	NA[2]	NA[2]	—	—	—	Outside cap edge
1257	SWSA 6	12	765.08	766.45	767.9	2.82	NA[2]	NA[2]	—	—	—	Outside cap edge
2217	SWSA 6	12	dry	dry	dry	0	767.6	2.5	--	--	--	Dry@769.58
4127	SWSA 6	12	771.17	772.76	773.8	2.68	772.3	2.25	Y	N	N	Bedrock well
0052	PT-2,3,4	12	dry	dry	dry	0	791.0	NA[3]	—	--	—	Dry
0055	PT-2,3,4	359	786.76	787.35	787.81	1.05	795	NA[3]	Y	Y	—	
0057	PT-2,3,4	12	781.52	782.7375	783.48	1.96	795	NA[3]	Y	Y	—	
0125	PT-2,3,4	12	782.25	784.47	785.36	3.11	NA[2]	NA[2]	—	—	—	Outside cap edge
2730	PT-2,3,4	12	777.71	778.69	779.21	1.5	791	NA[3]	Y	Y	—	
2815	PT-2,3,4	12	769.28	769.83	770.05	0.77	789	NA[3]	Y	Y	—	

[1]Target elevations and target fluctuation ranges specified in Appendix K of the Phased Construction Completion Report(PCCR) for Hydrologic Isolation at Solid Waste Storage Area 6 at the Oak Ridge National Laboratory, Oak Ridge, Tennessee (DOE/OR/01-2285&D1). Target elevation is the groundwater elevation equivalent to 75% fluctuation reduction. Target range is the fluctuation range equivalent to 75% fluctuation reduction.
[2]Fluctuation ranges and target elevations not applicable for wells outside hydrologic isolation area boundaries. These wells reflect conditions in unremediated areas.
[3]No target range specified in PCCR.

Avg. Elev. = average elevation
C = continuous flow measurement
Fluct. = fluctuation
FY = fiscal year
M = monthly
Max. Elev. = maximum elevation
Meas. Freq. = measurement frequency
Min. Elev. = minimum elevation
No. of Meas. = number of measurements
Obs. = observed
SWSA = Solid Waste Storage Area
TE = target elevation
TR = target fluctuation range
NA = not applicable

Seepage Trench 6 and SWSA 4 Groundwater Elevation Monitoring

Wells selected during the design processes at Seepage Trench 6 and SWSA 4 to monitor the effectiveness of hydrologic isolation at suppressing groundwater interaction with buried waste and associated contaminated soils are shown on Fig. 3.6.

Three wells were selected for groundwater level monitoring at Seepage Trench 6 (Table 3.12). One of the wells is located outside the capped area and the other 2 are within the cap. Average and maximum groundwater levels measured during FY 2007 were below the target groundwater elevation that was set equal to the liquid waste seepage trench floor. Groundwater level fluctuations beneath the cap responded to wet season rise and dry season decline. Although the measured groundwater level fluctuation in the two wells beneath the cap exceeded the desired range, the groundwater elevation remained well below the bottom of Trench 6 groundwater target elevation.

As discussed in Sect. 3.2.1.2, the intent of the fluctuation range metric was to limit interaction of a fluctuating groundwater table with buried waste which would cause continuing waste leaching. The water level observation wells at Trench 6 show that groundwater levels have dropped below the target elevation that indicates the performance goal is met although the fluctuation range remains greater than the pre-remediation range. This condition is identified in this RER as an issue to be addressed by the ORNL CERCLA Core Team to consider refinement of this ROD performance metric.

The SWSA 4 and Trench 6 hydrologic isolation system functioned as intended during FY 2007.

Thirty-seven wells are monitored at SWSA 4 to determine groundwater level behavior at that site. Fourteen of the wells are used to monitor the effectiveness of groundwater level control at the downgradient trench (DGT), 15 wells are located in the interior portion of the capped area, 5 wells are located in or very close to the upgradient trench (UGT), and 3 wells are located outside the cap. Groundwater level fluctuations observed inside the hydrologically isolated area at SWSA 4 were generally less than 1 ft during the monitoring period while wells outside the isolated region fluctuated several feet. Several of the wells inside SWSA 4 showed continuing gradual declines in groundwater elevation during FY 2007. Comparison of groundwater level fluctuations north of the UGT with those located in or inboard of the trench (toward the burial ground) demonstrate that the trench functions effectively to intercept and divert shallow inflows from the north.

Figure 3.7 shows the daily rainfall and groundwater elevations measured in the 3 DGT segments and in adjacent locations outside the SWSA 4 hydrologically isolated area in the IHP. The well hydrographs show that groundwater levels in the DGT are generally held at lower levels than those outside of the hydrologic isolation area consistent with the design objective. Groundwater elevations in the IHP respond to rainfall events to a much greater degree than the increases measured within most of the DGT and those observed inside the burial ground. Although FY 2007 was a drought year there were several rainfall events during autumn and winter that produced significant groundwater level rises outside the hydrologically isolated areas. Groundwater capture in the DGT was maintained and groundwater levels in the trench returned to pre-storm levels within about 72 hrs. The data obtained during FY 2007 show that the SWSA 4 hydrologic isolation system is functioning as intended.

SWSA 5 Groundwater Elevation Monitoring

All wells at SWSA 5 have maximum groundwater levels below their target elevations.

Wells selected during the design processes at SWSA 5 South and North to monitor the effectiveness of hydrologic isolation at suppressing groundwater interaction with buried waste and associated contaminated soils are shown on Fig. 3.8. Table 3.13 lists the wells and provides a data summary for FY 2007 results.

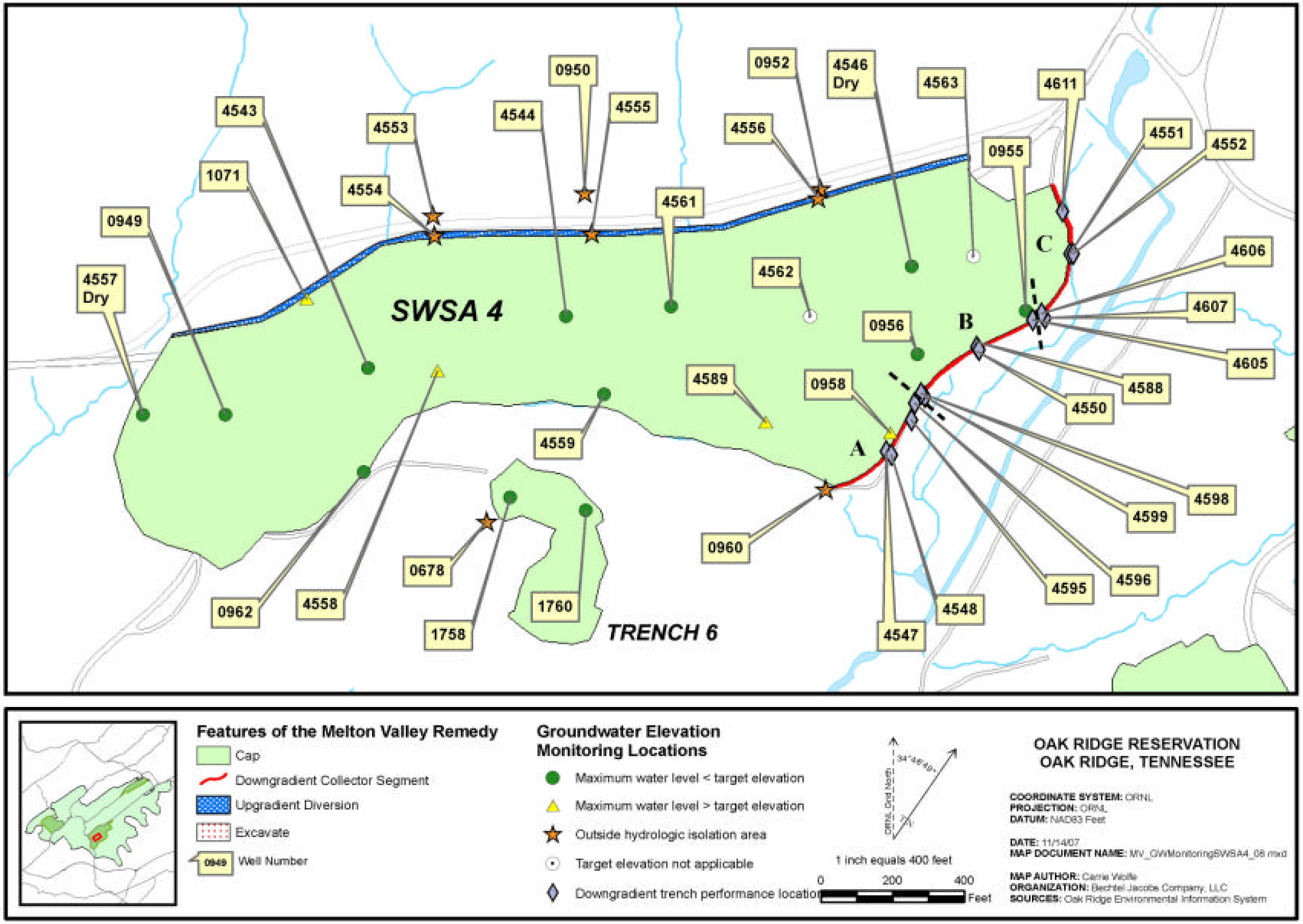


Fig. 3.6. Seepage Trench 6 and SWSA 4 wells used to monitor groundwater elevations.

Table 3.12. Summary of FY 2007 groundwater elevation monitoring at Seepage Trench 6 and SWSA 4 (continued)

Well	Area	No. of Meas.	Min. Elev.	Avg Elev.	Max. Elev.	Obs. Range	Target Elev. (TE)[1]	Target Range (TR)[1]	Avg. Meets TE	Max. Meets TE	Meets Fluct.	Comment
0678	PT-Trench 6	12	818.52	820.16	821.3	2.78	836	1.35	Y	Y	N	Outside cap edge
1758	PT-Trench 6	12	825.26	827.26	828.32	3.06	836	4.42	Y	Y	Y	WL below waste
1760	PT-Trench 6	12	817.91	818.98	819.87	1.96	836	1.0	Y	Y	N	WL below waste
0949	SWSA 4	359	803.93	804.67	805.37	1.44	813.78	1.48	Y	Y	—	Stable @ <804 Jul - Sep
0950	SWSA 4	359	820.4	824.36	828.12	7.72	NA[2]	NA[2]	—	—	—	Outside cap edge
0952	SWSA 4	12	808.17	810.62	814.77	6.6	NA[2]	NA[2]	—	—	—	Outside cap edge
0955	SWSA 4	12	758.2	758.46	759.06	0.86	759.42	1.03	Y	Y	Y	
0956	SWSA 4	360	768.51	768.77	769.21	0.7	770.49	0.4	Y	Y	N	Steadily declining
0958	SWSA 4	4	758.66	759.51	761.6	2.94	761.25	0.72	Y	N	N	Stable after first quarter
0960	SWSA 4	4	761.83	763.17	765.41	3.58	NA[2]	NA[2]	—	—	—	Outside cap edge
0962	SWSA 4	4	817.25	818.9	819.33	2.08	822.85	0.57	Y	Y	N	Near cap edge
1071	SWSA 4	4	802.09	802.25	802.45	0.36	802.44	0.79	Y	N	Y	
4543	SWSA 4	359	800.24	800.78	801.88	1.64	803.31	NA[3]	Y	Y	—	
4544	SWSA 4	359	789.21	789.34	789.48	0.27	791.89	NA[3]	Y	Y	—	
4546	SWSA 4	12	dry	dry	dry	dry	NA[3]	1.1	—	—	—	Dry
4553	SWSA 4	12	812.63	816.70	818.32	5.69	NA[3]	NA[3]	—	—	—	
4554	SWSA 4	12	809.14	809.42	809.81	0.67	NA[3]	NA[3]	—	—	—	
4555	SWSA 4	359	808.77	809.22	809.75	0.98	NA[3]	1.25	—	—	Y	Just inside UGT
4556	SWSA 4	359	803.7	805.08	806.81	3.11	NA[4]	—	—	—	—	In UGT
4557	SWSA 4	4	dry	dry	dry	—	NA[3]	NA[3]	—	—	—	Dry@802.12
4558	SWSA 4	12	789.7	789.83	789.98	0.28	NA[3]	0.18	—	—	N	Burial grnd interior
4559	SWSA 4	12	777.31	777.44	777.62	0.31	NA[3]	0.38	—	—	Y	Burial grnd interior
4561	SWSA 4	12	790.97	791.09	791.23	0.26	NA[3]	0.58	—	—	Y	Burial grnd interior

Table 3.12. Summary of FY 2007 groundwater elevation monitoring at Seepage Trench 6 and SWSA 4 (continued)

Well	Area	No. of Meas.	Min. Elev.	Avg Elev.	Max. Elev.	Obs. Range	Target Elev. (TE)[1]	Target Range (TR)[1]	Avg. Meets TE	Max. Meets TE	Meets Fluct.	Comment
4562	SWSA 4	12	783.32	784.08	784.48	1.16	NA[3]	NA	—	—	—	Steadily declining
4563	SWSA 4	359	777.96	778.84	779.77	1.81	NA[3]	NA	—	—	—	Steadily declining
4589	SWSA 4	359	772.91	773.34	774.19	1.28	NA[3]	0.88	—	—	N	Steadily declining
4547	SWSA 4 DGT	359	756.53	757.18	762.44	5.91	NA[5]	NA[5]	—	—	—	DGT Seg A Trench
4596	SWSA 4 DGT	359	756.29	756.97	762.52	6.23	NA[5]	NA[5]	—	—	—	DGT Seg A Trench
4598	SWSA 4 DGT	359	757.27	757.52	757.88	0.61	NA[5]	NA[5]	—	—	—	DGT Seg A Trench
4548	SWSA 4 DGT	359	757.68	759.85	762.45	4.77	NA[5]	NA[5]	—	—	—	IHP Seg A
4595	SWSA 4 DGT	359	757.96	759.80	762.48	4.67	NA[5]	NA[5]				IHP Seg A
4599	SWSA 4 DGT	359	758.25	760.92	762.07	3.82	NA[5]	NA[5]	—	—	—	IHP Seg A
4588	SWSA 4 DGT	359	756.21	757.29	757.81	1.6	NA[5]	NA[5]	—	—	—	DGT Seg B Trench
4605	SWSA 4 DGT	359	757.77	758.06	758.51	0.74	NA[5]	NA[5]	—	—	—	DGT Seg B Trench
4550	SWSA 4 DGT	359	757.44	758.17	762.16	4.72	NA[5]	NA[5]	—	—	—	IHP Seg. B
4606	SWSA 4 DGT	359	758.38	759.30	762.12	3.74	NA[5]	NA[5]	—	—	—	DGT Seg. C Trench
4551	SWSA 4 DGT	359	758.82	758.98	761.7	2.88	NA[5]	NA[5]	—	—	—	DGT Seg. C Trench
4611	SWSA 4 DGT	359	758.64	759.7	762.36	3.72	NA[5]	NA[5]	—	—	—	DGT Seg. C Trench
4607	SWSA 4 DGT	359	757.98	759.1	761.92	3.94	NA[5]	NA[5]	—	—	—	IHP Seg. C
4552	SWSA 4 DGT	359	759.25	761.29	764.5	5.25	NA[5]	NA[5]	—	—	—	IHP Seg. C

[1]Seepage Trench 6 target elevations and target fluctuation ranges specified in Appendix K of Phased Construction Completion Report (PCCR) for Hydrologic Isolation at Solid Waste Storage Area 6 at the Oak Ridge National Laboratory, Oak Ridge, Tennessee (DOE 2006e). SWSA 4 target elevations and target fluctuation ranges specified in Sect. 8 of Phased Construction Completion Report (PCCR) for the Solid Waste Storage Area 4 and the Intermediate Holding Pond at the Oak Ridge National Laboratory, Oak Ridge, Tennessee (DOE 2006h). Target elevation is the groundwater elevation equivalent to 75% fluctuation reduction. Target range is the fluctuation range equivalent to 75% fluctuation reduction.

[2]Fluctuation ranges and target elevations not applicable for wells outside hydrologic isolation area boundaries. These wells reflect conditions in unremediated areas.

[3]Target range not specified in PCCR.

[4]Piezometer is located within upgradient trench. Water levels represent saturation thickness in diversion trench backfill.

[5]Elevation/fluctuation not specified. Performance metric is based on gradient control between downgradient collector trench and Intermediate Holding Pond area. See Fig. 3.7 and text.

Table 3.12. Summary of FY 2007 groundwater elevation monitoring at Seepage Trench 6 and SWSA 4 (continued)

Avg. = average
C = continuous flow measurements
DGT = downgradient trench
Elev. = elevation
Fluct. = fluctuation
Freq. = frequency
FY = fiscal year
Ground = grnd
IHP = Intermediate Holding Pond
M = monthly
Meas. = measurement
Min. = minimum
NA = not applicable
Obs. = observed
UGT = upgradient trench
Seg. = segment
SWSA = Solid Waste Storage Area
TE = target elevation
TR = target fluctuation range
W = weekly

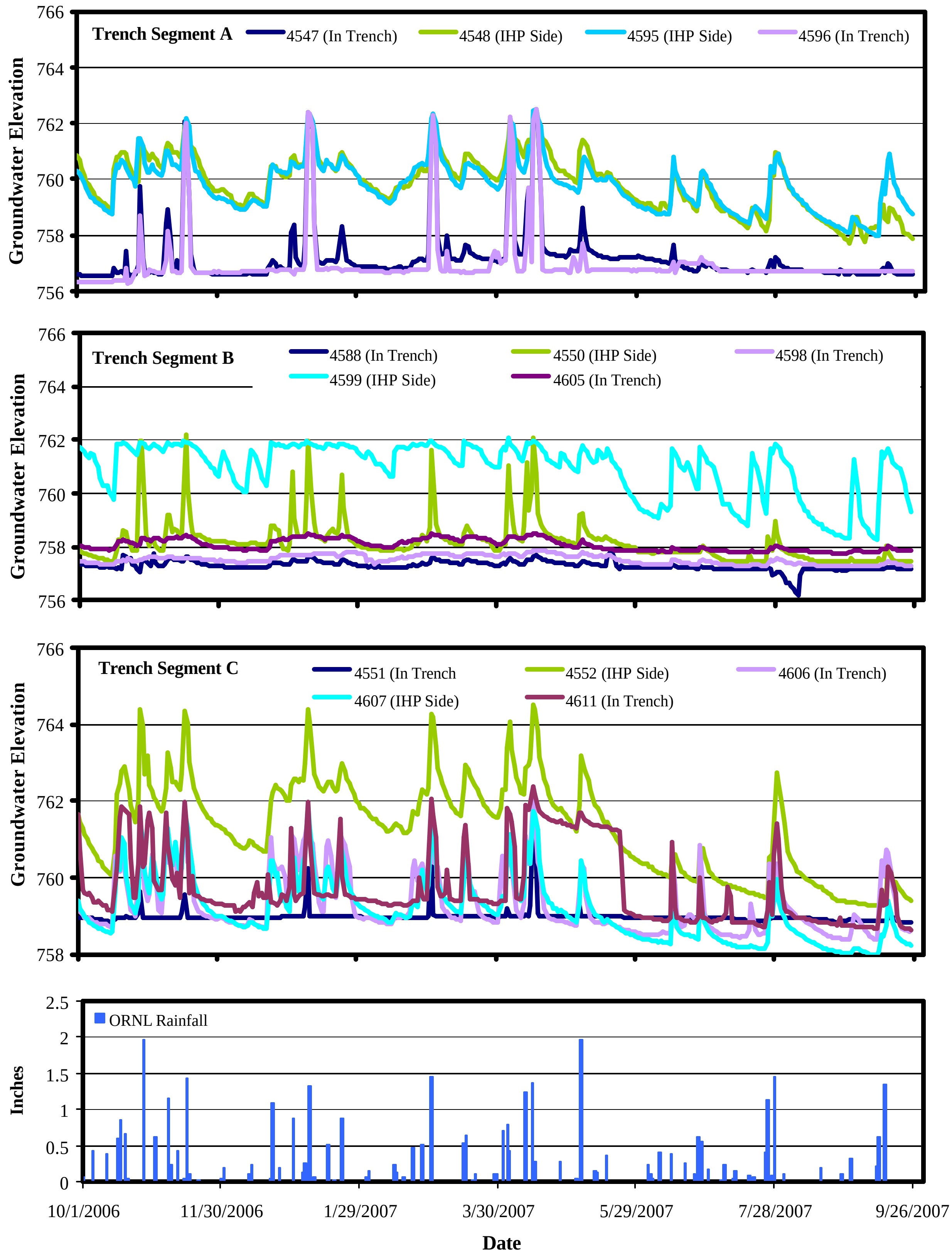


Fig. 3.7. Well hydrographs for SWSA 4 Downgradient Trench monitoring locations.

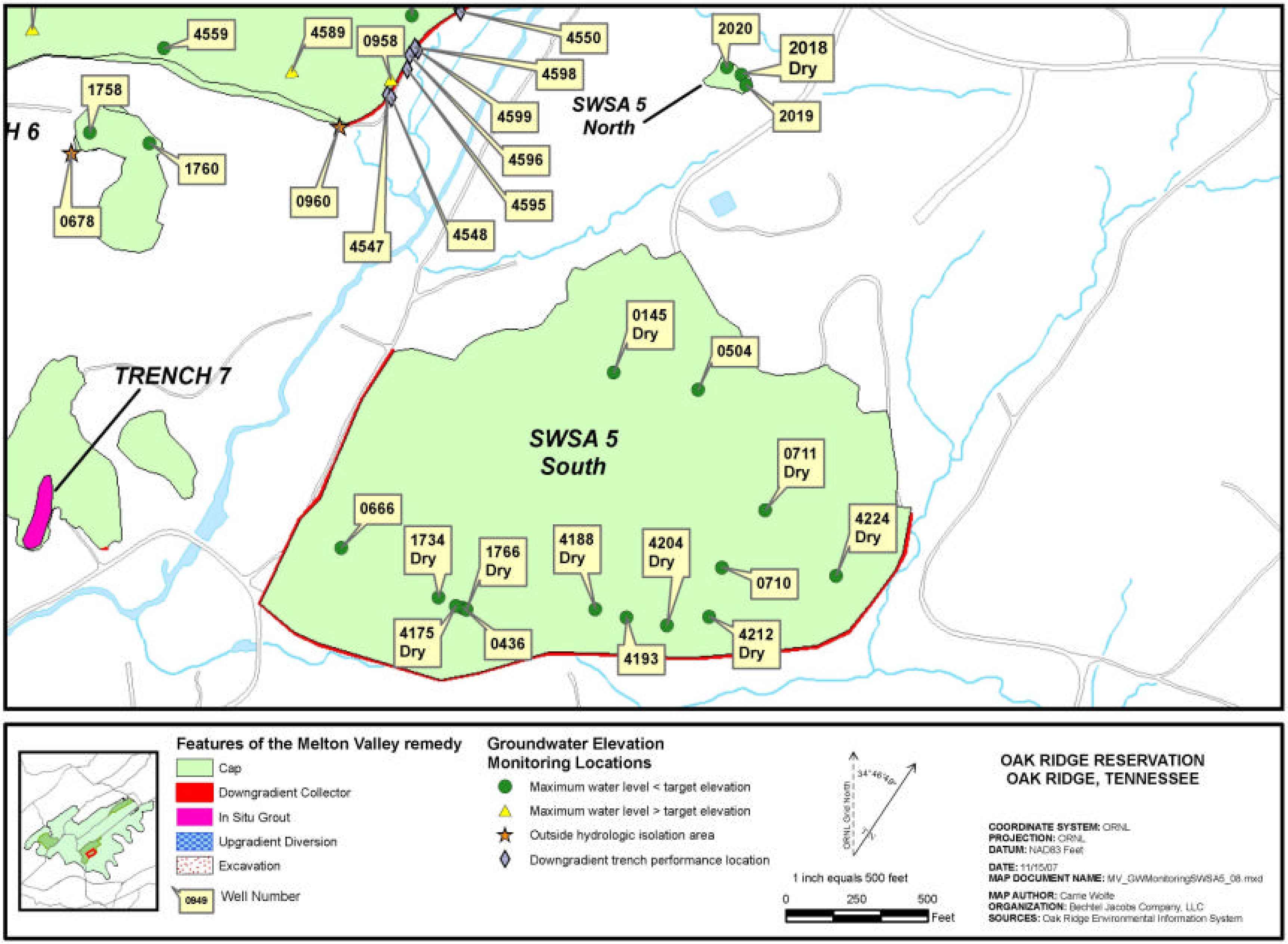


Fig. 3.8. SWSA 5 wells used to monitor groundwater elevations.

Table 3.13. Summary of FY 2007 groundwater elevation monitoring at SWSA 5

Well	Area	No.of Meas.	Min. Elev.	Avg. Elev.	Max. Elev.	Obs. Range	Target Elev. (TE)[1]	Target Range (TR)[1]	Avg. Meets TE	Max. meets TE	Meets Fluct. TR	Comment
2018	SWSA 5-N	12	dry	dry	dry	0	822.2	2.5	—	—	—	Dry@824.15
2019	SWSA 5-N	12	803.04	806.93	809.93	6.89	824.3	1.67	Y	Y	N	WL below waste
2020	SWSA 5-N	12	817.89	821.57	821.95	4.06	828.2	0.78	Y	Y	N	WL below waste
0145	SWSA 5-S	12	dry	dry	dry	0	829.10	1.9	—	—	—	Dry@826.72
0436	SWSA 5-S	3	770.68	770.82	770.99	0.31	773.90	2.35	Y	Y	Y	Steadily declining
0504	SWSA 5-S	7	810.66	810.67	810.71	0.05	813.10	1.83	Y	Y	Y	
0666	SWSA 5-S	12	818.52	820.16	821.3	2.78	836	1.35	Y	Y	N	Steadily declining
0710	SWSA 5-S	10	783.14	783.68	784.3	1.16	791.5	1.1	Y	Y	N	Steadily declining
0711	SWSA 5-S	12	dry	dry	dry		806.1	2.9	—	—	—	Dry@800.83
1734	SWSA 5-S	12	dry	dry	dry	—	776.70	2.2	—	—	—	Dry@773.06
1766	SWSA 5-S	12	dry	dry	dry	—	773.9	2.1	—	—	—	Dry@773.04
2026	SWSA 5-S	12	dry	dry	dry	—	773.3	1.2	—	—	—	Dry@771.39
4175	SWSA 5-S	12	769.29	769.84	770.5	1.21	775.8	4.1	Y	Y	Y	Steadily declining
4188	SWSA 5-S	12	dry	dry	dry	--	772.90	1.63	—	—	—	Dry@770.78
4193	SWSA 5-S	12	768.28	769.23	770.13	1.85	775.4	1.32	Y	Y	N	Steadily declining
4204	SWSA 5-S	12	dry	dry	769.25	--	773.00	1.4	--	--	--	Dry after Oct 06@769.48
4212	SWSA 5-S	12	dry	dry	dry	—	773.7	1.68	--	--	--	Dry@771.6
4224	SWSA 5-S	12	dry	dry	dry	—	781.6	1.88				Dry@793.31

[1]Target elevations and target fluctuation ranges specified in Appendix K of the Phased Construction Completion Report for Hydrologic Isolation at Solid Waste Storage Area 6 at the Oak Ridge National Laboratory, Oak Ridge, Tennessee (DOE 2006g). Target elevation is the groundwater elevation equivalent to 75% fluctuation reduction. Target range is the fluctuation range equivalent to 75% fluctuation reduction.

Avg. Elev. = average elevation
C = continuous flow measurement
Fluct. = fluctuation
FY = fiscal year
M = monthly
Max. Elev. = maximum elevation
Meas. Freq. = measurement frequency
Min. Elev. = minimum elevation
No. of Meas. = number of measurements
Obs. = observed
SWSA = Solid Waste Storage Area
TE = target elevation
TR = target range

At SWSA 5 North, a small cap was constructed to cover the 4-Trench area. Three wells were selected at this area to monitor post-remediation groundwater elevation fluctuations. As noted in Table 3.13, one well was dry on all dates of groundwater level measurement during FY 2007 and the two wells at this site that still intersect the groundwater table have average and maximum groundwater elevations below their target elevations. Groundwater levels have remained below the base of buried waste at SWSA 5 North.

At SWSA 5 South, 15 wells were selected during the design process to monitor post-remediation groundwater elevation fluctuations. Nine of the wells were dry on all monitoring occasions during FY 2007 compared to 6 wells that were dry throughout FY 2006. The remaining 6 wells all had maximum groundwater elevations lower than the target groundwater levels established during design. During FY 2007, groundwater level fluctuations at 3 wells were greater than target ranges although the maximum groundwater levels were below target elevations. Water levels in 5 of these 6 wells showed steadily declining elevations throughout the year as water table drainage continued to occur beneath the SWSA 5 cap.

3.2.2.2.2 Groundwater Quality

Groundwater monitoring is conducted for CERCLA remediation effectiveness evaluation in MV Exit Pathway wells and at the Seepage Pits and Trenches. Groundwater monitoring at SWSA 6 is conducted in compliance with the SWSA 6 proposed RCRA permit requirements and results are reported annually to the TDEC DSWM. This section presents summary information on groundwater monitoring at the Seepage Pits and Trenches and discusses groundwater data collected in the MV Exit Pathway.

Seepage Pits and Trenches Area Groundwater Quality

Prior to ISG of LLLW Seepage Trenches 5 and 7, TDEC requested that baseline groundwater monitoring be conducted in proximity to the trenches. In response, a SAP was prepared and baseline sampling was conducted during FY 2005 and 2006 prior to trench grouting. Although post-remediation monitoring requirements were not specified, sampling of the wells is continuing to establish contaminant concentration trends in groundwater near the grouted trenches. Figure 3.9 shows the locations of wells that are monitored at the Pits and Trenches area. Table 3.14 includes a summary of radiological contaminants detected in monitoring wells at Trenches 5 and 7 during FY 2007. Initial results established that VOCs and semivolatile organic compounds (SVOCs) are not present in groundwater at these trenches at levels that would warrant their further sampling and analysis, so they are not discussed here. Principal radiological groundwater contaminants detected at Trenches 5 and 7 include ^{14}C, ^{60}Co, ^{90}Sr, ^{99}Tc, ^{3}H, $^{233/234}$U, and ^{238}U. Carbon-14 was a constituent of the LLLW disposed in the seepage trenches, and because the chemical treatment used to immobilize strontium and cesium had little affect on carbon, this contaminant is detected in most wells near these trenches. Groundwater contaminant concentrations in wells near Trenches 5 and 7 are generally decreasing compared to concentrations measured during FY 2005 and 2006.

Groundwater contaminant concentrations near Trenches 5 and 7 are generally decreasing.

Data from monitoring wells along the perimeter of the Seepage Pits and Trenches area indicates that ^{99}Tc is elevated in wells 1084 (215 and 56 pCi/L in February and September 2007) and 1244 (118 and 195 pCi/L in February and September 2007). Strontium-90 is detected at concentrations of about 20 pCi/L or less in wells 1076 and 1086. Uranium-233/234 is detected in well 1079 at concentrations greater than 300 pCi/L with a gradual increase observed in data collected during the 2005–2007 time period. This increase may be a result of reduced recharge in the capped area upslope and a consequential concentration increase. Uranium-233/234 is also detected in well 1244 at concentrations less than 20 pCi/L with no apparent concentration trend. Carbon-14 is the most mobile radiological constituent detected in the

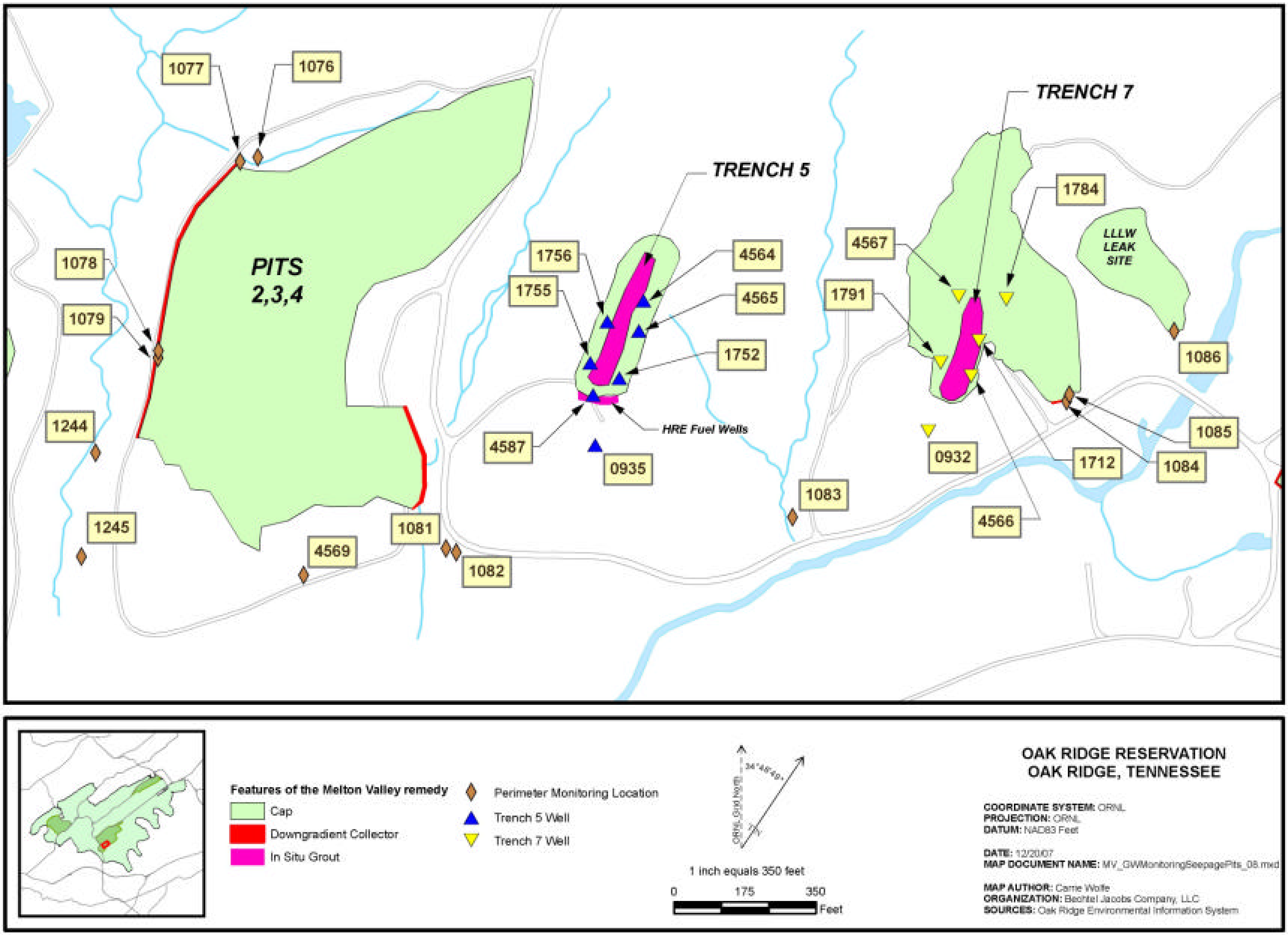


Fig. 3.9. Locations of monitoring wells sampled in the vicinity of the Seepage Pits and Trenches.

Table 3.14. Summary of radiological groundwater contaminants detected at Seepage Trenches 5 and 7, FY 2007

	Well	Alpha activity			Beta activity			Carbon-14			Cobalt-60			Strontium-90		
		N	Avg[a]	Max[b]	N	Avg	Max	N	Avg	Max	N	Avg	Max	N	Avg	Max
Trench 5	0935	2		<2.6	2	17.8	20	2	1,050	1,150	2		<11.1	2		<2.25
	1752	2	624	698	2	10,790	11,900	2	122,000	137,000	2	1,020	1,050	2	8.7	13.8
	1755	2	984	1050	2	4,560	5,520	2	59,000	69,000	2	709	763	2	24.3	24.6
	1756	2	1480	1580	2	1,980	1,990	2	39,700	41,500	2	154	166	2	<2.66	2.83
	4564	1	--	45.8	1	--	434	1	--	8,070	1	--	33.7	1	--	<0.69
	4565	1	--	22.2	1	--	2,890	1	--	17,600	1	--	105	1	--	<1.25
	4587	2	75.1	76	2	3,260	4,560	2	44,900	45,800	2	270	327	2	<2.13	1.97
Trench 7	1712	2	279	410	2	326	383	2	31,600	33,400	2	255	287	2	9.41	11.8
	1784	2	21.3	23.6	2	263	274	2	8,060	8,260	1	--	11.6 J	2	41.8	46.58
	1791	1		12.7	2	2,210	2,400	2	20,500	21,700	2	724	828	2	<2.16	2.67
	4566	2	24.1	28.7	2	1,640	1,880	2	49,200	52,800	2	2,190	2,280	2	--	<1.72
	4567[c]															

	Well	Technetium-99			Tritium			Uranium-233/234			Uranium-238		
		N	Avg	Max	N	Avg	Max	N	Avg	Max	N	Avg	Max
Trench 5	0935	2		<10	2	38,000	40,600	2	<0.32	0.45	2		<0.36
	1752	2	16,900	17,800	2	26,500	26,600	2	558	608	2	57.3	64.5
	1755	2	3,840	3,960	2	2,330	2,380	2	863	890	2	73.9	81.8
	1756	2	2,930	2,930	2	17,450	18,400	2	1,110	1,160	2	120	124
	4564	1	--	776	1	--	999	1	--	45.1	1	--	6.96
	4565	1	--	4,540	1	--	53,700	1	--	2.19	1	--	<0.5
	4587	2	6,110	4,890	2	15,700	18,200	2	38.6	53.5	2	3.7	5.25
Trench 7	1712	2	430	781	2	3,530	3,810	2	178	278	2	7.2	11.1
	1784	2	361	413	2	<2,000	2,230	2	23.8	24	2	1.13	1.13
	1791	2	3,210	3,390	2	4,765	5,980	2	0.33	0.42	2	<0.2	0.11
	4566	2	1,030	1,340	2	987	1,080	2	9.7	10.4	2	<1.6	3.83
	4567												

Table 3.14. Summary of radiological groundwater contaminants detected at Seepage Trenches 5 and 7, FY 2007 (continued)

[a] less-than symbol in the average value field indicates one result for the analyte at this location was below the detection limit. The stated average is the average of the detected result and the detection limit for non-detect result.
[b] less-than symbol in the maximum value field indicates all results for the analyte at this location were below the detection limit. The maximum detection limit is used as the maximum value.
[c] Well 4567 was dry – no sample could be obtained.
FY = fiscal year   pCi/L = picoCuries per liter

perimeter monitoring wells. Carbon-14 is detected at significant concentrations in wells 1079 (~1,500 pCi/L) where concentrations are decreasing, 1084 (11,000–13,000 pCi/L) also with decreasing concentrations, and 1244 (500–800 pCi/L) which is a significant decrease from FY 2006 when concentrations were greater than 2,500 pCi/L. As reported previously, ^{14}C at well 1078 was greater than 40,000 pCi/L during FY 2006. However this well, which is located inside the hydrologic isolation area, was dry during FY 2007 as a result of hydrologic isolation of Pits 2, 3, and 4 and the extreme drought. Cobalt-60 is detected at wells 1078 (57.8 pCi/L), 1079 (9–10 pCi/L) in FY 2007 which is consistent with a decreasing trend observed since 2005. Cobalt-60 was formerly detected at well 1078 which was dry during FY 2007 and at well 1244 where concentrations of ^{60}Co have decreased from levels in the 20–40 pCi/L range to values typically below 10 pCi/L between 2003 and 2007. This decrease occurred subsequent to construction of the cap over Pits 2, 3, and 4.

Melton Valley Exit Pathway Groundwater Quality Results

The MV ROD (DOE 2000a) stipulated that additional groundwater monitoring wells be installed in the western end of MV to serve as sentinel wells to detect site-related contaminants that may seep toward the CR. Six deep, multi-zone monitoring wells were constructed in a line extending from the toe of Haw Ridge southward to the south side of the WOCE near WOD. Locations of these wells are shown on Fig. 3.10.

In MV, relatively fresh groundwater extends to depths of approximately 300 ft below ground surface. Beneath the fresh water zone groundwater contains elevated sodium chloride, and sulfate that are components of the naturally occurring ancient waters contained in the bedrock. At depths greater than about 500 ft in MV the groundwater is saline brine that contains extremely high concentrations of chloride, sulfate, sodium, and calcium. This deep groundwater is non-potable because of natural salinity and wells constructed in the bedrock at such depths produce very little water. The exit pathway wells were designed and installed to sample groundwater above the brine zone.

Each well was drilled to a depth of 500 ft and was tested to determine the locations of water-bearing fractures that could be instrumented for sampling. Based on the results of testing, a total of 37 sampling zones were created by installation of WestBay® multi-zone sampling systems. Subsequent to installation, each zone was purged to prepare the wells for sampling. Over FY 2005 and 2006 baseline samples were collected and analyzed to evaluate the stabilization of groundwater quality in the sampled wells. Figure 3.11 provides a cross-sectional view of the location, depth of sample zones, and indicates zones sampled during FY 2007.

Sampling was conducted consistent with the requirements of the MV RAR. In addition, three sample zones were added to the 2007 program and three zones were re-sampled to evaluate previous results. Field measurements included pH, specific conductance, and redox. Samples were analyzed for major anions (fluoride, chloride, sulfate), metals (including major dissolved cations, minor and trace metals), radiological constituents (alpha and beta activity, radionuclides measurable using gamma spectroscopy, and tritium and uranium in selected samples), and volatile organic compounds. Many of the lab analyses of samples from the exit pathway wells yielded non-detected results.

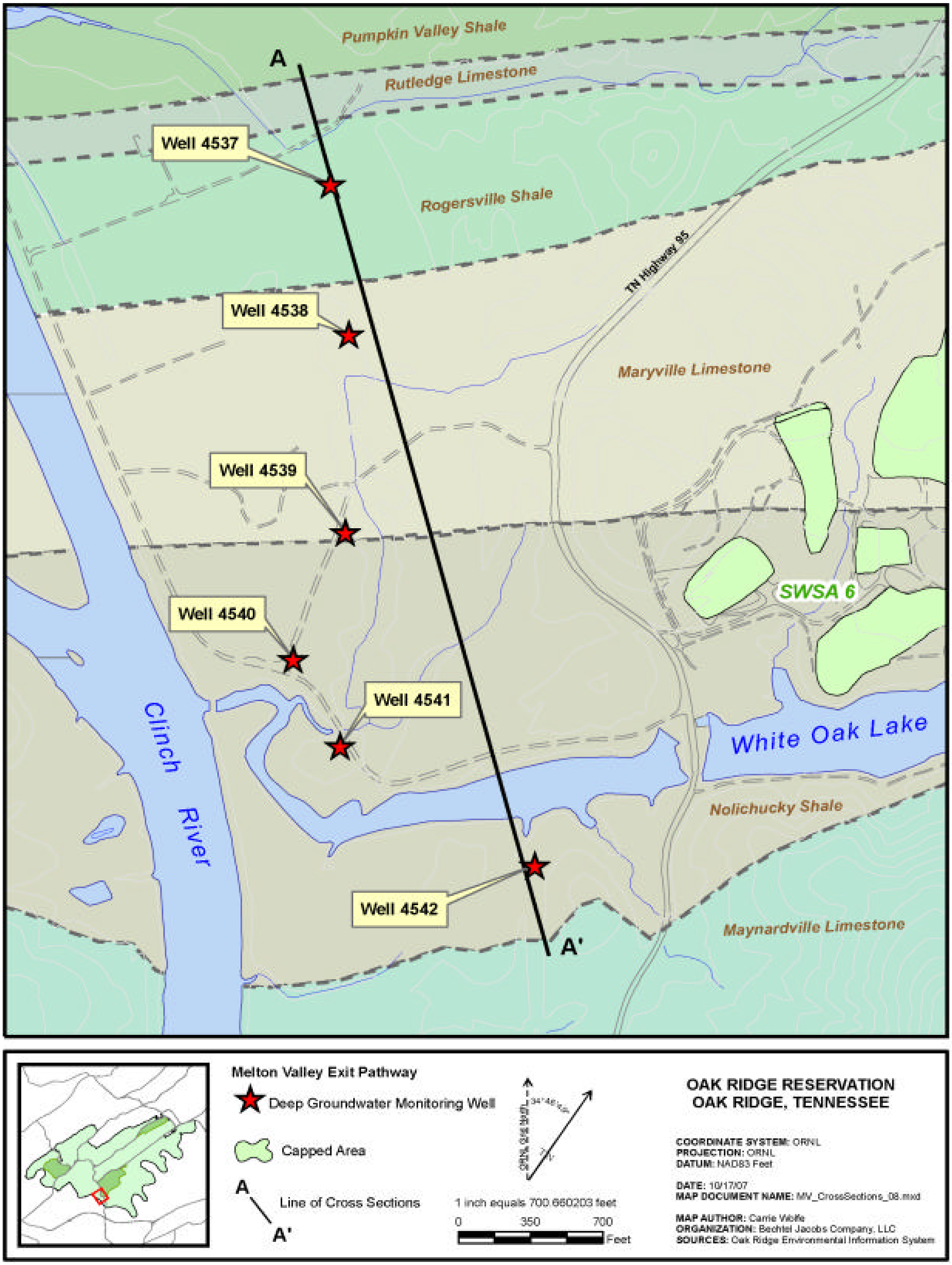


Fig. 3.10. Locations of Melton Valley Exit Pathway deep groundwater monitoring wells.

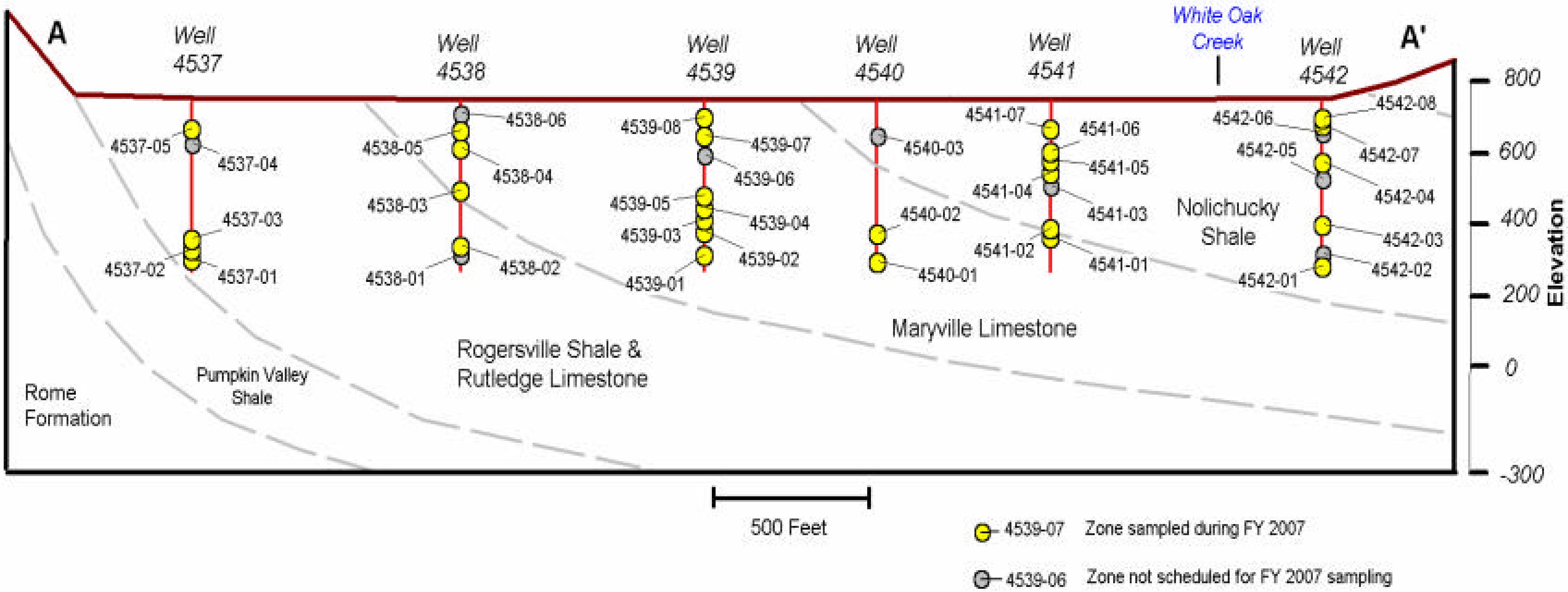


Fig. 3.11. Locations of Exit Pathway sampling zones.

Table 3.15 summarizes the results of analyses for samples collected during FY 2007 and compares results to the SWDA primary and secondary drinking water standards. Results are the maximum concentrations detected in cases where zones were sampled on more than one occasion or in instances where more than one lab analysis was conducted for a specific parameter from one sample zone for a particular sample event. Total dissolved solids in many of the sampled zones were greater than the secondary drinking water standard screening value and are attributable to naturally occurring chloride, sulfate, calcium and sodium. Water pH in many of the zones is elevated. As was observed during baseline monitoring, many of the sample zones continue to produce water with significant turbidity and measurable suspended solids that apparently contribute significantly to the measured concentrations of aluminum, iron, and manganese. Samples for metals analysis have historically been acid-preserved in the field without filtration to remove solids. The acid-preservation of turbid samples allows dissolution of fine-grained and colloidal oxy-hydroxides of aluminum, iron, and manganese and can dissolve metals adsorbed to clay particles. Chloride and sulfate in some of the sampled zones were greater than the secondary drinking water standards. Fluoride was detected at concentrations greater than the secondary drinking water standards in 4 zones and exceeded secondary and primary standards in 10 sampled zones. Barium and lead were detected at concentrations greater than the drinking water reference concentrations in 3 and 2 sample zones, respectively.

Exit pathway wells exhibit site related contaminants.

In five of the sampled zones the radiological screening parameters for alpha and beta activity were elevated. In four of the five zones with elevated alpha and beta activity the combination of elevated turbidity, suspended solids, and dissolved solids were also observed. The presence of high solids content in these samples can lead to unreliable analytical results for these parameters. The fifth sample with elevated alpha and beta results had elevated dissolved solids but low turbidity and less than 5 mg/L suspended solids. Strontium-90 was analyzed on 26 samples obtained from 14 of the zones sampled during FY 2007. Strontium-90 was detected in samples from 4 of the zones as indicated in Table 3.15 and the maximum detected concentration from one zone was greater than 8 pCi/L during FY 2007. Uranium isotopes were analyzed in 6 of the sample zones during FY 2007 to evaluate the possible contribution of uranium to some of the elevated alpha and beta concentrations. The results for uranium isotopes indicated that $^{233/234}U$ was detected at less than 2 pCi/L in sample zones 4539-04, 4540-01, 4540-02, and 4541-04 and ^{238}U was detected in zone 4540-02 at a concentration less than 1 pCi/l. These results indicated uranium detected in these wells do not currently indicate a human health risk. Potassium-40, a naturally occurring radionuclide, was detected in zones 4537-01 (139 pCi/L) and 4538-03 (80 pCi/L). One replicate analysis of a sample collected from zone 4540-02 suggested the possible presence of ^{137}Cs slightly above the detection limit of about 7.6 pCi/L however results from a the other sample collected at the same time did not indicate ^{137}Cs was present in the sample.

The results of VOCs analyses conducted during FY 2007 indicate that trichloroethene was detected at concentrations less than its 5 µg/L drinking water standard screening concentration in four zones – 4538-05, 4539-05, 4541-02, and 4541-05. The degradation product cis-1,2-dichloroethene was also detected at less than its 7 µg/L drinking water standard screening level in zone 4538-05 and chloromethane was reported at an estimated concentration of 0.2 µg/L. Acetone was reported at an estimated concentration of 3 µg/L in zone 4537-03 and was not indicated in the quality assurance (QA) sample results as present in the laboratory or trip blank.

In addition to the parameters discussed previously, screening for metals did not detect antimony, arsenic, beryllium, cadmium, chromium, copper, mercury, selenium or thallium at concentrations greater their drinking water standard screening levels. Cobalt-60 was not detected in any of the samples obtained during FY 2007. Tritium, a radionuclide that is common in several of the MV waste disposal areas, was not detected in any sample at detection levels ranging from 278–349 pCi/L. The drinking water standard screening concentration for tritium is 20,000 pCi/L.

Continued monitoring of the exit pathway wells will be conducted consistent with the approach presented in the MV RAR (DOE 2004a). Additional radiological analyses will be added to better characterize sample zones where elevated levels of alpha and beta activity have been and continue to be observed. Monitoring results from the MV exit pathway wells is identified as an issue in this RER and a recommendation is made for this topic to be addressed in the ORNL CERCLA Core Team.

Table 3.15. Summary of Melton Valley Exit Pathway FY 2007 data

Sample Zone	Number of times sampled	Sp. Cond. (umho/cm)	pH (6.5-8.5[a] std Unit)	Redox (mV)	Turbidity (NTU)	TSS (mg/L)	TDS (500[a] mg/L)	Al (0.2[a] mg/L)	Fe (0.3[a] mg/L)
4537-01	1	992	7.22	-44	5	< 5	**1,130**	ND	**1.78**
4537-02[d]	2	572	7.4	211	16	< 5	**541**	0.07	**0.99**
4537-03	1	421	7.26	44	8	< 5	414	ND	**0.41**
4537-05	1	853	**9.45**	215	23	12	**821**	0.886	**0.366**
4538-02[d]	2	1,459	**8.96**	202	813	102	**1,930**	22.7	**35.9**
4538-03[d]	2	7,120	**8.6**	204	523	102	**4,660**	36.6	**59.2**
4538-04	1	1,268	**8.89**	195	5	< 5	**1,230**	0.26	**0.3**
4538-05	1	986	**9.12**	124	6	< 5	**954**	0.28	0.176
4539-01	1	12,940	7.63	174	292	28	**11,000**	2.59	**3.48**
4539-02[d]	2	1,125	**9.02**	79	356	50	**1,450**	21.7	**18.7**
4539-03	1	1,203	**8.97**	167	10	< 5	**1,120**	1.86	**0.718**
4539-04[d]	2	1,017	**9.49**	207	34	< 5	**1,070**	5.33	**1.67**
4539-05	1	702	**8.8**	162	6	< 5	**977**	1.63	**0.45**
4539-07	1	403	**8.77**	66	3	< 5	**613**	0.5	0.223
4539-08	1	378	**8.71**	116	1	5	282	ND	0.039
4540-01	1	16,180	7.85	222	8	5	**10,300**	ND	**0.597**
4540-02[d]	1	1,375	**8.8**	146	1,000	47.5	**2,490**	**68.1**	**61.5**
4541-01	1	3,040	8.4	177	10	6	**2,040**	0.079	0.136
4541-02	1	2,930	8.42	156	1	< 5	**1,860**	ND	0.052
4541-04	1	728	**9.21**	155	100	< 5	**1,160**	**5.20**	**2.89**
4541-05	1	746	**9.15**	83	31	< 5	**1,070**	**4.54**	**3.31**
4541-06	1	778	**9.41**	181	34	< 5	**1,030**	**6.52**	**3.83**
4541-07	1	399	**10.12**	387	8	< 5	298	**1.61**	**0.636**
4542-01	1	211	8	216	219	305	**13,200**	**23.5**	**25.8**
4542-03	1	1,330	**8.83**	171	38	5	**1,310**	**1.07**	**0.748**
4542.05	1	674	**8.98**	-203	21	< 5	**900**	**6.09**	**2.07**
4542-04	1	943	**8.97**	114	51	< 5	**1,380**	**21.3**	**8.38**
4542-07	1	525	**9.08**	136	47	< 5	**515**	**1.09**	**0.931**
4542-08	1	464	7.86	113	2	< 5	401	ND	0.291

Table 3.15. Summary of Melton Valley Exit Pathway FY 2007 data (continued)

Sample Zone	Number of times sampled	Mn (50[a] µg/L)	Cl (250[a] mg/L)	SO_4 (250[a] mg/L)	F (2[a], 4[b] mg/L)	Ba (2[b] mg/L)	Pb (15[b] µg/L)	Alpha (15[b] pCi/L)	Beta (pCi/L)	^{90}Sr (8[c] pCi/L)
4537-01	1	**130**	23.3	**656**	0.51	0.05	< 3	4.09	7.55	NA
4537-02[e]	2	33.2	4.7	226	0.34	0.04	< 2	4.65	21	7.81
4537-03	1	37.8	3.7	176	0.36	0.03	< 2	< 1.65	6.09	NA
4537-05	1	6.4	10.7	162	**4.6**	0.01	< 3	2.06	6.18	NA
4538-02[e]	2	**345**	**253**	**436**	**2.4**	0.12	6.9	**22.4**	182	**12.4**
4538-03[e]	2	**540**	**1,140**	**1,530**	**2.1**	0.20	15.3	**15.4**	1330	4.85
4538-04	1	5.5	137	**266**	**4.1**	0.01	< 3	< 2.61	< 5.06	NA
4538-05	1	ND	96	147	**3.5**	0.02	< 2	< 2.61	< 6.52	NA
4539-01	1	**182**	**6,660**	0.25 U	1.1	**6.16**	< 3	<3.12	34.9	< 2.07
4539-02[e]	2	**180**	116	7.4	**5**	0.60	5.7	8.79	30.3	< 9.61
4539-03	1	6.9	51.5	7.4	**5.4**	0.17	< 3	< 2.56	4.39	NA
4539-04[e]	2	12.9	57.1	12.6	**5.5**	0.20	< 2	< 2.62	10.4	1.92 J
4539-05	1	ND	7.7	18.6	**21.3**	0.15	< 2	< 3.1	< 5.08	NA
4539-07	1	ND	2.8	11.2	1.6	0.22	< 3	< 1.58	< 3.21	NA
4539-08	1	ND	2.2	7.5	1	0.18	< 2	< 1.35	3.6	NA
4540-01	1	**73.6**	NA	NA	NA	**9.04**	< 3	< 19.6	87.6	< 4.62
4540-02[e]	1	**678**	NA	NA	NA	1.60	**23.4**	**89.7**	136	< 8.05
4541-01	1	6.2	**773**	9.3	**4.8**	0.36	< 3	< 4.18	< 7.04	NA
4541-02	1	ND	**738**	7.2	**4.3**	0.27	< 2	**28.8**	982	NA
4541-04	1	22.3	NA	NA	NA	0.28	< 3	10.9	30.4	< 3.47
4541-06	1	39.8	39.6	16.6	1.5	0.57	< 2	6.93	27.2	< 1.91
4541-07	1	ND	15.7	7.1	0.56	0.07	< 3	< 2.26	< 4.02	NA
4542-01	1	**184**	NA	NA	NA	**4.28**	6.7	**22.9**	40.8	< 3.78
4542-03	1	ND	**311**	36.7	**6.4**	0.05	< 3	< 2.91	8.07	NA
4542.04	1	7.3	35.6	18.8	**9.7**	0.10	< 2	< 2.56	24.1	NA
4542-05	1	26.7	40.8	57.1	**9.3**	0.37	< 2	5.83	27.4	< 1.95
4542-07	1	8.5	2.3	9.8	0.57	0.06	< 3	< 2.23	4.63	NA
4542-08	1	10.9	3	8.3	0.3	0.53	< 2	< 1.85	8.56	NA

[a] Reference concentration is a secondary drinking water standard.
[b] Reference concentration is a primary drinking water standard.
[c] Reference concentration is a primary drinking water standard action level applicable to a public water supply.
[d] Reference concentration is the regulatory annual average concentration equivalent to a 4 mrem/yr beta exposure.
[e] Sample zone was either added to FY07 monitoring or was re-sampled for evaluation of previous results.
Reporting units are shown in parentheses. Where drinking water standard exists for comparison it is included with the units.
Bold font entries exceed screening comparison with reference concentration

< = analyte not detected at detection limit
J = estimated value
ND = not detected
NA = not analyzed
Sp. Cond. = specific conductance
Std. Unit = standard unit used for pH measurement
Redox = oxidation/reduction potential
mV = millivolts
NTU = nephelometric turbidity units
TSS = total suspended solids
TDS = total dissolved solids
µmho/cm = micromhos/centimeter
µg/L = micrograms/liter
mg/L = milligrams/liter
pCi/L = picoCuries per liter

3.2.2.2.3 PWTC WAC Compliance for Collected Groundwater

Groundwater from the combined flows of all the downgradient collection trenches in MV is sampled at the equalization tank. Results of the analyses are compared to the PWTC WAC to evaluate acceptability of the MV groundwater at the facility. Sampling of the collected groundwater stream at the equalization tank was conducted monthly during FY 2007. The collected groundwater has generally met the expected concentration ranges with the exception of one result for ^{241}Am and eight of the twelve monthly tritium samples. The source of most of the tritium in the collected groundwater stream is the SWSA 5 DGT with subordinate concentrations and mass fluxes contributed from SWSA 4 and Seep D. Although the tritium concentrations in collected groundwater are greater than the WAC, this component of the total treatment volume at the PWTC does not create a problem for the facility to meet its annual discharge limits.

The flow volumes that are collected in the MV groundwater collection system have decreased from greater than 1E+6 gallons/month during FY 2006 and through spring of 2007 to about 250,000 gallons/month or less during August and September 2007. Reasons for this decrease include drainage of stored groundwater within the hydrologic isolation areas that causes reduced yield to collectors as well as the extreme drought that essentially eliminated recharge to shallow groundwater during summer of 2007. Continued monitoring of groundwater levels as required by the RAR along with tracking the volume of water captured in the groundwater collection system will provide data on the nature of groundwater behavior in the remediated areas.

3.2.2.3 Performance Summary

Remedy effectiveness data obtained during FY 2007 for the MV ROD actions collectively indicate that the remedy is generally operating and functioning as planned. The extreme drought conditions of FY 2007 caused surface water flows to be quite low throughout the area and groundwater recharge was minimal during the second half of the year. Contaminant releases of the principal COCs in MV have decreased significantly during and since remediation of the contaminant source areas. Surface water quality goals established in the ROD are met on average in all areas except mercury concentrations which are dominated by discharges from BV. Hydrologic isolation systems at the burial grounds functioned as intended as demonstrated by attainment of groundwater level goals in most areas. Groundwater contaminant concentrations in the Seepage Pits and Trenches area showed decreasing trends. Groundwater quality data from the in the Exit Pathway Picket Wells shows evidence of contaminant migration from MV waste disposal areas toward the Clinch River.

3.2.3 Compliance with MV ROD LTS Requirements

3.2.3.1 Requirements

The ROD requires implementation of LUCs to protect against unacceptable exposures to contamination during the remedial actions, as well as after completion of all remedial actions in MV (see Table 3.2). During remedial actions, interim LUCs were imposed and will remain until permanent LUCs are established in future remedial decisions for this area. The LUC objectives stated in the ROD are as follows:

1. ***Industrial area***: prevent unauthorized access to or use of groundwater; control excavations or penetrations below prescribed contamination cleanup depths; prevent unauthorized access; and preclude uses of the area that are inconsistent with LUCs.
2. ***Waste management area***: prevent unauthorized access to or use of groundwater; prevent unauthorized contact, removal, or excavation of source material; prevent unauthorized access; and preclude alternate uses of the area (e.g., additional waste disposal or development).

3. ***Surface water and floodplain area****:* prevent unauthorized access to surface water, sediment, floodplain soils, or underlying groundwater; prevent fish consumption; and preclude uses of the media that are inconsistent with planned LUCs.

The implementation and maintenance of these LUC objectives identified in the ROD are specified in the MV LUCIP (DOE 2006c), which was approved in May 2006. Because of the similarity in interim LUC objectives between the three remediation areas (i.e., industrial, waste management. and surface water/floodplain) identified in the ROD, most of the LUCs specified in the LUCIP apply generally throughout the watershed. The LUCs are defined as follows:

1. DOE land notation (property record restrictions) on land use and groundwater use in areas where waste is left in place.
2. Property record notices to provide records about existence and location of areas where wastes are left in place.
3. Zoning notices to provide notice to the city of Oak Ridge of existence and locations where wastes are left in place.
4. Excavation/penetration permit program.
5. State advisories/postings (e.g., no fishing or contact advisories at WOL and WOCE).
6. Access controls (fences, gates, portals).
7. Signs at 13 designated locations throughout the valley, to provide warning to prevent unauthorized access.
8. Surveillance patrols.

These LUCs can be grouped into administrative controls (land use and groundwater deed restrictions, property record notices, zoning notices, permits program) and physical controls (state advisories/postings, access controls, signs, and security patrols), as shown in Table 3.2.

The MV LUCIP also states that, as individual remediation projects are undertaken within the MV Watershed, project-specific LUCs, if any, will be identified in the project construction completion report. None of the MV PCCRs contained project-specific LUCs.

The hydrologic isolation projects PCCRs require engineering controls be maintained at the 13 separate waste caps in MV. Details of the surveillance and maintenance of the engineering controls at the caps is addressed in the S&M Plan (DOE 2007d) that is attached to the RAR. This plan covers the surveillance and maintenance required by all remedial actions performed in MV; however, only the hydrologic isolation caps constructed at SWSA 5, SWSA 4, Seepage Pits and Trenches, and SWSA 6 require long-term maintenance. No other remedial action performed in MV required long-term S&M after completion of the construction activities. Inspections of the engineering controls and maintenance began immediately upon closure and were implemented in accordance with the ORNL Facility Inspection and Training (FIT) Manual (BJC 2006).

The requirements of the MV LUCIP are presented in a tabular summary in Appendix B, along with the required certification.

3.2.3.2 Status of Requirements for FY 2007

Below are summaries of the implementation verification and status of all eight LUCs specified in the LUCIP. Four of the LUCs have been implemented in MV during FY 2007 and are listed below and highlighted in Table B.1.

Excavation/penetration permit program

The ROD requires that an EPP program be in place throughout the MV remediation areas to provide notice to the worker/developer (i.e., permit requestor) on the extent of contamination and to prohibit or limit excavation/penetration activity as appropriate. The LUCIP requires a DOE official (or its contractor) to verify no less than annually the functioning of the permit program against existing procedures.

Verification was provided by the BJC MV Project Engineer stating that the EPP program was functioning during FY 2007 in accordance with existing procedures listed in Appendix B of the MV LUCIP and also in accordance with the BJC MV EPP procedure OR-1010, *Excavation/Penetration Permit for ORNL Site*. Excavations conducted by the UT-B when operating as the prime workgroup were performed in accordance with the UT-B procedure titled *Initiating and Issuing an Excavation or Penetration Permit*, which requires the BJC MV Project Engineer signature on every excavation permit before work can begin. The UT-B ORNL excavation permit form (form ORNL-211) also requires that the BJC MV Project Environmental Compliance (EC) Lead review the area to determine if any CERCLA Land Use Control Implementation Plans (LUCIPs) are established, and if so, specify the relevant details. In FY 2007, there were no UT-B excavation permits requested for MV CERCLA remediated areas.

Excavations conducted by BJC at MV were performed in accordance with BJC procedure OR-1010, which requires that a BJC ORNL EPP Log be maintained and that all EPPs for the ORNL be entered into the log and maintained by one person. The procedure also requires that an Environmental Compliance (EC) Review Form (BJCF 147B) be completed by MV EC for all excavations and that EC review existing information sources to determine if the area is covered by a LUCIP to ensure that the activity will not unknowingly violate CERCLA LUCs. In FY 2007, there were no BJC excavation permits requested for MV CERCLA remediated areas.

Access controls

The ROD requires that access controls (e.g. fences, gates, portals) be maintained by DOE throughout MV remediation areas to control and restrict access to workers and the public to prevent unauthorized uses. A map depicting the location of access controls that are necessary to ensure protectiveness of the remedy is included in the RAR.

The LUCIP states that any selected access controls will be monitored and maintained by DOE and its contractors as part of its S&M program indefinitely or for as long as needed. The LUCIP requires that a DOE official (or its contractor) conduct a field survey no less than annually of all controls to assess their condition and ensure fences are erect or intact and gates/portals are functioning properly. In addition to routine site inspections conducted by the BJC MV S&M Program according to the FIT manual of all remediated areas in MV, a field survey was conducted by the WRRP and the BJC MV S&M manager to verify access controls designated in the PCCRs were in place, in good condition and functioning properly. All major access points (e.g., portals, exterior gates) remain guarded or locked at all times, and interior gates are selectively locked. Specifically, access is restricted by the DOE ORR perimeter fence and security portals at the east and west ends of BV Road. There also is a locked gate at the junction of the haul road and the MV Access Road. Perimeter roads around MV have gates that allow access for maintenance activities.

Signs

The ROD requires that signs be maintained by DOE at select locations throughout MV to provide notice or warning to prevent unauthorized access. A map depicting the location of the signs that apply to the MV Watershed is included in the RAR.

The LUCIP requires that, within six months of approval of the LUCIP, signs will be in place at 13 designated locations throughout MV watershed near major access points to provide notice or warning to prevent unauthorized access. In November 2006, an initial field survey was conducted by the BJC MV S&M manager to assess the condition of all the signs at the 13 locations. All 13 locations contained one or more signs warning against unauthorized access. A second field survey of the signs was conducted in the fall of FY 2007 by the WRRP with the BJC MV S&M manager. It was noted during this time that several of the signs currently posted state that access is limited to those who have been trained to MV Access Requirements. This particular training is no longer a requirement for working in MV and therefore the signs are being revised.

Surveillance patrols

The LUCIP requires that surveillance patrols of selected areas in MV be effective immediately upon LUCIP approval and conducted no less frequently than once a quarter as part of the routine S&M site inspections that are required for units/areas. The LUCIP requires a DOE official (or its contractors) to verify no less than annually against approved procedures/plans that routine patrols are conducted to ensure that incompatible uses have not occurred for units/areas requiring land use restrictions. In FY 2007, surveillance patrols were performed by the BJC ORNL S&M Program as part of routine S&M site inspections. The BJC ORNL S&M Program developed the FIT manual to initiate routine S&M inspections as a means to monitor, maintain and enforce the LUC compliance requirements of the MV LUCIP. Inspections of the capped areas within MV were performed on a quarterly basis. In addition, UT-B security personnel also perform required daily patrols of various areas within MV.

Four of the LUCs were not implemented in MV during FY 2007 and are listed below and summarized in Table B.1. Implementation of only portions of the MV LUCIP are being certified at this time because: (1) the implementation is in progress but was not completed before September 30, 2007, or (2) the intent of the requirement is being completed by DOE in lieu of TDEC (e.g., State advisories/postings).

DOE land notation (property record restrictions)

Implementation of this control is in progress but was not completed before September 30, 2007. A summary of this control and the certification of its implementation will be provided in the 2009 RER.

Property Record notices and Zoning notices

Implementation of these controls are in progress but were not completed before September 30, 2007. A summary of these controls and the certification of their implementation will be provided in the 2009 RER.

State advisories/postings

The LUCIP states that advisories established by the TDEC Division of Water Pollution Control that provide notice to potential resource users of contamination and prohibit fishing/swimming in WOCE and WOL on signs and in the fishing regulations published by the Tennessee Wildlife Resources Agency (TWRA) will be effective immediately upon LUCIP approval. Although adequate warning signs have been established and maintained by the DOE on the WOL and WOCE, the LUCIP requirements for State advisories/postings have not been implemented because TDEC has taken the position that they do not have statutory authority to post such warnings on property that does not afford public access (e.g., the DOE ORR).

Per the LUCIP, the purpose of the advisories/postings is to provide the public with important warnings that seek to limit/restrict incompatible uses and prevent unsafe exposure to contaminants. Currently there are eight DOE established signs posted along the WOL dam access areas at HWY 95 and seventeen posted at the access gate and on fencing along WOCE that state, "Warning, No Fishing, No Water Contact, Area Contaminated."

The LUCIP requires that a DOE official (or its contractor) conduct a field survey no less than annually to assess sign condition to ensure signs along streams remain intact, erect, and legible. A field survey was conducted by the WRRP and the BJC MV S&M Manager verifying that the currently established DOE warning signs were still intact at the WOCE and were legible and providing adequate protection. It was noted during the survey that no DOE established warning signs stating, "Warning, No Fishing, No Water Contact, Area Contaminated" were located at the Sediment Retention Structure (SRS) facing the CR. However, there are signs posted here stating, "Warning, Radiation Hazard Area, Contaminated, Keep Out" along with United States Government signs stating, "No Trespassing." In addition, the SRS prevents boaters and fishermen from accessing the WOCE.

The LUCIP also requires that a DOE official (or its contractor) verify the information in the fishing regulations with a TWRA official to ensure that fishing regulations accurately describe impacted streams. TWRA receives guidance from the TDEC on publishing these advisories in their annual fishing regulations. Currently, there are no TDEC-established advisories on WOL and WOCE because the DOE ORR property does not afford public access and, therefore, no information has been published in the TWRA fishing regulations for these areas.

In addition to implementing the physical LUCs (i.e., access controls, signs, surveillance patrols) as detailed above, the BJC MV S&M Program also performed inspections of the MV hydrologic isolation areas to inspect each of the engineering controls listed below as applicable at each site:

- Vegetative cover on compacted fill or isolation cap,
- Compacted fill cover or isolation cap outslopes,
- Rock buttress outslopes,
- Surface drainage features,
- Monitoring wells (including well interior conditions),
- Weirs at surface water monitoring locations,
- Groundwater (leachate) collection equipment,
- Gas vents,
- Wetlands,
- Melton Branch relocation area, and
- Cover/cap maintenance roads, fences, gates, and signs.

The ROD states that for the first 2 years after installation of a hydrologic isolation cap, an engineer familiar with the cap design shall inspect each cap and associated featured quarterly and after any 5-year recurrence interval or 24-hr storm event. After a minimum 2-year period or until the hydrologic isolation cap and surface drainage features remain stable, the inspection schedule will revert to twice per year.

In FY 2007, engineering controls were inspected quarterly by the MV S&M Program according to the ORNL FIT Manual at the following sites:

- SWSA 4,
- SWSA 5 North 4-Trench Area,
- SWSA 5 South,
- SWSA 6 Capped Area – CAP A,
- SWSA 6 Capped Area – CAP B,
- SWSA 6 Capped Area – CAP C,
- SWSA 6 Capped Area – CAP D,
- SWSA 6 Capped Area – CAP E,
- SWSA 6 Capped Area – Hill Cut Test Facility,
- Pits 2, 3, and 4,
- Trench 5,
- Trench 6 and Trench 6 Leak Sites,
- Trench 7 and Trench 7 Leak Sites Cap, and
- Trench 7 East Leak Site.

No deficiencies were noted on the inspection checksheets. Minor maintenance included repairing gas vents, reseeding thin spots and fertilizing, and fixing small erosion damage. The MV S&M Plan requires that all of the caps be mowed at a minimum of once per year. Only 5 of the 13 caps were mowed in FY 2007 due to the prolonged drought in the summer. It was agreed upon by the regulators that to mow the caps containing less grass cover would be detrimental to the caps and would likely cause the grass to die out and allow for more erosion.

3.3 COMPLETED SINGLE ACTIONS IN MELTON VALLEY WITH MONITORING AND/OR LTS REQUIREMENTS

3.3.1 White Oak Creek Embayment Sediment Retention Structure

Location of the WOC SRS is shown on Fig. 3.1. The scope of this action involved the construction of a sediment retention structure, referred to as the SRS, at the mouth of WOC to contain the sediments in lower WOCE and minimize transport off-site to the CR and Watts Bar Reservoir. The SRS uses rip-rap-filled wire gabions to slow water movement, preventing scour of sediment out of the embayment during changes in WOC flow and fluctuation of Watts Bar Reservoir levels. This site has only LTS requirements (Table 3.2). A review of compliance with these LTS requirements is included in Sect. 3.3.1.1. Background information on this remedy and performance standards are provided in Chapter 3 of Volume 1 of the 2007 RER.

No surface water or groundwater monitoring is required to verify the effectiveness of the removal action.

3.3.1.1 Compliance with LTS Requirements

3.3.1.1.1 Requirements

Long-term stewardship requirements for this action include inspection and maintenance of the SRS.

3.3.1.1.2 Status of Requirements for FY 2007

The site was inspected monthly to check the fence and gate to ensure they were preventing access, inspect the condition of the warning signs, determine if excessive debris or vegetation had built up on the SRS, and identify any evidence that there had been any movement or shift of the embayment structure. No deficiencies were noted on the inspection checksheets. No maintenance was required.

3.3.2 WAG 13 Cesium Plots Interim Remedial Action

Location of the WAG 13 Cesium Plots Interim Remedial Action is shown on Fig. 3.1. The scope of this action involved excavation of contaminated soil from the plots, placement of permeable liner in each excavated plot and backfill with clean, compacted fill material and topsoil layer. This site has only LTS requirements (Table 3.2). A review of compliance with these LTS requirements is included in Sect. 3.3.2.1. Background information on this remedy and performance standards are provided in Chapter 3 of Volume 1 of the 2007 RER (DOE 2007a).

No surface water or groundwater monitoring is required to verify the effectiveness of the removal action.

3.3.2.1 Compliance with LTS Requirements

3.3.2.1.1 Requirements

Long-term stewardship requirements specified in the completion documents for this site include long term S&M of the fenced enclosure.

3.3.2.2.2 Status of Requirements for FY 2007

The site underwent monthly inspections conducted by the ORNL S&M Program to verify that all gates to the site were closed and locked, the fence was not damaged, vegetation within the fenced area was cut, vegetation growth along fence line was acceptable, radiological postings were in place, point of contact signs were in place, and the site was clear of unauthorized materials. No deficiencies were noted on the inspection checksheets. Minor maintenance was required including fixing broken barbed wire on the fence and routine mowing.

3.3.3 MSRE D&D Uranium Deposit Removal

Location of the MSRE D&D Uranium Deposit Removal is shown on Fig. 3.1. The scope of this action involved the break up and removal of nongranular uranium-laden charcoal and vacuuming of the remaining loose charcoal and chips from the auxiliary charcoal bed (ACB) to ensure that less than a critical mass remains. This site has only LTS requirements (Table 3.2). A review of compliance with these LTS requirements is included in Sect. 3.3.3.1. Background information on this remedy and performance standards are provided in Chapter 3 of Volume 1 of the 2007 RER.

No surface water or groundwater monitoring is required to verify the effectiveness of the removal action.

3.3.3.1 Compliance with LTS Requirements

3.3.3.1.1 Requirements

Long-term stewardship requirements specified in the RmAR (DOE 2001a) include S&M activities for the interim storage of the collector canister holding the uranium-laden charcoal removed from the ACB, specifically, periodic pressure measurements (daily checks of the pressure gauge and hourly recorder data) and venting of the canister as necessary to maintain a pressure of less than 50 psig.

3.3.3.1.2 Status of Requirements for FY 2007

Inspections were conducted daily of the uranium-laden charcoal canister, in accordance with MSRE procedures. These inspections included periodic pressure measurements, and periodic venting of the canister to reduce pressure when needed. No maintenance was required during FY 2007.

3.4 MELTON VALLEY WATERSHED CONDITIONS AND TRENDS

This section provides an assessment of the FY 2007 environmental quality conditions compared to past conditions in the watershed. The comparisons include an evaluation of radiological contaminant flux (Sect. 3.4.1) and surface water quality evaluation based on trends observed in biological monitoring results in the watershed (Sect. 3.4.2).

3.4.1 Surface Water Contaminant Flux

Major reductions in annual discharges of tritium, ^{90}Sr, and ^{137}Cs from MV sources are observed.

Evaluation of trends in the radiological contaminant flux from MV areas is based on the long term data available at the key surface water integration points which include WOD, MBWeir, WOC Weir, and the 7500 Bridge Weir. Figure 3.12 shows surface water sampling locations for which contaminant flux or concentration trends are discussed in this section. Table 3.16 includes the annual flux of ^{90}Sr, ^{3}H, and ^{137}Cs measured at the key surface water integration points from 1993 through FY 2007. Figure 3.13 shows the relationship between rainfall and contaminant discharge fluxes for ^{3}H and ^{90}Sr, which are dissolved constituents. This relationship exists because increased rainfall causes increased surface water runoff and because, prior to hydrologic isolation of contaminant sources, increased rainfall caused increased leachate formation and release to streams. Figure 3.14 shows the annual contaminant discharge fluxes attributed to releases from MV source areas based on the difference between total watershed fluxes measured at WOD and influxes from BV measured at the 7500 Bridge Weir. In the mid-1990s, removal actions were completed to intercept and treat the Core Hole Plume 8 in BV and at Seeps C and D at SWSA 5, and trench grouting was conducted at SWSA 4 in MV. These actions contribute to the observed decreases in the total ^{90}Sr flux observed at WOD prior to 1998 and in the MV contribution to that total. The observed decreases in ^{90}Sr and ^{3}H between FY 2003 and FY 2007 are attributed to the combined effects of RA and lower rainfall in FY 2005 and 2006 that progressed to the extreme drought conditions of FY 2007. Continued monitoring through years with average and above-average rainfall patterns is necessary to fully evaluate the effectiveness of the remedy and to demonstrate sustained remedy performance.

During FY 2004 and FY 2005, an imbalance in the measured ^{90}Sr flux was noted between the 7500 Bridge and the WOC Weir locations. This issue was identified for "tracking" in the FY 2006 RER. During first quarter of FY 2007 sediment accumulations at the 7500 Bridge Weir and the WOC Weir were removed to allow more accurate flow volume measurements through the full range of flow. As shown on Table 3.16, during FY 2006 and FY 2007 the ^{90}Sr flux imbalance between these two stations was not observed.

Table 3.16 and Figs. 3.13 and 3.14 show that the ^{137}Cs flux within the WOC watershed continues to be highly variable. The mass balance of ^{137}Cs in the WOC surface water system has always been difficult to reconcile because this contaminant is transported with sediment as a result of the strong adsorption of cesium to soil particles. Figure 3.13 shows that the total flux of ^{137}Cs at WOD has historically fluctuated between about 0.6 to 1 curie per year although the FY 2007 flux was a record low of 0.33 Ci. The extremely low surface water flow volumes during FY 2007 resulted in less sediment transport, which is the likely mechanism that explains the low flux. Sources of ^{137}Cs in MV are primarily contaminated soils in the WOC floodplain and at LLLW leak and spill areas. The MV remedy included remediation of soils at leak sites and the former IHP near SWSA 4, which formerly held a large quantity of cesium contaminated soil. However, the majority of the ^{137}Cs source in terms of mass and spatial distribution remains the WOC floodplain soils and stream channel sediment and lakebed sediment in WOL. Remediation of these contaminated media will be included in the scope of a future CERCLA decision.

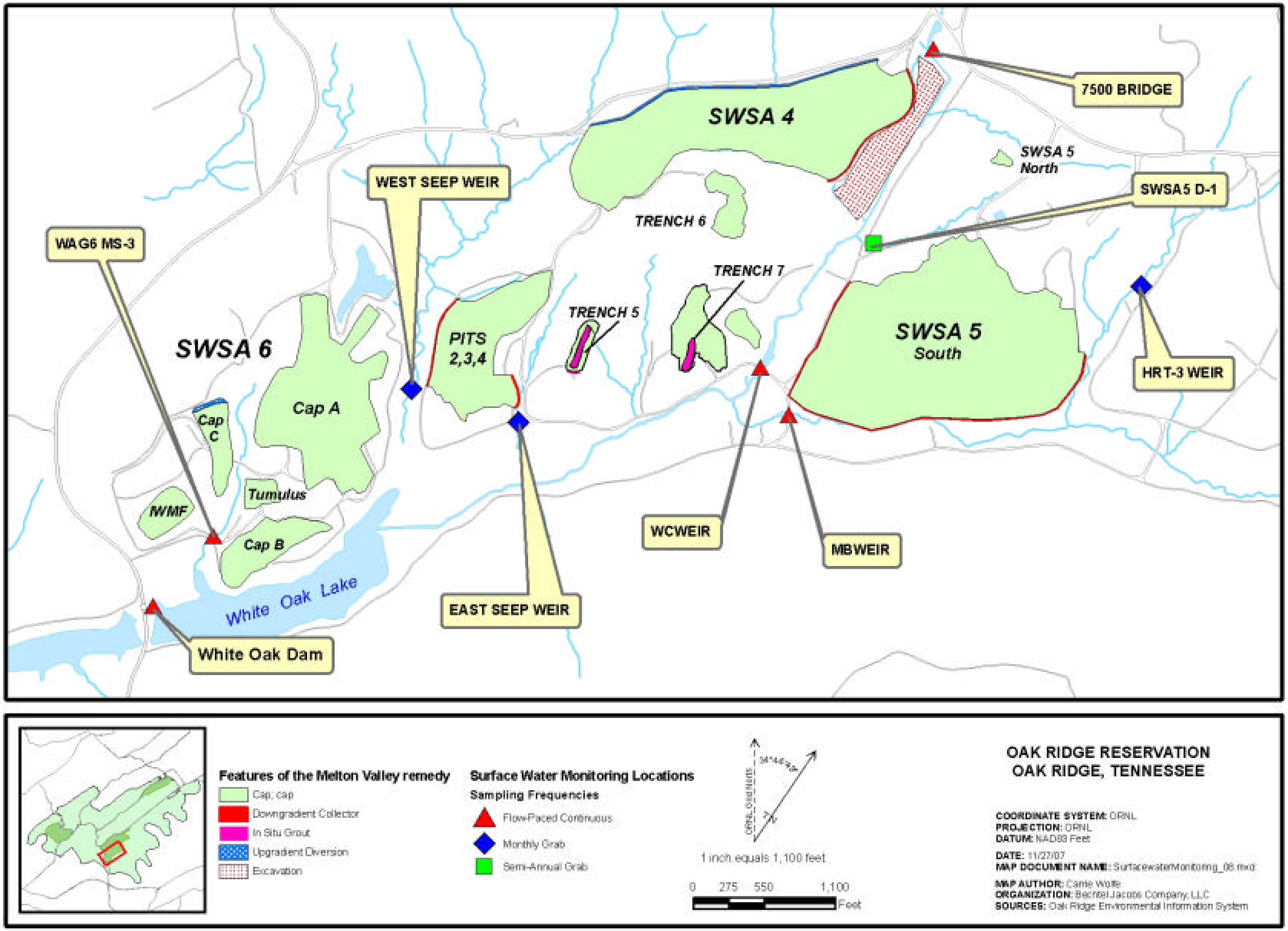


Fig. 3.12. Surface water monitoring locations.

Table 3.16. Melton Valley surface water integration point radionuclide fluxes

Year	^{90}Sr Flux (Ci)				^{3}H Flux (Ci)				^{137}Cs Flux (Ci)			
	White Oak Dam	MBWeir	WCWeir	7500 Bridge	White Oak Dam	MBWeir	WCWeir	7500 Bridge	White Oak Dam	MBWeir	WCWeir	7500 Bridge
CY 1993	2.44	0.88	0.99	0.61	2141	1700	340	58	0.59	0.025	1.10	0.99
CY 1994	3.37	1.20	1.40	0.75	2783	2000	480	81	0.62	0.015	0.65	0.66
FY 1995	1.55	0.05	0.04	0.45	2340	1830	342	70	NA	NA	NA	NA
FY 1996	2.04	NA	NA	NA	2250	NA	NA	NA	NA	NA	NA	NA
FY 1997	1.99	NA	NA	NA	1860	NA	NA	NA	NA	NA	NA	NA
FY 1998	1.37	0.39	0.64	0.22	937	777	254	48	NA	NA	NA	NA
FY 1999	1.45	0.38	0.06	0.19[a]	1080	732	160	31[a]	NA	NA	NA	0.34[a]
FY 2000	1.10	0.40	0.49	0.15[a]	892	229	609	81[a]	NA	NA	NA	0.98[a]
FY 2001	1.20	0.47	0.45	0.22	795	568	210	27	0.63	0.002	0.27	1.40
FY 2002	1.49	0.52	0.55	0.25	956	700	237	61	0.96	0.003	0.63	0.74
FY 2003	1.88	0.78	0.65	0.41	1442	964	450	96	0.80	0.004	0.31	0.43
FY 2004	1.58	0.74	0.36	0.64	1267	1238	134	60	1.06	0.004	0.40	0.37
FY 2005	1.42	0.52	0.30	0.69	951	948	72	27	0.75	0.005	0.35	0.82
FY 2006	0.67	0.16	0.20	0.20	334	171	109	88	0.88	0.003	0.12	0.17
FY 2007	0.48	0.06	0.17	0.14	225	25.6	151	122	0.33	0.003	0.10	0.08

[a]A 12-month flux was not available for 7500 Bridge. An 11-month flux was used for FY 2000, and an 8-month flux was used for FY 1999.
Ci = Curie
Cs = cesium
CY = calendar year
FY = fiscal year
^{3}H = hydrogen or tritium
MB = Melton Branch
NA = not applicable
Sr = strontium

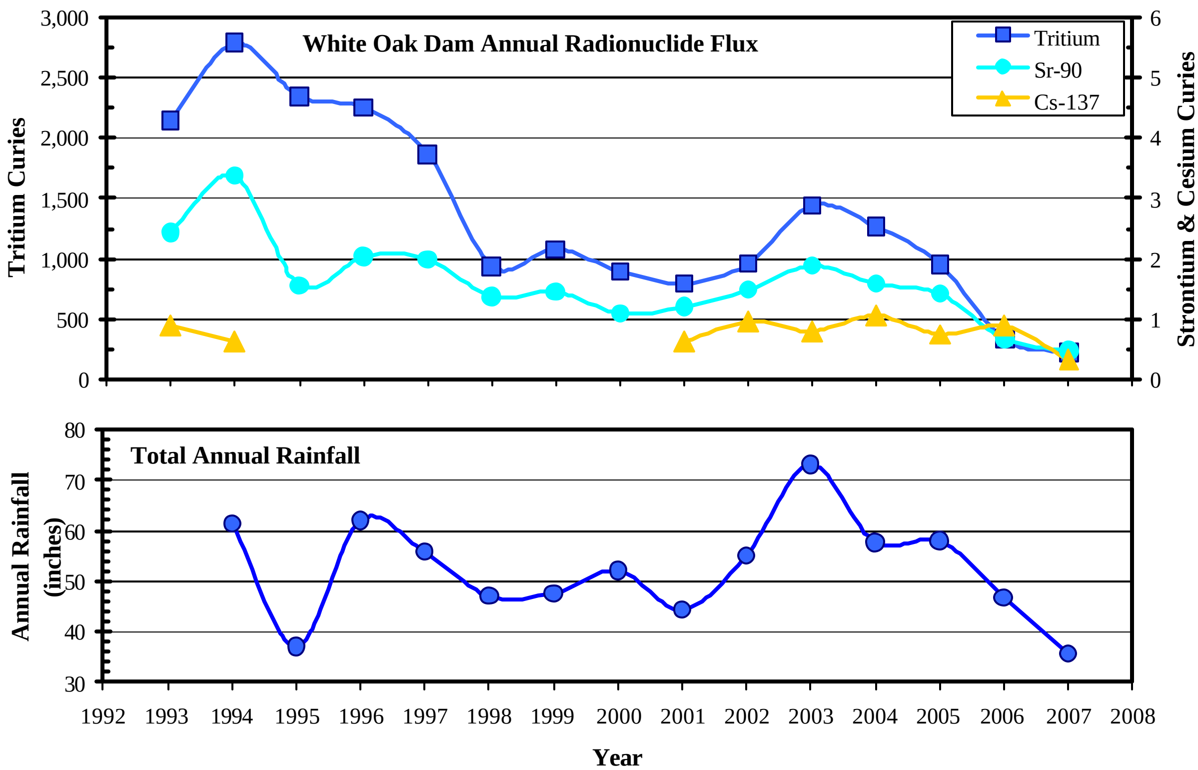


Fig. 3.13. Annual radionuclide fluxes at White Oak Dam and annual rainfall at ORNL.

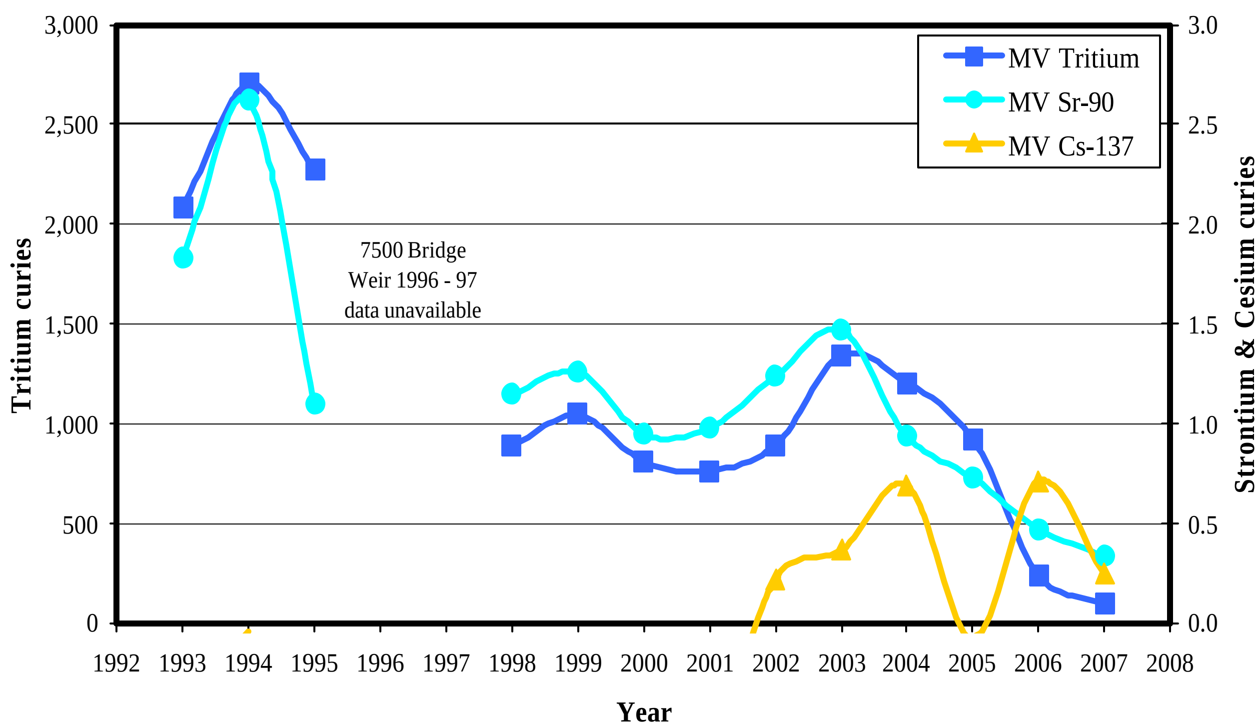


Fig 3.14. Annual radionuclide fluxes from Melton Valley (excluded contribution from Bethel Valley).

Several tributary sampling locations shown on Fig. 3.12 have sufficient historic data to evaluate contaminant concentration trends. Table 3.17 contains annual average concentrations for radionuclides of interest at several tributary surface water monitoring locations in MV where multi-year records are available. For purposes of this evaluation, radionuclides of interest include those constituents that are indicative of site related COCs that are detected consistently at each location. Radiological contaminants of interest at WAG 6 MS3 include ^{3}H and ^{90}Sr. Monitoring data in Table 3.17 show little change in ^{90}Sr concentrations from FY 2000 through FY 2006. However, during FY 2007 ^{90}Sr concentrations decreased to about 65% of the average for the previous 6 years and its standard deviation decreased to about 24% of the previous average. This decrease is attributed to the combined effect of hydrologic isolation of contaminant source areas and to the extreme drought conditions. Tritium concentrations have varied over the 2001–2004 time period and have declined steadily since 2004, as shown in Fig. 3.15. The decrease since 2004 is attributed to the combination of decreased total annual rainfall, as well as capping of the Tumulus, which has decreased discharges from that waste disposal facility.

At the West Seep monitoring location, alpha activity and ^{90}Sr are the radionuclides of interest. Both have decreased significantly since FY 2001–FY 2002 and appear to be stabilizing near the FY 2005 levels, with decreasing variability of results as indicated by the decreasing standard deviations (Fig. 3.16). Capping of Pits 2, 3, and 4 occurred during the summer of 2004 and the downgradient groundwater interceptor pumps along the western side of the area were started in November 2005.

