3. East Tennessee Technology Park

ETTP was originally built during World War II as part of the Manhattan Project. Known as the K-25 Site, its primary mission was to enrich uranium for use in atomic weapons. After the war, the mission was changed to include the enrichment of uranium for nuclear reactor fuel elements and recycling of uranium recovered from spent fuel, and the name was changed to the Oak Ridge Gaseous Diffusion Plant. In the 1980s, a reduction in the demand for nuclear fuel resulted in the shutdown of the enrichment process, and production ceased. The emphasis of the mission then changed to environmental management and restoration operations, and the name was changed to the East Tennessee Technology Park. Environmental management and remediation operations consist of operations such as waste management, the cleanup of outdoor storage and disposal areas, the demolition and/or cleanup of the facilities, land restoration, and environmental monitoring. Proper disposal of the huge quantities of waste that were generated over the course of production operations is also a major task. Beginning in the 1990s, reindustrialization (the conversion of underused government facilities for use by the private sector) also became a major mission at ETTP. Reindustrialization allows private industry to lease underused facilities, thus providing both jobs and a new use for facilities that otherwise would have to be demolished. State and federally mandated effluent monitoring and environmental surveillance at ETTP involve the collection and analysis of samples of air, water, soil, sediment, and vegetation from ETTP and the surrounding area. Monitoring results are used to assess exposures to members of the public and the environment, to assess the performance of treatment systems, to help identify areas of concern, to plan remediation efforts, and to evaluate the efficacy of remediation efforts. In 2012, there was 100% compliance with permit standards for emissions/discharges from ETTP operations.

3.1 Description of Site and Operations

Construction of ETTP (Fig. 3.1), originally known as the K-25 Site, began in 1943 as part of the World War II Manhattan Project. The plant's original mission was the production of enriched uranium for nuclear weapons. Enrichment was initially carried out in the S-50 thermal diffusion process facility, which operated for 1 year, and the K-25 and K-27 gaseous diffusion process buildings. Later, the K-29, K-31, and K-33 buildings were built to increase the production capacity of the original facilities by raising the assay of the feed material entering K-27. Following the war years, the site became officially known as the Oak Ridge Gaseous Diffusion Plant (ORGDP).

After military production of highly enriched uranium was concluded in 1964, the two original process buildings were shut down. For the next 20 years, the plant's primary missions were the production of only low enriched uranium to be fabricated into fuel elements for nuclear reactors. Other missions during the latter part of this 20-year period included developing and testing the gas centrifuge method of uranium enrichment and laser isotope separation R&D.

By 1985, the demand for enriched uranium had declined, and the gaseous diffusion cascades at ORGDP were placed in standby mode. That same year, the gas centrifuge program was canceled. The decision to permanently shut down the diffusion cascades was announced in late 1987, and actions necessary to implement that decision were initiated soon thereafter. Because of the termination of the original and primary missions, ORGDP was renamed the "Oak Ridge K-25 Site" in 1990. Figure 3.2 shows the K-25 Site areas before the start of D&D activities. In 1997, the K-25 Site was renamed the "East Tennessee Technology Park" to reflect its new mission. Figure 3.3 shows the ETTP areas designated for D&D activities through 2012.

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Fig. 3.1. East Tennessee Technology Park.

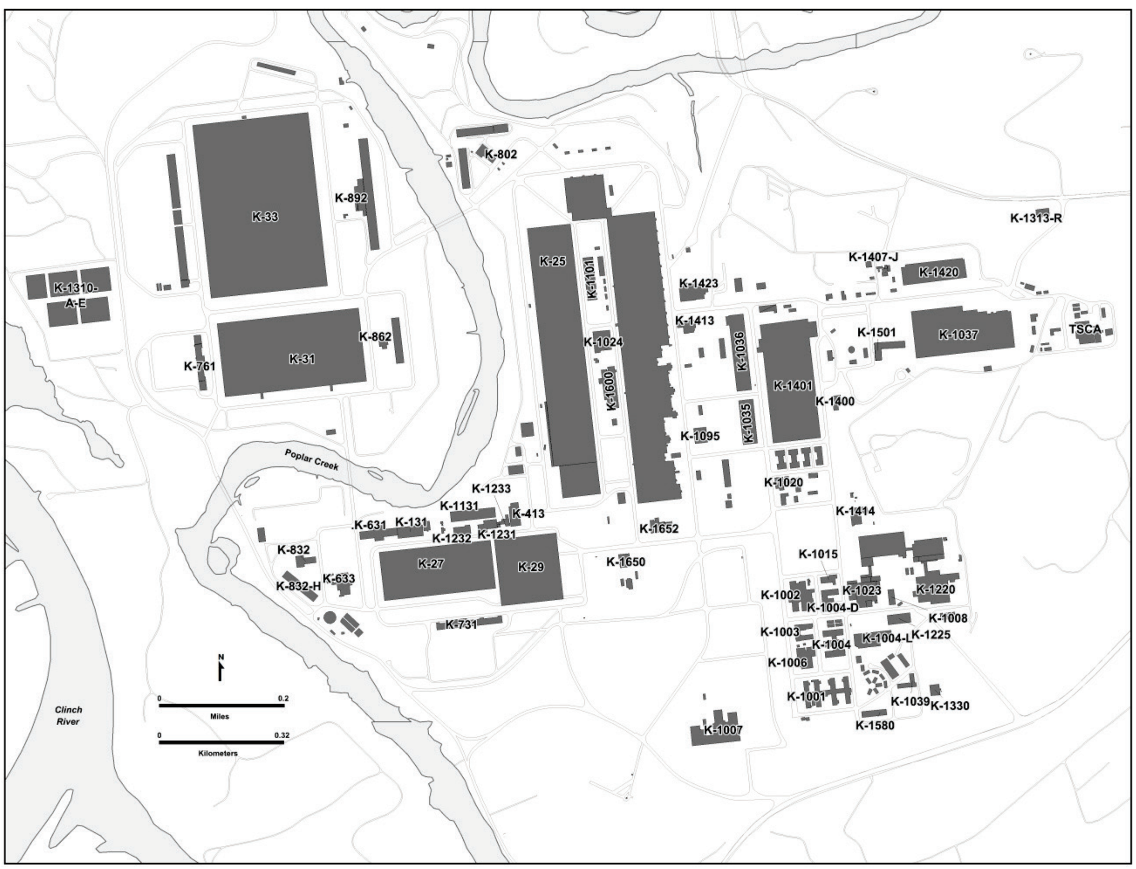


Fig. 3.2. East Tennessee Technology Park before the start of decontamination and decommissioning activities in 1991.