Radionuclides of interest at the East Seep creek include ^{60}Co and $^{233/234}$U. Data collected during FY 2004–FY 2007 (Table 3.17) suggest that concentrations of these contaminants are decreasing in response to hydrologic isolation of Pits 2, 3, and 4 and operation of a downgradient groundwater collection trench along the eastern side of the cap, which also started operation in November 2005.

Data from the SWSA 5 D1 stream are available for FY 2004 through FY 2007 (Table 3.17). During this time ^{90}Sr and tritium concentrations have trended downward. The HRT-3 monitoring station monitors contaminants that originate from the HRE and MSRE reactor areas. Data presented in Table 3.17 show that ^{90}Sr and its beta activity have shown persistent presence in this area and no significant trend is observed in the data collected from FY 2000 through FY 2007. Remedial activities in this area included excavation of contaminated soils and the former wastewater holding pond at the HRE site, remediation of LLLW tanks and an associated pumping station, and excavation of contaminated soils near the MSRE facility. Strontium-90 concentrations decreased at the HRT-3 site during FY 2007 and concentrations dropped to as low as about 10 pCi/L during September. Concentrations may increase again when normal rainfall patterns resume.

3.4.2 Aquatic Biological Monitoring

The monitoring of fish and benthic macroinvertebrate communities provides a useful measure of watershed trends and whether watershed ROD goals of achieving narrative AWQC and protecting ecological populations are met. As is the case for most watershed units, biological monitoring data in MB include: (1) contaminant accumulation in fish, (2) fish community surveys, and (3) benthic macroinvertebrate surveys. In addition to MB, fish and benthic macroinvertebrate monitoring results include a site in WOC just downstream of the MB confluence (Fig. 3.1).

Redbreast sunfish were collected in 2007 from lower MB (MEK 0.2) and analyzed for mercury, PCBs, metals, and ^{137}Cs. Mean (± SE) mercury concentration in these fish (0.07 ± 0.01 µg/g) was typical of reference site concentrations in this species, while PCBs were below detection limits in all fish. As expected, all metals (As, Se, Sb, Be, Cd, Cr, Cu, Pb, Ni, Ag, and Tl) were below detection limits or at levels observed previously in fish from the Hinds Creek reference site. Zinc, at 11 mg/kg, was slightly higher in MB sunfish than observed previously in Hinds Creek sunfish, or observed in previous monitoring at MEK 0.2 (Ashwood 1993). Cesium-137 was not detected in sunfish samples from MEK 0.2.

Table 3.17. Average annual radionuclide concentrations at tributary surface water monitoring locations in Melton Valley

Location	Year	Alpha activity			Beta activity			Cobalt-60			Strontium-90			Tritium			U-233/234		
		N	Avg	StD	N	Avg	StD	N	Avg	StD	N	Avg	StD	N	Avg	StD	N	Avg	StD
EAST SEEP	2004							12	18	7.2							12	146	96
	2005							12	12	4.1							12	69	24
	2006							13	9.9	3.9							11	35	28
	2007							10	5.4	2.5							9	16	4.5
HRT-3	2000				12	461	75				12	200	36.3						
	2001				12	382	165				12	184	50						
	2002				12	385	160				12	137	57						
	2003				13	519	121				13	207	52						
	2004				14	658	253				14	293	132						
	2005				12	584	225				12	248	89						
	2006				12	317	151				13	144	65						
	2007				13	254	158				13	114	73						
SWSA5D1	2004	11	197	68	11	150	46				11	24	5	11	166,800	62,900			
	2005	11	250	114	11	179	82				11	26	7	11	81,100	32,200			
	2006	10	97	59	9	74	43				10	12	5	10	40,900	50,400			
	2007	9	36	12	9	46	61				9	8	4	9	11,800	6,800			
WAG6 MS3	2002	12	27	24	12	714	309				12	224	103	12	977,600	695,800			
	2003	12	10	12	12	829	247				12	253	84	12	693,900	271,300			
	2004	12	6.3	4.3	12	883	200				12	338	67	12	905,500	355,500			
	2005	12	14	13	12	841	193				12	299	659	12	613,400	349,600			
	2006	10	24	57	9	550	167				12	211	81	10	338,600	147,000			
	2007	9	4.1	1.7	9	402	48				10	166	19	10	292,900	95,600			
WEST SEEP	2001	12	281	252	12	428	133	12	4.4	5.4	12	153	43						
	2002	13	363	322	13	457	140	13	5.1	5.6	13	116	36						
	2003	13	159	150	13	312	121	13	2.5	3.1	13	101	33						
	2004	12	85	82	12	176	120				12	68	33						
	2005	12	112	124	12	132	87				12	33	13						
	2006	14	107	83	12	122	57	14	1.7	1. 6	14	38	12						
	2007	13	41	25	13	82	45	13	ND		13	29	7						

Avg = average
StD = standard
HRT = Homogeneous Reactor Test
SWSA = Solid Waste Storage Area
N = number of samples
WAG = Waste Area Grouping
ND = not detected

The monitoring results for MB and WOC below the MB confluence continue to indicate some moderate impact to fish and benthic communities relative to uncontaminated sites, but most stream sites are much improved relative to their ecological status in the mid 1980s. The fish communities in MB have been fairly stable in terms of overall numbers of species in recent samples (Fig. 3.17), but both the larger site in WOC (WCK 2.3) and the smaller sites in MB (MEK 0.6 and 1.4) have species richness values below that of comparable reference fish communities (Brushy Fork Creek and Mill Branch, respectively). The benthic macroinvertebrate community in lower WOC (WCK 2.3) continues to have reduced numbers of pollution-intolerant taxa (Fig. 3.18). The macroinvertebrate community in lower MB (MEK 0.6) in contrast, is inhabited by a similar to only slightly lower number of pollution-intolerant taxa than at reference sites, indicating that the condition of this site is nearing that of reference conditions (Fig.3.18).

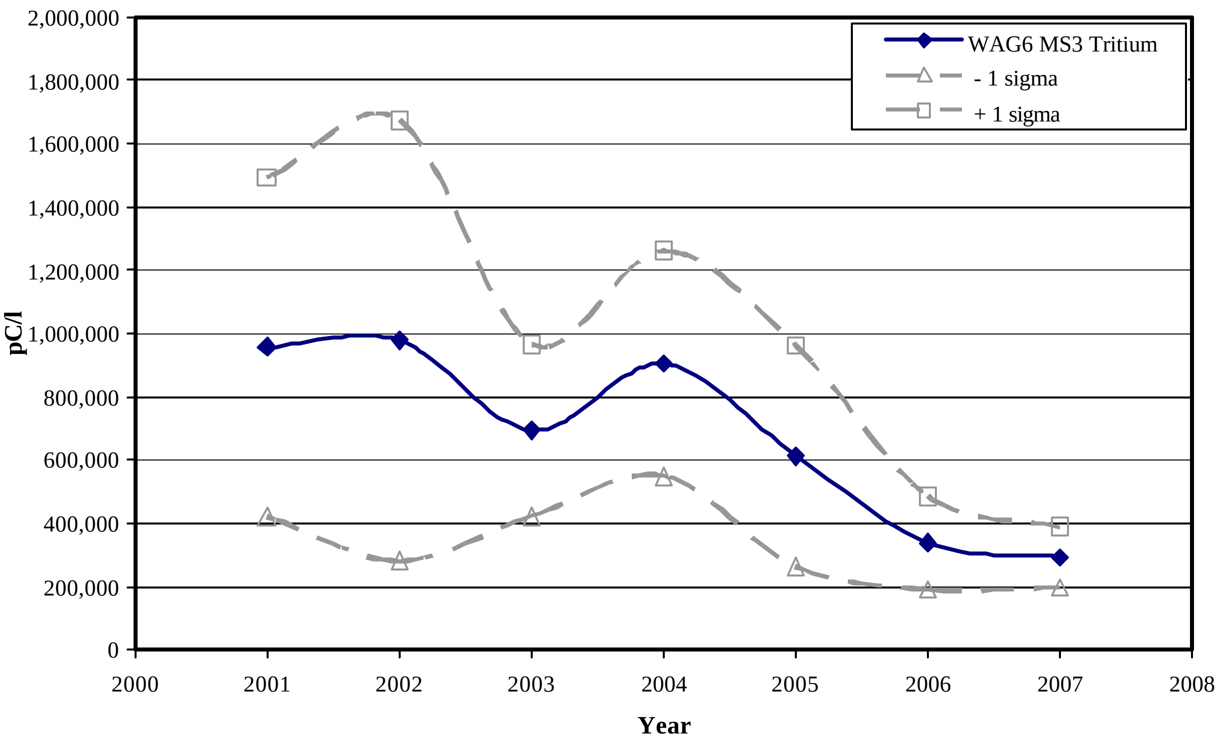
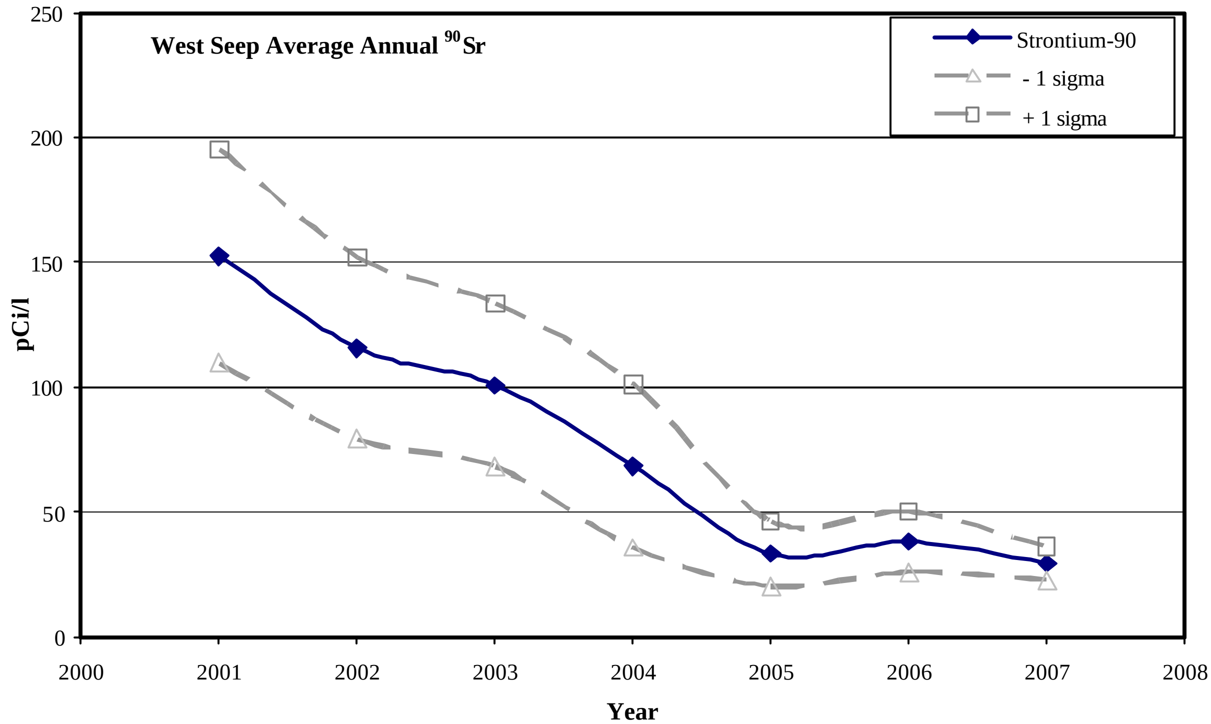


Fig. 3.15 Average annual tritium concentrations at WAG 6 MS3.



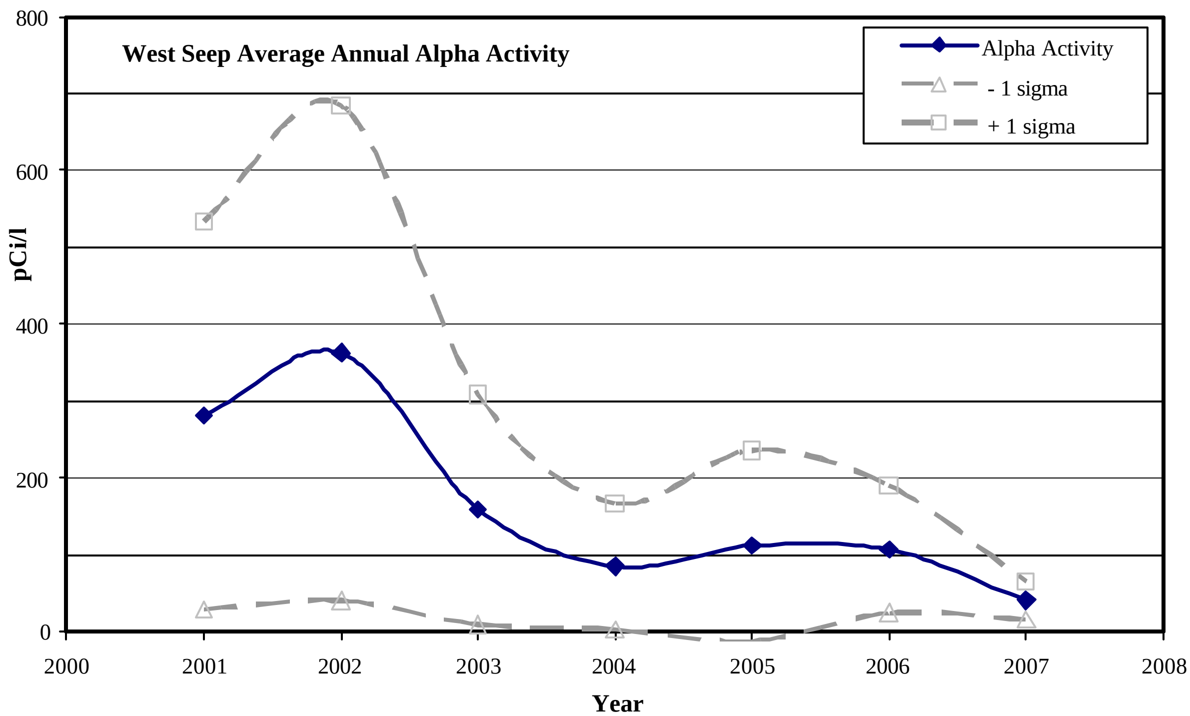


Fig. 3.16. West Seep Creek average annual ^{90}Sr and alpha activity concentrations.

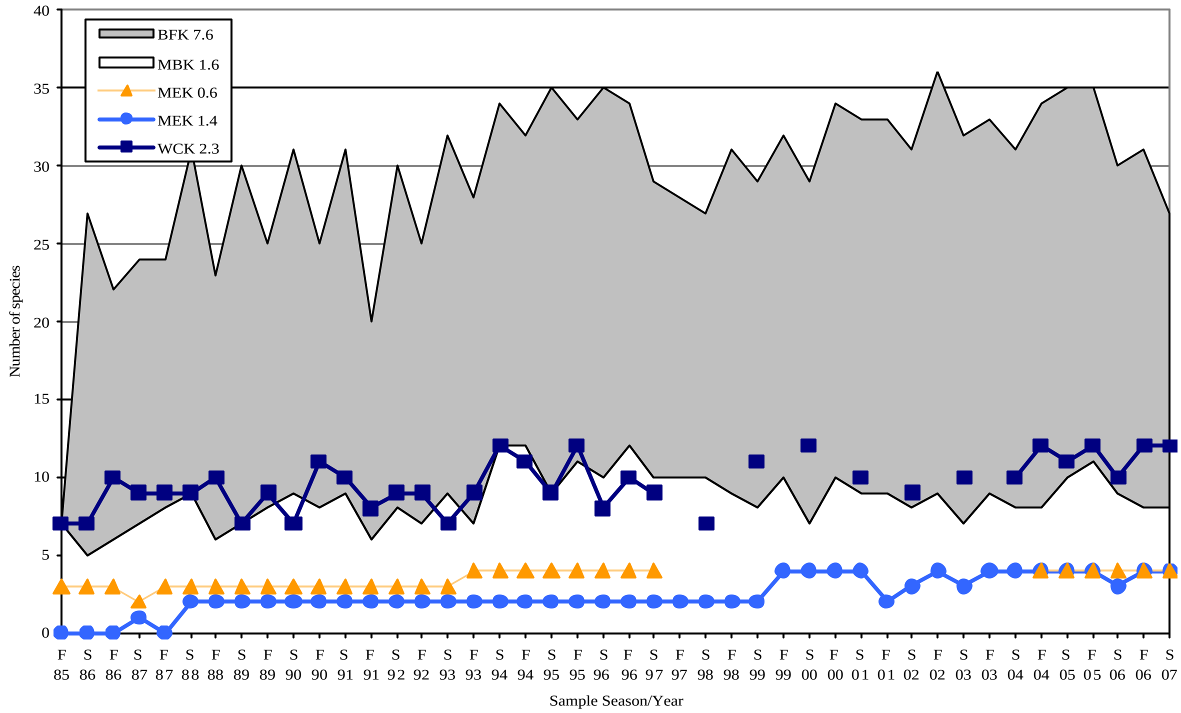


Fig. 3.17. Species richness (number of species) in samples of the fish community in Melton Valley (WCK and MEK) and reference streams, Brushy Fork (BFK) and Mill Branch (MBK), 1985 to 2007.

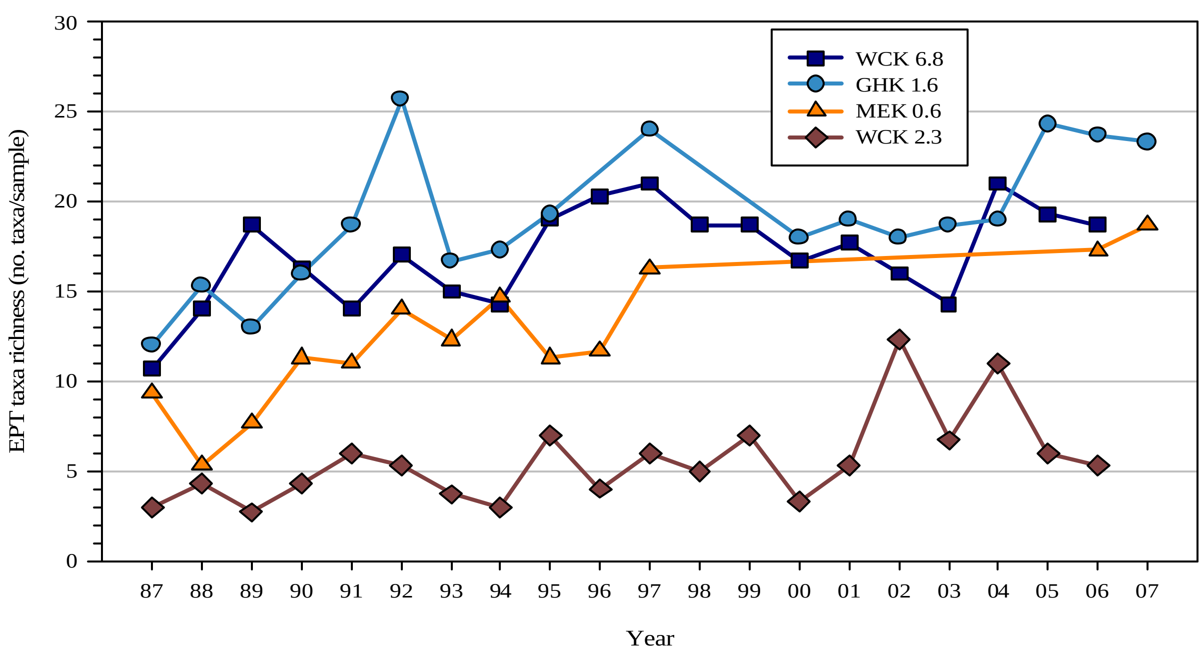


Fig. 3.18. Mean (n = 3) taxonomic richness of the pollution-intolerant taxa for the benthic macroinvertebrates communities in lower White Oak Creek (WCK 2.3), lower Melton Branch (MEK 0.6), and reference sites in upper White Oak Creek (WCK 6.8) and Gum Hollow Branch (GHK 1.6), April sampling periods, 1987–2007.

Sample from WCK 6.8 and WCK 2.3 for 2007 have not been processed.

3.4.3 Summary: Watershed Condition and Trends

Monitoring during FY 2007 showed the combined influences of RAs and extreme drought. The affects of hydrologic isolation caps and groundwater collection systems are demonstrated by suppression of groundwater levels within capped areas, reduced groundwater level fluctuations inside hydrologically isolated areas compared to those outside the remediated areas, and significant reductions in both contaminant concentrations and discharge fluxes in surface water. Surface water radiological contaminant fluxes measured in MV were the lowest on record since the onset of such monitoring in the early 1990s. Most of the groundwater levels in the hydrologically isolated areas in MV met the performance targets for effectiveness. Additionally, contaminant concentrations in most wells in the vicinity of the LLLW Seepage Pits and Trenches showed decreasing contaminant concentrations. These decreases are attributed primarily to the effects of remedial actions. Although flow volumes in the MV groundwater collection systems declined during summer because of the drought and continuing drain-down of groundwater beneath capped areas, analysis of the collected groundwater shows beneficial contaminant mass removal due to treatment. The extreme drought was evident as a number of surface water monitoring stations on tributaries to WOC became dry during the summer months and some reaches of MB were dry through much of the late spring and summer. It is expected that a return to normal precipitation patterns may produce some increases in groundwater levels in remediated areas and overall surface water flows will increase.

Monitoring was conducted on 29 of the 36 groundwater sampling zones in the MV exit pathway wells during FY 2007. Strontium-90 was detected in four of the sampling zones in 2007 with a maximum measured concentration of 12.4 pCi/L. Low (< 5 µg/L) concentrations of the following VOCs were detected -- TCE in 4 sampling zones, 1,2-DCE in one sampling zone, and acetone and chloromethane were both detected once in separate sample zones. Alpha and beta activity levels showed elevated values in several sample zones that typically also contained elevated suspended solids. Detection of elevated alpha and beta activity in the exit pathway wells is identified as an issue in this RER to be addressed by the ORNL CERCLA Core Team.

Aquatic biota monitoring in MV shows that the fish community richness in WOC is stable and lies near the lower range of reference streams. The benthic community data from lower MB shows signs of recovery and has reached levels comparable to the WOC headwater sampling location. The benthic community in the WOC mainstem still shows significant impairment relative to a reference stream, the WOC headwater area, and MB.

3.5 MELTON VALLEY MONITORING CHANGES AND RECOMMENDATIONS

Table 3.18 provides a summary of technical issues and recommendations for the MV Watershed based on evaluations of FY 2007 data evaluations. Issues identified in previous RERs that remain unresolved are carried forward for tracking purposes. In addition, issues that have been completed or are resolved are listed in the summary table one final time and will not be included next year.

The mass imbalance noted previously for ^{90}Sr and ^{3}H was not observed during FY 2006 or FY 2007. Field work was completed in FY 2007 to remove sediment from behind weirs in MV to increase the accuracy of flow measurements used in future flux calculations, which may increase the reliability of ^{137}Cs flux calculations. However, ^{137}Cs is a particle reactive element and its behavior is to adhere to stream channel sediment. This issue will not be formally tracked in future RERs as an action item, but will be discussed by the ORNL CERCLA Core Team and mass balance data reported in future RERs.

Two new issues have been identified in the MV remedy effectiveness monitoring: refinement of hydrologic isolation effectiveness evaluation, and evaluation of the MV exit pathway groundwater monitoring results. Both of these issues will be addressed by the MV CERCLA Core Team.

Table 3.18. Summary of Melton Valley Watershed technical issues and recommendations

ISSUE [(1)]	ACTION/ RECOMMENDATION
FY 2008 ISSUES:	
1. The groundwater level fluctuation metric for hydrologic isolation effectiveness evaluation is applicable only in cases where wells do not extend into bedrock beneath buried waste units.	1. In several instances in which wells completed in bedrock were selected for hydrologic isolation effectiveness evaluation, the actual fluctuation range remains greater than the stated ROD fluctuation metric although the groundwater level is far below the buried waste. The intent of the fluctuation range metric was to limit interaction of fluctuating groundwater with buried waste which would cause continuing waste leaching. In cases where the groundwater level remains below the waste unit, the fluctuation range metric should be disregarded. In cases where groundwater level fluctuation rise to levels equivalent to the base of waste in nearby trenches, the metric should be interpreted as 75% reduction of water level fluctuation in the buried waste elevation zone compared to pre-remediation fluctuations.
2. Monitoring results for some zones in the Melton Valley exit pathway wells yield elevated alpha and beta activity results that are apparently the result of elevated suspended and/or dissolved solids. These results raise concern over possible migration of contamination across the DOE property boundary in western Melton Valley.	2. Issues related to Melton Valley exit pathway groundwater monitoring will be addressed in the ORNL CERCLA Core Team. The issues will be compiled and a path forward concerning modification or enhancement of this monitoring will be prepared.
ISSUE(S) RESOLVED:	
3. During FY 2003 through 2005 there was a flux imbalance noted with respect to ^{90}Sr, ^{3}H, and ^{137}Cs between contaminant inflows at the 7500 Bridge and those measured at the White Oak Creek Weir.	3. The mass imbalance noted previously for ^{90}Sr and ^{3}H was not observed during FY 2006 or FY 2007. The mass balance of ^{137}Cs in the WOC surface water system has always been difficult to reconcile because this contaminant is transported with sediment as a result of the strong adsorption of cesium to soil particles. Consistent with the recommendation from previous years' RERs, to increase the accuracy of flow measurements used in flux calculation, field work was completed during FY 2007 to remove excess sediment from four weirs in MV: WOC weir, 7500 Bridge weir, Melton Branch weir, and MB2 weir. The ORNL CERCLA Core Team discussed the weir cleanout and EPA/TDEC approved the RDR/RAWP Addendum (DOE 2006b), which identified the waste cleanout activities. Data collected after the weir cleanout was discussed by the Core Team and will be reported in subsequent RERs.

[(1)] Issues are identified in the table as (1) "FY 2008 ISSUE" to indicate an issue identified during evaluation of current FY 2008 data, or [(2)] "ISSUE(S) RESOLVED" to indicate that the issue is considered completed or resolved by the FFA parties and will no longer be included in the Issues/Recommendations table of the RER. Any additional discussion will occur at the appropriate CERCLA Core Team level.

EPA = Environmental Protection Agency
FY = fiscal year
^{3}H = hydrogen or tritium
MB = Melton Branch
MV = Melton Valley
ORNL = Oak Ridge National Laboratory
RAWP = Remedial Action Work Plan
RDR = Remedial Design Report
RER = Remediation Effectiveness Report
Sr = strontium
TDEC = Tennessee Department of Environment and Conservation
WOC = White Oak Creek

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4. CERCLA ACTIONS IN BEAR CREEK VALLEY WATERSHED

4.1 INTRODUCTION AND OVERVIEW

This chapter provides an update to CERCLA activities ongoing and completed in Bear Creek Valley (BCV) Watershed. Only sites that have performance monitoring and/or LTS requirements are included in the performance evaluations; those sites are noted on Table 4.1. Figure 4.1 shows the location of each of the CERCLA actions, Table 4.2 provides a summary of LTS requirements and Fig. 4.2 shows future land uses in BCV. In this chapter, performance goals and objectives, monitoring results, and an assessment of the effectiveness of each completed action are presented. A review of compliance with any LTS requirements is also included (Sect. 4.2.3, Sect. 4.3.1.3, Sect. 4.3.2.1, and Sect. 4.6.1).

Several single-project decisions within BCV predate the ROD for Phase I activities. These earlier actions do not contain specific performance criteria for reduction of contaminant flux or risk reduction at the watershed scale. The Phase I ROD, a watershed-scale decision, incorporates the preceding single-project actions and sets specific performance standards for contaminant flux and risk reduction at the watershed scale. The Phase I ROD also includes expected outcomes for the selected remedy against which effectiveness of individual actions is measured. The Phase I ROD addresses groundwater and surface water by dividing the valley into three zones and establishing performance standards for each zone in terms of resource uses and residential risks. The EMWMF, an ongoing, single-project action that post-dates the Phase I ROD, does not include performance criteria at the watershed scale. However, the EMWMF decision does specify a detection monitoring program (groundwater, surface water, storm water, and air monitoring) for the facility to ensure that it operates within design specifications.

For background information of each remedy and performance standards, a compendium of all CERCLA decisions in the watershed within the context of a contaminant release conceptual model is provided in Chapter 4 of Volume 1 of the 2007 RER (DOE 2007a). This information will be updated each year in the annual RER and republished every fifth year at the time of the CERCLA FYR.

Implementation of required monitoring included in CERCLA decision and post-decision documents is often implemented in a manner to establish a baseline against which the effectiveness of the action can be evaluated. Due to sequencing of actions, monitoring frequency may be initiated on a 3-5 year cycle and increase in frequency as the action grows closer to start-up or completion. Because some of the CERCLA actions have not yet been implemented within the BCV Watershed and monitoring data collected to date are not sufficient to assess the watershed-wide impact of the remedial strategy, this chapter concludes with a preliminary evaluation of the early indicators of effectiveness at the watershed scale, such as contaminant trends at the surface water IP.

4.1.1 Status and Updates

During FY 2007, no CERCLA actions were started nor completed in BCV. The EMWMF continued operations (Sect. 4.6) and the annual report is included as Appendix A of this report.

In March 2007, a "Revised Request for Concurrence to Modify Monitoring in BCV [Adler (DOE) to Crane (EPA) and McCoy (TDEC)] was approved. Because the remediation goal for North Tributary (NT)-3 at the Boneyard/Burnyard (BYBY) has been attained each year since FY 2003, the regulators agreed to: (1) discontinue flow-paced composite sampling at NT-3 and replace it with monthly grab sampling for isotopic uranium, (2) discontinue monitoring at BCK 11.84, (3) upgrade BCK 11.54 for a more accurate flow measurement to use as the upstream IP for the Bear Creek Burial Grounds (BCBGs), and (4) reduce the frequency of AWQC monitoring at NT-3 to every 5 years corresponding to the CERCLA FYR.

Although the S-3 Pathways 1 and 2 treatment system has effectively removed uranium from the groundwater intercepted by the collection trenches, the volume of groundwater collected is extremely low in comparison to the total discharge of contaminated groundwater that reaches the Bear Creek headwaters in the S-3 Ponds area. Based on the low quantity of uranium that is being removed from the groundwater via the *ex situ* treatment boxes and the high cost per unit of uranium removed from the environment, DOE recommended discontinuation of the Pathways 1 and 2 groundwater collection system in a formal Addendum to the RmAR. The Addendum was approved by the regulators in June 2007, allowing all performance monitoring to cease and changes in monitoring to evaluate uranium flux and COCs to continue.

Table 4.1. CERCLA actions in Bear Creek Valley Watershed

CERCLA action	Decision document; date signed (mm/dd/yy)	Action status[a]	Monitoring/ LTS requirements	RER section
		Watershed-scale actions		
BCV Phase I ROD	ROD: 06/16/00 LUCIP submitted 9/29/06	BYBY PCCR approved (01/12/04)	Yes/Yes	4.2
		S-3 Site Pathway 3 - deferred	No/Yes	4.2.3
		DARA Facility - deferred	No/Yes	4.2.3
		Completed single project actions		
BCV OU 2 Remedial Action (Spoil Area 1, SY-200 Yard)	ROD: 09/09/96	No additional actions required; institutional control and S&M ongoing	No/Yes	4.3.2
S-3 Site Tributary Interception (Pathways 1 and 2)	AM: 07/10/98 AM Addendum: 10/20/00	RmAR: 02/11/02 RmAR Addendum: 06/20/07	No/No	4.3.1
CERCLA Waste Facility (a.k.a. EMWMF)	ROD 11/2/99 ESD 9/26/01 ESD (haul road) 2/7/05 ESD (leachate) 11/10/05	Construction of waste cell complete	Yes/Yes	4.6

[a] Detailed information of the status of ongoing actions is from Appendix E of the FFA and is available at **http://www.bechteljacobs.com/ettp-ffa-appendices.html**

AM = Action Memorandum
BCV = Bear Creek Valley
BYBY = Boneyard/Burnyard
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DARA = Disposal Area Remedial Action
EMWMF = Environmental Management Waste Management Facility
ESD = Explanation of Significant Differences
LTS = long-term stewardship
LUCIP = Land Use Control Implementation Plan
OU = operable unit
PCCR = Phased Construction Completion Report
RER = Remediation Effectiveness Report
RmAR = Removal Action Report
ROD = Record of Decision
S&M = surveillance and maintenance

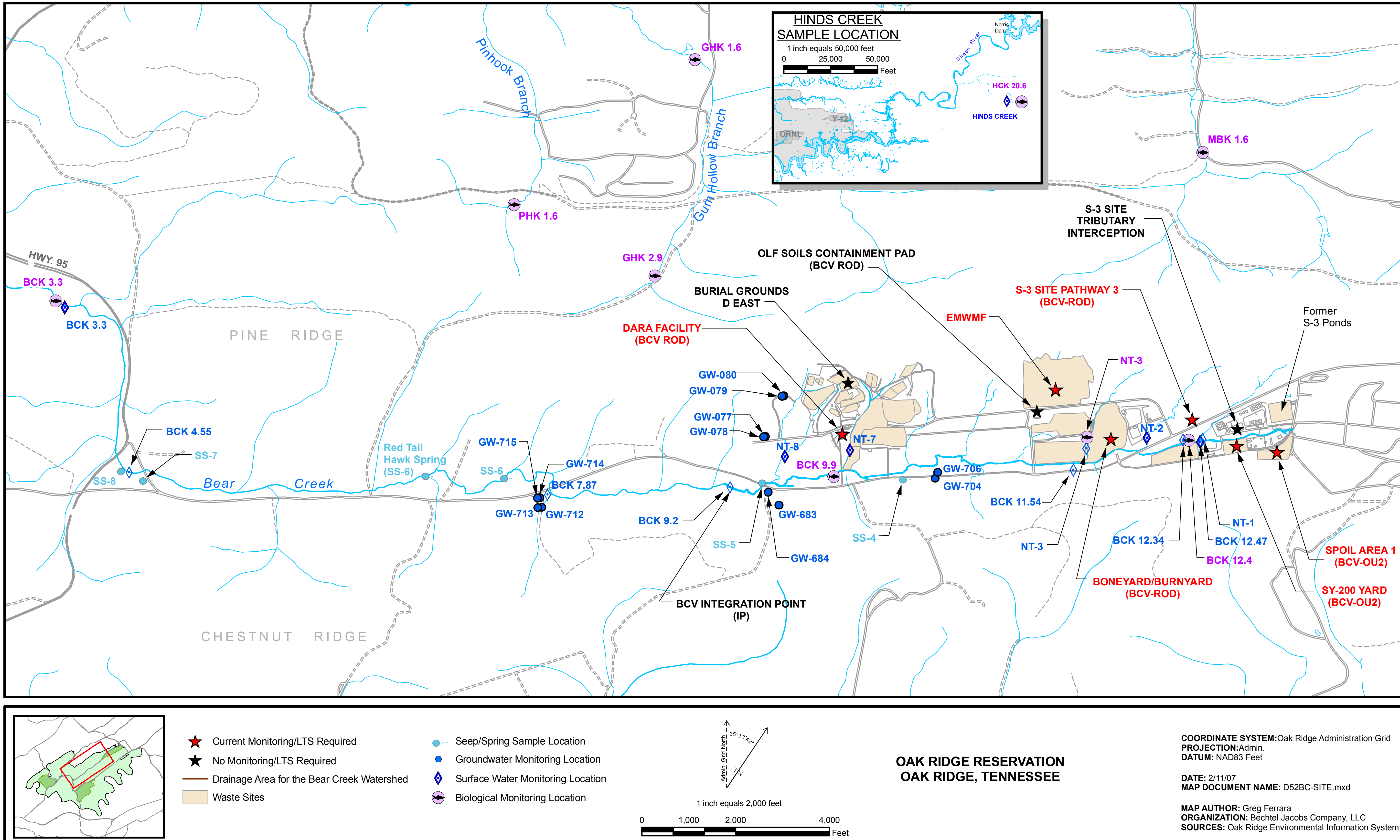

Fig. 4.1. CERCLA actions in the Bear Creek Watershed.

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Table 4.2. Long-term stewardship requirements for CERCLA actions in Bear Creek Watershed

Site/Project	LTS Requirements		Status	RER Section
	Land Use Controls	Engineering Controls		
Watershed-scale actions				
BCV Phase I ROD [(a)] ▪ BYBY PCCR	Watershed LUCs Administrative: ▪ land use and groundwater deed restrictions[(b)] ▪ property record notices ▪ zoning notices ▪ permits program Physical: ▪ access controls ▪ signs ▪ security patrols BYBY PCCR specific: ▪ Access controls ▪ Signs	BYBY PCCR specific: ▪ Maintain cap at BYBY	Watershed LUCs ▪ Physical LUCs in place. ▪ Administrative LUCs required at completion of actions. BYBY PCCR specific: ▪ LUCs in place. ▪ Engineering Controls remain protective.	4.2.3
Completed single project actions				
BCV OU2 Remedial Action (Spoil Area 1, SY-200 Yard)	▪ Deed restrictions ▪ Access controls (fencing) ▪ Signs	▪ Maintain vegetated soil cover	▪ LUCs in place. ▪ Engineering Controls remain protective.	4.3.2.1
S-3 Site Tributary Interception[(c)]	None Specified		N/A	4.3.1.3
EMWMF	▪ Access controls (fencing) ▪ Signs	▪ S&M inspections	▪ LUCs in place. ▪ Engineering Controls remain protective.	4.6.1

[(a)]Remaining actions have not been implemented (e.g., S-3 Site Pathway 3 and DARA Facility)
[(b)]Includes restrictions on surface water use.
[(c)] LTS is not required under this CERCLA action.

BCV = Bear Creek Valley
BYBY = Boneyard/Burnyard
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
EMWMF = Environmental Management Waste Management Facility
LTS = long-term stewardship
LUC = land use controls
N/A = not applicable
OU2 = Operable Unit 2
PCCR = Phased Construction Completion Report
RER = Remediation Effectiveness Report
ROD = Record of Decision
S&M = surveillance and maintenance

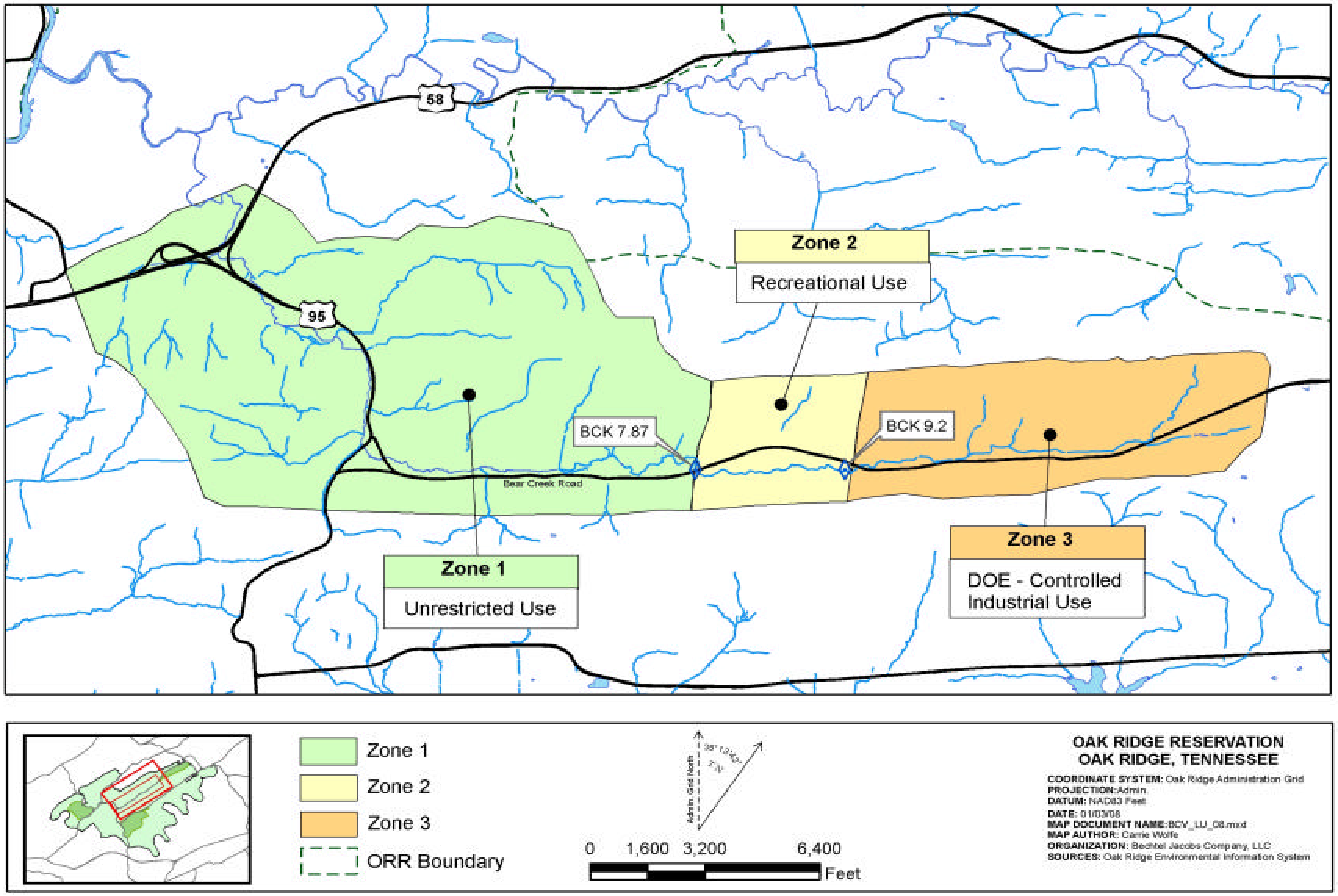

Fig. 4.2. Bear Creek Valley future land use.

4.2 BEAR CREEK VALLEY PHASE I RECORD OF DECISION

The selected remedy cited in the Phase I BCV ROD (DOE 2000b) involves a combination of watershed decisions and specific actions at three areas in BCV (Fig. 4.1): the S-3 Site, the Oil Landfarm area, and the Disposal Area Remedial Action (DARA) facility. Specifically, the following components of the selected remedy are listed in the ROD:

- **S-3 Site.** Install trench at Pathway 3 for passive in situ treatment of shallow groundwater (DOE 2001b).
- **Oil Landfarm Area.** Actions in the Oil Landfarm Area include:
  - Remove waste stored in Oil Landfarm Soil Containment Pad (OLFSCP) for commercial off-site disposal, and dismantle structure.
  - Excavate source areas in BYBY and contaminated floodplain soils and sediments. Excavated materials meeting the WAC of the EMWMF will be disposed on-site; materials exceeding EMWMF WAC will be disposed off-site. Install clay cap over uncapped disposal areas at BYBY, and maintain existing caps.
  - Implement hydraulic isolation measures at BYBY, including reconstruction of NT-3, elimination of stagnation points, and installation of drains or well points.
- **Other Sites.** Remove waste stored in the DARA facility for off-site disposal, and dismantle structure.

Field implementation of actions under the Phase I ROD was initiated in FY 2000. Remedial actions in the Oil Landfarm Area are complete (BYBY and OLFSCP). Other key components of the remedy (S-3 Site Pathway 3 and DARA) have not yet been implemented.

4.2.1 Performance Goals and Monitoring Objectives

Performance goals and monitoring objectives of all the components of the Phase I BCV ROD are provided in the Volume 1 Compendium of this RER. Only monitoring performance goals of the actions that have been completed are discussed in this section. These metrics are summarized in Tables 4.3 and 4.4, and monitoring locations are shown in Fig. 4.1.

4.2.2 Evaluation of Performance Monitoring Data

4.2.2.1 Boneyard/Burnyard

Effectiveness of remedial actions at the BYBY is measured by water quality in the NT-3 stream and monitoring at Bear Creek main stream stations Bear Creek Kilometer BCK 11.54 downstream of NT-3 (see Tables 4.3 and 4.4, and Fig. 4.3). In addition to surface water monitoring at the BYBY, the PCCR (DOE 2003e) specifies monitoring of benthic macroinvertebrate and fish communities in NT-3, and stream channel stability and riparian vegetation monitoring of the restored NT-3 channel. Benthic macroinvertebrate and fish community monitoring are presented in Sect. 4.4.3. Stream channel stability and riparian vegetation monitoring are discussed in this section.

Remediation goal of =4.3 kg/yr uranium flux has been attained each year since FY 2003 at NT-3 (BYBY).

The remediation goal for the BYBY excavation was to attain less than 4.3 kg/year uranium from NT-3. The flux reduction goal was confirmed with the sustained flux reduction in all years since the RA was completed in 2002. Regulatory approval to discontinue flow paced composite sampling at NT-3 and replace with monthly grab samples for uranium was granted in April 2007. Grab samples for uranium are collected monthly and are evaluated in the RER. The average uranium concentration for FY 2007 grab samples at NT-3 was 41.6 pCi/L, which is consistent with concentrations from the previous 4 years that show declining Uranium at NT-3 since the completion of the remedial action. Previous years flux was demonstrated to be well below the BCV Phase I ROD performance standard as discussed in Sect. 4.4.1.

Table 4.3. Land and resource use goals and residual risk goals for the Bear Creek Valley Phase I ROD

Area of the valley[a]	Pre-ROD situation	Agreed-upon goal
Zone 1—western half of BCV	No unacceptable risk posed to a resident or a recreational user.	Maintain clean groundwater and surface water so that this area continues to be acceptable for unrestricted use. MCLs are not exceeded in groundwater; AWQCs are not exceeded in surface water. Land use: unrestricted
Zone 2—a 1-mile-wide buffer zone between Zones 1 and 3	No unacceptable risk posed to a recreational user. Risk to a resident is within the acceptable risk range except for a small area of groundwater contamination.	Improve groundwater and surface water quality in this zone consistent with eventually achieving conditions compatible with unrestricted use in 50 years. AWQCs are not exceeded in surface water. Groundwater goals to be determined in future decisions. Land use: recreational (short-term); unrestricted (long-term)
Zone 3—eastern half of BCV	Contains all the disposal areas that pose considerable risk.	Conduct source control actions to: (1) achieve AWQC for surface water compatible with recreational use 5 years following implementation of respective BYBY and S-3 Site Pathway 3 actions, (2) improve conditions in groundwater to allow Zones 1 and 2 to achieve the intended goals, and (3) reduce risk from direct contact to create conditions compatible with future industrial use. Land use: controlled industrial

Source: DOE 2000b.
[a] See Fig. 4.7
AWQC = ambient water quality criteria
BCV = Bear Creek Valley
BYBY = Boneyard/Burnyard
MCL = maximum contaminant level
ROD = Record of Decision

Table 4.4. Bear Creek Valley Phase I ROD performance standards with BYBY and IP monitoring requirements

Area/Site	Performance standard	Monitoring action	Schedule and parameters
Zone 1/Zone 2 Boundary (performance measurement for Zone 1)	AWQC	SW at BCK 7.87	Semiannual grab samples for metals and anions during Five Year Review period
	MCLs	GW at GW-712, GW-713, GW-714 (Picket W)	Semiannual grab samples for nitrate, metals, VOCs, and uranium
Zone 2/Zone 3 Boundary (performance measurement for Zone 2)	AWQC	SW at IP (BCK 9.2)[a]	Semiannual grab samples for metals and anions during Five Year Review period
	COCs	SW at IP (BCK 9.2)	Semiannual grab samples for metals, mercury, nitrate, and uranium
	U flux = 34 kg/yr	SW at IP (BCK 9.2)	Continuous flow-paced monitoring for uranium
	GW performance standard TBD[b]	GW at GW-683, GW-684 (Picket A)	Semiannual grab samples for nitrate, metals, anions, VOCs, and uranium
Zone 3	AWQC	SW at BCK 12.34, NT-1, NT-2, NT-3[c]	Five Year Review Monitoring for AWQC including: Monthly grab samples for mercury at NT-3; Quarterly grab samples for metals, including mercury, at BCK 12.34, and NT-1 Semiannual grab samples for metals at NT-2 and NT-3[c]
	COCs	SW at BCK 12.34, NT-3[c], BCK 11.54, BCK 11.84	Monthly grab samples for mercury and uranium at NT-3; Quarterly grab samples for metals, including mercury, and uranium at BCK 12.34; Semiannual grab samples for metals at NT-3[c]; Semiannual grab samples for metals, mercury, and uranium at BCK 11.54 and BCK 11.84; Semiannual grab samples for nitrate at BCK 12.34
BYBY	U flux = 4.3 kg/yr	SW at NT-3	Continuous flow-paced monitoring for uranium
	Mercury concentration ≤ 51 ng/L[d]	SW at NT-3	Monthly grab samples for mercury
	AWQC (recreational use within 5 years)	SW at NT-3[c]	Monthly grab samples for mercury; Semiannual grab samples for metals[c]

Table 4.4. Bear Creek Valley Phase I ROD performance standards with BYBY and IP monitoring requirements (continued)

Area/Site	Performance standard	Monitoring action	Schedule and parameters
BYBY (cont.)	Success of the restoration and recovery of NT-3	In-stream biological monitoring at NT-3	Semiannual sampling of fish and benthic macroinvertebrate communities
		Stream channel stability and riparian recovery monitoring at NT-3	Annually (until stabilized and recovery is complete)
S-3 Ponds Pathway 3[e]	U flux = 27.2 kg/yr	SW at BCK 12.34	Continuous flow-paced monitoring for uranium
	Nitrate – 40% seasonal reduction	SW at BCK 12.34	Continuous flow-paced monitoring for nitrate
	AWQC (recreational use within 5 years)	SW at BCK 12.34	During 5 year review: Quarterly grab samples for metals, including mercury
	Cadmium concentration = 0.25 µg/L[f]	SW at BCK 12.34, NT-1	Quarterly grab samples for metals

[a]Beginning in FY 2006, the IP has been located downstream of BCK 9.47 to location BCK 9.2. Surface water monitoring, since the RI, indicates that there may be underflow of the monitoring locations at BCK 9.47 and SS-5 that is captured at BCK 9.2.
[b]Cleanup levels for groundwater are to be determined under future decisions following source actions.
[c]Grab sample frequency reduced from monthly to semiannual for metals (other than mercury and uranium) at NT-3 as a result of Water Resources Restoration Program data quality objective workshop in June 2003.
[d]The Phase I ROD originally established the mercury concentration performance standard as 12 ng/L. This standard changed to 51 ng/L due to a change in the promulgated AWQC.
[e]Performance evaluation deferred until all actions are implemented. Current monitoring to collect baseline data.
[f]The Phase I ROD originally established the cadmium concentration performance standard as 3.9 µg/L. This standard changed to 0.25 µg/L due to a change in the promulgated AWQC.

AWQC = ambient water quality criteria
BCK = Bear Creek kilometer
BYBY = Boneyard/Burnyard
COC = contaminant of concern
GW = groundwater
IP = integration point
kg/yr = kilograms/year
MCL=maximum contaminant level
ng/L = nanograms/liter
NT = North Tributary
RI = remedial investigation
ROD = Record of Decision
SW = surface water
TBD = to be determined
µg/L = micrograms/liter
VOC = volatile organic compound

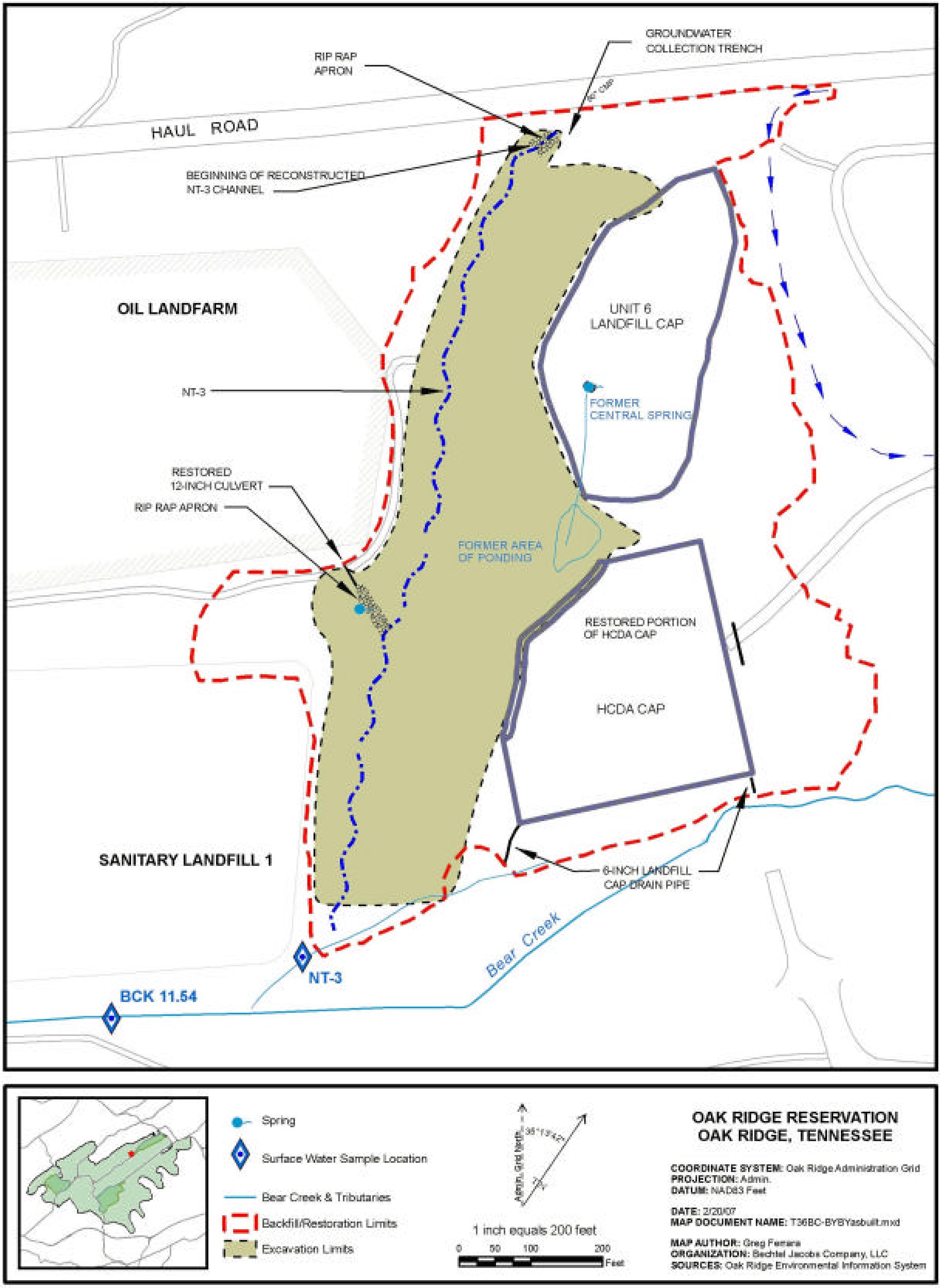

Fig. 4.3. Location of Boneyard/Burnyard site and monitoring locations.

Regulatory approval to discontinue monitoring at BCK 11.84 was granted in an April 2007 correspondence. The purpose for monitoring at BCK 11.84 was to measure upstream flux above the confluence of Bear Creek and NT-3 prior to the BYBY remediation. The remediation goal for NT-3 (reduce uranium flux to <4.3 kg/yr) was met with excavation of the BYBY, so the upstream measurements are no longer relevant. In addition, the monitoring equipment and support facilities at BCK 11.84 have deteriorated considerably and would require significant maintenance to retain as a monitoring station. BCK 11.54 is used as the surface water IP sampling station upstream of the BCBGs.

The BCV ROD also requires that AWQC in surface water be met in NT-3 and that surface water results be compared to risk-based screening criteria (RBC) for risk to an industrial receptor <1x10-5. Along with the other monitoring changes discussed above for NT-3, regulatory approval was granted in correspondence from EPA and TDEC to reduce frequency of AWQC monitoring at NT-3. AWQC goals for NT-3 have been achieved through the BYBY remedial action. Therefore, the AWQC monitoring will be reduced to every 5 years corresponding to the FYR. The next sampling year will be FY 2010. The analyses that are used to evaluate the AWQC will also be used to calculate risk in the corresponding FYRs.

In addition to uranium, the BCV ROD identifies mercury and cadmium, ecological risk contributors, as COCs. Comparison of pre- and post-remediation estimates of daily total mercury loading in surface water at the mouth of NT-3 showed a 90% reduction after BYBY remediation. The estimates were based on results of monthly grab samples collected between January 2001 and may 2002 (prior to remediation) compared to those of monthly grab sample results obtained between November 2002 and September 2006 (post-remediation). Pre-remediation Hg daily loads showed mean and median values of 0.04 and 0.01 g/d, respectively, while post-remediation mean and median loads were 0.004 and 0.001 g/d, respectively. The mean total mercury concentration in the 17 months prior to remediation was about 130 ng/L while the mean total mercury concentration post-remediation was about 40 ng/L. Cadmium was not included with the FY 2007 analysis since it is included with the AWQC analytes. However, historic results for cadmium have been below the BCV ROD remedial goal of 3.9 mg/L at NT-3 since January 1999.

NT-3 Stream Channel Stability Monitoring

An annual survey to measure any changes in the restored NT-3 stream channel is required by the PCCR (DOE 2003e). With the completion of NT-3 channel restoration in FY 2003, the initial monitoring program was established. Measurements are taken across riffles located on the upper, middle, and lower sections of the restored NT-3 channel. Monuments were installed at cross-section locations along with bank pins and scour chains. At these permanent cross-sections, detailed measurements of the existing stream channel and floodplain are made. Bank pins and scour chains are monitored for erosion and deposition. These areas are revisited on an annual basis to compare conditions from year to year. Some “adjustment” in channel conditions is expected. This monitoring allows for the adjustment to be quantified and evaluated to determine if the restoration effort has been successful. In FY 2003, data were collected on baseline conditions to be used for comparison to subsequent data sets.

Data collected from FY 2003 through FY 2007 indicate that adjustments in the stream channel morphology are occurring. The initial channel was constructed with a uniform depth. Typically, natural stable channels contain deeper areas (pools) and shallower areas (riffles). The NT-3 channel has adjusted in some areas to create pools and riffles. Material is being scoured and removed in those areas where pools are being created. That scoured material is being deposited elsewhere with the effect of creating shallower riffle sections. The channel was constructed with a uniform meander pattern. Typically, natural channels have more irregularity in their pattern. In a couple of areas, high flows across the floodplain are scouring material from the point bars. If this continues, a new channel will be created and the channel in that adjacent meander will be abandoned. This will result in a more irregular pattern with some meanders spaced farther apart than others. A pebble count is conducted each year to determine the composition of material in the stream bed. The average size of material has evolved since channel construction from very fine gravel to medium gravel. This is probably the result of finer material remaining from construction being flushed from the system. Vegetative cover has been established on the adjacent upland areas, and the supply of fine material has decreased, resulting in coarsening of the stream bed material.

The natural channel design approach to stream restoration, which was used at NT-3, attempts to construct a channel as near to a natural stable configuration as possible. This minimizes the potential for channel instability and the associated negative impacts on the channel, water quality, and ecosystem. The observed changes in NT-3 channel morphology and bed material are consistent with a channel that is undergoing adjustment as it moves toward more stable conditions. This type of adjustment is expected in a newly constructed channel and should diminish over time. As vegetation in the riparian zone adjacent to the channel and the surrounding upland area improves, this will also help to minimize channel adjustment.

Based on the data collected over the last 5 years, channel conditions have stabilized and the occurrence of significant channel instability is not likely in the future. At this time it is recommended that stream stability monitoring be discontinued. This is consistent with monitoring protocols specified in the TDEC document "Stream Mitigation Guidelines for the State of Tennessee", (TDEC 2004a) which calls for monitoring for 5 years after this type of stream channel restoration project.

NT-3 Riparian Vegetation Monitoring

An annual stream habitat assessment of NT-3 is also a mitigation requirement specified in the PCCR (DOE 2003e). Calendar year 2007 is the fourth year of a five-year monitoring effort. Surveys included measures of in-stream habitat within established stream transects. Riparian habitat included primarily vegetation cover (% cover and species diversity). Trees and shrubs were planted adjacent to NT-3, along with native herb seeding, in the fall/winter of 2003 (the last of the trees and shrubs were planted on December 16, 2003) and the condition of planted trees and shrubs is also monitored.

Transect and plot results from the stream and riparian surveys are presented in Tables 4.5 and 4.6. In general, NT-3 is a small first order stream that is a little over half a meter wide in most places in summer (Table 4.5). The stream widens during high flows to as much as 1-2 meters, with overland sheet flow in some bends that allows for some riparian wetland development. Stream sediments are primarily of a gravel substrate, with occasional sand, fine sediments, and clays in some stream sections.

The results of the 2007 vegetation survey showed very similar conditions to 2006 (Table 4.6 and Figs 4.4, 4.5 and 4.6). The average number of plant species observed per plot in 2007 (15) was similar to the number observed in 2006 (17). The slight decrease in plant species is probably due to the greater coverage of lespedeza within the riparian plots (Fig 4.6). Lespedeza is a well known invasive plant that commonly out-competes other species. In September 2007, ORNL's natural resource team sprayed this area to control the lespedeza. The average diversity of plants in 2007 was still higher than the early years of the remediation, and the areas near the stream are particularly diverse with high numbers of native species.

The annual percent vegetation cover (~85%) in 2007 was also similar to that in 2006. The approximately 15% of bare ground was found in the areas with poorest soils and steepest banks. Tree and shrub volunteers were more abundant within plots in 2007. Over time, these woody species will become more dominant and crowd out many of the sun-loving herbaceous species at the site. Overall, based on the most recent results the NT-3 remediation site is well on its way towards a more stable natural riparian community.

Table 4.5. Select physical stream habitat metrics obtained from NT-3 on August 1, 2007

Transect Plot #	Stream width (m)	Percentage substrate[1]						Percent Embed[2]
		Small bolder	Cobble/ rubble	Gravel	Sand/ Fine sed	Silt	Clay	Ave
1	0.6			71	29			88
2	0.5			40	60			75
3	0.2		33	33			33	27
4	0.7		14	71		14		61
5	0.7			86	14			88
6	0.3		33	66				35
7	0.2			100				43
8	0.3			50	50			48
9	0.4			80	20			46
10	0.8			56		22		50
25	DRY							
26	DRY							
27	0.2			100				30
2007 Ave	0.4	0	7.3	68	16	3.3	3.0	54
2006 Ave	0.6	2.6	7.5	66	18.9	0	5.6	44

[1]Particle size ranges in mm: clay = <0.004, silt = 0.004 – 0.062, sand/fine sediment = 0.062-2.0, and gravel= 2.0-64.0.
[2]Percent embeddedness: Percentage of surface of predominant particles covered by fine sediment. Measurements were taken every 10 cm.

cm = centimeters mm = millimeters sed = sediment
m = meter NT = North Tributary

Table 4.6. The percent ground and canopy cover, plant species diversity, the amount of riparian overhang, the planted tree/shrub survival and condition for each monitored transect at the NT-3 restoration site, August 1, 2007

Transect/ Plot #	% Canopy	% Ground Cover	No. of plant species	L Bank Overhang (cm)	R Bank Overhang (cm)	Number of trees and shrubs/plot
1	0	90	18	5	10	1
2	3	95	17	29	11	1
3	0	95	14	0	0	1
4	0	95	17	3	0	3
5	0	85	20	0	0	5
6	1	80	13	0	26	4
7	0	70	13	12	0	1
8	0	80	10	15	2	5
9	0	80	6	0	7	1
10	0	87	8	3	0	3
25	0	90	24	DRY	DRY	5
26	1	70	NS	DRY	DRY	NS
27	1	95	19	15	4	4
2007 Ave	<1	86	15	7	5	34 (total)
2006 Ave	<1	88	17	5	6	20 (total)

cm = centimeter R = right
L = left NT = North Tributary

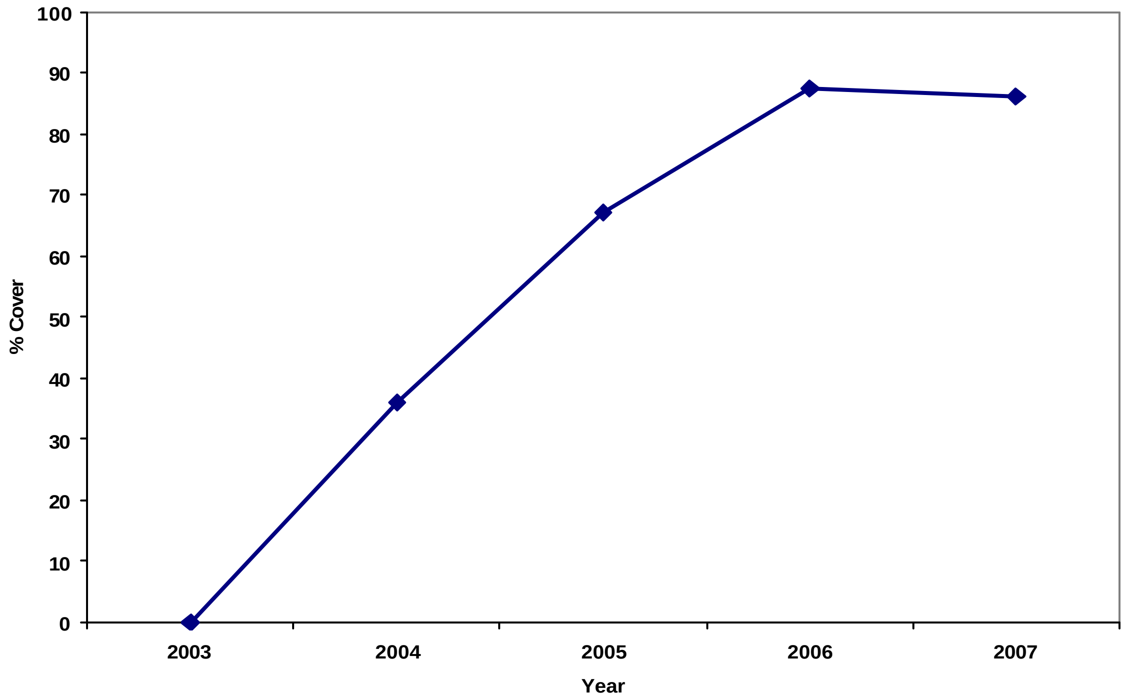

Fig. 4.4. Average annual percent herbaceous cover in survey plots (n=13), 2003-2007.

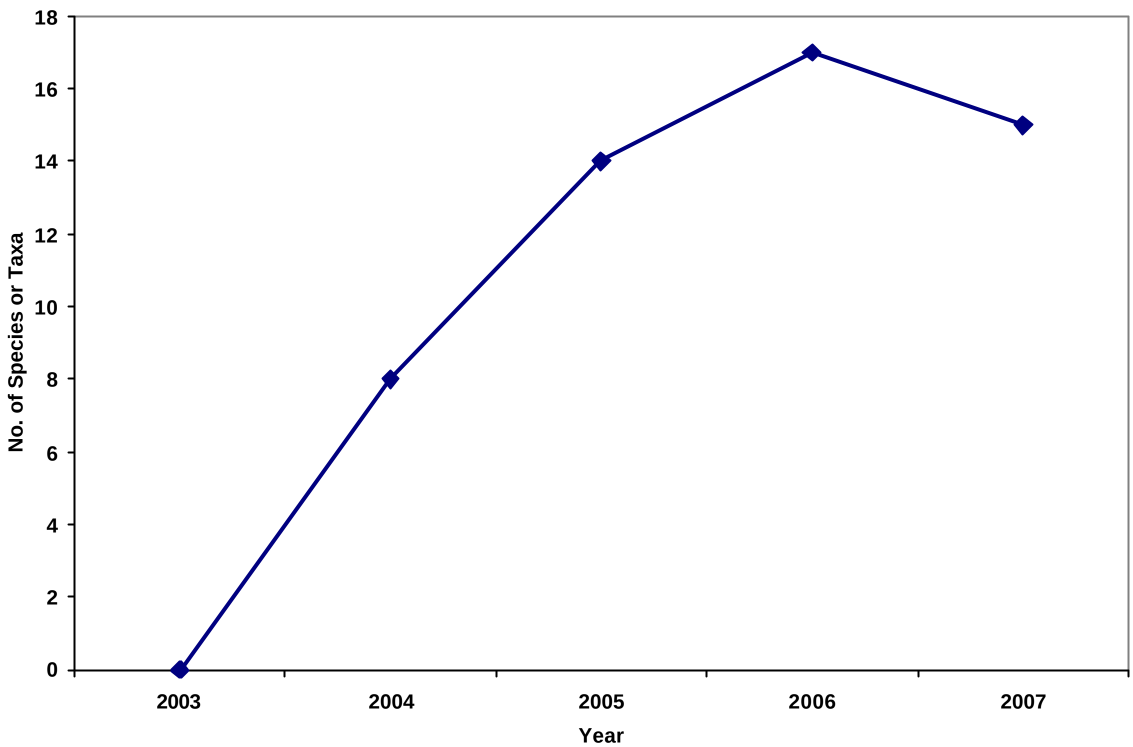

Fig. 4.5. Average annual number of species or taxa per survey plot (n=13), 2003-2007.

Fig. 4.6. Wide -angle view of the restored North Tributary 3 looking south in fall of 2003 (top left), summer of 2004 (top right), fall of 2004 (middle left, after topsoil added), summer of 2005 (middle right), summer of 2006 (bottom left) and summer of 2007 (bottom right).

4.2.2.2 Surface Water and Groundwater Quality in Zones 1, 2, and 3

Figure 4.7 shows BCV land use zones and monitoring locations that are used to evaluate surface water and groundwater conditions relative to the RAOs listed in Table 4.3. Additionally, several monitoring stations identified in Fig. 4.7 along Bear Creek [BCK 3.3, BCK 4.55 (STA 304)] and a number of springs (SS-6, SS-6.6, SS-7, SS-8) located on the floodplain of Bear Creek are used to evaluate the overall watershed conditions (see Sect. 4.4).

Resource Use Zone 1

Zone 1 of BCV constitutes all of the valley west of BCK 7.87 (Fig. 4.7). Surface water quality is monitored at BCK 7.87. Groundwater quality within Zone 1 is monitored at the upgradient boundary with Zone 2 by three wells located at Picket W (GW-712, -713, and -714). Comparative criteria for surface water and groundwater in Zone 1 are derived from the agreed-upon unrestricted resource use goals listed in Table 4.3.

For Zone 1 surface water, results are compared to AWQC, consistent with the unrestricted use goal. In addition, risk-based remediation goals for residential exposure to surface water (1×10^{-5}) are included as part of the evaluation. For groundwater, RBC for residential use (1×10^{-5}) and maximum contaminant level (MCLs) are used as the primary criteria to measure progress toward goal attainment. AWQC were not monitored in FY 2007, but will be included in the FYR year sampling.

For Zone 1 groundwater, monitoring of Picket-Wells GW-712, GW-713, and GW-714 was performed in FY 2007. These wells intercept groundwater moving from Zone 2 into Zone 1. For this period, there were no exceedances of MCLs or RBCs in these wells. In FY 2006, tetrachloroethene was detected at a concentration of 14 µg/L in well GW-713, which exceeds the MCL (5 µg/L) and the RBC (7.8 µg/L) for groundwater. However, tetrachloroethene was below the detection limit in FY 2007.

Resource Use Zone 2

Zone 2 of BCV constitutes the section of the valley located between BCK 7.87 and BCK 9.2 (Fig. 4.7). Surface water is monitored by the sample location that defines the IP, specifically Bear Creek surface water station BCK 9.2. Groundwater monitoring wells GW-683, and -684 are also used to monitor Zone 2. Zone 2 surface water data are evaluated against AWQC during the FYR year. For groundwater, MCLs are used as the primary criteria for measuring progress toward attainment of resource use goals. The RAO for cleanup levels in Zone 2 is risk to residential receptors below 1×10^{-5}; therefore, surface water and groundwater data are compared to RBC to measure progress toward attainment of the RAO. The RAO specifically applies as a performance criterion at BCK 9.2 (IP).

Total uranium, ^{234}U, and ^{238}U exceeded the residential RBCs at BCK 9.2 (see Resource Use Zone 3 discussion). Based on an evaluation of FY 2007 flow-paced composite sample data, total uranium flux exceeds the RAO of 1×10^{-5} (equivalent to uranium flux of 34 kg/yr). Further evaluation of uranium results at BCK 9.2 is presented in the IP flux assessment in Sect. 4.2.2.3 and Sect. 4.4.

Groundwater contaminants at the IP did not exceed MCLs in FY 2007. The only constituent to exceed residential risk target levels is ^{238}U at the Picket A boundary. The maximum result for ^{238}U in FY 2007 in Zone 2 was 8.23 pCi/L at well GW-684, which slightly exceeds the 5.5 pCi/L RBC. No VOCs were detected in Zone 2 boundary wells that exceeded MCLs or RBC.

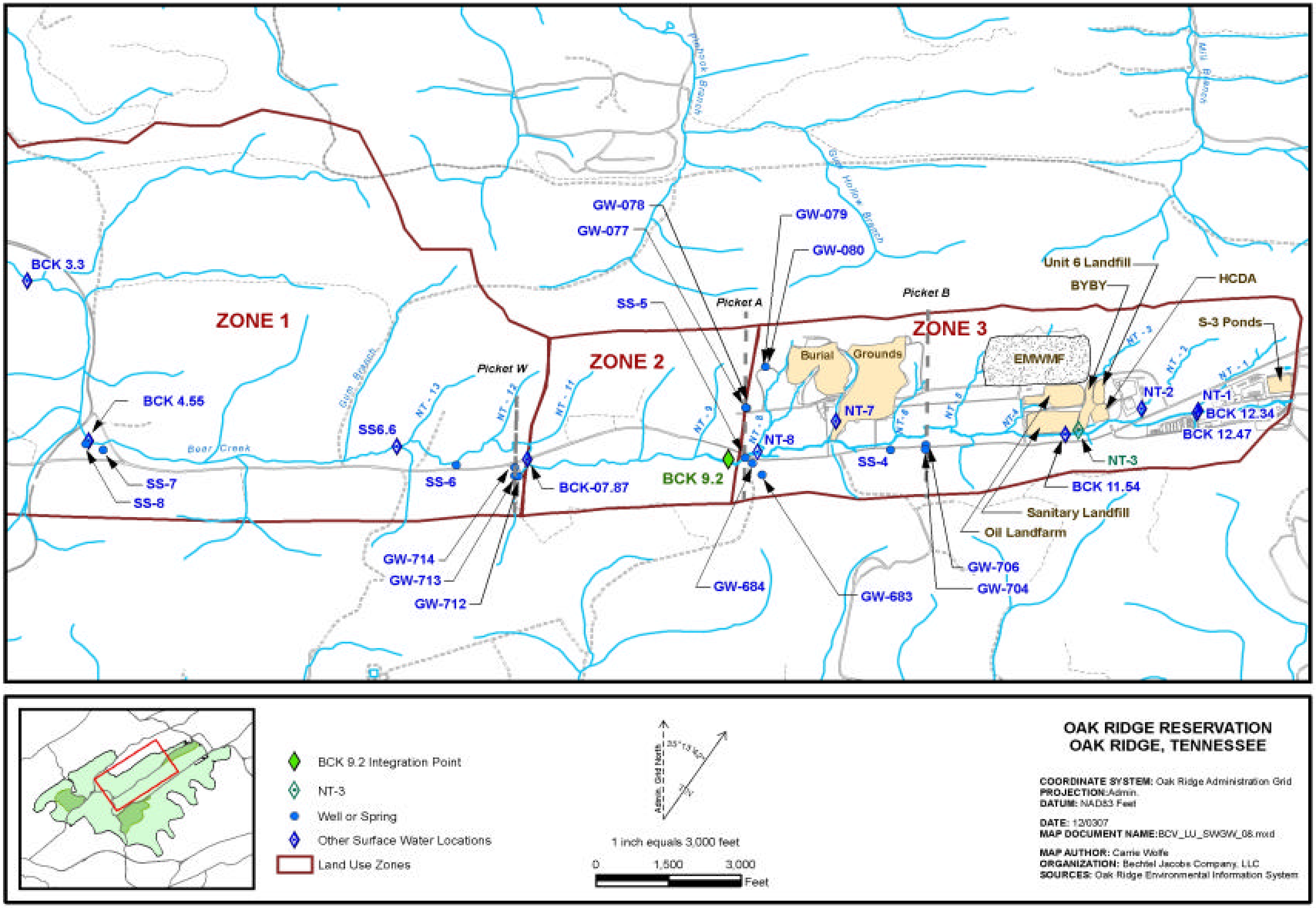

Fig. 4.7. Bear Creek Valley Land Use Zones and surface water and groundwater monitoring locations.

Resource Use Zone 3

Zone 3 of BCV is the section of the valley, east of BCK 9.2 (Fig. 4.7) that contains a currently operating CERCLA waste disposal facility (EMWMF) and former waste disposal sites. Surface water and groundwater quality are monitored at a number of surface water locations and groundwater wells. Comparative criteria for evaluation of remediation effectiveness for Zone 3 are based on the agreed-upon goals following the completion of ROD prescribed remedial actions. The remedial goals for Zone 3 are to attain AWQC in all surface water (short-term), and reduce risks from direct contact to achieve conditions compatible with a long-term, controlled industrial land use. Zone 3 surface water data will be evaluated in the FYR against AWQC and RBC as a measure with respect to short-term and long-term goals. For groundwater, a cleanup criteria will be determined in a future decision; however, MCLs and RBC are used to measure effects of interim source actions on groundwater contaminant concentrations (Table 4.7).

Uranium concentrations in Bear Creek Surface water generally exceeded the ROD risk goals. At the Zone 3 IP (BCK 9.2) the average concentrations of $^{233/234}U$, ^{235}U, and ^{238}U were 8.7, 0.9, and 18.8 pCi/L, respectively compared to the risk based concentration goals of 6.7, 6.6, and 5.5 pCi/L. These risk-based concentration goals are equivalent to the ROD hypothetical residential exposure goal of a 1E-5 excess lifetime cancer risk attributable to these uranium isotopes. Further upstream in Zone 3 industrial exposure scenario comparisons are relevant since the ROD remediation goal for that area is controlled industrial use. At BCK 12.34, near the S-3 Ponds, the average $^{233/234}U$, ^{235}U, and ^{238}U concentrations were about 21, 2, and 42 pCi/L, respectively. The values for $^{233/234}U$, ^{235}U, and ^{238}U exceed their respective industrial exposure goals of about 23, 22, and 18 pCi/L, respectively. Uranium discharge flux goals were derived during the development of the Bear Creek Valley ROD and discussion of progress toward meeting those goals is summarized in Section 4.4, Watershed Conditions and Trends.

In Zone 3 groundwater (Table 4.7), nitrate, uranium, alpha activity, beta activity, cis-1,2-DCE and TCE results exceeded safe drinking water standards at GW-706. Results for $^{233/234}U$ and ^{238}U also exceeded RBC at GW-706. Nitrate and TCE concentrations exceeded safe drinking water standards and RBC at GW-704 (see Sect 4.4 for further discussion of groundwater quality in Zone 3).

4.2.2.3 Integration Point (IP, BCK 9.2)

The BCV Phase I ROD includes a key performance goal to reduce residual human health risk at the watershed IP to 1 x10^{-5}/HI = 1. Uranium flux of 34 kg/yr is equivalent to a risk of 1 x10^{-5}. Prior to FY 2006, IP uranium flux calculations were based primarily on the sum of estimated fluxes from spring discharge at SS-5 and from the stream channel at BCK 9.47. The bulk of the estimated flux at these two locations was measured at BCK 9.47 at which flow measurement calibration was problematic. Beginning in FY 2006, station BCK 9.2 has been adopted as the new IP, replacing the combined flux from BCK 9.47 and SS-5.

During FY 2007, the majority of total-uranium flux at the IP was from ungauged pathways.

Comparing the total flux of uranium at BCK 9.2 to the estimated contributions from primary upstream source areas (e.g., NT-3 at BYBY and BCK 12.34 at the S-3 Site) would indicate that uranium is bypassing upgradient monitoring stations as ungauged flux. Though flux is no longer calculated at NT-3 with flow composite monitoring, grab samples from NT-3 are consistent with decreasing concentrations measured in previous years. Based on the concentrations of the grab samples from FY 2007 the estimated total uranium flux contribution from BYBY (less than 2 kg/yr) would continue to be a low percentage of the total flux measured at BCK 9.2 (59.5 kg/yr). Contributions from the S-3 Site, measured as total uranium flux at BCK 12.34 (15.8 kg/yr), during FY 2007 represented about 27% of the total flux measured at BCK 9.2. During FY 2007, ungauged total-uranium flux represents about 70% of the total flux at the IP. Additional discussion of total uranium flux trends is presented in Sect. 4.4.

Table 4.7. Groundwater results for Zone 3 compared to MCLs and risk-based cleanup levels for FY 2007

Detected Constituent	Units	Number of Samples	Number of Detected Results	Average[a]	Maximum Detected Result[a]	Criteria	
						SDWA MCL[b]	Human Health Risk 1 x 10^{-5} (RBC)
Anions							
Nitrate	mg/L	4	4	**14.1**	**24.2**	10	58
Metals							
Uranium	mg/L	4	3	**0.05**	**0.07**	0.03	0.022
Radionuclides							
Alpha activity	pCi/L	4	3	13.5	**20.5**	15	--
Beta activity	pCi/L	4	4	41.3	**75.2**	50	--
Uranium-$^{233/234}$	pCi/L	4	4	**7.2**	**12.6**	--	6.7
Uranium-^{238}	pCi/L	4	3	**15.7**	**22.3**	--	5.5
VOCs							
Trichloroethene	µg/L	4	4	**13.5**	**19**	5	19
cis-1,2-Dichloroethene	µg/L	4	3	**10.7**	**16**	7	360
Vinyl Chloride	µg/L	4	1	0.1	0.1	2	0.25

[a]Results evaluated from groundwater monitoring wells GW-704 and GW-706.

[b]Cleanup criteria for groundwater are to be determined in a future decision document; however, MCLs are used here for screening and trending purposed to measure effects of source actions on groundwater contaminant concentrations.

Bold values exceed at least one of the criteria.

FY = fiscal year
MCL = maximum contaminant limit
mg/L = milligrams per liter
pCi/L = picoCuries per liter
RBC = risk-based screening criteria
SDWA = Safe Drinking Water Act of 1974
µg/L = micrograms per liter
VOC = volatile organic compound

4.2.3 Compliance with LTS Requirements

4.2.3.1 Requirements

Long-term stewardship requirements outlined in the ROD (DOE 2000b) include use restrictions on groundwater and surface water, as well as LUCs (Table 4.2). Objectives of these controls include preventing unauthorized contact, removal, or excavation of buried waste in the BCV; preclude residential use of Zone 3; and prevent unauthorized access to contaminated groundwater in the BCV. The ROD also states that DOE will maintain the BCV Phase 1 sites as controlled industrial areas, and limit public access by posting signs and conducting security patrols. The individual remedial actions under the BCV Phase 1 ROD have the following additional LTS activities.

- BYBY——The site will be inspected by the Y-12 S&M Program quarterly until (i.e. capped areas) the site is stabilized, then on a semi-annual basis. Surveillance activities include inspection of capped areas for unwanted vegetation and erosion, and inspection of access controls to the site. Routine maintenance includes mowing of the capped areas. Non-routine maintenance will be performed as necessary.

- S-3 Ponds Pathway 3——Control and restrict access; once action is complete, inspect and maintain the passive *in situ* treatment system.

- DARA Solids Storage Facility——Control and restrict access.

4.2.3.2 Status of Requirements for FY 2007

Institutional controls in place in the BCV were maintained throughout FY 2007 as part of the BJC Y-12 S&M Program and in conjunction with B&W Technical Services Y-12 LLC (B&W Y-12, formerly known as BWXT Y-12). Current land use restrictions in BCV (i.e., government-controlled, heavy-industrial land use in Zone 3 and access restrictions in Zones 1 and 2) were maintained. Individual remedial actions under the BCV Phase 1 ROD underwent routine site inspections conducted by the BJC Y-12 S&M Program as follows:

- BYBY——All components of the site were inspected quarterly in FY 2007 including, assessing the vegetative covers for erosion or subsidence; checking for blockage or erosion of the drainage control system; ensuring there are no construction activities and unauthorized materials within the area; evaluating that signs are not missing or damaged and contain correct contact information; ensuring access controls are in place and gates are locked; and ensuring the stability of the channel and banks of NT-3 from the Haul Road to the confluence with Bear Creek. No deficiencies were noted on the inspection check sheets. Minor maintenance included a broken sign and updating contact information. This site received routine mowing and was also inspected monthly as a best management practice (BMP). During FY 2007, the capped areas at BYBY were judged to be sufficiently stabilized to warrant a change in inspection frequency from quarterly to semi-annual.

- S-3 Ponds Pathway 3——This RA has not yet been implemented. Access control requirements were maintained in FY 2007 and will be maintained until the action is complete. This site is located within the Y-12 property protection area (PPA) and, as such, is not accessible to the public. Signs restricting access are in place and the area is routinely patrolled by Y-12 security personnel.

- DARA Solids Storage Facility——This remedial action has not yet been implemented. The site will be maintained until the action is complete. All components of the site were inspected weekly in FY 2007 including inspecting the condition of the ventilation system, sump, gutter drains, foundation drains and north door grate coverings. Proper signage was maintained and the doors were kept locked. This site also received routine mowing. No deficiencies were noted on the inspection checksheets.

4.3 COMPLETED SINGLE ACTION PROJECTS WITH MONITORING AND/OR LTS REQUIREMENTS

4.3.1 S-3 Site Tributary Interception Removal Action

The S-3 Site Tributary Interception Removal Action was a groundwater remediation that was performed as a non-time-critical removal action. The AM and subsequent Addendum (DOE 1998a and DOE 2000c) were approved to implement a technology demonstration of intercept trenches and reactive barrier treatment designed to reduce the health and environmental risks associated with uranium transport in groundwater Pathways 1 and 2 from the S-3 Ponds. Location of the S-3 Site and monitoring locations are shown in Fig. 4.8.

4.3.1.1 Performance Objectives and Monitoring Requirements

The performance goal of the S-3 Site Tributary Interception Removal Action was to demonstrate efficient removal of uranium from groundwater captured in the treatment system trenches. The expected outcome was to reduce the flux of uranium in Bear Creek associated with discharge from shallow groundwater at the S-3 Site Pathways 1 and 2. No specific flux goal was specified in the AM (DOE 1998a) or RmAR (DOE 2001b).

The Pathway 1 and 2 treatment system experienced significant mechanical problems because of extensive buildup of mineral precipitates that clog and foul the pumps. The system was off-line due to mechanical problems related to fouling, in 2003, part of FY 2005, and during most of FY 2006. Fouling-related mechanical problems are caused by the extremely high total dissolved solid content in the S-3 plume resulting from the large amount of acid that seeped into the ground beneath the ponds. The acid dissolved the soluble soil and shallow bedrock constituents, such as calcium carbonate, in the dispersed limestone beds that occur in the underlying Nolichucky Shale.

Though data confirm that the treatment technology is effective in removing uranium from groundwater, the Pathway 1 & 2 treatment systems did not remove sufficient uranium mass from groundwater to benefit water quality in Bear Creek relative to the flux entering Bear Creek from other seepage sources, and commensurate with the associated operations and maintenance costs. An Addendum to the RmAR (DOE 2007d) was approved in June 2007 by the regulators for the treatment system to remain in shut-down mode and all monitoring associated with the S-3 Pathways 1 & 2 action be discontinued. Monitoring at BCK 12.34 will continue to be performed.

To the extent that uranium will continue to be removed from groundwater flowing through the zero valent iron (ZVI) materials *in situ* in the Pathway 1 funnel and gate and in the Pathway 2 collection trench, some mass removal may continue. The ultimate disposition of the Pathways 1 & 2 systems will be included in future design considerations for Pathway 3 and/or in the final groundwater decision for BCV, at which time a more comprehensive strategy will be developed for remediation of the S-3 Ponds groundwater plume.

4.3.1.2 Evaluation of Performance Monitoring Data

The Pathway 1 and 2 treatment system remained in shut-down mode during FY 2007 and monitoring associated with performance of the action was discontinued.

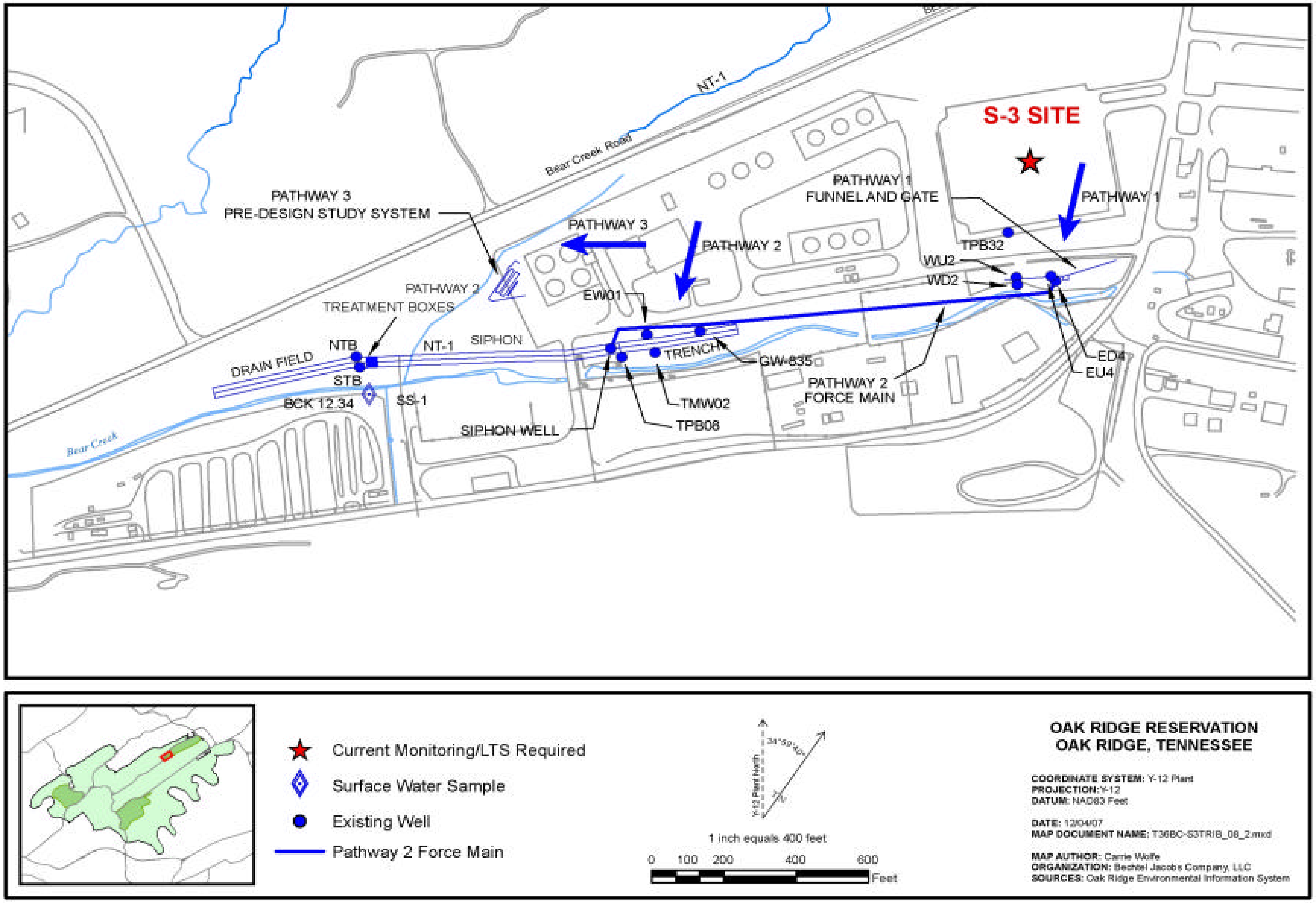

Fig. 4.8. Location of S-3 Tributary Interception project and monitoring locations.

4.3.1.3 Compliance with LTS Requirements

4.3.1.3.1 Requirements

Long-term stewardship requirements are not specified in the decision document for this site; however, there are operations and maintenance requirements, as discussed below. When the collection system was placed in stand-by mode in June 2007 the operations and maintenance requirements ceased and the site became managed only as a BMP.

Operations and maintenance of the Pathway 1 and 2 systems were conducted by the Y-12 S&M Program in FY 2007 until the systems were shut down in June. All components of the Pathway 1 system were inspected monthly including ensuring the red warning light or alarm is not activated on the control panel for the funnel and gate system and the power is on, making sure the above ground components of the site piezometers are not damaged, verifying that the warning signs on the vault are present and the metal door and manhole cover are closed, and ensuring the creek boundary fencing and signs are intact. All components of the Pathway 2 system were inspected monthly including ensuring the integrity of the rip-rap drainage channel, identifying any unauthorized materials placed in the area, and ensuring the creek boundary fencing and signs are intact. Both treatment systems also underwent a weekly inspection of the control panel and flow-meter as a BMP to monitor flow. Minor maintenance included repairing the boundary control chain, re-attaching signs at the vault, and updating contact information. When the treatment systems were shut down the operations and maintenance inspections were no longer required. The site, however, continued to receive monthly inspections as a BMP to maintain signs and access controls that remain in place at the site to protect the area.

4.3.2 BCV OU2 Remedial Action

Location of the Spoil Area 1 and SY-200 Yard (BCV OU2) RA is shown on Fig. 4.1. The primary objective of this action was to mitigate exposure to contaminated soil and waste left in place. The scope of the remedy was to address the principle threats at the sites by maintaining the existing waste covers and implementing specific access and use restrictions. Background information on this remedy and performance standards are provided in Chapter 4 of Volume 1 of the 2007 RER. These sites have only LTS requirements, which are provided in Table 4.2. A review of compliance with these LTS requirements is included in Sect. 4.3.2.1.

No surface water or groundwater monitoring is required to verify the effectiveness of the remedial action.

4.3.2.1 Compliance with LTS Requirements

4.3.2.1.1 Requirements

Long-term stewardship requirements specified in the BCV OU2 ROD (DOE 1996b) include physical barriers (fences, gates, and signs) to limit access to the site, deed restrictions to restrict construction at the sites and prohibit waste intrusion to mitigate direct exposure, and periodic physical surveillance of the soil cover and other features of the site and maintenance or repair, as required. Restrictions also require incorporation of indoor radon mitigative measures in accordance with EPA guidelines for any future structure built on-site. These sites are designated as restricted industrial use areas in the BCV Phase I ROD (DOE 2000b).

4.3.2.1.2 Status of Requirements for FY 2007

Spoil Area 1 and the SY-200 Yard sites were inspected quarterly by the Y-12 S&M Program for items including erosion of the cover, integrity of surface drainage control systems, evidence of rodent damage, proper signage, unlocked gates, and the presence of unauthorized materials within the area. These sites also underwent monthly inspections as BMP. No deficiencies were noted in the inspection checksheets. Minor maintenance included fixing a broken sign, updating contact information, and routine mowing and vegetation control. In addition, the deed restrictions for both Spoil Area 1 and the SY-200 Yard, originally filed on April 12, 1999, were verified on-line at the Anderson County Register of Deeds office.

4.4 BEAR CREEK VALLEY WATERSHED CONDITION AND TRENDS

Section 4.2 summarizes the RAOs for the BCV Phase I ROD as control of uranium discharges in surface water at key integration points, attainment and maintenance of AWQC in waters of the state, and maintenance or improvement in groundwater quality to protect surface water quality.

This section summarizes conditions in BCV with respect to the Phase I ROD RAOs and includes data not tied to any specific action. Included herein are discussions of annual variations in uranium flux at the integration points and other surface water and groundwater locations within the watershed, and aquatic biological indicators of AWQC.

4.4.1 Surface Water

Uranium flux is the lowest measured at BCK 9.2 (IP) (59.5 kg/yr), but still exceeds goal of = 34 kg/yr during FY 2007.