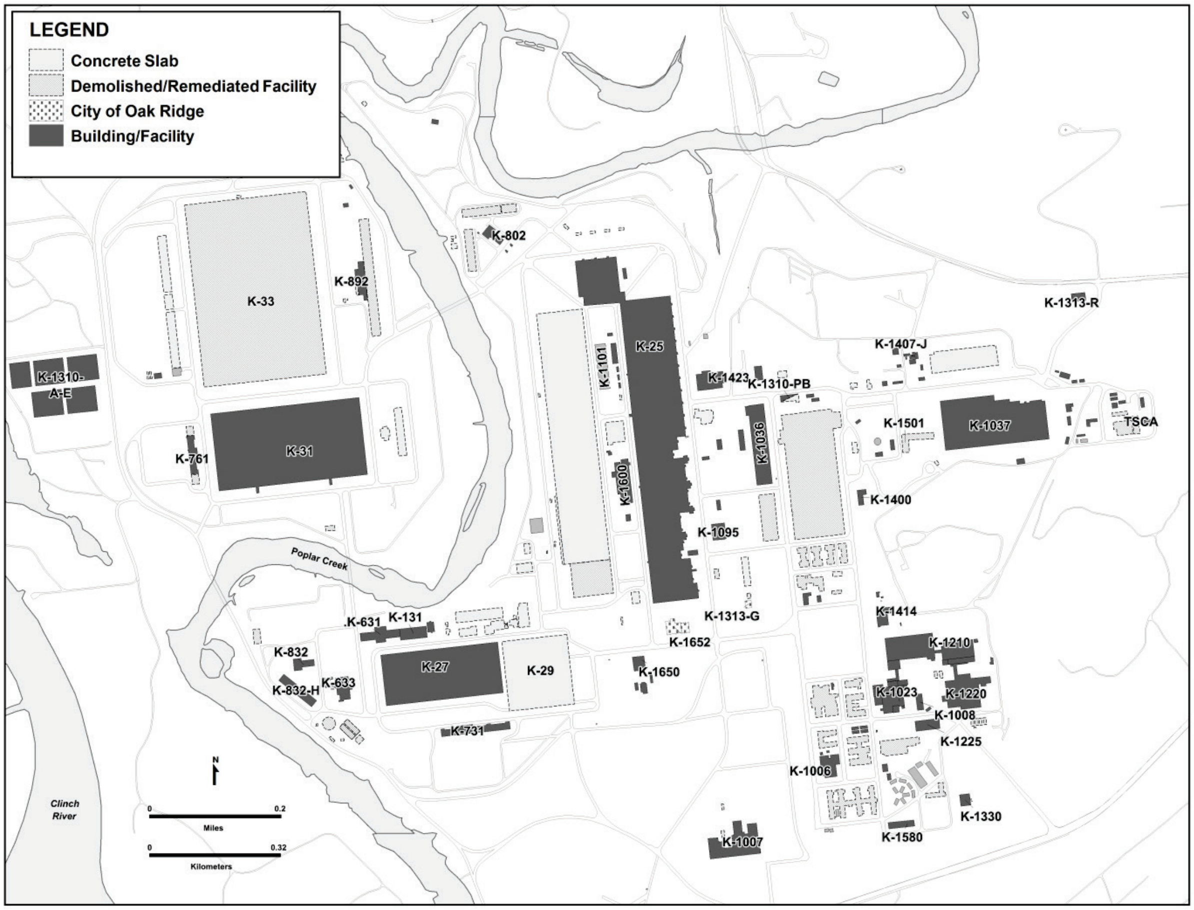


Fig. 3.3. East Tennessee Technology Park in 2012.

The ETTP mission is to reindustrialize and reuse site assets through leasing excess or underutilized land and facilities and through incorporating commercial industrial organizations as partners in the ongoing environmental restoration, D&D, and waste treatment and disposal.

DOE's long-term goal for ETTP is to convert as much as possible of the site into a private mixed-use business and industrial park. The site is undergoing environmental cleanup of its land as well as D&D of most of its buildings. The reuse of key facilities through title transfer is part of the site's closure plan. The cleanup approach makes land and various types of buildings (e.g., office, manufacturing) suitable for private industrial use and for title transfer to CROET or other entities such as the city of Oak Ridge. The facilities may then be subleased or sold, with the goal of stimulating private industry and recruiting business to the area.

UCOR, the environmental management contractor for ETTP, supports DOE in the reindustrialization program that transferred one land parcel to CROET in 2012 as part of the continuing effort to transform ETTP into a private-sector industrial park. An excellent example of reindustrialization efforts this past year was the construction and commissioning of an array of solar panels at the entrance to Portal 3 (see Section 3.2.1). Unless otherwise noted, information on non-DOE entities located on the ETTP site is not provided in this document.

3.2 Environmental Management System

The UCOR Environmental Management System (EMS) is integrated with the UCOR Integrated Safety Management System (ISMS). UCOR's EMS is based on a graded approach for a closure and remediation contract and reflects the elements and framework contained in International Organization for Standardization (ISO) standard 14001:2004 (ISO 14001:2004), *Environmental management systems—Requirements with guidance for use*. UCOR is committed to incorporating sound environmental management, protection, and sustainability practices in all work processes and activities that are part of the DOE EM program in Oak Ridge, Tennessee. UCOR's environmental policy states, "our commitment to protect and sustain human, natural, and cultural resources is inherent in our mission to complete environmental cleanup safely with reduced risks to the public, workers, and the environment." To achieve this, UCOR's environmental policy adheres to the following principles.

- **Management Commitment**—Integrate responsible environmental practices into project operations.
- **Environmental Compliance and Protection (EC&P)**—Comply with all environmental regulations and standards.
- **Sustainable Environmental Stewardship**—Minimize the effects of our operations on the environment through a combination of source reduction, recycling, and reuse; sound waste management practices; and pollution prevention.
- **Partnership/Stakeholder Involvement**—Maintain partnerships through effective two-way communications with our customer and other stakeholders.

3.2.1 Environmental Stewardship Scorecard

The Environmental Stewardship Scorecard is used to track and measure site-level EMS performance. During 2012, UCOR received "green scores" for EMS performance. As an example, Fig. 3.4 presents information on UCOR's pollution prevention recycling activities for 2012. UCOR recycles office and mixed paper, cardboard, phone books, newspapers, magazines, aluminum cans, antifreeze, engine oils, batteries (lead acid, universal waste, and alkaline), universal waste bulbs, plastic bottles, all types of #1 and #2 plastics, and surplus electronic assets such as computers (CPUs and laptops) and monitors (CRT and LCD). Other recycling opportunities include unique structural steel, stainless steel structural members, transformers, and electrical breakers. Figure 3.4 shows the pollution prevention recycling activities at ETTP related to solid waste reduction.

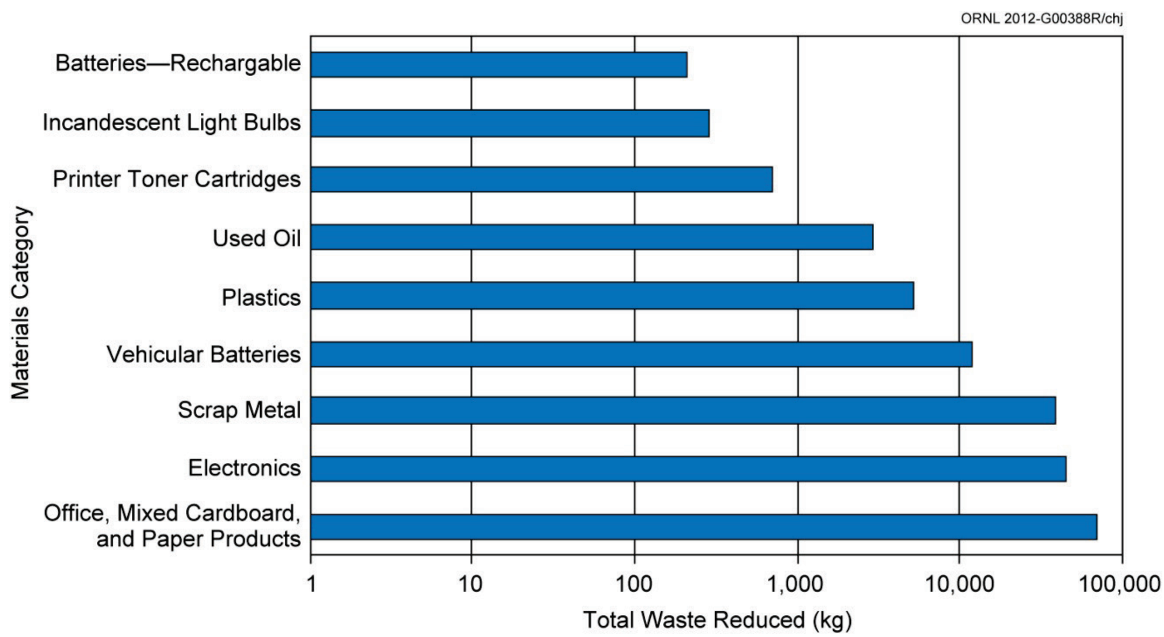


Fig. 3.4. Pollution prevention recycling activities related to solid waste reduction at East Tennessee Technology Park in FY 2012.