Uranium flux measurements have been made at several surface water monitoring stations in BCV consistent with geographic locations of land use goals and measurement of effectiveness of RAs for specific contaminant source units. Figure 4.7 shows BCV RAO zones and monitoring locations that are used to evaluate surface water and groundwater conditions relative to the RAOs. Uranium is the principal surface water contaminant of concern for which remedial performance goals are stipulated in the Phase I ROD in (Tables 4.3 and 4.4). Table 4.8 includes uranium flux measured at BCV surface water monitoring stations from FY 2001 through FY 2007 and the average of annual rainfall measured at six rain gauges across the ORR (see Fig. 1.3). During FY 2007, uranium flux in BCV was the lowest measured at most locations. Phase I ROD flux goals for S-3 Ponds discharge at BCK 12.34 (<27.2 kg/yr) were met in FY 2007 with a measured uranium flux of 15.8 kg/yr. The watershed flux goal for the Zone 3 IP (= 34 kg/yr) was not met in FY 2007 based on the 59.5 kg of uranium measured at BCK 9.2. Because of the extreme drought conditions, during much of spring and summer seasons in FY 2007 there was no flow in long sections of Bear Creek between the SS-5 discharge and BCK 12.34.

Station BCK 9.2 was adopted as the Zone 3 IP as of FY 2006. The BCK 9.2 station is a stable concrete flume structure that has been calibrated to accurately measure surface water flow over the full range of flow conditions. Prior to FY 2006, IP uranium flux calculations were based primarily on the sum of estimated fluxes from spring discharge at SS-5 and from the stream channel at BCK 9.47. The bulk of the estimated flux at these two locations was measured at BCK 9.47 at which flow measurement calibration was problematic.

Data from Table 4.8 are shown graphically in Fig. 4.9 to illustrate the relationship between uranium flux at various locations in BCV relative to annual rainfall. The monitoring stations in BCV show a fairly linear relationship between rainfall and uranium flux with the exceptions of BCK 11.54, which was affected by an increased uranium flux in 2002 when the BYBY remediation was in progress; and SS-5, which exhibits a rather constant annual uranium flux from groundwater discharge. The linear relationship between annual rainfall and uranium fluxes in BCV surface water are estimated in Fig. 4.9 for BCK 9.2 and BCK 12.34. Fairly good correlations between rainfall and uranium flux are indicated by the high R^2 values.

Table 4.8. Bear Creek Valley uranium flux[a] at flow-paced monitoring locations

Fiscal Year	FY 2007 IP[b]	Pre-FY 2006 IP[c]			BCK 11.54	NT-3	BCK 11.84	BCK 12.34	Average ORR Rainfall[d]
	BCK 9.2	BCK 9.47	SS-5	IP Total					
2001	88.7	76.4	17.2	93.6		79.9		**24.5**	45.9
2002	120.2	94.8	13.1	107.9	158.2	62.8	29.4	**25.4**	52.7
2003	165.4	176.9	12.3	189.2	87.0	4.6	76.4	44.3	73.7
2004	115.0	109.7	9.5	119.3	45.8	**1.2**	51.2	27.3	56.4
2005	115.4	136.6	11.1	147.7	39.8	**4.1**	72.9	40.3	58.9
2006	68.5	--[b]	--[b]	--[b]	25.2	**1.7**	41.0	**21.3**	46.4
2007	59.5	--[b]	--[b]	--[b]	12.56	--[e]	--[e]	**15.8**	36.8

Bold values indicate the Phase I ROD goal for uranium flux has been met.

[a] All flux values are kilograms of uranium.

[b] BCK 9.2 was adopted as the Integration Point in FY 2006

[c] IP = Flow/flux measurement integration point at the downstream (western) end of Zone 3.

[d] Average rainfall in inches for rain gauges at Y-12, ETTP, ORNL, and DOE Town Site.

[e] Flow paced monitoring discontinued at these stations.

BCK = Bear Creek kilometer
DOE = U.S. Department of Energy
ETTP = East Tennessee Technology Park
FY = fiscal year
IP = integration point
NT = North Tributary
ORNL = Oak Ridge National Laboratory
ORR = Oak Ridge Reservation
SS = surface spring

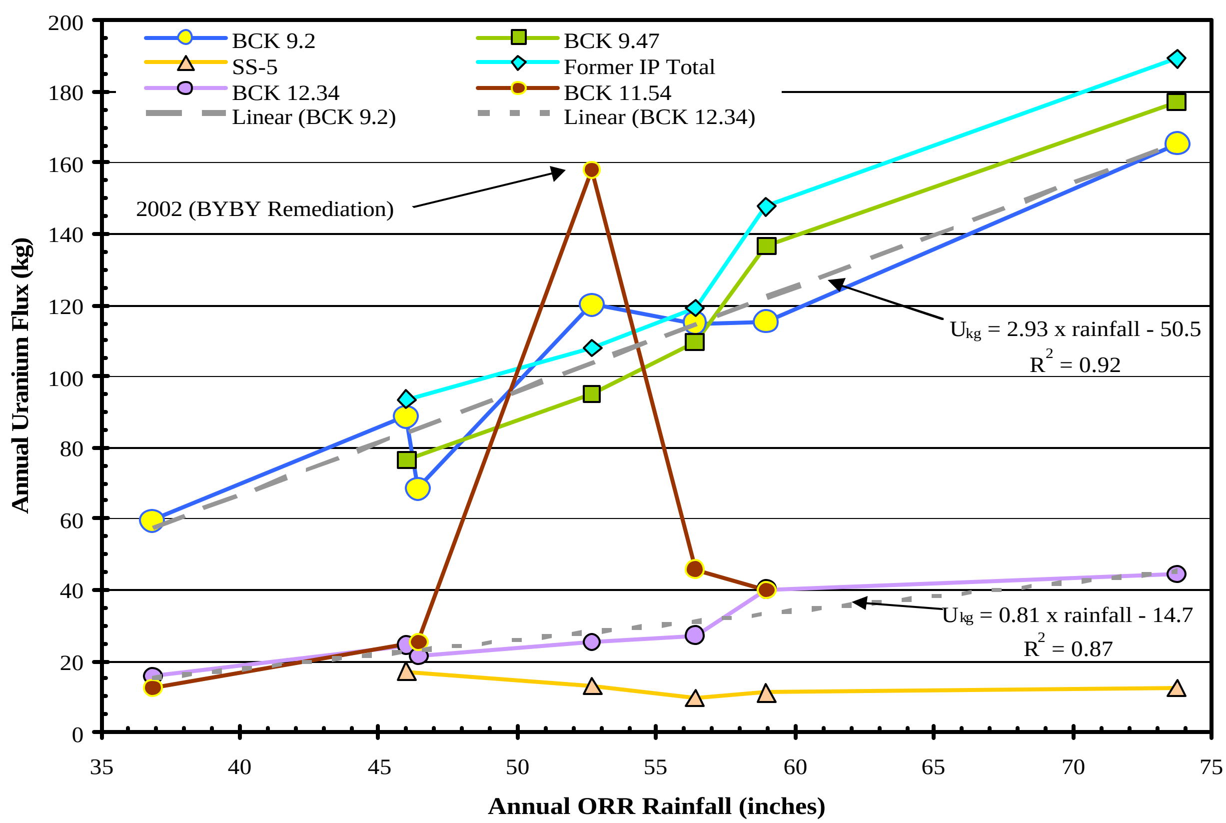

Fig. 4.9. Annual rainfall and Bear Creek uranium discharge fluxes.

During FY 2007 BCV surface water uranium data were evaluated with respect to identifying potential sources of ungauged uranium flux that affects the annual IP flux values. Ratios of $^{238}U/^{234}U$ activity were determined from mainstem and tributary weekly composite sample results, where available, and from grab samples at NT-8, which has a significant concentration of uranium that originates from the western end of the BCBGs. The uranium isotope ratios were used to describe "signatures" of the respective monitoring areas. These uranium ratios were observed to vary within fairly narrow ranges at each station over short time periods, and at some stations longer term changes in the isotopic ratio signatures occurred over time. For example, the uranium isotope ratio for surface water originating in the BYBY at NT-3 shifted dramatically following remediation that removed a large source of depleted uranium. The evaluation of area contributions indicated that the contribution of uranium mass from NT-8 to the measured flux at the IP may range between 20 - 40% depending on hydrologic stresses. The remainder of the uranium flux measured at BCK 9.2 apparently originates from the S-3 Ponds plume that largely discharges via groundwater flow through conduits in the Maynardville Limestone. Monitoring stations BCK 12.34 and BCK 11.54 measure the fraction of the S-3 plume that flows as surface water in Bear Creek. As a result of this data evaluation, continuous, flow-paced sampling has been initiated at NT-8 to measure the contribution of uranium from the west end of the BCBGs to Bear Creek. This contribution will be reported in the FY 2009 RER.

Nitrate is also a key contaminant of concern in surface water in Bear Creek Valley. The principal source of nitrate contamination is legacy disposal of acid liquids in the S-3 Ponds which created nitrate plumes in groundwater with discharge in the headwaters of Bear Creek. Nitrate has been monitored historically at a number of locations in Bear Creek Valley. Concentrations are highest near the S-3 source and decrease with distance to the west and downstream. Figure 4.10 shows the average nitrate concentration in surface water at BCK 12.34 along with the annual average ORR rainfall. The tendency for dilution of the nitrate concentrations during years of elevated rainfall is apparent in the graph with the mirror relationship between increased rainfall and decreased nitrate concentration. The low concentrations during FY 2007 may be partly caused by decreased groundwater discharge activity associated with the drought. Nitrate concentrations were sampled semi-annually from FY 2001 through FY 2006 at the BCK 9.2 Zone 3 IP. During that time period 4 out of 12 grab samples had nitrate concentrations that exceeded the drinking water MCL of 10 mg/L and the highest detected concentration was 17.6 mg/L measured in August 2003.

4.4.2 Groundwater Quality

Groundwater is monitored at selected wells and springs in BCV Zones 1 through 3 to observe changes in contaminants detected and their concentrations. Groundwater quality goals for each Zone are described in Table 4.3. Monitoring in Zone 1 (see Fig. 4.7) includes sampling of 3 monitoring wells (GW-712, GW-713, and GW-714) and four springs (SS-6, SS-6.6, SS-7, and SS-8). Historically, water quality has been good in Zone 1 with few contaminants detected and concentrations of those few maintaining levels below drinking water limits. There were no exceedances of the drinking water standard in Zone 1 during FY 2007. There was no recurrence of VOC contamination observed in FY 2006 or any detection of VOCs in the Zone 2 Picket W monitoring wells. The only observation of a VOC in the Picket A Wells was the detection of TCE below the MCL at Well GW-684 at the Zone 3 IP boundary. The TCE was estimated at a concentration of 0.1 µg/L.

Groundwater and surface water are sampled at the boundary of Zones 2 and 3 in six wells and in surface water at BCK 9.2 (see Fig. 4.7). Historically, the groundwater quality in wells west of the BCBG has been good, with few contaminants being intermittently detectable at low concentrations. Two wells in the Maynardville Limestone, GW-683 and GW-684, which are part of a north/south monitoring transect referred to as Picket A, show the consistent presence of uranium, ^{99}Tc, and nitrate at low and stable levels. Occasionally, low concentrations of VOC degradation products (1,2-DCE) are detected in these wells.

Groundwater surveillance monitoring of the Bear Creek Burial Grounds conducted by the Y-12 Groundwater Protection Program documents increasing VOC concentrations in the area. The concentration of PCE has exceeded 1 ppm at a depth of 270 feet in one well in the western BCBG. PCE transformation products are also present at high concentrations in nearby wells and cis-1,2-DCE is routinely measured at > 5 ppm concentrations in two wells. These contaminants are not detected to date in the Picket A wells that lie further west of the burial grounds and Bear Creek Tributary NT-8. However PCE, TCE, and cis-1,2-DCE are detected in surface water at the mouth of NT-8. Tributary NT-8 is a component of the Picket A monitoring transect.

Also within Zone 3, groundwater is monitored at wells GW-704 and GW-706 (see Fig. 4.7). These two wells are part of a transect of wells referred to as Picket B installed in the Maynardville Limestone downgradient of the Oil Landfarm Waste Management Area. The wells are located midway between BCK 11.54 and SS-5 and sample groundwater from depths of 256 and 182 ft bgs, respectively. These wells contain uranium, VOCs, ^{99}Tc, and nitrate. Contaminant levels at GW-704 and GW-706 have exhibited a decreasing contaminant signature over the past several years. Figure 4.11 shows the $^{233/234}$U and ^{238}U results at GW-704 and GW-706 from FY 2000 through FY 2007. TCE is the principal VOC detected in wells GW-704 and GW-706. Since 2000, TCE concentration at well GW-704 has gradually decreased from approximately 60 µg/L to less than 20 µg/L in a trend similar to the uranium results decrease. At GW-706, TCE concentrations have fluctuated between 6 and 20 µg/L with apparent dilutional response to high rainfall periods that caused the low concentrations. Nitrate in GW-704 has fluctuated at concentrations <20 mg/L. At GW-706, nitrate historically fluctuated between about 20 and 100 mg/L; however, since 2003, concentrations have remained <30 mg/L and continue to show a gradually decreasing trend. Historically, ^{99}Tc was detected in both wells (100-300 pCi/L in GW-706 and <50 pCi/L in GW-704).

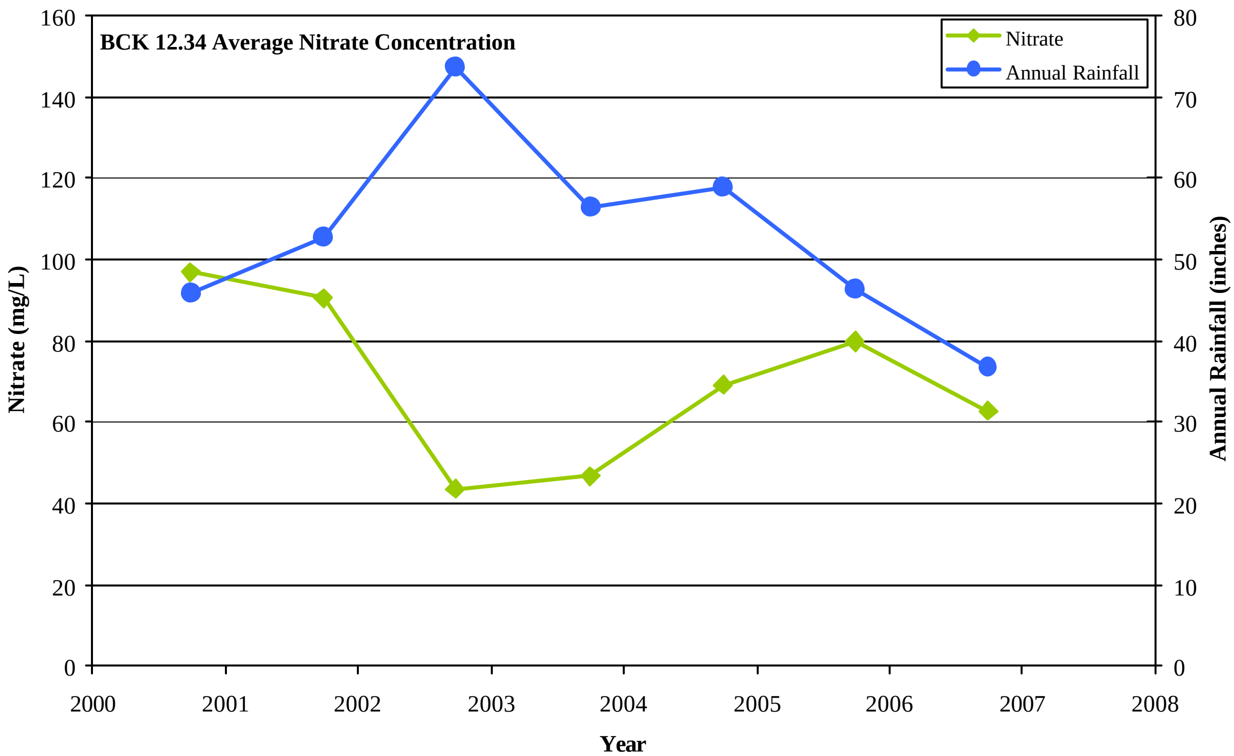

Fig. 4.10. BCK 12.34 average nitrate concentration and annual ORR rainfall.

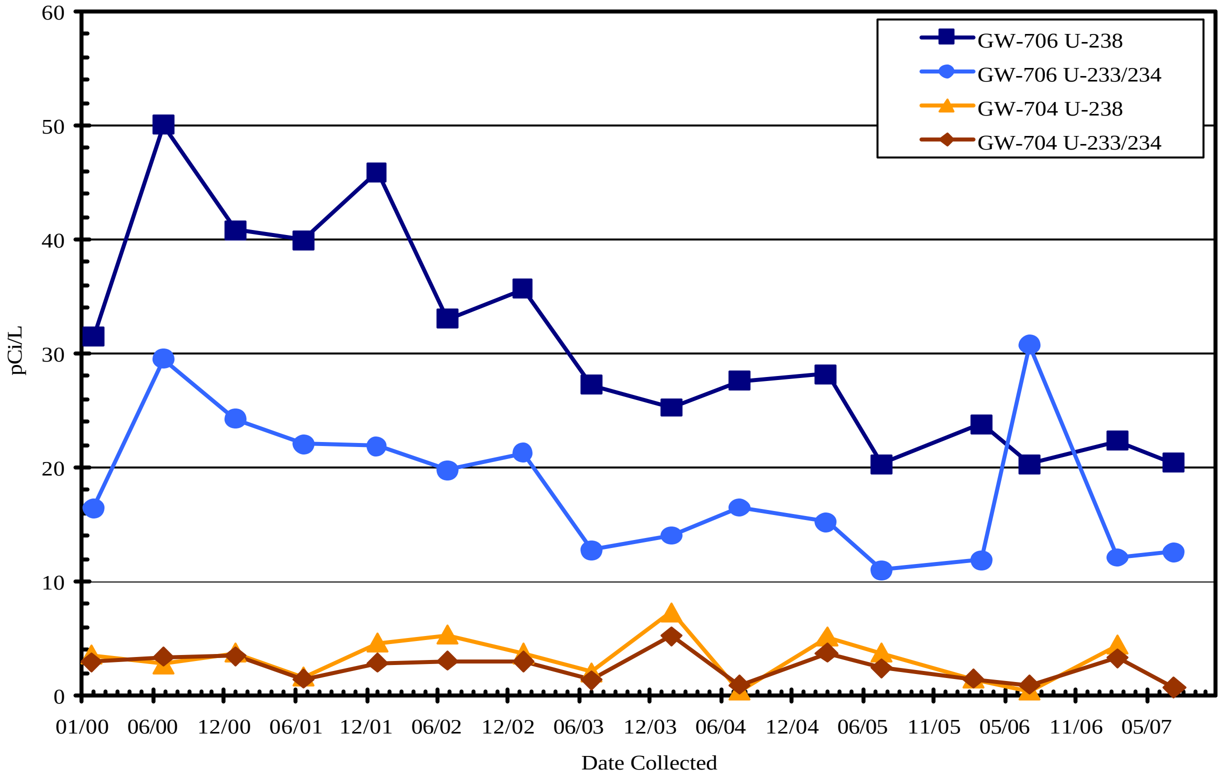

Fig. 4.11. Uranium isotope results at GW -704 and GW-706.

4.4.3 Aquatic Biological Monitoring

To evaluate instream contaminant exposure and potential human and ecological risks in the Bear Creek watershed, fish are collected twice a year at BCK 3.3, BCK 9.9, and BCK 12.4 and analyzed for a suite of metals and PCBs (see Fig. 4.1). An evaluation of overall ecological health of the streams is conducted by monitoring the fish and benthic macroinvertebrate communities at the same locations and at NT-3.

Mercury concentrations in rock bass in lower Bear Creek continued to exhibit a pronounced seasonal variation (ranging from ~0.5 to 0.7 mg/kg) and remained elevated relative to rock bass from the Hinds Creek reference site (Hinds Creek mean of 0.17 mg/kg in FY 2007; Fig. 4.12). Concentrations of nickel, cadmium, and uranium have historically exceeded background concentrations in stoneroller minnows from upper Bear Creek, and maintained that trend through 2007 (Figs. 4.13–4.15). Cadmium and nickel (associated with the S-3 site plume) exhibited the highest concentrations in fish at the uppermost site, as expected. Due to additional uranium sources between BCK 12.4 and BCK 9.9, fish at BCK 12.4 and BCK 9.9 exhibited similar uranium concentrations in the spring of 2007. PCB concentrations in stoneroller minnows show wide temporal variation, but overall do not indicate any decrease over the past ten years (Fig. 4.16). Concentrations at BCK 9.9 exceeded those at the downstream site by 2 – 3 fold in 2007.

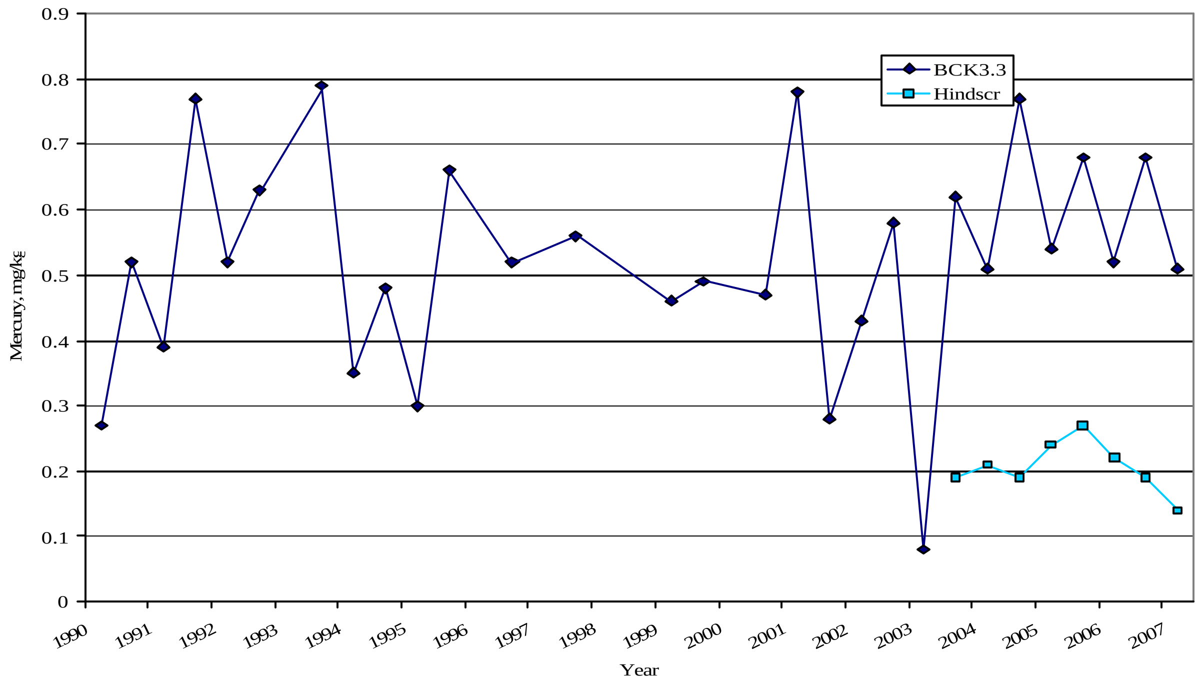

Fig. 4.12. Mean concentrations of mercury in rockbass from sites in lower Bear Creek, BCK 3.3, 1987-2007.

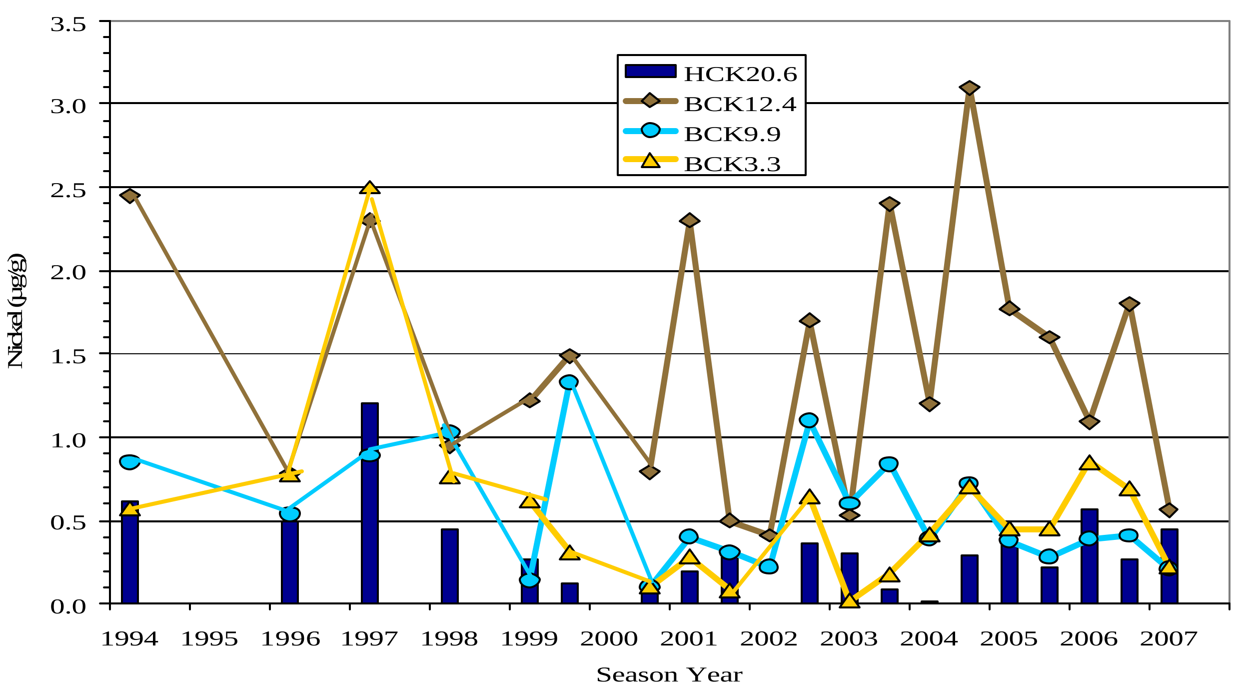

Fig. 4.13. Nickel concentrations in stoneroller minnows at three sites in Bear Creek and a reference stream (HCK 20.6), 1994–2007.

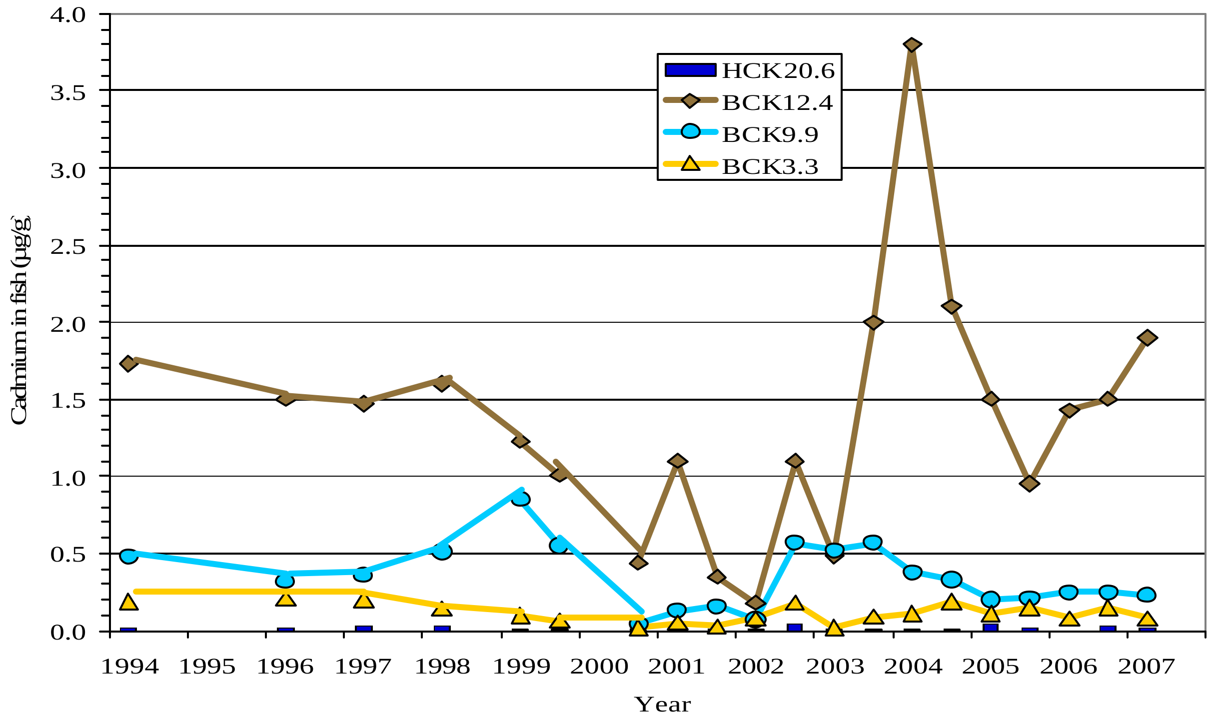

Fig. 4.14. Cadmium concentrations in stoneroller minnows at three sites in Bear Creek and a reference stream (HCK 20.6), 1994–2007.

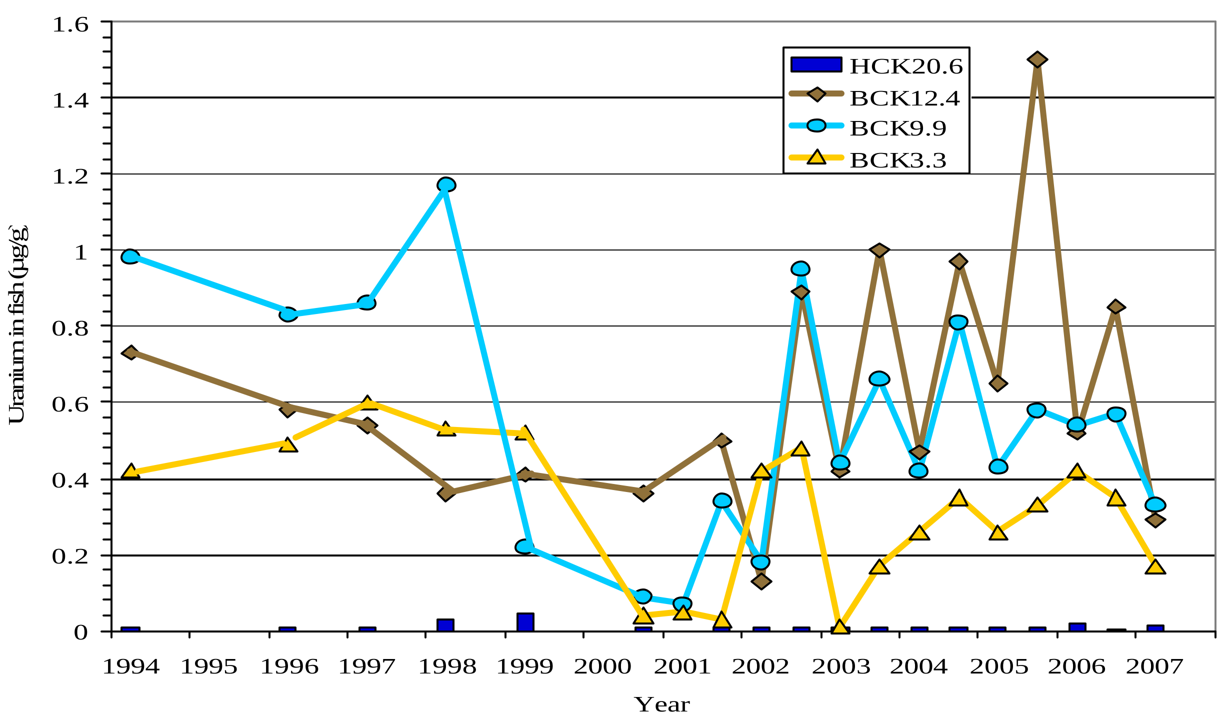

Fig. 4.15. Uranium concentrations in stoneroller minnows at three sites in Bear Creek and a reference stream (HCK 20.6), 1994–2007.

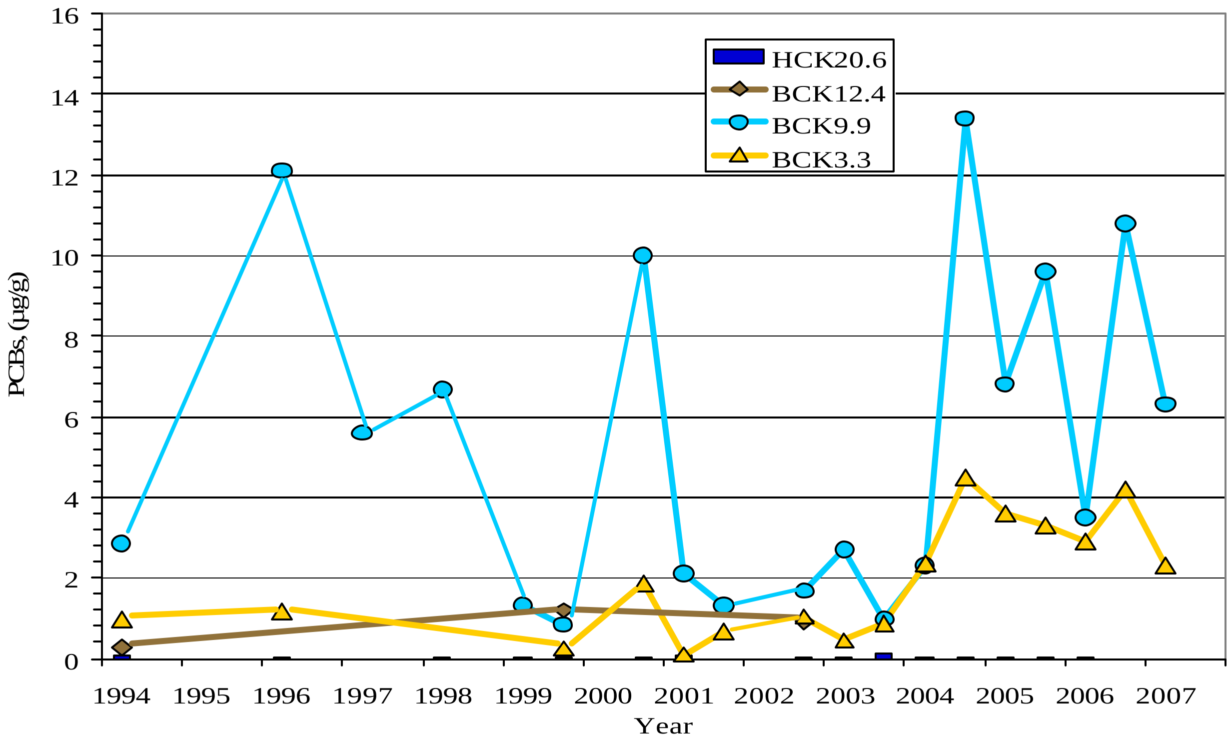

Fig. 4.16. Polychlorinated biphenyl (PCB) concentrations in stoneroller minnows at three sites in Bear Creek and a reference stream (HCK 20.6), 1994–2007.

The fish communities in Bear Creek (BCK) and NT-3 show a clear gradation based on stream size in terms of species richness and have generally been stable with some variation between samples (Fig. 4.17). Although total richness is less at the lowermost site and at NT-3 compared to reference streams, the uppermost sites were comparable in 2007. Upper Bear Creek (BCK 12.4) and Bear Creek NT-3 continue to support substantially fewer pollution-intolerant macroinvertebrate taxa than nearby reference streams (~3-fold difference, Fig. 4.18). The number of intolerant taxa at BCK 9.9 is also lower than at reference sites, especially during the fall when there is an approximate 2-fold difference. The number of intolerant taxa at BCKs 3.3 and 4.6 is comparable to reference sites (Fig. 4.18).

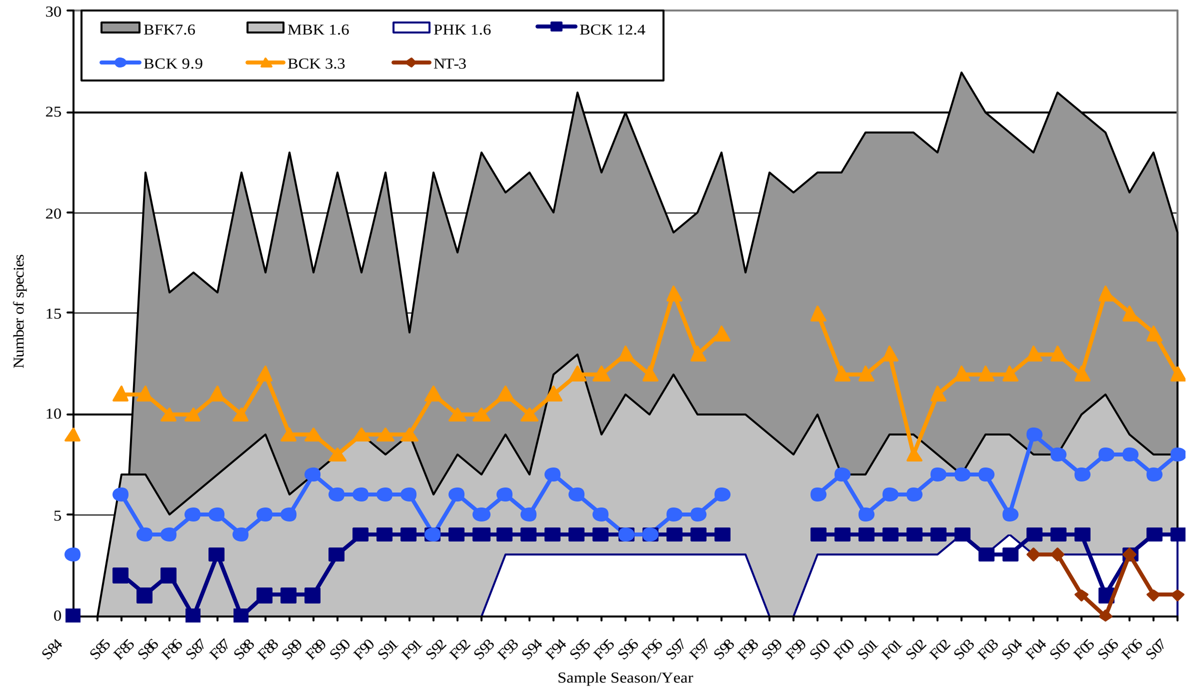

Fig. 4.17. Species richness (number of species) in samples of the fish community in Bear Creek (BCK) and two reference streams, Mill Branch (MBK), Brushy Fork (BFK), and Pinhook Branch (PHK), 1984 to 2007.

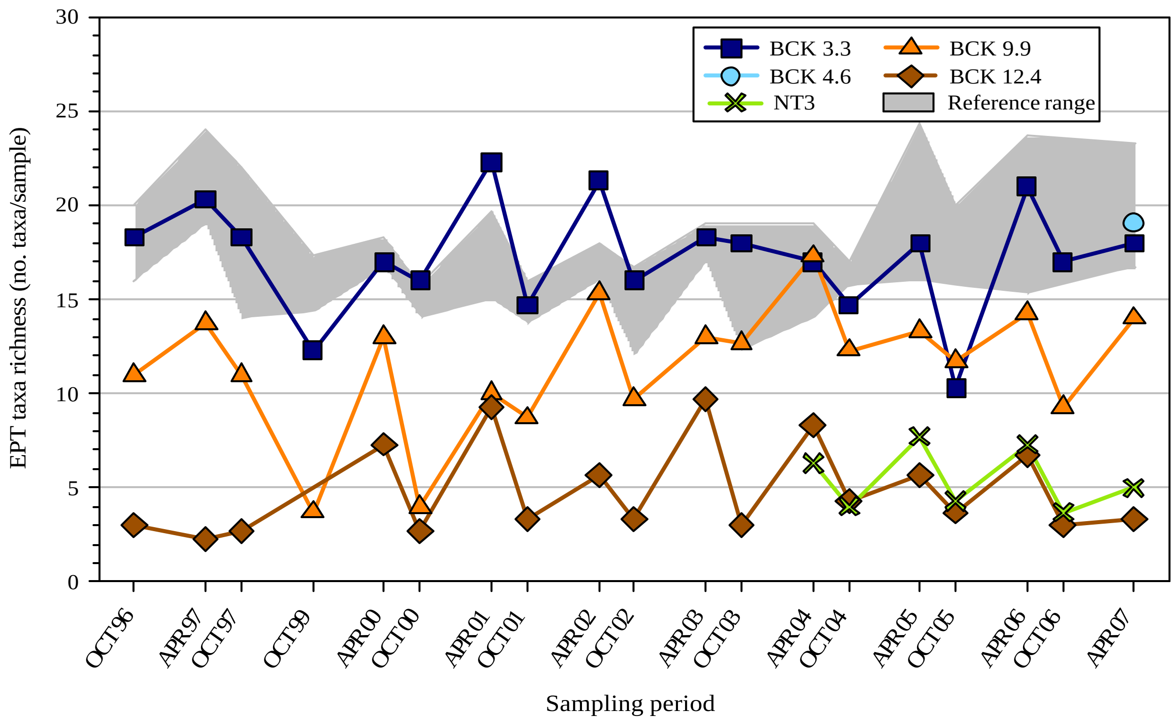

Fig. 4.18. Mean (n = 3) taxonomic richness of the pollution-intolerant taxa for the benthic macroinvertebrate community at sites in Bear Creek, NT-3, and range of mean values among reference streams (two sites in Gum Hollow Branch and one site in Mill Branch), October 1996 - April 2007.

4.4.4 Summary: Watershed Condition and Trends

Contaminant discharges in BCV were low during FY 2007 largely because of the extreme drought conditions. The uranium fluxes measured at BCK 9.2 and BCK 12.34 were the lowest on record. The Phase I ROD goal for uranium flux at BCK 12.34 (< 27.2 kg/yr) was attained in FY 2007 as it was during FY 2006. Although the uranium flux of 59.5 kg was the lowest on record at BCK 9.2, the discharge was significantly greater than the Phase I ROD goal of = 34 kg/yr. Much of the uranium flux measured at BCK 9.2 originated from ungauged sources that are suspected to include discharges from NT-8 and groundwater in the Maynardville Limestone karst aquifer. To further define the role of the western portion of the BCBGs in watershed uranium discharge, continuous flow-paced sampling will be initiated at Bear Creek tributary NT-8 in FY 2008.

Riparian zone monitoring of the constructed NT-3 demonstrates that habitat conditions have improved since remediation of the BYBY in 2003. Although stream habitat conditions were similar or slightly worse than in 2006, the spraying of invasive plants in September 2007 is expected to benefit riparian habitat in 2008.

Aquatic biota monitoring during FY 2007 shows continuing impact to the aquatic ecosystem related to contaminant discharge and residual contamination in the Bear Creek environment. PCBs and a number of metals, including mercury, nickel, uranium, and cadmium, accumulate in Bear Creek fish. Fish species richness in the most downstream portion of Bear Creek (BCK 3.3) is in the range of the reference sites. Fish species richness in the headwater region (NT-3 and BCK 12.4) are in the lower range of reference streams while at BCK 9.9, near the Zone 3 integration point, a gradual increase in species richness has been observed from 2000 through 2007. Benthic macroinvertebrate community richness in Bear Creek is also similar to reference streams at the lowermost sites, but in Upper Bear Creek and the mid valley area remain well below reference stream values.

4.5 BEAR CREEK VALLEY MONITORING CHANGES AND RECOMMENDATIONS

Table 4.9 summarizes technical issues and recommendations for monitoring changes in the BCV Watershed. Issues that were identified during evaluation of FY 2007 monitoring data are listed as a 2008 RER issue; issues identified in previous year's RERs are identified as "Issues Carried Forward" for tracking purposes. Issues that have been completed or resolved are identified as such at the end of the table and will not be included in subsequent RERs.

Riparian zone monitoring of the restored NT-3 at the BYBY demonstrates that channel restoration and vegetation re-establishment has been successful. Concurrence is requested to discontinue formal monitoring and reporting.

Several approved changes in the BCV monitoring program were implemented during FY 2007, as indicated in Table 4.9. Because performance monitoring data for the BYBY action demonstrated that annual uranium flux has remained below the goal of 4.3 kg/year ever since FY 2003, flow-paced composite sampling at NT-3 was discontinued and replaced with monthly grab samples for isotopic uranium, monitoring at 11.84 was discontinued, and BCK 11.54 was upgraded to provide more accurate flow measurements. In addition, AWQC monitoring at NT-3 was reduced to every 5 years corresponding to the FYR.

In June 2007, the regulators authorized shutdown of the S-3 Pathways 1 and 2 groundwater collection systems and all monitoring associated with the early action. The treatment system was found to be effective at removing uranium from groundwater, but sufficient uranium mass was not removed to warrant the associated operations and maintenance costs.

Although uranium flux at the watershed IP (BCK 9.2) continues to be among the lowest measurements to date, the flux goal of =34 kg/yr is still exceeded, and ungauged total-uranium flux represents approximately two-thirds of the total flux. To determine the source(s) of the ungauged uranium flux, other potential sources of uranium (e.g., NT-8) will continue to be monitored and quantified during FY 2008. In addition, the effects on contaminant mass balance caused by multiple large-scale construction activities in the eastern portion of the watershed will be evaluated and addressed in the final BCV groundwater ROD.

Table 4.9. Summary of Bear Creek Valley Watershed technical issues and recommendations

ISSUE [(1)]	ACTION/ RECOMMENDATION
2008 RER ISSUE:	
1. In addition to surface water monitoring at the BYBY, the PCCR (DOE 2003e) specifies 5 years of monitoring benthic macroinvertebrate and fish communities in NT-3, and stream channel stability and riparian vegetation monitoring of the restored NT-3 channel.	1. DOE will complete the post-construction monitoring at BYBY in FY 2008 to confirm riparian stream and vegetation was successfully established and is now stable. Results will be reported in the 2009 RER and riparian monitoring will no longer be conducted.
ISSUES CARRIED FORWARD:	
2. Ungauged total-uranium flux at the watershed IP (BCK 9.2) represents more than half of the uranium measured during FY 2006 in Bear Creek Valley.	2. DOE is monitoring potential sources of uranium, e.g., NT-8, to determine and quantify the total uranium contributing to the uranium flux measured at the IP, BCK 9.2.
3. Results for BCK 9.2 show an increase in the	3. Evaluation of FY 2006 data indicates a significant decrease in uranium

Table 4.9. Summary of Bear Creek Valley Watershed technical issues and recommendations (continued)

ISSUE [(1)]	ACTION/ RECOMMENDATION
proportion of ungauged uranium flux beginning in FY 2002. Increasing uranium trends are not observed at gauged monitoring stations, or in principal groundwater exit points contributing to Bear Creek surface flow.	flux results at BCK 9.2. As remaining actions of the BCV Phase 1 ROD are completed, as well as any actions required by additional CERCLA decisions in BCV, corresponding decreases in uranium flux are anticipated.
4. Multiple large scale construction activities have occurred in the eastern portion of the watershed (e.g., EMWMF and the capping at BYBY). This has resulted in large-scale clearing of mature woodland-forested areas, extensive cut-and-fill construction, complete diversion of NT-4, and regarding most the NT-3 drainage basin. This may have altered runoff and infiltration patterns and evapotranspiration rates. Additionally, uranium flux attributable to NT-7 and NT-8 has not been quantified since the RI.	4. Evaluate water and contaminant mass balance for Bear Creek Valley upstream of the IP to evaluate the effect of substantial construction and physical changes that have occurred since the RI, and to help determine causes for the observed ungauged flux at the IP.
COMPLETED/RESOLVED ISSUES:	
5. Although the data confirm that the treatment technology is effective in removing uranium from groundwater, the Pathway 1 & 2 treatment systems (i.e., the S-3 Site Tributary Interception removal action) have not removed a sufficient uranium mass from groundwater to benefit water quality in Bear Creek commensurate with the associated operations and maintenance costs.	5. DOE recommended discontinuation of the Pathways 1 and 2 groundwater collection systems and all monitoring associated with the early action. An Addendum to the RmAR for the S-3 was approved by EPA and TDEC in June 2007 authorizing the treatment system to remain in shutdown mode. The ultimate disposition of the Pathways 1 and 2 systems will be included in future design consideration for Pathway 3 or in the final groundwater decision for BCV. (Note: Weekly flow-paced composite samples at BCK 12.34 will continue to be analyzed for nitrate and uranium isotopes. In the year prior to the CERCLA FYR, quarterly grab samples will be analyzed for metals, including mercury and total uranium).
6. Performance monitoring for the BYBY action has shown that annual uranium flux has remained below the goal of 4.3 kg/year ever since FY 2003.	6. DOE requested concurrence (December 2006) from EPA and TDEC to make the following changes to monitoring in BCV: (a) discontinue flow-paced composite sampling at NT-3 and replace with monthly grab samples for isotopic uranium, (b) discontinue monitoring at BCK 11.84, upstream of the confluence of Bear Creek with NT-3, (c) upgrade BCK 11.54 for more accurate flow measurements to use as the upstream IP for the Bear Creek Burial Grounds, and (d) reduce the frequency of AWQC monitoring at NT-3 to every 5 years corresponding to the FYR. Regulatory concurrence was provided in April 2007.

[(1)] Issues resulting from evaluations of FY 2007 data are identified in the table as 2008 RER ISSUES. Issues are also identified in the table as either "ISSUE(S) CARRIED FORWARD" to indicate that the issue is carried over from the previous year's RER to track the issue through resolution, or as COMPLETED/RESOLVED ISSUES to indicate that the issue has been resolved and will not be tracked in subsequent RERs.

AWQC = ambient water quality criteria
BCV = Bear Creek Valley
BCK = Bear Creek kilometer
BYBY = Boneyard/Burnyard
CERCLA = Comprehensive Environmental Response, Compensation and Liability Act of 1980
DOE = U.S. Department of Energy
EMWMF = Environmental Management Waste Management Facility
EPA = Environmental Protection Agency
FY = fiscal year
FYR = Five-Year Review
IP = integration point
NT = North Tributary
RER = Remediation Effectiveness Report
RI = remedial investigation
RmAR = Removal Action Report
ROD = Record of Decision
SNS = Spallation Neutron Source
TDEC = Tennessee Department of Environment and Conservation

4.6 CERCLA WASTE FACILITY (ENVIRONMENTAL MANAGEMENT WASTE MANAGEMENT FACILITY)

On-site disposal of CERCLA waste resulting from cleanup of the ORR was selected as the remedy in the ROD signed in November 1999. This remedy called for the detailed design, construction, operation, and closure of a disposal facility, with a projected minimum total disposal cell capacity of 357, 000 yd^3 for the low-end conceptual design and 1.7 million yd^3 for the high end design. The site selected for the facility is in east BCV approximately 1.6 km (1 mile) west of the Y-12 Complex.

The action consists of designing, constructing, operating, and closing an engineered, above-grade, earthen disposal cell and associated support facilities, commonly referred to as the EMWMF. The purpose of the EMWMF is to provide a disposal cell for non-classified and classified wastes, including low-level radioactive waste, RCRA waste, Toxic Substances Control Act Incinerator (TSCA) waste, and mixtures of the above (mixed waste) that meet the WAC. Wastes includes soil, dried sludge and sediments, solidified waste, stabilized waste, building debris, personal protective equipment, and scrap equipment.

Material generated from the CERCLA cleanup of former waste sites and buildings that have been impacted by past operations (both on the ORR and at nearby sites off the ORR within the state of Tennessee) are disposed in the EMWMF provided it is compliant with the facility's WAC.

EMWMF operations began in late May 2002. During FY 2007, a total of more than 177,288 tons of waste and fill were disposed in the facility. An annual report for the EMWMF is required, which contains detailed information regarding facility operations and monitoring results. The annual report for EMWMF operations (*Annual Report for 2006-2007 Detection Monitoring at the Environmental Management Waste Management Facility, Oak Ridge, Tennessee*) is contained in Appendix A of this report.

In 2005, DOE ORO constructed an extension to the existing EMWMF haul road ("Haul Road") built as a component of the CERCLA remedy for the EMWMF. DOE documented this decision in a CERCLA ESD document (DOE 2004b), issued with the concurrence of the EPA and TDEC. The general purpose of the Haul Road extension was to allow CERCLA waste to be transported on "out-of-commerce" restricted access roads not available to the general public from ETTP to the EMWMF, thereby reducing public exposure to hazardous conditions associated with the frequent transport of hazardous substances over public roadways and providing a more reliable dedicated infrastructure to implement the EMWMF ROD.

To the extent possible, environmental impacts as a result of Haul Road construction were avoided or minimized during the design phases of the project. However, the project could not avoid impacting 1.35 acres of wetland habitat within the road corridor. Environmental surveys of the affected environment were described by (Peterson et al. 2005a).

As a result of the wetland losses from the construction of the Haul Road project, compensatory wetland mitigation was required. Details of the wetland mitigation conducted for the Haul Road project is provided in the Wetland Mitigation Plan (Peterson et al. 2005b). The Wetland Mitigation Plan was appended to the Remedial Design Report (RDR) (DOE 2005c) to address wetland-related applicable or relevant and appropriate requirements (ARARs). In particular, the plan addressed the typical requirements of the aquatic resource alteration regulations [Tennessee Code Annotated (TCA) 69-3-108(b)(1)(j)], as detailed in Aquatic Resource Alteration Permits (ARAPs) issued by TDEC. The wetland mitigation for the Haul Road project included both in-kind (e.g., wetland creation) and out-of-kind (e.g., stream restoration) mitigation, and was based on numerous interactions and input from regulatory agencies.

The restoration construction work for the project was completed in spring of 2006. The assessment of stream and riparian habitat was conducted during the first summer after construction work was completed in August 2006, as described below in Sect. 4.6.2. In-stream measurements of fish and benthic communities will be conducted starting in the fall of 2007.

4.6.1 Performance Goals and Monitoring Objectives

Goals

The ROD specifies the regulatory requirements for design, construction, and operation of the facility to ensure protection of human health and the environment. The cell design and the facility WAC ensure that the total incremental lifetime cancer risk from the cell will meet regulatory guidelines for protection of human health and the environment. The WAC requirements are documented in a WAC Attainment Plan (DOE 2001c). The WAC Attainment Plan was developed to define the overall process for ensuring that all regulatory agreements and risk- and hazard-based performance criteria were attained during disposal operations. The WAC, inclusive of administrative, chemical, Auditable Safety Analysis (ASA), and physical criteria, are listed in Appendix A of the WAC Attainment Plan. Engineering and operational requirements to attain goals specified by the ROD for the EMWMF are summarized in Table 4.10.

The Environmental Compliance Plan (ECP) and the Environmental Monitoring Plan (EMP) for the EMWMF specify the requirements for a comprehensive monitoring program, including groundwater detection monitoring, routine surface water sampling, storm water sampling, and air monitoring, consistent with governing state and federal regulations. Table 4.11 summarizes performance objectives and measures and environmental monitoring requirements for the EMWMF during operations.

Monitoring Requirements

Monitoring locations listed in Table 4.11 are illustrated in the EMWMF annual report (included as Appendix A). Fourteen wells are used for detection monitoring at EMWMF. These include 10 shallow wells generally located along the perimeter of the waste disposal cell (2 upgradient and 8 downgradient) and 4 deep wells located downgradient of the cell. Quarterly samples are analyzed for the COCs known to be present in the waste placed in the cell (as determined by the WAC) and those detected in the quarterly leachate samples.

Surface water monitoring includes routine quarterly and monthly sampling, as well as semiannual stormwater sampling at selected stations. Four stations are sampled once per quarter for all COCs identified to date. All of these stations, except NT-04, are sampled monthly to meet the requirements in 40 *CFR* §*761.75(b)(6)(iii)*. Semiannual stormwater sampling is performed at all of the stations, except NT-04, to evaluate facility performance with respect to state water quality standards and AWQCs.

LTS Requirements

Maintenance and operational elements include equipment maintenance, mowing, support facility maintenance, dust control, stormwater runoff and sediment controls, and record keeping. Dust emissions during operations are controlled by wetting the access roads and working surfaces to prevent release of airborne particulates. Additionally, the waste is either covered daily with soil or sprayed with a fixative. This ensures that contaminants are not released into the air. Storm water from active disposal cells is collected and managed appropriately in accordance with applicable regulations. Leachate is collected and transported to a treatment facility located on the ORR; leachate is not released to the environment as part of the EMWMF program. Leachate samples are analyzed to ensure compliance with the treatment facility requirements.

Table 4.10. Goals and engineering and operational requirements for the EMWMF

Component	Requirement[a]
Minimize the potential of adverse effects	Apply appropriate engineering controls and construction practices during the construction and operation of the facility.
Ensure short-term protection of workers, the public, and the environment	Implement dust emission controls, leachate removal and treatment, stormwater runoff and sediment controls, and access restrictions. Implement mitigative measures during construction and operation, as needed.
Establish baseline site characteristics	Begin air and groundwater monitoring during the development of site facilities.
ARAR compliance	The cell will comply with substantive EPA and TDEC requirements for the disposal of RCRA-hazardous waste, EPA and TDEC requirements for the disposal of LLW, and TSCA-regulated waste (with a waiver for the requirement that a landfill liner be 50 ft above the historical high groundwater table).

[a]As specified in the Record of Decision (DOE 1999i).

ARAR = applicable or relevant and appropriate requirement
EMWMF = Environmental Management Waste Management Facility
EPA = U. S. Environmental Protection Agency
LLW = low-level (radioactive) waste
RCRA = Resource Conservation and Recovery Act of 1976
TDEC = Tennessee Department of Environment and Conservation
TSCA = Toxic Substances and Control Act of 1976

Long-term stewardship requirements specified in the ROD include institutional controls, such as physical (perimeter fence with warning signs) and administrative (badging) access controls to prevent public access to the disposal cell indefinitely; and S&M activities, including regular inspections. Site-specific operations and safety training is also required for project personnel.

Upon closure of the facility, support facilities will be removed, contaminated materials placed into the cell, the final multi-layer cap installed, and the site restored. Site restoration will include grading and seeding of the disturbed areas in and around the disposal cell. Additional details regarding LTS requirements will be provided in post-ROD documentation. Per the Consent Agreement signed between DOE and TDEC (TDEC 1999), TDEC will assume responsibilities for S&M of the closed facility, will conduct regular inspections, and will continue long-term groundwater monitoring in accordance with the post-closure plan to be prepared at time of closure.

4.6.2 Evaluation of Performance and LTS Data

EMWMF Baseline

During FY 2002, baseline groundwater monitoring for future performance evaluations was conducted at the EMWMF. Results are reported in the Baseline Groundwater Monitoring Report (DOE 2002d). Baseline monitoring involved collection of a series of four samples on an approximately quarterly frequency between March 2001 and the end of January 2002. From these data, groundwater quality conditions prior to facility operations were evaluated and threshold values (TVs) were developed. The TVs are used for future comparisons of groundwater and routine surface water monitoring results to provide early detection of any potential releases. The EMP also contains risk-based action levels against which monitoring data are compared to determine if corrective actions are required with respect to facility operations.

Table 4.11. Performance objectives and measures for EMWMF

Medium	Required action[a]	Performance objectives (protection goals)	Performance measure (demonstration of effectiveness)
Groundwater	Quarterly sample 14 monitoring wells	Groundwater concentrations are protective of human health and the environment; protect and maintain the integrity of the clay liner.	Compare concentrations to site-specific threshold values and risk-based action levels.
	Quarterly measure water levels in shallow monitoring wells	Protect and maintain the integrity of the clay liner.	Compare water levels to the geologic buffer and the clay liner to identify potential incursions.
Surface water	Quarterly sample four surface water locations: EMWNT-03 NT-04 EMWNT-05 EMW-VWEIR	Shallow groundwater is not adversely impacting surface water; surface water concentrations are protective of human health and the environment.	Compare concentrations to site-specific threshold values and risk-based action levels.
	Monthly sample three surface water locations: EMWNT-03 EMWNT-05 EMW-VWEIR	Surface water concentrations are as low as reasonably achievable.	Measure/analyze for parameters listed in 40 *CFR §761.75(b)(6)(iii)*, plus gross alpha and beta activity.
Stormwater	Semi-annually sample three surface water locations: EMWNT-03 EMWNT-05 EMW-VWEIR	Stormwater concentrations are as low as reasonably achievable and satisfy Tennessee General Water Quality Criteria.	Compare measured/analyzed parameters to site-specific maximum values (e.g., for total suspended solids, pH, etc.). EMW-VWEIR only: Compare analytical results to TDEC 1200-4-3-.03 criteria.
Leachate	Quarterly sample leachate tanks for VOCs and one composite for remaining analytes	COCs in the operating cell have been adequately identified.	Add any newly detected COCs to the monitoring program.
Ambient air	Quarterly sample three ambient air locations: EMWAA-UW1 EMWAA-DW1 EMWAA-DW2	Air concentrations at the site perimeter are protective of human health and the environment.	Monitor for hazardous air pollutants and satisfy NESHAP reporting requirements.

[a]As described in the Environmental Monitoring Plan.
COC = contaminant of concern
CFR = Code of Federal Regulations
EMWMF = Environmental Management Waste Management Facility
NESHAP = National Emission Standards for Hazardous Air Pollutants
NT = North Tributary
TDEC = Tennessee Department of Environment and Conservation
VOC = volatile organic compound

FY 2007 Monitoring

Monitoring during Year 5 operation of the EMWMF was conducted over four quarters from October 1, 2006 through September 30, 2007, in accordance with decision document requirements. Additional potentiometric surface data were collected from facility monitoring wells and supplemental piezometers to evaluate water table elevations and configurations. A full discussion of results is presented in the Annual Report for 2006–2007 Detection Monitoring at the EMWMF (included in Appendix A of this report).

The second annual assessment of stream and riparian habitat associated with EMWMF haul road construction was conducted in August and September 2007 and included a survey of the constructed wetland and the constructed stream and riparian zone. In general, Bear Creek in the constructed section is about 4 meters wide and 14 cm deep on average. Relative to the un-impacted upstream section, the constructed stream channel is similar, although on average the section is shallower and wider than upstream. It is expected that the constructed section will change toward the reference condition with time, as substrate moves during flooding and channeling events.

The percent vegetation cover in riparian plots within the constructed section averaged 68%, a slight improvement relative to last year (60%). Riparian cover was 100% in all reference plots. The percent vegetative cover was deemed satisfactory given the short time since the construction project was completed (only the 2nd growing season), and given the proximity of the plots to the stream and the associated high velocity flooding events that make plant establishment difficult. Within the riparian plots, the species diversity was good (mean 18 species, a slight decrease from 2006), although many plants were nonnative, tolerant of disturbance, and fairly aggressive in growth character. The reference site averaged 25 species.

In general, the created wetland was in excellent condition, with a good number of native wetland species (average 14) and a high percentage of vegetative cover. Non-vegetated areas were mostly confined to the deeper water areas of the wetland or near the weir. Presumably, the organic soil placed at the site was an important source of native seeds to the wetland. Some plantings by hand from local sources were also successful. However, the average species diversity decreased from 24 in 2006 to 14 in 2007. This is likely due to the more aggressive and hardy species beginning to take over. For example, cattails were a much greater percentage of the species cover in 2007.

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5. CERCLA ACTIONS ON CHESTNUT RIDGE

5.1 CHESTNUT RIDGE OVERVIEW

This chapter provides an update to CERCLA actions completed on ChR (Sect. 5.1.1), all of which have performance monitoring and LTS requirements. ChR is not physically situated within one of the five established watersheds, but is located south of the Y-12 Complex on the ORR (Fig. 5.1). Because ChR is dissected by a number of small tributaries rather than forming a single defining hydrologic watershed, all completed remedies have been single-action decisions to address known or potential sources of releases. This chapter, presents performance goals and objectives, monitoring results, and a technical assessment of the results for each completed action. A review of compliance with LTS requirements is included (Sect. 5.2.3, Sect. 5.3.3, and Sect. 5.4.3), as well as any proposed monitoring changes and recommendations.

For background information of each remedy and performance standards, a compendium of all CERCLA decisions in ChR is provided in Chapter 5 of Volume 1 of the 2007 RER (DOE 2007a). This information will be updated in the annual RER and republished every fifth year at the time of the CERCLA FYR.

Table 5.1 summarizes the CERCLA actions completed in ChR and Table 5.2 provides a summary of LTS requirements.

All of the actions to date along ChR have post-remediation monitoring and site inspection requirements.

5.1.1 Status and Updates

Elevated gross beta activity observed in downgradient monitoring well GW-205 at the United Nuclear Corporation (UNC) Site (Sect. 5.2) suggests a potential contaminant release from the site. The issue was deferred to the UEFPC Core Team, who agreed to continue monitoring at the current frequency in the existing well network and to add a downgradient spring (UNC SW-1) to the monitoring network. This recommendation has been incorporated into the FY 2008 WRRP SAP.

The RCRA post-closure permit for the Chestnut Ridge Hydrogeologic Regime (TNHW-128), which includes Kerr Hollow Quarry (KHQ), was re-issued in late September 2006 and changes were implemented during FY 2007. Monitoring at the KHQ was reduced from semiannually to annually (Sect. 5.3). The CERCLA no further action (NFA) ROD for KHQ defers any monitoring and land use controls to the RCRA post-closure permit requirements.

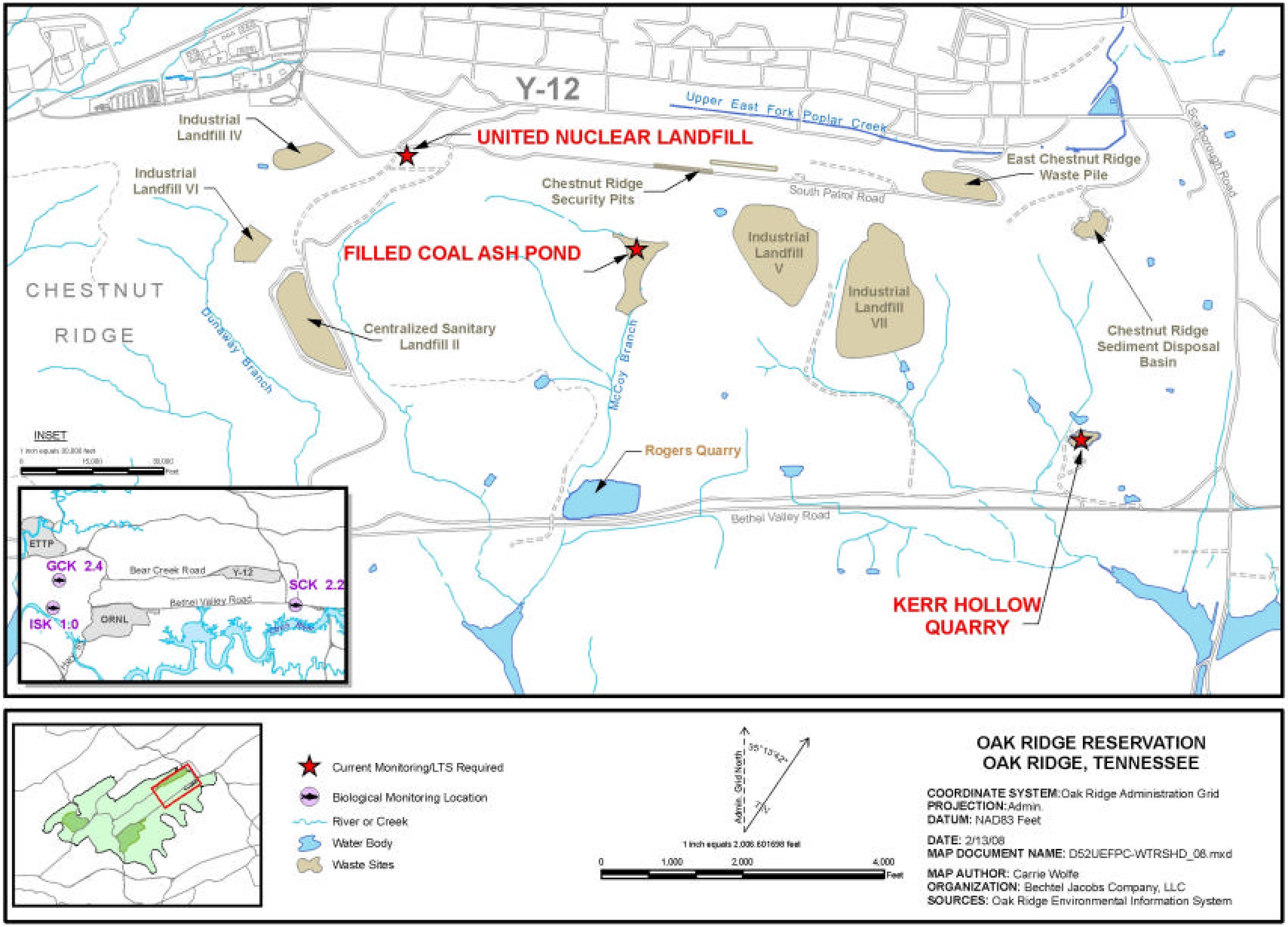

Fig. 5.1. CERCLA actions on the Chestnut Ridge administrative watershed.

Table 5.1. CERCLA actions on ChR

CERCLA action	Decision document: date signed (mm/dd/yy)	Action status[a] (approval date mm/dd/yy)	Monitoring/ LTS required	RER Section
UNC Disposal Site Remedial Action	ROD: 06/28/91	Remedial action complete. (PCR approved 09/16/93)	Yes/Yes	5.2
KHQ Remedial Action	NFA ROD: 09/29/95	Remedial action completed under approved RCRA closure plan.	Yes/Yes[b]	5.3
FCAP/Upper McCoy Branch Remedial Action	ROD: 02/21/96	Remedial action complete. (RAR approved 06/03/97)	Yes/Yes	5.4

[a] Detailed information of the status of ongoing actions is from Appendix E of the FFA and is available at http://www.bechteljacobs.com/ettp-ffa-appendices.html

[b] CERCLA NFA ROD defers all monitoring and LTS/LUC requirements to the RCRA post-closure permits.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
ChR = Chestnut Ridge
FCAP = Filled Coal Ash Pond
FFA = Federal Facility Agreement
KHQ = Kerr Hollow Quarry
LTS = long-term stewardship
LUC = land use control
NFA = No Further Action
PCR = Post-Construction Report
RAR = Remedial Action Report
RCRA = Resource Conservation and Recovery Act of 1976
RER = Remediation Effectiveness Report
ROD = Record of Decision
UNC = United Nuclear Corporation

Table 5.2. Long-term stewardship requirements for CERCLA actions on ChR

Site/Project	LTS Requirements		Status	RER Section
	Land Use Controls	Engineering Controls		
UNC Disposal Site Remedial Action		▪ Maintain cap	▪ Engineering Controls remain protective.	5.2.3
KHQ Remedial Action[(a)]	▪ Access controls (fences and locked gates) ▪ Deed restrictions	▪ Inspections	▪ LUCs in place. ▪ Engineering Controls remain protective.	5.3.3
FCAP/Upper McCoy Branch Remedial Action		▪ Inspect and maintain dam, slope, and spillway	▪ Engineering Controls remain protective.	5.4.3

[(a)] All requirements deferred to RCRA post-closure permit.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
ChR = Chestnut Ridge
FCAP = Filled Coal Ash Pond
KHQ = Kerr Hollow Quarry
LTS = long-term stewardship
LUC = land use control
RCRA = Resource Conservation and Recovery Act
RER = Remediation Effectiveness Report
UNC = United Nuclear Corporation

5.2 UNITED NUCLEAR CORPORATION SITE REMEDIAL ACTION

The UNC Disposal Site is a 1.3-acre landfill located near the crest of ChR south of the Y-12 Complex (Fig. 5.2). The ROD for the UNC Site (DOE 1991a) was approved in June 1991. Field activities began in May 1992 and were completed in August 1992. Remedial activities included construction of a multilayer cover system, installation of access controls, and implementation of a groundwater monitoring program using existing wells.

A more complete discussion of the UNC closure and a summary of performance goals and requirements are provided in Chapter 5 of Volume 1 of the 2007 RER. This waste disposal facility utilized an unlined excavation in the thick soils near the crest of ChR for retention of approximately 11,000 55-gal drums of cement-fixed sludge, 18,000 drums of contaminated soil, 288 wooden boxes of contaminated building and process equipment demolition debris from the UNC uranium recovery facility in Wood River Junction, Rhode Island. In addition, Formerly Utilized Sites Remedial Action Program (FUSRAP) waste from the Elza Gate site in Oak Ridge was placed in the site before the final multi-layer cap was constructed to limit percolation of rainwater into the waste.

5.2.1 Performance Goals and Monitoring Objectives

The major goal of the UNC remedial action, per the ROD, is to "ensure that mobile contaminants in the UNC waste, principally nitrate and ^{90}Sr, are not leached to groundwater at a rate that would result in concentrations of these contaminants above safe drinking water standards." The feasibility study (FS) for the UNC Site (DOE 1991b) included results of contaminant transport modeling that indicated possible impacts to groundwater including potential nitrate concentrations of as much as 193 mg/L and ^{90}Sr concentrations as great as about 50 pCi/L. The ROD stated that the expected performance of the remedy is to control contaminant migration so that nitrate is less than the SDWA limit of 10 mg/L and no more than 2 pCi/L of ^{90}Sr would occur in groundwater, which is within the CERCLA risk range of 10^{-4} to 10^{-6}. The ROD also states that groundwater concentration "is not expected to exceed 8 mg/L for nitrate." The PCR (DOE 1993a) specifies implementation of a groundwater monitoring program. Although specific frequencies, locations, and analytes are not mandated by the PCR, groundwater is monitored for COCs on which performance assessment is based (nitrate and ^{90}Sr).

5.2.2 Evaluation of Performance Monitoring Data

Groundwater monitoring was performed in FY 2007 at upgradient well 1090 and downgradient wells GW-203, GW-205, and GW-221 (Fig. 5.2). Samples were analyzed for metals, nitrate, gross alpha and beta activity, and ^{90}Sr. Additional isotopic analyses were conducted on samples collected from well GW-205 as noted below. Data for nitrate, gross alpha and beta activity, and ^{90}Sr analyses for all wells are shown in Table 5.3.

In FY 2007, nitrate concentrations downgradient of the site have remained well below the 10 mg/L SDWA MCL and the "not expected to exceed range" of 8 mg/L. Also, the downgradient concentrations were below the concentrations in the upgradient well. Strontium-90 is the specific radionuclide COC at UNC and a beta-emitter. Strontium-90 was slightly above the detection limit or not detected in upgradient and downgradient wells in FY 2004 or FY 2005. In FY 2007, ^{90}Sr was below the detection limit in all of the monitoring wells. Strontium-90 has been slightly above the detection limit or not detected in well GW-205 in previous years but not detected in FY 2007.

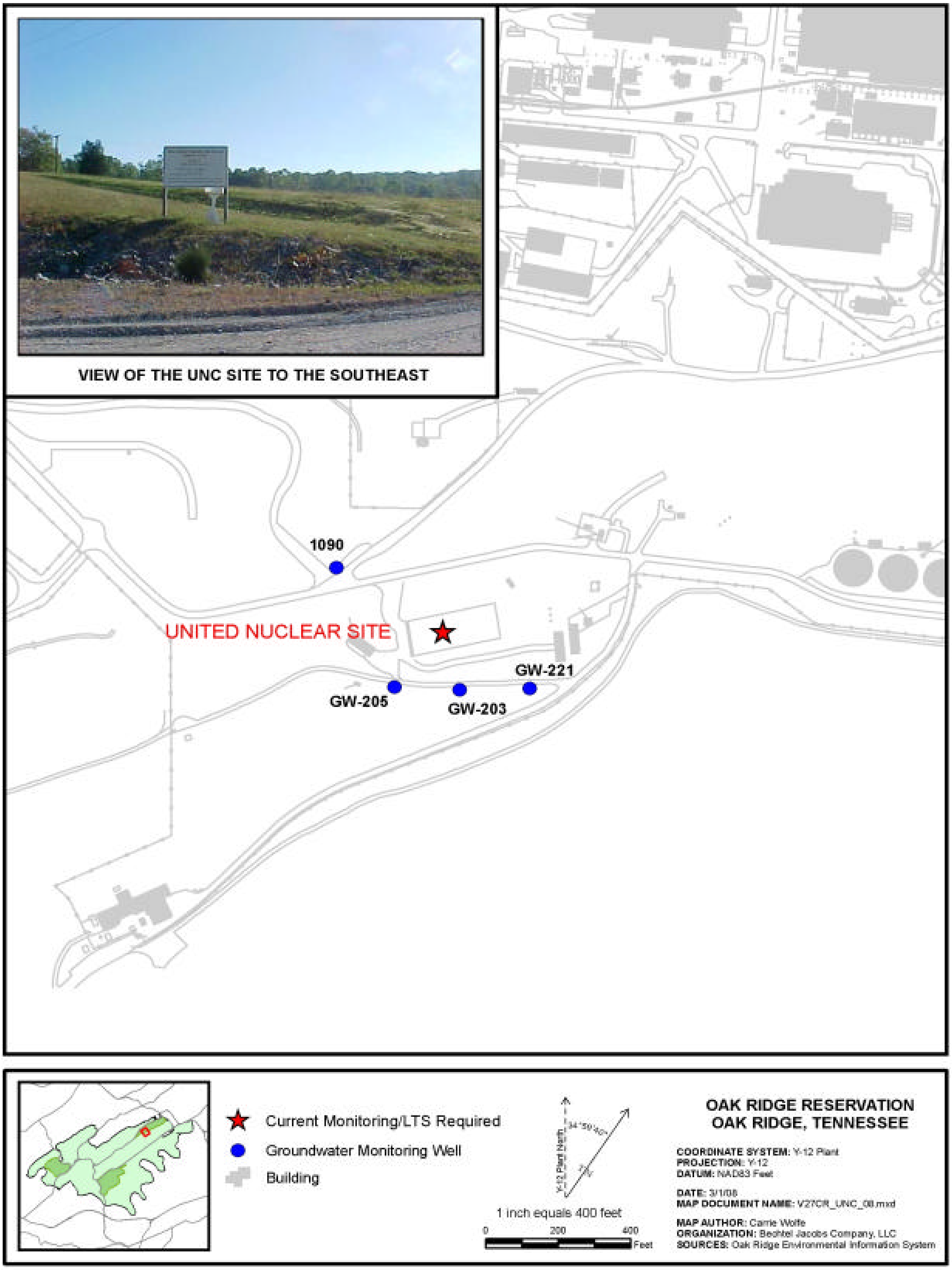

Fig. 5.2. United Nuclear Corporation site map.

Table 5.3. Analytical results for performance indicator constituents at the UNC site, FY 2007

Date	Upgradient well 1090	Downgradient wells GW-203	GW-205	GW-221
		Nitrate (mg/L)		
Jan-07	0.58	0.46	0.28	0.39
Jul-25	0.58	0.45	0.066	0.38
		Gross alpha (pCi/L)		
Jan-07	<0.828U	3.35±1.67	<0.0321U	0.723
Jul-25	<0.505U	<1.5U	<0.318U	<0.488U
		Gross beta (pCi/L)		
Jan-07	<1.98U	<2.48U	**67.1±4.63**	<1.87U
Jul-25	<1.34U	<0.266U	**67.1±4.39**	<0.898U
		^{90}Strontium (pCi/L)		
Jan-07	<0.242U	<0.0593U	<0.28U	<-0.009U
Jul-25	<-0.209U	<0.186U	<-0.103U	<0.175U
		^{40}Potassium (pCi/L)		
Jan-07	-	-	17U	-
Jul-25	-	-	201±	

Bolded value indicates gross alpha above the drinking water maximum contaminant level [15 picoCuries per liter (pCi/L)] or gross beta above the effective dose equivalent (50 pCi/L) to the drinking water maximum contaminant level (4 mrem/yr).

GW = groundwater well
FY = fiscal year
mg/L = milligrams per liter
pCi/L = picoCuries per liter
U = Not detected or result less than minimum detectable activity and/or counting errors (radiological results)
UNC = United Nuclear Corporation

Gross alpha activities have remained well below the 15 pCi/L MCL in FY 2007. With the exception of well GW-205, gross beta activity in groundwater at the site was below the 50-pCi/L screening value for compliance with a 4-mrem/year dose limit for man-made radionuclides. Gross beta results in FY 2007 for well GW-205 were 67.1 pCi/L for both sampling events, which is consistent with results in previous years. The FY 2006 143 pCi/L measurement appears to be an outlier on the gross beta trend.

The history of monitoring at well GW-205 started in 1987. In 1998 the well purge method was changed from a standard 3-well-volume method to low-flow purging. Contemporaneous with that change, beta activity and potassium concentrations increased, possibly an indication of grout or other alkaline material influence on local groundwater.

The concentration of radioactive ^{40}K based on its natural abundance in total elemental potassium has been calculated for all samples from GW-205. The calculated ^{40}K activities closely track the beta activity values indicating that increased potassium concentrations that are detected under lower stress sampling are responsible for the increase in beta activity. Analyses for other contaminant-related beta-emitting radionuclides have not detected site-related contaminants other than the low concentrations of ^{90}Sr observed at wells GW-203, GW-205, and GW-221 as previously discussed.

5.2.3 Compliance with LTS Requirements

5.2.3.1 Requirements

The PCR (DOE 1993a) requires that surveillance activities continue for 30 years from remedial action completion to ensure that the cap is adequately containing the waste in the site (see Table 5.2). UNC RA construction was completed in August 1992. Specific requirements include a visual inspection of the cap be conducted quarterly for the first 2 years after construction, and semiannually thereafter. If necessary, restorative measures will be implemented. Minor deficiencies such as damaged drains or signs will be noted on the inspection forms and corrected. However, major deficiencies such as the collapse of the cap or major erosion problems will be reported. Required routine maintenance of the site includes mowing and replacement of any topsoil and vegetation, as required.

5.2.3.2 Status of Requirements for FY 2007

All components of the UNC site were inspected quarterly in FY 2007 including erosion or settlement of the cover, integrity of surface drainage, evidence of rodent damage, proper signage, and integrity of benchmarks and monitoring wells. No deficiencies were noted during the inspections. Minor maintenance included repairing a broken sign. This site received routine mowing and was also inspected monthly as a BMP. Additionally, the UNC site is located within the Y-12 PPA and, as such, is not accessible to the public. The area is routinely patrolled by Y-12 security personnel.

5.2.4 Site Summary: Condition and Trends

The waste emplaced at the UNC site lies in a capped, unlined unit with a base elevation of approximately 1,100 feet. Groundwater elevations beneath the site range from about 1,040–1,060 along the northern side of the unit to 1,020 to 1,040 feet along the southern side. All waste is well above the groundwater elevation. However, during periods of sustained and extreme rainfall, saturation may occur in the base of the buried waste unit from lateral seepage in the soils. Infiltration of any water that contacts buried waste would have the potential to be detected in any of the wells surrounding the site because of the 40+ foot elevation difference between the base of the waste and the shallowest groundwater elevations at the site. The general groundwater seepage gradient is from the northern edge of the site toward the southern edge of the site, continuing toward the headwater of a McCoy Branch tributary.

Groundwater monitoring has been conducted at the UNC site since the late 1980s. Evaluation of groundwater chemical and radiological data indicate that, as the FS predicted, chemical and radiological impacts to groundwater at the site are being detected. In 2003, when annual rainfall was 72 inches compared to the average of 54 inches, the specific conductance of groundwater in the four site monitoring wells showed significant increases with highly variable values through 2006. In 2002 one well, GW-205 measured groundwater pH at the time of sampling increased from values in the 7.5 – 8.5 range to values in the 9.5 to 10.5 range. This change was accompanied by a sharp decrease in calcium concentrations (from near 30 mg/l to less than 3 mg/L) and a sharp increase in potassium concentrations (from less than 10 mg/L to concentrations greater than 60 mg/L). As stated in Sect. 5.2.2, the increase in potassium concentration in well GW-205 was accompanied by an increase in beta activity detected in samples from that well. Strontium-90 has been detected at concentrations less than 5 pCi/L in wells 1090, GW-203, GW-205, and GW-221. The highest ^{90}Sr concentration detected to date was 17.8 pCi/L in well GW-205 in July 2006. While this value exceeds the ROD-stated objective for groundwater protection at the site, the result is within the FS predicted concentration at the site.

5.2.5 Monitoring Changes and Recommendations

Data indicate a release of waste-related constituents from the UNC site. Potassium, which includes the naturally-occurring ^{40}K isotope, and ^{90}Sr have been detected in groundwater beneath the site. The issue was brought before the UEFPC Core Team in a briefing. The Core Team consensus was that monitoring should continue and a downgradient surface water sampling location included in monitoring to evaluate whether groundwater seepage from the UNC site affects nearby surface water quality. Results of monitoring will be reported in the 2009 RER (Table 5.4).

Table 5.4. Summary of UNC technical issues and recommendations

ISSUE	ACTION/ RECOMMENDATION
<u>ISSUE CARRIED FORWARD:</u>	
1. Elevated gross beta activity observed in downgradient monitoring well GW-205 at the UNC site suggests a potential contaminant release from the site.	1. The issue was discussed by the UEFPC Core Team in FY 2007. The UEFPC Core Team agreed to continue monitoring in existing wells, but added a downgradient spring to better understand shallow groundwater flow dynamics. Spring (UNC SW-1) was added to WRRP FY 2008 SAP. Results will be reported in the 2009 RER.

DOE = U.S. Department of Energy
FY = fiscal year
RER = Remediation Effectiveness Report
SAP = Sampling and Analysis Plan
UEFPC = Upper East Fork Poplar Creek
UNC = United Nuclear Corporation
WRRP = Water Resources Restoration Program

5.3 KERR HOLLOW QUARRY REMEDIAL ACTION

The ROD (DOE, 1995b) for Kerr Hollow Quarry (Fig. 5.3) presents the decision for NFA at the site, deferring all monitoring, reporting, and maintenance requirements to the RCRA post-closure permit (TDEC 1996) and amendments. Because the RCRA closure left contaminated material in place, the permit requires monitoring of groundwater. The RCRA post-closure permit for the ChR Hydrogeologic Regime was reissued in September 2006 (TDEC 2006a), changing monitoring requirements beginning in January 2007. However, because the permit was reissued in late September 2006, the revised monitoring program was not fully implemented until the following calendar year (2007). Therefore, the site was sampled twice during FY 2007 – once in early October 2006 and again in January 2007. Both data sets are discussed below (Sect. 5.3.2)

A more complete discussion of the closure of Kerr Hollow Quarry and a summary of the regulatory history of the site are provided in Chapter 5 of Volume 1 of the 2007 RER. This information will be updated in the annual RER and republished every fifth year at the time of the CERCLA FYR.

5.3.1 Performance Goals and Monitoring Objectives

The objective of the site closure was to prevent physical exposure to contaminants within the quarry and mitigate migration of contaminants to groundwater or surface water runoff. The RCRA closure was deemed protective of human health and the environment under CERCLA, resulting in the NFA ROD. The RCRA post-closure permit for the ChR Regime specifies annual detection monitoring, alternating between seasonally high and low flow conditions, to identify any potential future releases to groundwater from the unit. Statistical analysis for groundwater target list compounds is conducted for each annual sampling event. If statistically significant contamination is detected in groundwater at the site while conducting monitoring in accordance with the permit, notification is provided in accordance with the terms of the permit and any necessary remediation will be addressed under CERCLA.

The ROD states that monitoring of the surface water discharge point (Outfall 301) from the quarry will be performed as a BMP. Because the outfall was typically dry, DOE obtained approval to discontinue monitoring of Outfall 301 at the quarry in 2002.

5.3.2 Evaluation of Performance Monitoring Data

During FY 2007, semi-annual groundwater monitoring was conducted in upgradient/background well GW-231 and in downgradient wells GW-143, GW-144, and GW-145 (Fig. 5.3) for metals, VOCs, and gross alpha and beta. Statistical analyses of target constituents were conducted in accordance with the post-closure permit requirements. Monitoring results and statistical analyses are reported to TDEC in post-closure permit monitoring reports. There was only one estimated detection of any VOCs in Kerr Hollow groundwater samples collected during FY 2007. Carbon tetrachloride was detected (1J µg/L) in October 2006 in well GW-144, and was also below the project quantitation level (PQL).

Uranium was detected in all samples from monitoring wells at KHQ, along with corresponding levels of gross alpha activity, but was only above the PQL at downgradient well GW-145 (0.011 mg/L and 0.012 in October 2006 and January 2007, respectively). This uranium result is typical for the well and is below the applicable upper tolerance limit (~0.024 mg/L) calculated for the ChR area.

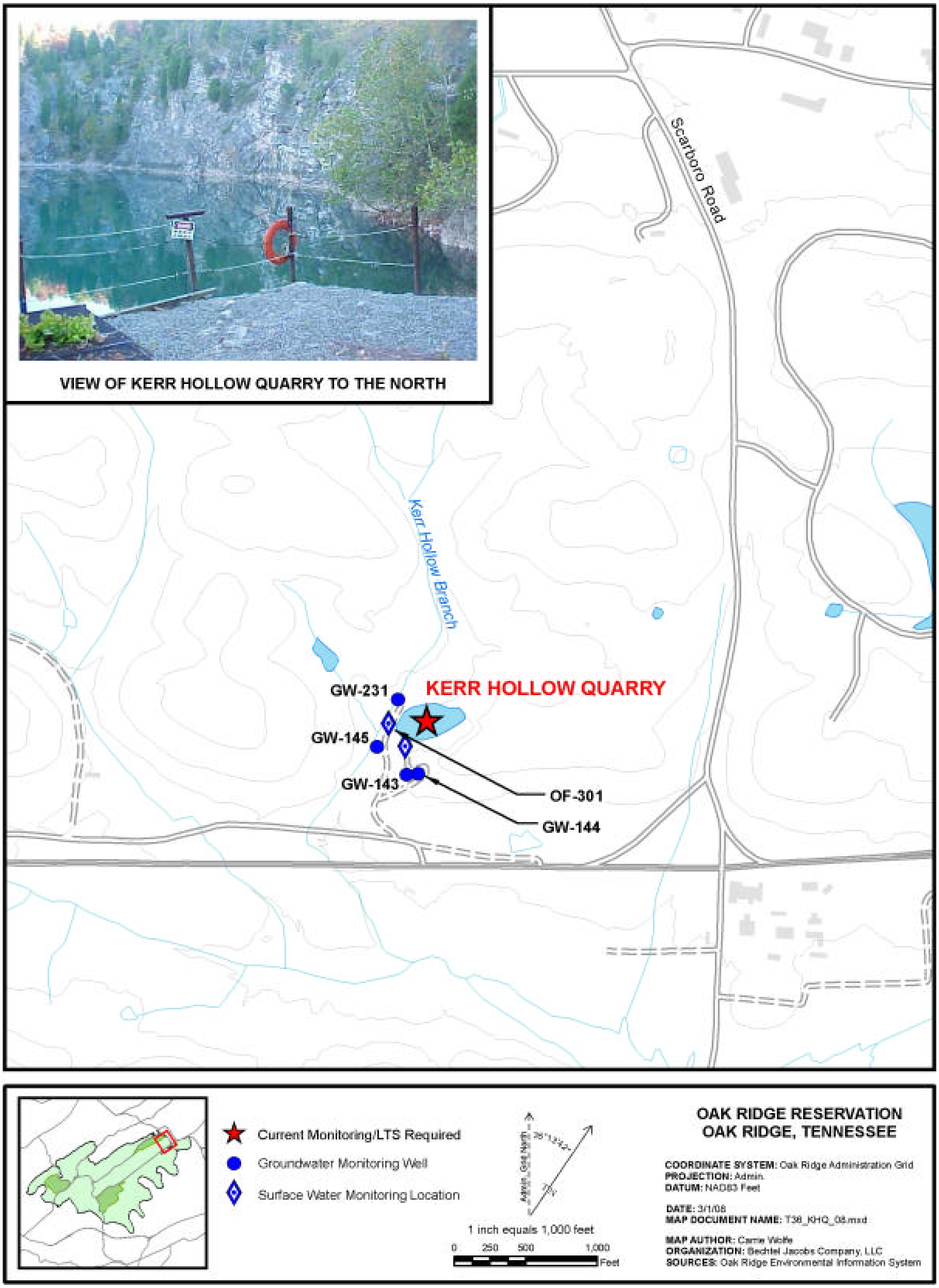

Fig. 5.3. Kerr Hollow Quarry site map.

5.3.3 Compliance with LTS Requirements

5.3.3.1 Requirements

The KHQ ROD (DOE 1995b) does not specify any LTS requirements; however, the RCRA post-closure permit requires that all security components, signage, survey benchmarks, and monitoring systems at KHQ be inspected quarterly throughout the post-closure care period.

5.3.3.2 Status of Requirements for FY 2007

Kerr Hollow Quarry was inspected quarterly for items including proper signage; integrity of benchmarks and monitoring wells; condition of the fences, gates, and locks; and condition of the access road. No deficiencies were noted during the inspections. Minor maintenance included mowing and removing a fallen tree that was blocking access to a monitoring well. A comprehensive monitoring well inspection was conducted in FY 2007. Additionally, the KHQ is located outside the Y-12 PPA; therefore, separate security fencing and signs exist at the site.

5.3.4 Site Summary: Condition and Trends

Results of statistical analyses of target constituents in accordance with the RCRA post-closure permit were conducted for FY 2007 data. Low levels of total uranium have typically been detected in downgradient well GW-145 with corresponding levels of gross alpha activity. However, these values are below any regulatory limit.

Results of statistical evaluations of applicable analytical data for KHQ do not indicate a contaminant release for the uppermost aquifer and do not warrant any response action specified in the post-closure permit.

5.3.5 Monitoring Changes and Recommendations

If statistically significant contamination is detected in groundwater at the site while conducting monitoring in accordance with the RCRA post-closure permit, any necessary remediation will be addressed under CERCLA.

No changes to monitoring at KHQ are recommended at this time.

5.4 FILLED COAL ASH POND/UPPER MCCOY BRANCH REMEDIAL ACTION

The Filled Coal Ash Pond (FCAP) is situated south of the Y-12 Complex along the southern slope of ChR (see Figs. 5.1 and 5.4). The ChR OU2 ROD was approved on February 21, 1996 (DOE 1996c), to remediate FCAP and vicinity. The RAR was approved on May 29, 1997 (DOE 1997b), documenting the following actions: the crest of the dam was raised, the face of the dam was reinforced, a subsurface drain was installed, large trees from the face of the dam were removed, the emergency spillway was repaired (including removal of the steep slope to the east of the spillway), a settling basin and oxygenation weir were constructed at the foot of the dam, and a small wetland was replaced downstream of the settling basin. The RA also includes long-term monitoring of the dam and controls to limit access.

A more complete discussion of the FCAP remedy and a summary of performance goals and requirements are provided in Chapter 5 of Volume 1 of the 2007 RER (DOE 2007a). This information will be updated in the annual RER and republished every fifth year at the time of the CERCLA FYR.

5.4.1 Performance Goals and Monitoring Objectives

The goal of the response action is to reduce risk posed by the site to "plants, animals and humans by: (1) upgrading containment of the coal ash with dam improvements and stabilization, (2) reducing contaminant migration into Upper McCoy Branch with a passive treatment system (existing wetland), and (3) restricting human access to the contamination by implementing institutional controls." The functional goals per the ROD are to do the following:

- minimize the migration of contaminants into surface water,
- minimize direct contact of humans and animals with the ash,
- reduce the potential for future failure of the dam, and
- preserve the local habitat in the long-term.

The ROD requires that surface water be periodically sampled "and analyzed to verify that the passive treatment system reduces contaminant levels in water entering Upper McCoy Branch at least as well as the existing wetland and to evaluate whether the passive treatment system requires maintenance." The RAR (DOE 1997b) specifies that surface water samples "be collected and analyzed for the primary contaminants of concern (aluminum, arsenic, iron, manganese, and zinc) and other constituents of relevance to evaluating wetland performance at the site." Two locations, one at the outlet to the dam (MCK 2.05) and one below the wetland (MCK 2.0), are monitored for metals, anions, radionuclides, and water quality parameters on a semiannual basis.

Monitoring of biological communities is conducted to evaluate protection of the ecosystem in the FCAP vicinity in accordance with ARARs for protection of aquatic resources specified in the ROD. Biological communities are monitored near the wetland (MCK 1.9) and also below the Rogers Quarry dam (MCK 1.4 and MCK 1.6). Fish are also collected from Rogers Quarry for contaminant analysis on an annual basis.

5.4.2 Evaluation of Performance Monitoring Data

Results for surface water monitoring at FCAP in FY 2007 did not exceed the upper range of baseline values from pre-remediation monitoring conducted in 1996. Results for pre-remediation baseline monitoring and FY 2007 monitoring are presented in Tables 5.5 and 5.6, respectively. The results are for unfiltered samples taken at locations above and below the wetland.