UCOR's electronic stewardship is award winning. For 2012, EPA awarded ETTP with the 2012 Federal Electronics Challenge (FEC) Platinum–Level Award at the White House Conference Center in Washington, DC (Fig. 3.5), for its electronics assets management achievements, including the Radio Frequency Identification Transportation System (RFITS). This award was earned by only 10 sites across the nation, and this was DOE EM's first award at this level.

Fig. 3.5. 2012 Federal Electronics Challenge Platinum–Level Award.

Additionally, UCOR internally recognized six projects for their pollution prevention/waste minimization accomplishments during the year, representing 17.7 million lb of construction debris being diverted from landfills and a cost savings of $447,000. In the area of alternative energy, Restoration Services, Inc. (RSI), in concert with UCOR, completed construction of ETTP's first solar farm on the east end of the plant property in April 2012. Brightfield 1 (Fig. 3.6) is a 200 kW solar array located at ETTP and built by RSI as part of the UCOR commitment to the revitalization of the former K-25 Site. The 0.405 ha (1-acre) tract was purchased from CROET. RSI self-financed the project, used solar panels manufactured in Tennessee, and partnered with other local small businesses for the installation. Power generated from Brightfield 1 is being sold to TVA through the City of Oak Ridge Electric Department using a TVA Generation Partners contract. The completed project was commissioned in April of 2012 and is part of RSI's brownfield to brightfield initiative that works to develop restricted use properties into solar farms. Brightfield 1 energy production in its first year was 110% more than projected, with no downtime due to maintenance issues. UCOR also continued to use "green" products whenever possible and evaluated large quantity purchases for less toxic alternatives. In addition, UCOR maintained its extensive recycling program and benefitted the local community through donations of proceeds to local charities from its aluminum beverage can (ABC) recycling efforts.

Fig. 3.6. Brightfield 1 Solar Farm.

3.2.2 Environmental Compliance

UCOR maintains various layers of oversight to ensure compliance with legal and other requirements. The methods of evaluation include independent assessments by outside parties, management assessments conducted by functional or project organizations, and routine field walkdowns conducted by a variety of functional and project personnel. Management and independent assessments are performed in accordance with *Management Assessment*, PROC-PQ-1420, and *Independent Assessment*, PROC-PQ-1401. Assessments are scheduled on the UCOR Assessments SharePoint Site in accordance with PROC-PQ-1420. Records are maintained for all formal assessments and audits. Issues identified in assessments are handled as required by ISO 14001, Section 4.5.3, "Nonconformity, Corrective Action, and Preventive Action" (ISO 2004).

3.2.3 Environmental Aspects/Impacts

Using a graded approach appropriate for EMS includes an environmental policy that provides a unified strategy for the management, conservation, and protection of natural resources; the control and attenuation of risks; and the establishment and attainment of all environment, safety, and health (ES&H) goals. UCOR works continuously to improve EMS to reduce impacts from activities and associated effects on the environment (i.e., environmental aspects) and to communicate and reinforce this policy to its internal and external stakeholders.

3.2.4 Environmental Performance Objectives and Targets

UCOR conserves and protects environmental resources by incorporating environmental protection and the elements of an enabling EMS into the daily conduct of business; fostering a spirit of cooperation with federal, state, and local regulatory agencies; and using appropriate waste management, treatment, storage, and disposal methods. The environmental performance objectives are to achieve zero unpermitted discharges to the environment; comply with all conditions of environmental permits, laws, regulations, and DOE orders; integrate EMS and environmental considerations as part of ISMS; and, to the extent practicable, reduce waste generation, prevent pollution, maximize recycle and reuse potential, and encourage environmentally preferable procurement of materials with recycled and bio-based content.