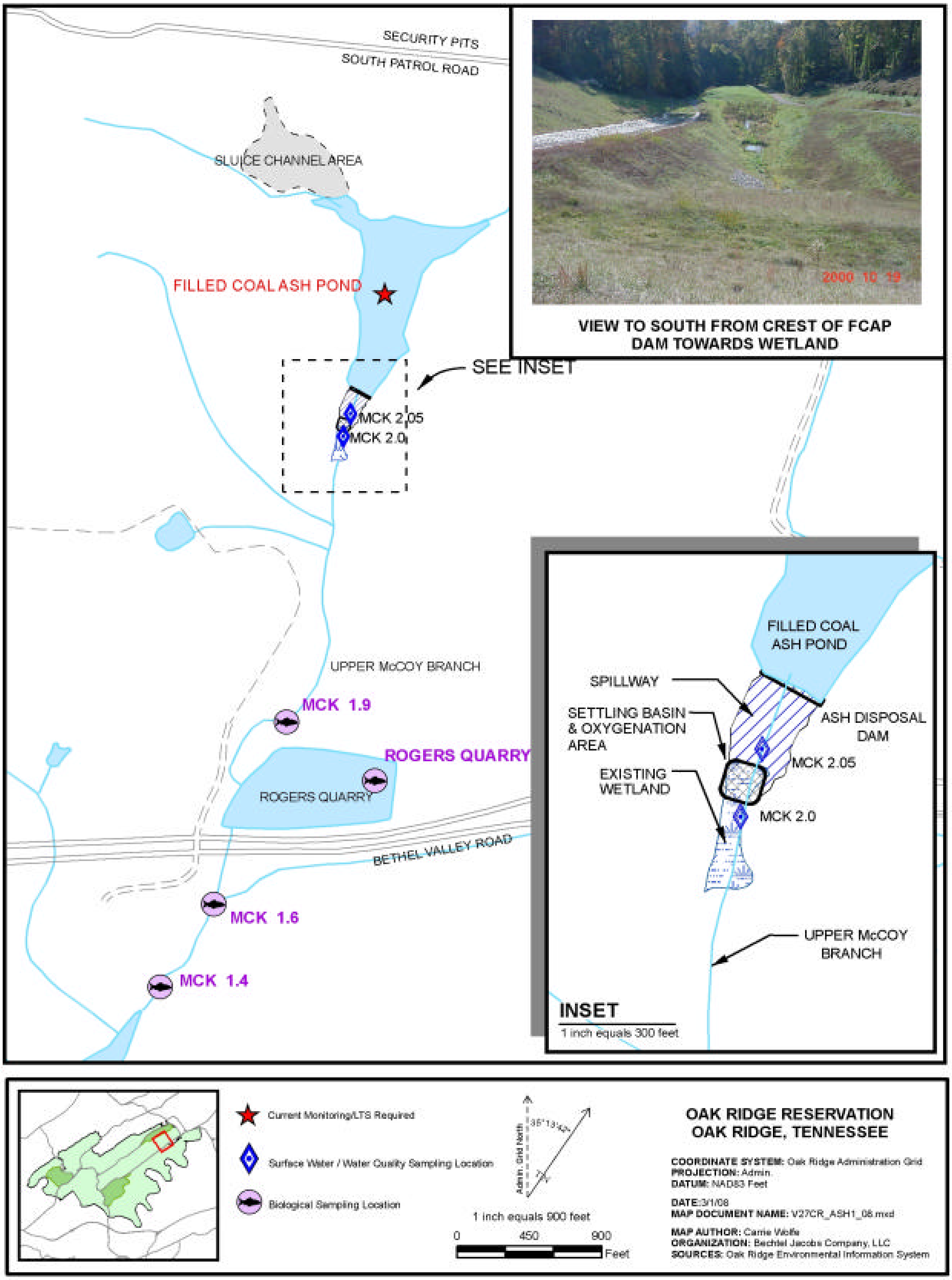

Fig. 5.4. Filled Coal Ash Pond site map.

Table 5.5. Summary of FCAP pre-remediation monitoring results

Analyte	Units	Entry to Wetland[a]	Exit from Wetland[b]
Arsenic	mg/L	0.007–1.4	0.029–1.2
Iron	mg/L	5.6–43	0.6–48
Manganese	mg/L	0.47–3.8	0.6–39.0
Zinc	mg/L	0.0094–0.056	ND-0.2

[a]Wetland influent MCK 2.05.
[b]Wetland effluent MCK 2.0.
FCAP = Filled Coal Ash Pond
MCK = McCoy Branch kilometer
mg/L = milligrams per liter
ND = not detected

Table 5.6. Summary of FY 2007 post-remediation data from MCK 2.05 and MCK 2.0

		Wet-season sample		Dry-season sample		
Analyte	**Units**	**MCK 2.05[a] Jan-07**	**MCK 2.0[b] Jan-07**	**MCK 2.05[a] Jul-07**	**MCK 2.0[b] Jul-07**	**AWQC**
Aluminum	mg/L	0.050 U	0.050 U	0.079	0.050U	N/A
Arsenic	mg/L	**0.0576**	**0.0107**	**0.0716**	**0.0161**	0.01[c]
Iron	mg/L	1.88	0.106	2.18	0.549	N/A
Manganese	mg/L	1.09	0.088	1.3	0.243	N/A
Zinc	mg/L	0.01 U	0.01U	0.01U	0.01U	0.12[d]

[a] Dam effluent/wetland influent.
[b] Wetland effluent.
[c] *Source*: TDEC 1200-4-3-.03(4) recreation criteria for organisms only.
[d]*Source*: TDEC 1200-4-3-.03(3) criterion continuous concentration for protection of fish and aquatic life. Ambient water quality criteria for zinc are hardness dependent. *The 120 µg/L AWQC for zinc is based on the most conservative criterion for hardness.*
Bold value indicates sample concentration exceeds AWQC.
AWQC = ambient water quality criteria
FY = fiscal year
MCK = McCoy kilometer
mg/L = milligrams per liter
N/A = not applicable
U = not detected

January 2007 concentrations of COCs (Al, As, Fe, Mn, and Zn) below the wetland (MCK 2.0) were consistent with results from previous years; however, the dry-season results (July 2007) were slightly elevated. The elevated sample results for COCs indicate the presence of oxyhydroxide precipitate particles of these metals in the FCAP leachate, consistent with below average rainfall. Results for COCs presented in Table 5.6 show a decrease from dam effluent/wetland influent (MCK 2.05) to wetland effluent (MCK 2.0). In FY 2007, the only detected exceedances of AWQC at FCAP were for arsenic.

Biota Monitoring

Fly-ash disposal from the Y-12 Complex into the FCAP, as well as direct disposals of ash into Rogers Quarry, affected water quality in the lower reaches of McCoy Branch and the quarry. Biological monitoring studies have documented contaminants in fish and impacts to biota in the lower reaches of the McCoy Branch watershed and Rogers Quarry. To evaluate in-stream exposure and potential human health risks in the McCoy Branch watershed, adult largemouth bass are collected from Roger's Quarry and analyzed for key COCs. An evaluation of overall ecological health in the stream is conducted by monitoring the fish and benthic macroinvertebrate communities.

Selenium concentrations in largemouth bass in Rogers Quarry remained elevated about 2–3 times above typical background concentrations (0.5 µg/g); suggesting possible continuing low level inputs from the

FCAP site (Fig. 5.5). Arsenic concentrations were at background levels. Mercury concentrations in bass from Rogers Quarry (Fig. 5.6) were slightly lower in 2007, but remained within the range typical of the past ten years. The large increase in mercury concentrations in fish following the elimination of fly ash discharges was probably a consequence of the reduction in selenium inputs associated with that action (selenium is known to have an antagonistic effect on mercury methylation).

Mercury concentrations in fish increased as selenium concentrations decreased in the 1990s.

The species richness (number of species) of the fish community at MCK 1.6 in McCoy Branch has been declining since 2004 (Fig. 5.7) and is now below species richness values in comparable reference streams, although the values are still in the lower end of the range of samples previously taken from this site. The number of pollution-intolerant benthic macroinvertebrate taxa at both sites in McCoy Branch continues to be slightly lower than at nearby reference streams, particularly in October (Fig. 5.8).

McCoy Branch fish and invertebrate communities are slightly impacted relative to reference sites.

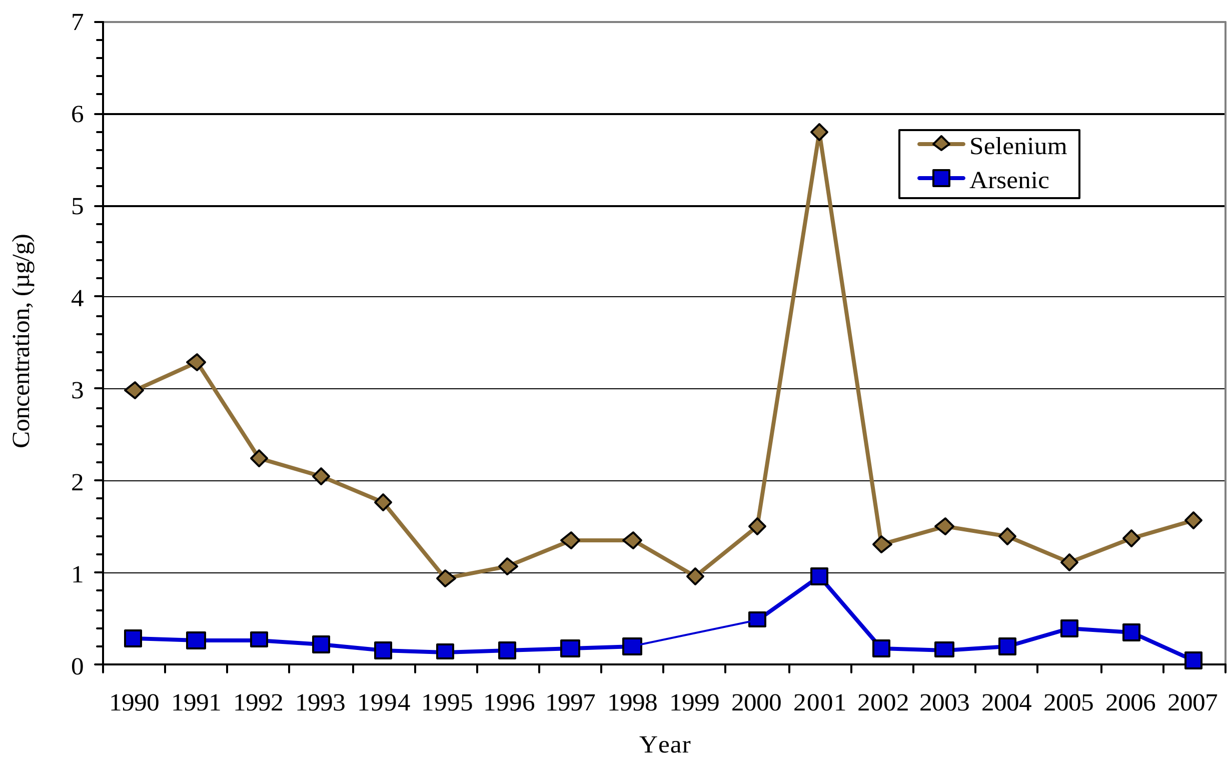

Fig. 5.5. Mean concentrations of selenium and arsenic in fillets of largemouth bass from Rogers Quarry.

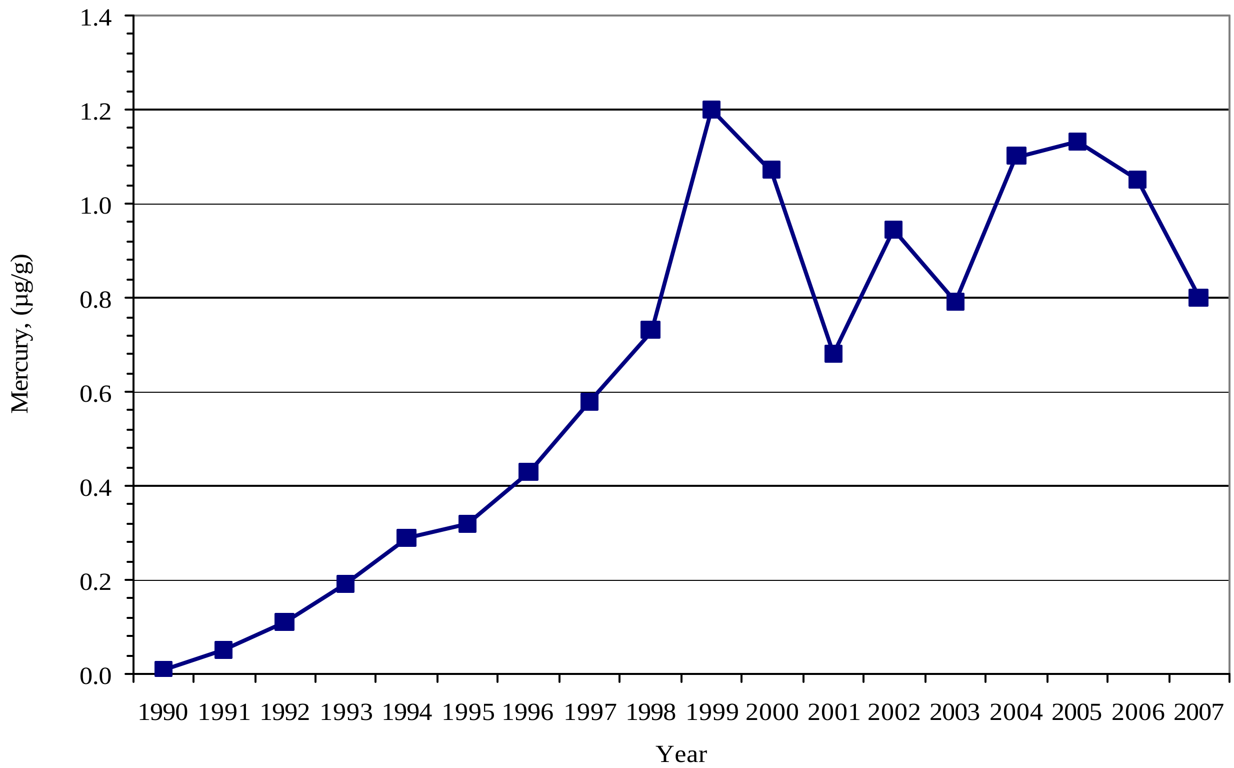

Fig. 5.6. Mean concentrations of mercury in fillets of largemouth bass from Rogers Quarry.

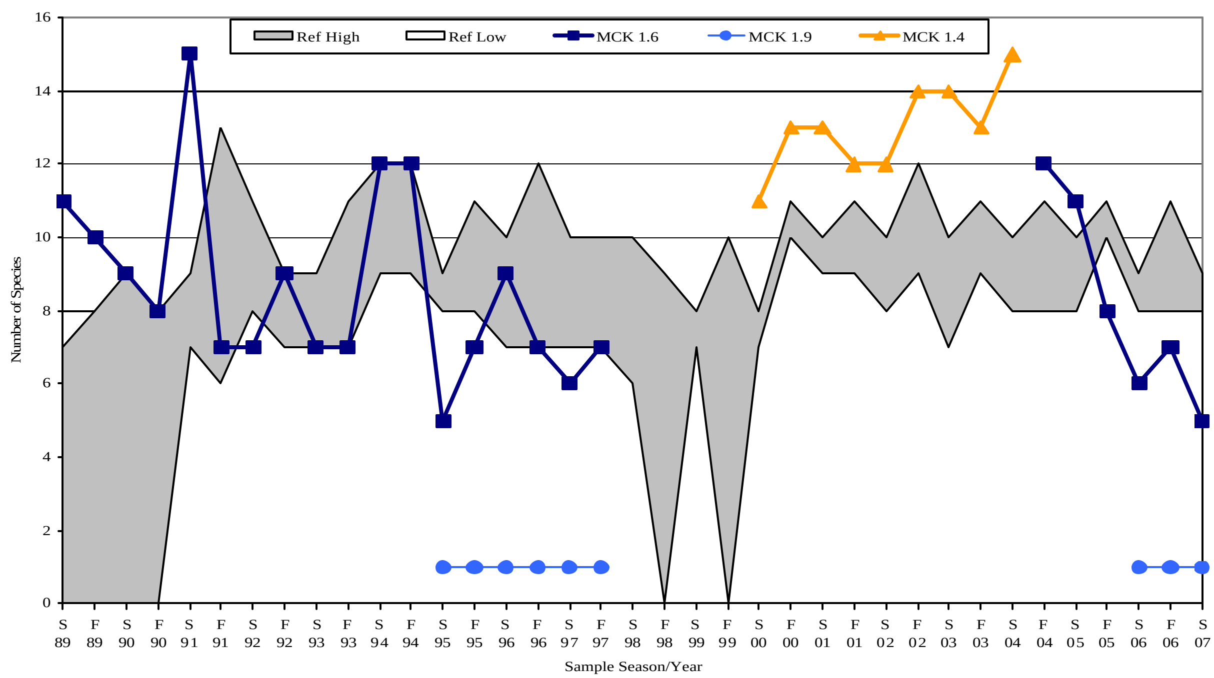

Fig. 5.7. Species richness (number of species) in samples of the fish community in McCoy Branch (MCK) and three reference streams, Scarboro Creek (SCK), Grassy Creek (GCK), and Ish Creek (ISK), 1989 – 2007.

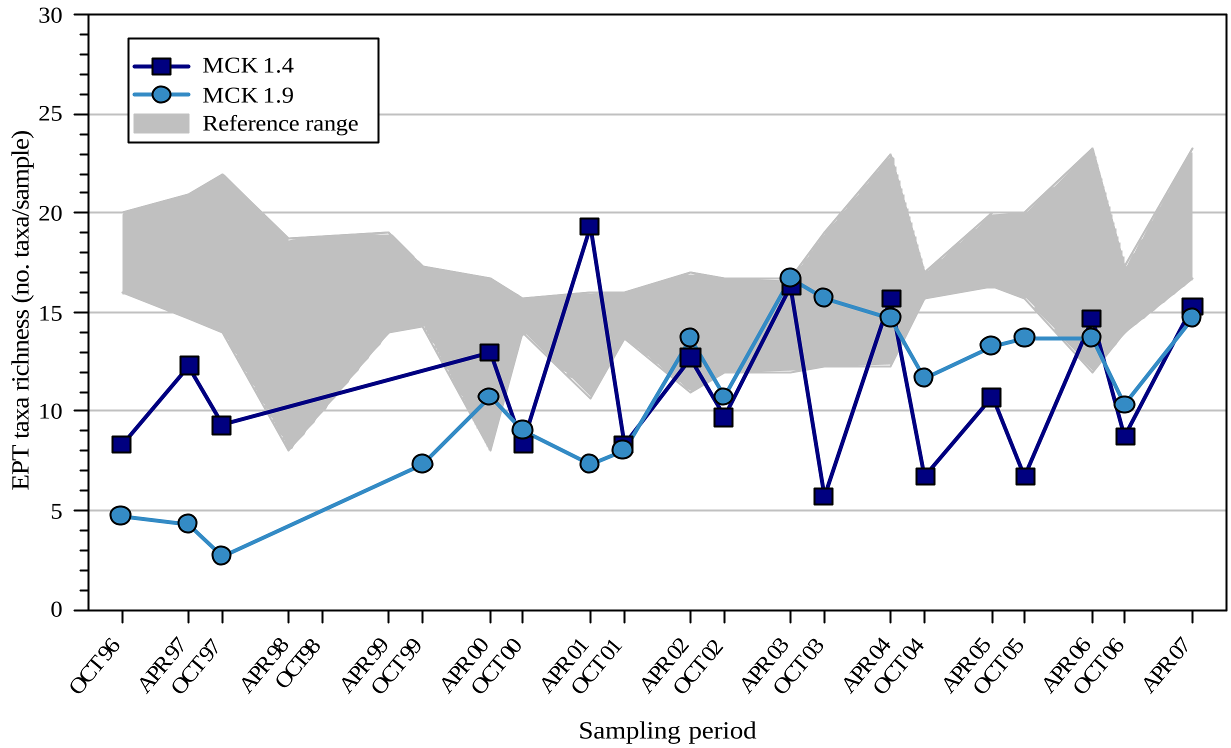

Fig. 5.8. Mean (n = 3) taxonomic richness of the pollution-intolerant taxa for the benthic macroinvertebrate community at sites in McCoy Branch, and range of mean values among reference streams (First Creek, Fifth Creek, Gum Hollow Branch, Mill Branch, Walker Branch, and White Oak Creek), 1989 - 2007.

(MCK = McCoy Branch kilometer, EPT = Ephemeroptera, Plecoptera, and Trichoptera, or mayflies caddisflies, and stoneflies.)

5.4.3 Compliance with LTS Requirements

5.4.3.1 Requirements

Long-term stewardship requirements for FCAP are summarized in Table 5.2. The RAR (DOE 1997b) requires that inspections of the site be conducted quarterly throughout the post-remediation care period, and any required maintenance be conducted based on inspection findings. Post-remediation performance of FCAP is strongly dependent on adequate inspection and maintenance of the dam, spillway channel, adjacent slopes, settling basin, and wetlands. Because erosional damage is of great concern, the dam and spillway will also be inspected following any rainfall event equivalent to a 25-year, 24-hour intensity.

5.4.3.2 Status of Requirements for FY 2007

All components of the FCAP were inspected quarterly including dam and slope stability, vegetative cover of dam and adjacent slopes, settling basin, spillway, underdrain discharge pipe, wetland area, benchmarks, and site security and access controls. No deficiencies were noted during the quarterly inspections. Minor maintenance included removing vegetation from the spillway and exit drains.

5.4.4 Site Summary: Condition and Trends

Surface water quality data directly above and below the wetland at FCAP are consistent with monitoring results from previous years since implementation of the remedial action are within the range baseline values established during pre-remediation monitoring. Elevated results obtained for COCs during July 2007 indicate the presence of oxyhydroxide precipitate particles contained in the FCAP leachate, consistent with below average rainfall during the year.

Communities of fish and invertebrates in McCoy Branch exhibit small differences from reference sites that suggest only slight impacts from the FCAP. A variety of scenarios may explain results of bioaccumulation monitoring in Rogers Quarry, including that selenium-enriched groundwater originating from the FCAP may discharge to McCoy Branch or may discharge directly to Rogers Quarry, or possibly that highly efficient internal recycling of selenium in the quarry is occurring. The interaction of selenium with mercury is poorly understood, but the increase in mercury is likely a result of a decrease in selenium inputs, which had acted to suppress mercury bioaccumulation.

5.4.5 Monitoring Changes and Recommendations

No changes to the monitoring network at FCAP are recommended at this time.

6. CERCLA ACTIONS IN UPPER EAST FORK POPLAR CREEK WATHERSHED

6.1 INTRODUCTION AND OVERVIEW

This chapter provides an update to completed CERCLA actions in the UEFPC watershed during FY 2007. Fig. 6.1 shows the locations of the actions within the watershed. Only sites that have performance monitoring and/or LTS requirements, as noted in Table 6.1, are included in the performance evaluations provided in this chapter. In this chapter, performance goals and objectives, monitoring results, and an assessment of the effectiveness of each completed action are presented. A summary of LTS requirements is provided in Table 6.2, and a review of compliance with these requirements is included in Sects. 6.2.3 and 6.3.1.3.

For background information on each remedy and performance standards, a compendium of all CERCLA decisions in the watershed within the context of a contaminant release conceptual model is provided in Chapter 6 of Volume 1 of the 2007 RER (DOE 2007a). This information will be updated in the annual RER and republished every fifth year at the time of the CERCLA FYR.

Because many CERCLA actions have not yet been implemented within the UEFPC watershed and monitoring data collected to date are not sufficient to assess the watershed-wide impact of the remedial strategy, this chapter concludes with a preliminary evaluation of the early indicators of effectiveness at the watershed scale, such as contaminant trends at the surface water IP.

6.1.1 Status and Updates

No new CERCLA actions were initiated nor completed in UEFPC watershed during FY 2007. Most attention remained on the impact of Big Spring Water Treatment System (BSWTS) on the mercury flux at Station 17 and the continued success of the East End Volatile Organic Compound (EEVOC) treatment system at apparent capture of the off-site contaminant migration. The approval of the RmAR for the EEVOC plume removal action in FY 2006 reduced the required monitoring for the pump and treat action.

A Non-Significant Change (NSC) (DOE 2007e) to the Phase I Interim Source Control Actions for UEFPC was approved in October 2006. As part of the NSC, sampling equipment at Station 200A6 was upgraded to obtain continuous flow-proportional 7-day composite samples to measure mercury flux to provide a baseline prior to implementation of West End Mercury Areas (WEMA) actions; flow measurement was continued at Station 8 but sampling was changed to a weekly grab to evaluate ungauged Hg influx to UEFPC; and monitoring of outfalls 150, 160, 163, and 169 were discontinued until 1 year prior to when the WEMA actions are implemented.

Another NSC (DOE 2007g) to the Phase I ROD for the UEFPC was approved in May 2007. This NSC documented the discontinuation of treatment of Bldg. 9201-5 sump water at the Central Mercury Treatment System (CMTS) at the Y-12 Complex until the threat of brine leaks have been sufficiently reduced by rerouting of Bldg. 9201-5 brine system piping (see Chapter 6 of Vol. 1 of the 2007 RER for a thorough discussion of this issue). This NSC does not impact any CERCLA monitoring requirements in the watershed.

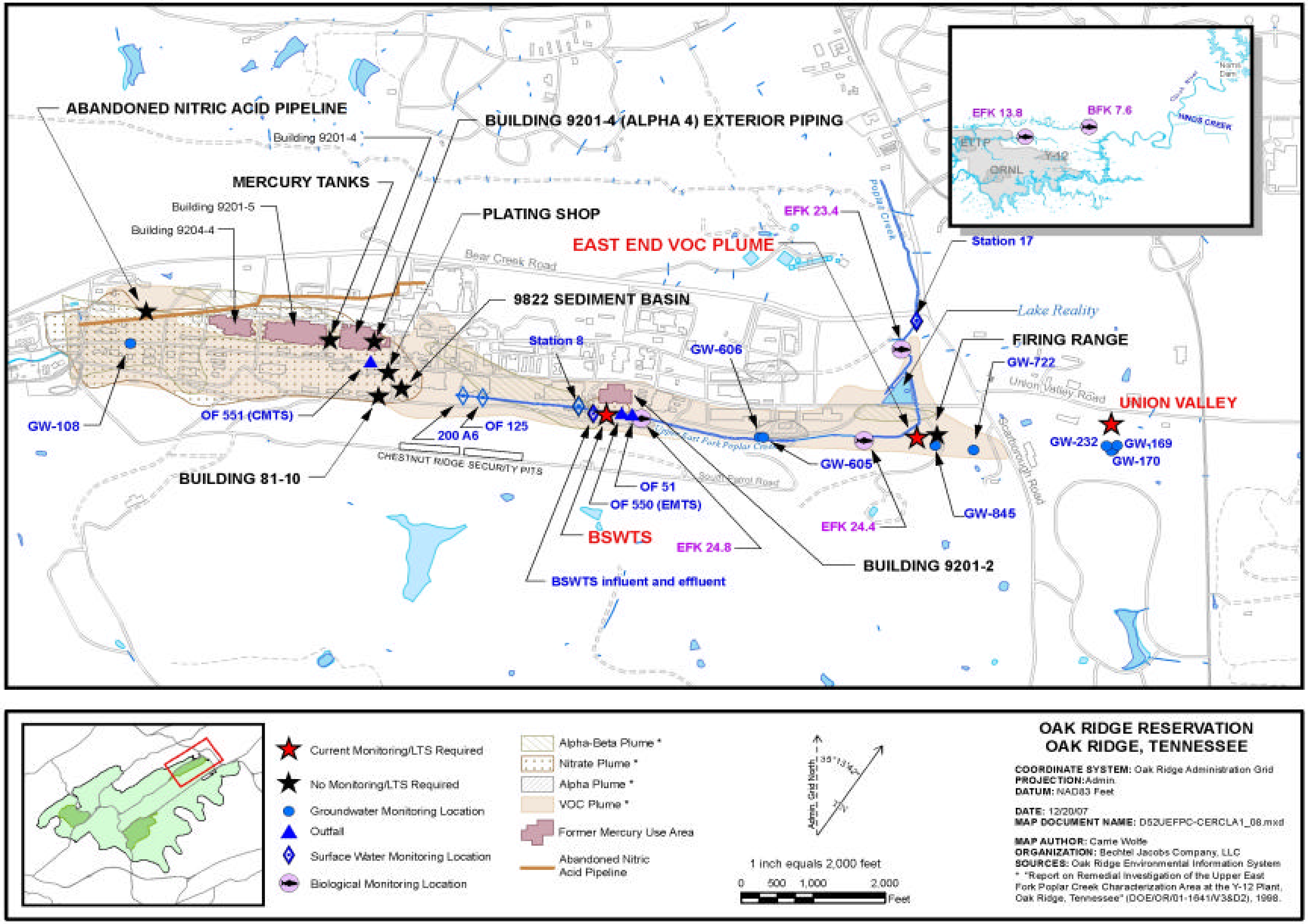

Fig. 6.1. CERCLA actions in the UEFPC Watershed.

Table 6.1. CERCLA actions in UEFPC Watershed with monitoring and LTS requirements

CERCLA action	Decision document: date signed (mm/dd/yy)	Action status[a] (approval date mm/dd/yy)	Monitoring/ LTS required	RER section
Watershed-scale actions				
Phase I Interim Source Control Actions	ROD: 05/02/02 NSC: 10/04/06 NSC: 05/17/07	Remedial actions in progress - PCCR for BSWTS for Building 9201-2 (07/01/05) - WEMA remediation - UEFPC & Lake Reality sediment/soil removal - UEFPC & WEMA outfalls monitoring	Yes/Yes No additional projects initiated as of 9/30/07.	6.2.2
Phase II Interim Remedial Action for Contaminated Soils and Scrapyard	ROD: 03/01/06	No Projects were initiated during FY 2007	TBD	--
Completed single project actions				
Y-12 Complex EEVOC Plume Removal Action	AM: 06/28/99	RmAR: 06/07/06	Yes/No	6.3.1
Mercury Tanks Interim Remedial Action (Tanks 2100-U, 2101-U, 2104-U)	IROD: 09/26/91	RAR: 12/20/93	No/No	--
Plating Shop Container Areas NFA	ROD: 09/30/92	NFA	No/No	--
ANAP (UEFPC OU 2)	ROD: 09/12/94	NFA	No/No	--
Bldg. 9201-4 Exterior Process Piping	AM: 04/22/97	RmAR: 09/29/99	No/No	--
Lead Source Removal of Former YS860, Firing Range Removal Action	AM: 03/10/98	RmAR 02/23/99	No/No	--
9822 Sediment Basin and 80-10 Sump	AM: 06/19/98	RmAR: 02/23/99	No/No	--

[a] Detailed information of the status of ongoing actions is from Appendix E of the FFA and is available at **http://www.bechteljacobs.com/ettp-ffa-appendices.html**.

AM = Action Memorandum
ANAP = Abandoned Nitric Acid Pipeline
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
EEVOC = East End Volatile Organic Compound
IROD = Interim Record of Decision
LTS = long-term stewardship
NFA = no further action
PCCR = Phased Construction Completion Report
RER = Remediation Effectiveness Report
RmAR = Removal Action Report
ROD = Record of Decision
TBD = to be determined
UEFPC = Upper East Fork Poplar Creek
WEMA = West End Mercury Area
WTS = Water Treatment System

Table 6.2. Long-term stewardship requirements for CERCLA actions in UEFPC Watershed

Site/Project	LTS Requirements		Status	RER Section
	Land Use Controls	Engineering Controls		
Watershed-scale actions				
ROD for Phase I Interim Source Control Actions in the UEFPC Watershed[(a)] ▪ BSWTS PCCR	Watershed LUCs Administrative: ▪ land use and groundwater deed restrictions ▪ property record notices ▪ zoning notices ▪ permits program Physical: ▪ access controls ▪ signs ▪ security patrols	▪ Maintenance of treatment facilities	▪ Physical LUCs in place. ▪ Administrative LUCs required at completion of actions. ▪ Engineering Controls remain protective.	6.2.3
Single project actions in progress				
Y-12 Complex EEVOC Plume Removal Action[(b)]	None specified		N/A	6.3.1.3

[(a)]Remaining actions have not been implemented (e.g., West End Mercury Area)
[(b)]LTS is not required under CERCLA.

BSWTS = Big Spring Water Treatment System
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
EEVOC = East End Volatile Organic Compound
LTS = long-term stewardship
LUC = land use control
N/A = not applicable
PCCR = Phased Construction Completion Report
RER = Remediation Effectiveness Report
ROD = Record of Decision
UEFPC = Upper East Fork Poplar Creek
RER = Remediation Effectiveness Report
ROD = Record of Decision
UEFPC = Upper East Fork Poplar Creek

6.2 PHASE I INTERIM SOURCE CONTROL ACTIONS IN THE UEFPC CHARACTERIZATION AREA

The ROD for Phase I Interim Source Control Actions (DOE 2001d) addresses a combination of source control and receptor media (e.g., sediment) remedies designed to reduce mercury loading within UEFPC. The RAO for the selected remedy presented in the ROD is to restore surface water to human health recreational risk-based values at Station 17 (DOE 2001d). Principal components of the decision include:

- hydraulic isolation (e.g., capping contaminated soils) of the WEMA;
- removal of contaminated sediments in storm sewers, UEFPC, and Lake Reality;
- treatment of discharge from Outfall 51 (including a large-volume spring) and Bldg. 9201-2;
- temporary water treatment using existing facilities East End Mercury Treatment System (EEMTS) and the CMTS;
- LUCs to prevent consumption of fish from UEFPC and to control/monitor access by workers and the public; and
- monitoring of surface water (Station 17).

The BSWTS was constructed to treat discharge from Outfall 51 (including the large-volume spring) and, to treat water from the Bldg. 9201-2 sumps. Contaminated water was rerouted from Bldg. 9201-2 sumps and EEMTS to the BSWTS during December 2006. The EEMTS and Outfall 550 are no longer in operation.

6.2.1 Performance Goals and Monitoring Objectives

Performance goals and monitoring objectives of all the components of the Phase I Interim Source Control ROD are provided in Chapter 6 of Volume 1 of the 2007 RER (DOE 2007a). Only monitoring performance goals of the actions that have been completed or are on-going are discussed in this section. These metrics are summarized in Table 6.3, and monitoring locations are shown in Fig. 6.1. Land use for Y-12 as identified in the Phase I ROD (DOE 2001d) is controlled industrial throughout the entire facility. (Note, the Phase I ROD only addresses the surface water).

The UEFPC Phase I ROD (DOE 2001e) includes a 200-parts per trillion (ppt) performance goal for mercury in surface water at the UEFPC IP (Station 17) since this was the NPDES permit limit at the time the ROD was developed. Surface water monitoring at Station 17, including analysis for uranium and zinc, is conducted to gauge the cumulative effects of the various actions as they are completed. In addition, biological monitoring is performed to assess reductions of mercury in fish tissue at EFK 23.4. To achieve the watershed-wide mercury reduction objectives, individual components of the Phase I remedy have action-specific performance standards. The BSWTS effluent must meet NPDES discharge limits[1] and a 0.2 µg/L (200 ppt) interim performance goal for mercury. The performance standards for other on-going

[1] At the time the UEFPC Phase I ROD was prepared the NPDES permit requirement for BSWTS was 200 ppt. However, the NPDES permit for Y-12 National Security Complex (TDEC 2006) currently lists no mercury discharge limit for BSWTS or Outfall 51. There is a pH limit for Outfall 51 and mercury and flow must be reported (no discharge limit).

components of the remedy include an NPDES discharge limit (see footnote 2, Table 6.3) for mercury of 2 µg/L (2000 ppt) for both the EEMTS and the CMTS.

Baseline monitoring data are collected within the WEMA, and will be reported in future RERs once the actions have been implemented. See Sect. 6.5 for a discussion of changes in WEMA monitoring.

Table 6.3. Performance measures for Phase I Interim Source Control Ac tions in the UEFPC Watershed

Site	UEFPC ROD goal	Performance standard	Monitoring location	Schedule and parameters
Station 17	Reduce mercury levels to a level protective of a recreational receptor based on fish consumption	0.2 µg/L (200 ppt) total mercury	Station 17	Continuous flow-paced monitoring for mercury (minimum weekly collection frequency); daily grab samples as collected by NPDES compliance program.
Building 9201-2 WTS (BSWTS)	Reduce mercury levels to a level protective of a recreational receptor based on fish consumption	Less than NPDES discharge limits and 0.2 µg/L (200 ppt) total mercury[1]	WTS effluent discharge point	Continuous flow-paced monitoring for mercury and metals (minimum weekly collection frequency) prior to and following system startup.
CMTS	Ongoing treatment of effluents from WEMA pending demonstration of effectiveness of remedy (hydraulic controls, capping)	Less than NPDES permit discharge limits for all constituents.[2]	Outfall 551	Continuous flow-paced monitoring for mercury (minimum weekly collection frequency); continue current system performance monitoring as required by operations and maintenance specifications.
EEMTS no longer operational	Treatment of effluents from Bldg. 9201-2 sumps was tied-in to BSWTS December 2006.	Less than NPDES permit discharge limits for all constituents[2]	Outfall 550 flow piped to the BSWTS in December 2006	Continuous flow-paced monitoring for mercury (minimum weekly collection frequency); discontinued.

[1]*At the time theUEFPC Phase I ROD states that the NPDES permit requirement for BSWTS was 200 ppt. However, the NPDES permit for Y-12 National Security Complex (TDEC 2006b) currently lists no mercury discharge limit for BSWTS or Outfall 51. There is a pH limit for Outfall 51 and mercury and flow must be reported (no discharge limit).*

[2] *The UEFPC Phase I ROD states that the NPDES discharge limit for CMTS and EEMTS is 200 ppt; however, the NPDES discharge limit for CMTS and EEMTS is 2000 ppt (2 µg/L) per NPDES Permit No. TN0002968 for Y-12 National Security Complex (DOE 2001d).*

BSWTS = Big Spring Water Treatment System
CMTS = Central Mercury Treatment System
EEMTS = East End Mercury Treatment System
NPDES = National Pollutant Discharge Elimination System
ppt = parts per trillion
µg/L = micrograms per liter
ROD = Record of Decision
UEFPC = Upper East Fork Poplar Creek
WEMA = West End Mercury Area
WTS = Water Treatment System

6.2.2 Evaluation of Performance Monitoring Data

6.2.2.1 Ongoing Treatment Systems and Outfall 51

Continued monitoring of effluent from the CMTS (Outfall 551), which treats building sump discharges from the WEMA, is specified in the UEFPC Phase I ROD pending demonstration of the effectiveness of actions (e.g., hydraulic controls, storm sewer relining/replacement).

The UEFPC Phase I ROD states that the NPDES discharge limit for CMTS and EEMTS is 200 ppt; however, the NPDES discharge limit for CMTS (Outfall 551) and EEMTS (Outfall 550) is 2000 ppt (2 µg/L) per NPDES Permit No. TN0002968 for the Y-12 National Security Complex (TDEC 2006b). The EEMTS no longer treats groundwater from Bldg. 9201-2 sumps. EEMTS effluent (Outfall 550) is no longer monitored since the rerouting of the mercury-contaminated groundwater to the BSWTS was completed in December 2006. Prior to rerouting of the EEMTS effluent (Outfall 550), mercury concentrations for early FY 2007 were nondetect except for one detection of 1.69 µg/L, which is below the NPDES discharge limit of 2 µg/L.

The CMTS effluent discharges through Outfall 551. At Outfall 551, mercury concentrations for FY 2007 were all less than the NPDES discharge limit of 2 µg/L. The CMTS has operated all of FY 2007 with no system problems. The CMTS no longer receives water from sump pumps located in the basement of Bldg. 9201-5, which discontinued pumping operations since coolant containing methanol leaked from the building cooling system into the building sumps caused bacterial fouling of the CMTS carbon filters. Water containing methanol in the building sumps was allowed to accumulate and eventually routed away from the CMTS and placed in storage tanks located at a Y-12 water treatment facility. A Non-Significant Change to the UEFPC Phase I ROD was approved in May 2007. The accumulated water containing methanol was discharged to the sanitary system for treatment at the City of Oak Ridge's Publicly Owned Treatment Works. The CMTS continues treatment of Bldg. 9201-4 sump water (a much larger source of mercury).

Metallic mercury continues to be observed in two manholes in the WEMA southeast of Bldg. 9201-4. Between October 2006 and September 2007 an estimated 4.5 lbs of mercury were recovered from these manholes by Y-12 Operations Staff.

The main source of flow at Outfall 51 was Big Spring, located near the southeast corner of Bldg. 9201-2. Mercury contamination within shallow groundwater beneath and adjacent to Bldg. 9201-2 discharges at this spring. The spring discharge was captured within a brick enclosure (spring box) during Bldg. 9201-2 construction in 1943 and directed to UEFPC via a drainpipe. Big Spring flow was routed to the new BSWTS in the latter part of FY 2005 during test and start-up operations. As a result, the flow at Outfall 51 decreased significantly and consists now only of minor contributions from groundwater infiltration. While it was anticipated that construction and operation of BSWTS would cut off flow to Outfall 51, during BSWTS construction it was discovered that, in addition to flow from the spring box, Outfall 51 also provides a conduit for drainage of the BSWTS area shallow subsurface flow.

The BSWTS has been fully operational since September 26, 2005, with no significant downtime or operational problems. There is currently no NPDES permit discharge limit for mercury at Outfall 51 or the BSWTS effluent; however, the UEFPC Phase I ROD specifies a 0.2 µg/L (200 ppt) goal for mercury in BSWTS effluent. Outfall 51, BSWTS influent, and BSWTS effluent are separate monitoring locations. Figure 6.2 provides a comparison of mercury concentrations at Outfall 51 and the BSWTS influent and effluent. The BSWTS treated approximately 119.8 million gal of mercury contaminated water and an estimated 7.6 kg of mercury was removed by the system in FY 2007. The average removal efficiency of BSWTS in FY 2007 was 97.7%. The estimated mercury removal and average removal efficiency are based on average influent and effluent concentrations and total treated volume.

The average mercury concentration in BSWTS influent during FY 2007 was 17.0 µg/L which is nearly double the influent concentration in FY 2006. The average mercury concentration in BSWTS effluent during FY 2007 was 0.386 µg/L, which is greater than the 0.2 µg/L goal specified in the UEFPC Phase I ROD. Four out of twelve samples from the BSWTS effluent exceeded the 0.2 µg/L goal, with the highest mercury concentration of 1.94 µg/L during June 2007. The cause of the increase in mercury concentration has not been conclusively determined. The BSWTS effluent will continue to be monitored and adjustments made as necessary to ensure treatment system performance.

Monitoring at Outfall 200A6 was modified at the beginning of FY 2007 to obtain continuous, 7-day flow-paced composite samples for mercury analysis. Outfall 200A6 is located in the main storm drain that carries discharge from the WEMA to the headwater of the UEFPC (Fig. 6.1). This monitoring location serves as an integration point for contamination leaving WEMA. The flux of mercury measured at Outfall 200A6 for FY 2007 was estimated as 2,063 grams, or 2 kg. This measured discharge is approximately half of the mercury flux discharged from the UEFPC measured at Station 17.

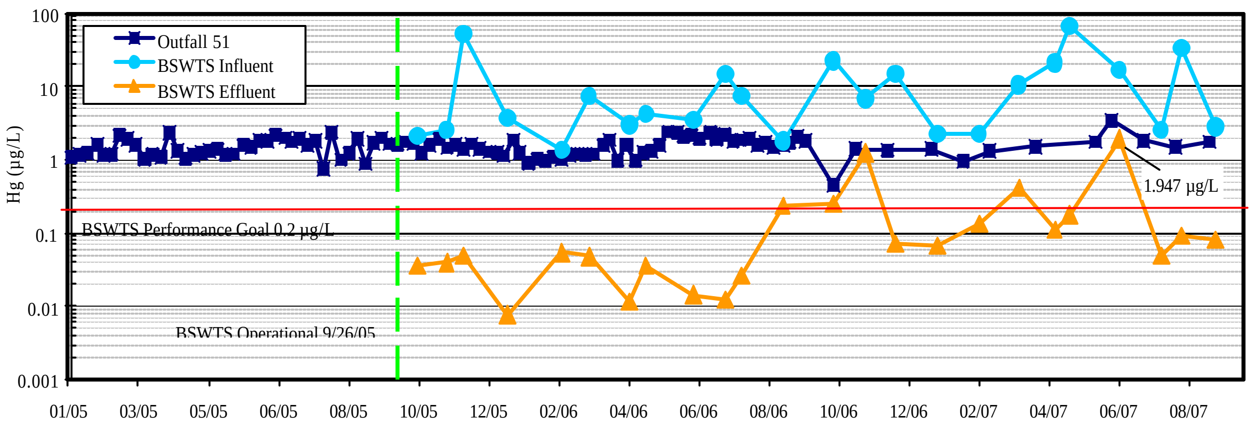

Fig. 6.2. Mercury concentrations at Outfall 51 and BSWTS.

6.2.2.2 Station 17 IP

The performance standard set by the UEFPC Phase I ROD (DOE 2001d) at Station 17, the IP for UEFPC watershed, is 0.2 µg/L (200 ppt). In FY 2007, the mercury concentration in weekly flow-paced composite samples at Station 17 was an average of 0.198 µg/L, which meets the performance standard, and is a decrease from previous years (see Sect. 6.4). Flow-paced monitoring for mercury at Station 17 is stipulated by the UEFPC Phase I ROD. Grab samples collected 4 days per week (Monday—Thursday) in FY 2007 have an average mercury concentration of 0.312 µg/L. Flow-paced composite sampling is conducted to determine the average concentrations and loadings (fluxes) of contaminants in surface water while grab sampling allows determination of peak concentrations. Both sampling approaches are utilized at Station 17.

The total estimated flux at Station 17 for FY 2007, based on flow composite samples, was 4.0 kg, which is the same as the FY 2006 flux. During FY 2007, three factors are potential contributors to the continued reduction of mercury flux at Station 17: (1) the BSWTS treatment of contaminated groundwater at Outfall 51, (2) below average rainfall and corresponding reduction of groundwater influx of mercury, and (3) change to flow-paced 7-day composite samples (see Sect. 6.4 for further discussion of mercury flux and trends at Station 17). As discussed above, BSWTS removed an estimated 7.6 kg of mercury in FY 2007. Figure 6.3 shows daily and cumulative mercury flux and daily water flow at Station 17 in FY 2007. The BSWTS captured and removed almost double the mass of mercury that was discharged from the

The Hg flux at Station 17 meets the performance standard, perhaps attributed to treatment of shallow groundwater discharge through BSWTS in FY 2007.

watershed via surface water leaving the site at Station 17. For FY 2007, the BSWTS operation achieved nearly a 50% reduction of mercury discharge from the UEFPC watershed, which is a significant improvement over past conditions.

In addition to mercury, the UEFPC Phase I ROD requires samples at the Station 17 IP to be analyzed for total uranium and zinc until a final surface water ROD is signed. The total FY 2007 uranium flux at Station 17 was 86 kg, which falls within the range of baseline annual flux observed over the preceding 7 years (see Sect. 6.4 for further discussion of uranium flux as part of the overall watershed water evaluation). In FY 2007, the average zinc concentration at Station 17 was 14.3 µg/L—well below 165 µg/L, the AWQC criterion continuous concentration for protection of fish and aquatic life adjusted for water hardness (see Sect. 6.4).

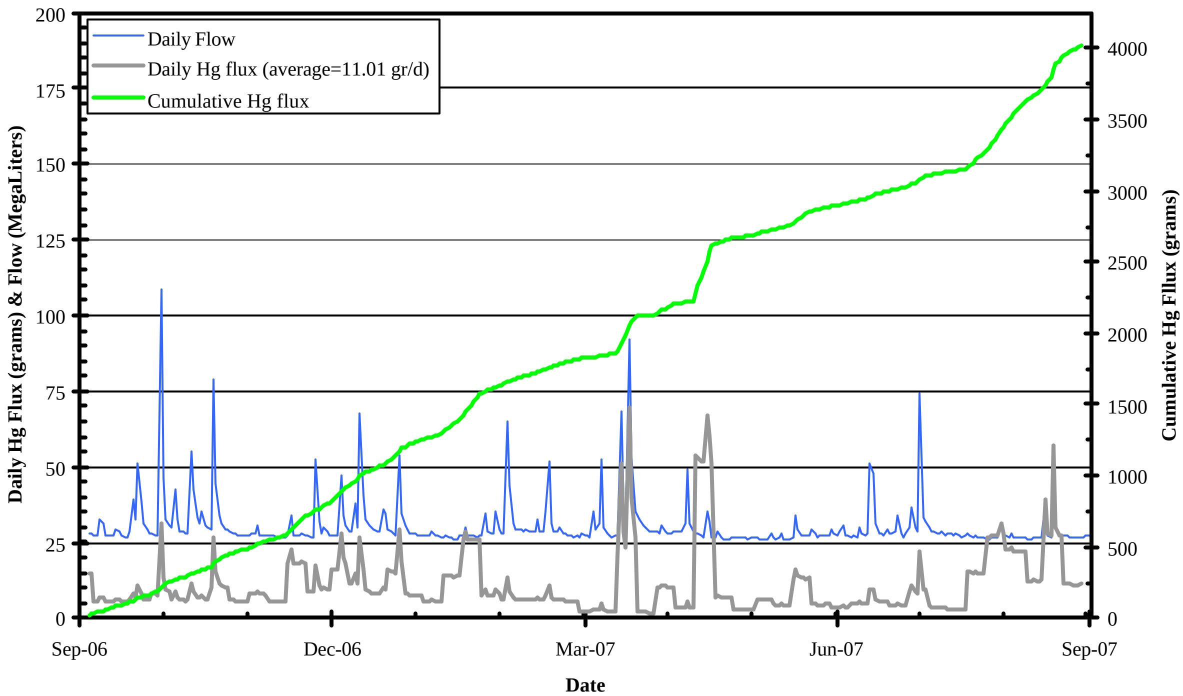

Fig. 6.3. Daily and cumulative mercury flux and daily flow at Station 17.

6.2.2.3 Performance Summary

During FY 2007 mercury discharge from the UEFPC was lower than in years prior to startup of the BSWTS. The BSWTS performed quite well considering that the influent mercury concentrations were well above the design criterion for the system. Mercury removal efficiency was greater than 97% for the year. The average mercury concentration measured at Station 17 was much lower than in previous years. Mercury flux quantification remains a challenge as indicated by the disparity in concentration data obtained from some of the flow-paced samples, which appeared to be significantly lower than instantaneous grab samples collected during the same time period.

6.2.3 Compliance with LTS Requirements

6.2.3.1 Requirements

The UEFPC Phase 1 ROD (DOE 2001d) specifies LTS activities, such as maintenance and LUCs, to reduce the risk of human exposure to contaminants (see Table 6.2). Required maintenance activities include periodic inspections and repair of the WEMA asphalt caps upon completion. The LUCs include an excavation penetration permit program, property record restrictions, property record notices, zoning notices, signs, and surveillance patrols for the former mercury use areas in the Y-12 Complex.

6.2.3.2 Status of Requirements for FY 2007

Because not all of the UEFPC Phase I ROD actions have been completed, no maintenance activities and LUCs were verified as part of this action in FY 2007. However, the Y-12 Complex is an active federal installation and many of the LUCs in the UEFPC are already in place to prevent consumption of fish from UEFPC and to control/monitor access by workers and the public, including an ongoing EPP program. Signs are in place and the security patrols continue to provide protection. Operation and maintenance of water treatment systems (EEMTS, CMTS, and BSWTS) are discussed in Sect. 6.2.2.

6.3 COMPLETED SINGLE PROJECT ACTIONS WITH MONITORING AND LTS REQUIREMENTS

6.3.1 Y-12 East End VOC Plume Removal Action

The East End VOC Plume Removal Action was initiated in October 2000 as a non-time critical removal action documented in an AM (DOE 1999b). Construction of the extraction/treatment system began in May 2000 and operation of the system started in October to prevent further migration of the VOC-contaminated groundwater plume off of the ORR. At the request of the regulators so that performance could be evaluated, the system operated for five years before preparation and approval of the RmAR in FY 2006 (DOE 2006h). The RmAR recommended continuation of the current plume interception system and specified evaluation of the system performance in the annual RER.

6.3.1.1 Performance Objectives and Monitoring Requirements

The goals of the action are to "reduce health and environmental risks associated with the migration of VOC-contaminated groundwater from the east end of the Y-12 Complex. In addition, the action will reduce the potential risk from exposure to this contamination in off-site areas." The AM also includes a goal to mitigate off-site migration of contaminants. No specific numeric performance standards were established for the selected alternative. Existing human health or ecological risks specific to groundwater were evaluated during the UEFPC RI (DOE 1998b) and a Union Valley Interim Study and incorporated into the removal action. The risk assessments presented in the Union Valley Interim Study addressed hypothetical risks related to groundwater use, as well as potential risk related to exposure to spring discharges in Union Valley (Sect. 7.6). These risk estimates form a comparative baseline for future performance evaluations.

As stated in the AM (DOE 1999b), system performance is measured by evaluating reductions in VOC concentrations downgradient of the extraction well (GW-845). The RmAR identified changes to monitoring frequencies and analysis, which have been implemented in the FY 2007 monitoring. Quarterly sampling will be performed on extracted groundwater from GW-845 with analysis to include VOCs, metals, nitrate, and uranium. Additional analysis is performed on the effluent from the treatment system discharging to UEFPC. The performance goal of the treated effluent is to meet the AWQC recreational (for organism only) criteria (16 µg/L carbon tetrachloride). Semiannual sampling will be performed at the downgradient multi-port well (GW-722), and downgradient well cluster (GW-169 and GW-170) for VOCs analysis.

6.3.1.2 Evaluation of Performance Monitoring Data

Figures 6.4 and 6.5 show the EEVOC chlorinated hydrocarbon concentrations before pumping at well GW-845 was started in FY 2000 and in FY 2007, respectively. Concentrations represent the sum of chlorinated volatile organic compounds (CVOCs). Two distinct contaminant sources are evident – a carbon tetrachloride source near the southwestern portion of the plume and a source of PCE and TCE near the northwestern portion of the plume. Comparison of the two figures shows that the groundwater pump and treat system has decreased CVOC concentrations along the extent of the southern half of the plume while concentrations along the northern edge have remained essentially constant. This contrast is attributed to the occurrence of less permeable bedrock at the base of the Maynardville limestone and Nolichucky Shale contact area. The groundwater extraction system has fairly effectively withdrawn contaminant mass from the more permeable limestone area but the contaminated groundwater is not as effectively withdrawn from the shaley bedrock. PCE and TCE are detected at low concentrations in the GW-845 groundwater that is sent to the treatment system, suggesting that there is capture of that portion of the plume, although the mass removal is small.

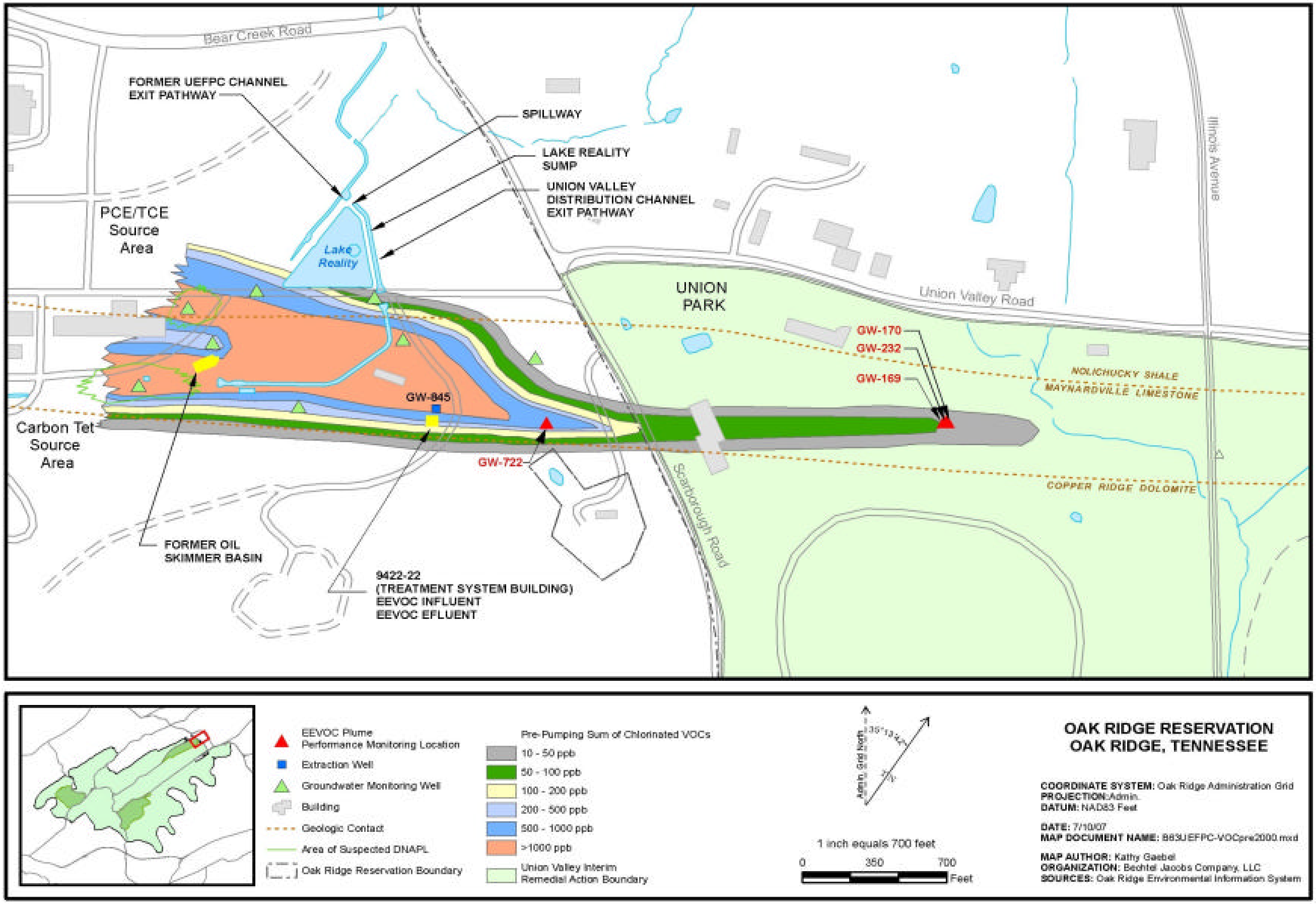

Fig. 6.4. EEVOC Plume before Pump and Treatment System startup (1998–2000).

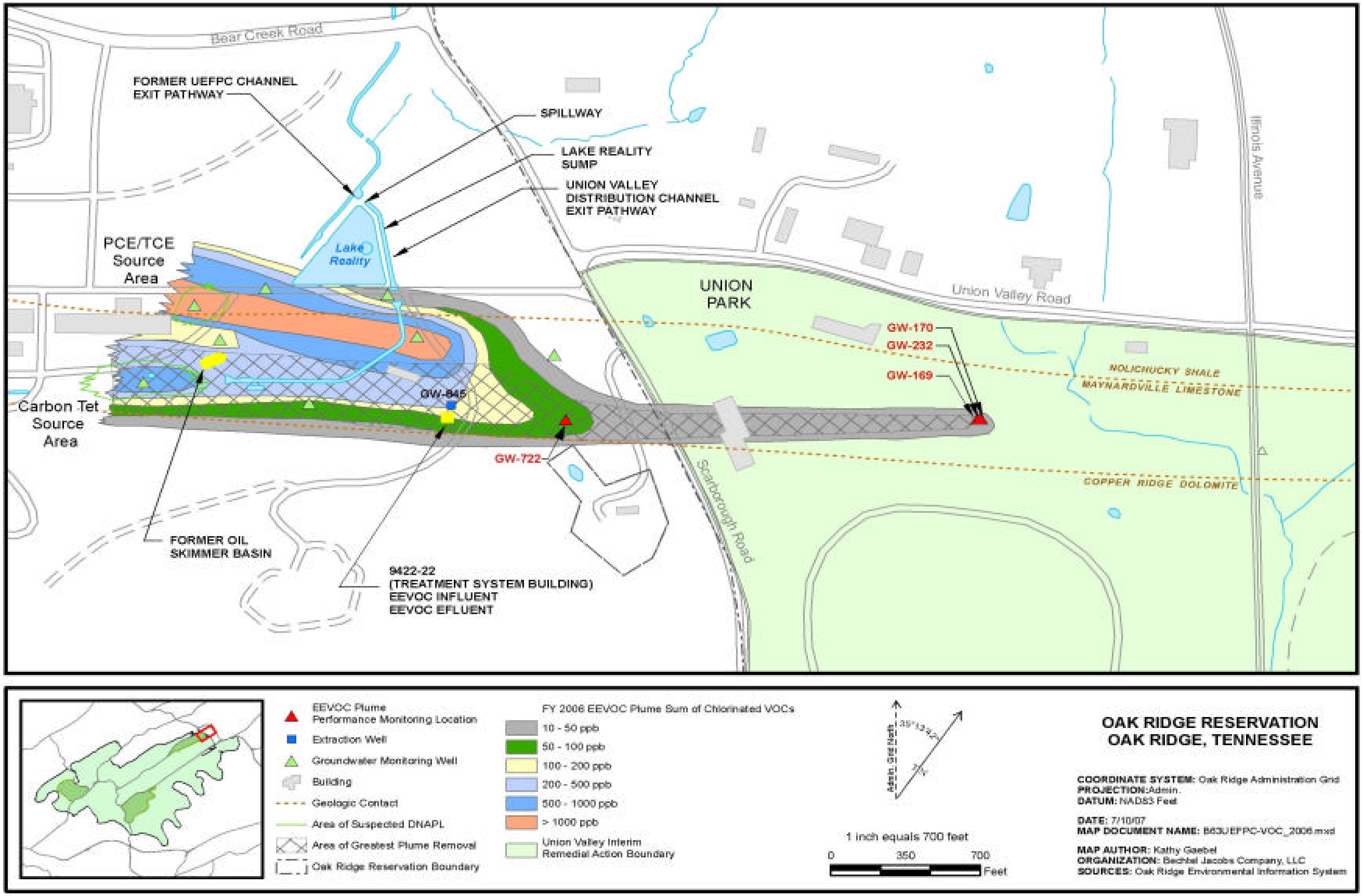

Fig. 6.5. EEVOC Plume in FY 2007 showing region of maximum CVOC removal.

Figure 6.6 shows the drawdown feature created by pumping of well GW-845 in plan view and in cross sectional views. The asymmetrical drawdown feature is created because of the dipping attitude of bedrock and spatial variability of permeability. The screened interval of well GW-845 is quite long as shown in Figure 6.6 which allows the well to capture contaminants from a large vertical region in bedrock. This tall vertical capture capability increases the likelihood that this system will intercept contaminants seeping eastward in the Maynardville Limestone from source areas to the west in the Y-12 industrial area.

As stated in the AM (DOE 1999b), system performance is measured by evaluating reductions in VOC concentrations downgradient of the extraction well (GW-845). The AM specified quarterly sampling and analysis at the extraction well; well GW-722 located approximately 180 m (600 ft) downgradient of the extraction well; and wells GW-169, -170, and -232 located about 730 m (2400 ft) east along geologic strike in Union Valley (Fig. 6.4). Additional analyses for uranium, mercury, and nitrate were specified to evaluate whether long-term pumping mobilizes metals, radiological contaminants, or nitrate from upgradient sources within Y-12, such as the former Oil Skimmer Basin located approximately 300 m (1000 ft) west of well GW-845 (Fig. 6.4). Consistent with recommendations in the approved 2006 RER FYR and RmAR (DOE 2006h) sampling of well GW-232 in Union Valley has been discontinued and sampling frequency and target analytes at other AM-specified wells have been modified (see Sect. 6.5 for a discussion of these changes).

Treated groundwater is discharged into UEFPC. Discharges must not cause exceedances of any existing AWQC related to VOCs. The AM references a prior AWQC of 44 µg/L for carbon tetrachloride (organisms only criterion) that must be maintained downstream of the treatment unit discharge point. This criterion was updated in the January 2004 revision of TDEC Rule 1200-4-3-.03 to 16 µg/L. The EEVOC treatment system discharge is conservatively evaluated by monitoring the effluent prior to discharge to UEFPC. Performance of the groundwater treatment system is evaluated by quarterly sampling (at a minimum) of treatment system effluent and well GW-845, which represents treatment system influent. Influent and effluent are analyzed for VOCs, metals (including uranium), and nitrate. Performance of the air stripper component of the treatment system is evaluated by determining mass reduction for selected constituents. More frequent sampling may be required if radionuclides (uranium) are detected in the influent from well GW-845 in the future. FY 2007 EEVOC treatment system performance is discussed in Sect. 6.3.1.2.2.

6.3.1.2.1 Maynardville Limestone Exit Pathway

The EEVOC influent station is a valved sample port allowing collection of water before treatment and represents groundwater concentrations from well GW-845. Data obtained to date indicate that carbon tetrachloride concentrations in the pumping well have stabilized at about 200 µg/L or less (Fig. 6.7). Likewise, chloroform concentrations have stabilized at about 10 to 15 µg/L.

Signature VOCs within the intermediate and deep intervals of the Maynardville Limestone directly downgradient of the pumping well also decreased significantly relative to baseline data. This pathway is monitored via well GW-722 (Port 14 at 425 ft bgs, Port 17 at 385 ft bgs, Port 20 at 333 ft bgs, and Port 22 at 313 ft bgs). The FY 2007 analytical results for several signature VOCs in well GW-722, Port 17, are provided in Table 6.4. Sample Port 17 has historically shown some of the highest and most consistent VOC results; therefore, data from this sampling point are used to best illustrate carbon tetrachloride trends over time (Fig. 6.7). Since operation of the extraction system, carbon tetrachloride concentrations fell from approximately 500 to about 150 µg/L through FY 2004. Over the past two years, carbon tetrachloride concentrations were less than 100 µg/L. Overall, since system operations began, concentrations of PCE have decreased by a factor of about three and similar trends have also been noted for TCE and DCE. The other sampling zones in well GW-722 show similar decreases in VOC concentrations.

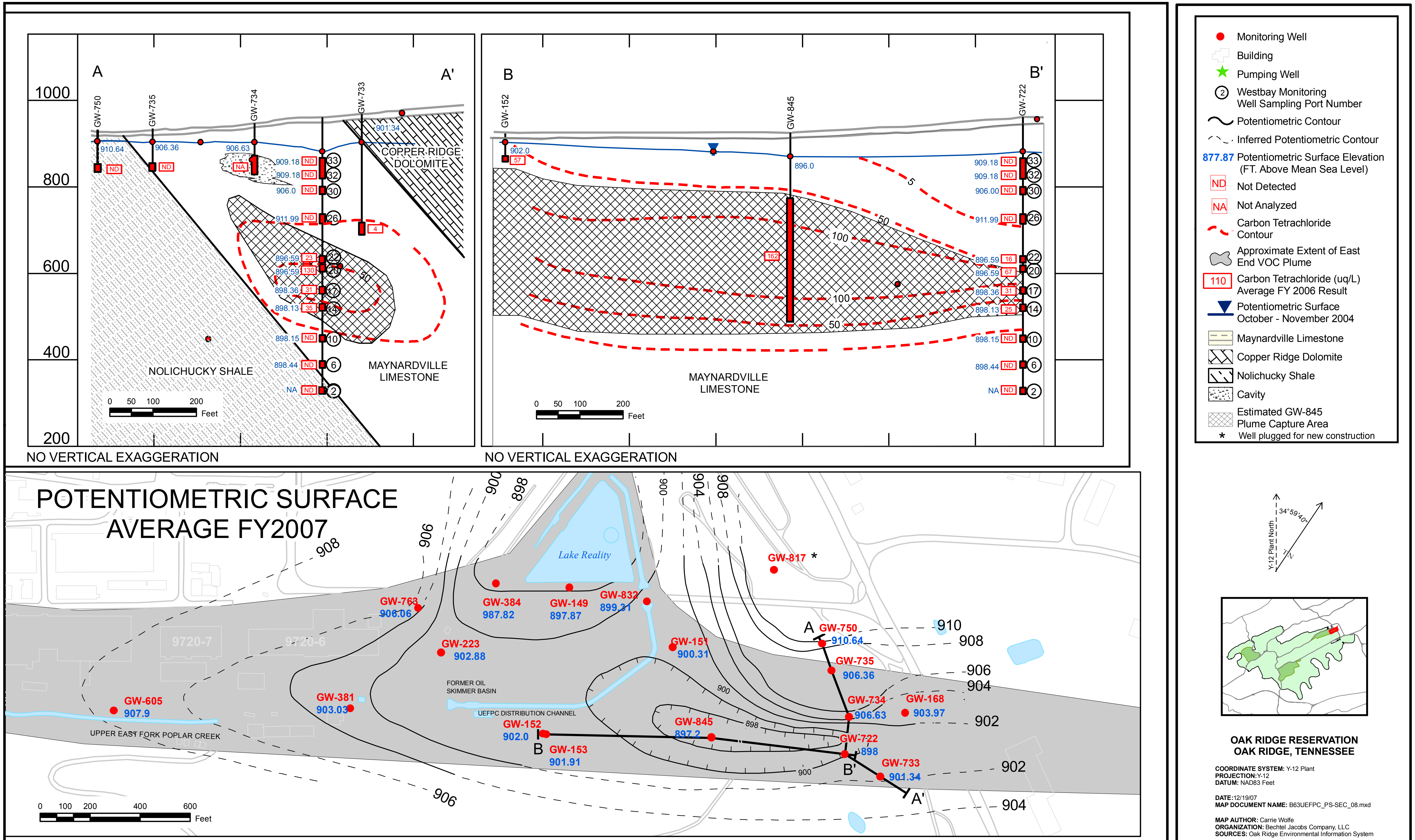

Fig. 6.6. Potentiometric surface at the eastern Y-12 area FY 2007.

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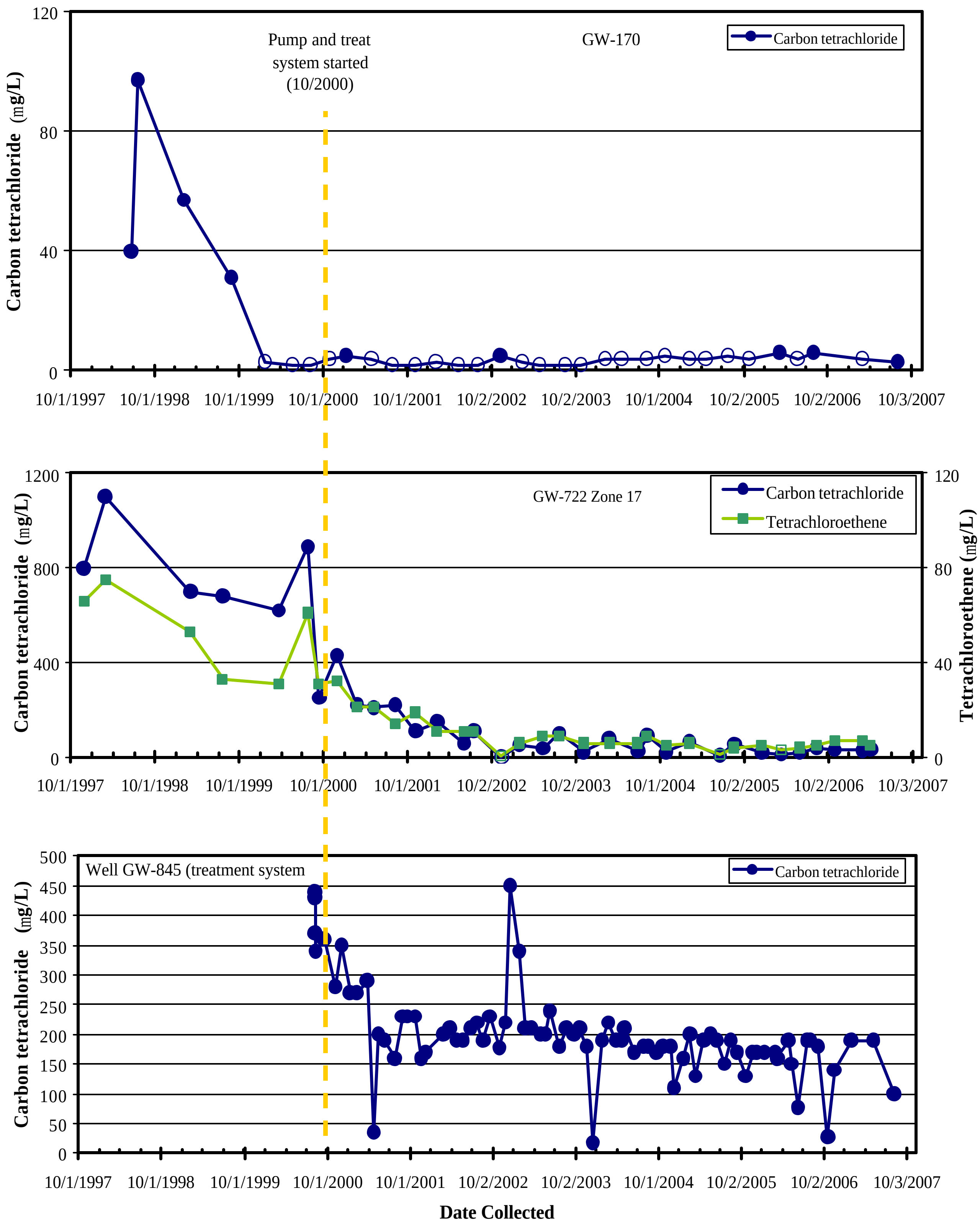

Open symbol indicates estimated (J qualified) result less than required reporting limits

Fig. 6.7. Selected VOC trends in the Maynardville Limestone exit pathway.

Table 6.4. Selected FY 2007 data for Y-12 East End VOC Plume performance

CHEMICAL	UNITS (Station Name / Sample Date)	GW-169[a] 03/01/2007	GW-169 08/02/2007	GW-170 03/01/2007	GW-170 03/07/2006
Alpha activity	pCi/L	< 2.46 (U)	1.75 ±0.94	< 2.4 (U)	2.28±1.23
Beta activity	pCi/L	< 3.84 (U)	6.58±1.98	16.7±2.56	11±2.56
Carbon tetrachloride	μg/L	5 U	5 U	4 J	3
Chloroform	μg/L	5 U	5 U	2 J	2
Tetrachloroethene	μg/L	2 J	1	2 J	1
Trichloroethene	μg/L	5 U	2 U	1 J	1
Nitrate	mg/L	0.77	0.81	0.24	0.23

CHEMICAL	UNITS (Station Name / Sample Date)	GW-722-17 10/30/2006	GW-722-17 02/28/2007	GW-722-17 04/05/2007
Carbon tetrachloride	μg/L	31	30	33
Chloroform	μg/L	9	9	8
Tetrachloroethene	μg/L	7	7	5
Trichloroethene	μg/L	1 J	1 J	1 J

FY = fiscal year
GW = groundwater well
J = estimated value
L = liter
mg = milligrams
pCi = picoCurie
U = Not detected or result less than minimum detectable activity and/or counting errors (radiological results).
μg = micrograms
VOC = volatile organic compound

EEVOC Plume Removal Action continues to reduce VOC concentrations within the off-site exit pathway in Union Valley.

In UV west of Illinois Avenue, signature VOCs (carbon tetrachloride, chloroform, PCE, and TCE) have historically been detected in wells GW-169 (water table interval) and GW-170 (intermediate interval; 120 ft bgs), which are directly along strike to the east of the Y-12 Complex. Well GW-170 has historically had the highest levels of carbon tetrachloride and chloroform with highly variable concentrations, but with an overall decline since 1994. Historical VOC concentrations in well GW-170 suggest that contaminant migration is episodic and may be driven primarily by rainfall events, which produce short-term concentration peaks. Since 2000, carbon tetrachloride concentrations have stabilized at about 5 μg/L or less. A sharp, persistent decrease of carbon tetrachloride concentrations occurred in well GW-170 prior to the EEVOC Plume treatment system start-up in October 2000 (Fig. 6.7), which correlated to an increase in pH. The available data suggest that water quality in the UV area west of Illinois Avenue may have been affected by large-scale construction activities near Scarboro Road, resulting in elevated pH conditions and increased surface water dilution in the shallow and intermediate zones of the Maynardville Limestone in this area. Signature VOCs observed in well GW-169 have remained consistently low over time at between 1 and 4 μg/L.

Low levels of benzene (2 to 4 μg/L) have been frequently detected in well GW-170 since first appearing in FY 2001. Benzene was not detected in FY 2002, but was routinely detected between FY 2003 and FY 2005, was detected in two of four samples collected in FY 2006, and in one of two samples collected in FY 2007. A source for benzene in the well has not been identified to date.

6.3.1.2.2 Treatment System Performance

Treatment system performance monitoring began in November 2000, following system startup. In FY 2006, the system experienced short downtime periods for routine maintenance, power outages, and component repairs. The system was out of service for 7 days in January 2007 for equipment repair. Approximately 11.7 million gallons of groundwater were pumped and treated in FY 2007.

To evaluate the effectiveness of the treatment system, influent and corresponding effluent samples have been collected since operations began. Prior to FY 2007 influent/effluent sampling was conducted monthly. During FY 2007 this sampling was reduced to quarterly. Annual evaluation of treatment system performance has been conducted in previous RERs. In FY 2007, concentrations of carbon tetrachloride in treatment system influent (from well GW-845) ranged from 27 µg/L to 190 µg/L and averaged 129 µg/L for the year, respectively (Table 6.5). The concentration range for carbon tetrachloride in the effluent stream was 5 µg/L to 61 µg/L and averaged 22 µg/L. Removal efficiency for carbon tetrachloride averaged about 66% in FY 2007. FY 2007 effluent concentrations measured in a sample port prior to discharge to UEFPC exceeded the 16 µg/L AWQC for carbon tetrachloride; however, an approximate dilution factor of 200 occurs within UEFPC considering the typical daily flow in the creek is maintained at about 7 mgd. Reductions were observed for other signature VOCs detected in the influent stream, although removal efficiencies were not as high (Table 6.5).

Table 6.5. Selected Y-12 Complex East End VOC Plume treatment system performance data, FY 2007

Chemical	Date	Influent result (µg/L)	Effluent result (µg/L)	Percent reduction	Estimated net mass removal (kg)[a]
Carbon tetrachloride	10/18/2006	27	26	3.7%	0.003
	11/15/2006	140	5	96.4%	0.515
	1/29/2007	190	5	97.4%	1.89
	5/8/2007	190	14	92.6%	2.5
	8/6/2007	100	61	39.0%	0.478
FY 2007 Annual average:		129	22.2	65.8%	
FY 2007 Annual mass removal:					5.67
Chloroform	10/18/2006	4	4 J	0.0%	0.0
	11/15/2006	9	3 J	66.7%	0.023
	1/29/2007	13	2 J	84.6%	0.112
	5/8/2007	9	3 J	66.7%	0.081
	8/6/2007	7	7	0.0%	0.0
FY 2007 Annual average:		8.4	3.8	43.6%	
FY 2007 Annual mass removal:					0.216
PCE	10/18/2006	4	4 J	0.0%	0.0
	11/15/2006	19	4 J	78.9%	0.057
	1/29/2007	25	1 J	96.0%	0.246
	5/8/2007	24	3	87.5%	0.283
	8/6/2007	20	18	10.0%	0.025
FY 2007 Annual average:		18.4	6	54.5%	
FY 2007 Annual mass removal:					0.625

[a]Estimated net mass removal is based on a constant flow rate of 25 gal per minute. Influent and effluent concentrations are assumed to be constant between sample events.

FY = fiscal year
J = estimated value
kg = kilogram
PCE = tetrachloroethene
µg/L = micrograms per liter
VOC = volatile organic compound

Assuming a constant pumping rate, the total mass of carbon tetrachloride extracted by the treatment system (based on the difference in influence and effluent values) in FY 2007 was approximately 5.7 kg (Table 6.5). Table 6.6 illustrates total mass removals for selected VOCs since operations began in 2000. Maximum FY 2007 results of selected inorganic and radiological constituents in both influent and effluent samples are listed in Table 6.7. Consistent with previous years, the FY 2007 monitoring data for treatment system influent do not show any indication of substantially increased levels of total uranium, nitrate, or radiological constituents relative to baseline levels.

The reduction of sampling frequency to quarterly caused a problem in evaluation of system performance for FY 2007 because of the longer periods between sampling. The actual system performance is probably better than that reported because system maintenance was conducted following sampling that indicated degraded performance and short term improvements in performance may not have been resolved in the monitoring data. To prevent this condition from recurring, monthly sampling of the EEVOC system influent/effluent for VOCs has been reinstated as of December 2007.

6.3.1.2.3 Performance Summary

Evaluation of baseline performance data was performed in the 2001 RER (DOE 2001e) to document environmental conditions prior to system testing and startup in October 2000. Since system operations began, performance monitoring has been conducted as specified in the AM (DOE 1999b) and RmAR (DOE 2006h). Performance monitoring provides data to evaluate contaminant reductions at the plume intercept well and in the Maynardville Limestone exit pathway downgradient within approximately 1500 ft of the system, which was the specific objective of the remedy.

6.3.1.3 Compliance with LTS Requirements

6.3.1.3.1 Requirements

No specific LTS requirements were specified in the decision documents for this site.

6.3.1.3.2 Status of Requirements for FY 2007

Although no requirements are specified, the site remained protected by the DOE 229 Boundary access controls and was regularly patrolled by security personnel. In addition, groundwater use remained restricted within the Y-12 Complex and Union Valley.

Table 6.6. Mass removals for key East End VOC Plume constituents since inception of treatment operations

Fiscal year	Carbon tetrachloride (kg)	Chloroform (kg)	Tetrachloroethene (kg)
FY 2001	9.18	0.805	0.741
FY 2002	7.69	0.396	0.81
FY 2003	9.96	0.437	1.03
FY 2004	7.39	0.269	0.832
FY 2005	6.33	0.296	0.860
FY 2006	6.66	0.338	0.856
FY 2007	5.67	0.216	0.625
Totals	**52.9**	**2.76**	**5.76**

kg = kilogram VOC = volatile organic compound

Table 6.7. Summary of Y-12 Complex East End VOC Plume groundwater treatment system performance results, FY 2007

Analyte[a]	Units	Maximum influent detect (GW-845)	Maximum effluent detect
2-Butanone	μg/L	10 U	10 U
Carbon tetrachloride	μg/L	190	61
Chloroform	μg/L	13	7
cis-1,2-DCE	μg/L	3 J	2
1,2-DCE (total)	μg/L	3 J	2
PCE	μg/L	25	18
TCE	μg/L	4	3
Nitrate	mg/L	1.2	1.2
Total uranium	mg/L	0.0041	0.0042
^{234}U	pCi/L	3.06 ± 1.03	3.91 ± 1.1
^{235}U	pCi/L	< 0.508 U	<0.499 U
^{238}U	pCi/L	1.68 ± 0.76	1.52 ± 0.65

[a] All VOCs detected are listed

DCE = dichloroethene
FY = fiscal year
GW = groundwater well
PCE = tetrachloroethene
TCE = trichloroethene
VOC = volatile organic compound
^{234}U, ^{235}U, and ^{238}U = uranium-234, uranium-235, and uranium-238
U = Result less than method reporting limits or minimum detectable activity

μg/L = micrograms per liter
mg/L = milligrams per liter
pCi/L = picoCuries per liter

6.4 UPPER EAST FORK POPLAR CREEK WATERSHED CONDITION AND TRENDS

This section summarizes environmental conditions in the UEFPC using key contaminant indicators for surface water, groundwater, and aquatic biota.

6.4.1 Surface Water Quality

Surface water monitoring in the UEFPC is conducted at Station 17, the IP where the stream leaves the Y-12 Complex site. The UEFPC Watershed remediation goals focus on reduction of mercury in surface water in and downstream of the Y-12 Complex area. Uranium and zinc are also COCs in UEFPC surface water.

Annual fluxes and average concentrations of uranium and mercury at Station 17 are provided in Table 6.8. Locations of mercury source areas are shown on Fig. 6.1 and completed actions to reduce mercury discharges to the Upper East Fork are discussed in Sect. 6.2. As shown in Table 6.8, the FY 2007 mercury discharge measured at Station 17 based on flow-paced continuous sampling data was equal to the FY 2006 discharge of 4 kg. About half (2 kg) of this flux originated from sources in the WEMA as measured at Outfall 200A6. The other half is attributed to ungauged contributors from groundwater and storm drain discharges. During prior years, mercury fluxes ranged from 7.3 kg in FY 2002 to 14.6 kg measured in FY 2005. The average flow-paced composite sampling mercury concentration measured during FY 2007 was also very low at approximately 0.198 μg/L compared to previous low average concentrations of 0.524 μg/L and 0.536 μg/L measured during FY 2004 and FY 2002, respectively. Flow-paced composite sampling is conducted to determine the average concentrations and loadings (fluxes) of contaminants in surface water while grab sampling allows determination of peak concentrations. Both sampling approaches are utilized at Station 17. The flow-paced composite average mercury concentration was lower than that obtained from grab samples collected at Station 17 on a 4 days/week frequency throughout the year. Reasons for this difference include differences in laboratory procedures for analysis and differences in the sampling processes used. The FY 2007 result reflects a continued significant improvement in conditions that started during FY 2006 when the BSWTS became operational. Additionally, FY 2007 was a year of extreme drought conditions which reduced groundwater transport of contaminants and reduced sediment transport caused by storm-induced flows. The reduction in average mercury concentration measured at Station 17 compared to prior years is thought to be largely influenced by the collection and treatment of approximately 80% of the contaminated groundwater that formerly discharged via Outfall 51 from Big Spring (Sect. 6.2.2).

Areas of radiologically contaminated groundwater in the UEFPC watershed are shown on Fig. 6.1. Uranium contamination in the UEFPC originates from groundwater seepage and stormwater transport of surface contamination in the Y-12 Complex. As shown in Table 6.8, the uranium flux and average concentrations measured at Station 17 during FY 2007 were low and were comparable to those measured in FY 2001, which also had below-average rainfall.

Zinc concentrations measured at Station 17 during FY 2007 were consistently less than the AWQC value. The AWQC value for zinc is dependent on water hardness. The hardness of surface water at Station 17 is approximately 150 mg/L and using methods published in TDEC Rules for General Water Quality Criteria (Chapter 1200-4-3, revised October 2007), the calculated AWQC criteria continuous concentration for zinc at a 150 mg/L hardness would be in the range of 165–170 μg/L. Based on a review of Station 17 zinc data obtained from FY 2000 through FY 2007, zinc has been detected at concentrations greater than 165 μg/L on only two occasions, once in 2000 and once in 2004.

Table 6.8. Annual uranium and mercury fluxes and average concentrations at Station 17

Date	Hg Flux (kg)	Avg Hg (μg/L)	U Flux (kg)	Avg U (mg/L)	Annual Rainfall (in)
2000	12.0	0.746	143	0.012	52
2001	9.4	0.638	85	0.007	45.98
2002	7.3	0.536	172	0.014	52.67
2003	8.8	0.597	148	0.011	73.73
2004	8.2	0.524	119	0.010	56.38
2005	14.6	0.742	157	0.012	58.96
2006	4.0	0.328	89	0.008	46.42
2007	4.0	0.198[1]	86	0.007	36.26

[1]Reported average is for 7-day continuous flow-paced samples. Average Hg concentration from grab samples collected 4 days/week was 0.312 μg/L.

Avg. = average; kg = kilogram; μg/L = micrograms per liter
Hg = mercury; mg/L = milligrams per liter
in = inches; U = uranium

6.4.2 Groundwater Quality

East End VOC Plume pump and treat system protects off-site water quality.

The UEFPC RI/FS estimated that groundwater contamination underlies about half of the industrial portion of the UEFPC watershed and VOCs, radionuclides, nitrate, and metals are the prevalent groundwater contaminants. Figure 6.1 incorporates the UEFPC Remedial Investigation/Feasibility Study (RI/FS) groundwater contaminant plume map that shows several areas of VOC and radiological contamination as well as monitoring locations. Well GW-108 is a 58-ft deep well located in the eastern portion of the S-3 Ponds plume. Figure 6.8 shows analytical results for ^{99}Tc and nitrate in well GW-108. The data show a slight decrease in the ^{99}Tc concentrations, which had been steadily increasing for several years. Ongoing monitoring will determine if this decrease is a result of the drought conditions or if concentrations in this part of the S-3 Ponds plume are beginning to decline. In FY 2007 nitrate concentrations at well GW-108 decreased more sharply than the trend observed since 2000.

Wells GW-605 and GW-606 are located in the Maynardville Limestone exit pathway upgradient of the EEVOC plume interception and treatment system (see Fig. 6.1). Well GW-605 is a relatively shallow well (40.5 ft deep), while GW-606 is deeper (175 ft deep). Figure 6.9 shows concentrations of signature contaminants in wells GW-605 and GW-606. GW-605 exhibits increasing long term trends in both VOC and alpha activity levels although the alpha activity decreased somewhat during FY 2007 compared to levels measured in 2003. The alpha activity is associated with uranium contamination in groundwater in the area. The cause of these concentration increases is not apparent; however, evolution of groundwater contaminant plumes in the UEFPC watershed is an ongoing process and well GW-605 may be indicative of these trends. As shown on Fig. 6.6, groundwater in the vicinity of GW-605 tends to follow the hydraulic gradient eastward into the edge of the well GW-845 drawdown feature where it would enter the treatment system for the EEVOC plume. At well GW-606, which samples water from a depth likely influenced by EEVOC plume groundwater extraction at well GW-845, concentrations of carbon tetrachloride and its degradation product chloroform have decreased since the FY 2000 time period, apparently as a consequence of EEVOC plume extraction. Nitrate was present in GW-606 prior to initiation of groundwater withdrawal and treatment. As shown in Fig. 6.9, the nitrate concentration increased after groundwater withdrawal started and has fluctuated in the concentration range between 8 and 15 mg/L. Like the VOCs detected in GW-606, the nitrate contamination is thought to be captured in the zone of influence of well GW-845 and the EEVOC treatment system. However, FY 2007 data for well

GW-845, the treatment system influent, do not exhibit any indication of substantially increased levels of total uranium, nitrate, or radiological constituents relative to baseline levels.

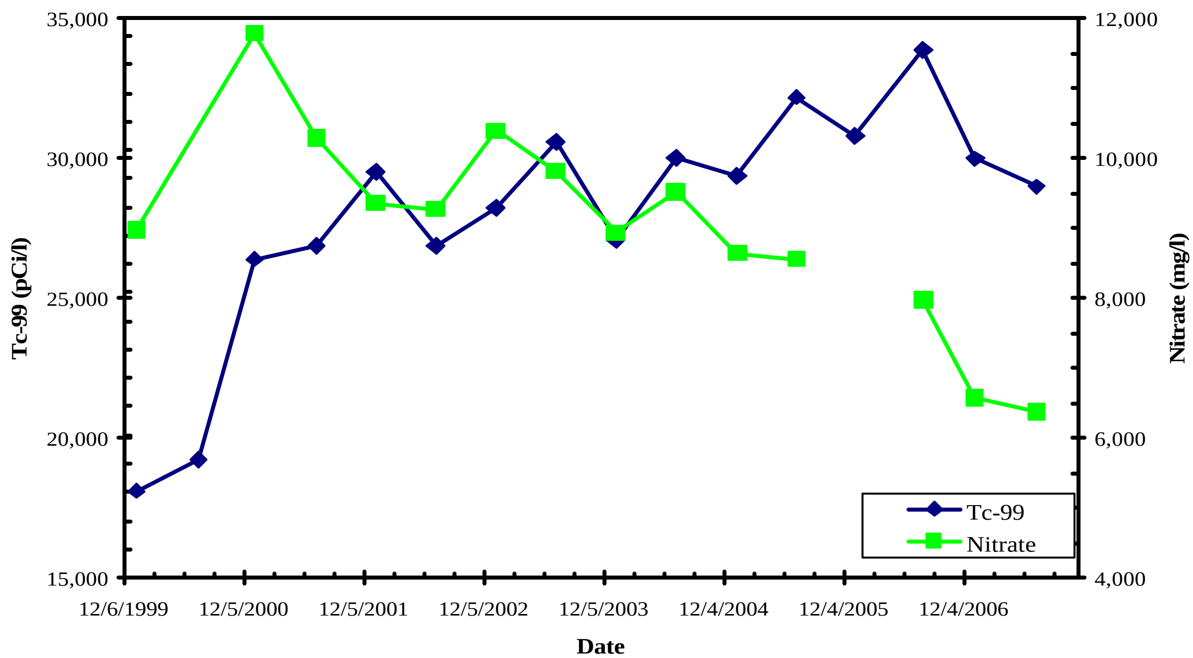

Fig. 6.8. Well GW-108 nitrate and ^{99}Tc concentrations.

6.4.3 Aquatic Biological Monitoring

Although instream communities and PCBs in fish have improved over time in EFPC, mercury concentrations in fish remain a continuing problem.

The ecological health of East Fork Poplar Creek (EFPC) has been monitored since 1985. Data collected on contaminant bioaccumulation and the composition and abundance of communities of aquatic organisms provide direct evaluation of the effectiveness of abatement and remedial measures in improving ecological conditions in the stream. Since 1986, these studies have been augmented by twice yearly monitoring of aqueous mercury concentrations and speciation at sites throughout the length of EFPC.

Mercury in sunfish at EFK 23.4 (just upstream from Station 17, the UEFPC IP) remained at levels similar to those observed for the past 20 years (Fig. 6.10), showing no decreasing trend over time despite the large decrease in aqueous mercury concentration in the UEFPC over time. There continues to be no decrease in mercury in fish in response to the abrupt change in aqueous mercury following completion of BSWTS in 2005. See Sect. 7.2.3 for additional information about mean mercury concentrations in sunfish in UEFPC and hydrologically-connected locations downstream in LEFPC and CR/PC. Mean

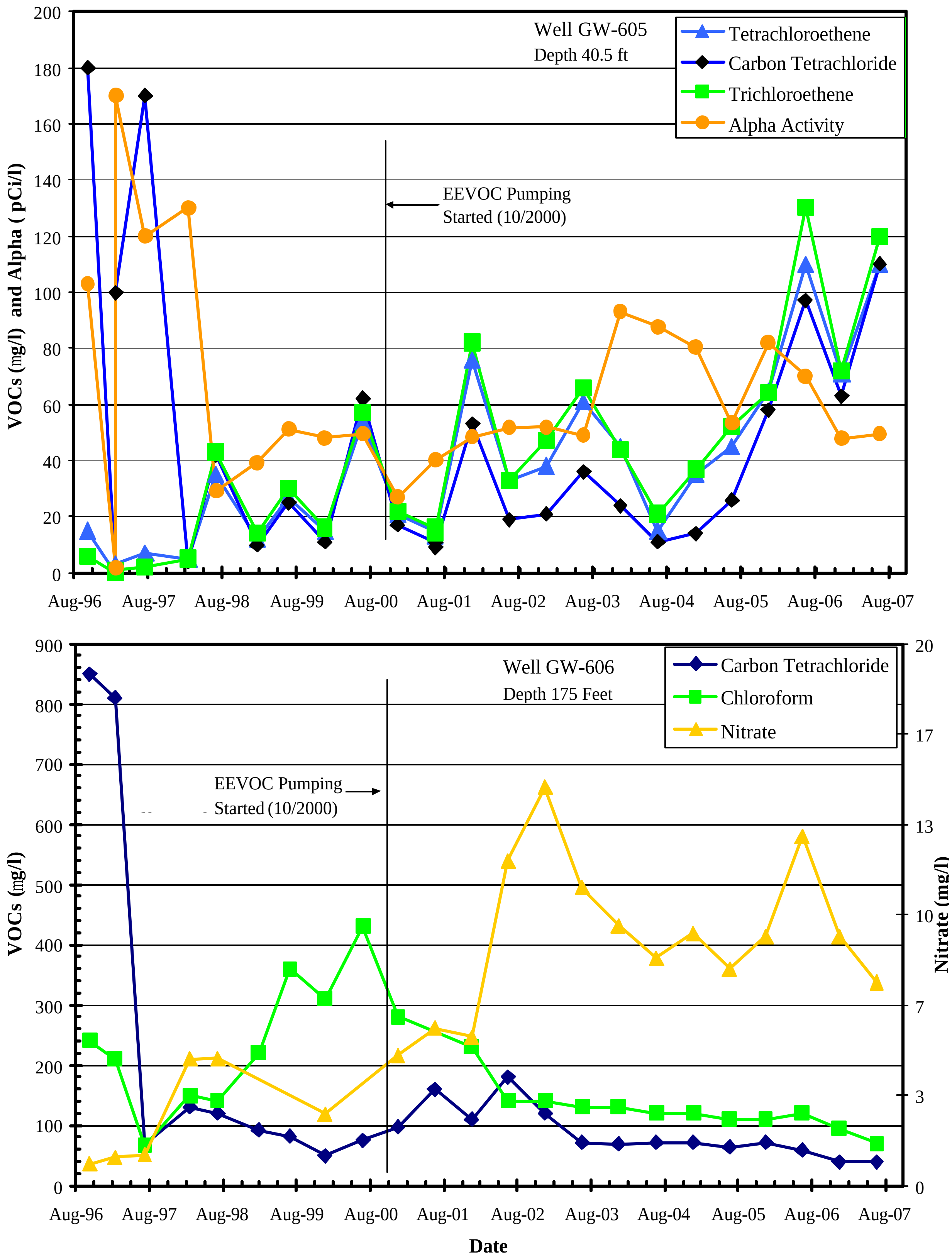

Fig. 6.9. Wells GW-605 and GW-606 signature contaminant concentrations.