UCOR has established a set of core EMS objectives that remain relatively unchanged from year to year. These objectives are generally applicable to all operations and activities throughout UCOR's work scope. The core environmental objectives are based on complying with applicable legal requirements and sustainable environmental practices contained in DOE O 436.1, *Departmental Sustainability* (DOE 2011a), and include the following:

- comply with all environmental regulations, permits, and regulatory agreements;
- reduce or eliminate the acquisition, use, storage, generation, and/or release of toxic, hazardous, and radioactive materials; waste; and greenhouse gas (GHG) emissions through acquisition of environmentally preferable products, conduct of operations, waste shipment, and pollution prevention and waste minimization practices; and
- reduce degradation and depletion of environmental resources through postconsumer material recycling; energy, fuel, and water conservation efforts; and use or promotion of renewable energy.

3.2.5 Implementation and Operations

UCOR protects the safety and health of workers and the public by identifying, analyzing, and mitigating aspects, hazards, and impacts from ETTP operations and by implementing sound work practices. All UCOR employees and subcontractors are held responsible for complying with all ES&H requirements during all work activities and are expected to correct noncompliant conditions immediately. UCOR internal management assessments also provide a measure of how well EMS attributes are integrated into work activities through ISMS. UCOR has embodied its program for EC&P of natural resources in a companywide environmental management and protection policy. The policy is UCOR's fundamental commitment to incorporating sound environmental management practices into all work processes and activities.

3.2.6 Pollution Prevention/Waste Minimization

UCOR's work control process requires that all waste-generating activities be evaluated for source reduction and that product substitution be used to produce a less toxic waste when possible. The reuse or recycling of building debris or other wastes generated is evaluated in all cases.

ETTP continues to operate its nationally recognized RFITS, an electronic waste management tracking system that uses paperless and otherwise enhanced transportation logistics to track and monitor on-site waste shipments to EMWMF. An electronic tracking station is shown in Fig. 3.7. The system eliminated errors associated with manual data entry, improved cycle times by 25 min per truck shipment (i.e., saving large quantities of fuel and paper that significantly reduces GHG emissions), improved performance of vehicle searches at truck stations when exiting controlled areas, and centralized logistics for all shipments to EMWMF. The overall project cost savings of $15.6 million from using RFITS is shown in Table 3.1.

ORNL 2011-G00565/chj

Fig. 3.7. A waste shipment passing an electronic tracking station as it prepares to enter the haul road from East Tennessee Technology Park en route to the Environmental Management Waste Management Facility.

3.2.7 Competence, Training, and Awareness

The UCOR training and qualification process ensures that needed skills for the workforce are identified and developed. The process also documents knowledge, experience, abilities, and competencies of the workforce for key positions requiring qualification. This process is described in PROC-TC-0702, *Training Program*. Completion and documentation of training, including required reading, are managed by the Local Education Administration Requirements Network.

Table 3.1. Radio Frequency Identification Transportation System sustainable results

Sustainable factor	Results
Diesel fuel use avoidance	99,416 L
NO_X and CO_2 emissions avoidance	4,611 kg and 263,394 kg
Paper and trees saved	11 MT and 73 trees
Electricity saved	112.23 MJ
Water use avoided	120,230 L
Total project cost savings	**$15.6 million**

3.2.8 Communication

UCOR has decided to communicate externally regarding environmental aspects through the UCOR public website, which includes a link to its environmental policy statement, POL-UCOR-007; a list of environmental aspects; and a link to the ISMS Description, PPD-EH-1400. A number of other documents and reports that address environmental aspects and cleanup progress are also published and made available to the public (e.g., the Annual Site Environmental Report, Annual Cleanup Progress Report). UCOR participates in a number of public meetings related to environmental activities at the site (e.g., Site Specific Advisory Board meetings, permit review public meetings, and CERCLA decision document public meetings). Written communications from external parties are tracked using the weekly Open Action Report.