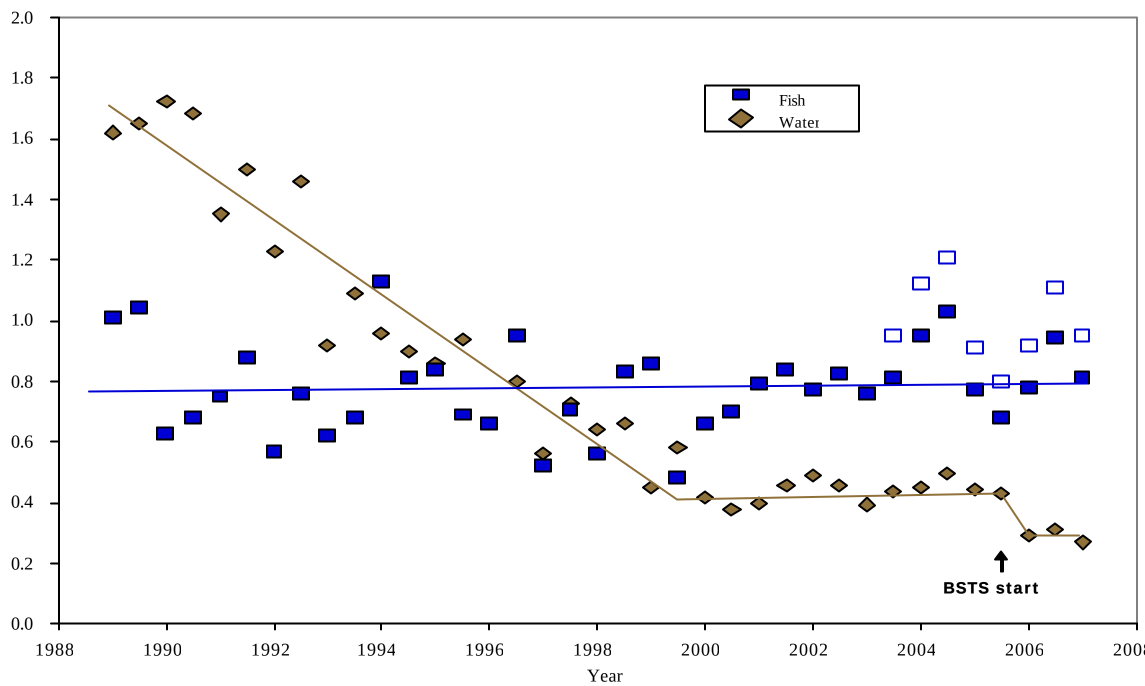

Fig. 6.10. Mean concentration of mercury in redbreast sunfish (closed boxes) and rockbass (open boxes) at EFK 23.4.
Redbreast sunfish could not be found at this site since fall of 2003. Rockbass data were multiplied by 0.85 to adjust for the interspecies difference in mercury accumulation and provide an estimate for redbreast sunfish

concentrations of mercury and PCBs in stoneroller minnows at EFK 24.5 were 2.29 ± 0.31 µg/g and 4.6 ± 0.23 µg/g, respectively. Mean PCB concentrations in sunfish at EFK 23.4 remained much lower than the peak levels observed in the mid 1990's, continuing a steadily decreasing trend since that time (Fig 6.11).

The number of fish species at EFK 23.4 just downstream of the discharges from the Y-12 Complex has leveled out in recent years (Fig. 6.12) and remains below comparable reference fish communities like BFK 7.6. In contrast, the species richness (number of species) of the fish community further downstream at EFK 13.8 has continued to improve. Upper EFPC (EFKs 24.4 and 23.4), which has exhibited no persistent changes in benthic macroinvertibrate community areas since moderate recovery occurred after implementation of flow management, continues to support 50% fewer pollution-intolerant taxa than the Brushy Fork reference site (Fig. 6.13).

6.4.4 Summary: Watershed Condition and Trends

Surface water contaminant discharge conditions in UEFPC during FY 2007 were stable and consistent with the conditions observed during FY 2006. The extreme drought condition continued to minimize the mobilization and transport of mercury via groundwater and storm flows. During FY 2007 mercury discharges measured at the WEMA integration point (Outfall 200A6) and at the watershed integration point (Station 17) were about 2 and 4 kg respectively. The 4 kg watershed discharge of mercury is essentially identical with the FY 2006 value. The BSWTS operated with a >97% mercury removal efficiency despite receiving influent mercury concentrations in excess of the system design criteria. The EEVOC Plume groundwater pump and treat system continued to contain the plume, protecting groundwater and surface water offsite in Union Valley.

Aquatic biological monitoring shows that mercury concentrations remain stable in fish tissue at EFK 23.4 near the watershed integration point although surface water mercury concentrations have decreased by nearly 30% as a result of BSWTS operation. PCB concentrations in fish tissue have apparently stabilized at about 0.2 ppm which is a significant decrease from levels above 1 ppm measured in 1999. Although fish and benthic communities in UEFPC are relatively stable, they continue to show impairment compared to the reference streams.

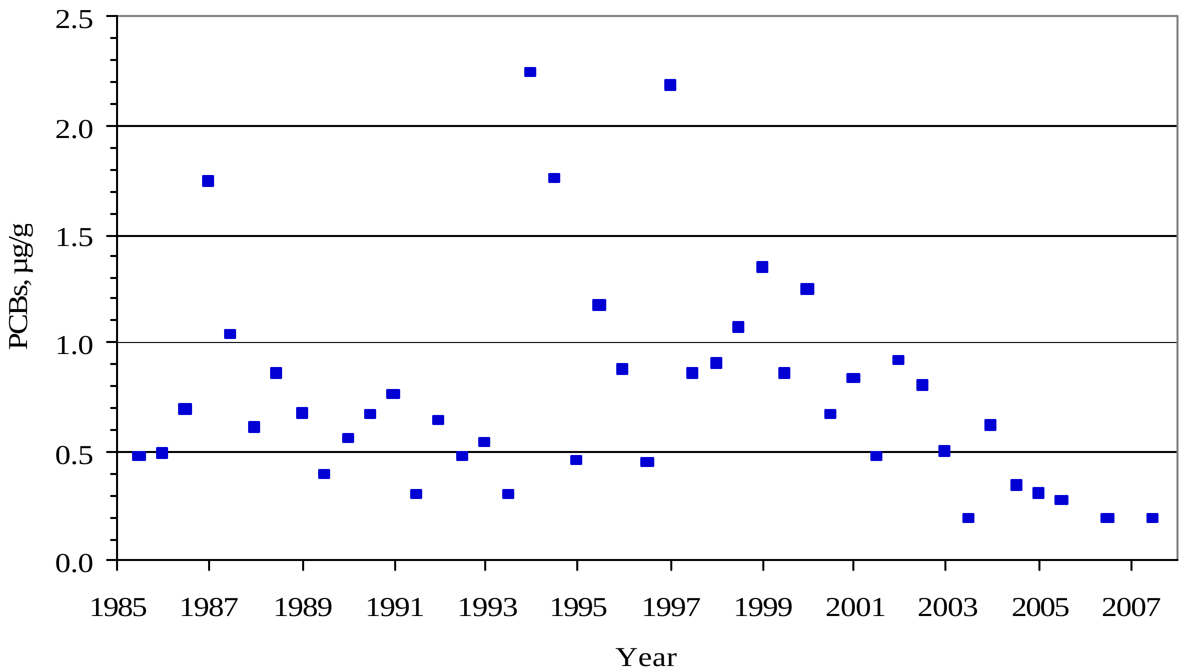

Fig. 6.11. Mean concentrations of polychlorinated biphenyls (PCBs) in redbreast sunfish and rockbass at EFK 23.4, 1985–2007.

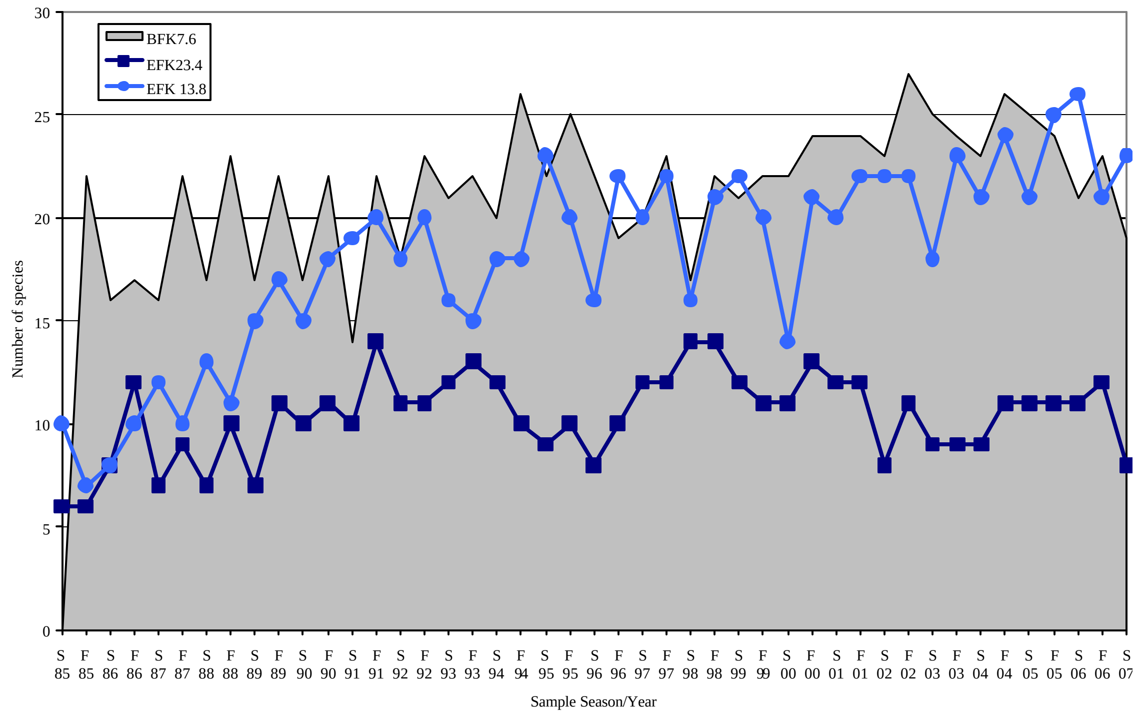

Fig. 6.12. Species richness (number of species) in samples of the fish community in East Fork Poplar Creek (EFK) and a reference stream, Brushy Fork (BFK), 1985 to 2007.

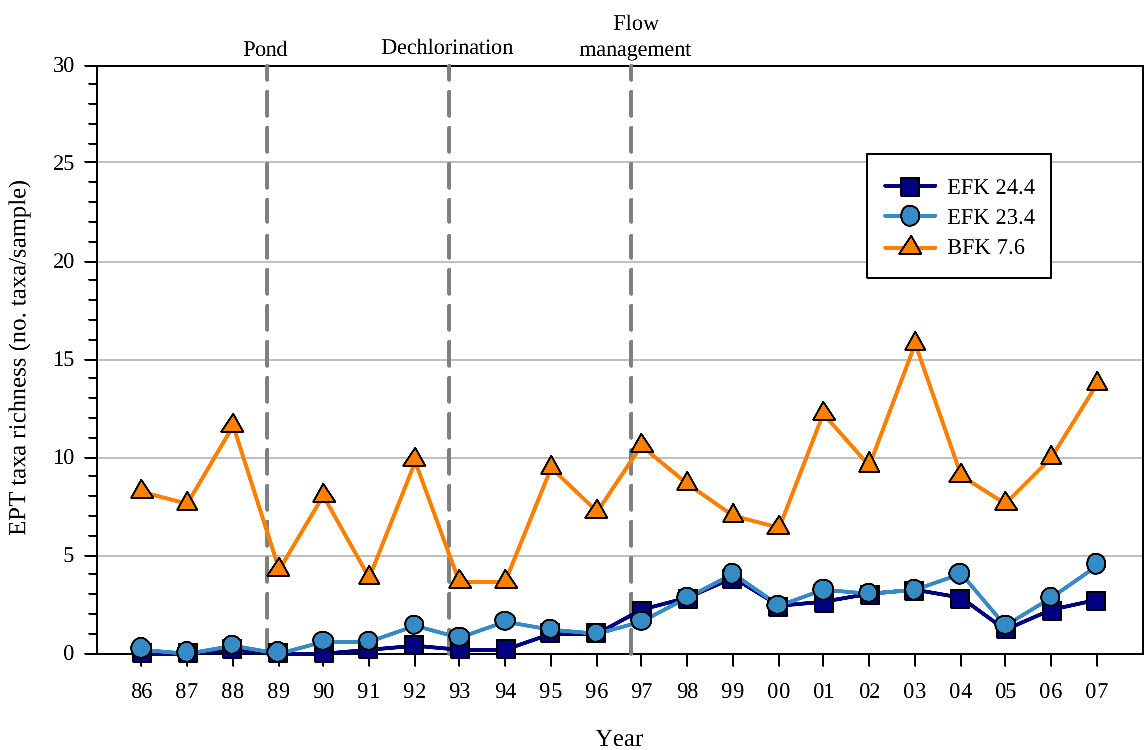

Fig. 6.13. Mean (n = 5) taxonomic richness of the pollution-intolerant taxa for the benthic macroinvertebrate community at sites in East Fork Poplar Creek and Brushy Fork, April sampling periods, 1986–2007.
(EFK = East Fork Poplar Creek kilometer; BFK = Brushy Fork kilometer)

6.5 UPPER EAST FORK POPLAR CREEK MONITORING CHANGES AND RECOMMENDATIONS

Table 6.9 summarizes issues and recommendations/actions for the UEFPC Watershed. Several issues remain unresolved from previous RERs and are carried forward for tracking purposes. Completed/resolved issues are included in the last section of the table and will no longer be carried in subsequent RERs. No additional issues were identified from evaluation of the FY 2007 monitoring data and, therefore, no changes to the existing monitoring network are recommended at this time.

Table 6.9. Summary of UEFPC Watershed technical issues and recommendations

ISSUE [1]	ACTION/ RECOMMENDATION
ISSUES CARRIED FORWARD:	
1. Mercury concentrations in fish within the EFPC system remain elevated, despite decreasing concentrations in aqueous mercury levels.	1. A team consisting of DOE EM, NNSA, and Office of Science is being brought together to develop a conceptual model(s) for mercury fate and transport relevant to methyl mercury concentrations in the EFPC ecosystem. The effort will be coordinated with the UEFPC Core Team.
2. FY 2005 pre-action Hg concentrations at Station 17 are above the 200-ppt performance goal. Hg concentrations in fish in UEFPC have yet to respond to commensurate reductions of Hg from historical RMPE actions. Biota monitoring in UEFPC shows impaired diversity and density of pollution-intolerant species.	2. Remedial measures required by the UEFPC Phase I ROD are expected to reduce Hg concentrations at Station 17, as well as in fish in UEFPC (see Issue Carried Forward #1 above). These measures include Hg source removal and surface water treatment. The BSWTS Water Treatment System was fully operational during FY 2007 and a corresponding 50% decrease in Hg flux was observed at Station 17. Also, FY 2007 Hg levels in LEFPC fish remain above federal ambient water quality criteria, but are less than peak levels observed in 2001-2002. Below-average rainfall likely contributed somewhat to the decrease. It is anticipated that implementation of the Hg-source removal actions will result in a similar decrease in flux at the IP.
COMPLETED/RESOLVED ISSUES:	
3. The FY 2006 RER/CERCLA FYR demonstrated that the EEVOC Plume removal action is achieving its performance goal of reducing VOC concentrations within the off-site exit pathway along the eastern boundary of the ORR	3. Based on 5 years of analytical data, a number of changes to performance monitoring for the EEVOC Plume Removal Action were recommended in the FY 2006 RER/CERCLA FYR and approved with the acceptance of the RmAR in June 2006. The changes that were implemented in FY 2007 include: (a) semiannual monitoring of GW-169, GW-170, and Westbay well GW-722 for VOCs only, and (b) discontinue monitoring of GW-232.
4. Pre-action data do not definitively indicate whether there is a net gain or loss of Hg mass between source areas in the western portion of Y-12 and Station 200A6. Substantial fluctuations in Hg mass balance (flux) have been observed the past 3 years.	4. At the beginning of FY 2007, DOE implemented a revised monitoring approach for measuring the Hg mass discharged from the WEMA, as approved by both EPA (9/29/06) and TDEC (10/04/06). This monitoring is required by the UEFPC Phase I Interim Source Control Actions ROD (DOE/OR/01-1951&D3). The modified monitoring approach includes (a) up-grading sampling equipment at Station 200A6 for continuous Hg flux measurement on 7-day (full week) composites to provide baseline Hg flux data for the WEMA actions, (b) changing monitoring at Station 8 to weekly grab samples to evaluate ungauged Hg influx to UEFPC, and (c) discontinuing monitoring at outfalls 150, 160, 163, and 169 until 1 year prior to implementation of the WEMA actions. This change has been incorporated into the WRRP SAP.

[1] Issues are identified in the table either as "ISSUE(S) CARRIED FORWARD" to indicate that the issue is carried forward from the previous year's RER so as to track the issue through resolution, or as "COMPLETED/RESOLVED ISSUES" to identify an issue that has been resolved and will no longer be included in subsequent RERs.

CERCLA = Comprehensive Environmental Response, Compensation and Liability Act of 1980
EEVOC = East End Volatile Organic Compound
EPA = Environmental Protection Agency
RmAR = Removal Action Report
RMPE = Reduction of Mercury in Plant Effluents
ROD = Record of Decision
SAP = Sampling and Analysis Plan

Table 6.9. Summary of UEFPC Watershed technical issues and recommendations (continued)

FY = fiscal year
FYR = Five-Year Review
GW = groundwater well
IP = integration point
LEFPC = Lower East Fork Poplar Creek
NNSA = National Nuclear Security Administration
ORR = Oak Ridge Reservation
ppt = part per trillion
RER = Remediation Effectiveness Report
TDEC = Tennessee Department of Environment and Conservation
UEFPC = Upper East Fork Poplar Creek
VOC = volatile organic compound
WEMA = West End Mercury Area
WRRP = Water Resources Restoration Program

7. CERCLA OFF-SITE ACTIONS

7.1 INTRODUCTION AND OVERVIEW

This chapter provides an update to completed CERCLA actions outside the DOE ORR, all of which have performance monitoring and/or LTS requirements (Table 7.1). In this section, performance goals and objectives, monitoring results, and an assessment of the effectiveness of each completed action are presented. Table 7.2 provides a summary of LTS requirements for each action and a review of compliance with those requirements is also included.

For background information on each remedy and performance standards, a compendium of all CERCLA decisions for off-site actions is provided in Chapter 7 of Volume 1 of the 2007 RER (DOE 2007a). This information will be updated in the annual RER and republished every fifth year at the time of the CERCLA FYR.

Poplar Creek, the CR, and Watts Bar Reservoir comprise a single, hydrologically connected system through which contaminants originating from the ORR are transported. In September 1999, DOE recommended combining the monitoring plans for the CR/PC and LWBR OUs. This combined monitoring plan was revised in FY 2004 (DOE 2004c) to better identify and evaluate changes in COC concentrations in fish. However, the CERCLA decisions and evaluations of effectiveness are discussed separately within this report (Sects. 7.3 and 7.4). All other actions within this chapter (i.e., Oak Ridge Associated University (ORAU) SCF and the UV Interim Action) are distinct single actions and are treated accordingly.

Table 7.1. CERCLA actions at off-site locations

CERCLA action	Decision document, date signed	Action status[a]	Monitoring/ LTS required	RER section
		Completed actions		
Lower East Fork Poplar Creek	ROD: 8/17/95 ESD: 9/1/96	RAR approved (8/2/00)	Yes/Yes	7.2
CR/PC	ROD: 9/23/97	RAR issued (2/1/99)	Yes/Yes	7.3
Lower Watts Bar Reservoir	ROD: 9/29/95 NSC: 5/18/07.	RAWP issued March 1996[b]	Yes/Yes	7.4
Oak Ridge Associated Universities South Campus Facility	ROD: 12/28/95 NSC: 12/20/06	RAR approved (7/10/96)	Yes/Yes	7.5
Union Valley	Interim ROD: 7/19/97	See Sect. 5.5[b]	No/Yes	7.6

[a] Detailed information of the status of ongoing actions is from Appendix E of the FFA and is available at http://www.bechteljacobs.com/ettp-ffa-appendices.html

[b] These actions were completed prior to uniform adherence to the RAR process; hence, no RAR exists for these decisions

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
ESD = Explanation of Significant Difference
LTS = long-term stewardship
RAR = Remedial Action Report
RAWP = Remedial Action Work Plan
RER = Remediation Effectiveness Report
ROD = Record of Decision

Table 7.2. Long-term stewardship requirements for CERCLA actions at off-site locations

Site/Project	LTS Requirements: Land Use Controls	LTS Requirements: Engineering Controls	Status	RER Section
Lower East Fork Poplar Creek Remedial Action	▪ Annual land use survey at Dean Stallings Ford ▪ Periodic survey to detect residential use of shallow groundwater		▪ LUCs in place.	7.2.3
CR/PC Remedial Action	▪ Fish consumption advisories ▪ Permits for sediment disturbing activities ▪ Survey to confirm effectiveness of fish consumption advisories (one time only) ▪ Survey of local irrigation practices (one time only prior to issuing surface water ROD)		▪ LUCs in place.	7.3.3
Lower Watts Bar Reservoir Remedial Action	▪ Fish consumption advisories ▪ Permits for sediment disturbing activities		▪ LUCs in place.	7.4.3
ORAU South Campus Facility Remedial Action	▪ Environmental Notice filed at Register of Deeds		▪ LUCs in place.	7.5.3
UEFPC Union Valley Interim Action	Institutional controls related to groundwater use. ▪ License agreements ▪ Annual property owner notification ▪ Annual title searches ▪ Annual water use surveys ▪ Annual notification to well drillers		▪ LUCs in place.	7.6.3

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
LTS = long-term stewardship
LUC = land use controls
ORAU = Oak Ridge Associated Universities
RER = Remediation Effectiveness Report
ROD = Record of Decision
UEFPC = Upper East Fork Poplar Creek

7.1.1 Status and Updates

In December 2006, DOE proposed a NSC to the approved ROD for the ORAU SCF (DOE 1995e). The NSC was approved by TDEC in May 2007 and is pending EPA approval. If approved in FY 2008, a more comprehensive discussion of this will be included in the subsequent RER (FY 2009).

The DOE proposed a NSC to the Lower Watts Bar ROD (DOE 1995d) in May 2007 (see Sect. 7.4). The NSC has not been approved by either TDEC or EPA. If approved in FY 2008, a more comprehensive discussion of the NSC will be included in the subsequent RER (FY 2009).

7.2 LOWER EAST FORK POPLAR CREEK

The ROD for LEFPC (DOE 1995e) addressed the mercury contamination in the floodplain sediments of the creek that runs from the Y-12 Complex (in the UEFPC Watershed) through the city of Oak Ridge (Fig. 7.1). A complete discussion of the LEFPC ROD is provided in Chapter 7 of Volume 1 of the 2007 RER.

7.2.1 Performance Goals and Monitoring Objectives

A major component of the selected remedy for LEFPC was for DOE to perform appropriate monitoring to ensure effectiveness of the remediation. The RAR for LEFPC (DOE 2000d) provides a description of all measures taken during the remedial activities to comply with action-specific ARARs and supplemental monitoring activities needed to support the subsequent FYR (through 2005). The following monitoring was performed during FY 2007:

- Monitor mercury inputs from UEFPC to LEFPC at Station 17. This requirement is covered by the mercury monitoring at Station 17 required by the UEFPC Phase I ROD.

- Perform an annual survey of the Dean Stallings Ford automobile dealership parking lot to ensure land use has not changed that would bring into question the protectiveness of leaving soils with > 400 ppm mercury.

7.2.2 Evaluation of Performance Monitoring Data

Mercury Input from UEFPC to downstream waters

One of the concerns of decision makers and public commentors regarding cleanup of LEFPC floodplain soils was the fact that mercury continues to be released from the Y-12 Complex, and these releases could re-contaminate the floodplain. At the time, it was acknowledged that the existing contamination occurred in the 1950s and 1960s when different processes were in use at Y-12. As required by the RAR, mercury releases from the Y-12 Complex have been, and continue to be, measured at the Station 17, the point at which the government land transitions to city property along EFPC (Fig. 7.1). Data are reported annually in the RERs. The average mercury concentration measured at Station 17 during FY 2007 was 198 ng/L, which meets the 200 ng/L goal and is a significant improvement compared to previous years. A full discussion of the historical and current trends in mercury releases at Station 17 is presented in Chapter 6, Sect. 6.4 of this RER.

The effect of the upstream mercury source in EFPC and downstream dilution on mercury bioaccumulation in sunfish is depicted in Fig. 7.2. Mercury levels in fish were similar from EFK 23.4 to EFK 6.3, but decreased in response to downstream dilution of EFPC in PC, and of PC in the CR (Fig. 7.1). Mean mercury concentrations in sunfish in the lowermost reaches of PC and the CR in 2007 were below EPAs 0.3 µg/g fish-based federal AWQC, although levels in largemouth bass in PC did exceed the AWQC (Sect 7.3). TDEC adopted EPAs 0.3 criterion for use in issuing the State of Tennessee's fish advisories in April 2007.

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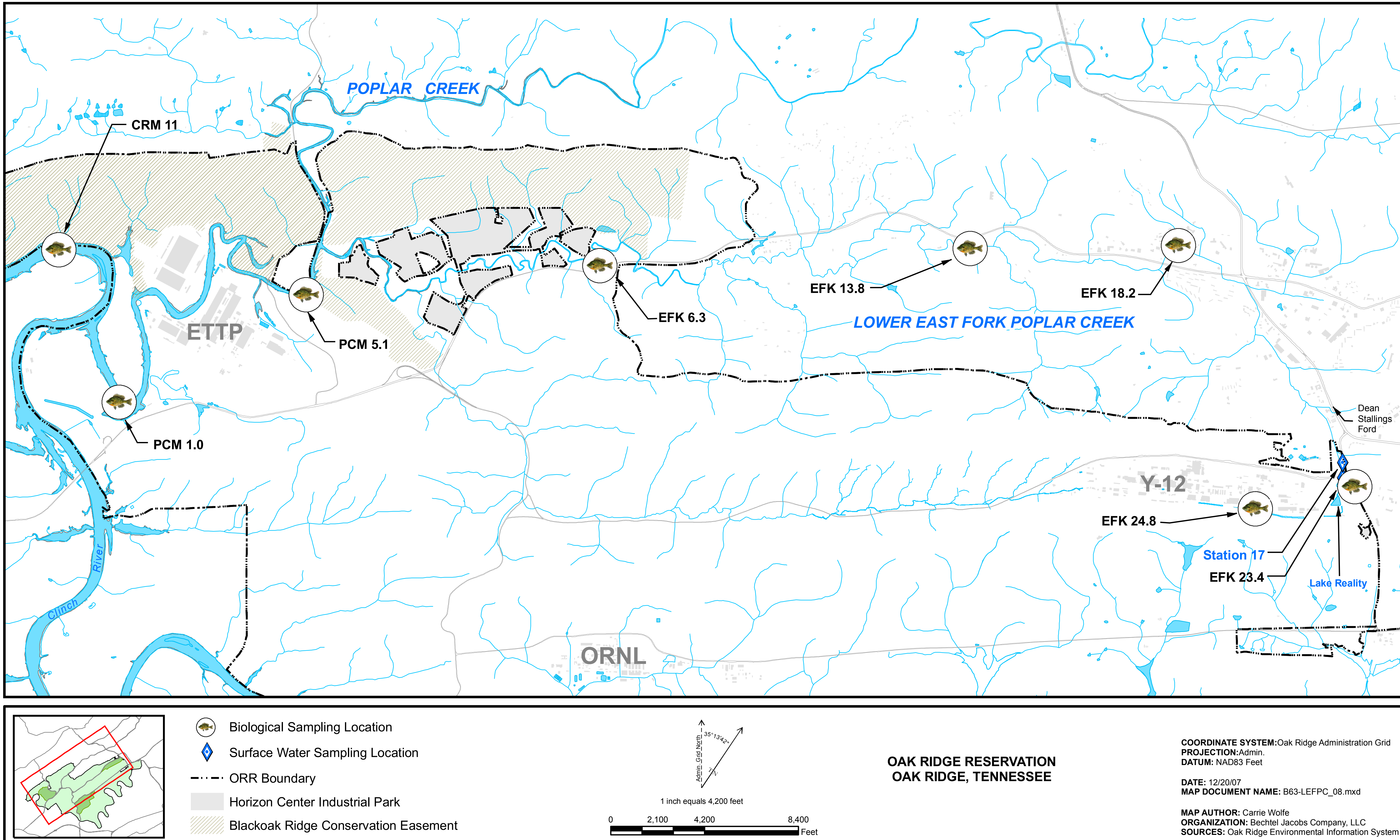

Fig. 7.1. Site map of Lower East Fork Poplar Creek.

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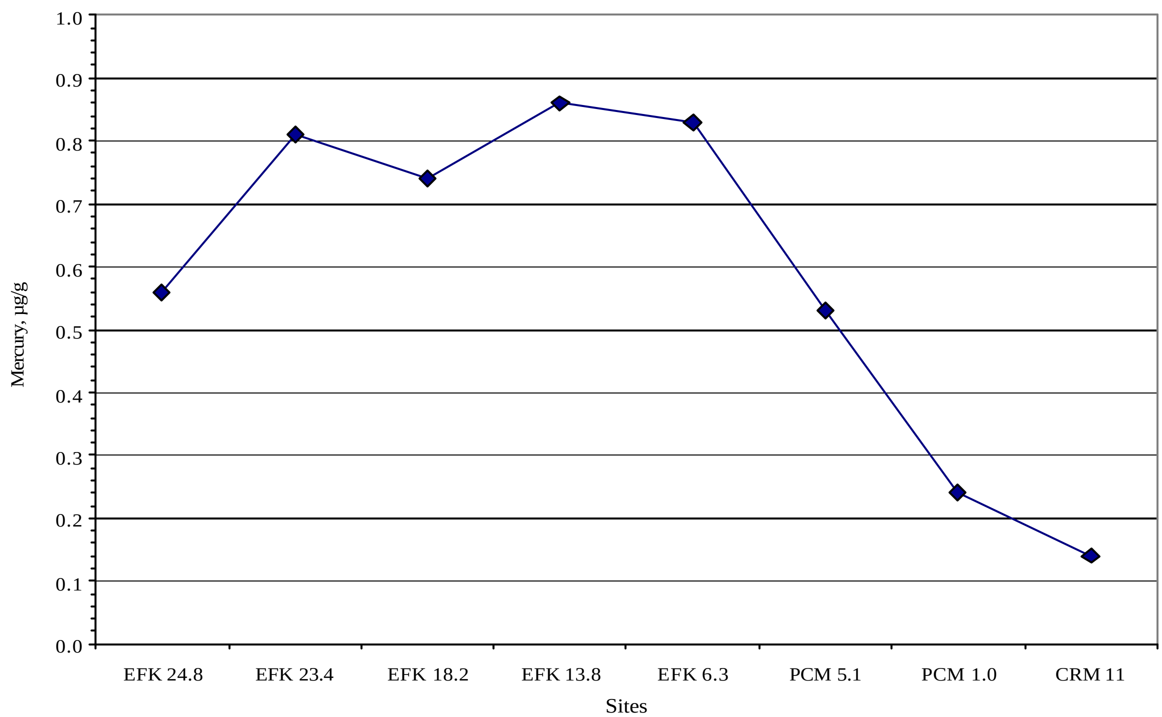

Fig. 7.2. Spatial pattern of mercury bioaccumulation in sunfish (redbreast sunfish and bluegill) collected in spring 2007 from sites in East Fork Poplar Creek (EFK 6.3 - 24.8), Poplar Creek (PCM 5.1 and 1.0), and the Clinch River (CRM 11). Data for EFK 23.4 are for rock bass, adjusted by multiplying the mean by 0.85 to compensate for interspecific differences in bioaccumulation of Hg.

Mercury trends in Lower East Fork Poplar Creek

The LEFPC ROD (DOE 1995e) addressed soil, sediment, and groundwater, and deferred surface water to a future ROD. When fish mercury concentrations were shown to be increasing over time at two locations in LEFPC in the early 2000s, concerns were raised about some of the assumptions in the LEFPC ROD regarding the importance of upstream industrial sources of mercury relative to floodplain or in-stream sediment sources.

To address these concerns, a technical evaluation was conducted of: (1) the mercury trends in LEFPC, and (2) the causal mechanisms for the observed mercury increases in fish.

The 2007 monitoring data continue to show that the increase observed in the early 2000s has moderated in recent years. In 2007, mean mercury concentrations in redbreast sunfish in LEFPC (EFK 6.3) remained at levels typical of the 2003-2005 time period (Fig. 7.3), around 0.8 µg/g. Although fish in the 0.8 µg/g range are higher than levels typically observed in the mid 1980s, they are lower than historical peak concentrations in 2001-2002 (when concentrations in fish on two occasions exceeded 1.2 µg/g).

FY 2007 Hg levels in LEFPC fish remain above federal AWQC, but are less than peak levels observed in 2001-2002.

Evaluation of the mercury patterns in EFPC fish and the potential underlying causes continued in FY 2007. A model of downstream transport and conversion of inorganic mercury to methylmercury was developed to test the hypothesis that changes in water chemistry over the

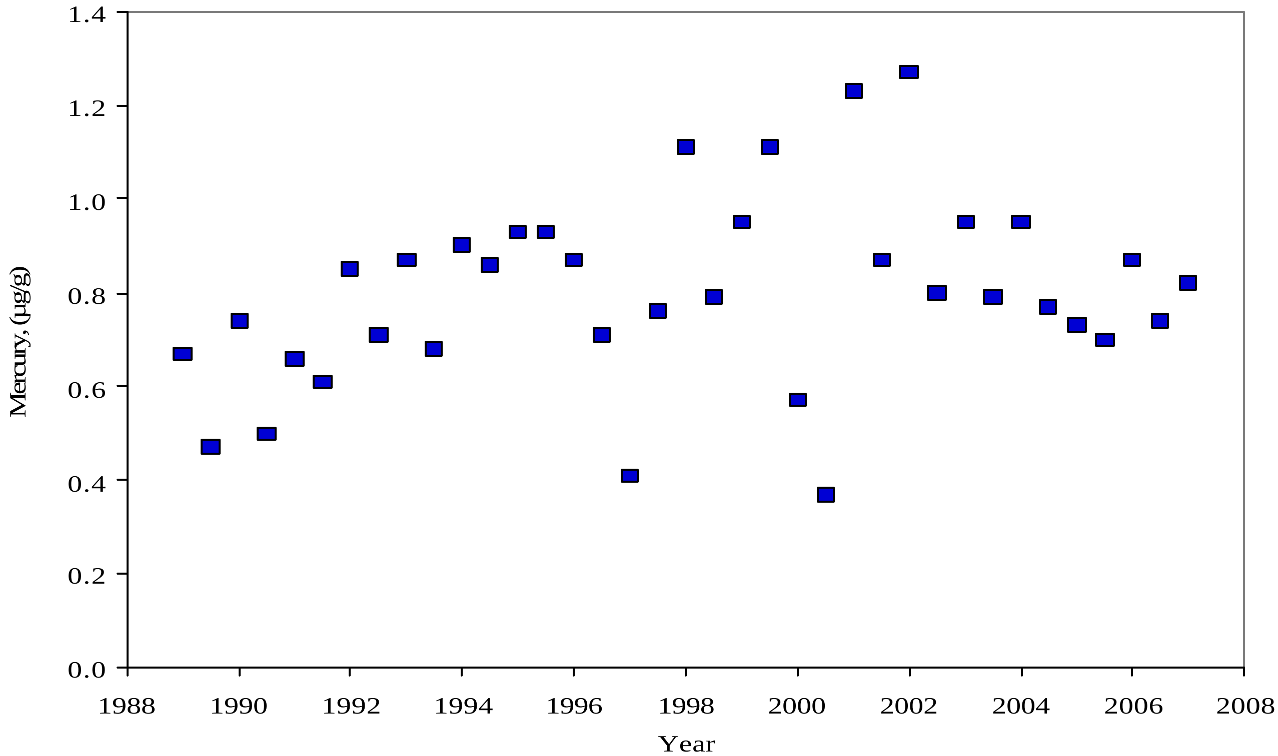

Fig. 7.3. Mean mercury concentration in muscle tissue of redbreast sunfish at EFK 6.3.

the 1985-2007 period in the upper reaches of the stream (likely associated with dechlorination and inorganic Hg concentration) could produce the observed temporal and spatial changes in mercury bioaccumulation throughout the length of EFPC. That model was capable of reproducing the observed patterns when the rate of microbial destruction of methylmercury was assumed to decrease over time and distance. Demethylation factors may be only one of a number of potential factors affecting mercury concentrations in fish, but further investigation into this possibility may have merit. Recent research at other contaminated sites indicates that demethylation rates are much higher in systems with high concentrations of inorganic mercury, suggesting that reductions in inorganic mercury concentrations could increase the persistence of methylmercury in contaminated aquatic ecosystems undergoing remediation.

The role of contaminated floodplain deposits as a potential source of mercury to EFPC biota remains under investigation. A comparison of mercury in largemouth bass with mercury in sediments at contaminated sites on the ORR found only a weak relationship between the two variables, consistent with the hypothesis that water column mercury concentration is more important than sediment-associated mercury in driving bioaccumulation of methylmercury. The downstream profile of dissolved mercury vs. distance from the Y-12 Complex in EFPC continues to show a decrease consistent with dilution of a point source, with no evidence of inputs of dissolved mercury from floodplain sources. An effort to estimate wet weather export of mercury from EFPC indicated that stormflow transport of mercury from floodplain sources had decreased roughly 70% since 1985, but also suggested that erosion of floodplain deposits remains a significant portion of the total mercury loading to downstream environments.

The development and issuance by TDEC of a Total Maximum Daily Load (TMDL) for mercury in EFPC, planned for 2008, has the potential to change Y-12 cleanup and abatement targets. TDEC has indicated that fish-based levels will be used for the TMDL as the measure of cleanup success. Since EPA and TDEC have adopted a more conservative fish-based target of 0.3 µg/g in fish than historically was the case, there are new questions about the present mercury cleanup strategy and whether it will be ultimately successful. The strategy to date has focused on reducing aqueous inorganic mercury concentration, but substantial reductions in water concentrations have not had the desired effect on fish concentrations. A multi-organizational Mercury TMDL Team was started in FY 2007 in an effort to take a fresh look at the mercury problem and to consider an appropriate path forward. The team has agreed that an updated conceptual model for EFPC was needed that considered revised mercury cleanup goals, the most recent mercury data, and potential new strategies. Work on this model continued in FY 2007. Some data gaps were identified and new sampling of mercury flux in EFPC was planned for FY 2008.

Although inputs of mercury from floodplain soils cannot be ruled out as influencing fish mercury concentrations in LEFPC, the upstream source continues to provide sufficient mercury to more than account for the observed concentrations in fish, and will confound the ability to ascertain the role of floodplain soils and stream sediments as sources until it is substantially reduced.

7.2.3 Compliance with LTS Requirements

7.2.3.1 Requirements

The LEFPC ROD (DOE 1995e) states that although residential use of soil horizon (shallow) groundwater in not realistic, as a safeguard, DOE will monitor to detect any future residential use of the shallow groundwater.

The RAR (DOE 2000d) requires an annual survey to verify land use in the area of the Dean Stallings Ford automobile dealership parking lot has not changed since the issuance of the LEFPC ROD (DOE 1995e) and exposure pathways remain protected (Table 7.2).

7.2.3.2 Status of Requirements for FY 2007

A survey to detect residential use of shallow groundwater was performed in FY 2007. A list of residential wells recorded in the Elverton, BV, and Windrock quadrangles was obtained from the TDEC, Division of Water Supply. There are no records of water wells in the area along LEFPC.

DOE verified that the property is still owned and continues to be used as a parking lot by Dean Stallings Ford.

7.2.4 Site Summary: Condition and Trends

Mercury input from UEFPC to downstream waters has shown significant improvement compared to previous years, especially with the implementation of the BSWTS remedial action during FY 2006. It is anticipated that implementation of the additional mercury-source removal actions within UEFPC will have similar impacts on water quality in LEFPC. In addition, the down-stream profile of dissolved mercury continues to show a decrease with distance from the Y-12 Complex.

Mercury concentrations in LEFPC fish exceed the federal AWQC, but remain at levels typical of 2003-2005 and less than peak levels observed in 2001-2002.

7.2.5 Monitoring Changes and Recommendations

Changes to the monitoring strategy for LEFPC are not recommended at this time. However, DOE recognized the need to better understand mercury dynamics in EFPC and brought together technical resources to develop a conceptual model for mercury fate and transport, as well as approaches to reduce total and methylmercury concentrations in the EFPC ecosystem. It is recommended that this technical working group continues. This work will continue in FY 2008.

7.3 CLINCH RIVER/POPLAR CREEK

The CR/PC OU extends 34 river miles from the mouth of the CR at Tennessee River mile (TRM) 567.5 (CRM 0.0) at Kingston, upstream past the Melton Hill Reservoir dam at CRM 23.1, to the upstream boundary of the ORR at CRM 43.7 (Fig. 7.4). The CR/PC OU also includes the lower portion of PC from the mouth of PC on the CR at CRM 12.0, upstream to its confluence with EFPC at Poplar Creek mile (PCM) 5.5 (Fig. 7.4). A complete discussion of the CR/PC ROD is provided in Chapter 7 of Volume 1 of the 2007 RER.

7.3.1 Performance Goals and Monitoring Objectives

A major component of the selected remedy for CR/PC is for DOE to perform appropriate monitoring to ensure the institutional controls remain protective against the risk of potential exposure to COCs in sediments and fish tissue.

The original post-ROD monitoring plans for the action are in the RAR for the CR/PC OU (DOE 1999c). However, in September 1999, DOE recommended two broad changes to the monitoring plans for the LWBR and CR/PC OUs. The first was to combine the two OUs into a single entity for monitoring purposes. The second was to change the number and locations of monitoring stations and sampling techniques in both OUs. Based on these recommendations, which were based on the hydrological connection of PC, CR, and WBR. DOE implemented a combined monitoring plan for the LWBR and CR/PC OUs (DOE 1999d) in FY 2000.

Based on sampling results from 1999–2004, the combined monitoring plan was revised in FY 2004. This revised plan is presented in *Combined Monitoring Plan for the Lower Watts Bar Reservoir and Clinch River/Poplar Creek Operable Units* (DOE 2004f). The current plan consists of two components for the CR/PC: (1) annual monitoring of major COCs in fish, and (2) additional monitoring for CR/PC (sediment, surface water, turtles) once every 5 years to support the CERCLA FYR (Table 7.3).

The combined monitoring program uses a scientifically rigorous sampling design supporting the identification and evaluation of changes in COC concentrations in fish. This evaluation is directly applicable to the ROD-specified requirements to detect changes in fish contaminant concentrations and to evaluate whether institutional controls (i.e., the fish consumption advisory) are effective (DOE 2004c). If concentrations of contaminants in tissues of these species increase substantially, a study to determine the cause of the change may be warranted. Conversely, decreases in COC concentrations would support the evaluation of the need for continuing the fish advisory.

DOE addresses the ROD requirements for the CR/PC hydrologic unit by conducting annual sampling of contaminant concentrations in CR/PC fish. Sites sampled in FY 2007 include three sites in the CR, a site in PC, and two reference sites in Melton Hill Reservoir upstream of the OUs that are sampled for comparison purposes (Fig. 7.4). The sites sampled are based on their position below key DOE inputs and stream/river exit points, as well as their importance as long-term measures of change. Most of the designated sites have been monitored annually since the mid-1980s and are important sites for evaluating long-term change (DOE 2003f). Target species are channel catfish, largemouth bass, and striped bass. Depending on the site and species, PCBs, mercury, and ^{137}Cs concentrations are determined in fish fillets. Snapping turtle tissue, including muscle, liver, and fats, are also checked for contaminants on a 5-year cycle, and this sampling was last conducted in the summer of 2005.

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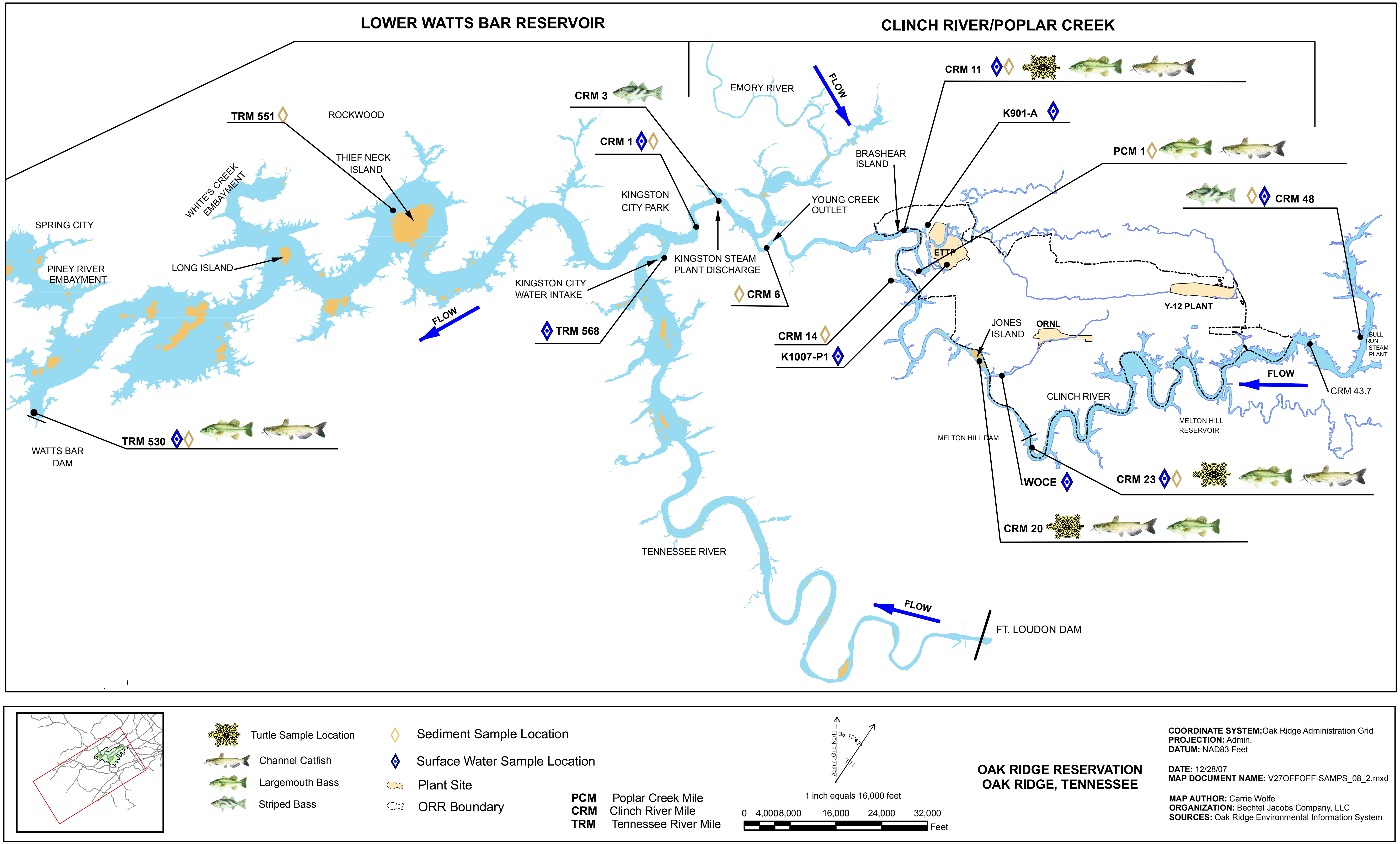

Fig. 7.4. Monitoring locations in the Clinch River/Poplar Creek and Lower Watts Bar Reservoir Operable Units.

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Table 7.3. Monitoring locations in CR/Poplar Creek

Monitoring stations	Analyses[a]
Surface water: CRM 48, CRM 23.4–24.7, WOCE, K-1007-P1 Pond, K-901-A Pond, CRM 10.5–12, and CRM 1, once every 5 years	Surface water—isotopic uranium, total mercury, TAL metals, and hydrolab profile
Sediment: CRM 48, CRM 23.4–24.7, CRM 14–15, PCM 1, CRM 10.5–12, CRM 6–7, and CRM 1, once every 5 years	Total metals, total mercury, and ^{137}Cs. Samples from Poplar Creek will also be analyzed for ^{99}Tc, ^{234,235,238}U, ^{60}Co, and PCBs.
Fish: CRM 23.4–24.7, PCM 1, CRM 10.5–12 , and CRM 19.7-20.7 (catfish and largemouth bass), annually, summer only	PCBs (catfish only), total mercury, ^{137}Cs (CRM 19.7–20.7 only), and total lipid
Bull Run Steam Plant effluent, Kingston Steam Plant effluent (striped bass), winter only	PCBs and total lipid
Turtles: CRM 23.4–24.7, CRM 19.7–20.7, and CRM 10.5–12, once every 5 years in summer	PCBs, total mercury, ^{137}Cs, and total lipid

[a]Analyses listed are those required to monitor action effectiveness.
Cs = cesium
CRM = Clinch River mile
PCB = polychlorinated biphenyl
PCM = Poplar Creek mile
TAL = target analyte list
WOCE = White Oak Creek Embayment

7.3.2 Evaluation of Performance Monitoring Data

The selected remedy identified in the CR/PC ROD (DOE 1997c) is still in place and effective in CR/PC: institutional controls prevent exposure to contaminated sediment [via the Watts Bar Interagency Working Group (WBIWG) activities], fish consumption advisories issued by TDEC reduce (not remove) human exposure to contaminated fish, and annual monitoring is conducted to evaluate changes in contaminant levels. Performance monitoring for the CR/PC has primarily focused on contaminant trending in fish to address the ROD requirement of "annual monitoring to detect changes in CR/PC contaminant levels or mobility."

Results of FY 2007 monitoring for PC and the CR arm of Watts Bar Reservoir are presented in Table 7.4. PCB concentrations in channel catfish were somewhat higher at most sites than those observed in 2006 but substantially lower than levels observed during the last two decades (Fig. 7.5). PCB concentrations in striped bass from Melton Hill Reservoir and the CR portion of Watts Bar Reservoir were high enough to be of concern for human consumption. TDEC typically issues fish consumption advisories on waters where fish exceed approximately 0.8-1.0 mg/kg PCBs. PCB concentrations in CR/PC channel catfish have been trending downward for more than a decade, although there is substantial year to year variability (Fig. 7.5). The influence of PCB flux in the PC/EFPC drainage, which has historically been evident in higher PCB concentrations in catfish at PCM 1, was again evident in 2007.

FY 2007 PCB levels in CR/PC fish are substantially lower than levels observed during the 1980s and 1990s.

Mean mercury concentrations exceeded the EPA fish tissue-based water quality criterion (0.3 µg/g) only in largemouth bass collected from lower PC. Concentrations of ^{137}Cs were below analytical detection limits in all fish at the site downstream from ORNL (Table 7.4)

Table 7.4. Mean concentrations[a] (N = 6 fish, ± standard error) of total PCBs (Aroclor-1254 ± 1260), total mercury, and ^{137}Cs in fish muscle fillet from off-site locations in FY 2007

Monitoring location		Total PCBs (mg/kg)		Mercury (mg/kg)		Cs-137 (pCi/g)[c]
Site[b]	Description	Channel catfish	Striped bass	Largemouth bass	Channel catfish	Channel catfish
		Clinch River				
CRM 20	Jones Island downstream of WOC	0.50 ± 011		0.18 ± 0.02	0.14 ± 0.02	<0.01 – 0.22
CRM 11	Brashear Island downstream of PC	0.30 ± 0.07		0.28 ± 0.02	0.23 ± 0.06	
CRM 3	Kingston Steam Plant discharge		1.08 ± 0.26			
		Poplar Creek				
PCM 1	Near K-1007-P1 outlet	0.70 ± 0.16		0.39 ± 0.04	0.36 ± 0.08	
		Lower Watts Bar Reservoir				
TRM 530	Watts Bar Reservoir forebay	0.63 ± 0.10		0.11 ± 0.02	0.07± 0.01	
		Reference sites (upstream of CR/PC-LWBR)				
CRM 48	Bull Run Steam Plant		1.09 ± 0.24			
CRM 23	Melton Hill Reservoir forebay	0.27 ± 0.05		0.11 ± 0.01	0.12 ± 0.02	

[a]Reported concentrations above the detection limit, but below the quantitation limit, were included in the table (i.e., values with J qualifiers included).
[b]CRM = Clinch River mile, PCM = Poplar Creek mile, and TRM = Tennessee River mile.
[c]Concentrations of ^{137}Cs in five of six fish were at, or below, the method detection limit.

CR = Clinch River
LWBR = Lower Watts Bar Reservoir
mg/kg = milligrams/kilogram
pCi/g = picoCuries per gram
PC = Poplar Creek
PCB = polychlorinated biphenyl
WOC = White Oak Creek

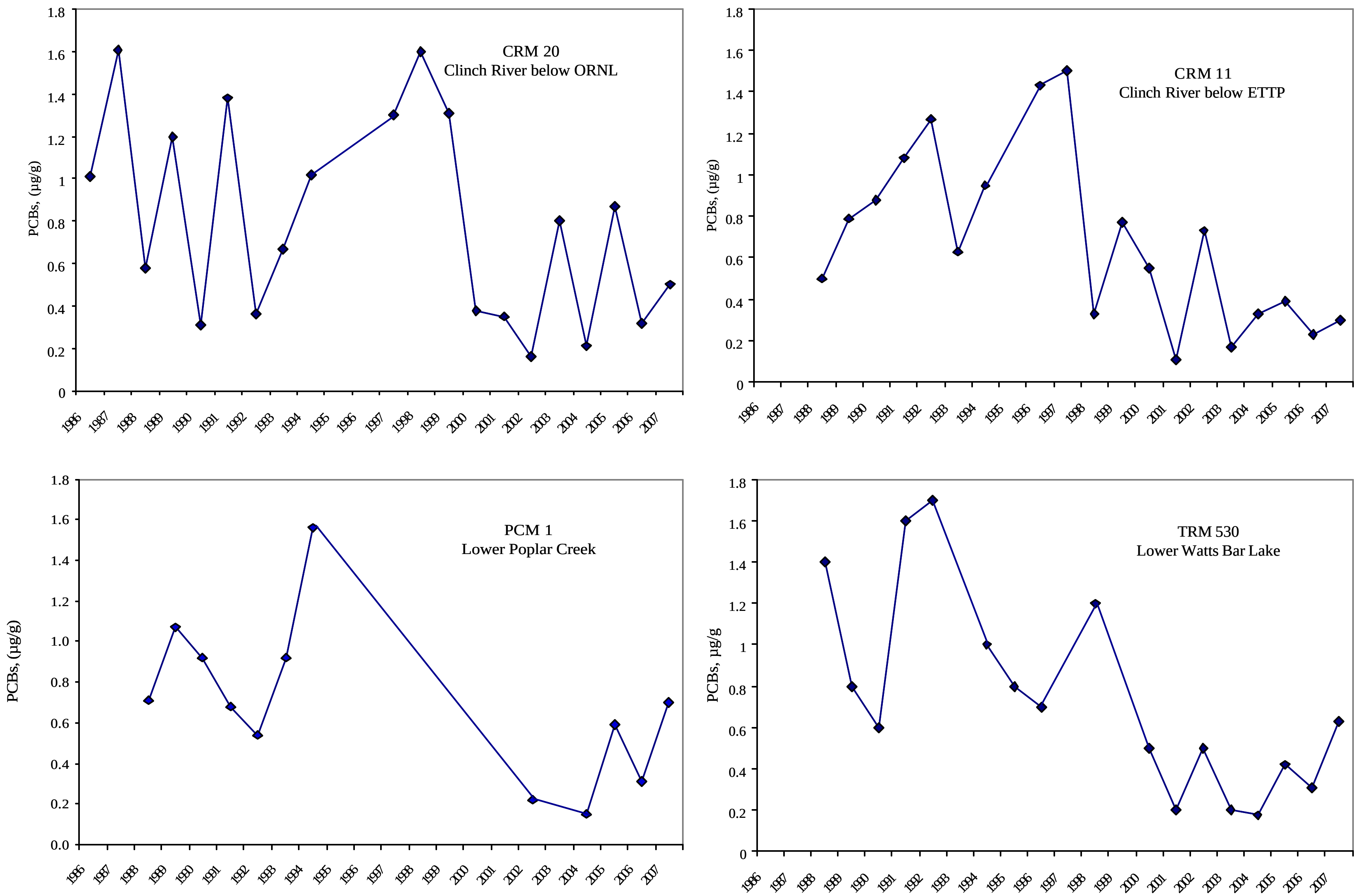

Fig. 7.5. Average PCB concentrations in channel catfish from CR/PC and LWBR sites, 1986 - 2007.
Courtesy of multiple programs, including BMAP, ASER, and Tennessee Valley Authority, 1986–2003. WRRP, 2004-2006.

7.3.3 Compliance with LTS Requirements

7.3.3.1 Requirements

Long-term stewardship requirements specified in the RAR (DOE 1999c) include conducting a survey of irrigation practices and determining the effectiveness (i.e., awareness) of fish consumption advisories (Table 7.2.). The CR/PC irrigation survey will be conducted before preparation of the decision document for the CR/PC surface water OU. A survey of local fishermen was conducted in the fall of 1998 and spring of 1999 to determine their awareness of the fish consumption advisory program.

7.3.3.2 Status of Requirements for FY 2007

TDEC, Division of Water Pollution Control, maintains fish consumption advisories for the local area. The TWRA posts these advisories on their web site and it was last updated in April 2007. These same advisories are included in the TWRA's 2007 Fishing Regulations that is available on-line and where fishing licenses are sold.

7.3.4 Site Summary: Condition and Trends

The implementation of the fish advisory in CR/PC was deemed protective as a ROD institutional control action in the early 1990s when PCBs in fish were approximately 1.0–1.5 mg/kg. PCB concentrations in fish from CR/PC are currently well below these levels, averaging 0.4–1.0 mg/kg, so the advisory continues to be protective. The current fish advisory for CR/PC will remain in effect because some species at some CR/PC sites continue to exhibit mercury and PCB concentrations above advisory levels.

7.3.5 Monitoring Changes and Recommendations

No monitoring changes are recommended for CR/PC. Annual monitoring will provide information as to how contaminant concentrations are changing in fish over time. If decreasing trends continue and risk reduction to acceptable levels is achieved, the advisory in the CR/PC could also be reevaluated in future years.

7.4 LOWER WATTS BAR RESERVOIR

The LWBR OU extends 38 river miles from TRM 567.5, at the mouth of the CR, downstream to the Watts Bar Reservoir dam at TRM 529.9 (Fig. 7.4). A complete discussion of the LWBR ROD is provided in Chapter 7 of Volume 1 of the 2007 RER.

7.4.1 Performance Goals and Monitoring Objectives

The original post-ROD monitoring plans for the action are in the RAWP for the LWBR OU (DOE 1996d). As discussed in Sect. 7.3.1, monitoring requirements for the LWBR are included with requirements for CR/PC in a combined monitoring plan (DOE 2004c).

The overall goal of the remedy for LWBR is to protect human health and the environment by reducing exposure to: (1) contaminated sediment in the main river channel, and (2) contaminants in fish. The fish monitoring strategy for LWBR is provided in the combined monitoring plan and summarized in Table 7.5.

Table 7.5. Monitoring locations in Lower Watts Bar Reservoir

Monitoring stations	Analyses[a]
Surface water: TRM 568.4 and TRM 530–532, once every 5 years	Surface water—isotopic uranium, total mercury, TAL metals, and hydrolab profile
Sediment: TRM 551–556 and TRM 530–532, once every 5 years	Total metals, total mercury, and ^{137}Cs
Fish: TRM 530–532 (catfish and large mouth bass), annually, summer only	PCBs, total mercury, and total lipid

[a]Analyses listed are those required to monitor effectiveness
PCB = polychlorinated biphenyl
TAL = target analyte list
TRM = Tennessee River mile

7.4.2 Evaluation of Performance Monitoring Data

The selected remedy defined in the ROD for the LWBR OU (DOE 1995d) is still in place and effective: (1) institutional controls prevent exposure to contaminated sediment; (2) fish consumption advisories reduce human exposure to contaminated fish; and (3) annual monitoring is conducted to evaluate changes in contaminant levels. A review of the efficacy of institutional controls preventing sediment exposure and the effectiveness of the fish consumption advisory was provided in the 2006 CERCLA/FYR (DOE 2007b). The results of that review suggest that institutional controls in place are effective in limiting human exposure, although some areas of the reservoir are not well posted and there are some groups of fisherman who do not follow advisories. The State of Tennessee is responsible for issuing fish consumption advisories and communicating relevant health information to the public.

Performance monitoring in LWBR has primarily focused on the Combined Monitoring Plan (DOE 2004c) requirements to evaluate changes in fish contaminant levels. These trending results are directly related to the ROD requirement that monitoring of water, sediment, and biota “be continued to determine if there is a change in the currently calculated risk that would pose a threat to human health and/or the environment.” The ROD indicated that the response action (namely, monitoring of contaminant levels or mobility) was considered applicable to reducing ecological risk.

Monitoring results indicate that PCB concentrations in 2007 averaged 0.63 mg/kg in channel catfish (Table 7.4). In general, TDEC has issued fish consumption advisories when PCB levels in fish are approximately 0.8 to 1 mg/kg (or higher). PCB concentrations in channel catfish have remained below the advisory level since 1998. Although PCBs in LWBR fish are higher in 2007 than in most recent years, the current levels are substantially lower than the concentrations observed in the 1980s and 1990s when the advisories were first issued (Fig. 7.5).

FY 2007 PCB levels in LWBR fish are below fish consumption advisory levels and are substantially lower than levels observed during the 1980s and 1990s.

Mercury concentrations in fish from LWBR are also low, averaging less than 0.15 mg/kg (Table 7.4). This level is less that the EPA fish tissue-based water quality criterion of 0.3 mg/kg. Mercury concentrations in the 0.2 mg/kg range are typical of largemouth bass and channel catfish in Tennessee reservoirs.

7.4.3 Compliance with LTS Requirements

7.4.3.1 Requirements

The RAWP (DOE 1996d) requires institutional controls (Table 7.2) for the LWBR, including: (1) continued use of TDEC's fish consumption advisories to limit exposure to contaminated fish, and (2) continued scrutiny of sediment-disturbing activities in LWBR by TDEC, Tennessee Valley Authority (TVA), U. S. Army Corps of Engineers (COE), and DOE to prevent exposure to potentially contaminated dredged soil.

7.4.3.2 Status of Requirements for FY 2007

Tennessee Department of Environment and Conservation, Division of Water Pollution Control, maintains fish consumption advisories for the local area. The TWRA posts these advisories on their web site and it was last updated in April 2007. These same advisories are also published in the TWRA's 2007 Fishing Regulations that is available on-line and where fishing licenses are sold.

The WBIWG provided continued controls on sediment-disturbing activity in the deep-water channel of the LWBR. In FY 2007, 11 dredging permit applications were received and reviewed by the WBIWG. All requests were approved.

7.4.4 Site Summary: Condition and Trends

The implementation of the fish advisory in LWBR was deemed protective as a ROD institutional control action in the early 1990s when PCBs in fish were approximately 1.5 mg/kg. The current PCB concentrations in fish from LWBR are substantially lower than the early 1990s. Based on the current levels in fish, the fish advisory in LWBR would seem to be protective. Mercury concentrations in LWBR fish are also below EPA and TDEC guidelines.

7.4.5 Monitoring Changes and Recommendations

No monitoring changes are recommended for LWBR. However, in addition to annual monitoring of LWBR catfish and bass required by the CERCLA ROD, a joint TVA-TDEC-ORNL effort to collect and analyze other species currently included on the fish advisory in LWBR is being conducted to evaluate the possibility of removing some of these advisories.

7.5 ORAU SOUTH CAMPUS FACILITY

The SCF is a former experiment station where the radionuclide effects on animals were studied (Fig. 7.6). In 1995, a ROD was signed that specified groundwater monitoring in the vicinity of a VOC contaminated area and land use controls including a groundwater use restriction. The land use restrictions have been maintained and groundwater monitoring has been conducted at the site. These activities are discussed in this section. A complete discussion of the facility and CERCLA decision is provided in Chapter 7 of Volume 1 of the 2007 RER (DOE 2007a).

7.5.1 Performance Goals and Monitoring Objectives

The SCF ROD (DOE 1995c) did not establish clear goals for groundwater quality; however, it did specify periodic monitoring of groundwater at selected wells and at a surface seep location. During the FY 2006 FYR of the decision, it was recommended that the remedy be redefined as a monitored natural attenuation remedy for groundwater with the ultimate goal of reaching MCLs for the volatile organic contamination in groundwater at the site. Additionally, in the FY 2006 FYR, continued annual sampling of two wells (GW-841 and GW-842) and a surface water location was recommended.

7.5.2 Evaluation of Performance Monitoring Data

During FY 2007, samples were collected from wells GW-841 and GW-842 and were analyzed for VOCs. No water was present at SCF-WS2 during the sampling site visit. Figure 7.7 shows the concentrations of detected VOCs in wells GW-841 and GW-842 from FY 1994 through FY 2007. Volatile organic contaminant concentrations in wells GW-841 and GW-842 have exhibited a long-term decreasing concentration history. The 2007 results showed decreased concentrations compared to the short-term increase observed during summer 2006. VOC concentrations remain higher at GW-841 than at GW-842, indicative of the lingering dissolved contamination near the spill site. TCE and its transformation product, *cis*-1,2-DCE, are detected in nearly equivalent concentrations at the wells indicating that degradation of the TCE is continuing to occur. PCE has been detected only sporadically at estimated low concentrations in well GW-841 and was not detected in the 2007 sample.

Groundwater continues to show evidence of VOC contamination.

7.5.3 Compliance with LTS Requirements

7.5.3.1 Requirements

The ROD (DOE 1995c) requires that a notification of the contamination be placed in the property title to alert potential owners of risk. A notice was filed with the Anderson County Register of Deeds on August 28, 1996.

7.5.3.2 Status of Requirements for FY 2007

An on-line search of the Anderson County Register of Deeds web site was conducted in FY 2007 and verified that the notice remains filed.

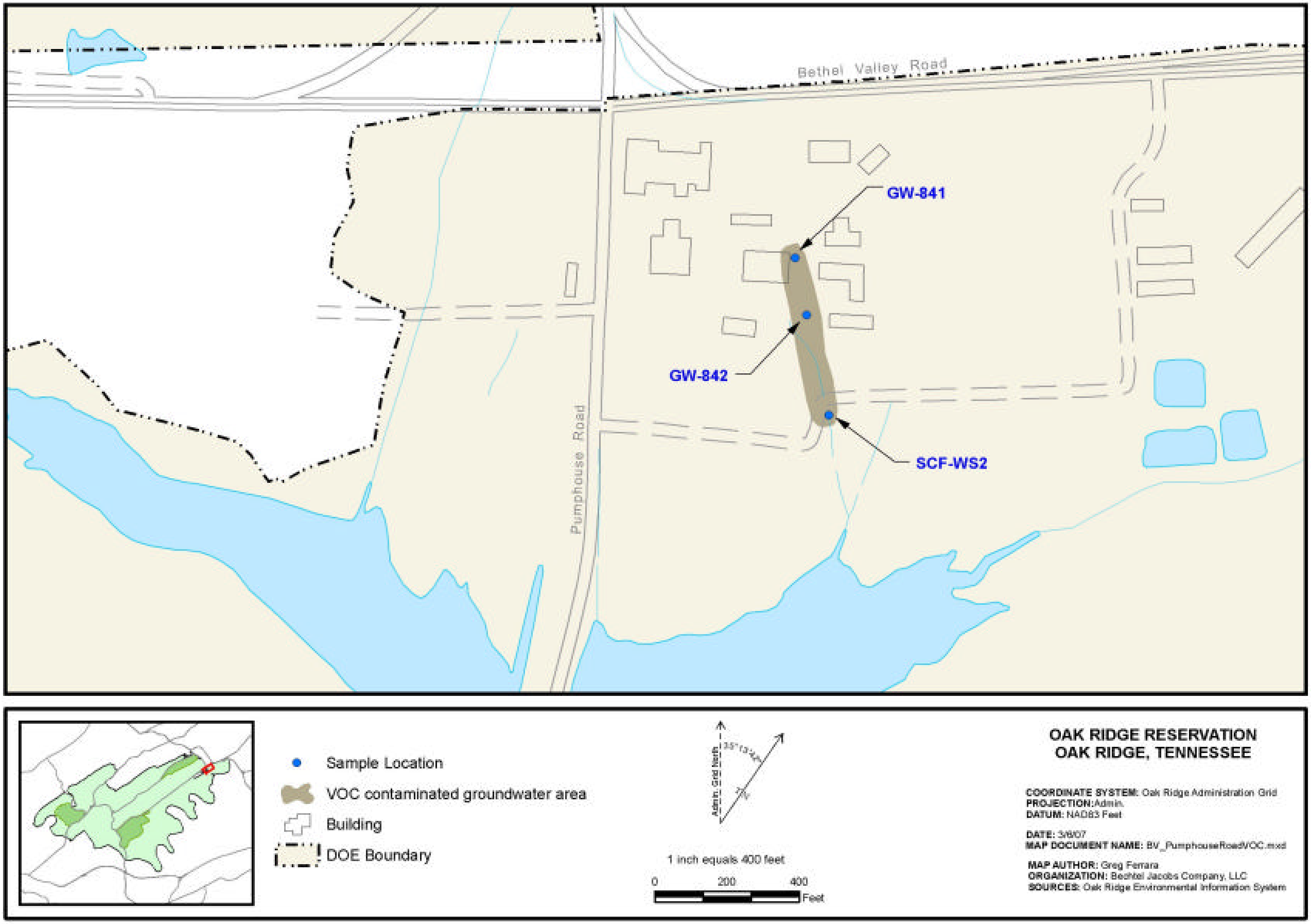

Fig. 7.6. South Campus Facility monitoring locations and contaminated groundwater area.

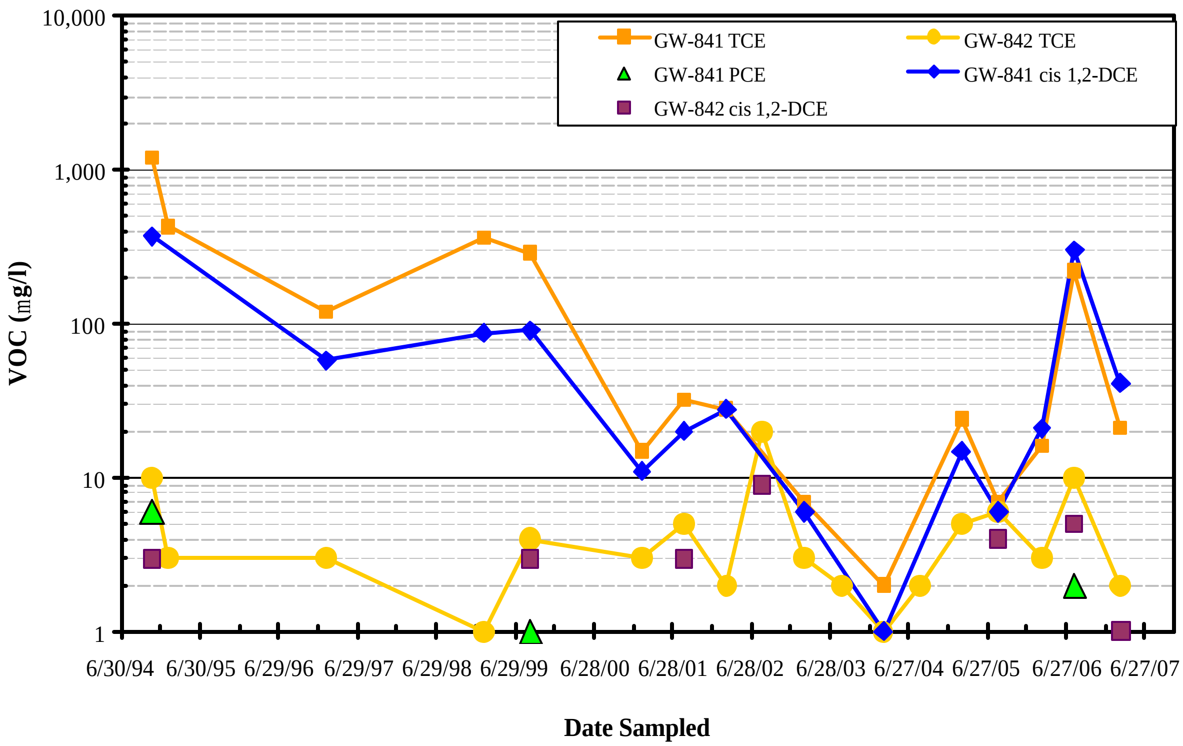

Fig. 7.7. VOC concentrations in wells GW-841 and GW-842 at South Campus Facility.

7.5.4 Site Summary: Condition and Trends

VOC concentrations continue to fluctuate within the general concentration ranges that have been observed since about 2001. Concentrations appear to fluctuate in response to periods of increasing and decreasing rainfall which control the amount of groundwater recharge in the area.

TCE and its degradation product, *cis*-1,2-DCE, were detected in nearly equivalent concentrations in the monitoring wells, consistent with ongoing Monitored Natural Attenuation (MNA) of the site contamination.

7.5.5 Monitoring Changes and Recommendations

No changes in monitoring at SCF are recommended at this time.

7.6 UNION VALLEY INTERIM ACTION

Location of the UV Interim Action is shown on Fig. 6.1. The primary objective of this interim action was to protect human health from a contaminated plume originating from beneath the Y-12 Complex and detected in the groundwater below privately owned land in UV. Institutional controls were selected as the interim remedy to accomplish the following goals: ensure that public health is protected while final actions are being developed and implemented, and identify and prohibit, if necessary, future activities with a potential to accelerate the rate of contaminant migration from the characterization area (CA) or increase the extent of the contaminant plume. A discussion of the UV groundwater plume is included in Chapter 6 on the UEFPC watershed. Background information on this remedy and performance standards are provided in Chapter 7 of Volume 1 of the 2007 RER.

This site has only LTS requirements. A review of compliance with these LTS requirements is included in Sect. 7.6.3.

7.6.1 Performance Goals and Monitoring Objectives

No surface water or groundwater monitoring is required as part of this interim action to verify the effectiveness of the remedial action. The EEVOC Plume Removal Action (see Sect. 6.3.1) included construction of a groundwater treatment facility to prevent further migration of the VOC-contaminated groundwater plume off of the ORR.

7.6.2 Evaluation of Performance Monitoring Data

No surface water or groundwater monitoring is required as part of the UV Interim Action. However, evaluation of performance goals and monitoring objectives for the EEVOC Plume Removal Action is included in Sect. 6.3.1.3 of this report.

7.6.3 Compliance with LTS Requirements

7.6.3.1 Requirements

The ROD (DOE 1997d) requires that the DOE Program Office ensure that the required property title searches and appropriate notifications are made during the term of the ROD (i.e., until a final ROD is issued for the UEFPC CA). The DOE Real Estate Office is responsible for the following institutional controls:

- Complete an annual title search by the anniversary date of the ROD to determine whether any affected property has changed hands;
- Notify property owners, the Oak Ridge city manager, and the TDEC/DOE Oversight Division of their obligations under the agreements and updating them on the status of the environmental investigations;
- Survey owners by telephone to determine whether any new groundwater wells have been constructed or planned or there are any new uses for surface water; and
- Notify licensed well drillers in Tennessee of the license agreements and their terms.

7.6.3.2 Status of Requirements for FY 2007

Compliance with all requirements was verified. The DOE-ORO Realty Officer provided documentation that property owners, the Oak Ridge City Manager, and TDEC-DOE/O had been notified of their respective obligations and that Tennessee licensed well drillers were notified of the license agreements and terms. Documentation that all required title searches were conducted and that property owners were surveyed by telephone as required was provided by the BJC Property Management Office. There were no deficiencies noted in meeting the requirements.

7.6.4 Site Summary: Condition and Trends

An evaluation of performance goals and monitoring objectives for the EEVOC Plume Removal Action is included in Sect. 6.3.1.3 of this report, which describes the effectiveness of that action to reduce VOC concentrations within the upgradient off-site exit pathway in UV.

7.6.5 Changes and Recommendations

No changes are recommended at this time.

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8. CERCLA ACTIONS AT EAST TENNESSEE TECHNOLOGY PARK

8.1 INTRODUCTION AND OVERVIEW

This chapter provides an update to CERCLA activities completed during FY 2007 at ETTP (Sect. 8.1.1). Only sites that have performance monitoring and/or LTS requirements are included in the performance evaluations; those sites are noted in Table 8.1. Performance goals and objectives, monitoring results, an assessment of the effectiveness of each completed action are presented, and a review of compliance with any LTS requirements (Table 8.2) is also included, as appropriate (Sect. 8.2.1, Sect. 8.3.1, and throughout Sect. 8.4). Figure 8.1 shows the locations of completed actions at ETTP.

Background information about each remedy and performance standards, and a compendium of all CERCLA decisions in the watershed within the context of a contaminant release conceptual model is provided in Chapter 8 of Volume 1 of the 2007 RER (DOE 2007a). This information will be updated with information provided in the annual RER and republished every fifth year at the time of the CERCLA FYR.

Table 8.1 CERCLA actions at ETTP

CERCLA action	Decision document: date signed (mm/dd/yy)	Action status[a] (approval date mm/dd/yy)	Monitoring/ LTS required	RER Sect.
Watershed-scale actions				
Zone 1 Selected Contaminated Areas Interim Removal Actions	ROD: 11/08/02	Remedial action in progress		
		Duct Island/K-901 Area PCCR (04/08/06)	No/Yes	8.2
		K-1007 Ponds/Powerhouse PCCR (10/04/06)	No/Yes	
		K-770 Scrap Removal PCCR (05/30/07)	No/Yes	
Zone 2 Soil, Buried Waste, and Subsurface Structure Removal Actions	ROD: 04/06/05	Remedial action in progress		
		FY 2006 PCCR for Zone 2 (02/08/07)	No/Yes	8.3
		FY 2007 PCCR for Zone 2 (submitted 09/28/07; approval pending)	No/Yes	
ETTP Site-Wide Residual Contamination Remedial Action	ROD: TBD	TBD	TBD	--
	AM: 03/23/07[b] (K-1007-P and K-901-A holding ponds, K-720 Slough, and K-770 Embayment)	Removal action in planning stage (Once completed, will supersede existing AM for K 901-A and K-1007-P1 ponds).	Monitoring plan to be developed when action implemented.	
Completed single-project actions				
K-1417-A/B Drum Storage Yards Remedial Action	ROD: 09/19/91	Remedial action complete. RAR approved (03/02/95).	No/No	--

Table 8.1 CERCLA actions at ETTP (continued)

CERCLA action	Decision document: date signed (mm/dd/yy)	Action status[a] (approval date mm/dd/yy)	Monitoring/ LTS required	RER Sect.
K-1070-C/D SW-31 Spring Remedial Action	IROD: 09/30/92 ESD: 07/08/93	Remedial action complete. Remedial Action Effectiveness Report (RAER) approved (12/11/96). Addendum to RmAER approved (02/28/07).	Yes/No	--[e]
K-1407-B/C Ponds Remedial Action	ROD: 09/30/93	Remedial action complete. Also, closed under RCRA. RAR approved (08/16/95).	Yes/Yes	8.4.1
K-1401 and K-1420 Sumps Removal Action	AM: 08/18/97	Removal action complete. RmAR approved (02/01/99). Addendum to RmAR to terminate operation approved (04/20/06).	No/No	--
K-1070-C/D and Mitchell Branch Removal Action	AM: 08/25/97	Removal action complete. D2 RmAR approved (03/02/99).	Terminated[c]	--
K-901-A and K-1007-P Pond Removal Action	AM: 10/17/97	Removal action complete. RmAR approved (11/12/99).	Yes/Yes (To be superseded)	8.4.2
K-1070-C/D G-Pit and Concrete Pad Remedial Action	ROD: 11/18/97	Remedial Action complete. RAR approved (02/18/03).	No/Yes	8.4.3
K-1070-A Burial Ground Remedial Action	ROD: 01/19/00	Remedial action complete. RAR approved (11/28/03).	No/Yes	8.4.4
K-1085 Old Firehouse Burn Area Drum Burial Site Removal Action	AM: 03/04/01	Removal action complete. RmAR conditionally approved (02/18/03). Completion Letter approved (01/19/07).	No/No	--
Outdoor Low-Level Waste Removal Action	AM: 11/14/03	Removal Action complete. RmAR approved (08/24/05).	No/No	--
ETTP decontamination and demolition projects				
K-25 Auxiliary Facilities Group I Building Demolition (KAFaD)	AM: 01/17/97	Removal action complete. RmAR issued August 1999. Addendum I approved 06/02/05. Addendum II approved 06/05/06.	No/No	--
K-29, K-31, and K-33 Equipment Removal and Building Decontamination	AM: 09/29/97	Removal Action complete. RmAR approved (06/08/07). Addendum submitted (09/26/07)	No/No	--
K-25 Auxiliary Facilities Group II, Phase 1 Building Demolition, Main Plant	AM: 09/08/00	Removal action complete. RmAR approved (09/24/04).	No/Yes	--
K-25 and K-27 Buildings Decontamination and Decommissioning	AM: 03/08/02 NSC: 12/16/05	Removal action in progress. PCCR for Hazardous Materials Abatement conditionally approved (12/19/05) Completion of Hg ampoules disposal in accordance with the PCCR (02/22/06)	No/No	--
K-25 Auxiliary Facilities Group II, Phase 2 Building Demolition, K-1064 Peninsula Area	AM: 07/31/02	Removal action complete. RmAR approved (06/27/07).	No/Yes	8.5

Table 8.1 CERCLA actions at ETTP (continued)

CERCLA action	Decision document: date signed (mm/dd/yy)	Action status[a] (approval date mm/dd/yy)	Monitoring/ LTS required	RER Sect.
K-25 Group II, Phase 3 Building Demolition, Remaining Facilities	AM: 09/12/03	Removal action in progress.		
		FY 2004 PCCR – PUF (03/28/05)	No/No	8.5
		FY 2005 PCCR – PUF (02/15/06)	No/No	
		FY 2005 PCCR – LR/LC Facilities (02/15/06)	No/No	
		FY 2006 PCCR – PUF (06/07/07)	No/No	
		FY 2006 PCCR – LR/LC Facilities (06/06/07)	No/Yes	
		BOS D&D-Labs D&D PCCR (08/30/07)	No/Yes	
		FY 2007 PCCR – PUF (submitted 09/28/07)	No/No	
		FY 2007 PCCR – LR/LC Facilities (submitted 09/28/07)	No/No[d]	
		K-29 Process Building PCCR (pending TDEC approval)	No/Yes	
		K-1420 Decon & Recovery Facility (pending TDEC approval)	No/Yes	

[a] Detailed information of the status of ongoing actions is from Appendix E of the FFA and is available at **http://www.bechteljacobs.com/ettp-ffa-appendices.html**

[b] Once completed, monitoring activities associated with this AM (DOE/OR/01-2314&D2) will supersede monitoring associated with the previous removal action (DOE/OR/01-1550&D2), and will then be incorporated into the format of the annual RER. Until that time, the reader is referred to Sect. 8.4.2 for a summary of performance monitoring results for K-1007-P1 and K-901-A holding ponds.

[c] See discussion of terminated action in FY 2007 RER Vol. 1, Chapter 8.

[d] No additional environmental and radiological monitoring is required. The "Contamination Area" which contains the Building K-726 subsurface concrete footings and the Building K-736 asphalt slab is monitored in accordance with the K-770 Scrap Removal Project. The K-1232 tank farm is monitored as of the Poplar Creek project. The site containing the K-601 slab is monitored by the K-25/K-27 D&D Project as a waste staging area (DOE/OR/01-2362-D1).

[e] Monitoring data for the SW-31 Spring will be reported in the FYR or applicable RER, when collected.

AM = Action Memorandum
BOS = Balance of Site
D&D = decontamination and demolition
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
ESD = Explanation of Significant Difference
ETTP = East Tennessee Technology Park
FY = fiscal year
LR/LC = low risk/low complexity
LTS = long-term stewardship
NSC = Non-Significant Change
PCCR = Phased Construction Completion Report
PUF = predominantly uncontaminated facilities
RAR = Remedial Action Report
RCRA = Resource Conservation and Recovery Act of 1976
RmAR = Removal Action Report
RAER = Remedial Action Effectiveness Report
ROD = Record of Decision
TDEC = Tennessee Department of Environment and Conservation

ETTP does not have a sole surface water IP at which all upstream contaminant releases converge to exit the watershed; ETTP has several subwatersheds and, therefore, has several surface water IPs (see Fig. 8.1). Because many CERCLA decisions have not yet been implemented at ETTP and baseline monitoring data continue to be collected, this chapter concludes with a preliminary evaluation of the early indicators of effectiveness for each sub-watershed, such as contaminant trends at the surface water IPs for the various subwatersheds.

For planning and administrative purposes, ETTP is divided into three zones (Fig. 8.2). Zone 1 comprises approximately 1400 acres outside the fenced main plant area, but within the area where most disposal activities took place, and Zone 2 comprises approximately 800 acres containing the main plant area. The Balance of Site, which encompasses approximately 2800 acres surrounding Zones 1 and 2, is primarily uncontaminated and part of DOE's planned footprint reduction. Figure 8.2 illustrates the land uses identified in the Zone 1 and Zone 2 RODs.

Table 8.2 Long-term stewardship requirements for CERCLA actions at ETTP

Site/Project	LTS Requirements: Land Use Controls	LTS Requirements: Engineering Controls	Status	RER Section
Watershed-scale actions				
ROD for Interim Actions for Selected Contaminated Areas Within Zone 1, ETTP ▪ Duct Island/K-901 Area PCCR ▪ K-1007 Ponds/Powerhouse PCCR ▪ K-770 Scrap Removal PCCR	Watershed LUCs Administrative: ▪ property record restrictions ▪ property record notices ▪ zoning notices ▪ permits program Physical: ▪ access controls ▪ signs ▪ security patrols K-770 PCCR specific: ▪ fencing ▪ CA postings	K-770 PCCR specific: ▪ radiological surveys	Watershed LUCs ▪ Physical LUCs in place. ▪ Administrative LUCs required at completion of actions. K-770 PCCR specific: ▪ LUCs in place. ▪ Engineering Controls remain protective.	8.2.3
ROD for Soil, Buried Waste and Subsurface Structure actions in Zone 2, ETTP ▪ FY 2006 PCCR ▪ FY 2007 PCCR	Watershed LUCs Administrative: ▪ property record restrictions ▪ property record notices ▪ zoning notices ▪ permits program Physical: ▪ access controls ▪ signs ▪ security patrols K-1070-C/D Burial Ground specific: ▪ access controls		Watershed LUCs ▪ Physical LUCs in place. ▪ Administrative LUCs required at completion of actions. ▪ Property record restrictions filed upon transfer of buildings in Zone 2. K-1070-C/D Burial Ground specific: ▪ LUCs in place.	8.3.3
Completed single-project actions				
K-1407-B/C Ponds Remedial Action	▪ Access and activity controls	S&M, including ▪ Periodic inspections ▪ Radiological and industrial hygiene surveillance	▪ LUCs in place. ▪ Engineering Controls remain protective.	8.4.1.3
K-901-A Pond and K-1007-P Ponds Removal Action	▪ Signs	▪ Maintain weir	▪ LUCs in place. ▪ Engineering Controls remain protective.	8.4.2.3
K-1070-C/D G-Pit and Concrete Pad Remedial Action	▪ Fences ▪ EPP program	▪ Maintain vegetated soil cover on concrete pad ▪ Periodic radiological surveys	▪ LUCs in place. ▪ Engineering Controls remain protective.	8.4.3.2
K-1070-A Burial Ground	▪ Access controls ▪ EPP program ▪ Surveillance patrols	▪ Maintain soil cover	▪ LUCs in place. ▪ Engineering Controls remain protective.	8.4.4.2

Table 8.2 Long-term stewardship requirements for CERCLA actions at ETTP (continued)

Site/Project	LTS Requirements		Status	RER Section
	Land Use Controls	Engineering Controls		
ETTP D&D Projects				
K-25 Auxiliary Facilities Group II, Phase 1 Building Demolition, Main Plant	▪ EPP program		▪ LUCs in place.	--
K-25 Auxiliary Facilities Group II, Phase 2 Building Demolition, K-1064 Peninsula Area	▪ CA postings	▪ radiological surveys	▪ LUCs in place. ▪ Engineering Controls remain protective.	8.5.1
K-25 Group II, Phase 3 Building Demolition, Remaining Facilities ▪ FY2006 PCCR-LR/LC Facilities ▪ BOS D&D-Labs D&D PCCR[(1)] ▪ K-29 Process Building PCCR ▪ K-1420 Decon & Recovery Facility	▪ CA postings	▪ radiological surveys	▪ LUCs in place. ▪ Engineering Controls remain protective.	8.5.1

[(1)] All the slabs under this action were removed in FY 2007 and no longer require CA postings or radiological surveys.

BOS = balance of sites
CA = Characterization Areas
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
D&D = decontamination and decommissioning
EPP = excavation/penetration permit
ETTP = East Tennessee Technology Park
LTS = long-term stewardship
LUC = land use control
PCCR = Phased Construction Completion Report
RER = Remediation Effectiveness Report
ROD = Record of Decision
S&M = surveillance and maintenance

To date, most of the completed remedies at the ETTP have been single-action project decisions to address primary sources of contamination or primary release mechanisms. Concurrent with these actions, D&D of most buildings at ETTP is occurring under CERCLA removal authority. While these actions ultimately help to reduce contaminant loading or minimize the potential for future releases to exit pathways from ETTP, the goals of many of these actions have not included specific, measurable performance criteria for reductions in flux or risk in surface water and groundwater at the watershed scale. Recent watershed-scale decisions relate to soil, buried waste, and subsurface structures for the protection of human health and to limit further contamination of groundwater through source reduction or removal. The remaining media (e.g., groundwater, surface water, and sediments) and ecological receptors will be evaluated and addressed by final sitewide decision(s).

8.1.1 Status and Updates

This section provides the status and updates of remedial actions and D&D projects at ETTP for FY 2007. Historically, D&D projects did not include any monitoring and/or LUCs and, therefore, were not included in the annual CERCLA document that evaluated monitoring data to assess the effectiveness of the remedial action, e.g., the RER. But now because some D&D projects do have LUC requirements, all D&D projects are included in Table 8.1, although only those with interim LUCs will be discussed in the text.

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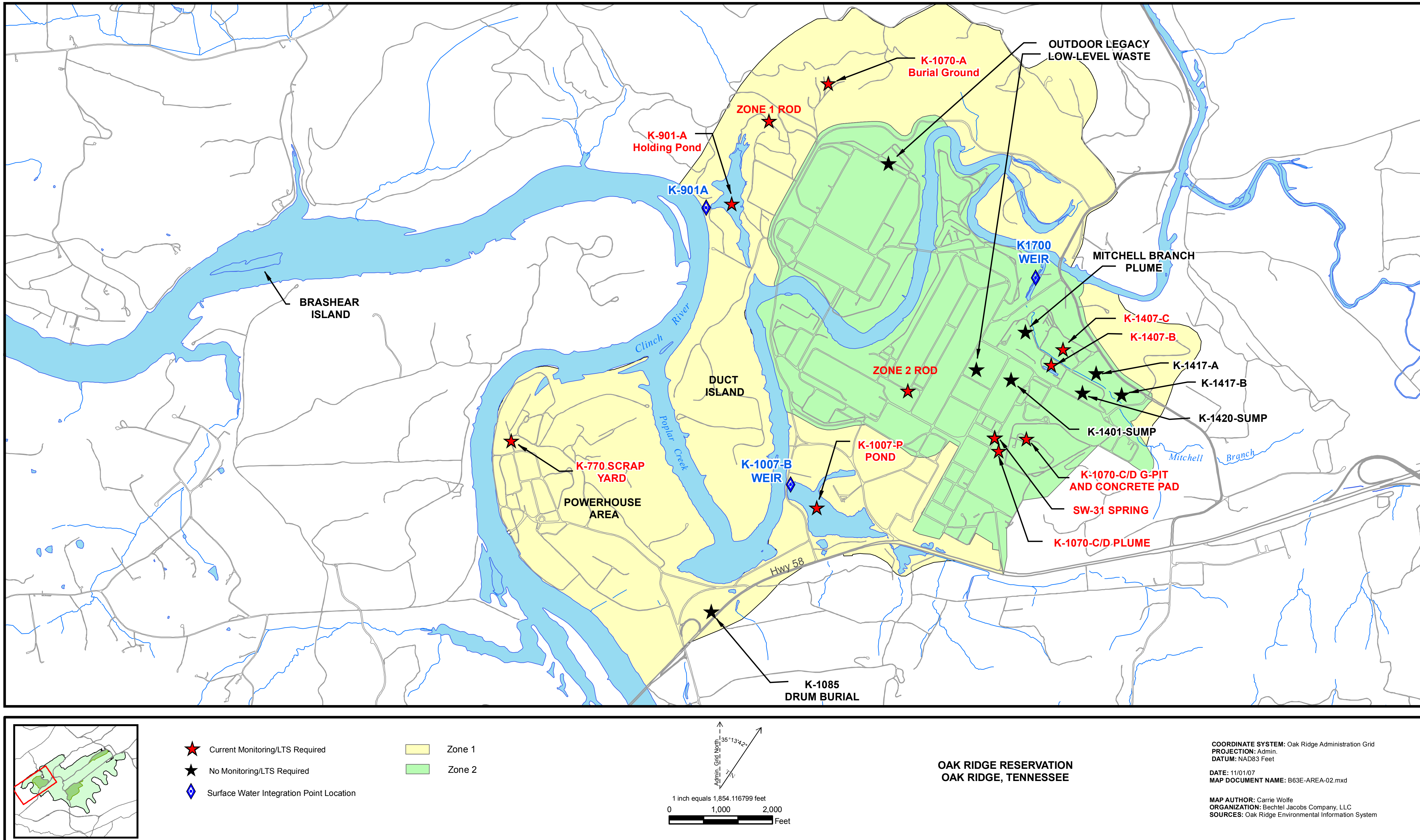

Fig. 8.1 ETTP RA site map.

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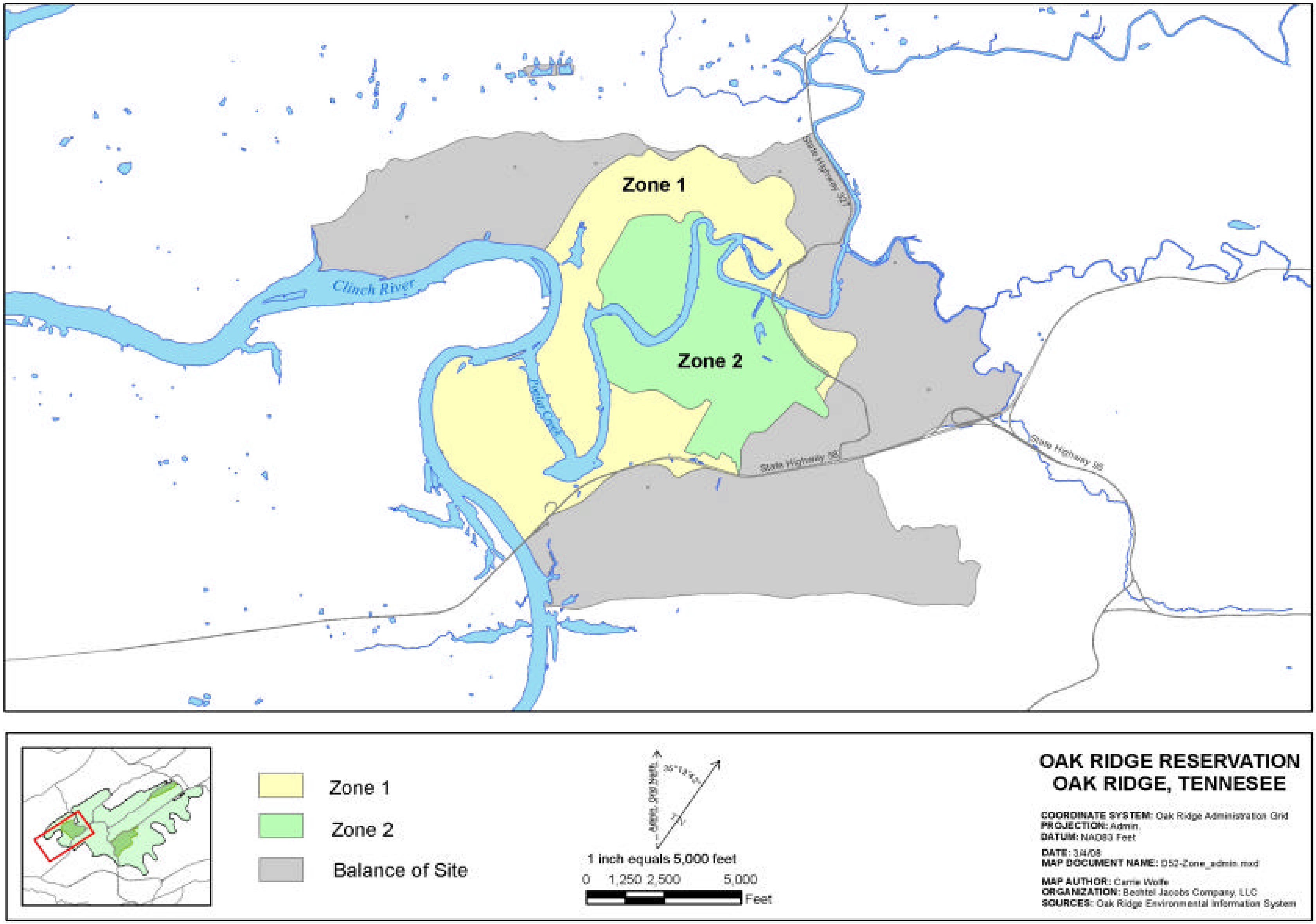

Fig. 8.2. ETTP administrative subdivisions.

ETTP Watershed-scale Actions

The PCCR for the K-770 Scrap Removal Project (DOE 2007f) completed under the Zone 1 ROD, was approved on May 30, 2007. Because there were contaminated slabs left behind, monitoring and access controls are required, which are discussed in more detail in Sect. 8.2.3.

The FY 2006 PCCR for Zone 2 (DOE 2006j) was approved in February, 2007. The PCCR documents the characterization results of the DVS for the accessible EUs in Zone 2 for FY 2006; describes and documents the risk evaluation for each EU and the determination of whether the EU met the Zone 2 ROD requirements for unrestricted industrial use to 10 ft bgs; and identifies additional areas not defined in the Zone 2 ROD that require remediation based on the DVS evaluation results. The FY 2007 PCCR for Zone 2 (DOE 2007g) was submitted to the regulators on September 28, 2007, and has not been approved. Neither of these post-decision documents include any requirements for monitoring or additional land-use controls.

An AM to document the non-time-critical removal action for four surface water bodies (K-1007-P, K901-A holding ponds, K-720 Slough, and K-770 Embayment) at ETTP was approved on March 23, 2007 (DOE 2007h). This action memorandum supersedes the previous action memorandum for the K-901-A Pond and the K-1007-P1 Pond removal action (DOE 1997e), which addressed the removal and disposition of gas cylinders and other hazardous material containers, as well as other metal debris, from the ponds. Monitoring and routine surveillance and maintenance activities (Sect. 8.4.2) will continue unchanged under the existing requirements until a new monitoring plan is developed under the requirements of the recently-approved AM.

ETTP Single-action Projects

An Addendum (DOE 2007i) to the Remedial Action/Effectiveness Report (DOE 1996e) for K-1070 OU SW-31 Spring interim action was approved in February 2007. The Addendum documents that the collection and treatment of the SW-31 Spring at the ETTP can be stopped, noting that the water currently meets AWQC. However, the Addendum requires continued monitoring on an "interim basis" until the Sitewide ROD identifies long-term monitoring requirements for ETTP. The spring will be checked for flow the year prior to the CERCLA FYR or in a particularly wet year, as appropriate. These data will be reported in the FYR or appropriate RER.

ETTP Decontamination and Demolition Projects

During FY 2007, most of the CERCLA actions at ETTP focused on completion of D&D activities. Most buildings, except for a few usable ones, are scheduled for demolition as part of DOE's accelerated cleanup plan. The facilities that will remain are targeted for potential title transfer to private sector organizations under a reindustrialization program. Thus far, six building transfers have taken place (K-1036, K-1400, K-1225, K-1330, K-1580, and K-1007). Building demolition is performed as part of CERCLA removal actions, organized into several projects as follows:

1) K-25/K-27 Buildings. An AM for the demolition of the K-25 and K-27 buildings was signed in 2002, stipulating that the buildings be demolished to slab and the associated waste disposed. Hazardous materials removal, phase 1 of the demolition, was completed in June 2005. A new plan for demolishing the buildings was developed in 2006 that would better protect workers from the deteriorated conditions in the buildings by removing high-risk components and demolishing the buildings from the outside using heavy equipment. Activities in FY 2007 included constructing segmentation and nondestructive assay shops to expand dismantling capabilities,

installing nets and barriers to protect workers from falling debris, and initiating removal of approximately 2,700 light ballasts.

2) Group I Auxiliary Facilities. In FY 1997, the AM to demolish five ETTP auxiliary facilities was signed. This project was completed in FY 2006 with the final addendum to the RmAR approved.

3) Group II, Phase 1 Main Plant Facilities. In FY 2000, DOE signed an AM to demolish the ETTP main plant facilities. This project began in August 2000 and was completed in December 2003. In FY 2004, the RmAR was approved.

4) Group II, Phase 2 Building Demolition (K-1064 Peninsula). DOE signed an AM in July 2002 for the demolition of 18 facilities and the removal of scrap material located in the K-1064 peninsula area. In FY 2007, the work was completed, and the RmAR was approved June 27, 2007.

5) K-29/K-31/K-33 Buildings Decontamination. The AM was approved in 1997 to decontaminate and remove equipment from the K-29, K-31, and K-33 gaseous diffusion buildings. The work was completed in FY 2005 and the RmAR was approved in FY 2007.

6) Group II, Phase 3 Remaining Facilities Demolition. In September 2003, an AM was approved to demolish approximately 500 remaining facilities at ETTP. In FY 2007, 16 predominantly uncontaminated facilities, 20 low-risk/low-complexity facilities, and two high risk facilities–K-1401 and K-1420–were demolished. Building K-1401, a maintenance facility built to support the gaseous diffusion process, was approximately 400 ft by 1000 ft by 32 ft in height with a basement measuring approximately 200 ft by 340 ft. Demolition of K-1401 was completed in September 2007. The K-1420 building, used to recondition uranium enrichment equipment, had approximately 101,600 sq ft of floor space; demolition was completed in December 2006.

Also during FY 2007, as part of the Remaining Facilities Demolition Project, in the PC area, asbestos abatement was completed in K-633, K-131, K-631, K-1231, and K-1413; chemical treatment was completed in K-633 and the K-27/K-633 tie line; characterization was completed in K-1231, K-1233, K-633, and K-633/K-27 tie line; chemical treatment was completed in all facilities and tie lines associated with hydrofluoric acid distribution to the uranium processing facilities; and the remaining uranium hexafluoride (UF_6) cylinders from Building K-33 were disposed.

During FY 2007, completion of D&D activities (see Group II, Phase 2 and Group II, Phase 3 above) has been documented by various PCCRs (Table 8.1), many of which include requirements for radiological surveys and access controls because slabs or portions of foundations were left in place. If radiological surveys indicated a slab or the remaining soil had residual contamination that exceeded the release criteria of DOE Order 5400.5, then interim access controls were implemented and the slab was posted and became part of the radiological surveillance and monitoring program. In general, storm water runoff from concrete pads is not sampled directly. The ETTP ECP determines the effectiveness of the radiological control program through ongoing storm drain outfall sampling and instream water sampling, i.e., monitoring in compliance with the ETTP NPDES permit and storm water runoff plans.

Section 8.5 has been added to this year's RER to provide a summary of monitoring and reporting requirements for each of the D&D closure projects that left slabs/foundations or contaminated soils in place. Because all D&D activities have been completed as removal actions, the CERCLA Zone 1 and the Zone 2 RODs will determine the final remedy for the contaminated slabs, soils, and below-grade structures that remain.

8.2 ZONE 1 SELECTED CONTAMINATION AREAS INTERIM REMOVAL ACTION RECORD OF DECISION

The ROD for Interim Remedial Actions for Selected Contaminated Areas within Zone 1 (Fig. 8.2) of ETTP (Zone 1 ROD) focuses on known sources of releases and on known areas of soil contamination (DOE 2002e). Major components of the remedy include:

- excavation of contaminated soil in the K-895 Cylinder Destruct Facility Area and in the Powerhouse Area (including K-725 Beryllium Building Slab);
- excavation of the Blair Quarry burial area;
- removal of scrap metal and debris from the K-770 area;
- removal of sludge and demolition of the K-710 sludge beds and Imhoff tanks;
- characterization of areas with insufficient data to determine if a release occurred or if the potential for a release is present; and
- interim land use controls to prevent access to remaining contamination.

Zone 1 was divided into four geographic areas for evaluation for unrestricted industrial use to 10 ft bgs– the Duct Island Area, K-901 Area, K-1007 Ponds Area, and the Powerhouse Area. The final status assessments and associated data gap sampling efforts for the remaining areas of soil in these four geographic areas is being conducted using the DVS. These four areas are further divided into EUs. The PCCR (DOE 2006k) for the Duct Island Area and K-901 Area of Zone 1 documents completion of the remedial activities at Blair Quarry, describes the risk assessment evaluations performed and determinations made using DVS, and identifies additional sites requiring remedial actions. A second PCCR (DOE 2006l) documents the characterization results of the DVS for the accessible EUs within the K-1007 Ponds Area and Powerhouse Area, and identifies additional areas that require remediation.

The K-770 Scrap Removal Project was conducted as part of the Zone 1 ROD and began shipping contaminated scrap from the K-770 Scrap Yard (Fig. 8.1) to the EMWMF in July 2004. The PCCR (DOE 2007h) was approved in May 2007. Over 10,050 tons of waste material was shipped for disposal. However, contamination on several slabs and in the soil was not removed and a final remedy awaits the results of DVS. Because the action under this ROD (DOE 2002e) did not remove all contamination, interim monitoring and land use controls are required to verify contamination is not migrating from the site, as discussed below.

A complete discussion of the ETTP Zone 1 ROD and a summary of actions is provided in Chapter 8 of Volume 1 of the FY 2007 RER.

8.2.1 Performance Goals and Monitoring Objectives

The RAOs for Zone 1 are: (1) to protect human health under an unrestricted industrial land use (allows industrial use to 10 ft bgs) to a risk level not to exceed 10^{-4}, and (2) to control leaching and migration from contaminated soil to help minimize further impacts to groundwater. The industrial risk scenario is based on direct contact routes of exposure: (1) incidental ingestion, (2) inhalation of particulates and vapors, (3) dermal contact, and (4) external exposure. The industrial worker is assumed to have an exposure frequency of 2000 hours/year (8 hours/day for 250 days/year) and an exposure duration of 25 years (DOE 2002e). When actions within Zone 1 are completed, they are deemed effective for industrial land use based on confirmatory sampling.

8.2.2 Evaluation of Performance Monitoring Data

Because all of the actions under this ROD remove contamination, thereby removing any risk to groundwater, no performance monitoring is required (DOE 2002e).

8.2.3 Compliance with LTS Requirements

8.2.3.1 Requirements

Long-term stewardship requirements for CERCLA actions at ETTP are summarized in Table 8.2. The Zone 1 ROD (DOE 2002e) establishes "unrestricted industrial" as the land use for Zone 1, and requires LUCs to prevent disturbance of soils below 10 ft in depth and to restrict future land use to industrial/commercial activities. To implement restrictions that prohibit more aggressive use of this area and to restrict access to this area until that land use has been achieved, seven LUCs will be implemented. Until the land use is achieved, reliance will be primarily on property record and zoning notices, the excavation/penetration permit program, access controls, and surveillance patrols. Once it has been established that Zone 1 is safe for unrestricted industrial use, property record restrictions, property record notices, zoning notices, excavation permits, and less significant surveillance patrols will be used. The objectives of these controls are as follows:

- Property record restrictions to restrict uses of the property by imposing limitations on its use and to prohibit uses of groundwater;
- Property record notices to provide notice to anyone searching records about the existence and location of contaminated areas and limitations on their use;
- Zoning notices to provide notice to the city about the existence and location of waste disposal and residual contamination areas for zoning/planning purposes;
- An excavation/penetration permit program to provide notice to permit requestors of the extent of contamination and prohibiting or limiting excavation/penetration activity;
- Access controls to control and restrict access to workers and the public in order to prevent unauthorized uses; and
- Surveillance patrols to control and monitor access by workers and the public.

The PCCRs completed under the Zone 1 ROD for the Duct Island/K-901-A Area and K-1007 Ponds/Powerhouse Area state that, consistent with the Zone 1 ROD, the NFA decision means that an EU is available for unrestricted industrial use to a depth of 10 ft. bgs. All EUs that have been cleared for industrial use to a depth of 10 ft bgs have a high probability of being cleared for industrial use to all depths, with the exception of EU 59 in the Duct Island Area and EU 9 at the K-1085 Burn Area in the Powerhouse Area. Formerly buried wastes and/or contaminated groundwater are present at depths in these EUs, and therefore, LUCs are in place and an action is required.

The K-770 Scrap Removal PCCR under the Zone 1 ROD requires additional LTS activities including controlling access to the K-770 Scrap Metal Yard and ensuring the fence surrounding the area remains intact. Additionally, interim controls such as maintaining CA postings and conducting radiological surveys are required at the following areas with residual radiological contamination above the release criteria of DOE Order 5400.5.

- **K-770 -** The boundary of the CA and the flood control area will be surveyed annually to verify that no contamination has crossed the CA boundary into the adjoining flood control area.
- **K-725 -** The pad will be surveyed annually. Final disposition will be as part of the Power House soils action.
- **K-736 -** The slab is still located within the posted CA, so it is not necessary to post the slab as an fixed contamination area (FCA). If that portion of the CA where the slab remains is released from CA posting and control, the slab will be removed or the area will be posted as a FCA, and appropriate surveys will be performed.
- **K-1300 -** The area will be surveyed annually until remediated under the Zone 2 ROD.
- **K-1066-G -** Annual routine surveys will be performed on these Radioactive Materials Areas (RMAs) until final disposition occurs under the Zone 2 ROD.

Requirements provided in the PCCR (DOE 2007h) listed in Table 8.3 for the K-770 Scrap Removal Project include the following: (1) radiological surveillance, (2) storm drain characterization performed once within each NPDES permitting period (=5 yrs.), and (3) surface water monitoring. Figure 8.3 shows the locations of the storm drains and surface water locations relative to the K-770 Scrap Yard. Storm drain characterization and surface water monitoring results are used to verify the effectiveness of the Radiological Control Program.

Table 8.3. Long-term stewardshiprequirements for K-770 Scrap Removal Project facilities associated with remaining contaminated media.

Area/action	Slab/Foundation (annual survey)	Storm drain (characterize at least once every NPDES permit cycle)	Surface water
ROD for Interim Actions in Zone 1 at ETTP/PCCR for the K-770 Scrap Removal Project	K-770 Scrap Metal Yard soil K-725 slab K-736 slab K-1300 area –contaminated soil and concrete pad(1) K-1066-G yard – contaminated material	SD-724 SD-730 SD-740 SD-760 SD-770 SD-780 SD-800 SD-820 SD-830 SD-860 SD-870 SD-880 SD-890 SD-892	Clinch River kilometer 16 (Brashear Island)

(1)This area refers to the contaminated K-1302 pad and the soils area where the K-1300 stack used to be. This is not referring to the K-1300 clean spoils area.

ETTP = East Tennessee Technology Park
LTS = long-term stewardship
NPDES = National Pollution Discharge Elimination System
PCCR = Phased Construction Completion Report
ROD = Record of Decision
SD = storm drain

Radiological gross alpha and gross beta surveys, at a minimum, are conducted annually. If radiological contamination is found to be migrating out of the contamination area, then additional controls are implemented. The frequency and level of surveillance and monitoring is established at each site by the

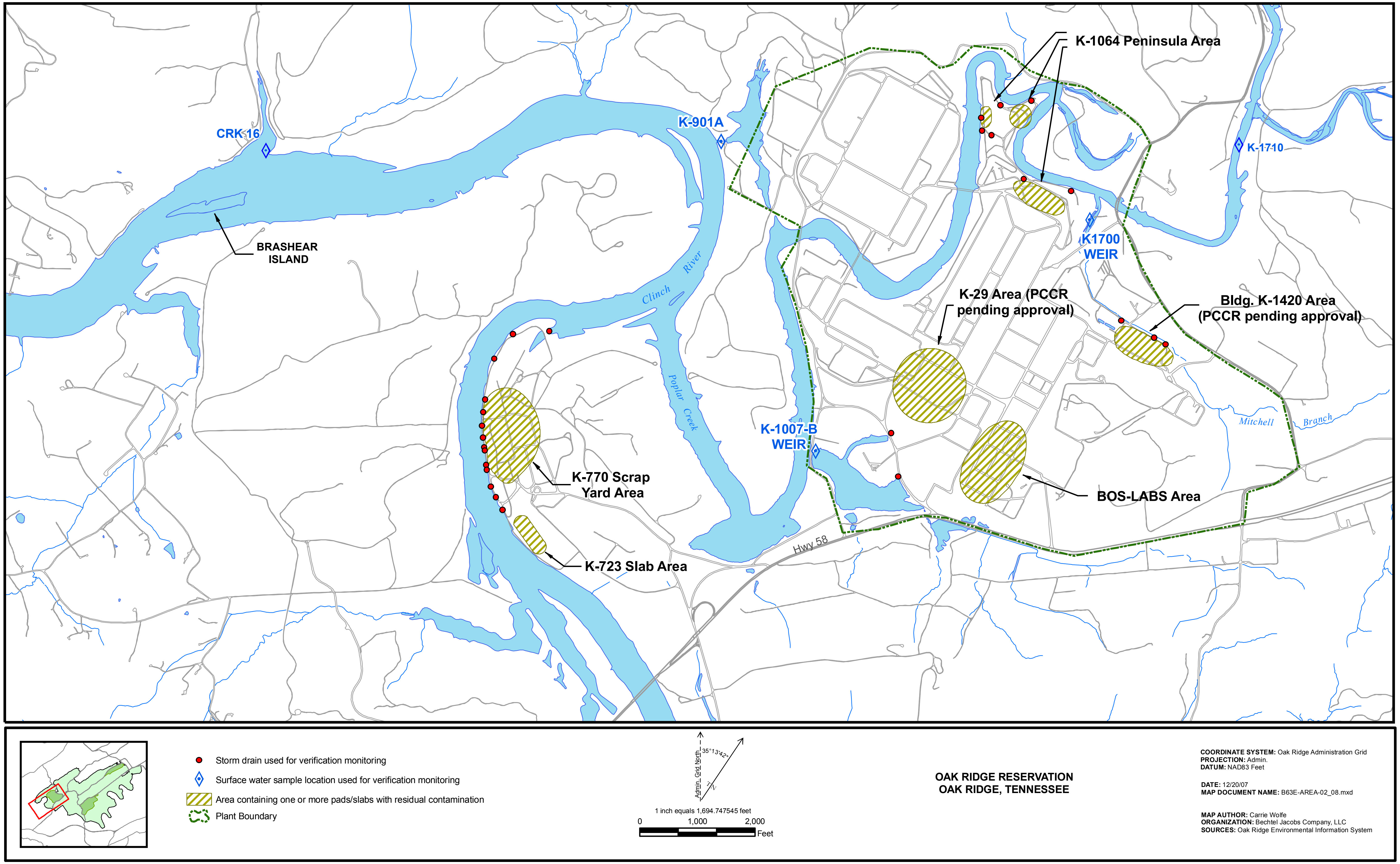

Fig. 8.3. ETTP Environmental Compliance Program monitoring locations to verify Radiological Control Surveillance monitoring of remaining contaminated slabs in accordance with approved CERCLA PCCRs.

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radiological engineers responsible for the program, in accordance with requirements and criteria set forth in 10 *CFR* §*835*, Occupational Radiation Protection.

In general, storm water runoff from concrete or asphalt pads is not sampled directly. Instead, the ETTP Environmental Compliance Program determines the effectiveness of the radiological control program through ongoing storm drain sampling and instream water sampling, i.e., monitoring in compliance with the ETTP NPDES permit and storm water runoff plans. Storm drain discharges are characterized at least once during each NPDES permitting period, a maximum of 5 years, for a minimum of gross alpha, gross beta, isotopic uranium, and ^{99}Tc. Instream water monitoring is conducted annually downstream of ETTP at Clinch River kilometer 16 (Brashear Island) for a minimum of gross alpha, gross beta, isotopic uranium, and ^{99}Tc. Data are compared to screening levels established at 4% of DOE Order 5400.5 Derived Concentration Guidelines (DCGs) to maintain discharges ALARA. When a screening level is exceeded, a field investigation is conducted to determine the source of the radiological release. Corrective measures are implemented, as needed. The ETTP Environmental Compliance Program provides an annual summary of data and any exceedance in the RER. Because the PCCR for the K-770 Scrap Removal Project was not approved until the latter half of FY 2007, the first annual summary and any associated exceedances will not be reported until the 2009 RER.

8.2.3.2 Status of Requirements for FY 2007

Restrictions were maintained for government-controlled industrial land use. The EPP functioned according to established procedures and plans for the site. Signs were maintained to control access, and surveillance patrols conducted as part of routine S&M inspections were effective in monitoring access by unauthorized personnel.

A summary of the interim radiological monitoring conducted for K-770 Scrap Removal PCCR is included in Table 8.4. Radiological monitoring of the facilities listed in the table below is performed as part of the Radiological Compliance Monitoring as required by 10 *CFR* §*835* and adopted in the BJC Radiation Protection Plan (RPP). All surveys are performed and documented in compliance with applicable BJC procedures. Limits that apply to the surveys performed are found in Attachment D to 10 *CFR* §*835* and repeated in Table 8.5.

Storm drain sampling and surface water monitoring of these areas was initiated in FY 2007. The 2007 Annual Site Environmental Report (ASER) due September 2008 will summarize the FY 2007 data and note any exceedances. The 2009 RER will contain these results and exceedances from the ASER.

Table 8.4. Summary of radiological monitoring for K-770 Scrap Removal Project

ROD for Interim Actions in Zone 1 at ETTP/PCCR for the K-770 Scrap Removal Project				
Facility/Location	**Status**	**Survey Frequency**	**Survey Date(s)**	**Survey Summary**
K-770 Scrap Metal Yard soil	Boundary included in Radiological Compliance Survey Program	Annually	Scheduled to be performed on 3/1/2008.	N/A
K-725 slab	Fixed Contamination Area	Annually	4/30/2007	No removable activity above 10 *CFR* §*835* limits detected.
K-736 slab	Located within K-770 CA and is not routinely surveyed.	N/A	N/A	N/A
K-1300 area –	Contamination Area	Annually	4/8/2007	No removable

Table 8.4. Summary of radiological monitoring for K-770 Scrap Removal Project (continued)

ROD for Interim Actions in Zone 1 at ETTP/PCCR for the K-770 Scrap Removal Project				
Facility/Location	**Status**	**Survey Frequency**	**Survey Date(s)**	**Survey Summary**
contaminated soil and concrete pad[(1)]				activity above 10 *CFR §835* limits detected.
K-1066-G yard – contaminated material	Radioactive Material Area	Semi-Annually	6/1/2007	No removable activity above 10 *CFR §835* limits detected.

[(1)]This area refers to the contaminated K-1302 pad and the soils area where the K-1300 stack used to be. This is not referring to the K-1300 clean spoils area.

CA = Characterization Area
CFR = Code of Federal Regulation
CR = Clinch River
ETTP = East Tennessee Technology Park
N/A = not applicable
PCCR = Phased Construction Completion Report
ROD = Record of Decision

Table 8.5. 10 *CFR §835* limits

Radionuclide	**Removable dpm/100cm^2**	**Total (Fixed + Removable) dpm/100cm^2**
U-Nat, U-235, U-238, and associated decay products	1,000	5,000
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	500
Th-Nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1000
Beta-Gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	1,000	5,000
Tritium and tritiated compounds	10,000	N/A

CFR = Code of Federal Regulations
cm^2 = square centimeter
dpm = disintegrations per minute
I = iodine
Nat = natural occurring
Pa = protactinium
Ra = radium
Sr = strontium
Th = thorium
U = uranium

8.3 ZONE 2 SOIL, BURIED WASTE, AND SUBSURFACE STRUCTURE REMOVAL ACTIONS RECORD OF DECISION

The Zone 2 ROD (DOE 2005d) addresses contaminated soil, buried waste, and other subsurface structures within Zone 2 of ETTP (see Fig. 8.2). The selected remedy consists primarily of removal of existing contamination and also establishes RLs based on anticipated future land use. LUCs, including institutional controls, are a key element of the action. Major components of the remedy include:

- Assess data sufficiency for each EU and supplement data as necessary to determine if RLs are exceeded. Verify all acreage in Zone 2 as compliant with soil RLs established by the ROD.

- Remove soil up to 10 ft in depth that exceeds RLs set to protect a future industrial worker; remove soils to bedrock, water table, or acceptable levels of contamination to protect underlying groundwater to MCLs.

- Remove or decontaminate subsurface structures to average RLs met across an EU and maximum RLs met at any location to a depth of 10 ft.

- Remove the debris in the K-1070-B Burial Ground, regardless of depth, to minimize potential future impact to surface water and to lessen long-term security needs; remove soil that exceeds RLs for protection of workers (upper 10 ft) or protection of groundwater (water table or bedrock).

- Remove the debris and soil in the K-1070-C/D Burial Ground that exceeds RLs for the protection of workers (upper 10 ft) or protection of groundwater (water table or bedrock).

- Implement LUCs to prevent exposure to residual soil contamination left on-site and/or to prevent residential use of the land.

Zone 2 was divided into 44 EUs for planning and evaluation purposes. Final status assessments and associated data gap sampling efforts for accessible EUs in Zone 2 is being conducted using the DVS. The FY 2006 PCCR (DOE 2006j) addresses 108.8 acres in six EUs. Based on the results of the DVS evaluation, approximately 93.2 acres are recommended for unrestricted industrial use to 10 ft bgs. Following completion of two recommended soil remedial actions, the remaining 15.6 acres will be suitable for unrestricted industrial use and the action will be documented in the annual PCCR the year that the action is completed. The FY 2007 PCCR (DOE 2007f) addresses approximately 195 additional acres including several EUs, of which about 143 acres are recommended for unrestricted industrial use to 10 ft bgs. After completion of two remedial actions, the remaining 52 acres will be recommended for NFA. Neither of the PCCRs include monitoring requirements.

A complete discussion of the ETTP Zone 2 ROD and summary of actions is provided in Chapter 8 of Volume 1 of the FY 2007 RER.

8.3.1 Performance Goals and Monitoring Objectives

The RAOs for Zone 2 are: (1) to protect human health under an industrial land use to an excess cancer risk at or below 1×10^{-4} and non-cancer risk levels at or below an HI of 1, and (2) to protect groundwater to levels at or below MCLs. The industrial risk scenario is based on direct contact routes of exposure: (1) incidental ingestion, (2) inhalation of particulates and vapors, (3) dermal contact, and (4) external exposure. The industrial worker is assumed to have an exposure frequency of 2000 hours/year (8 hours/day for 250 days/year) and an exposure duration of 25 years (DOE 2005d). When soil removal actions are completed, they are deemed effective for industrial land use based on confirmatory sampling evaluated against the established RLs.

The monitoring requirements of the selected alternative include monitoring of groundwater adjacent to potential sources of groundwater contamination, including the K-1070-C/D Burial Ground (DOE 2005d). This monitoring will continue until a site-wide ROD at ETTP is approved. Monitoring of groundwater adjacent or downgradient of other contaminant sources at ETTP are addressed in Sect. 8.6 Watershed Condition and Trends.

Monitoring locations, analytical parameters, and clean-up levels were not specified for groundwater monitoring at the K-1070-C/D Burial Ground, although the primary contaminants of concern in that area are VOCs. Semi-annual samples are analyzed for VOCs and general water quality parameters in numerous wells and surface water locations outside the perimeter of the K-1070-C/D Burial Grounds. Monitoring at the site is focused on providing data for evaluating changes in contaminant concentrations near the source units or potentially discharging to surface water within the boundaries of the ETTP.

8.3.2 Evaluation of Performance Monitoring Data

Monitoring wells UNW-114, TMW-011, and UNW-064 (Fig. 8.4) monitor the VOC plume leaving the K-1070-C/D Burial Ground. Results of monitoring at these wells continue to show elevated VOC concentrations. The primary VOC detected in well UNW-114 near the K-1070-C/D Burial ground was the degradation product 1,1-DCA at 300 µg/L. Significant concentrations of 1,1-DCA were detected in wells TMW-011 (520 µg/L) and UNW-064 (110 µg/L). Other VOCs detected in concentrations =85 µg/L were 1,1-DCE (210 µg/L) and TCE (85 µg/L) at TMW-011 and chloroethane (130 µg/L) at UNW-064. MCLs were exceeded for 1,1-DCE, TCE, and vinyl chloride at all three wells. The PCE concentration in well UNW-114 exceeded the MCL and the cis-1,2 DCE concentration in well TMW-011 also exceeded the MCL.

8.3.2.1 Performance Summary

An evaluation of VOC concentrations in wells UNW-064 and UNW-114 over the past several years (Fig. 8.5 and 8.6, respectively) indicates that generally VOC concentrations in groundwater continue to decline or remain relatively stable. VOC concentrations in well TMW-011 (Fig. 8.7) which is farthest from K-1070-C/D Burial Ground indicates a potential increasing trend (although recent sample concentrations are significantly lower than sample results in September 2000) and will continue to be monitored.

8.3.3 Compliance with LTS Requirements

8.3.3.1 Requirements

The Zone 2 ROD (DOE 2005d) establishes “industrial” as the land use to a depth of 10 ft. To implement restrictions that prohibit residential or agricultural use of this area under the Zone 2 ROD and to restrict access to this area until that end use has been achieved, seven LUCs will be implemented: (1) property record restrictions, (2) property record notices, (3) zoning notices, (4) EPP, (5) access controls, (6) signs, and (7) surveillance patrols. The objective of these controls are as follows:

- Control land use to prevent exposure to contamination by controlling excavations or soil penetrations below 10 ft, and prevent uses of the land involving exposures to human receptors greater than those from industrial use. Significant accumulations of material with residual contamination above unrestricted use levels will also be monitored and controlled. This will avoid accumulation of

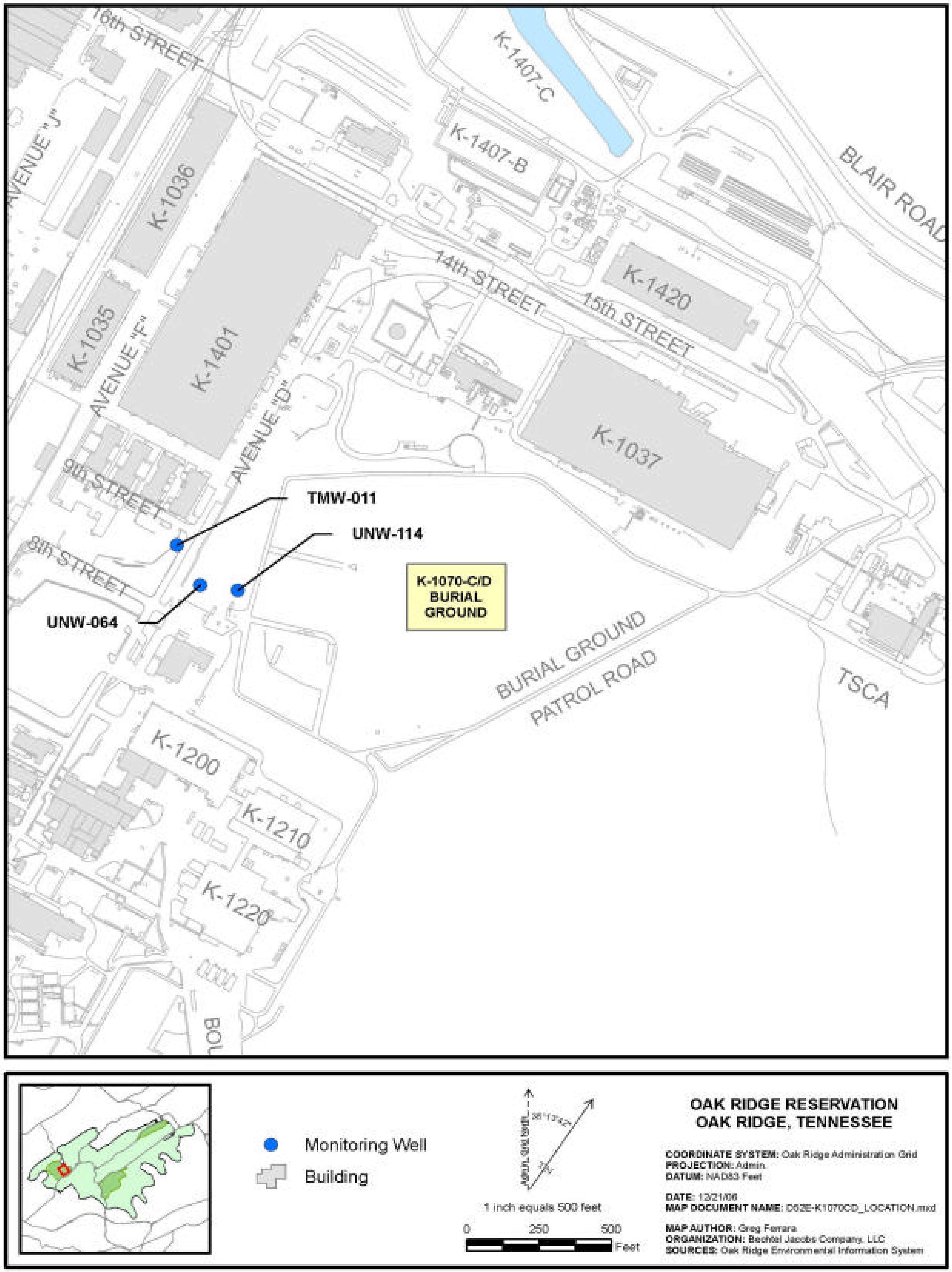


Fig. 8.4. Location map for K-1070-C/D Burial Ground.

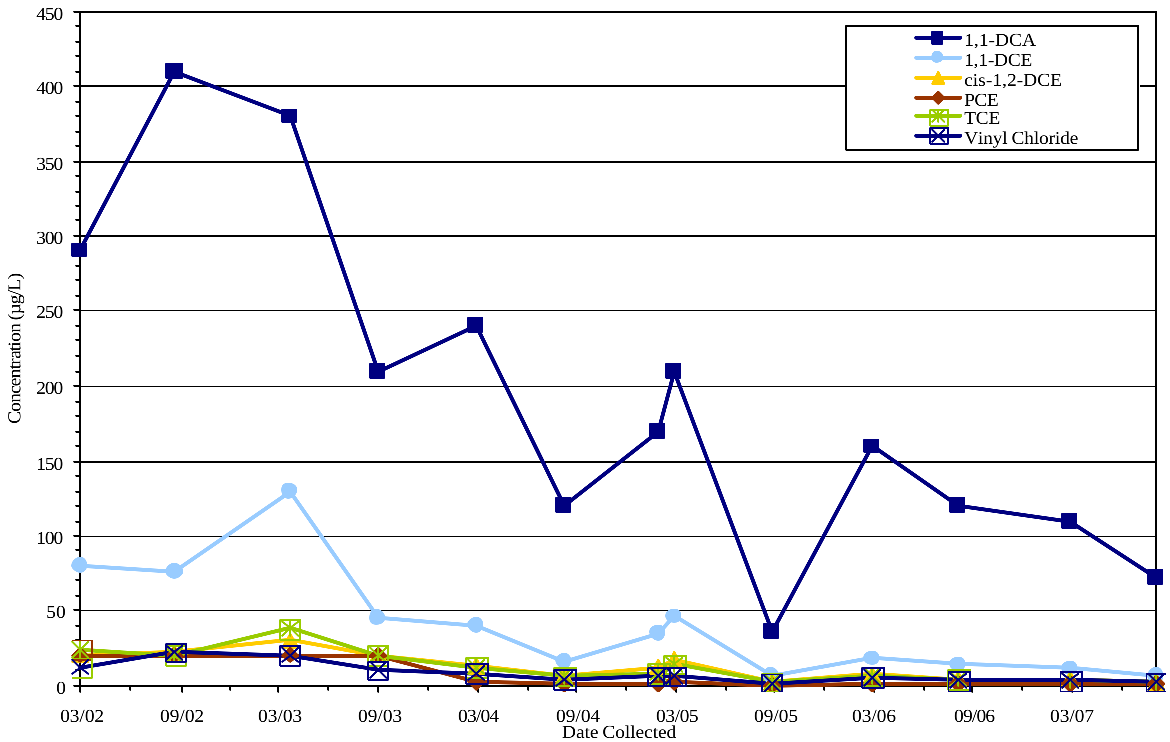


Fig. 8.5. VOC concentrations in well UNW-064 for FY 2002 through FY 2007.

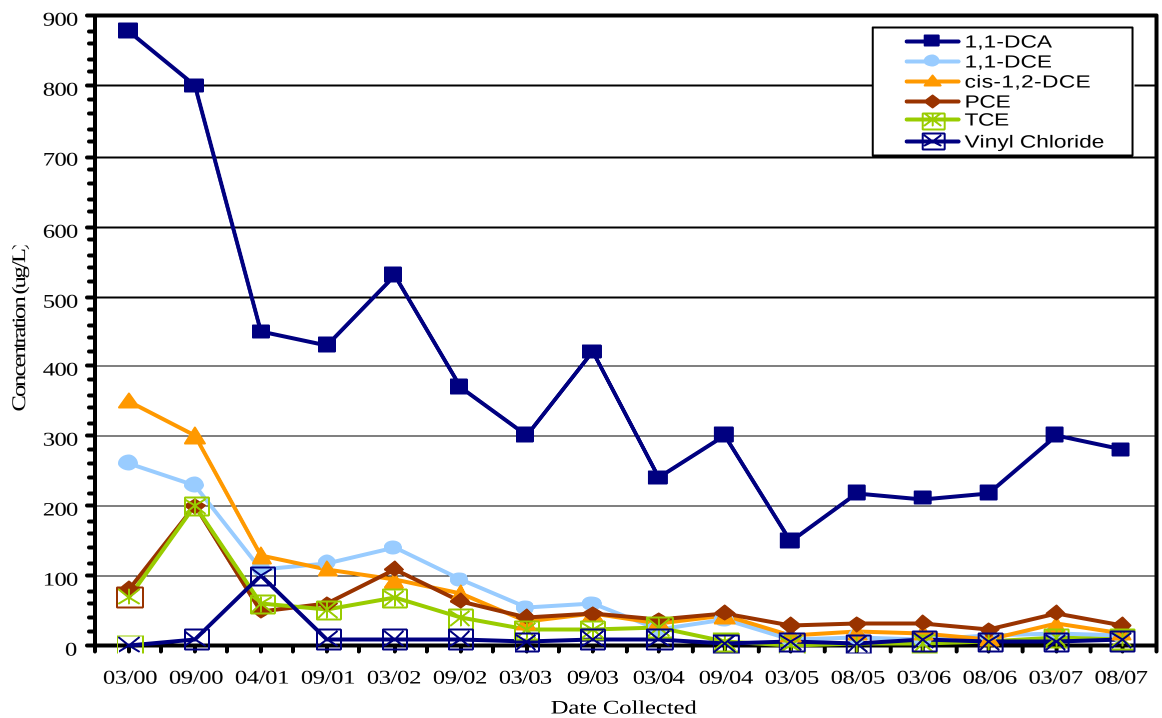


Fig. 8.6. VOC concentrations in well UNW-114 for FY 2000 through FY 2007.

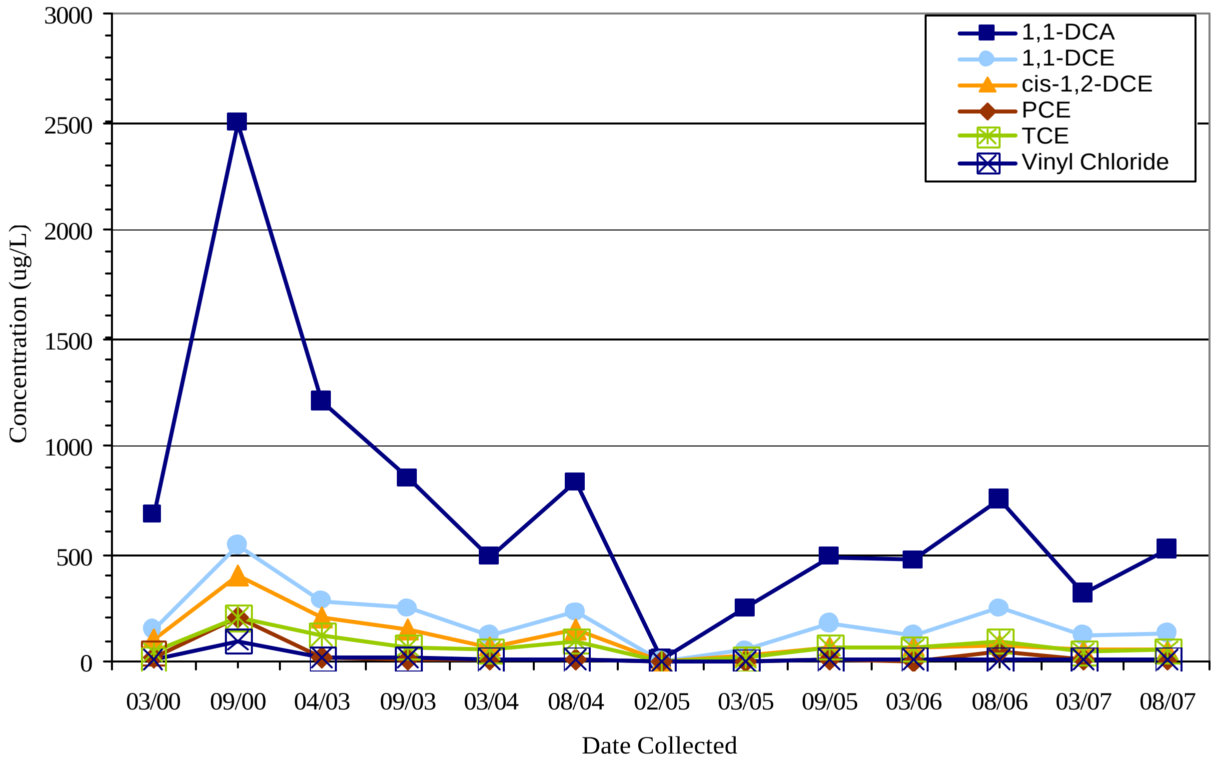


Fig. 8.7. VOC concentrations in well TMW-011 for FY 2000 through FY 2007.

contamination placed in an area not currently designated for disposal that could re-establish a risk to a future industrial user.

- Prohibit the development and use of property for residential housing, elementary or secondary schools, childcare facilities, children's playground, other prohibited commercial uses, or agricultural use.

- Maintain the integrity of any existing or future monitoring system until the ETTP sitewide residual contamination remedial action is implemented.

- Maintain the integrity of access controls at the K-1070-C/D Burial Ground for as long as the residual debris represents a concern. Maintenance of patrol roads and fences at the K-1070-C/D Burial Ground would occur in the short-term until there is no further security issue. No maintenance of engineered components is necessary for environmental protection. Additionally, the need for security measures at the K-1070-C/D Burial Ground will be evaluated annually. These security controls will be removed as soon as no longer needed.

The PCCRs completed under the Zone 2 ROD for FY 2006 and FY 2007 state that, consistent with the Zone 2 ROD, the NFA decision means that an EU is available for unrestricted industrial use to a depth of 10 ft bgs. All EUs that have been cleared for industrial use to a depth of 10 ft bgs have a high probability of being cleared for industrial use to all depths, with the exception of EU Z2-42 in the FY 2006 PCCR and EUs Z2-28, Z2-34, Z2-37, Z2-41, and Z2-44 in the FY 2007 PCCR. Formerly buried wastes and/or contaminated groundwater are present at depths in all of these EUs and, therefore, LUCs are in place and an action is required.

Until remediation is complete and the industrial land use is achieved, the seven LUCs mentioned above will be implemented to restrict residential or agricultural use of the land. Reliance will be primarily on property record and zoning notices, the excavation/penetration permit program, access controls, and surveillance patrols. Once remediation is complete, property record restrictions, property record and other public notices, zoning notices, excavation permits, and less intensive surveillance patrols and fences for the short-term at the K-1070-C/D Burial Ground will be used. In addition, when an area within Zone 2 is transferred, property record restrictions and notices will be implemented. Details of these LUCs will be included in the ETTP Zone 1 and Zone 2 RARs. Fences, signs, and surveillance patrols will be used to restrict access only in the short-term until remediation is complete.

8.3.3.2 Status of Requirements for FY 2007

Short-term restrictions were maintained for government-controlled industrial land use. Signs were maintained to control access, and surveillance patrols conducted as part of routine S&M inspections were effective in monitoring access by unauthorized personnel. The excavation/penetration permit program functioned according to established procedures and plans for the site. Signs and access controls at the K-1070-C/D Burial Ground were inspected monthly by the ETTP S&M Program and are summarized in Sect. 8.4.3.2.

Building and land transfers that occurred on June 7, 2005 and February 14, 2006, have had property record restrictions filed with the deed in the Roane County Register of Deeds office. The following buildings within Zone 2 at ETTP have been transferred from DOE to the Community Reuse Organization of East Tennessee (CROET): K-1007, K-1225, K-1330, K-1580, K-1036, and K-1400.

8.4 COMPLETED SINGLE ACTIONS AT ETTP WITH MONITORING AND/OR LTS REQUIREMENTS

8.4.1 K-1407-B/C Ponds Remedial Action

The ROD for the K-1407-B/C Ponds (DOE 1993b) addressed potential risks associated with residual wastes and soils remaining in the K-1407-B/C Ponds from the initial removal of sludge conducted as a previous RCRA closure action. The location of the K-1407-B/C ponds at ETTP is shown in Fig. 8.8. Components of the selected remedy include the following activities:

- Placement of clean soil and rock fill for isolation and shielding,
- Maintenance of institutional controls, and
- Groundwater monitoring to assess performance of the action and develop information for use in reviewing the effectiveness of the remedy.

8.4.1.1 Performance Goals and Monitoring Objectives

The objective of the K-1407-B/C Ponds remedial action was to reduce potential threats to human health and the environment posed by residual metal, radiological, and VOC contamination within the pond soils (DOE 1993b).

The RAR (DOE 1995f) proposes semi-annual groundwater monitoring for nitrate, metals, and selected radionuclides, including gross alpha and beta activity, ^{99}Tc, ^{90}Sr, ^{137}Cs, ^{230,232}Th, and ^{234,238}U. However, VOCs are the primary groundwater contaminant in the Mitchell Branch area of the ETTP. Remediation target concentrations were not established in the CERCLA decision documents for use in post-remediation monitoring. As recommended by EPA, with concurrence from TDEC, performance monitoring is conducted in wells UNW-003, UNW-009, and the Mitchell Branch weir (K-1700 Weir shown on Fig. 8.8).

8.4.1.2 Evaluation of Performance Monitoring Data

The primary groundwater contaminants in the K-1407-B and -C ponds area of the ETTP are VOCs, which are widespread in this portion of the plant, including contaminant sources upgradient of the ponds. Groundwater samples were collected at UNW-003 and UNW-009 in March and August 2007. Monitoring results for FY 2007 at wells are generally consistent with results from previous years. Gross alpha activity was measured at 5.23 and 7.93 pCi/L at UNW-003 and was not detected at UNW-009. Gross beta activity ranged from 27.5 to 38.4 pCi/L at UNW-003, and had one measurement of 4.86 pCi/L at UNW-009. The only radionuclides detected at UNW-003 >1 pCi/L during both FY 2007 sampling events were ^{99}Tc, $^{233/234}$U, and ^{238}U. Technetium-99 ranged from 24.2 to 26.2 pCi/L, and uranium isotopes were less than 3 pCi/L during both sampling events. No individual radionuclides were detected at UNW-009 in FY 2007. The metals results for both wells were similar to historical results, and no metals were detected at concentrations exceeding MCLs. Monitoring results for Mitchell Branch for FY 2007 are also similar to historical monitoring results, except for some trends of increasing chromium and ^{99}Tc. No significant changes to water chemistry in Mitchell Branch are evident as a result of the remedial action at the former K-1407-B/C Ponds.

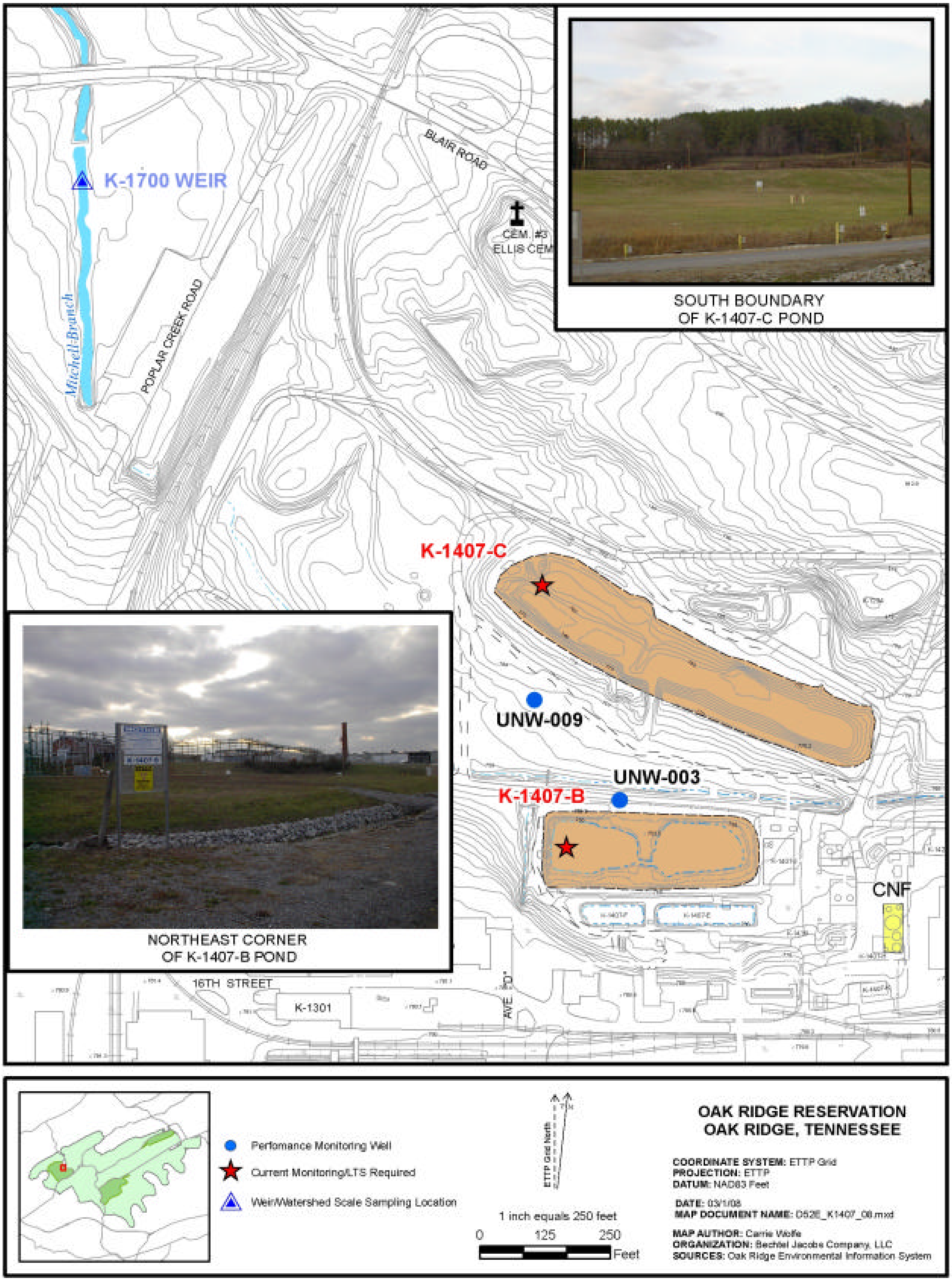


Fig. 8.8. Location of K-1407-B/C Ponds.

High concentrations of several VOCs are present in groundwater in well UNW-003 downgradient of the former K-1407-B Pond and adjacent to Mitchell Branch. Significant concentrations of parent compounds PCE and TCE and the degradation products 1,1-DCE, 1,1-DCA, *cis*-1,2-DCE, and vinyl chloride were detected at UNW-003 in FY 2007. The detection of VOCs at concentrations well above 1,000 µg/L and the steady concentrations over recent years strongly suggest the presence of dense non-aqueous-phase liquid (DNAPL) in the vicinity of this well. The ETTP Sitewide ROD will address groundwater contamination present in the area of the former ponds.

VOCs were detected in surface water at the Mitchell Branch (K-1700) Weir, which is consistent with historical results for this location. Some, but not all of the VOC loading in Mitchell Branch originates from the K-1407-B Pond. The VOCs detected included *cis*-1,2-DCE, 1,1-DCE, 1,1-DCA, chloroform, PCE, TCE, carbon tetrachloride, and vinyl chloride (see Sect. 8.6 for a discussion of water quality trends at the K-1700 Weir). The concentrations of TCE and vinyl chloride at this weir exceed the MCLs[1] of 5 and 2 µg/L, respectively, for these two compounds although MCLs do not apply and are not ARAR for surface water on the ORR. Tennessee fish and aquatic life Water Quality Criteria (WQC) [TDEC 2004b] have not been established for DCE, TCE, vinyl chloride, chloroform, or PCE; however, there are Tennessee WQC for recreation (organisms only criteria) for chloroform, 1,1-DCE, PCE, TCE, and vinyl chloride. Concentrations of each detected VOC at the K-1700 Weir are less than the Tennessee WQC for recreation, organisms only.

Surface water monitoring data for the K-1700 Weir indicates some radiological contamination in Mitchell Branch that was higher than previous years. Significant D&D activities were ongoing during this time period. FY 2007 results for gross alpha and gross beta activity in surface water at the weir were elevated, with gross alpha activities ranging from 18.5 to 52.9 pCi/L, and gross beta activities ranging from 31.1 pCi/L to 86.3 pCi/L. Technetium-99 activity ranged from 43 to 123 pCi/L at the K-1700 Weir which is in contrast to the highest ^{99}Tc activity of 67 pCi/L reported in FY 2006.

Metals detected at the K-1700 Weir in FY 2007 include barium, cadmium, chromium, iron, nickel, and zinc. Chromium concentrations in Mitchell Branch increased during FY 2007 in excess of the AWQC at the K-1700 Weir (max 95.8 µg/L) and upstream at storm drain outfall 170. Concentrations of hexavalent chromium exceeded the AWQC concentration of 11 µg/L from Outfall 170 and instream as far downstream as the K-1700 Weir. In response to this condition, DOE is conducting an investigation to identify possible sources of the chromium and started planning for construction of a groundwater collection system to capture the chromium contaminated groundwater. The K-1407-B Pond is not suspected to be the source of chromium contamination in Mitchell Branch. During FY 2006 lead exceeded the fish and aquatic life criterion continuous concentration of 2.5 µg/L, however lead was not detected in Mitchell Branch during FY 2007.

8.4.1.2.1 Performance Summary

The K-1407-B remedy protects aquatic organisms in Mitchell Branch

FY 2007 monitoring results for UNW-003 and UNW-009 are similar to historical monitoring results. Monitoring of surface water at K-1700 Weir in Mitchell Branch is consistent with historic trends except an increase of hexavalent chromium above the AWQC in FY 2007.

[1] MCLs are used for screening purposes only.

8.4.1.3 Compliance with LTS Requirements

8.4.1.3.1 Requirements

Long-term stewardship requirements specified in the RAR (DOE 1995f) include maintenance of institutional controls (Table 8.2); specifically, conduct periodic inspections, radiological and industrial hygiene surveillances, ensure access and activity controls, and implement maintenance activities.

8.4.1.3.2 Status of Requirements for FY 2007

All components of the K-1407-B/C Ponds site were inspected monthly by the ETTP S&M Program, including access controls and sign conditions; vegetation maintenance including dead spots, excessive weeds or deep rooted vegetation, grass not mowed, discoloration or withering of vegetation; soil/surface maintenance including evidence of soil erosion, gullies or rills, staining, debris or trash. No deficiencies were noted on the inspection checksheets. Minor maintenance was performed including inspection of staining/discoloration, removal of debris, grass cutting and weed clearing.

8.4.2 K-901-A and K-1007-P1 Ponds Removal Action

A removal action was performed at the K-901-A and K-1007-P1 Ponds (Figs. 8.9 and 8.10) to mitigate current and future risk of PCB-contaminated fish. The AM (DOE 1997e) called for removal of gas cylinders and other potentially hazardous containers and metal debris from the ponds, as well as removal of PCB-contaminated fish from each pond. Although the removal actions specified in the AM were completed at the K-901-A Holding Pond, the pond has naturally repopulated with fish, and those fish currently exhibit low concentrations of PCBs. The actions specified in the AM for the K-1007-P1 Pond were not implemented, relying on current administrative controls to mitigate human health risks from ingestion of fish containing PCBs until addressed by future CERCLA decisions. A complete discussion of the history and implementation of the K-901-A Holding Pond and K1007-P1 Pond removal action is provided in Chapter 8 of Volume 1 of the FY 2007 RER.

The FFA parties have agreed to address cleanup of the ponds as part of a Non-Time Critical Removal Action. A new AM for these ponds was approved in March 2007, that includes decisions for K-901-A Holding Pond, K-1007-P Holding Ponds, K-720 Slough, and the K-770 Embayment. This new AM (DOE 2007h) supersedes the previous AM (DOE 1997e), but until the new AM is implemented, monitoring associated with the previous actions will remain in effect.

Activities associated with the newly approved removal action include:

- K-1007-P1 Holding Pond - Drain pond, kill undesirable fish, establish vegetation, replace desirable fish, adjust water quality (ecological enhancement) to protect piscivorous wildlife and recreational fishermen. Institutional controls to prevent residential use, monitoring.

- K-901-A Holding Pond - Institutional controls to prevent residential use, monitoring.

- K-720 Slough - Institutional controls to prevent residential use, monitoring

- K-770 Embayment - No action (Institutional controls specified in Zone 1 ROD remain in effect).

- K-1007-P3, P4, and P5 Holding Ponds - No action (Institutional controls specified in Zone 1 ROD remain in effect).

8.4.2.1 Performance Goals and Monitoring Objectives

Although the new AM (DOE 2007h) supersedes the previously completed AM (DOE 1997e), monitoring performed in support of the previous AM will continue until a new monitoring plan is developed and approved after the new removal action is completed. Performance monitoring will continue as proposed in the previous RmAR (DOE 1999e), which includes annual biological monitoring in both ponds, and is intended to evaluate bioaccumulation trends of PCBs. Numeric performance goals are not specified.

8.4.2.2 Evaluation of Performance Monitoring Data

PCB concentrations in largemouth bass collected in 2007 from K-1007-P1 Pond were higher than observed in 2006, but remained within the range of historical observations (Fig. 8.11). PCB concentrations in K-1007-P1 bass are greater than 10-fold higher than PCB levels in fish that trigger fish consumption advisories in Tennessee (~0.8 to 1.0 ppm). Large year-to-year variation in PCB concentrations in bass have been observed at this site (as well as in WOL),and may be due to fluctuations in the relative abundance of

PCB levels in K-1007-P1 fish continue to exceed fish advisory limits.

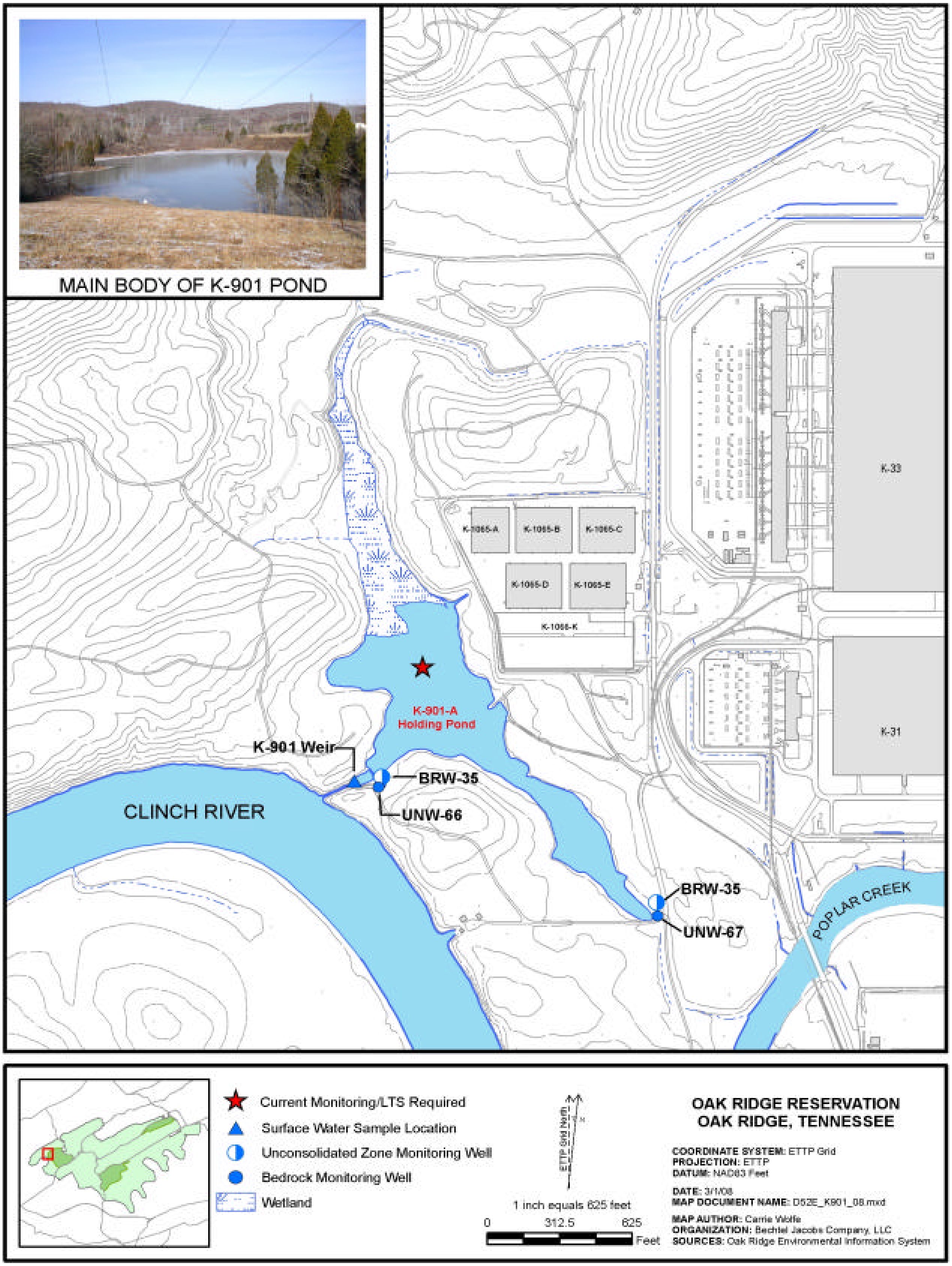


Fig. 8.9. Location of K-901-A Holding Pond.

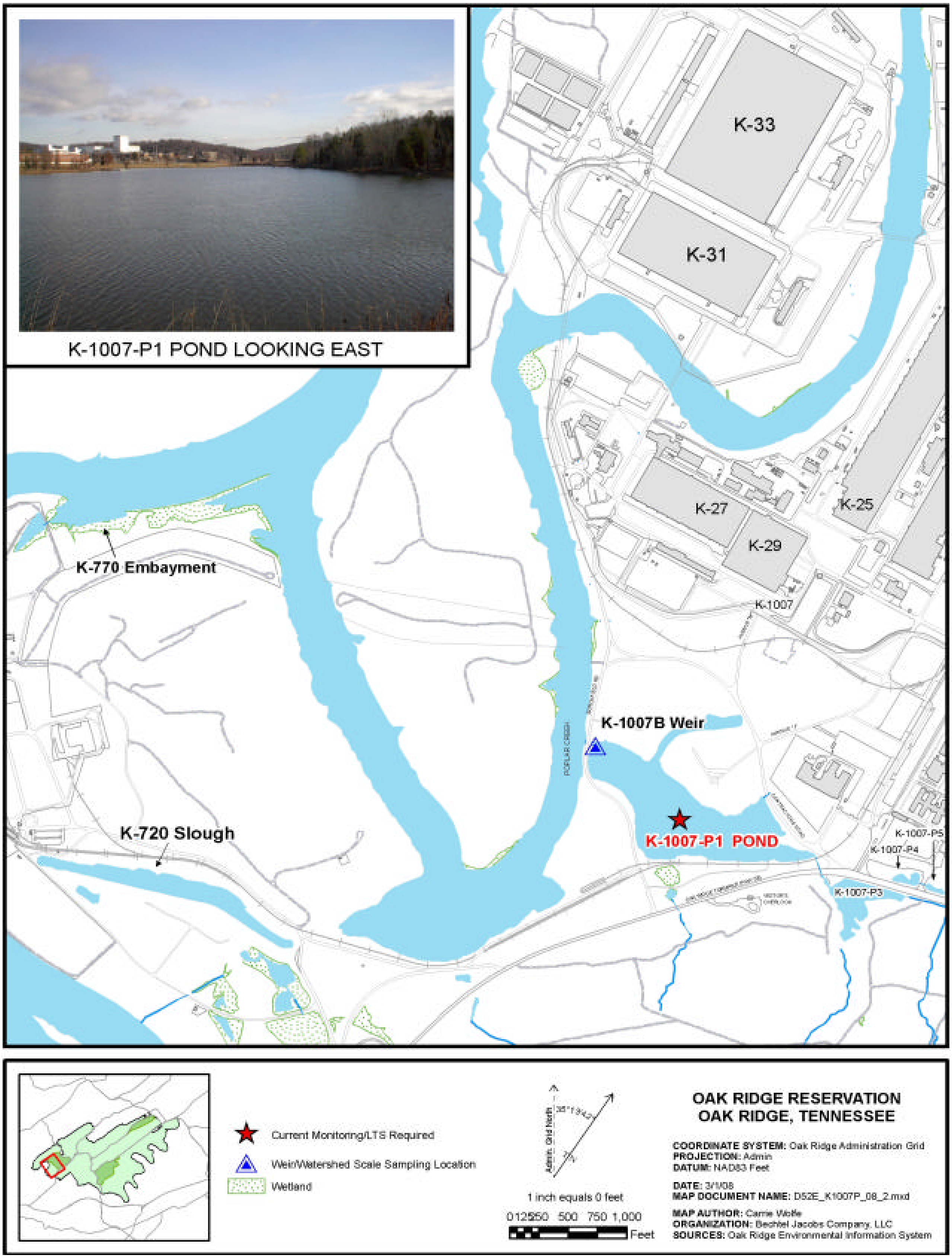


Fig. 8.10. Location of K-1007-P1 Pond.

gizzard shad, which accumulate much higher levels of PCBs than other forage species. Mean PCB concentrations in bass from K-901-A Pond were much lower than in the K-1007-P1 Pond (Fig 8.12), but with similar annual fluctuations in PCBs.

Caged Asiatic clams (*Corbicula fluminea*) were placed near and within various storm drains entering the K-1007-P1 and K-901-A ponds for a four week exposure from June 22 to July 20, 2007. PCB concentrations in clams were again highest in storm drains entering the K-1007-P1 Pond, with substantially lower PCB values at sites around the K-901-A Pond. There continues to be no evidence of PCB contamination at the K-1007-P3 Pond, upstream of the K-1007-P1 Pond. Storm drains with relatively high PCB concentrations in clams again were at storm drains (SD) 100, SD 120, and SD 490 (all entering the K-1007-P1 Pond). In general, PCB concentrations in FY 2007 clams were higher than in FY 2006, particularly at the SD 100 outfall.

8.4.2.3 Compliance with LTS Requirements

8.4.2.3.1 Requirements

The RmAR (DOE 1999e) states that S&M personnel will conduct routine activities including verifying and repairing damage after storms or flooding, verifying signs are visible and in place, and maintaining the weirs between the K-1007-P1 Pond and Poplar Creek and the K-901-A Pond and Clinch River.

8.4.2.3.2 Status of Requirements for FY 2007

Activities conducted at the ponds included monthly inspections by the ETTP S&M Program for visible evidence of storm or flood damage, inspections of the weirs for evidence of debris or vegetation or erosion of the banks, and inspections of the warning signs. No deficiencies were noted on the inspection checksheets. Minor maintenance was performed, including securing the oil boom at K-1007-P1 Pond after a storm, fixing signs at the K-901-A Pond, cleaning weeds from the weirs at both ponds, and monitoring erosion of the bank at the K-901-A Pond.

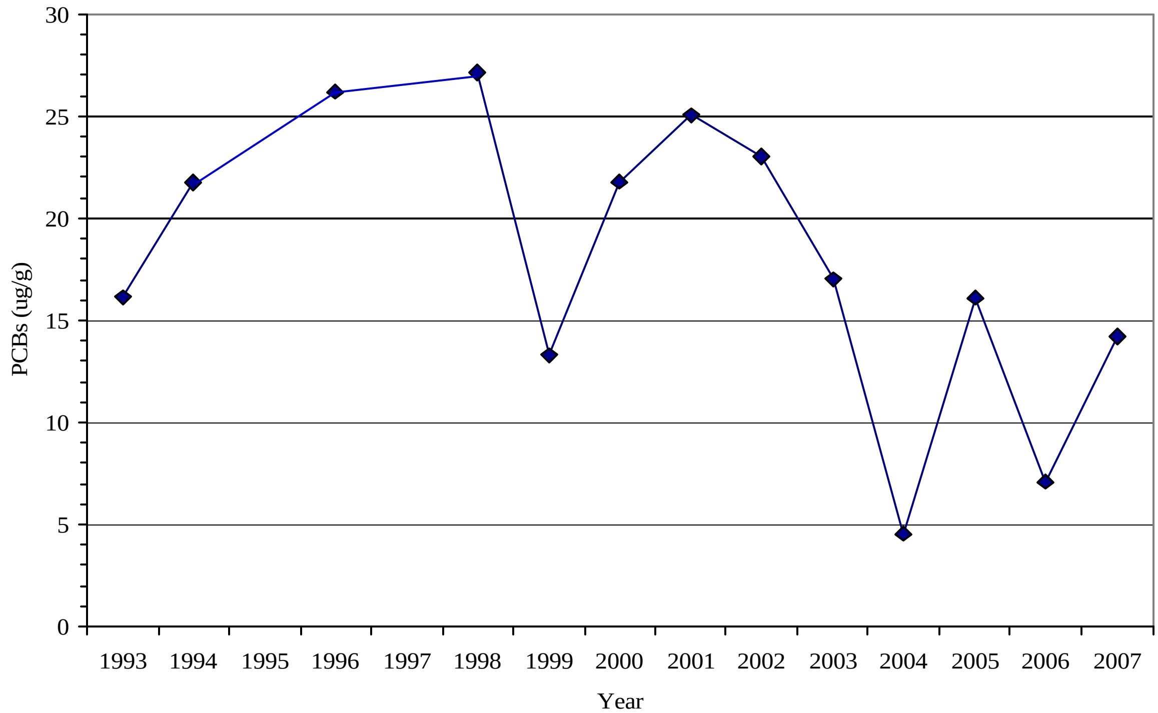


Fig. 8.11. Mean concentrations of PCBs in largemouth bass from K-1007-P1 Pond, 1993 – 2007.

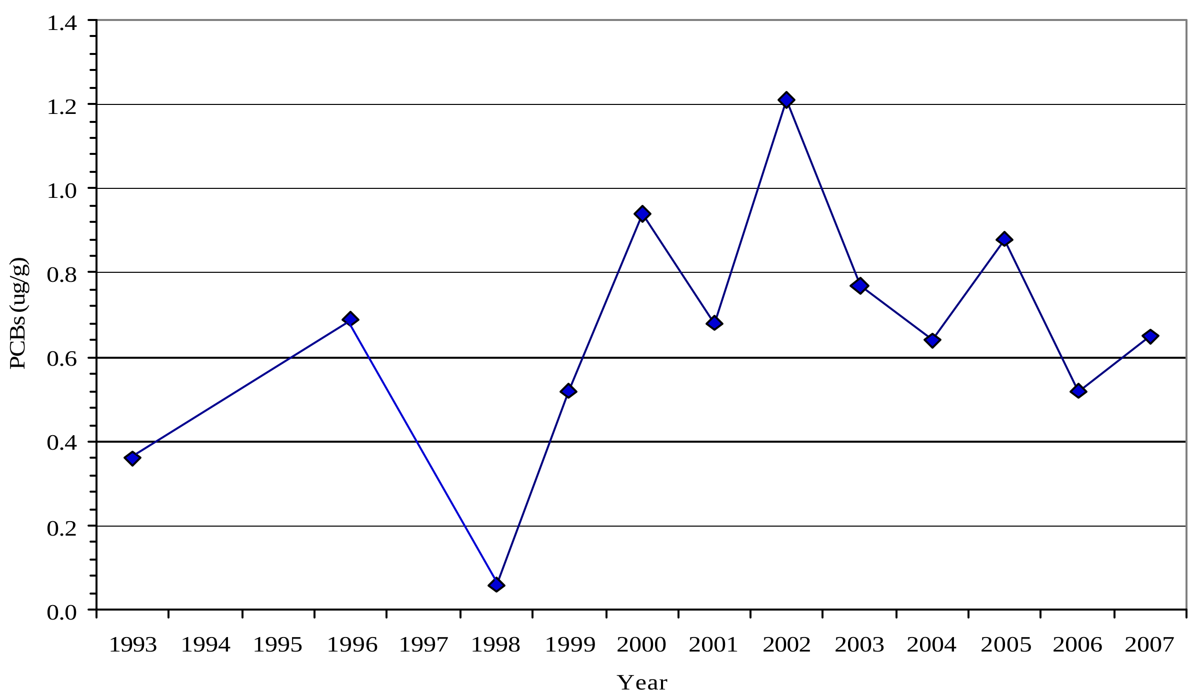


Fig. 8.12. Mean concentrations of PCBs in largemouth bass from K-901-A, 1993–2007.

8.4.3 K-1070-C/D G-Pit and Concrete Pad Remedial Action

The K-1070-C/D G-Pit is the primary source of organic contaminant releases to soil and groundwater in the area. The Concrete Pad, located in the southeastern portion of the K-1070-C/D area, was determined to pose an unacceptable health risk to workers from future exposure to soil radiological contaminants. The location of the area at ETTP is shown in Fig. 8.13. Components of the remedy included:

- Excavation of the G-Pit contents, interim storage of the material, treatment, and disposal, and
- Placement of a 2-ft soil cover over the Concrete Pad.

A complete discussion of the remedial action at K-1070-C/D G-Pit and Concrete Pad is provided in Chapter 8 of Volume 1 of the FY 2007 RER.

8.4.3.1 Performance Goals and Monitoring Objectives

The primary objective to address the principal threats to industrial workers and mitigate the primary release mechanism to groundwater was met by removal of the source of groundwater contamination and using a soil cover to prevent direct contact and provide radiation shielding from the Concrete Pad.

No monitoring requirements are specified for this action.

8.4.3.2 Compliance with LTS Requirements

8.4.3.2.1 Requirements

The decision documents for this site require interim LTS activities including maintaining institutional controls (see Table 8.2). Specifically, inspections of the soil cover over the pad are to be conducted weekly to look for erosion, and the grass on the cover is to be mowed at an estimated frequency of 5 times a year. Annual radiological walkover surveys are to be conducted to confirm the effectiveness of the Concrete Pad soil cover in preventing exposure to ionizing radiation. Existing institutional controls will continue including semiannual inspections of the fence, as well as ensuring the existing excavation/penetration permitting system remains in place. These controls are to continue until final decisions are made for the K-1070-C/D OU in the ETTP Zone 2 ROD.

8.4.3.2.2 Status of Requirements for FY 2007

The site was inspected by the ETTP S&M Program monthly for items including condition of the warning signs, condition of fencing and locked gate, condition of the Concrete Pad soil cover and maintenance of vegetation including inspecting for excessive weeds or deep-rooted vegetation, grass not mowed, or discoloration or withering of vegetation. No deficiencies were noted in the inspection checksheets. Minor maintenance was performed including repairing the fence, mowing, clearing fallen trees from the fence and re-hanging fallen signs. Ongoing maintenance is needed to repair broken outriggers on the fence and remove fallen trees and branches from communication lines near the fence. The fence continues to provide acceptable access control while the maintenance issues are being resolved.

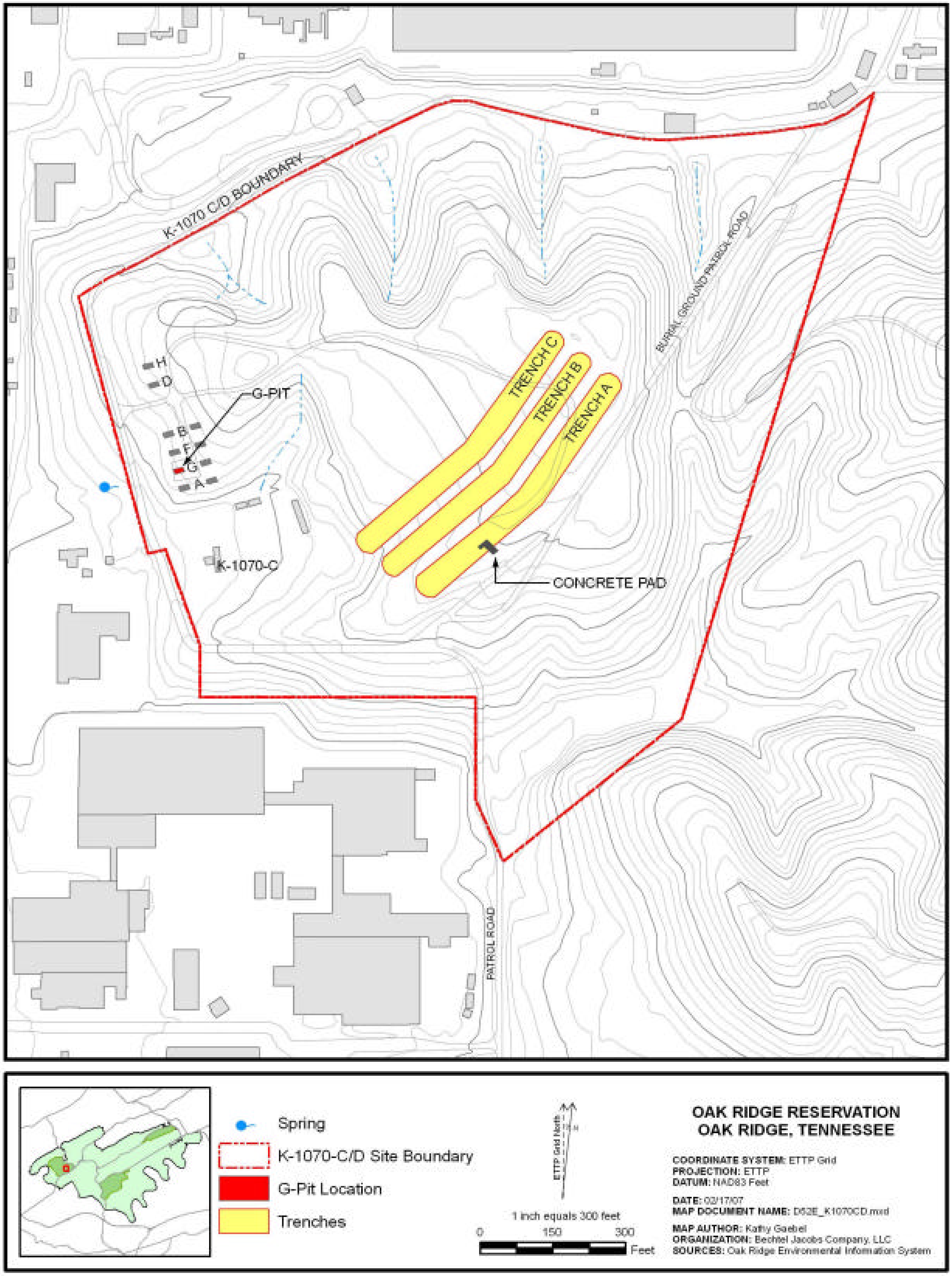


Fig. 8.13. Location of K-1070-C/D G-Pit and Concrete Pad.

8.4.4 K-1070-A Burial Ground Remedial Action

The selected remedy in the ROD (DOE 2000e) for the K-1070-A Burial Grounds (Fig. 8.14) included waste removal and disposal, along with institutional controls. Major components of the remedy include:

- Waste characterization,
- Excavation and disposal,
- Residual soil characterization, and
- Backfilling excavated areas with clean fill.

A complete discussion of the remedial action at K-1070-A Burial Ground is provided in Chapter 8 of Volume 1 of the 2007 RER.

8.4.4.1 Performance Goals and Monitoring Objectives

The source removal action addressed the present and projected future principal threats posed by the K-1070-A Burial Ground, primarily by chlorinated VOCs and radionuclides. No known unacceptable residual risk from soils for industrial or recreational land use remain within the K-1070-A Burial Ground fenced area subsequent to completion of the remedial action defined in the ROD (DOE 2000e).

Post-action monitoring requirements are not specified for this action, and cleanup standards for environmental media were not identified (DOE 2003g). Until a groundwater decision is finalized, DOE monitors downgradient Spring 21-002 as an exit pathway point (Sect. 8.6).

8.4.4.2 Compliance with LTS Requirements

8.4.4.2.1 Requirements

The ROD states that following implementation of the remedial action, protectiveness at the site will be ensured through continuation of current ETTP site-wide controls including physical and administrative access restrictions, surveillance, security patrols, restrictions on excavation, and restrictions on groundwater and surface water use (DOE 2000e). In addition, the RAR (DOE 2003g) states that to maintain the effectiveness of the soil cover, the cover will be inspected monthly and the grass on the site will be mowed at an estimated frequency of five times a year. If erosion is found, “clean” soil will be used to repair the eroded area, and the area will be reseeded, if necessary.

8.4.4.2.2 Status of Requirements for FY 2007

The site was inspected monthly during FY 2007 by the ETTP S&M Program for evidence of soil erosion, gullies or rills; staining, and debris or trash on the soil cover; dead spots, excessive weeds or deep rooted vegetation, need to mow, and discoloration or withering of vegetation. No deficiencies were noted on the inspection checksheets. Minor maintenance was performed including mowing.

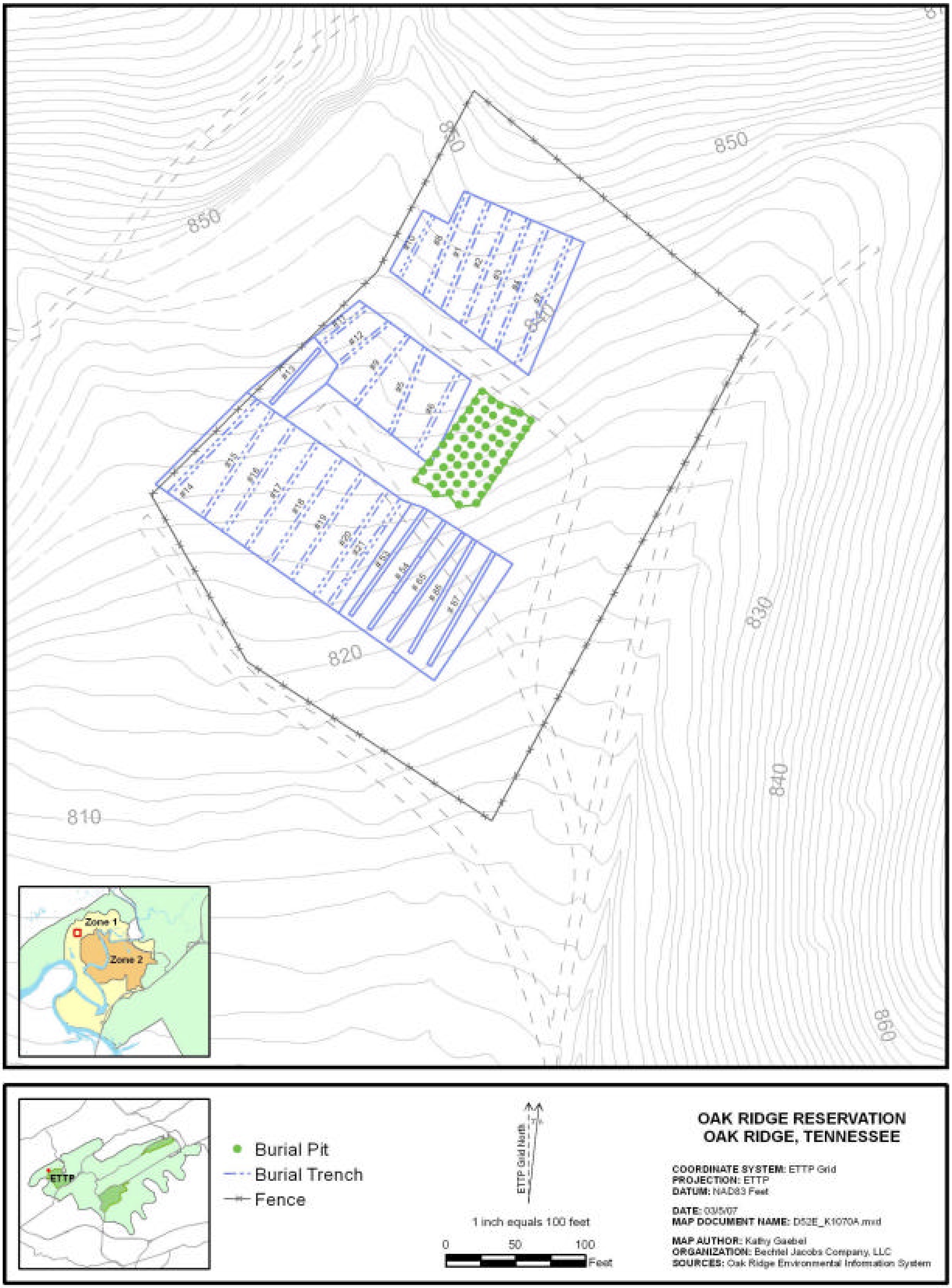


Fig. 8.14. Location of former K-1070-A Burial Ground at ETTP.

8.5 COMPLETED DEMOLITION PROJECTS WITH ACCESS CONTROLS AND LTS REQUIREMENTS

During FY 2007, most of the CERCLA actions at ETTP focused on completion of D&D activities documented by various PCCRs, some of which include interim requirements for monitoring and access controls because slabs or portions of foundations were left in place. If radiological surveys indicated a slab exceeded the release criteria of DOE Order 5400.5, then interim access controls were implemented and the slab was posted and became part of the radiological surveillance and monitoring program. Table 8.6 identifies the completed D&D projects with remaining contaminated media and the slabs/soil requiring interim land use controls and monitoring. Section 8.5.1 details these LTS requirements and their status. The ETTP Zone 1 and Zone 2 RODs will determine the final remedy for the contaminated slabs and soil.

Table 8.6. Long-term stewardshiprequirements for D&D facilities associated with remaining contaminated media

Area/action	Slab/Foundation (annual surve y)	Storm drain (characterize at least once every NPDES permit cycle)	Surface water (annually)
Group II, Phase 2 RmAR for K-1064 Peninsula Area	K-1025-A slab K-1025-B slab K-1025-C slab K-1025-D slab K-1064-D slab K-1025-E K-1064 Salvage Material Yard soil (survey performed only when worker entries required)	SD-230 SD-240 SD-270 SD-280 SD-294 SD-296 SD-297	Surface water from Poplar Creek downstream (K-1007-P1 pond weir) and upstream from ETTP Mitchell Branch, and the K-901-A Pond.
Group II, Phase 3 PCCR for BOS-LABS	K-1004-A K-1004-B K-1004-C K-1004-D K-1004-E K-1004-L K-1004-H K-1004-M K-1015	SD-100	K-1007-P1 Pond weir (weir K-1007-B4)
Group II, Phase 3 PCCR, Bldg. K-1420 (Submitted – Pending TDEC approval)	K-1420 slab – storm flow sample required Uranium Recovery Room and calciner room – quarterly radiological survey Pad boundary – annual radiological survey	SD-158 SD-160 SD-170	Weir K-1700
Group II, Phase 3 FY 2006 PCCR for Low Risk/Low Complexity Facilities	K-723 slab	SD-780 SD-800 SD-820 SD-830	Clinch River kilometer 16 (CRK16 Brashear Island)
Group II, Phase 3 PCCR for K-29 (Submitted – Pending TDEC approval)	K-29 slab	SD-490	Weir K-1007-B4

Table 8.6. Long-term stewardship requirements for D&D facilities associated with remaining contaminated media (continued)

CRK = Clinch River kilometer
D&D = decontamination and decommissioning
ETTP = East Tennessee Technology Park
FY = fiscal year
LTS = long-term stewardship
NPDES = National Pollution Discharge and Elimination System
PCCR = Phased Construction Completion Report
RmAR = Removal Action Report
SD = storm drain
TDEC = Tennessee Department of Environment and Conservation

8.5.1 Compliance with LTS Requirements

8.5.1.1 Requirements

PCCRs for the various D&D projects listed in Table 8.6 include the following: (1) annual radiological surveillance, (2) storm drain characterization performed once within each NPDES permitting period (=5 yrs.), and (3) annual surface water monitoring. Figure 8.3 shows the locations of the storm drains and surface water locations relative to areas containing the remaining contamination. Storm drain characterization and surface water monitoring results are used to verify the effectiveness of the Radiological Control Program.

If radiological contamination is found to be migrating out of the contamination area, then additional controls are implemented. The frequency and level of surveillance and monitoring is established at each site by the radiological engineers responsible for the program, in accordance with requirements and criteria set forth in 10 *CFR* §*835*, Occupational Radiation Protection.

In general, storm water runoff from concrete or asphalt pads is not sampled directly (the K-1420 slab is an exception). Instead, The ETTP Environmental Compliance Program determines the effectiveness of the radiological control program through ongoing storm drain sampling and instream water sampling, i.e., monitoring in compliance with the ETTP NPDES permit and storm water runoff plans. Storm drain discharges are characterized at least once during each NPDES permitting period, a maximum of 5 years, for a minimum of gross alpha, gross beta, isotopic uranium, and ^{99}Tc. Instream water monitoring is conducted annually at Mitchell Branch weir, K-1007-P1 Ponds weir (K-1007-B4), K-901-A Pond weir, upstream of ETTP in PC, and downstream of ETTP at CR kilometer 16 (Brashear Island) for a minimum of gross alpha, gross beta, isotopic uranium, and ^{99}Tc. Data are compared to screening levels established at 4% of DOE Order 5400.5 Derived Concentration Guidelines to maintain discharges ALARA. The ETTP Environmental Compliance Program will provide an annual summary of data and any exceedances in the ASER. Additionally, the RER will include the same summary.

8.5.1.2 Status of Requirements for FY 2007

Radiological monitoring of the facilities listed below (Table 8.7) is performed as part of the Radiological Compliance Monitoring as required by 10 *CFR* §*835* and adopted in the BJC RPP. All surveys are performed and documented in compliance with applicable BJC procedures. Limits that apply to the surveys performed are found in Attachment D to 10 *CFR* §*835* and repeated in Table 8.8.

Storm drain sampling and surface water monitoring of these areas was initiated in late FY 2007. The 2007 ASER due September 2008 will summarize the FY 2007 data and note any exceedances. The 2009 RER will contain these results and exceedances from the ASER.

Table 8.7. Summary of radiological monitoring information

Facility/Location	Status	Survey Frequency	Survey Date(s)	Survey Summary
Group II, Phase 2 RmAR for K-1064 Peninsula Area				
K-1025-A slab	Fixed Contamination Area	Annually	4/4/2007	No removable activity above 10 *CFR* §835 limits detected.
K-1025-B slab	Fixed Contamination Area	Annually	4/4/2007	No removable activity above 10 *CFR* §835 limits detected.
K-1025-C slab	Fixed Contamination Area	Annually	4/4/2007	No removable activity above 10 *CFR* §835 limits detected.
K-1025-D slab	Fixed Contamination Area	Annually	4/7/2007	No removable activity above 10 *CFR* §835 limits detected.
K-1064-D slab	Fixed Contamination Area	Annually	5/3/2007	No removable activity above 10 *CFR* §835 limits detected.
K-1025-E	Fixed Contamination Area	Annually	4/7/2007	No removable activity above 10 *CFR* §835 limits detected.
K-1064 Salvage Material Yard soil	Contamination Area	(survey performed only when worker entries required)	N/A	N/A
Group II, Phase 3 PCCR for BOS-LABS				
K-1004-A	Slab removed FY2007, no monitoring required.	None	N/A	N/A
K-1004-B	Slab removed FY2007, no monitoring required.	None	N/A	N/A
K-1004-C	Slab removed FY2007, no monitoring required.	None	N/A	N/A
Group II, Phase 3 PCCR for BOS-LABS				
K-1004-D	Slab removed FY2007, no monitoring required.	None	N/A	N/A
K-1004-E	Slab removed FY2007, no monitoring required.	None	N/A	N/A
K-1004-L	Slab removed FY2007, no monitoring required.	None	N/A	N/A
K-1004-H	Slab removed FY2007, no monitoring required.	None	N/A	N/A
K-1004-M	Slab removed FY2007, no monitoring required.	None	N/A	N/A
K-1015	Slab removed FY2007, no monitoring required.	None	N/A	N/A
Group II, Phase 3 PCCR Bldg. K-1420				
K-1420 slab – storm flow sample required	Not Applicable to Radiological Controls.	Not Applicable to Radiological Controls.	Not Applicable to Radiological Controls.	Not Applicable to Radiological Controls.
Uranium Recovery Room and calciner room – quarterly	Contamination Area. Included in radiological Compliance Survey Program.	Quarterly	10/9/2007	No removable activity above 10 *CFR* §835 limits

Table 8.7. Summary of radiological monitoring information (continued)

Facility/Location	Status	Survey Frequency	Survey Date(s)	Survey Summary
radiological survey				detected.
K-1420 Pad boundary – annual radiological survey	Included in Radiological Compliance Survey Program	Quarterly	10/8/2007	No removable activity above 10 *CFR* §*835* limits detected.
Group II, Phase 3	**FY 2006 PCCR for Low Risk/Low Complexity Facilities**			
K-723 slab	Fixed Contamination Area	Annually	Survey scheduled for December 15, 2007.	N/A
Group II, Phase 3	**PCCR for K-29**			
K-29 slab	Fixed Contamination Area	Annually	10/1/2007	No removable activity above 10 *CFR* §*835* limits detected.