3.2.9 Benefits and Successes of Environmental Management System Implementation

UCOR uses EMS objectives and targets, an internal pollution prevention recognition program, environmentally preferable purchasing, work control processes, and a recycle program to meet sustainability and stewardship goals and requirements. The approach is outlined in UCOR's *Pollution Prevention and Waste Minimization Program Plan for the East Tennessee Technology Park, Oak Ridge, Tennessee* (UCOR 2012d). In 2012 the UCOR EMS program underwent the independent program verification required triennially by EO 13423 (CEQ 2007). The independent assessment evaluated the EMS program for conformance with the requirements of ISO 14001:2004. The results were zero findings and five opportunities for improvement (mostly related to documentation). Further, the report noted several practices worthy of benchmarking.

3.2.10 Management Review

Senior management review of EMS is performed at several layers and frequencies. A formal review/presentation with UCOR senior management that addresses the requirement elements contained in this section is conducted at least once per year. At least two of the senior managers are present for management reviews. The ISMS description is updated annually to address improvements and lessons learned and to update objectives and targets as necessary and signed by the UCOR president. The environmental policy is also reviewed during the management review annually and revised as necessary.

3.3 Compliance Programs and Status

During 2012, ETTP operations were conducted in compliance with contractual and regulatory environmental requirements, and there were no National Pollutant Discharge Elimination System (NPDES) permit noncompliances. Figure 3.8 shows the trend of NPDES compliance at ETTP since 1999. No notices of violation (NOVs) or penalties were issued to ETTP operations in 2012. The following sections provide more detail on each compliance program and the activities in 2012.

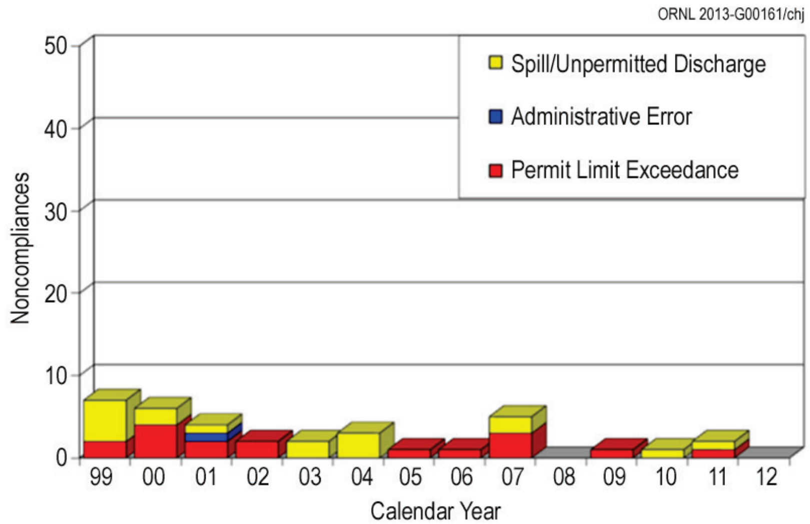


Fig. 3.8. East Tennessee Technology Park National Pollutant Discharge Elimination System permit compliance since 1999.

3.3.1 Environmental Permits

Table 3.2 contains a list of environmental permits that were effective at ETTP in 2012.

3.3.2 Notices of Violations and Penalties

ETTP did not receive any NOVs or penalties from regulators in 2012.

3.3.3 Audits and Oversight

Table 3.3 presents a summary of environmental audits conducted at ETTP in 2012.

3.3.4 National Environmental Policy Act/National Historic Preservation Act

The National Environmental Policy Act (NEPA) provides a means to evaluate the potential environmental impact of proposed federal activities and to examine alternatives to those actions. ETTP maintains compliance with NEPA through the use of site-level procedures and program descriptions that establish effective and responsive communications with program managers and project engineers to ensure NEPA is a key consideration in the formative stages of project planning.