BOS-LABS = Balance of Sites Laboratories
CA = contamination area
CFR = Code of Federal Regulations
FY = fiscal year
ETTP = East Tennessee Technology Park
N/A = not applicable
PCCR = Phased Construction Completion Report
RmAR = Removal Action Report
ROD = Record of Decision

Table 8.8. 10 *CFR* §*835* limits

Radionuclide	Removable dpm/100cm^2	Total (Fixed + Removable) dpm/100cm^2
U-Nat, U-235, U-238, and associated decay products	1,000	5,000
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	500
Th-Nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1000
Beta-Gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	1,000	5,000
Tritium and tritiated compounds	10,000	N/A

CFR = Code of Federal Regulations
cm^2 = square centimeter
dpm = disintegrations per minute
I = iodine
Nat = natural occurring
Pa = protactinium
Ra = radium
Sr = strontium
Th = thorium
U = uranium

8.6 EAST TENNESSEE TECHNOLOGY PARK WATERSHED CONDITION AND TRENDS

This section provides a summary of ETTP site-wide groundwater and surface water conditions, including a discussion of exit pathway contaminants. It includes an update on conditions as characterized by the biological monitoring in area surface water bodies.

8.6.1 Major Site Plumes

Extensive groundwater monitoring at the ETTP site has identified VOCs as the most significant groundwater contaminant on site. For purposes of analyzing the groundwater contaminant issues at ETTP, the RI/FS subdivided the site into several distinct areas–Mitchell Branch watershed, K-1004 and K-1200 area, the K-27/K-29 area, and the K-901 area. Each of these areas has significant VOC contamination in groundwater. The principal chlorinated hydrocarbon chemicals that were used at ETTP were PCE, TCE, and 1,1-DCA.

Figure 8.15 shows the distribution and concentrations of the primary chlorinated hydrocarbon chemicals and their transformation products, respectively. Several plume source areas are identified within the regions of the highest VOC concentrations. In these areas, the primary chlorinated hydrocarbons have been present for decades and mature contaminant plumes have evolved. The degree of transformation, or degradation, of the primary chlorinated hydrocarbon compounds is highly variable across the ETTP site. In the vicinity of the K-1070-C/D source, a high degree of degradation has occurred, although a strong source of contamination still remains in the vicinity of the “G-Pit”, where approximately 9,000 gallons of chlorinated hydrocarbon liquids were disposed in an unlined pit. Other areas where transformation is significant include the K-1401 Acid Line leak site, and the K-1407-B Pond area. Transformation processes are weak or inconsistent at the K-1004 and K-1200 area, K-1035, K-1413, and K-1070-A Burial Ground, and little transformation of TCE is observed in the K-27/K-29 source and plume area.

8.6.2 Exit Pathway Monitoring

Groundwater exit pathway monitoring sites are shown in Fig. 8.15. Groundwater monitoring results for the exit pathways are discussed below starting with the Mitchell Branch exit pathway and then progressing in a counterclockwise fashion.

The Mitchell Branch exit pathway is monitored using surface water data from the K-1700 Weir on Mitchell Branch and wells BRW-083 and UNW-107. Figure 8.16 shows the detected concentrations of TCE, 1,2-DCE (essentially all cis-1, 2-DCE), and vinyl chloride at the K-1700 Weir on Mitchell Branch from FY 1994 through FY 2007. These contaminants are the major contaminants in Mitchell Branch, although low concentrations of carbon tetrachloride, chloroform, and TCA are sometimes detected. As noted in Sect. 8.4.1.2, VOC concentrations measured during FY 2007 were below AWQC levels at K-1700. See Sect. 8.4.1.2 for a discussion of FY 2007 surface water monitoring results in Mitchell Branch.

Wells BRW-083 and UNW-107, located near the mouth of Mitchell Branch have been monitored since 1994. Table 8.9 shows the history and concentrations of detected VOCs in groundwater. Detection of VOCs in groundwater near the mouth of Mitchell Branch is considered an indication of the migration of the Mitchell Branch VOC plume complex.

Wells BRW-003 and BRW-017 monitor groundwater at the K-1064 Peninsula burn area (Fig. 8.15). Figure 8.17 shows the history of VOC concentrations in groundwater from FY 1994 through FY 2007. TCE concentrations have declined in both wells; 1,1-TCA has declined in Well BRW-003; and 1,2-DCE is detected at variable concentrations between about 5 and 12 μg/L.

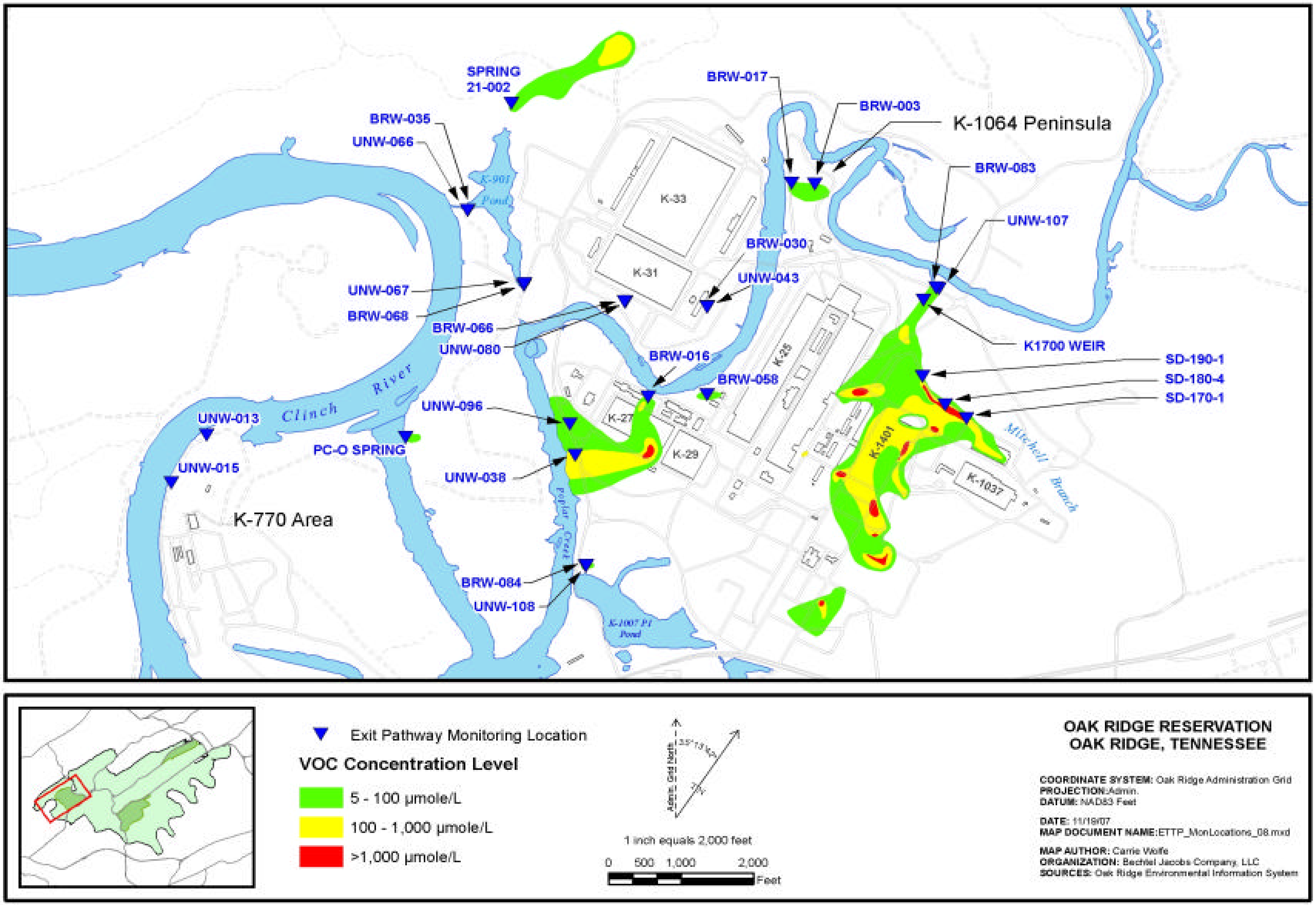


Fig. 8.15. ETTP exit pathways monitoring locations.

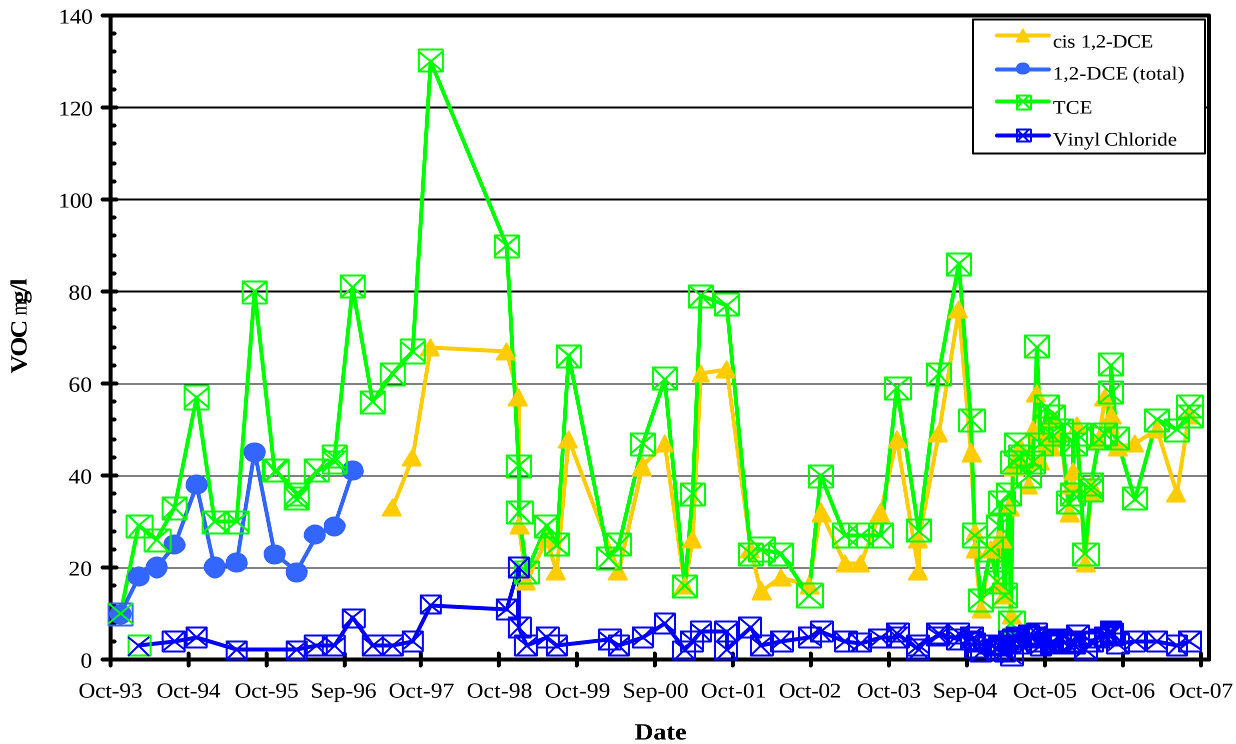


Fig. 8.16. K-1700 Weir VOC concentrations.

Table 8.9. VOCs detected in groundwater in the Mitchell Branch Exit Pathway

Well	Date	*cis*-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
BRW-083	8/29/2002		5	28	
	3/16/2004	0.69	2.2	9.9	
	8/26/2004	2	4.7	20	
	3/14/2007	5	9	28	
UNW-107	8/3/1998			3	
	8/26/2004	4.7		3.6	
	8/21/2006	3.4	14	2	1.2
	3/13/2007	25	2 J	23	2[1]
	8/21/2007	17		30	0.3 J

[1]Detection occurred in a field replicate. Constituent not detected in regular sample.
All concentrations µg/L.
BRW = bedrock wells
UNW = unconsolidated wells
VOCs = volatile organic compounds

Groundwater is monitored in 4 wells (BRW-066, BRW-030, UNW-080, and UNW-043) that lie between buildings K-31/K-33 and PC, as shown on Fig. 8.15. VOCs are not COCs in this area; however, leaks of recirculated cooling water have left residual chromium contamination in groundwater. Figure 8.18 shows the history of chromium detection in wells at K-31/K-33. Well UNW-043 exhibits the highest residual chromium concentrations of any in the area. Chromium concentrations in well UNW-043 correlate with the turbidity of samples and acidification of unfiltered samples that contain suspended solids often causes detection of high metals content because the acid preservative dissolves metals that are adsorbed to the solid particles at the normal groundwater pH. During FY 2006 an investigation was conducted to determine if groundwater in the vicinity of the K-31/K-33 buildings contained residual hexavalent chromium from recirculated cooling water leaks. The data indicated the chromium in groundwater near the leak sites was essentially all the less toxic trivalent species.

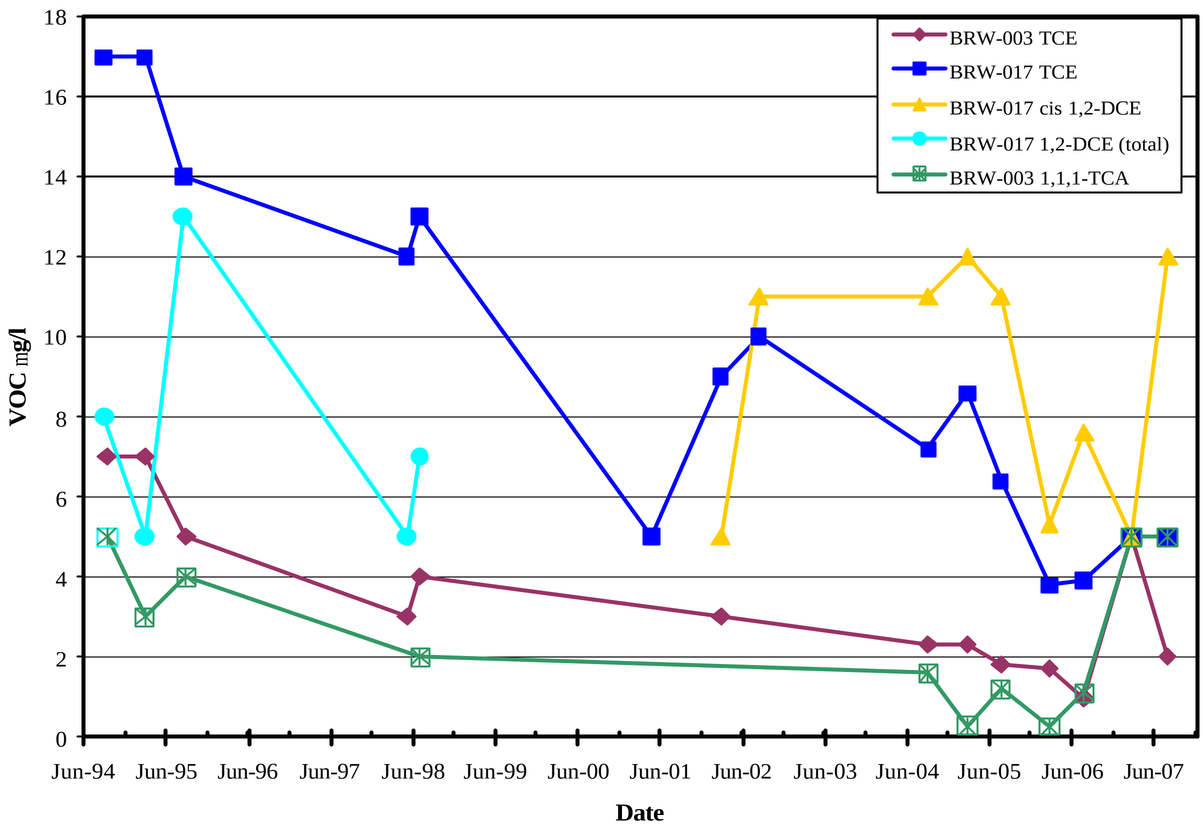


Fig. 8.17. VOC concentrations in groundwater at K-1064 Peninsula area.

Several exit pathway wells are monitored in the K-27/K-29 area, as shown on Fig. 8.15. Figure 8.19 shows the history of detected VOC concentrations in wells both north and south of K-27 and K-29. The source of VOC contamination in well BRW-058 is not suspected to be from K-27/K-29 area operations. VOC concentrations in this area show very slowly declining concentrations.

Wells BRW-084 and UNW-108 are exit pathway monitoring locations at the northern edge of the K-1007-P1 Pond (see Fig. 8.15). These wells have been monitored intermittently from 1994 through 1998 and semi-annually from FY 2001 through FY 2007. The first detections of VOCs in these wells occurred during FY 2006 with detection of low (~10 µg/L or less) concentrations of TCE and *cis* 1,2-DCE. The source area for these VOCs is not known. Volatile organic compounds were not detected in either of these wells during FY 2007, however, metals were detected associated with the presence of high turbidity in the samples.

Exit pathway groundwater in the K-901-A Pond area (see Fig. 8.15) is monitored by 4 wells (BRW-035, BRW-068, UNW-066 and UNW-067) and 2 springs (21-002 and PC-0). Very low concentrations (<5 µg/L) of VOCs are occasionally detected in wells adjacent to the K-901 Pond. However, these contaminants are not persistent in groundwater west and south of the pond. TCE is the most significant groundwater contaminant detected in the springs, and the historic TCE concentrations are shown in Fig. 8.20. Spring PC-0 was added to the sampling program in 2004. During the spring through autumn seasons, spring PC-0 is submerged beneath the Watts Bar lake level, so this location is accessible for sampling only during winter when the lake level is lowered by TVA. At spring 21-002, 1,1,1-TCA, 1,2-DCE, carbon tetrachloride, and PCE are sometimes present at concentrations typically less than 5 µg/L.

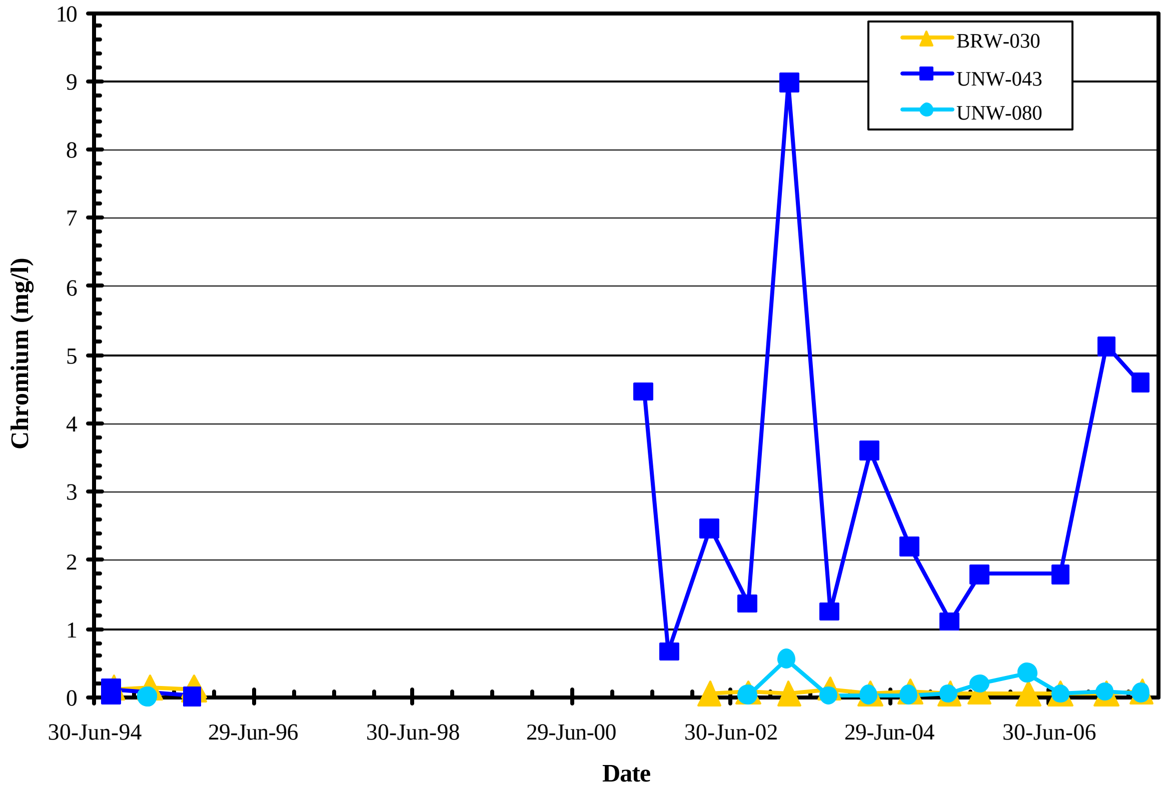


Fig. 8.18. Chromium concentrations in groundwater in the K-31/K-33 area.

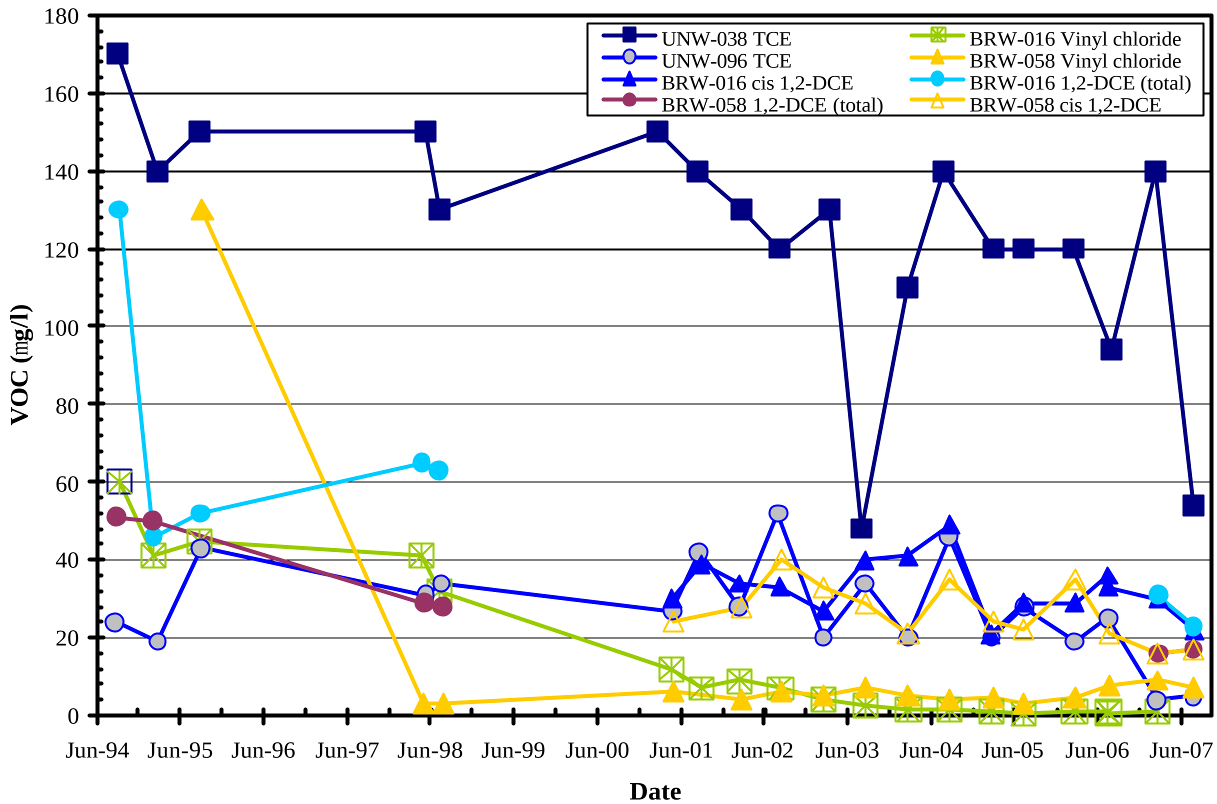


Fig. 8.19. Detected VOC concentrations in groundwater exit pathway wells near K-27 and K-29.

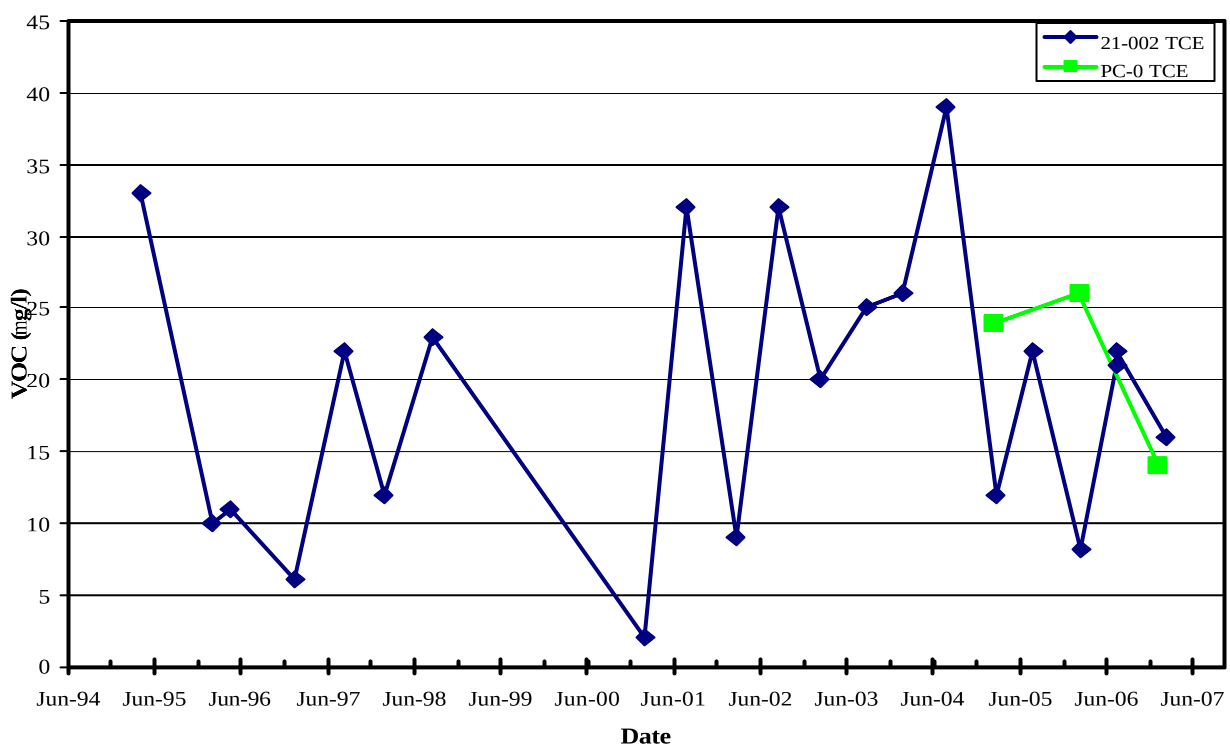


Fig. 8.20. TCE concentrations in K-901 area springs.

Exit pathway groundwater monitoring is also conducted at K-770 where wells UNW-013 and UNW-015 are used to assess radiological groundwater contamination along the CR (see Fig. 8.15). Figure 8.21 shows the history of measured alpha and beta activity in this area. Analytical results indicate that the alpha activity is largely attributable to uranium isotopes, and well UNW-013 historically contained ^{99}Tc that is a strong beta emitting radionuclide responsible for the elevated beta activity in that well.

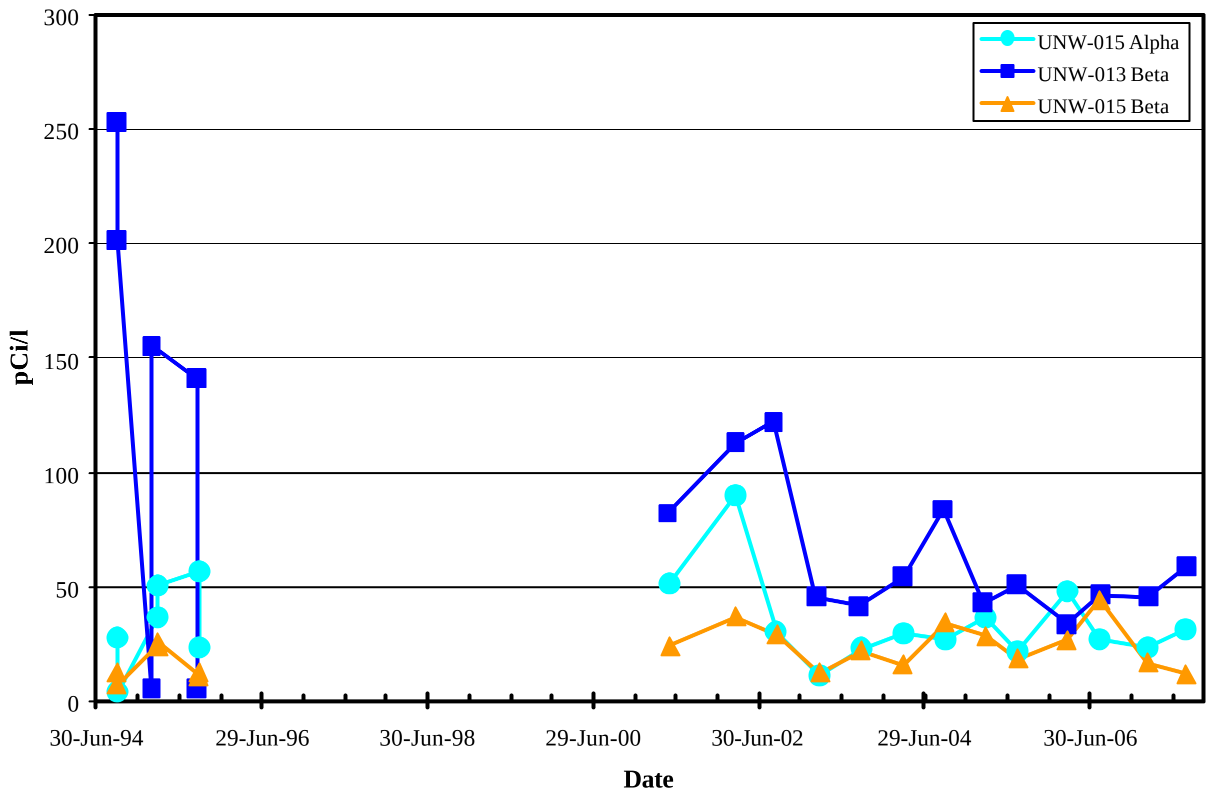
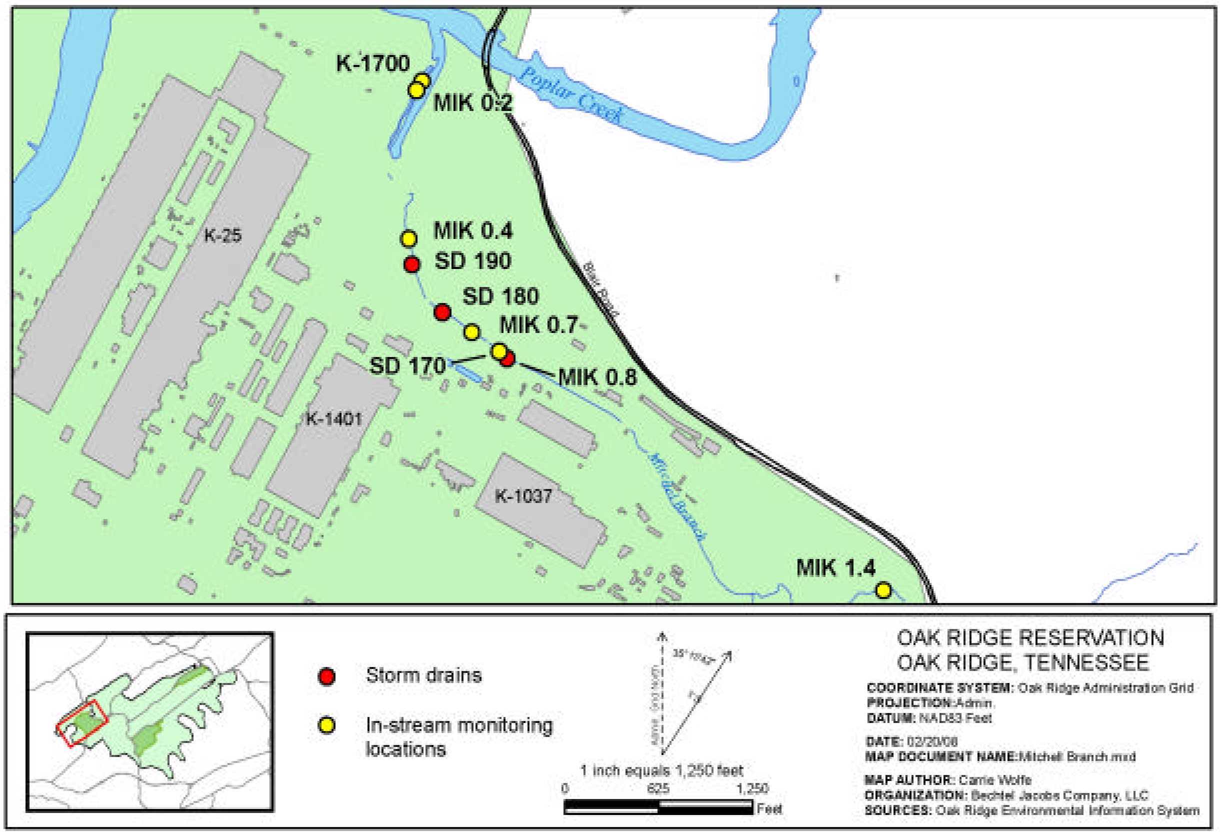


Fig. 8.21. History of measured alpha and beta activity in the K-770 area.

8.6.3 Aquatic Biological Monitoring

Long-term trends in PCB accumulation in fish from K-901-A and K-1007-P1 were presented in Sect. 8.4.2. Biological monitoring in Mitchell Branch, conducted by the ETTP Biological Monitoring and Abatement Program (BMAP), includes: (1) contaminant accumulation in fish, (2) fish community surveys, and (3) benthic macroinvertebrate surveys.

Figure 8.22 shows surface water and biological monitoring locations in Mitchell Branch. Mean PCB concentration in redbreast sunfish collected from Mitchell Branch in 2007 was the lowest observed in that species at that location since 1993, continuing a substantial and relatively steady decrease over the past 5 years (Fig. 8.23). However, at 0.88 µg/g, this remains one of the highest mean PCB concentrations found in sunfish at any site on the ORR. Caged clams are used to monitor potential sources of PCBs to Mitchell Branch. Monitoring sites are located upstream and downstream of major storm drains and in lower Mitchell Branch near the weir (MIK 0.2). Based on the clam results, SD 190 and lower Mitchell Branch (MIK 0.2) continue to be the areas with the highest PCB exposure in the creek, averaging greater than 2 µg/g at both sites. Unlike the fish PCB trends, PCBs in clams did not decrease in 2007 relative to last year.



8.22. Surface water and biological monitoring locations in Mitchell Branch.

The species richness (number of species) of the fish community in Mitchell Branch (MIK 0.4) has improved since the completion of the interceptor trench in early 1998 (Fig. 8.24), but remains below richness in communities of comparable reference streams. The most recent results for Mitchell Branch indicated that the recovery experienced by the macroinvertebrate community the first few years after the interceptor trench was completed has persisted (Fig. 8.25). However, further recovery has not occurred since approximately 2002, and overall trends indicate that the sites downstream of the reference site generally have fewer pollution-intolerant species.

Toxicity testing, using the water flea, *Ceriodaphnia dubia*, is conducted in Mitchell Branch and adjacent storm drains as part of the ETTP BMAP. Toxicity testing in 2007 occurred during April 4 – 10, and was deemed useful in interpreting the potential ecological impact of the recently observed elevated chromium concentrations in the stream. Statistical analyses of toxicity tests performed on water samples from SD 190 and 170 and Mitchell Branch have confirmed toxicity in both storm drain effluents and water from Mitchell Branch sites located immediately downstream of the storm drains. These results appear to coincide with the spatial pattern of chromium concentrations in the stream, with the highest concentrations associated with a seep in the vicinity of SD 170 and decreasing concentrations with distance downstream. As of April 2007, however, there appears to be no clear indication that the chromium seep is having any gross negative effects on the fish and macroinvertebrate community in Mitchell Branch relative to previous years (Figs 8.24 and 8.25).

8.6.4 Summary: Watershed Condition and Trends

Surface water and groundwater contaminant trends at ETTP reflect relatively stable conditions. The extreme drought of FY 2007 may have contributed to an observed slight increase in VOC concentrations in Mitchell Branch although effects of remedial actions may also have contributed to the increase. The notable observation at ETTP concerning surface water contamination during FY 2007 was the detection of hexavalent chromium in Mitchell Branch. The chromium was found to emanate from Outfall 170 and was found to be tied to contaminated groundwater seepage. Investigations were initiated to determine the source of contamination and to prevent impacts to surface water quality in Mitchell Branch.

Groundwater quality data reflect generally decreasing concentrations of VOCs in most monitored areas and the continuing presence of low concentrations of VOCs in groundwater exit pathways was similar to previous observations reported from FY 2006. Metals contamination, particularly chromium, largely associated with suspended solids in shallow groundwater wells continued to affect water quality in several areas. Redevelopment of selected monitoring wells is planned to enable collection of more representative groundwater samples.

Aquatic biota monitoring also shows that conditions are fairly stable in surface water bodies at ETTP. PCB levels remain elevated in fish in the K-1007-P1 Pond. When implemented, the ecological enhancement of the P1 Pond is expected to reduce PCB uptake from pond sediment into the aquatic foodchain. PCB levels in sunfish in Mitchell Branch downstream of Outfall 190 remain elevated although concentrations have decreased in 2005 – 2007 to levels near the human health advisory. The number of fish species in Mitchell Branch appears to have stabilized to near the lower level observed in reference streams.

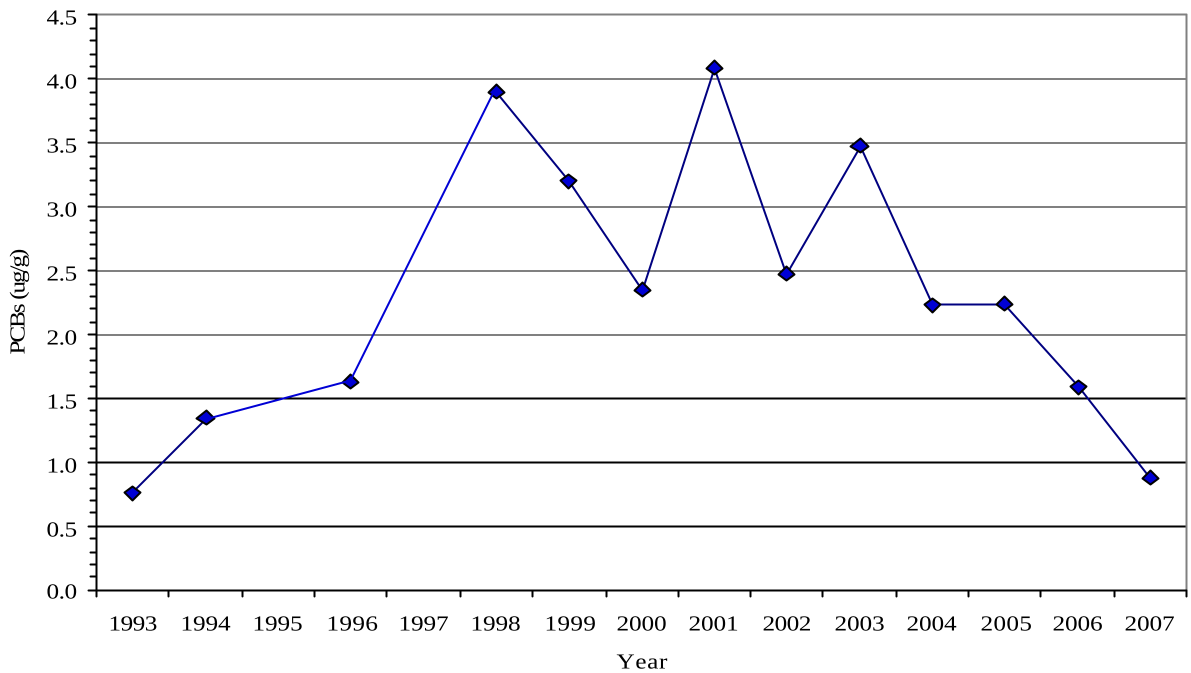


Fig. 8.23. Mean PCB concentrations (μg/g) in redbreast sunfish from Mitchell Branch, 1993-2007.

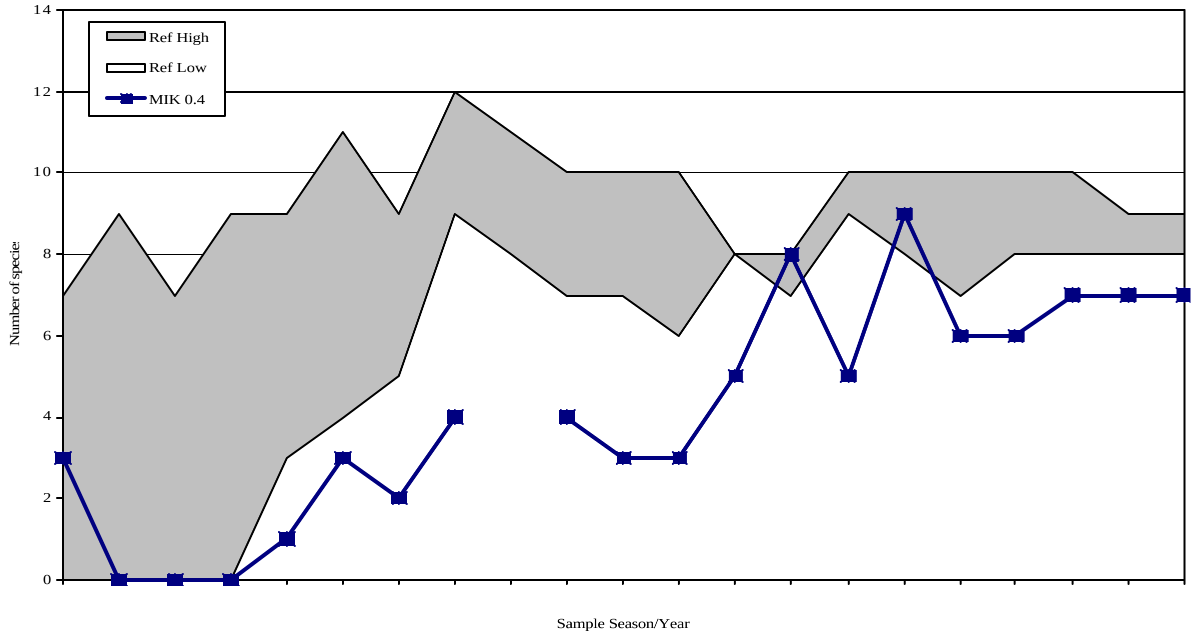


Fig. 8.24. Species richness (number of species) in spring samples of the fish community in Mitchell Branch (MIK) and a range of reference streams (Ref High-Low), 1986 to 2007.
Interruptions in data lines indicate missing samples.

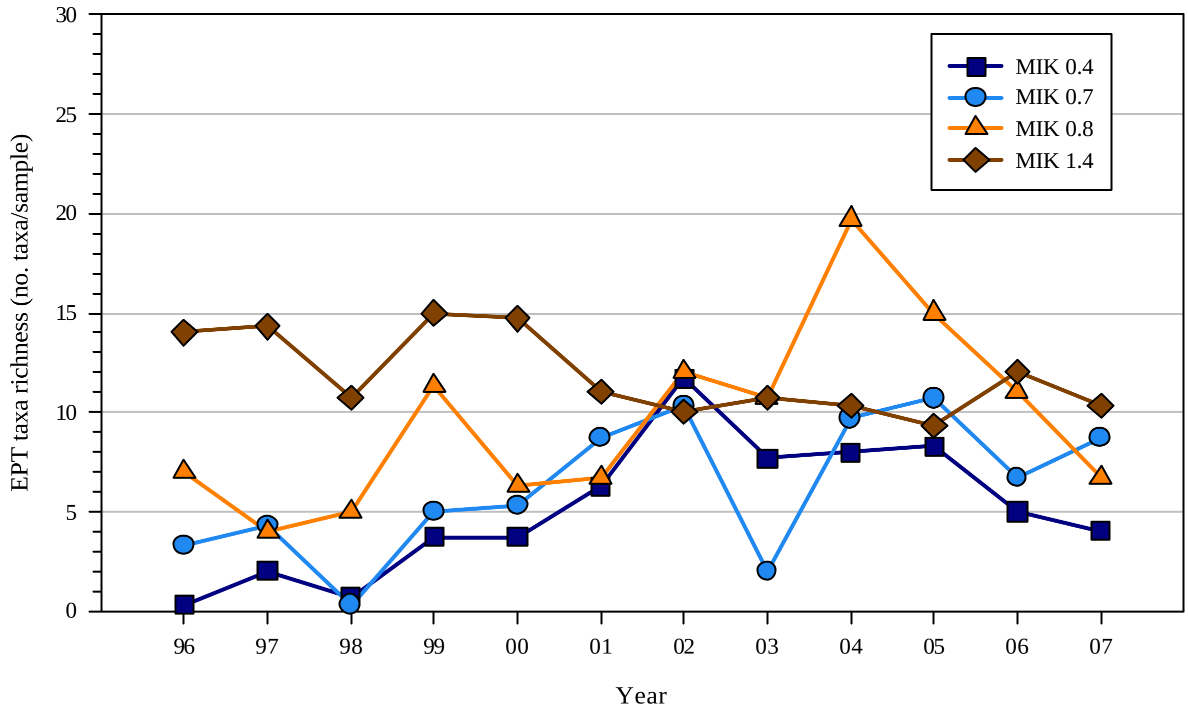


Fig. 8.25. Mean (n = 3) taxonomic richness of the pollution-intolerant taxa for the benthic macroinvertebrate community at sites in Mitchell Branch at the ETTP, April sampling periods, 1996–2007.
MIK = Mitchell Branch kilometer. EPT = Ephemeroptera, Plecoptera, and Trichoptera, or mayflies caddisflies, and stoneflies.

8.7 EAST TENNESSEE TECHNOLOGY PARK MONITORING CHANGES AND RECOMMENDATIONS

Recent watershed-scale decisions at ETTP relate to soil, buried waste, and subsurface structures for the protection of human health and to limit further contamination of groundwater through source reduction or removal. The remaining media (e.g., groundwater, surface water, and sediments) and ecological receptors will be evaluated and addressed by final sitewide decisions(s). Therefore, changes to the monitoring network at ETTP are not recommended at this time.

The identified PCB risks in the K-1007-P1 and K-901-A ponds are being addressed through an AM which requires implementation of a non-TC RmA. The primary action to be taken is the ecological enhancement of the K-1007-P1 Holding Pond that targets the sediment and fish contamination and is designed to restore the pond to natural conditions much less conducive to PCB uptake in fish. Although monitoring associated with the previous action will remain in effect until the new AM is implemented, this issue is considered resolved for tracking purposes, as reflected in Table 8.10.

Table 8.10. Summary of ETTP technical issues and recommendations

ISSUE	ACTION/ RECOMMENDATION
<u>ISSUE COMPLETED:</u>	
1. PCB concentrations in fish within the K-1007-P1 and K-901-A holding ponds remain above acceptable risk levels.	1. The identified PCB risks are addressed through an AM, approved in March 2007, requiring a non-TC RmA that targets the sediment and fish contamination in the K-1007-P1 Holding Pond by restoring the pond to natural conditions less conducive to PCB uptake in fish. Monitoring and institutional controls will be implemented at the K-1007-P1 Holding Pond, as well as the K-901-A Holding Pond and K-720 Slough.

AM = Action Memorandum
ETTP = East Tennessee Technology Park
PCB = polychlorinated biphenyl
TC RmA = time critical removal action

9. CERCLA ACTIONS AT OTHER SITES

This chapter presents the remedial effectiveness evaluation for CERCLA actions that are not physically situated within one of the five established watersheds or ChR, but are located on the ORR. Presently only the White Wing Scrap Yard (WWSY), located north of the western end of BCV, falls into this category.

9.1 WHITE WING SCRAP YARD (WAG 11) SURFACE DEBRIS REMEDIAL ACTION

Location of the WWSY action is shown on Fig. 9.1. The scope of this action included removal of contaminated surface debris retrievable without excavation. Some buried materials remain at the site. WWSY has only LTS requirements (Table 9.1). A review of compliance with these LTS requirements is included in Sect. 9.1.2. Background information on this remedy and performance standards are provided in Chapter 9 of Volume 1 of the 2007 RER (DOE 2007a).

9.1.1 Status of Updates (RESERVED)

Table 9.1. Long-term stewardship requirements for CERCLA actions at other sites

Site/Project	LTS Requirements		Status	RER Section
	Land Use Controls	Engineering Controls		
Completed actions				
White Wing Scrap Yard (WAG 11) Surface Debris Remedial Action	▪ Long-term S&M		▪ LUCs in place	9.1.2

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
LTS = long-term stewardship
LUCs = land use controls
RER = Remediation Effectiveness Report
S&M = surveillance and maintenance
WAG = Waste Area Group

9.1.2 Compliance with LTS Requirements

9.1.2.1 Requirements

There are no requirements for post-remediation monitoring and no LTS requirements listed in the Interim Record of Decision (IROD) (DOE 1992). However, the Interim Remedial Action PCR (DOE 1994b) states, "because the interim remedial action was to remove debris, no operation and maintenance are necessary as a result of the interim action. However, long-term surveillance and maintenance will continue until decisions are made for future and/or final CERCLA remedial actions at the site."

9.1.2.2 Status of Requirements for FY 2007

The site underwent monthly inspections performed by the Y-12 S&M Program to inspect components including damaged or missing radiation roping or signs delineating radiation areas; deteriorating access road conditions or damaged or missing gate locks; debris buildup or blockage at the fence/creek boundaries; unauthorized materials placed within the area; damage to site perimeter fencing; and unlocked gate or missing or damaged radiation signs. Additionally, inspections included the separate fenced-in area west of the scrap yard. S&M personnel inspected the fencing by walking the entire perimeter of the site and the west fenced area. There were no deficiencies recorded on the inspection checksheets. Maintenance included clearing fallen trees from the fencing and routine mowing.

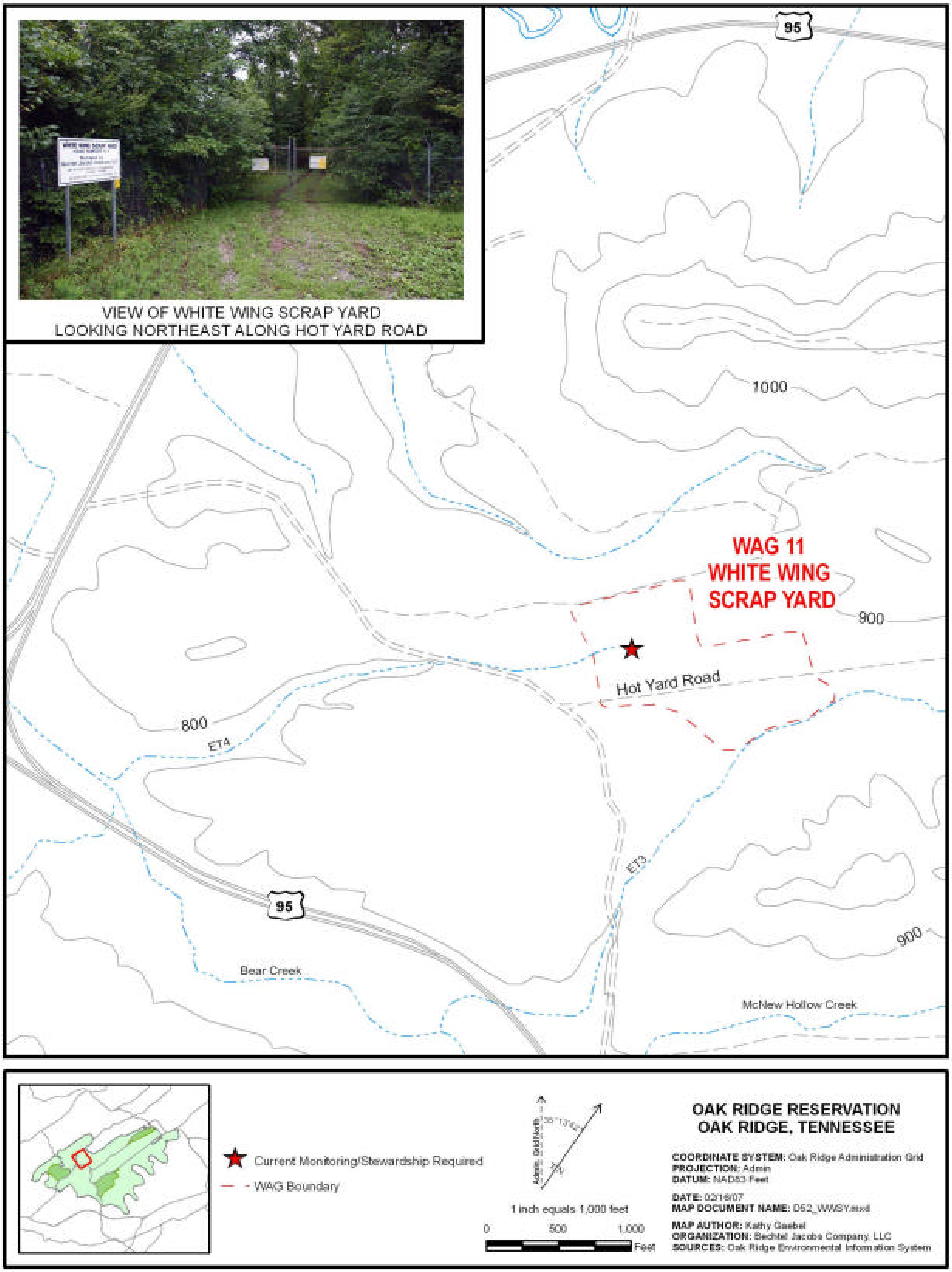


Fig. 9.1. Location of White Wing Scrap Yard (WAG 11).

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APPENDIX A:
EMWMF ANNUAL REPORT FOR FY 2007

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BJC/OR-3006

Annual Report for 2006 – 2007 Detection Monitoring at the Environmental Management Waste Management Facility, 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-3006

Annual Report for 2006 – 2007 Detection Monitoring at the Environmental Management Waste Management Facility, Oak Ridge, Tennessee

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BECHTEL JACOBS COMPANY LLC
managing the
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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

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ACRONYMS

ALARA	as low as reasonably achievable
AMSL	above mean sea level
ASA	Auditable Safety Analysis
AWQC	ambient water quality criteria
BJC	Bechtel Jacobs Company LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
COC	contaminant of concern
CY	calendar year
DAC	derived air concentration
DCE	dichloroethene
DCG	derived concentration guide
DO	dissolved oxygen
DOE	U. S. Department of Energy
EMP	Environmental Monitoring Plan
EMWMF	Environmental Management Waste Management Facility
EPA	U. S. Environmental Protection Agency
ES&H	environmental, safety, and health
FS	Feasibility Study
FY	fiscal year
OREIS	Oak Ridge Environmental Information System
ORR	Oak Ridge Reservation
PCB	polychlorinated biphenyl
PEL	permissible exposure limit
PQL	practical quantitation limit
Q	Quarter
RADCON	Radiological Control
ROD	Record of Decision
SOF	sum of fractions
SVOC	semivolatile organic compound
TDEC	Tennessee Department of Environment and Conservation
TSS	total suspended solids
TV	threshold value
UTL	upper tolerance limit
VOC	volatile organic compound
WAC	waste acceptance criteria

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ANNUAL REPORT FOR 2006 – 2007 DETECTION MONITORING AT THE ENVIRONMENTAL MANAGEMENT WASTE MANAGEMENT FACILITY, OAK RIDGE, TENNESSEE

- Record of Decision November 2, 1999 (DOE 1999)
- Status Accepting waste since May 2002

Decision Document: *Record of Decision for the Disposal of Oak Ridge Reservation Comprehensive Environmental Response, Compensation, and Liability Act of 1980 Waste*

1. PROJECT DESCRIPTION

In November 1999, the Federal Facility Agreement parties selected on-site disposal of Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) waste resulting from cleanup of the Oak Ridge Reservation (ORR) as the remedy for disposal of CERCLA waste (DOE 1999). This remedy called for the detailed design, construction, operation, and closure of a 306,000-m^3 (400,000-yd^3) disposal facility, with an option to expand to a nominal 1.3 million m^3 (1.7 million yd^3). The facility is located in East Bear Creek Valley west of the Y-12 National Security Complex (Fig. 1).

The action consisted of designing, constructing, operating, and closing an engineered, above-grade, earthen disposal cell and associated support facilities called the Environmental Management Waste Management Facility (EMWMF). The purpose of the EMWMF is to provide a disposal cell for ORR wastes, including low-level radioactive waste, Resource Conservation and Recovery Act of 1976 waste, Toxic Substances Control Act of 1976 waste, and mixtures of the above (mixed waste). Waste types that qualify for disposal include soil, dried sludge and sediment, solidified waste, stabilized waste, building debris, personal protective equipment, and scrap equipment.

Waste generated from the CERCLA cleanup of former waste sites and buildings that have been impacted by past operations [both on the ORR and at U. S. Department of Energy (DOE) sites off the ORR within the state of Tennessee] is disposed in the EMWMF, provided the waste is compliant with the facility's waste acceptance criteria (WAC).

Construction of Cells 1 and 2 at the EMWMF was completed in early May 2002 (DOE 2002a) and construction of Cells 3 and 4 was completed in April 2005. The design for Cell 5 to reach 1.7 million yd^3 has been approved, but construction has not yet begun. Elements of the facility include the following:

- installation of the multi-layer liner system, including the 3-ft-thick clay liner, primary liner, leachate detection system, secondary liner, and leachate collection system;
- installation of the liner system soil protective layer;
- installation of security features, such as fencing and lighting;

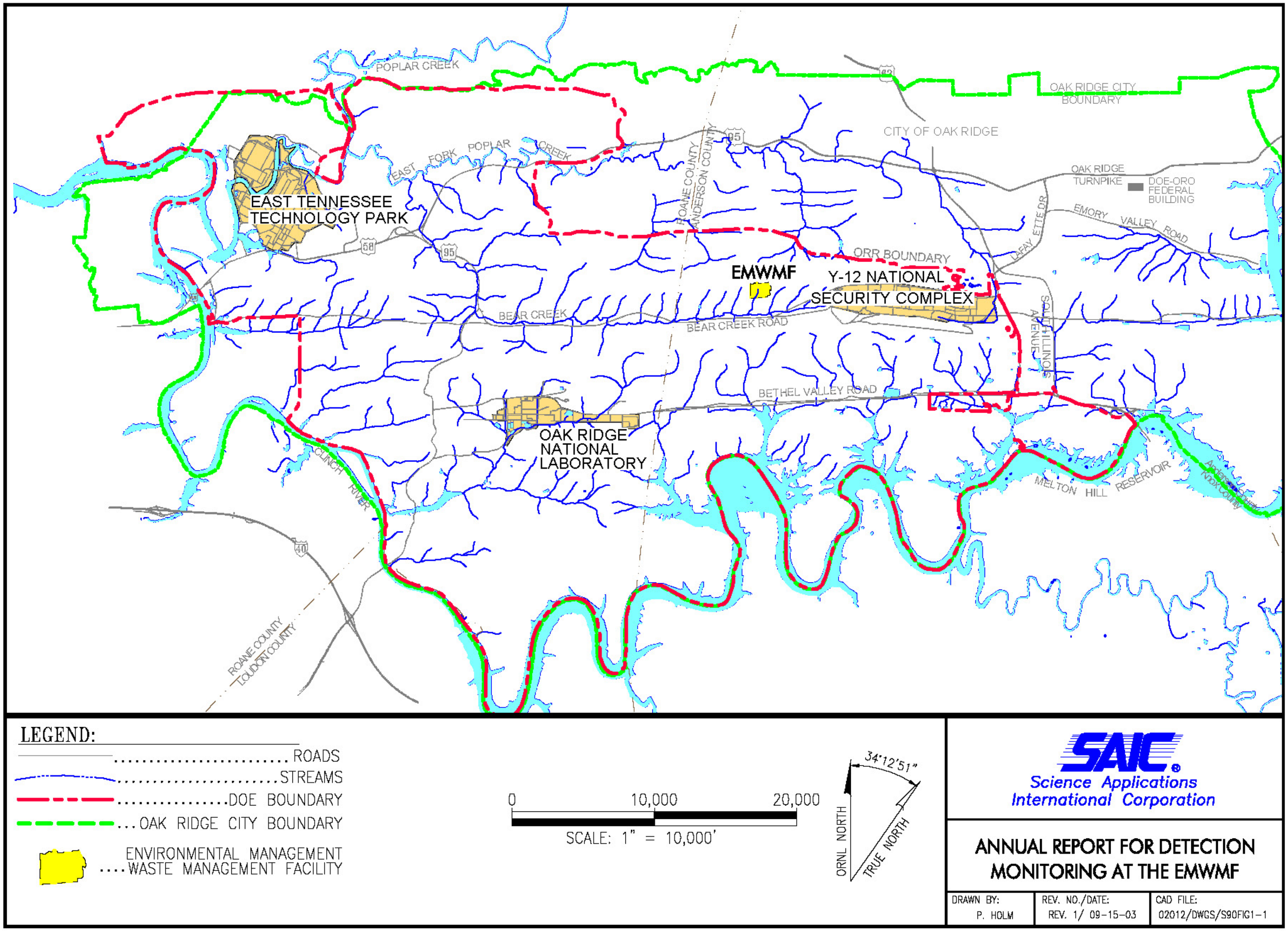

Fig. 1. EMWMF site map.

- completion of the leachate storage area, including five 30,000-gal tanks and associated piping;
- installation of four approximately 450,000-gal contact water ponds with synthetic liners;
- installation of the administration buildings;
- installation of the truck scale and regrading of access roads;
- installation of the dump ramp; and
- installation of an underdrain.

Oak Ridge Operations CERLCA projects contributed approximately 104,061 tons of waste from October 1, 2006, through September 30, 2007, as listed in Table 1. The number of shipments and cubic yards of waste received from each site are also provided. Through the end of fiscal year (FY) 2007, 581,180 tons (or 368,135 yd^3) of waste have been placed in the EMWMF.

2. EVALUATION OF DECISION DOCUMENT REQUIREMENTS

2.1 GOALS

Actual or threatened releases of hazardous substances from sites on the ORR and sites off the ORR impacted by past operations may present a substantial endangerment to public health and welfare or the environment. Remediation of such sites will generate large quantities of contaminated waste that must, in turn, be disposed in a manner that is protective of public health and welfare and the environment. The EMWMF provides capacity for the permanent, consolidated disposal of CERCLA wastes (i.e., radioactive, hazardous, and mixed) generated from response actions at individual sites.

The Record of Decision (ROD; DOE 1999) specifies engineering requirements for the EMWMF cells (as summarized in Chap. 1) and describes the WAC. The cell design and the facility WAC are designed to ensure that the total incremental lifetime cancer risk from the cells will meet U. S. Environmental Protection Agency (EPA) and Tennessee Department of Environment and Conservation (TDEC) guidelines for protection of human health and the environment via all complete exposure pathways. The WAC requirements are documented in the WAC Attainment Plan (DOE 2001). The overall WAC attainment process involves the completion of four separate sets of requirements:

- Administrative WAC were derived from applicable or relevant and appropriate requirements in the ROD (DOE 1999) and from other agreements between DOE, EPA, and TDEC.
- Analytical WAC were derived from the approved risk assessment model in the Remedial Investigation/Feasibility Study (FS; DOE 1998a) and FS Addendum (DOE 1998b) for the EMWMF.
- Auditable Safety Analysis (ASA)-derived WAC were derived from the facility authorization basis documentation for the EMWMF.
- Physical WAC were derived from operational constraints and contractual agreements between DOE's Environmental Management prime contractor and its EMWMF operations subcontractor.

Table 1. Waste inventory accepted from October 1, 2006, through September 30, 2007

Waste lot	Project name	Number of shipments	Weight received (tons)	Waste received (yd^3)
4.6	K-1085	3.0	17	10
4.8	Duct Island Soil	11	162	93
6.1	K-25/27 Abatement	69	160	139
6.2	K-25/27 Abatement	29	77	67
6.6	K-25 D&D	7.0	30	5.0
6.9	K-25 EMR	205	734	622
6.10	K-25 D&D EMR	9.0	12	7.0
6.11	K-25 EMR	147	457	280
6.12	K-25 Building D&D	43	312	271
6.13	K-25 Building D&D	41	116	21
6.19	K-25 Debris & Auxiliary Piping	16	76	21
6.27	K-25 D&D EMR	228	787	483
14.11	K-1420 Equipment and Debris	832	5,526	3,390
14.14	K-1401/K723 Debris	2,877	24,403	14,971
14.15	K-1420 Calciners	4.0	59	16
14.16	ETTP Mainplant D&D Housekeeping	1.0	17	13
14.17	Cylinder Saddles	88	318	636
65.1	ETTP Scrap Removal	462	6,688	1,190
65.3	ETTP Scrap Removal, Boxes	27	179	32
89.1	MSRE Debris	1.0	2.0	0.78
111.1	Melton Valley Weir Cleanout	45	731	422
146.1	DWI 1630 Site	3,454	54,187	25,560
149.9	7841 Scrapyard	2.0	4.0	0.75
155.1	K-1070-B Burial Ground	360	5,832	3,391
155.2	BOS Labs Miscellaneous	122	2,013	1,235
997.1	Low Risk/Low Complexity	103	1,162	713
	Totals	9,186	104,061	53,590

BOS = balance of site.
D&D = decontamination and decommissioning.
DWI = David Witherspoon Site.
EMR = excess material removal.
ETTP = East Tennessee Technology Park.
MSRE = Molten Salt Reactor Experiment.

The WAC Attainment Plan was developed to define the overall process for ensuring that all regulatory agreements and risk- and hazard-based performance criteria were attained during disposal operations. The administrative, chemical, ASA, and physical WAC are listed in Appendix A of the WAC Attainment Plan (DOE 2001). The ROD also provides general requirements for the maintenance and operation of the EMWMF, as listed in Table 2.

2.2 MONITORING AND STEWARDSHIP REQUIREMENTS

2.2.1 Site Baseline

The baseline groundwater monitoring program was conducted during FY 2002, and results are reported in the Baseline Groundwater Monitoring Report (DOE 2002b). For baseline monitoring, four rounds of samples were collected. The sampling was conducted on an approximate quarterly frequency between late March 2001 and the end of January 2002. Samples were taken from 13 permanent

Table 2. Requirements of the maintenance and operation of the EMWMF

Component	Requirement[a]
Minimize the potential of adverse effects.	Apply appropriate engineering controls and construction practices during the construction and operation of the facility.
Ensure short-term protection of workers, the public, and the environment.	Implement dust emission controls, leachate removal and treatment, storm water runoff and sediment controls, and access restrictions. Implement mitigative measures during construction and operation, as needed.
Establish baseline site characteristics.	Begin air, surface water, and groundwater monitoring during the development of site facilities.
ARAR compliance.	The cells will comply with substantive EPA and TDEC requirements for the disposal of RCRA-hazardous waste and EPA and TDEC requirements for the disposal of LLW and TSCA-regulated waste (with a waiver for the requirement that a landfill liner be 50 ft above the historical high groundwater table).

[a]As specified in the Record of Decision (DOE 1999).
ARAR = applicable or relevant and appropriate requirement.
EMWMF = Environmental Management Waste Management Facility.
EPA = U. S. Environmental Protection Agency.
LLW = low-level (radioactive) waste.
RCRA = Resource Conservation and Recovery Act of 1976.
TDEC = Tennessee Department of Environment and Conservation.
TSCA = Toxic Substances Control Act of 1976.

monitoring wells to establish baseline groundwater conditions for the EMWMF detection monitoring program (Fig. 2). Additionally, a complete groundwater baseline was established for a temporary monitoring well (GW-919), located in the current Cell 3 footprint, that was removed prior to the February 2004 underdrain construction activities. The baseline samples from well GW-919 were not included in the calculation of site-specific groundwater threshold values (TVs).

Baseline potentiometric data collected from the 13 monitoring wells indicated that water table levels across the site ranged from approximately 1020 to 1030 ft above mean sea level (AMSL) at the northern limits of disturbance to about 960 ft AMSL at the southern limits of disturbance. The data indicate an overall north-to-south flow pattern across the site. Typical water table levels fluctuate in individual wells between wet season and dry season from less than 1 ft to as much as 5.8 ft. During the baseline monitoring period, the water table levels ranged from approximately 1 to 11 ft below the base of the geologic buffer for the EMWMF under wet-season conditions (April/May 2001) and 3 to 11 ft below the buffer under dry-season conditions (August 2001).

Analytical data from the baseline sampling effort were subjected to intense scrutiny by analytical chemists/data validators, statisticians, geologists, health physicists, and regulators. Several anomalous findings were identified, including the following:

- some elevated quantitation limits that resulted from low sample volumes or other reasons,
- statistical outliers of individual analytes from individual wells, and
- unexplainable detections for non-naturally occurring radionuclides.

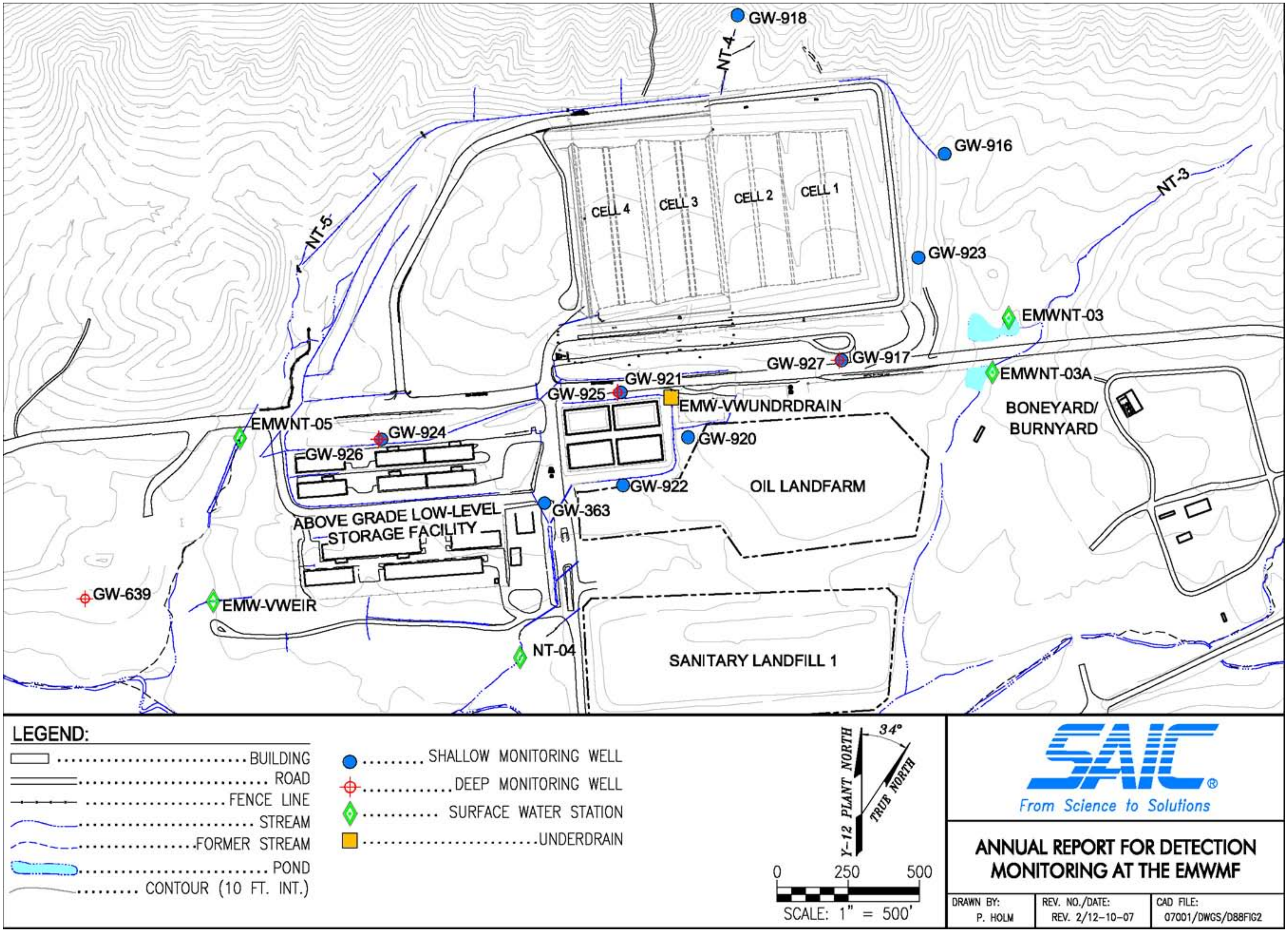

Fig. 2. EMWMF monitoring locations.

Based on these factors, TVs for the operations monitoring were established and agreed as follows:

1. For naturally occurring metals and radionuclides, TVs were based on the upper tolerance limit (UTL) calculated from the baseline dataset.

2. For man-made radionuclides, the TVs were based on agreed-to quantitation limits.

3. For all organic constituents, the TVs reflected practical quantitation limits (PQLs).

For non-radiological analytes, TVs were developed using data from all wells having a sufficient number of results to develop background statistics for each analyte, specifically the UTL of the data set for each analyte. For radiological analytes, UTLs were calculated for naturally occurring radionuclides (total radium, alpha, thorium series, ^{234}U, and ^{238}U). For non-naturally occurring radionuclides, proxy values were used as TVs. These proxy values were based on the PQL or upper approximation of PQLs. Finally, PQLs were used as TVs for some non-naturally occurring radionuclides that were detected at low frequencies (^{14}C, ^{90}Sr, ^{99}Tc, and tritium). Monitoring data for these four radionuclides were evaluated in 2004, and it was determined that the existing TVs are adequate for continued use.

With the exception of sodium and boron, evaluation of the EMWMF baseline data indicated that no wells in the monitoring network intercepted groundwater contaminated from historical sources within Bear Creek Valley. Sodium and boron were consistently elevated in three wells during baseline monitoring. These elevated results may reflect either a natural geochemical anomaly or groundwater impacts related to the nearby Oil Landfarm or other historical activities.

A review of baseline and monitoring data collected through September 2004 indicated that the TVs for potassium and ^{129}I should be changed. The TV for potassium was subsequently changed from 2.9 to 4.1 mg/L due to the variability of concentrations across wells, and the TV for ^{129}I was changed from 1 to 5 pCi/L, which is a level the analytical laboratory can consistently achieve. Additionally, TVs were assigned for several radionuclides that were not included in the baseline study but have been identified as EMWMF contaminants of concern (COCs) during the waste lot checklist review process. These radionuclides include ^{227}Ac, ^{36}Cl, ^{248}Cm, ^{234m}Pa, ^{226}Ra, and ^{228}Ra. Table 3 lists the TVs and PQLs developed from the baseline sampling and the 2004 evaluation. Note that all new COCs for this reporting cycle were identified as a result of new waste streams into the EMWMF.

2.2.2 Operation and Post-Closure

The Environmental Compliance Plan (BJC 2007a) and the Environmental Monitoring Plan (EMP) (BJC 2007b) for the EMWMF specify the operational requirements for the groundwater detection monitoring program consistent with governing state and federal regulations. Table 4 summarizes performance measures for environmental monitoring at the EMWMF during operations. Monitoring locations listed in Table 4 are presented in Fig. 2.

Maintenance during operation of the facility includes leachate collection, storage and transport to a treatment facility located on the ORR, equipment maintenance, mowing, support facility maintenance, dust control, storm water runoff and sediment control, and record keeping. When the facility is closed, support facilities will be removed, the final multi-layer cap will be installed, and the site will be restored. Site restoration will include grading and seeding of the disturbed areas in and around the disposal cells.

Table 3. EMWMF groundwater criteria

Chemical	CAS number	Units	PQL[a]	TV[b]
Anions and non-metals				
Bicarbonate	71-52-3	mg/L	NA	320
Carbonate	3812-32-6	mg/L	NA	120
Chloride	16887-00-6	mg/L	0.1	9.7
Dissolved solids	N340	mg/L	2.5	590
Fluoride	16984-48-8	mg/L	0.05	2.2
Nitrate/Nitrite	N599	mg/L	0.1	1.6
Sulfate	14808-79-8	mg/L	0.1	44
Suspended solids	N873	mg/L	2.5	490
Total organic carbon(TOC)	N997	mg/L	1	NA
pH	N704	Std unit	0.1	NA
Polychlorinated biphenyls				
PCB-1016	12674-11-2	μg/L	0.5	0.5
PCB-1221	11104-28-2	μg/L	0.5	0.5
PCB-1232	11141-16-5	μg/L	0.5	0.5
PCB-1242	53469-21-9	μg/L	0.5	0.5
PCB-1248	12672-29-6	μg/L	0.5	0.5
PCB-1254	11097-69-1	μg/L	0.5	0.5
PCB-1260	11096-82-5	μg/L	0.5	0.5
PCB-1262[c]	37324-23-5	μg/L	0.5	0.5
PCB-1268[c]	11100-14-4	μg/L	0.5	0.5
Radionuclides				
Actinium-227	14952-40-0	pCi/L	NA	1
Alpha activity	12587-46-1	pCi/L	5	5
Americium-241	14596-10-2	pCi/L	1	1
Americium-243[c]	14993-75-0	pCi/L	1	1
Beta activity	12587-47-2	pCi/L	5	10
Californium-252[c]	13981-17-4	pCi/L	10	10
Carbon-14	14762-75-5	pCi/L	50	50
Cesium-137	10045-97-3	pCi/L	10	10
Chlorine-36	13981-43-6	pCi/L	NA	2
Cobalt-60	10198-40-0	pCi/L	10	10
Curium-242[c]	15510-73-3	pCi/L	10	10
Curium-243/244	N191	pCi/L	1	1
Curium-245[c]	15621-76-8	pCi/L	1	1

Chemical	CAS number	Units	PQL[a]	TV[b]
Metals				
Aluminum	7429-90-5	mg/L	0.05	8.4
Antimony	7440-36-0	mg/L	0.006	0.006
Arsenic	7440-38-2	mg/L	0.005	0.0064
Barium	7440-39-3	mg/L	0.005	0.71
Beryllium	7440-41-7	mg/L	0.001	0.001
Boron	7440-42-8	mg/L	0.01	0.61
Cadmium	7440-43-9	mg/L	0.001	0.001
Calcium	7440-70-2	mg/L	0.25	65
Chromium	7440-47-3	mg/L	0.005	0.015
Cobalt	7440-48-4	mg/L	0.005	0.005
Copper	7440-50-8	mg/L	0.005	0.042
Iron	7439-89-6	mg/L	0.01	3.3
Lead	7439-92-1	mg/L	0.003	0.025
Lithium	7439-93-2	mg/L	0.01	0.13
Magnesium	7439-95-4	mg/L	0.05	13
Manganese	7439-96-5	mg/L	0.005	0.3
Mercury	7439-97-6	mg/L	2.0E-04	2.0E-04
Molybdenum[c]	7439-98-7	mg/L	.005	0.005
Nickel	7440-02-0	mg/L	0.01	0.018
Potassium	9/7/7440	mg/L	0.25	4.1
Selenium	7782-49-2	mg/L	0.005	0.005
Silver	7440-22-4	mg/L	0.005	0.005
Sodium	7440-23-5	mg/L	0.25	220
Strontium	7440-24-6	mg/L	0.005	1.2
Thallium	7440-28-0	mg/L	0.002	0.002
Tin	7440-31-5	mg/L	0.05	0.05
Uranium	7440-61-1	mg/L	0.004	0.012
Vanadium	7440-62-2	mg/L	0.01	0.014
Zinc	7440-66-6	mg/L	0.01	0.032
Zirconium	7440-67-7	mg/L	0.05	0.05
Semivolatile organics				
1,2,4-Trichlorobenzene	120-82-1	μg/L	NA	10
1,2-Dichlorobenzene	95-50-1	μg/L	NA	10
1,3-Dichlorobenzene	541-73-1	μg/L	NA	10

Table 3. EMWMF groundwater criteria (continued)

Chemical	CAS number	Units	PQL[a]	TV[b]
Radionuclides (continued)				
Curium-246[c]	15757-90-1	pCi/L	1	1
Curium-247[c]	15758-32-4	pCi/L	1	1
Curium-248	15758-33-5	pCi/L	NA	0.5
Europium-152	14683-23-9	pCi/L	10	10
Europium-154	15585-10-1	pCi/L	10	10
Europium-155	14391-16-3	pCi/L	10	10
Iodine-129	15046-84-1	pCi/L	10	5
Neptunium-237	13994-20-2	pCi/L	1	1
Nickel-63[c]	13981-37-8	pCi/L	7,300	7,300
Plutonium-236[c]	15411-92-4	pCi/L	NA	1
Plutonium-238	13981-16-3	pCi/L	1	1
Plutonium-239/240	N760	pCi/L	1	1
Plutonium-241[c]	14119-32-5	pCi/L	50	50
Plutonium-242[c]	13982-10-0	pCi/L	1	1
Plutonium-244[c]	14119-34-7	pCi/L	1	1
Potassium-40[c]	13966-00-2	pCi/L	170	170
Protactinium-234m	378783-76-7	pCi/L	NA	1.7
Radium-226	13982-63-3	pCi/L	0.5	1
Radium-228	15262-20-1	pCi/L	0.5	1.5
Strontium-90	10098-97-2	pCi/L	4	4
Technetium-99	14133-76-7	pCi/L	10	10
Thorium-227[c]	15623-47-9	pCi/L	1.5	1.5
Thorium-228	14274-82-9	pCi/L	1	1
Thorium-229[c]	15594-54-4	pCi/L	10	10
Thorium-230	14269-63-7	pCi/L	1	2
Thorium-232	N2608	pCi/L	1	1
Thorium-234[c]	15065-10-8	pCi/L	240	240
Tritium	10028-17-8	pCi/L	300	500
Uranium-232	14158-29-3	pCi/L	1	1
Uranium-233/234	NS632	pCi/L	1	2
Uranium-235/236	N1047	pCi/L	1	1
Uranium-238	24678-82-8	pCi/L	1	1.7
Yttrium-90[c]	10098-91-6	pCi/L	4	4

Chemical	CAS number	Units	PQL[a]	TV[b]
Semivolatile organics, continued				
1,4-Dichlorobenzene	106-46-7	µg/L	NA	10
2,3,4,6-Tetrachlorophenol[c]	58-90-2	µg/L	10	10
2,4,5-Trichlorophenol	95-95-4	µg/L	10	25
2,4,6-Trichlorophenol	88-06-2	µg/L	NA	10
2,4-Dimethylphenol	105-67-9	µg/L	NA	10
2,4-Dinitrophenol	51-28-5	µg/L	NA	25
2-Chloronaphthalene	91-58-7	µg/L	10	10
2-Chlorophenol	95-57-8	µg/L	10	10
2-Methyl-4,6-dinitrophenol	534-52-1	µg/L	10	25
2-Methylnaphthalene	91-57-6	µg/L	NA	10
2-Methylphenol	95-48-7	µg/L	NA	10
2-Nitrobenzenamine	88-74-4	µg/L	10	25
2-Nitrophenol	88-75-5	µg/L	NA	10
3- and 4-Methylphenol[c]	N2799	µg/L	10	10
3,3'-Dichlorobenzidine	91-94-1	µg/L	1	10
4-Chloro-3-methylphenol	59-50-7	µg/L	NA	10
4-Methylphenol	106-44-5	µg/L	NA	10
4-Nitrobenzenamine	100-01-6	µg/L	10	25
Acenaphthene	83-32-9	µg/L	10	10
Acenaphthylene	208-96-8	µg/L	NA	10
Acetophenone[c]	98-86-2	µg/L	10	10
Anthracene	120-12-7	µg/L	10	10
Benz(*a*)anthracene	56-55-3	µg/L	1	10
Benzenemethanol	100-51-6	µg/L	NA	10
Benzo(*a*)pyrene	50-32-8	µg/L	1	10
Benzo(*b*)fluoranthene	205-99-2	µg/L	1	10
Benzo(*ghi*)perylene	191-24-2	µg/L	NA	10
Benzo(*k*)fluoranthene	207-08-9	µg/L	1	10
Benzoic acid	65-85-0	µg/L	NA	10
Bis(2-ethylhexyl)phthalate	117-81-7	µg/L	5	10
Butyl benzyl phthalate	85-68-7	µg/L	NA	10
Carbazole	86-74-8	µg/L	5	10
Chrysene	218-01-9	µg/L	NA	10

Table 3. EMWMF groundwater criteria (continued)

Chemical	CAS number	Units	PQL[a]	TV[b]
Volatile organics				
1,1,1-Trichloroethane	71-55-6	µg/L	5	5
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	5	5
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	µg/L	NA	10
1,1,2-Trichloroethane	79-00-5	µg/L	5	5
1,1-Dichloroethane	75-34-3	µg/L	5	5
1,1-Dichloroethene	75-35-4	µg/L	5	5
1,2-Dichloroethane	107-06-2	µg/L	5	5
1,2-Dichloroethene	540-59-0	µg/L	5	5
1,2-Dichloropropane	78-87-5	µg/L	5	5
1,2-Dimethylbenzene[c]	95-47-6	µg/L	5	5
2-Butanone	78-93-3	µg/L	10	10
2-Hexanone	591-78-6	µg/L	10	10
4-Methyl-2-pentanone	108-10-1	µg/L	10	10
Acetone	67-64-1	µg/L	10	10
Benzene	71-43-2	µg/L	5	5
Bromodichloromethane	75-27-4	µg/L	5	5
Bromoform	75-25-2	µg/L	5	5
Bromomethane	74-83-9	µg/L	10	10
Carbon disulfide	75-15-0	µg/L	5	5
Carbon tetrachloride	56-23-5	µg/L	5	5
Chlorobenzene	108-90-7	µg/L	5	5
Chloroethane	75-00-3	µg/L	10	10
Chloroform	67-66-3	µg/L	5	5
Chloromethane	74-87-3	µg/L	10	10
Cumene[c]	98-82-8	µg/L	5	5
Dibromochloromethane	124-48-1	µg/L	5	5
Ethane	74-84-0	µg/L	10	10
Ethylbenzene	100-41-4	µg/L	5	5
Ethylene	74-85-1	µg/L	10	10
M + P Xylene[c]	136777-61-2	µg/L	5	5
Methane	74-82-8	µg/L	10	280

Chemical	CAS number	Units	PQL[a]	TV[b]
Semivolatile organics, continued				
Di-n-butyl phthalate	84-74-2	µg/L	10	10
Di-n-octylphthalate	117-84-0	µg/L	NA	10
Dibenz(a,h)anthracene	53-70-3	µg/L	1	10
Dibenzofuran	132-64-9	µg/L	NA	10
Diethyl phthalate	84-66-2	µg/L	NA	10
Dimethyl phthalate	131-11-3	µg/L	NA	10
Fluoranthene	206-44-0	µg/L	10	10
Fluorene	86-73-7	µg/L	10	10
Hexachlorobenzene	118-74-1	µg/L	NA	10
Hexachloroethane	67-72-1	µg/L	NA	10
Indeno(1,2,3-cd)pyrene	193-39-5	µg/L	1	10
Isophorone	78-59-1	µg/L	10	10
N-Nitroso-di-n-propylamine	621-64-7	µg/L	10	10
Naphthalene	91-20-3	µg/L	10	10
Nitrobenzene	98-95-3	µg/L	NA	10
Pentachlorophenol	87-86-5	µg/L	1	25
Phenanthrene	85-01-8	µg/L	10	10
Phenol	108-95-2	µg/L	10	10
Pyrene	129-00-0	µg/L	NA	10
Pesticides				
4,4'-DDD[c]	72-54-8	µg/L	0.10	0.10
4,4'-DDE[c]	72-55-9	µg/L	0.10	0.10
4,4'-DDT[c]	50-29-3	µg/L	0.10	0.10
Dieldrin	60-57-1	µg/L	1	1
Endosulfan II[c]	33213-65-9	µg/L	0.10	0.10
Endrin[c]	72-20-8	µg/L	0.10	0.10
Endrin Aldehyde[c]	7421-93-4	µg/L	0.10	0.10
Hepatachlor Epoxide[c]	1024-57-3	µg/L	1	0.050
Alpha-Chlordane[c]	5103-71-9	µg/L	0.1	0.050
Beta-BHC[c]	319-85-7	µg/L	0.1	0.050
Gamma-Chlordane[c]	5103-74-2	µg/L	0.1	0.050

Table 3. EMWMF groundwater criteria (continued)

Chemical	CAS number	Units	PQL[a]	TV[b]
Volatiles (continued)				
Methylcyclohexane[c]	108-87-2	µg/L	5	5
Methylene chloride	75-09-2	µg/L	5	5
Styrene	100-42-5	µg/L	5	5
Tetrachloroethene	127-18-4	µg/L	5	5
Toluene	108-88-3	µg/L	5	5
Total xylenes	1330-20-7	µg/L	5	5
Trichloroethene	79-01-6	µg/L	5	5
Vinyl chloride	75-01-4	µg/L	5	5
cis-1,2-Dichloroethene	156-59-2	µg/L	5	5
cis-1,3-Dichloropropene	10061-01-5	µg/L	5	5
trans-1,2-Dichloroethene	156-60-5	µg/L	5	5
trans-1,3-Dichloropropene	10061-02-6	µg/L	5	5

Chemical	CAS number	Units	PQL[a]	TV[b]
Physical measurements				
Depth to water	N317	ft	0.01	NA
Dissolved oxygen	N328	mg/L	0.1	NA
Temperature	N908	°C	1	NA
pH	N704	Std unit	0.1	NA

[a]PQLs taken from Tables 2a through 2f in the Environmental Monitoring Plan (BJC 2007b).
[b]TVs taken from Table 4-1 in Baseline Groundwater Monitoring Report (DOE 2002b), revised December 2004.
[c]Analytes and TVs not presented in the baseline study. Proposed TVs taken from Table 12 of the 2005-2006 Annual Report (BJC 2007c).
Note: Only the constituents sampled during the past five quarters are shown.
CAS = Chemical Abstracts Service.
EMWMF = Environmental Management Waste Management Facility.
NA = not available.
PCB = polychlorinated biphenyl.
PQL = practical quantitation limit.
TV = threshold value.

Table 4. Performance measures for the EMWMF

Medium	Required action[a]	Performance objectives (protection goals)	Performance measure (demonstration of effectiveness)
Groundwater	Quarterly sample 13 monitoring wells[b] and the underdrain.	Groundwater concentrations are protective of human health and the environment; protect and maintain the integrity of the clay liner.	Compare concentrations to site-specific TVs and risk-based action levels.
	Quarterly measure water levels in shallow monitoring wells (monthly monitoring during groundwater incursion to the geologic buffer).	Protect and maintain the integrity of the clay liner.	Compare water levels to the geologic buffer and the clay liner to identify potential incursions.
Surface water	Quarterly sample four surface water locations: EMWNT-03A, NT-04, EMWNT-05, and EMW-VWEIR.	Shallow groundwater is not adversely impacting surface water; surface water concentrations are protective of human health and the environment.	Compare concentrations to site-specific TVs and risk-based action levels.
	Monthly sample three surface water locations: EMWNT-03A, EMWNT-05, and EMW-VWEIR.	Surface water concentrations are as low as reasonably achievable.	Measure/analyze for parameters listed in 40 *CFR* Part 761.75.(b)(6)(iii), plus gross alpha and beta activity. Radiological COCs are analyzed monthly at the EMW-VWEIR.
Storm water	Semiannually sample three surface water locations: EMWNT-03A, EMWNT-05, and EMW-VWEIR.	Storm water concentrations are as low as reasonably achievable and satisfy Tennessee Water Quality Standards criteria.	Compare measured/analyzed parameters to site-specific maximum values (e.g., for total suspended solids, pH, etc.). EMW-VWEIR only: Compare analytical results to TDEC 120-4-3-.01(3) criteria.
Leachate	Quarterly sample leachate tanks for VOCs and one composite for remaining analytes.	COCs in the operating cell have been adequately identified.	Add any newly detected analytes to the monitoring program.
Ambient air	Quarterly sample three ambient air locations: one upwind and two downwind locations.	Ambient air quality at the site perimeter is protective of human health and the environment.	Monitor for hazardous air pollutants and satisfy NESHAP reporting requirements.

[a]As described in the Environmental Monitoring Plan (BJC 2007b).
[b]The temporary well GW-919 was removed and replaced in February 2004 by the underdrain.
CFR = Code of Federal Regulations.
COC = contaminant of concern.
EMWMF = Environmental Management Waste Management Facility.
NESHAP = National Emission Standards for Hazardous Air Pollutants.
TDEC = Tennessee Department of Environment and Conservation.
VOC = volatile organic compound.
TV = threshold value.

Stewardship requirements specified in the ROD include institutional controls, such as physical barriers (perimeter fence with warning signs), to prevent public access to the disposal cell indefinitely; surveillance and maintenance activities; and regular inspections. Additional details will be provided in post-ROD documentation. Per agreement, TDEC will conduct regular inspections and continue long-term groundwater monitoring of the closed facility per the post-closure plan.

3. EVALUATION OF PERFORMANCE AND STEWARDSHIP DATA

3.1 GROUNDWATER

The EMP requires two types of groundwater monitoring: (1) water level monitoring to determine the relationship of the cells' geologic buffer to the water table, and (2) water quality sampling for detection monitoring. Quarters (Q) are generally defined as Q1 for January through March, Q2 for April through June, Q3 for July through September, and Q4 for October through December. Monitoring results for four quarters of operation, from October 2006 through September 2007, are discussed in the following sections.

3.1.1 Water Level Monitoring

The EMP specifies that potentiometric data be evaluated to determine if the water table has encroached to within vertical 10 ft of the bottom of the clay liner (i.e. into the geobuffer) beneath the EMWMF. Data collected from shallow wells GW-916, GW-917, GW-918, GW-921, and GW-923 are specifically designated in the EMP for this purpose (Fig. 2). Water level data from 26 additional monitoring wells and piezometers are also collected for informational purposes. From startup of EMWMF operations on May 28, 2002, through December 2002, potentiometric data were collected and evaluated quarterly. Higher than normal rainfall in late fall 2002 resulted in increased overall potentiometric elevations at EMWMF, and encroachment of the water table into the geologic buffer was suspected in the southwestern portion of Cell 2. Beginning in January 2003, the Geologic Buffer/Groundwater Level Contingent Action Plan was implemented. This included enhanced monitoring and installation of additional piezometers. The additional piezometers were installed by Bechtel Jacobs Company LLC (BJC) and were separately measured and evaluated. An underdrain was installed in February 2004 to address the higher than expected potentiometric levels. Table 5 provides quarterly potentiometric data for the monitoring year for the wells that make up the initial EMWMF monitoring network plus the additional piezometers. Note that selected wells were measured twice in calendar year (CY) 2006 Q3.

During the reporting period, the following trends were observed:

- Rainfall was 38.2 inches for CY 2007 compared to normal average rainfall of 54.1 inches (ORNL 2008). The eastern portion of Tennessee was in an extreme-to-exceptional drought through the end of FY 2007.

- In Cells 1 and 2, water table elevations ranged from approximately 4 to 9 ft below that of the base of the geobuffer. The estimated water table position relative to the base of the geobuffer was generally consistent throughout both cells.

- In Cells 3 and 4, water table elevations ranged from approximately 2 to 7 ft below the base of the geobuffer throughout most of the cell footprint. As noted for Cells 1 and 2, the estimated water table position relative to the base of the geobuffer was generally consistent throughout both cells.

Table 5. 2006 to 2007 potentiometric data for EMWMF monitoring wells

Station name	November 2006 Date collected	November 2006 Water table level	December 2006 Date collected	December 2006 Water table level	February 2007 Date collected	February 2007 Water table level	April/May 2007 Date collected	April/May 2007 Water table level	August 2007 Date collected	August 2007 Water table level
GW-363	11/10/06	954.20	NM	NM	02/27/07	953.87	04/25/07	954.00	08/15/07	952.77
GW-639	11/10/06	929.80	NM	NM	02/14/07	929.66	04/17/07	930.61	08/14/07	927.83
GW-916	11/10/06	997.94	NM	NM	02/27/07	998.24	04/24/07	997.67	08/13/07	995.25
GW-917	11/10/06	972.67	12/06/06	973.58	02/22/07	973.92	04/18/07	974.40	08/09/07	972.35
GW-918	11/10/06	1062.16	12/06/06	1061.92	02/27/07	1061.97	04/16/07	1062.88	08/14/07	1061.49
GW-920	11/10/06	960.17	NM	NM	02/20/07	959.14	04/17/07	961.15	08/08/07	957.81
GW-921	11/10/06	964.41	12/06/06	964.05	02/26/07	964.09	04/23/07	964.86	08/07/07	963.19
GW-922	11/10/06	951.71	NM	NM	02/20/07	951.58	04/23/07	951.80	08/08/07	951.25
GW-923	11/10/06	983.95	12/06/06	982.44	02/26/07	984.28	04/23/07	985.82	08/07/07	978.38
GW-924	11/10/06	959.26	12/06/06	957.63	02/26/07	959.72	04/25/07	960.15	08/13/07	956.43
GW-925	11/10/06	965.68	12/06/06	965.77	02/15/07	965.88	04/23/07	966.37	08/07/07	965.19
GW-926	11/10/06	959.96	12/06/06	959.72	02/26/07	959.85	04/24/07	961.15	08/13/07	958.08
GW-927	11/10/06	976.11	12/06/06	976.91	02/21/07	977.18	04/18/07	978.08	08/13/07	975.22
GW-935	NM	NM	12/06/06	1041.56	02/28/07	1042.44	05/02/07	1043.94	08/14/07	1038.41
GW-938	NM	NM	12/06/06	979.53	02/28/07	980.29	05/02/07	980.73	08/14/07	978.95
GW-940	NM	NM	12/06/06	979.37	02/28/07	979.44	05/02/07	980.35	08/14/07	979.04
GW-941	NM	NM	12/06/06	968.39	02/28/07	969.30	05/02/07	969.84	08/14/07	967.05
GW-942	NM	NM	12/06/06	955.68	02/28/07	956.03	05/02/07	956.06	08/14/07	954.26
GW-943	NM	NM	12/06/06	964.41	02/28/07	965.25	05/02/07	965.39	08/14/07	963.75
GW-946	NM	NM	12/06/06	1035.43	02/28/07	1037.62	05/02/07	1040.94	08/14/07	1032.59
GW-947	NM	NM	12/06/06	1038.15	02/28/07	1039.61	05/02/07	1041.75	08/14/07	1036.83
GW-948	NM	NM	12/06/06	1049.78	02/28/07	1051.11	05/02/07	1053.09	08/14/07	1047.40
GW-949	NM	NM	12/06/06	1001.27	02/28/07	1001.27	05/02/07	1001.21	08/14/07	1001.21
GW-950	NM	NM	12/06/06	1035.45	02/28/07	1037.25	05/02/07	1040.57	08/14/07	1033.90
GW-951	NM	NM	12/06/06	969.86	02/28/07	969.86	05/02/07	969.86	08/14/07	969.86
GW-952	NM	NM	12/06/06	980.72	02/28/07	981.33	05/02/07	981.40	08/14/07	980.55
GW-953	NM	NM	12/06/06	975.85	02/28/07	976.82	05/02/07	977.07	08/14/07	974.41
PP-01	NM	NM	12/06/06	1000.3	NM	NM	05/02/07	1001.5	08/14/07	999.4
PP-02	NM	NM	12/06/06	1003.5	NM	NM	05/02/07	1003.3	08/14/07	1003.5
PP-03	NM	NM	12/06/06	1003.5	NM	NM	05/02/07	1003.3	08/14/07	1003.5
PP-05	NM	NM	12/06/06	983.4	NM	NM	05/02/07	983.4	08/14/07	983.4

Notes: All levels in feet above mean sea level.
Water level data are representative values for each month for each location. Contemporaneous data for each month are shown to the extent possible.
EMWMF = Environmental Management Waste Management Facility. NM = not measured.

- Following installation of the underdrain in 2004, groundwater levels were trending lower. In 2006, the groundwater levels stabilized, assisted by drought conditions during this reporting period. The CY 2007 groundwater levels were increasing through May 2007 but decreased dramatically in August 2007 as a result of the drought.

When it was determined that the underdrain had effectively lowered the water levels to an acceptable level, BJC recommended returning to the quarterly monitoring sampling schedule in accordance with the Geologic Buffer/Groundwater Level Contingent Action Plan. Monitoring of groundwater elevations continues to be performed as specified in the EMP (BJC 2007b).

3.1.2 Groundwater Quality Monitoring

Thirteen wells plus the outflow from the underdrain (EMW-VWUNDRDRAIN) are used for detection monitoring at the EMWMF (Fig. 2). Of the 13 monitoring wells, 9 are shallow wells generally located along the perimeter of the waste placement cells and 4 are deep wells located downgradient of the cells. The approved Cell 5 design includes a permanent shallow monitoring well located downgradient from Cell 5 for detection monitoring. All analytical data are available through the Oak Ridge Environmental Information System.

The EMP requires that quarterly samples will be collected at each location and analyzed for the COCs known to be present in the waste placed in the cells (as determined by the WAC) plus any additional contaminants detected in the quarterly leachate samples. COCs monitored during the evaluation period and the quarter when each COC was added to the monitoring program are listed in Table 6.

3.1.2.1 Data quality summary

The overall quality of the data was determined to meet the objectives established by the project for use in groundwater detection monitoring. The data produced for the monitoring effort can withstand scientific validation and are technically defensible. A very small percentage of the data was determined to be unusable and results were flagged (R) during validation, based on the professional judgment of data validators (reason code O03). Reason codes for all data qualifiers are documented in the Project Environmental Measurements System database.

All of the quarterly ambient air data and 10% of the quarterly surface water and groundwater analytical data were subjected to a systematic process of data verification, validation, and review in accordance with EPA Contract Laboratory Program guidelines and program procedures. Data validation summaries are presented in each quarterly report for FY 2007. The assessment concluded that data integrity was documented through proper implementation of quality assurance and quality control measures. Sample preservation, analytical methodologies, and sampling methodologies were documented to be adequate and to have been consistently applied. Analytical methods were effectively applied for this study. Chemical and radiochemical project-specified reporting levels were consistently achieved.

Table 6. Contaminants of concern identified for analysis

Chemical name[a]	CY06 Q4	CY07 Q1	CY07 Q2	CY07 Q3
Radionuclides				
Actinium-227	P	--	--	--
Americium-241	P	--	--	--
Americium-243	P	--	--	--
Californium-252	P	--	--	--
Carbon-14	P	--	--	--
Cesium-137	P	--	--	--
Chlorine-36	P	--	--	--
Cobalt-60	P	--	--	--
Curium-242	P	--	--	--
Curium-243/244	P	--	--	--
Curium-245	P	--	--	--
Curium-246	P	--	--	--
Curium-247	P	--	--	--
Curium-248	P	--	--	--
Europium-152	P	--	--	--
Europium-154	P	--	--	--
Europium-155	P	--	--	--
Iodine-129	P	--	--	--
Neptunium-237	P	--	--	--
Nickel-63	P	--	--	--
Plutonium-236	P	--	--	--
Plutonium-238	P	--	--	--
Plutonium-239/240	P	--	--	--
Plutonium-241	P	--	--	--
Plutonium-242	P	--	--	--
Plutonium-244	P	--	--	--
Potassium-40	P	--	--	--
Protactinium-234m	P	--	--	--
Radium-226	P	--	--	--
Radium-228	P	--	--	--
Strontium-90	P	--	--	--
Technetium-99	P	--	--	--
Thorium-227	P	--	--	--
Thorium-228	P	--	--	--
Thorium-229	P	--	--	--
Thorium-230	P	--	--	--
Thorium-232	P	--	--	--
Thorium-234	P	--	--	--
Tritium	P	--	--	--
Uranium-232	P	--	--	--
Uranium-233/234	P	--	--	--
Uranium-235/236	P	--	--	--
Uranium-238	P	--	--	--
Yttrium-90	P	--	--	--
Inorganics				
Aluminum	P	--	--	--
Antimony	P	--	--	--
Arsenic	P	--	--	--

Chemical name[a]	CY06 Q4	CY07 Q1	CY07 Q2	CY07 Q3
Volatile organics				
1,1,1-Trichloroethene		N	--	--
1,1-Dichloroethene		N	--	--
1,2-Dimethylbenzene	P	--	--	--
2-Butanone	P	--	--	--
2-Hexanone	P	--	--	--
4-Methyl-2-pentanone	P	--	--	--
Acetone	P	--	--	--
Benzene	P	--	--	--
Carbon disulfide	P	--	--	--
Carbon tetrachloride	P	--	--	--
Chlorobenzene	P	--	--	--
Chloroethene		N	--	--
Chloroform	P	--	--	--
***cis*-1,2-Dichloroethene**		N	--	--
Cumene	P	--	--	--
Ethylbenzene	P	--	--	--
M+P Xylene	N	--	--	--
Methylcyclohexane	P	--	--	--
Methylene chloride	P	--	--	--
Tetrachloroethene	P	--	--	--
Toluene	P	--	--	--
Total Xylene	P	--	--	--
Trichloroethene	P	--	--	--
Vinyl chloride		N	--	--
Semivolatile organics				
1,2,4-Trichlorobenzene	P	--	--	--
1,2-Dichlorobenzene	P	--	--	--
1,3-Dichlorobenzene	P	--	--	--
1,4-Dichlorobenzene	P	--	--	--
2,3,4,6-Tetrachlorophenol	P	--	--	--
2,3,7,8-TCDD		N	--	--
2,4-Dimethylphenol	P	--	--	--
2,4-Dinitrophenol	P	--	--	--
2-Methylnaphthalene	P	--	--	--
2-Methylphenol (o-cresol)	P	--	--	--
3-Methylphenol (m-Cresol)	P	--	--	--
4-Chloro-3-methylphelol	N	--	--	--
4-Methylphenol (p-Cresol)	P	--	--	--
Acenaphthene	P	--	--	--
Acenaphthylene	N	--	--	--
Acetophenone	P	--	--	--
Anthracene	P	--	--	--
Benz(*a*)anthracene	P	--	--	--
Benzenemethanol	N	--	--	--
Benzo(*a*)pyrene	P	--	--	--
Benzo(*b*)fluoranthene	P	--	--	--
Benzo(*g*,*h*,*i*)perylene	P	--	--	--
Benzo(*k*)fluoranthene	P	--	--	--

Table 6. Contaminants of concern identified for analysis (continued)

Chemical name[a]	CY06 Q4	CY07 Q1	CY07 Q2	CY07 Q3
Inorganics (continued)				
Barium	P	--	--	--
Beryllium	P	--	--	--
Boron	P	--	--	--
Cadmium	P	--	--	--
Calcium	P	--	--	--
Chromium	P	--	--	--
Cobalt	P	--	--	--
Copper	P	--	--	--
Cyanide		N	--	--
Iron	P	--	--	--
Lead	P	--	--	--
Lithium	P	--	--	--
Magnesium	P	--	--	--
Manganese	P	--	--	--
Mercury	P	--	--	--
Molybdenum	P	--	--	--
Nickel	P	--	--	--
Potassium	P	--	--	--
Selenium	P	--	--	--
Sodium	P	--	--	--
Silver	P	--	--	--
Strontium	P	--	--	--
Thallium	P	--	--	--
Tin	P	--	--	--
Titanium	N	--	--	--
Uranium	P	--	--	--
Vanadium	P	--	--	--
Zinc	P	--	--	--
Polychlorinated biphenyl				
PCB-1016	P	--	--	--
PCB-1221	P	--	--	--
PCB-1232	P	--	--	--
PCB-1242	P	--	--	--
PCB-1248	P	--	--	--
PCB-1254	P	--	--	--
PCB-1260	P	--	--	--
PCB-1262	P	--	--	--
PCB-1268	P	--	--	--

Chemical name[a]	CY06 Q4	CY07 Q1	CY07 Q2	CY07 Q3
Semivolatile organics (continued)				
Benzoic acid	P	--	--	--
Bis(2-ethylhexyl)phthalate	P	--	--	--
Butyl benzyl phthalate	P	--	--	--
Carbazole	P	--	--	--
Chrysene	P	--	--	--
Dibenz(*a*,*h*)anthracene	P	--	--	--
Dibenzofuran	P	--	--	--
Diethyl phthalate	P	--	--	--
Dimethyl phthalate	P	--	--	--
Di-n-butyl phthalate	P	--	--	--
Di-n-octylphthalate	P	--	--	--
Fluoranthene	P	--	--	--
Fluorene	P	--	--	--
Hexachlorobutadiene	N	--	--	--
Indeno(1,2,3-cd)pyrene	P	--	--	--
Isophorone	P	--	--	--
Naphthalene	P	--	--	--
Pentachlorophenol	P	--	--	--
Phenanthrene	P	--	--	--
Phenol	P	--	--	--
Pyrene	P	--	--	--
Pesticides				
4,4’-DDD	P	--	--	--
4,4’-DDE	P	--	--	--
4,4’-DDT	P	--	--	--
Aldrin		N	--	--
alpha-BHC	N	--	--	--
alpha-Chlordane	P	--	--	--
Beta-BHC	P	--	--	--
Delta-BHC	N	--	--	--
Dieldrin	P	--	--	--
Endosulfan I		N	--	--
Endosulfan II	P	--	--	--
Endosulfan sulfate	N	--	--	--
Endrin	P	--	--	--
Endrin aldehyde	P	--	--	--
gamma-Chlordane	P	--	--	--
Heptachlor epoxide	P	--	--	--
Methoxychlor		N	--	--

[a]Chemicals listed in **bold** were added during the CY.
CY06/07 = calendar year 2006 or 2007.
N = designated as a contaminant of concern (COC) in the indicated quarter.
P = COC in the previous monitoring year.
PCB = polychlorinated biphenyl.
Q = quarter.
-- indicates continued monitoring.

Since January 2004, 100% of all analytical results have been processed electronically using a SAS®[1] data assessment program to provide consistent electronic screening for data usability. This program compares:

- volatile organic compound (VOC) and semivolatile organic compound (SVOC) results to blank sample results,
- each radiological analyte result to the corresponding minimum detectable activity and associated counting error, and
- all results to historical data ranges to test whether a new result is within the range of expected values for a given well.

Results falling outside established criteria are evaluated, and data assessment qualifiers are assigned as appropriate.

In FY2007, the program rejected (R-flagged) a small group of radiological results primarily because the reported values were greater than the minimum detectable activity but less than the counting error (reason code T06).

3.1.2.2 Deep wells

The mean results for all detected COCs are below associated TVs and action levels for the four-quarter evaluation period[2]. Six individual detected results exceed TVs and are presented in Table 7. These results were only slightly above TVs, and all were well below groundwater action limits. Besides noting that boron results very slightly exceed the TV in GW-639 for the last two quarters, there are no obvious trends in the data for this evaluation period (FY 2007). Additionally, no trends are noted when comparing to data reported from the prior annual report.

3.1.2.3 Shallow wells

Evaluation of shallow groundwater data indicates that no mean concentrations exceed the associated TV or action level. However, five results for four metals (calcium, chromium, manganese, and strontium); and two results for two radionuclides (^{36}Cl and ^{232}U) were reported with positive detection values above the TV, but individual results do not exceed the respective groundwater action levels. These results are listed in Table 8. Detections above the TVs are not unexpected for the naturally occurring metal analytes because the TV represents the 95% UTL on the baseline dataset. Chromium has been detected above the 0.015-mg/L TV at shallow well GW-923 on multiple occasions, with a maximum result (0.0414 mg/L) reported during the baseline study. The 0.021-mg/L value reported in February 2007 is approximately one-half of this maximum value. The detected man-made radionuclide ^{36}Cl was detected in GW-922 in November 2006. This analyte was not detected at GW-922 during FY 2005. However, ^{36}Cl was previously detected in GW-921 in February and September of 2006, and GW-924 in March 2004, June 2005, and November 2006. The analyzing laboratory suggests that positive ^{36}Cl results may be due to interfereing isotopes remaining from incomplete separation. Preliminary results indicate that more thorough rinsing of the filtered precipitate during separation may resolve this issue. If continued

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[1] 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 or its contractors or subcontractors.

[2] Benzoic acid, although not detected, did produce a mean value of 10.3 μg/L for the 31 samples compared to the 10 μg/L TV, calculating the mean using one-half of the reported non-detect values.

Table 7. Individual groundwater results exceeding threshold values in deep wells

Chemical	CAS number	Station	Date sampled	Units	Result	Val. qual.	DA qual.	Lab. qual.	Det. limit	Rad. TPU	TV[a]
					Metals						
Boron[b]	7440-42-8	GW-639	02/14/07	mg/L	0.615		=		4.8E-04	--	0.61
Boron	7440-42-8	GW-639	04/19/07	mg/L	0.614	=	=		0.001	--	0.61
Lithium	7439-93-2	GW-639	04/19/07	mg/L	0.131	J	=	E	1.0E-04	--	0.13
Molybdenum	7439-98-7	GW-925	02/15/07	mg/L	0.008		=		4.0E-04	--	0.005
Vanadium	7440-62-2	GW-925	02/15/07	mg/L	0.02		=		1.5E-04	--	0.014
					Radionuclides						
Uranium-233/234	NS632	GW-925	02/16/07	pCi/L	2.08		=		0.16	0.22	2

[a]TVs are taken from *Baseline Groundwater Monitoring Report for the Environmental Management Waste Management Facility, Oak Ridge, Tennessee* (DOE/OR/01-2021&D3), November 2002, and revised December 1, 2004.

[b]Boron was consistently observed in wells GW-639, GW-363, and GW-925 relative to other wells during baseline monitoring. These data may reflect migration from the Oil Landfarm, which received mop waters containing borax (DOE 2002b).

All sample types are "REG"; no duplicates.
CAS = Chemical Abstracts Service.
DA = data assessment evaluation using SAS® program.
Oak Ridge Environmental Information System validation, assessment, and laboratory qualifier definitions:
= denotes the result was validated, detected, and unqualified.
J denotes an estimated value.
E denotes estimated, matrix interference.
TPU = total propagated uncertainty.
TV = threshold value.
-- = not applicable.

Table 8. Individual groundwater results exceeding threshold values in shallow wells

Chemical	CAS number	Station	Date sampled	Units	Result	Val. qual.	DA qual.	Lab. qual.	Det. limit	Rad. TPU	TV[a]
					Metals						
Calcium	7440-70-2	GW-923	11/14/06	mg/L	67.1		=		0.003	--	65
Calcium	7440-70-2	GW-923	04/24/07	mg/L	66.1		=		0.002	--	65
Chromium	7440-47-3	GW-923	02/28/07	mg/L	0.021		=		2.0E-04	--	0.015
Manganese	7439-96-5	VWUND	08/09/07	mg/L	0.926		=		1.8E-04	--	0.3
Strontium	7440-24-6	GW-921	08/07/07	mg/L	1.22		=		2.0E-05	--	1.2
					Radionuclides						
Chlorine-36	13981-43-6	GW-922	11/14/06	pCi/L	30.5	=	=		4.26	2.31	2.0
Uranium-232	14158-29-3	GW-363	02/28/07	pCi/L	1.4		=	J	0.04	0.69	1.0

[a]TVs are taken from Table 4.1 in the *Baseline Groundwater Monitoring Report for the Environmental Management Waste Management Facility, Oak Ridge, Tennessee* (DOE/OR/01-2021&D3), November 2002, and revised December 1, 2004.

All sample types are "REG"; no duplicates.
CAS = Chemical Abstracts Service.
DA = data assessment evaluation using SAS® program.
Oak Ridge Environmental Information System qualifier definitions:
= denotes the result was validated, detected, and unqualified.
J denotes an estimated value.
TPU = total propagated uncertainty.
TV = threshold value.
VWUND = EMW-VWUNDRDRAIN.
-- = not applicable.

monitoring shows that the issue has not been resolved, split sample analysis at a separate laboratory will be conducted to evaluate whether or not detections are analytical anomalies. There was a single ^{232}U exceedance of 1.4 pCi/L compared to the TV of 1.0 pCi/L in GW-363. This February 2007 exceedance was not repeated in later samples nor was it detected above the TV in the previous year; therefore, the detection of ^{232}U is an assumed anomaly.

3.2 SURFACE WATER

Surface water monitoring occurred at four stations: EMWNT-03A, NT-04, EMWNT-05, and EMW-VWEIR (Fig. 2). Each station is scheduled for sampling once per quarter for all COCs identified to date, plus monthly sampling to meet the requirements in 40 *Code of Federal Regulations* (*CFR*) Part 761.75(b)(6). Quarterly surface water data are compared to the same parameters as those for groundwater during the same quarter, per the EMP.

Former Station EMWNT-03 (Fig. 2) was relocated in September 2003 to a culvert on the south bank of the haul road for ease of sampling. The new location is identified as EMWNT03A. EMWNT03A captures surface flow in NT-3 downstream of the cells but nearby the former Boneyard/Burnyard. Station NT-04 is downstream of the cells where tributary NT-4 surfaces. Tributary NT-4 was rerouted upstream of this point to build the facility. Station EMWNT-05 lies west of the cell in tributary NT-5, which captures along-strike groundwater flow from the cell area. Station EMW-VWEIR is located at the v-notch weir where the sedimentation basin discharges into NT-5. These locations are shown on Fig. 2.

3.2.1 Quarterly Monitoring

The absence of flow precluded the quarterly sampling of all surface water stations including EMW-VWEIR during August 2007 (the same conditions as in 2006). All other stations were sampled quarterly as planned. Thirty-five quarterly surface water results exceed groundwater TVs (excluding duplicates). The number of exceedances is categorized by station, sample date, and analyte type in Table 9. Individual quarterly surface water results that exceeded groundwater TVs are presented in Table 10. The majority of exceedances were from naturally occurring metals and radionuclides, including ^{234m}Pa and uranium isotopes. There were also TV exceedances of naturally occurring metals at all surface water stations. However, there are no obvious trends in the data collected in this evaluation period (FY 2007) and when compared to the last evaluation period (FY 2006).

Metals concentrations in FY 2007 were generally consistent with those from FY 2006, although the number of detected analytes decreased from 11 to 8 and the total number of TV exceedances decreased from 31 to 20. The VOC *cis*-1,2-DCE was reported at NT-04 in both February and April of 2007. This compound was added to the analyte list for Q1 of CY 2007 and has since consistently been detected above the TV in NT-04. The compound was not detected in groundwater samples from

Table 9. Quarterly surface water exceedances by station, sample date, and analyte type

Exceedances by station		Exceedances by date		Exceedances by analyte	
Station	**Number of exceedances**	**Sample date**	**Number of exceedances**	**Analyte type**	**Number of exceedances**
EMWNT-03A	0	November 2006	8	Metals	19
NT-04	11	February 2007	19	Radionuclides	14
EMWNT-05	2	April 2007	8	Volatile organics	2
EMW-VWEIR	22	August 2007	NA		

NA = not applicable; sample was not collected due to low flow conditions.

Table 10. EMWMF quarterly surface water data exceeding threshold values

Chemical	CAS number	Station	Date sampled	Sample type	Units	Result	Val. qual.	DA qual.	Lab. qual.	Detection limit	Rad. TPU	TV[a]
						Metals						
Calcium	7440-70-2	EMW-VWEIR	02/20/07	Reg	mg/L	91.8	=	Q		0.003	--	65
Calcium	7440-70-2	NT-04	11/07/06	Reg	mg/L	101		=		0.003	--	65
Calcium	7440-70-2	NT-04	02/20/07	Reg	mg/L	92.7		=		0.003	--	65
Calcium	7440-70-2	NT-04	04/16/07	Reg	mg/L	70.8	=	=		0.002	--	65
Lead	7439-92-1	EMW-VWEIR	04/16/07	Dup	mg/L	0.0028		J	B	0.001	--	0.025
Lead	7439-92-1	EMW-VWEIR	04/16/07	Reg	mg/L	0.0029		J	B	0.001	--	0.025
Lithium	7439-93-2	EMW-VWEIR	02/20/07	Reg	mg/L	0.194	=	Q		5.0E-05	--	0.13
Magnesium	7439-95-4	EMW-VWEIR	02/20/07	Reg	mg/L	14.9	=	=		0.001	--	13
Magnesium	7439-95-4	NT-04	11/07/06	Reg	mg/L	17.9		=		0.001	--	13
Magnesium	7439-95-4	NT-04	02/20/07	Reg	mg/L	16.3		=		0.001	--	13
Magnesium	7439-95-4	NT-04	04/16/07	Reg	mg/L	13.1	=	=		0.002	--	13
Manganese	7439-96-5	EMWNT-05	11/07/06	Reg	mg/L	0.551		=		1.0E-04	--	0.3
Manganese	7439-96-5	EMWNT-05	02/20/07	Reg	mg/L	0.462		=		1.0E-04	--	0.3
Manganese	7439-96-5	NT-04	11/07/06	Reg	mg/L	0.584		=		1.0E-04	--	0.3
Manganese	7439-96-5	NT-04	02/20/07	Reg	mg/L	0.54		=		1.0E-04	--	0.3
Manganese	7439-96-5	NT-04	04/16/07	Reg	mg/L	0.518	=	=		5.0E-05	--	0.3
Molybdenum	7439-98-7	EMW-VWEIR	02/20/07	Reg	mg/L	0.01	=	Q		4.0E-04	--	0.005
Potassium	7440-09-7	EMW-VWEIR	11/07/06	Reg	mg/L	4.27	=	=		0.005	--	4.1
Potassium	7440-09-7	EMW-VWEIR	02/20/07	Reg	mg/L	5.44	=	=		0.005	--	4.1
Uranium	7440-61-1	EMW-VWEIR	02/20/07	Reg	mg/L	0.061	=	Q		0.003	--	0.012
						Volatile organics						
cis-1,2-Dichloroethene	156-59-2	NT-04	02/20/07	Reg	μg/L	5		=		5	--	5
cis-1,2-Dichloroethene	156-59-2	NT-04	04/16/07	Reg	μg/L	7	=	=		5	--	5
						Radionuclides						
Chlorine-36	13981-43-6	EMW-VWEIR	11/07/06	Reg	pCi/L	4.51	J	=	J	3.55	2.42	2
Chlorine-36	13981-43-6	EMW-VWEIR	02/20/07	Reg	pCi/L	31.8	=	=		4.29	2.42	2
Protactinium-234m	378783-76-7	EMW-VWEIR	02/20/07	Reg	pCi/L	17.9	=	=		0.35	1.72	1.7
Radioactive Sr (total)[b]	NS951	EMW-VWEIR	04/16/07	Dup	pCi/L	5.61		=		1.23	0.36	4
Radioactive Sr (total)[b]	NS951	EMW-VWEIR	04/16/07	Reg	pCi/L	5.47		=		1.02	0.32	4
Radium-226	13982-63-3	EMW-VWEIR	04/16/07	Reg	pCi/L	1.06		J		0.18	0.37	1
Strontium-90	10098-97-2	EMW-VWEIR	11/07/06	Reg	pCi/L	14.2	=	=		0.8	2.11	4
Strontium-90	10098-97-2	EMW-VWEIR	02/20/07	Reg	pCi/L	526	=	=		1.56	9.89	4
Technetium-99	14133-76-7	EMW-VWEIR	02/20/07	Reg	pCi/L	31.8	=	=		2.87	1.3	10
Uranium-233/234	NS632	EMW-VWEIR	02/20/07	Reg	pCi/L	33.7	=	=		0.32	2.93	2

Table 10. EMWMF quarterly surface water data exceeding threshold values (continued)

Chemical	CAS number	Station	Date sampled	Sample type	Units	Result	Val. qual.	DA qual.	Lab. qual.	Detection limit	Rad. TPU	TV[a]
Radionuclides (continued)												
Uranium-235/236	N1047	EMW-VWEIR	02/20/07	Reg	pCi/L	1.24	J	=		0.38	0.33	1
Uranium-238	24678-82-8	EMW-VWEIR	02/20/07	Reg	pCi/L	17.9	=	=		0.35	1.72	1.7
Yttrium-90	10098-91-6	EMW-VWEIR	11/07/06	Reg	pCi/L	14.2	=	=		0.8	2.11	4
Yttrium-90	10098-91-6	EMW-VWEIR	02/20/07	Reg	pCi/L	526	=	Q		1.56	9.89	4
Yttrium-90	10098-91-6	EMW-VWEIR	04/16/07	Dup	pCi/L	5.61		=		1.23	0.36	4
Yttrium-90	10098-91-6	EMW-VWEIR	04/16/07	Reg	pCi/L	5.47		=		1.02	0.32	4

[a]TVs are taken from Table 4.1 in the *Baseline Groundwater Monitoring Report for the Environmental Management Waste Management Facility, Oak Ridge, Tennessee* (DOE/OR/01-2021&D3), November 2002, and revised in December 2004.

[b]The TV for Strontium-90 was used for radioactive strontium (total).

CAS = Chemical Abstracts Service.

DA = data assessment evaluation using SAS® program.

EMWMF = Environmental Management Waste Management Facility.

TPU = total propagated uncertainty.

TV = threshold value.

-- = not applicable.

Oak Ridge Environmental Information System (OREIS) validation qualifier definitions:

= denotes the result was validated, detected, and unqualified.

J denotes the analyte was positively identified; the associated result is the approximate concentration of the analyte in the sample.

OREIS data assessment qualifier definitions:

= denotes the result was detected and unqualified.

J denotes the analyte was positively identified; the associated result is the approximate concentration of the analyte in the sample.

Q denotes the result is inconsistent with historical measurements or other reported results.

OREIS laboratory qualifier definitions:

B denotes found in blank.

J denotes estimated.

EMW-VWUNDRDRAIN, which is the outflow from the underdrain discussed in Sect. 3.1.1 and is upstream of the NT-04 sampling location. It also was not detected in contact water or leachate samples. Therefore, the source of *cis*-1,2-DCE in NT-04 does not appear to be the EMWMF disposal cell and may be related to the old oil landfarming activities or the closed sanitary landfill, both upgradient from NT-04. It should be noted that *cis*-1,2-DCE was not detected in surface water samples during Q4 of CY 2007, but those results are not included in this report. No obvious trends for man-made metals or organic compounds are evident within this evaluation period or when compared to FY 2006 results. It is noted, however, that a small set of natural metals (e.g., calcium, magnesium, manganese, and potassium) are consistently detected above respective TVs and more data are required to assess *cis*-1,2-DCE.

Three man-made radionuclides exceeded TVs (^{36}Cl, ^{90}Sr, and ^{90}T), all at EMW-VWEIR. Of these, the February 2007 results are of particular interest with 526 and 31.8 pCi/L for ^{90}Sr/^{90}Y and ^{36}Cl, respectively, and a 33.7 pCi/L result for $^{233/234}$U. Results for these analytes decreased by at least an order of magnitude in April 2007, when detected, and were more consistent with the FY 2006 ranges for EMW-VWEIR. No obvious long term trends for radionuclides are evident within this evaluation period or when compared to FY 2006 results. It is noted, however, that a small set of man-made radionuclides (^{36}Cl, ^{90}Sr, and ^{99}Tc) are consistently detected above respective TVs.

Detected concentrations were also compared to TDEC 120-4-3-.03(3) fish and aquatic ambient water quality criteria (AWQC) for chronic concentrations. April 2007 results for lead in both the regular and duplicate sample at EMW-VWEIR exceed the 2.5-μg/L criterion for continuous exposures. However, a continuous exposure is not likely to occur, and the maximum detected concentration of 2.8 μg/L is well below the acute exposure AWQC of 65 μg/L. The remaining detected analytes do not have associated fish and aquatic AWQC.

Quarterly data suggest shallow groundwater is not adversely impacting surface water. This conclusion is based on a comparison of detected analytes in groundwater and surface water samples, the timing of these detections, and visual inspection of monitoring stations as illustrated in Fig. 2. Chlorine-36 was detected at EMW-VWEIR in November of 2006 and in February of 2007, but not in any shallow well during the same period. As discussed in Sect. 3.1.2.3, the ^{36}Cl detections may result from inadequate rinsing of the sample precipitate during sample separation.

3.2.2 Monthly Monitoring

Monthly monitoring, as required by 40 *CFR* Part 761.75(b)(6)(iii), began in January 2003 after the first shipment of polychlorinated biphenyl (PCB)-contaminated waste was placed in Cell 1 in December 2002. Table 4 of the EMP (BJC 2007) lists analytical parameters for monthly monitoring, including pH, specific conductance, chlorinated organics, PCBs, gross alpha, and gross beta. There were 25 detected organic results. However, only one EMWNT-03A result is above the method detection limit: 1,4-dichlorobenzene at 2 μg/L in March 2007. It is noted this analyte was also detected in the method blank increasing the possibility of false positive in the regular samples. The situation will be closely monitored in the future sampling events. The maximum gross alpha and gross beta results occurred at EMWNT-03A: 6.42 pCi/L (October 2006) and 11.7 pCi/L (July 2007), respectively.

Monitoring is also performed for comparison to fish and aquatic life criteria, as specified in TDEC 1200-4-3-.03(3), and to demonstrate compliance with TDEC 1200-2-11-.16(2). PCBs, pH, dissolved oxygen (DO), temperature, and various toxic substances have AWQC to compare against monthly surface water monitoring data. PCB-1260 at EMWNT-05 in July 2007 (0.12 μg/L) exceeded its AWQC (0.014 μg/L) but was reported at a value less than the analytical detection limit (0.4 μg/L), receiving an estimated flag (J) from the laboratory (the sample was not validated). The situation will be closely monitored in future sampling events. Results for pH ranged from 6.08 to 8.01 standard units over the evaluation period; thus all pH measurements were within the 6.0 to 9.0 target range for wadeable streams. All measured monthly DO results were above the AWQC minimum criterion of 5 mg/L. Water temperatures ranged from 5.64 to 27.3 ºC satisfying the AWQC not-to-exceed value of 30.5 ºC. Two chemical analytes were detected above AWQC. The pesticides 4,4´-DDT at 0.01 μg/L (October 2006) and heptachlor epoxide at 0.017 μg/L (February 2007) exceed fish and aquatic AWQC of 0.001 μg/L and 0.0038 μg/L, respectively, at EMW-VWEIR.

Isotopic radiological analyses were performed at EMW-VWEIR in lieu of monthly gross alpha and gross beta measurements. These results were used for calculating the contact water annual average sum of fractions as required by 10 *CFR* 20.1301(a) and TDEC 1200-2-11-.16(2). Concentrations of a small number of radionuclides, most notably ^{90}Sr, ^{99}Tc, ^{238}U, and ^{90}Y, were elevated in some monthly surface water samples at station EMW-VWEIR. The highest detections for each analyte were 497 pCi/L for ^{90}Sr and ^{90}Y (consistent with the quarterly monitoring results), 29.5 pCi/L for ^{99}Tc, and 20.4 pCi/L for ^{238}U (all in February 2007).

3.3 STORM WATER

Semiannual storm water samples were collected in January and July 2007 (Q1 and Q3). Storm water results were compared to the site-specific “maximum values” as listed in EMP Table 5 (BJC 2007). The ammonia as nitrogen result of 0.42 mg/L (and the 0.34 mg/L duplicate) in the July EMW-VWEIR sample exceeded the EMP maximum value of 0.2 mg/L. The sample results of 500 pCi/L (January) and 271 pCi/L (July), both at the EMW-VWEIR, are above the gross beta activity maximum value of 50 pCi/L. The elevated data points appear to be associated with elevated levels of ^{90}Sr in contact water during that time period. The January gross alpha result of 27.6 pCi/L also exceeds the 15 pCi/L maximum value. Monthly storm water data were also compared to EMP Table 5 maximum values – there were no exceedances. Table A.1 in Appendix A lists all exceedances for semiannual and monthly analytes during the period of interest.

Semiannual and monthly storm water results were also compared to AWQC, where appropriate. Table A.1 shows lead at 0.004 mg/L (0.004 mg/L also for the duplicate) in the July 2007 EMW-VWEIR sample which is slightly above the 0.0025-mg/L AWQC. Additionally, DO at 4.6 mg/L was below the 5.0-mg/L lower limit AWQC in the July EMWNT-03A sample. All pH measurements were within the 6.0 to 9.0 target range for wadeable streams as indicated in Table A.1.

For completeness, Table A.2 in Appendix A lists detected analytes from all monthly storm water samples. Monthly samples were collected from EMW-VWEIR and analyzed for radiological COCs only, per the EMP. Field measurement data are also tabulated in Table A.2.

3.3.1 Total Suspended Solids

The EMW-VWEIR station is sampled for total suspended solids (TSS) to monitor surface water runoff and sediment controls associated with rain events of 0.5 inches or more. Of the 19 total TSS samples collected during the FY, 15 results were less than the EMP maximum level of 110 mg/L. In general, exceedances of the TSS comparison criterion are associated with high-intensity, short-duration rainfall events. BJC continues to evaluate TSS to determine whether there is a practical means of removing non-settleable solids. Figure 3 illustrates the relationship between rainfall and the measured amount of TSS in rainwater runoff.

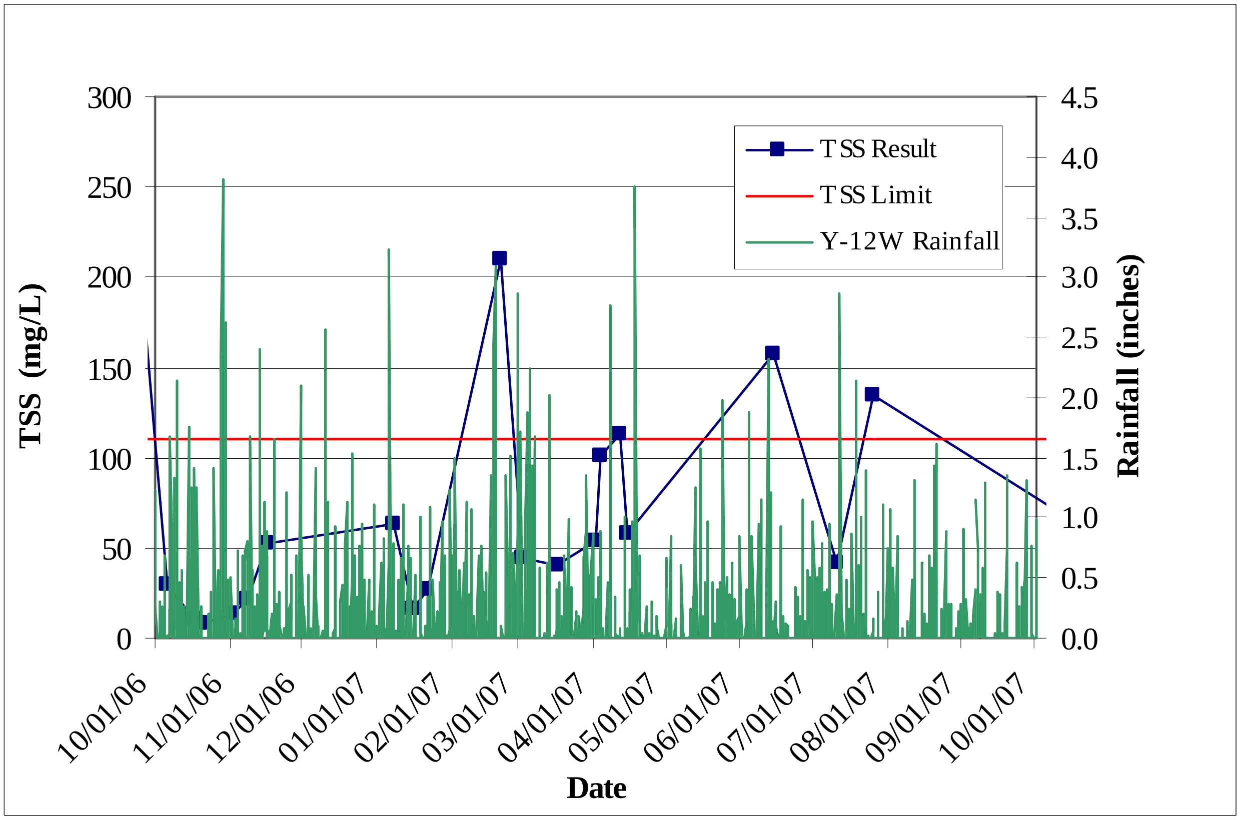

Fig. 3. Total suspended solids at EMW-VWEIR.

3.3.2 Contact Water

DOE Order 5400.5 establishes derived concentration guides (DCGs) for radionuclides in process effluents, which are used as reference concentrations for conducting environmental protection programs and as screening values for considering best available technology for treatment of liquid effluents at DOE sites. Per DOE agreement with TDEC, annual average sum-of-fractions (SOF) calculations for storm water discharge into Bear Creek are based on 25% of the DOE limit of 100-millirem per year (mrem/yr) DCG listed in Chap. III Fig. III-1 to DOE Order 5400.5. The CY 2007 EMWMF storm water SOF results are presented in this annual report to demonstrate compliance with TDEC 1200-2-11-.16.

The EMWMF storm water SOF is calculated on a CY basis using monthly surface water, monthly storm water, other storm water, quarterly surface water, and miscellaneous surface water samples collected at the discharge point of the site storm water retention and sedimentation pond. The environmental as low as reasonably achievable (ALARA) goal for EMWMF is a modified annual average SOF of 1, where 1.0 represents 24% of the DCG. All data presented are based on the modified SOF.

The EMWMF environmental ALARA target for storm water is an SOF less than or equal to 0.9. Figure 4 illustrates results for CY 2007 showing some sample event SOFs early in the year that were calculated above 1.0. The elevated data points appear to be associated with elevated levels of ^{90}Sr in contact water during that time period. However, the annual average SOF is below the ALARA target of 0.9. Thus, both compliance with TDEC 1200-2-11-.16 (25 mrem/yr) and the SOF goal for EMWMF (24 mrem/yr) were achieved (BJC 2008).

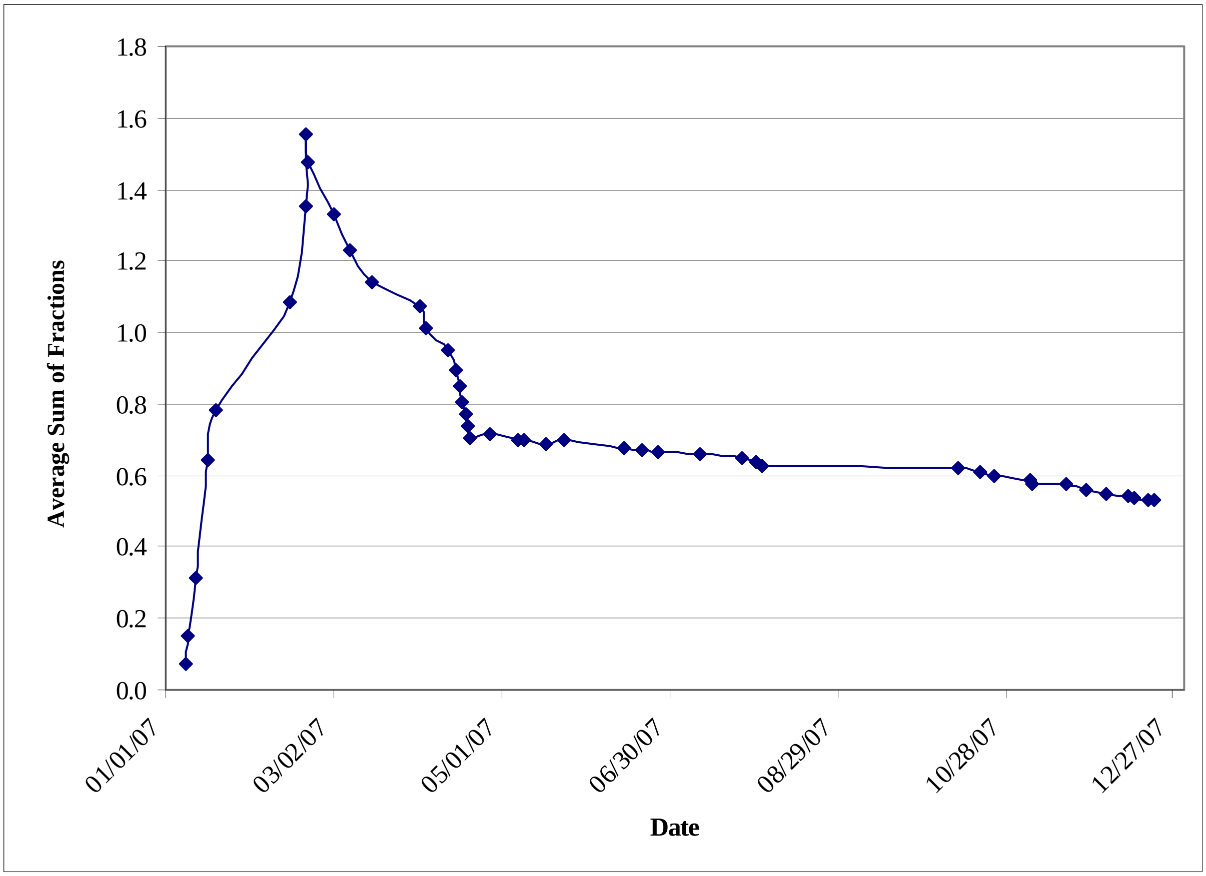

Fig. 4. Cumulative average sum of fractions at EMW-VWEIR.

3.4 AIR

3.4.1 Chemical Measurements

Ambient air sampling was performed quarterly in December 2006 and in February/March, June, and August/September 2007. For each event, samples were collected at two locations downwind and one location upwind of the disposal cells. The following analytes were detected in one or more air samples: barium (one detection), calcium (two), chromium (three), copper (three), iron (three), manganese (three), molybdenum (one), nickel (three), potassium (three), selenium (one), silver (one), sodium (three), strontium (two), 2-butanone (two), acetone (nine), carbon disulfide (1), toluene (2), and asbestos (3). Total particulate matter was also detected in eight samples. All detected results are at levels well below permissible exposure limits (PELs) based on Occupational Safety and Health Administration 29 *CFR* 1910.1000 limits. Results are presented in Appendix B.

3.4.2 Radiological Measurements

From October 1, 2006, through September 30, 2007, the BJC Radiological Control (RADCON) Perimeter Air Sampling Program at the EMWMF collected approximately 253 perimeter non-occupational air samples. According to RADCON records for that period (available through BJC), no sample exceeded 2% of the most restrictive derived air concentration (DAC) values in 10 *CFR* Part 835, Appendix A, for the radionuclides conservatively assumed to be present in the EMWMF disposal cell.

3.5 STEWARDSHIP REQUIREMENTS

Dust emissions are controlled during operations by wetting the access roads and working surface to prevent release of airborne particulates. Additionally, asbestos-containing waste and other bulk wastes are either covered daily or sprayed with a fixative when necessary. This helps ensure that there is no wind dispersion of contaminants into the air. Contact water from active disposal cells was collected and managed by Energy*Solutions* in accordance with applicable procedures and regulations (note BJC assumed responsibility near the end of October 2007). Disposition of contact water is not subject to evaluation by the detection monitoring program.

The cell design includes a leachate collection system and storage tanks. Leachate is shipped off-site for treatment and is not released to the environment as part of the EMWMF program. Leachate samples are analyzed to ensure compliance with the treatment facility requirements.

As specified in the ROD (DOE 1999), physical and administrative controls are implemented at the EMWMF to limit access to the site (see Sect. 2.2.2).

4. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations have been developed based on the results of compliance monitoring at EMWMF:

- The underdrain continues to control the water level beneath the cell to an elevation well below pre-underdrain conditions, helped this reporting period by drought conditions. Generally, water levels are below the cell geobuffer. Monitoring of groundwater wells and piezometers will continue in accordance with the EMP.

- The number of sample results exceeding the TVs has decreased in both quarterly groundwater and surface water samples as compared to the last annual reporting period. Specifically, the number of exceedances dropped from 19 to 13 in groundwater and from 63 to 36 in surface water. The annual average SOF remains within the target established for the EMWMF.

- Eight new analytes have been designated as COCs over the previous year, but do not have associated TVs. These analytes include one metal, six pesticides, and one inorganic. Table 11 presents proposed TVs for the target COCs, selected based on existing information and observed analytical detection limits. It is recommended that the proposed TVs be assigned for purposes of comparison with groundwater and surface water results.

- Some surface water samples were analyzed for total radioactive strontium instead of ^{90}Sr in order to achieve a quick turnaround time for results. Samples require a significant ingrowth period in order to report ^{90}Sr separately. Results for total radioactive strontium were conservatively assumed to be attributed solely to ^{90}Sr and compared to the associated TV in this report. It is recommended the ^{90}Sr TV be assigned to total radioactive strontium when reported. This assures potentially elevated levels are addressed.

Table 11. Example threshold values for new contaminants of concern

Analyte type (unit)	Contaminant of concern	Example TV	Source/Rational/Method
METAL (μg/L)	Titanium	TBD	SW-846 Method 6010B, Table 1; estimated instrument detection limit.
PEST (μg/L)	Aldrin	0.05	CLP Method SOM01.1 for Pesticides/Aroclors; Target Compound List and corresponding CRQLs.
	Endosulfan I	0.10	
	Endosulfan sulfate	0.10	
	Methoxychlor	0.50	
	alpha-BHC	0.05	
	delta-BHC	0.05	
WETCHEM(μg/L)	Cyanide	10	CLP Method ILM05.3 for Metals and Cyanide; Target Compound List and corresponding CRQLs.
RAD (pCi/L)	Radioactive strontium (total)	4.0	Assume all detected radioactive strontium is ^{90}Sr – use ^{90}Sr TV.

CLP = Contract Laboratory Program.
CRQL = contract-required quantitation limit.
PEST = pesticides.
RAD = radionuclides.
TBD = value will be calculated based on analyis of available data.
TV = threshold value.

- Average results for all COCs in both shallow and deep wells are below TVs, although one radionuclide result ($^{233/234}U$) exceeds the TV in deep monitoring wells, as well as individual results for four metals (boron, lithium, molybdenum, and vanadium). Two radionuclides (^{36}Cl and ^{233}U) and four metals (calcium, chromium, manganese, and strontium) also exceed TVs in the shallow monitoring wells. There are no obvious trends in the groundwater data collected in FY 2007 compared to the data reported for the last annual report. Because mean results are below TVs no action is required.

- Multiple quarterly surface water results, primarily for naturally occurring constituents, exceed TVs in surface water spanning across several quarters. One April 2007 lead result at EMW-VWEIR exceeded AWQC criteria for continuous concentrations; however, the result was below the maximum AWQC criterion. None of the other detected analytes have associated fish and aquatic AWQC. There were similar isolated slight AWQC exceedances of lead at EMW-VWEIR in the last 2 years in both quarterly surface water and semiannual stormwater samples, as well as TV exceedances of naturally occurring analytes at all surface water stations. However, there are no obvious trends in the surface water data. Additionally, data do not suggest shallow groundwater is adversely impacting surface water.

- Three analytical parameters for monthly surface water exceeded AWQC. PCB-1260 at 0.12 μg/L exceeded the 0.014-μg/L AWQC at EMWNT-05 in July 2007. The pesticides 4,4´-DDT at 0.01 μg/L (October 2006) and heptachlor epoxide at 0.017 μg/L (February 2007) exceed fish and aquatic AWQC of 0.001 and 0.0038 μg/L, respectively, at EMW-VWEIR. Results for pH were within the 6.0 to 9.0 target range for wadeable streams, DO results were above the 5-mg/L threshold, and all temperature measurements were less than the 30.5-ºC threshold. Isotopic concentrations of COC radionuclides were measured to calculate the contact water annual average SOF, as required by 10 *CFR* 20.1301(a) and TDEC 1200-2-11-.16(2). Elevated radionuclide concentrations, primarily ^{90}Sr, ^{99}Tc, ^{238}U, and ^{90}Y, were also detected in monthly surface water samples – continued monitoring appears sufficient based on available data.

- Storm water data were compared to AWQC and two exceedances were noted. The July EMW-VWEIR result for lead of 0.004 mg/L exceeds the 0.0025-μg/L AWQC, and the July EMWNT-03A measurement for DO of 4.6 mg/L exceeds the 5.0-mg/L minimum AWQC. Storm water data were also compared to the EMP Table 5 maximum values and three exceedances were noted. The ammonia as nitrogen result of 0.42 mg/L (and the 0.34-mg/L duplicate) exceeded the EMP maximum value of 0.2 mg/L in the July EMW-VWEIR sample. Both the January and July EMW-VWEIR samples produced results above the gross beta activity maximum value of 50 pCi/L (500 and 271 pCi/L, respectively, for primary samples).The January gross alpha result of 27.6 pCi/L exceeds the 15-pCi/L maximum value. It is noted that elevated results measured at EMW-VWEIR are directly related to contact water releases.

- Most TSS results at the EMW-VWEIR station were less than the EMP maximum level of 110 mg/L, and BJC continues to evaluate TSS to determine whether there is a practical means of removing non-settleable solids. The contact water cumulative average SOF peaked at 1.55 in February 2006, due to elevated ^{90}Sr levels, but fell below the 1.0 criterion by April 2007 and finished the CY well below the criterion.

- Air sampling results are below associated PELs for chemicals and associated DACs for radionuclides.

- Chlorine-36 continues to be detected in surface water and shallow groundwater samples but with no obvious spatial or temporal patterns. These detections *may be* analytical false positives, although additional study is required to conclusively confirm or eliminate this possibility. The analyzing laboratory suggests that positive ^{36}Cl results may be due to interfereing isotopes remaining from incomplete separation. Preliminary results indicate that more thorough rinsing of the filtered precipitate during separation may resolve this issue. If continued monitoring shows that the issue has not been resolved, split sample analysis at a separate laboratory will be conducted to evaluate whether or not detections are analytical anomalies.

- Based on the detection monitoring results for FY 2007, and with the exception of the above-noted evaluation of ^{36}Cl detection status, it is recommended that no changes be made at this time to the environmental monitoring frequency as described in the EMP.

5. REFERENCES

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APPENDIX A

EMWMF FISCAL YEAR 2007 STORM WATER DATA SUMMARIES

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Table A.1. EMWMF fiscal year 2007 storm water data exceeding EMP Table 5 or TDEC fish and aquatic life AWQC

Chemical	CAS number	Station	Date sampled	Sample type	Units	Result	DA qual.	Lab. qual.	Det. limit	Rad TPU	EMP Tbl 5[a]	Fish and aquatic[b]
Anions and non-metals												
Ammonia as nitrogen	N3350	EMW-VWEIR	07/11/07	Dup	mg/L	0.34	=		0.1	--	0.2	NA
Ammonia as nitrogen	N3350	EMW-VWEIR	07/11/07	Reg	mg/L	0.42	=		0.1	--	0.2	NA
Metals												
Lead	7439-92-1	EMW-VWEIR	07/11/07	Dup	mg/L	0.004			8.2E-04	--	NA	0.0025
Lead	7439-92-1	EMW-VWEIR	07/11/07	Reg	mg/L	0.004	=		8.2E-04	--	NA	0.0025
Physical measurements												
Dissolved oxygen	N328	EMWNT-03A	07/11/07	Reg	mg/L	4.6			--	--	NA	≥ 5
Radionuclides												
Alpha activity	12587-46-1	EMW-VWEIR	01/16/07	Reg	pCi/L	27.6	=		2.81	1.59	15	NA
Beta activity	12587-47-2	EMW-VWEIR	01/16/07	Reg	pCi/L	500	=		3.79	4.18	50	NA
Beta activity	12587-47-2	EMW-VWEIR	07/11/07	Dup	pCi/L	227	=		4.66	3.16	50	NA
Beta activity	12587-47-2	EMW-VWEIR	07/11/07	Reg	pCi/L	271	=		3.83	3.36	50	NA

[a]Storm water criteria are taken from Table 5 Maximum Levels in the EMWMF EMP (BJC 2007b).
[b]Fish and aquatic life criterion continuous concentrations are from TDEC 1200-4-3-.03(3).
The sum of fractions for radionuclides for EMW-VWEIR exceeds 25% of the derived concentration guide as specified in U. S. Department of Energy Order 5400.5.
Unless otherwise indicated, all results are for semiannual samples.
AWQC = ambient water quality criteria.
CAS = Chemical Abstract Service.
DA = data assessment evaluation using SAS® program.
EMWMF = Environmental Management Waste Management Facility.
EMP = Environmental Monitoring Plan.
TDEC = Tennessee Department of Environment and Conservation.
TPU = total propagated uncertainty.
NA = criteria not available.
-- = not applicable.
OREIS laboratory and data assessment qualifier definitions:
 = denotes the result was validated, detected, and unqualified.

Table A.2. EMWMF fiscal year 2007 detected storm water data

Chemical	CAS number	Station	Date sampled	Sample type	Units	Result	DA qual.	Lab. qual.	Detection limit
				Physical measurements					
Conductivity	N237	EMW-VWEIR	10/12/06	Reg	umho/cm	424			--
Conductivity	N237	EMW-VWEIR	11/07/06	Reg	umho/cm	207			--
Conductivity	N237	EMW-VWEIR	02/21/07	Reg	umho/cm	280			--
Conductivity	N237	EMW-VWEIR	03/16/07	Reg	umho/cm	244			--
Conductivity	N237	EMW-VWEIR	04/04/07	Reg	umho/cm	376			--
Conductivity	N237	EMW-VWEIR	05/17/07	Reg	umho/cm	380			--
Conductivity	N237	EMW-VWEIR	06/14/07	Reg	umho/cm	156			--
Conductivity	N237	EMW-VWEIR	07/31/07	Reg	umho/cm	215			--
Dissolved oxygen	N328	EMW-VWEIR	10/12/06	Reg	mg/L	8.3			--
Dissolved oxygen	N328	EMW-VWEIR	11/07/06	Reg	mg/L	7.7			--
Dissolved oxygen	N328	EMW-VWEIR	02/21/07	Reg	mg/L	27.4			--
Dissolved oxygen	N328	EMW-VWEIR	03/16/07	Reg	mg/L	12.4			--
Dissolved oxygen	N328	EMW-VWEIR	04/04/07	Reg	mg/L	8.34			--
Dissolved oxygen	N328	EMW-VWEIR	05/17/07	Reg	mg/L	11.5			--
Dissolved oxygen	N328	EMW-VWEIR	06/14/07	Reg	mg/L	9.08			--
Dissolved oxygen	N328	EMW-VWEIR	07/31/07	Reg	mg/L	8.22			--
Flow (total)	NS1855	EMW-VWEIR	11/07/06	Reg	L/min	53.5			--
Flow (total)	NS1855	EMW-VWEIR	02/21/07	Reg	L/min	58			--
Flow (total)	NS1855	EMW-VWEIR	03/16/07	Reg	L/min	60			--
Flow (total)	NS1855	EMW-VWEIR	04/04/07	Reg	L/min	200			--
Redox	NS215	EMW-VWEIR	10/12/06	Reg	mV	186			--
Redox	NS215	EMW-VWEIR	11/07/06	Reg	mV	132.4			--
Redox	NS215	EMW-VWEIR	02/21/07	Reg	mV	310.9			--
Redox	NS215	EMW-VWEIR	03/16/07	Reg	mV	208.9			--
Redox	NS215	EMW-VWEIR	04/04/07	Reg	mV	200			--
Redox	NS215	EMW-VWEIR	05/17/07	Reg	mV	111.4			--
Redox	NS215	EMW-VWEIR	06/14/07	Reg	mV	122.5			--
Redox	NS215	EMW-VWEIR	07/31/07	Reg	mV	146			--
Temperature	N908	EMW-VWEIR	10/12/06	Reg	°C	19.6			--
Temperature	N908	EMW-VWEIR	11/07/06	Reg	°C	12.6			--
Temperature	N908	EMW-VWEIR	02/21/07	Reg	°C	16.5			--
Temperature	N908	EMW-VWEIR	03/16/07	Reg	°C	13.7			--

Table A.2. EMWMF fiscal year 2007 detected storm water data (continued)

Chemical	CAS number	Station	Date sampled	Sample type	Units	Result	DA qual.	Lab. qual.	Detection limit
Temperature	N908	EMW-VWEIR	04/04/07	Reg	°C	16.8			--
Temperature	N908	EMW-VWEIR	05/17/07	Reg	°C	16.9			--
Temperature	N908	EMW-VWEIR	06/14/07	Reg	°C	22			--
Temperature	N908	EMW-VWEIR	07/31/07	Reg	°C	25.8			--
Turbidity	N1036	EMW-VWEIR	10/12/06	Reg	NTU	26.5			--
Turbidity	N1036	EMW-VWEIR	11/07/06	Reg	NTU	72			--
Turbidity	N1036	EMW-VWEIR	02/21/07	Reg	NTU	742			--
Turbidity	N1036	EMW-VWEIR	03/16/07	Reg	NTU	103			--
Turbidity	N1036	EMW-VWEIR	04/04/07	Reg	NTU	338			--
Turbidity	N1036	EMW-VWEIR	05/17/07	Reg	NTU	9.71			--
Turbidity	N1036	EMW-VWEIR	06/14/07	Reg	NTU	944			--
Turbidity	N1036	EMW-VWEIR	07/31/07	Reg	NTU	12			--
Water flow	NS211	EMW-VWEIR	10/12/06	Reg	L/min	60			--
Water flow	NS211	EMW-VWEIR	05/17/07	Reg	L/min	103			--
Water flow	NS211	EMW-VWEIR	06/14/07	Reg	L/min	572			--
Water flow	NS211	EMW-VWEIR	07/31/07	Reg	L/min	135			--
pH	N704	EMW-VWEIR	10/12/06	Reg	Std unit	6.45			--
pH	N704	EMW-VWEIR	11/07/06	Reg	Std unit	6.87			--
pH	N704	EMW-VWEIR	02/21/07	Reg	Std unit	8.05			--
pH	N704	EMW-VWEIR	03/16/07	Reg	Std unit	7.81			--
pH	N704	EMW-VWEIR	04/04/07	Reg	Std unit	6.84			--
pH	N704	EMW-VWEIR	05/17/07	Reg	Std unit	7.79			--
pH	N704	EMW-VWEIR	06/14/07	Reg	Std unit	7.58			--
pH	N704	EMW-VWEIR	07/31/07	Reg	Std unit	6.65			--
Radionuclides									
Americium-243	14993-75-0	EMW-VWEIR	02/21/07	Reg	pCi/L	0.33	=	J	0.15
Chlorine-36	13981-43-6	EMW-VWEIR	12/13/06	Reg	pCi/L	8.22	=		4.38
Curium-245	15621-76-8	EMW-VWEIR	11/07/06	Reg	pCi/L	0.38	J	J	0.22
Curium-245	15621-76-8	EMW-VWEIR	12/13/06	Reg	pCi/L	0.37	J	J	0.25
Curium-245	15621-76-8	EMW-VWEIR	02/21/07	Reg	pCi/L	0.43	=		0.16
Curium-245	15621-76-8	EMW-VWEIR	05/17/07	Reg	pCi/L	0.27	=	J	0.13
Curium-245	15621-76-8	EMW-VWEIR	07/31/07	Reg	pCi/L	0.33	J	J	0.15
Curium-246	15757-90-1	EMW-VWEIR	11/07/06	Reg	pCi/L	0.38	J	J	0.22

Table A.2. EMWMF fiscal year 2007 detected storm water data (continued)

Chemical	CAS number	Station	Date sampled	Sample type	Units	Result	DA qual.	Lab. qual.	Detection limit
Curium-246	15757-90-1	EMW-VWEIR	12/13/06	Reg	pCi/L	0.37	J	J	0.25
Curium-246	15757-90-1	EMW-VWEIR	02/21/07	Reg	pCi/L	0.43	=		0.16
Curium-246	15757-90-1	EMW-VWEIR	05/17/07	Reg	pCi/L	0.27	=	J	0.13
Curium-246	15757-90-1	EMW-VWEIR	07/31/07	Reg	pCi/L	0.33	J	J	0.15
Plutonium-239/240	N760	EMW-VWEIR	11/07/06	Reg	pCi/L	0.29	=		0.07
Plutonium-242	13982-10-0	EMW-VWEIR	11/07/06	Reg	pCi/L	0.16	J	J	0.06
Plutonium-242	13982-10-0	EMW-VWEIR	12/13/06	Reg	pCi/L	0.23	=		0.04
Plutonium-242	13982-10-0	EMW-VWEIR	04/04/07	Reg	pCi/L	0.21	J	J	0.12
Plutonium-242	13982-10-0	EMW-VWEIR	07/31/07	Reg	pCi/L	0.31	=		0.08
Plutonium-244	14119-34-7	EMW-VWEIR	04/04/07	Reg	pCi/L	0.18	=	J	0.08
Potassium-40	13966-00-2	EMW-VWEIR	04/04/07	Reg	pCi/L	68.1	=	J	56.4
Protactinium-234m	378783-76-7	EMW-VWEIR	10/12/06	Reg	pCi/L	2.37	=		0.15
Protactinium-234m	378783-76-7	EMW-VWEIR	11/07/06	Reg	pCi/L	0.82	=		0.11
Protactinium-234m	378783-76-7	EMW-VWEIR	12/13/06	Reg	pCi/L	3.84	=		0.38
Protactinium-234m	378783-76-7	EMW-VWEIR	02/21/07	Reg	pCi/L	3.34	=		0.15
Protactinium-234m	378783-76-7	EMW-VWEIR	03/16/07	Reg	pCi/L	0.82	=		0.34
Protactinium-234m	378783-76-7	EMW-VWEIR	04/04/07	Reg	pCi/L	0.38	J	J	0.3
Protactinium-234m	378783-76-7	EMW-VWEIR	05/17/07	Reg	pCi/L	1.61	=		0.36
Protactinium-234m	378783-76-7	EMW-VWEIR	06/14/07	Reg	pCi/L	0.75	=	J	0.29
Protactinium-234m	378783-76-7	EMW-VWEIR	07/31/07	Reg	pCi/L	1.07	=		0.26
Radioactive strontium (total)	NS951	EMW-VWEIR	12/13/06	Reg	pCi/L	111	=		0.88
Radioactive strontium (total)	NS951	EMW-VWEIR	04/04/07	Reg	pCi/L	12.1	=		1.56
Radioactive strontium (total)	NS951	EMW-VWEIR	05/17/07	Reg	pCi/L	69.3	=		1.71
Radioactive strontium (total)	NS951	EMW-VWEIR	06/14/07	Reg	pCi/L	7.57	=		1.33
Radioactive strontium (total)	NS951	EMW-VWEIR	07/31/07	Reg	pCi/L	18.3	=		0.98
Radium-226	13982-63-3	EMW-VWEIR	02/21/07	Reg	pCi/L	0.9	=		0.17
Radium-226	13982-63-3	EMW-VWEIR	05/17/07	Reg	pCi/L	0.37	=	J	0.15
Radium-226	13982-63-3	EMW-VWEIR	06/14/07	Reg	pCi/L	0.45	=	J	0.16
Strontium-90	10098-97-2	EMW-VWEIR	10/12/06	Reg	pCi/L	126	=		1.36
Strontium-90	10098-97-2	EMW-VWEIR	11/07/06	Reg	pCi/L	14.6	=		0.91
Strontium-90	10098-97-2	EMW-VWEIR	02/21/07	Reg	pCi/L	110	=		1.28
Strontium-90	10098-97-2	EMW-VWEIR	03/16/07	Reg	pCi/L	26.3	=		1.85
Technetium-99	14133-76-7	EMW-VWEIR	10/12/06	Reg	pCi/L	59.3	=		5.86
Technetium-99	14133-76-7	EMW-VWEIR	12/13/06	Reg	pCi/L	5.59	=		2.77

Table A.2. EMWMF fiscal year 2007 detected storm water data (continued)

Chemical	CAS number	Station	Date sampled	Sample type	Units	Result	DA qual.	Lab. qual.	Detection limit
Thorium-228	14274-82-9	EMW-VWEIR	02/21/07	Reg	pCi/L	0.34	=	J	0.17
Thorium-228	14274-82-9	EMW-VWEIR	04/04/07	Reg	pCi/L	0.35	=	J	0.22
Thorium-228	14274-82-9	EMW-VWEIR	06/14/07	Reg	pCi/L	0.47	=		0.17
Thorium-230	14269-63-7	EMW-VWEIR	10/12/06	Reg	pCi/L	1.05	J		0.23
Thorium-230	14269-63-7	EMW-VWEIR	03/16/07	Reg	pCi/L	0.59	=		0.13
Thorium-230	14269-63-7	EMW-VWEIR	06/14/07	Reg	pCi/L	0.69	=		0.16
Thorium-232	N2608	EMW-VWEIR	10/12/06	Reg	pCi/L	0.29	=	J	0.23
Thorium-232	N2608	EMW-VWEIR	02/21/07	Reg	pCi/L	0.38	=		0.13
Thorium-232	N2608	EMW-VWEIR	04/04/07	Reg	pCi/L	0.31	J	J	0.17
Thorium-232	N2608	EMW-VWEIR	06/14/07	Reg	pCi/L	0.61	J		0.17
Thorium-234	15065-10-8	EMW-VWEIR	10/12/06	Reg	pCi/L	2.37	=		0.15
Thorium-234	15065-10-8	EMW-VWEIR	11/07/06	Reg	pCi/L	0.82	=		0.11
Thorium-234	15065-10-8	EMW-VWEIR	12/13/06	Reg	pCi/L	3.84	=		0.38
Thorium-234	15065-10-8	EMW-VWEIR	02/21/07	Reg	pCi/L	3.34	=		0.15
Thorium-234	15065-10-8	EMW-VWEIR	03/16/07	Reg	pCi/L	0.82	=		0.34
Thorium-234	15065-10-8	EMW-VWEIR	04/04/07	Reg	pCi/L	0.38	J	J	0.3
Thorium-234	15065-10-8	EMW-VWEIR	05/17/07	Reg	pCi/L	1.61	=		0.36
Thorium-234	15065-10-8	EMW-VWEIR	06/14/07	Reg	pCi/L	0.75	=	J	0.29
Thorium-234	15065-10-8	EMW-VWEIR	07/31/07	Reg	pCi/L	1.07	=		0.26
Uranium-232	14158-29-3	EMW-VWEIR	02/21/07	Reg	pCi/L	0.39	=	J	0.15
Thorium-234	15065-10-8	EMW-VWEIR	10/12/06	Reg	pCi/L	2.37	=		0.15
Uranium-233/234	NS632	EMW-VWEIR	10/12/06	Reg	pCi/L	3.17	=		0.26
Uranium-233/234	NS632	EMW-VWEIR	11/07/06	Reg	pCi/L	1.36	=		0.1
Uranium-233/234	NS632	EMW-VWEIR	12/13/06	Reg	pCi/L	3.68	=		0.41
Uranium-233/234	NS632	EMW-VWEIR	02/21/07	Reg	pCi/L	4.72	=		0.26
Uranium-233/234	NS632	EMW-VWEIR	03/16/07	Reg	pCi/L	1.52	=		0.23
Uranium-233/234	NS632	EMW-VWEIR	04/04/07	Reg	pCi/L	1.25	=		0.32
Uranium-233/234	NS632	EMW-VWEIR	05/17/07	Reg	pCi/L	3	=		0.42
Uranium-233/234	NS632	EMW-VWEIR	06/14/07	Reg	pCi/L	1.05	=		0.33
Uranium-233/234	NS632	EMW-VWEIR	07/31/07	Reg	pCi/L	1.76	=		0.23
Uranium-235/236	N1047	EMW-VWEIR	11/07/06	Reg	pCi/L	0.31	=		0.09
Uranium-238	24678-82-8	EMW-VWEIR	10/12/06	Reg	pCi/L	2.37	=		0.15
Uranium-238	24678-82-8	EMW-VWEIR	11/07/06	Reg	pCi/L	0.82	=		0.11
Uranium-238	24678-82-8	EMW-VWEIR	12/13/06	Reg	pCi/L	3.84	=		0.38

Table A.2. EMWMF fiscal year 2007 detected storm water data (continued)

Chemical	CAS number	Station	Date sampled	Sample type	Units	Result	DA qual.	Lab. qual.	Detection limit
Uranium-238	24678-82-8	EMW-VWEIR	02/21/07	Reg	pCi/L	3.34	=		0.15
Uranium-238	24678-82-8	EMW-VWEIR	03/16/07	Reg	pCi/L	0.82	=		0.34
Uranium-238	24678-82-8	EMW-VWEIR	04/04/07	Reg	pCi/L	0.38	J	J	0.3
Uranium-238	24678-82-8	EMW-VWEIR	05/17/07	Reg	pCi/L	1.61	=		0.36
Uranium-238	24678-82-8	EMW-VWEIR	06/14/07	Reg	pCi/L	0.75	=	J	0.29
Uranium-238	24678-82-8	EMW-VWEIR	07/31/07	Reg	pCi/L	1.07	=		0.26
Yttrium-90	10098-91-6	EMW-VWEIR	10/12/06	Reg	pCi/L	126	=		1.36
Yttrium-90	10098-91-6	EMW-VWEIR	11/07/06	Reg	pCi/L	14.6	=		0.91
Yttrium-90	10098-91-6	EMW-VWEIR	12/13/06	Reg	pCi/L	111	=		0.88
Yttrium-90	10098-91-6	EMW-VWEIR	02/21/07	Reg	pCi/L	110	=		1.28
Yttrium-90	10098-91-6	EMW-VWEIR	03/16/07	Reg	pCi/L	26.3	=		1.85
Yttrium-90	10098-91-6	EMW-VWEIR	04/04/07	Reg	pCi/L	12.1	=		1.56
Yttrium-90	10098-91-6	EMW-VWEIR	05/17/07	Reg	pCi/L	69.3	=		1.71
Yttrium-90	10098-91-6	EMW-VWEIR	06/14/07	Reg	pCi/L	7.57	=		1.33
Yttrium-90	10098-91-6	EMW-VWEIR	07/31/07	Reg	pCi/L	18.3	=		0.98

CAS = Chemical Abstracts Service.
EMWMF = Environmental Management Waste Management Facility.
DA = data assessment evaluation using SAS® program.
Data assessment qualifier definitions:
= denotes the result was validated, detected, and unqualified.
J denotes the analyte was positively identified; the associated result is the approximate concentration of the analyte in the sample.
Laboratory qualifier definitions:
J denotes estimated value.

APPENDIX B

EMWMF FISCAL YEAR 2007 DETECTED AIR DATA

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Table B.1. EMWMF fiscal year 2007 detected air data

CAS number	Station	Date sampled	Sample type	Units	Result	Val. qual.	Lab. qual.	Detection limit
				Metals				
Barium								
7440-39-3	EMWAAGRID6/7W	12/18/06	Reg	mg/m^3	2.3E-04	J	B	3.4E-05
Calcium								
7440-70-2	EMWAAGRID18/19E	08/29/07	Reg	mg/m^3	0.013	J		0.011
7440-70-2	EMWAAGRID6/7E	08/29/07	Reg	mg/m^3	0.013	J		0.011
Chromium								
7440-47-3	EMWAAGRID18/19E	12/18/06	Reg	mg/m^3	5.9E-04	J	B	1.4E-04
7440-47-3	EMWAAGRID6/7E	12/18/06	Reg	mg/m^3	5.9E-04	J	B	1.4E-04
7440-47-3	EMWAAGRID6/7W	12/18/06	Reg	mg/m^3	5.8E-04	J	B	1.4E-04
Copper								
7440-50-8	EMWAAGRID18/19E	12/18/06	Reg	mg/m^3	2.4E-04	J	B	1.6E-05
7440-50-8	EMWAAGRID6/7E	12/18/06	Reg	mg/m^3	2.4E-04	J	B	1.7E-05
7440-50-8	EMWAAGRID6/7W	12/18/06	Reg	mg/m^3	2.3E-04	J	B	1.6E-05
Iron								
7439-89-6	EMWAAGRID18/19E	12/18/06	Reg	mg/m^3	5.9E-04	J	B	1.5E-04
7439-89-6	EMWAAGRID6/7E	12/18/06	Reg	mg/m^3	5.9E-04	J	B	1.5E-04
7439-89-6	EMWAAGRID6/7W	12/18/06	Reg	mg/m^3	6.4E-04	=		1.5E-04
Manganese								
7439-96-5	EMWAAGRID18/19E	12/18/06	Reg	mg/m^3	2.4E-04	J	B	2.9E-06
7439-96-5	EMWAAGRID6/7E	12/18/06	Reg	mg/m^3	2.4E-04	J	B	3.0E-06
7439-96-5	EMWAAGRID6/7W	12/18/06	Reg	mg/m^3	2.3E-04	J	B	2.9E-06
Molybdenum								
7439-98-7	EMWAAGRID6/7E	12/18/06	Reg	mg/m^3	3.6E-04	J	U	1.8E-04
Nickel								
7440-02-0	EMWAAGRID18/19E	12/18/06	Reg	mg/m^3	2.4E-04	J	B	3.1E-05
7440-02-0	EMWAAGRID6/7E	12/18/06	Reg	mg/m^3	2.4E-04	J	U	3.1E-05
7440-02-0	EMWAAGRID6/7W	12/18/06	Reg	mg/m^3	2.3E-04	J	B	3.0E-05
Potassium								
7440-09-7	EMWAAGRID18/19E	12/18/06	Reg	mg/m^3	0.002	J	B	5.3E-04
7440-09-7	EMWAAGRID6/7E	12/18/06	Reg	mg/m^3	0.002	J	U	5.3E-04
7440-09-7	EMWAAGRID6/7W	12/18/06	Reg	mg/m^3	0.002	J	B	5.2E-04
Selenium								
7782-49-2	EMWAAGRID6/7E	12/18/06	Reg	mg/m^3	0.004	J	U	0.001
Silver								
7440-22-4	EMWAAGRID6/7E	12/18/06	Reg	mg/m^3	5.9E-04	J	U	1.3E-05
Sodium								
7440-23-5	EMWAAGRID18/19E	12/18/06	Reg	mg/m^3	0.006	J	B	0.003
7440-23-5	EMWAAGRID6/7E	12/18/06	Reg	mg/m^3	0.006	J	B	0.003
7440-23-5	EMWAAGRID6/7W	12/18/06	Reg	mg/m^3	0.006	J	B	0.003
Strontium								
7440-24-6	EMWAAGRID18/19E	12/18/06	Reg	mg/m^3	2.4E-04	J	B	6.6E-06
7440-24-6	EMWAAGRID6/7W	12/18/06	Reg	mg/m^3	2.3E-04	J	B	6.5E-06

Table B.1. EMWMF fiscal year 2007 detected air data (continued)

CAS number	Station	Date sampled	Sample type	Units	Result	Val. qual.	Lab. qual.	Detection limit
				Volatile organics				
2-Butanone								
78-93-3	EMWAAGRID18/19E	09/14/07	Reg	ppb (v/v)	2	=		1.0
78-93-3	EMWAAGRID6/7E	09/14/07	Reg	ppb (v/v)	1	=		1.0
Acetone								
67-64-1	EMWAAGRID18/19E	06/18/07	Reg	ppb (v/v)	11	=		8.0
67-64-1	EMWAAGRID18/19E	09/14/07	Reg	ppb (v/v)	41	=		8.0
67-64-1	EMWAAGRID6/7E	12/22/06	Reg	ppb (v/v)	4.2	J		2.1
67-64-1	EMWAAGRID6/7E	03/06/07	Reg	ppb (v/v)	8	=		8.0
67-64-1	EMWAAGRID6/7E	06/18/07	Reg	ppb (v/v)	9	=		8.0
67-64-1	EMWAAGRID6/7E	09/14/07	Reg	ppb (v/v)	33	=		8.0
67-64-1	EMWAAGRID6/7W	12/22/06	Reg	ppb (v/v)	5.8	J		2.1
67-64-1	EMWAAGRID6/7W	06/18/07	Reg	ppb (v/v)	9	=		8.0
67-64-1	EMWAAGRID6/7W	09/14/07	Reg	ppb (v/v)	35	=		8.0
Carbon disulfide								
75-15-0	EMWAAGRID18/19E	09/14/07	Reg	ppb (v/v)	4	=		1.0
Toluene								
108-88-3	EMWAAGRID18/19E	12/22/06	Reg	ppb (v/v)	3	=		0.53
108-88-3	EMWAAGRID6/7W	12/22/06	Reg	ppb (v/v)	3	=		0.53
				Geotechnical				
Particulate matter, total								
NS2244	EMWAAGRID18/19E	12/18/06	Reg	mg/m^3	0.074	=		0.016
NS2244	EMWAAGRID18/19E	02/16/07	Reg	mg/m^3	0.06	=		0.06
NS2244	EMWAAGRID18/19E	08/30/07	Reg	mg/m^3	0.09	=		0.09
NS2244	EMWAAGRID6/7E	12/18/06	Reg	mg/m^3	0.063	=		0.016
NS2244	EMWAAGRID6/7E	02/16/07	Reg	mg/m^3	0.06	=		0.06
NS2244	EMWAAGRID6/7E	08/30/07	Reg	mg/m^3	0.09	=		0.09
NS2244	EMWAAGRID6/7W	12/18/06	Reg	mg/m^3	0.037	=		0.015
NS2244	EMWAAGRID6/7W	08/30/07	Reg	mg/m^3	0.093	=		0.093
				Other inorganics				
Asbestos								
1332-21-4	EMWAAGRID18/19E	12/18/06	Reg	fibers/cc	0.005	=		0.004
1332-21-4	EMWAAGRID6/7E	12/18/06	Reg	fibers/cc	0.005	=		0.005
1332-21-4	EMWAAGRID6/7W	12/18/06	Reg	fibers/cc	0.004	=		0.004

CAS = Chemical Abstracts Service.
EMWMF = Environmental Management Waste Management Facility.
Validation qualifier definitions:
= denotes the result was validated, detected, and unqualified.
J denotes the analyte was positively identified; the associated result is the approximate concentration of the analyte.
Laboratory qualifier definitions:
B denotes found in blank.
U denotes the analyte was analyzed for, but was not detected above, the reported sample quantitation limit.

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APPENDIX B:
CERTIFICATION OF LAND USE CONTROL IMPLEMENTATION
FY 2007

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CERTIFICATION OF LAND USE CONTROL IMPLEMENTATION
FY 2007

Signed LUCIP certification to be provided and inserted by DOE.

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APPENDIX B:
CERTIFICATION OF LAND USE CONTROL IMPLEMENTATION
FY 2007

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CERTIFICATION OF LAND USE CONTROL IMPLEMENTATION
FY 2007

Signed LUCIP certification to be provided and inserted by DOE.

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Table B.1. Verification of Land Use Controls for the Melton Valley Watershed
Highlighted in yellow are LUCIP requirements being certified as of September 30, 2007.
LUCIP requirements that are not highlighted were not implemented as of September 30, 2007.[(1)]

MV LUCIP Requirements					
Type of control	**Affected areas**	**Implementation**	**Frequency**	**Verification Requirements**	**Certification Documentation**
1. DOE land notation (property record restrictions) A. Land use B. Groundwater	All waste management areas and other areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions	To be drafted and implemented by DOE upon completion of all remediation activities or transfer of affected areas. Filed within 90 days after EPA and TDEC approval of the RAR.	Verify annually that information is being maintained properly.	Verify information properly recorded at County Register of Deeds Office(s).	Not certified. Implementation in progress but not completed before 9/30/07.
2. Property Record notices	SWSA 6 ICMAs/HTF; All waste management areas and other areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions	Notice provided by DOE EM to the public as soon as practicable, but no later than 90 days after approval of the LUCIP.	Verify annually that information is being maintained properly.	Verify information properly recorded at County Register of Deeds Office(s).	Not certified. Implementation in progress but not completed before 9/30/07.
3. Zoning notices	SWSA 6 ICMAs/HTF; All waste management areas and other areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions	Initial zoning notice (same as property record notice) filed with City Planning Commission as soon as practicable, but no later than 90 days after approval of the LUCIP; final zoning notice and survey plat filed with City Planning Commission upon completion of all remedial actions.	Verify annually that information is being maintained properly.	Verify information properly maintained with the City Planning Commission.	Not certified. Implementation in progress but not completed before 9/30/07.
4. Excavation/ penetration permit program	Remediation systems and all waste management areas and areas where hazardous substances/structures remain after remediation at levels requiring land use and/or groundwater restrictions	Currently established and functioning.	Monitor annually to ensure it is functioning properly.	Verify functioning of permit program against existing procedures.	Certified. Documentation fromMV Engineer verifying that the EPP program was functioning during FY07 against existing procedures.

Table B.1. Verification of Land Use Controls for the Melton Valley Watershed (continued)
Highlighted in yellow are LUCIP requirements being certified as of September 30, 2007.
LUCIP requirements that are not highlighted were not implemented as of September 30, 2007.[(1)]

MV LUCIP Requirements					
Type of control	**Affected areas**	**Implementation**	**Frequency**	**Verification Requirements**	**Certification Documentation**
5. State advisories/postings (e.g., no fishing or contact advisory)	White Oak Lake and White Oak Creek Embayment	Advisories established by TDEC and effective immediately upon LUCIP approval.	Inspect no less than annually.	Conduct field survey and assess signs condition (i.e., remain intact, erect, and legible). Verify information with Tennessee Wildlife Resources Agency official.	Not certified. Documentation of field survey by MV S&M manager verifying that adequate warning signs have been posted by DOE at White Oak Lake dam and at access to the White Oak Creek Embayment, however, current State advisories and published fishing regulations do not address the White Oak Lake and White Oak Creek Embayment [(2)]
6. Access controls (e.g., fences, gates, portals)	SWSA 6 ICMAs/HTF	If necessary, selected in the design or construction completion reports.	Inspect no less than annually.	Conduct field survey of all controls to assess condition (i.e., remain erect, intact, and functioning)	Certified. Documentation of field survey by the MV S&M manager verifying access controls are in place around MV.

Table B.1. Verification of Land Use Controls for the Melton Valley Watershed (continued)
Highlighted in yellow are LUCIP requirements being certified as of September 30, 2007.
LUCIP requirements that are not highlighted were not implemented as of September 30, 2007.[1]

MV LUCIP Requirements					
Type of control	**Affected areas**	**Implementation**	**Frequency**	**Verification Requirements**	**Certification Documentation**
7. Signs	At 13 locations throughout Melton Valley Watershed near major access points.	In place within 6 months of approval of the LUCIP.	Inspect no less than annually.	Conduct field survey of all signs to assess condition (i.e., remain erect, intact, and legible)	Certified. Documentation of field survey by the MV S&M Manager verifying signs are in place around MV.
8. Surveillance patrols	Patrol of selected areas throughout Melton Valley, as necessary.	Effective immediately following LUCIP approval and conducted no less frequently than once a quarter.	Adequacy of necessary patrols assessed no less than annually.	Verify against procedures/plans that routine patrols conducted	Certified. Documentation from MV S&M manager verifying that surveillance patrols were conducted according to S&M procedure.
Additional Project-Specific PCCR Requirements					
None specified [3]	T1, T2, and HFIR Tanks, MV ISG Trenches 5 & 7, SWSA 6, SWSA 4, Pit and Trenches, SWSA 5, TRU Trenches, Soils and Sediments	N/A	N/A	N/A	N/A

[1] Implementation of only portions of the Melton Valley LUCIP is certified at this time because: (1) The implementation is in progress but was not completed before September 30, 2007, or (2) the intent of the requirement is being completed by DOE in lieu of TDEC (e.g., State advisories/postings).

[2] Although signs stating no fishing/no water contact have been established and maintained by DOE at the White Oak Lake and White Oak Creek Embayment, the LUCIP requirement for State advisories/postings has not been implemented because TDEC has taken the position that state agencies do not have statutory authority to post such warnings on property that does not afford public access (e.g., the DOE ORR).

[3] No attachments to Appendix A of the MV LUCIP as of September 30, 2007.

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APPENDIX C:
FFA APPENDIX E, ENFORCEABLE MILESTONES, FY 2007—2009

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FY 2007 - 2009 Federal Facility Agreement Milestones
Appendix E

	FY 2007		FY 2008		FY 2009*	
	Milestone	**Date**	**Milestone**	**Date**	**Milestone**	**Date**
ETTP Dec Docs Subprojects						
Zone 1 ROD **(Dec Doc 11/8/02)**			RAR	6/26/08		
K-770 Scrap and Debris	PCCR	5/1/07				
K-1007 Powerhouse Areas	CS (K-710 Sludge Beds/Imhoff Tanks K-725 Beryllium Bldg. Slab)	7/9/07				
Zone 2 ROD **(Dec Doc 4/19/05)**	WHP (Generic)	12/5/06	PCCR	9/30/08	RAR	8/27/2009
	CS (K-1070-B Burial Ground)	12/18/06				
	PCCR	9/30/07				
Sitewide ROD (Final GW/SW/Sed/Eco)* **(Dec Doc FY06)**	ROD	9/30/07	LUCIP	11/8/07		
ETTP Ponds	AM	12/11/06				
ETTP Ponds	WHP	7/26/07				
ETTP Ponds			CS	11/6/07	RmAR	10/30/08
Mitchell Branch					PCCR	8/20/09
K-1085 Drum Burial Site **(Dec Doc 3/27/01)**	Comp. Letter	12/29/06				
Remaining Facilities D&D **(Dec Doc 9/12/03)**					RmAR	8/20/09
Predominantly Uncontaminated Facilities	PCCR	9/30/07	PCCR	9/30/08		
Low Risk/Low Complexity Facilities	PCCR	9/30/07	PCCR	9/30/08		
K-1401 Building			PCCR	3/31/08		
K-1420 Decon & Recovery Facility	PCCR	2/15/07				
Centrifuge Equipment (K-1210/1220)			PCCR	6/30/08		
Poplar Creek High Risk Facilities & Tielines	WHP Addendum	5/1/07	PCCR	8/7/08		
K-29 Process Bldg.	PCCR	4/28/07				
K-1037 Barrier Plant	WHP Addendum	3/28/07	CS	7/8/08	PCCR	6/30/09
Central Neutralization Facility					WHP	10/20/08
Central Neutralization Facility					PCCR	5/11/09

June 15, 2007

FY 2007 - 2009 Federal Facility Agreement Milestones
Appendix E

	FY 2007		FY 2008		FY 2009*	
	Milestone	**Date**	**Milestone**	**Date**	**Milestone**	**Date**
K-1064 Peninsula D&D (Group II, Ph II Removal Action) **(Dec Doc 7/31/02)**	RmAR (Scrap)	6/26/07				
K-25/K-27 D&D **(Dec Doc 3/8/02)**					RmAR	8/31/09
Excess Material Removal			Comp. Letter (Centrifuge & Y-12 Materials)	**3/27/08**		
Excess Material Removal			Comp. Letter (Nickel & Classified Chemicals)	9/30/08		
Process Equipment Removal					PCCR	7/31/09
K-29/31/33 Building D&D	**Test Cylinder Disposal Completion Letter**	**9/28/07**				
ORNL Dec Docs Subprojects						
Melton Valley ROD **(Dec Doc 9/21/00)**	ESD	12/29/06				
	RAR	5/31/07				
MSRE Flush & Fuel Salt **(Dec Doc 7/7/98)**	ESD	12/29/06				
	PCCR	9/30/07				
Bethel Valley ROD **(Dec Doc 5/2/02)**						
ORNL Soils & Sediments			RAWP	5/5/08		
ORNL Soils & Sediments			WHP	9/26/08		
ORNL Soils & Sediments					**CS**	**9/30/2009**
BV GW Engineering Study					**CS**	**9/30/2009**
ORNL Facilities D&D					RAWP	1/5/09
ORNL Small Facilities D&D					**WHP**	**5/26/09**
BV Chemical Development Lab Facilities					**WHP**	**7/15/09**
BV D&D Isotope Area Facilities					**WHP**	**7/15/09**
BV D&D Tank Area Facilities					**WHP**	**8/15/09**
BV D&D Isotope Area Facilities (3026 C&D)					**WHP**	**8/15/09**
BV D&D Reactor Area Facilities					RAWP	4/30/09
BV D&D Reactor Area Facilities					WHP	9/30/09

FY 2007 - 2009 Federal Facility Agreement Milestones
Appendix E

	FY 2007		FY 2008		FY 2009*	
	Milestone	**Date**	**Milestone**	**Date**	**Milestone**	**Date**
Corehole 8 **(Dec Doc 9/19/98)**			CS	11/30/07		
			RmAR	5/19/08		
Metal Recovery Facility **(Dec Doc 3/3/00)**			Completion Letter (Waste Disp.)	8/31/08		
EMWMF ROD Subprojects						
EMWMF ROD **(Dec Doc 11/11/99)**						
WAC Attainment - Capacity Assurance (CARAR)	CARAR	4/1/07	CARAR	4/1/08	CARAR	3/30/09
Y-12 Site						
UEFPC Ph. II ROD Soils and Scrap Yard **(Dec Doc 4/21/06)**	LUCIP	10/31/06			EE/CA (Generic)	4/30/09
Y-12 Salvage Yard, Scrap Removal			RAWP	5/13/08		
Y-12 Salvage Yard, Scrap Removal			WHP	9/30/08		
UEFPC Soils Remediation					**Soil Engineering Work Plan**	**9/30/2009**
UEFPC Ph. I ROD for Source Control Actions **(Dec Doc 5/2/02)**						
UEFPC West End Mercury Area Remediation					**RDR/RAWP**	**6/25/2009**
Alpha 4 D&D					**EE/CA**	**4/30/2009**
					AM	**8/24/2009**
BCV ROD - Ph. II (Burial Ground)			FFS/PP	9/30/08	**ROD**	**9/30/09**
ORR General						
Water Resources Restoration Program (WRRP)	RER	3/28/07	RER	3/28/08	RER	3/30/09
Public Involvement Plan (PIP)	PIP	5/31/07				
Other**						

* Additional 2008 milestones will be established with the approval of the Proposed Plan.

** Off-reservation PA/SI will be scheduled after ATSDR PHA reports identify area(s) that have been impacted by

FY 2007 – 2009 Federal Facility Agreement Milestones
Appendix E (continued)

AM = Action Memorandum
ATSDR = Agency for Toxic Substances and Disease Registry
BCV = Bear Creek Valley
BV = Bethel Valley
CARAR = Capacity Assurance Remedial Action Report
Comp = completion
CS = construction start
D&D = demolition & decommission
DOE = U.S. Department of Energy
Eco = ecological
EE/CA = Engineering Evaluation/Cost Analysis
EMWMF = Environmental Management Waste Management Facility
ESD = Explanation of Significant Difference
ETTP = East Tennessee Technology Park
FFS = Focused Feasibility Study
FY = fiscal year
GW = groundwater
LUCIP = Land Use Control Implementation Plan
MSRE = Molten Salt Reactor Experiment
ORNL = Oak Ridge National Laboratory
ORR = Oak Ridge Reservation
PA/SI = Preliminary Assessment/Site Investigation
PCCR = Phased Construction Completion Report
PHA = Preliminary Hazard Assessment
PIP = Public Involvement Plan
PP = Proposed Plan
RAR = Remedial Action Report
RAWP = Remedial Action Work Plan
RER = Remediation Effectiveness Report
RmAR = Removal Action Report
ROD = Record of Decision
SED = sediment
SW = site-wide
UEFPC = Upper East Fork Poplar Creek
WAC = waste acceptance criteria
WHP = Waste Handling Plan
WRRP = Water Resources Restoration Program

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