During 2012, ETTP continued to operate under site-level, site-specific procedures that provide requirements for project reviews and NEPA compliance. These procedures call for a review of each proposed project, activity, or facility to determine the potential for impacts to the environment. To streamline the NEPA review and documentation process, DOE ORO has approved generic categorical exclusion (CX) determinations that cover certain proposed activities (i.e., maintenance activities, facilities upgrades, personnel safety enhancements). A CX is one of a category of actions defined in 40 CFR 1508.4 that does not individually or cumulatively have a significant effect on the human environment and for which neither an environmental assessment nor an environmental impact statement is normally required. UCOR activities on ORR are in full compliance with NEPA requirements, and procedures for implementing NEPA requirements have been fully developed and implemented. At ETTP, a checklist incorporating NEPA and EMS requirements has been developed as an aid for project planners. For routine operations, generic CX determinations have been issued. During 2012, no new CXs were issued, and eight review reports (five reindustrialization projects and three maintenance projects) were prepared. A review report is generated when a NEPA review is conducted and the activity is found to fall within one of the DOE ORO generic CXs.

Table 3.2. East Tennessee Technology Park Environmental Permits, 2012[a]

Regulatory driver	Permit title/description	Permit number	Issue date	Expiration date	Owner	Operator	Responsible contractor
CWA	NPDES permit for the Central Neutralization Facility Wastewater Treatment System	TN0074225	10-29-10	12-31-13	DOE	UCOR	UCOR
CWA	NPDES permit for storm water discharges	TN0002950	02-26-10	12-31-13	DOE	DOE	UCOR
CWA	State operating permit—Waste Transportation Project; Blair Road and Portal 6 Sewage Pump and Haul Permit	SOP-05068	08-19-11	02-28-14	DOE	TOPS	TOPS
CWA	State operating permit—K-1310-DF and K-1310-HG Trailers	SOP-99033	04-30-10	04-30-15	DOE	UCOR	UCOR
CWA	State operating permit—K-1065 Facility; Trailer K-1310-BS added in March 2009	SOP-01042	11-30-06	Terminated 5-31-11	DOE	UCOR	UCOR
CWA	State operating permit—EMWMF. 5,000 gal holding tank and 1,500 gal holding tank	SOP-01043	07-31-12	08-31-17	DOE	UCOR	UCOR
CWA	Authorized/certified USTs at K-1414 Garage	Customer ID 30166 Facility ID 073008	03-20-89	Ongoing	DOE	UCOR	UCOR
RCRA	K-25 Site TSCA Incinerator	TNHW-015	09-28-87	Terminated 9-21-12	DOE	UCOR	UCOR
RCRA	ETTP Container and Tank Storage and Treatment Units	TNHW-133	09-28-07	Terminated 9-21-12	DOE	UCOR	UCOR

Table 3.2. (continued)

Regulatory driver	Permit title/description	Permit number	Issue date	Expiration date	Owner	Operator	Responsible contractor
RCRA	ETTP Container Storage and Treatment Units	TNHW-117	09-30-04	09-30-14	DOE	UCOR	UCOR
RCRA	Hazardous Waste Corrective Action Document (encompasses the entire ORR)	TNHW-121	09-28-04	09-28-14	DOE	DOE/All[b]	DOE/All[b]
TSCA	TSCA Incinerator PCB treatment authorization	Not applicable	03-20-89	Terminated 6-14-12	DOE	UCOR	UCOR

[a]In cases where permit renewal applications have been submitted to regulatory agencies in a timely manner but a new permit has not been issued, permission is granted by regulators to continue operating under the terms of the existing but expired permit.
[b]DOE and all ORR co-operators of hazardous waste permits.

Abbreviations
CWA = Clean Water Act
DOE = US Department of Energy
EMWMF = Environmental Management Waste Management Facility
ETTP = East Tennessee Technology Park
ID = identification (number)
NPDES = National Pollutant Discharge Elimination System
ORR = Oak Ridge Reservation
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
SOP = state operating permit
TOPS = Transportation, Operations and Professional Services, Inc.
TSCA = Toxic Substances Control Act
UCOR = URS | CH2M Oak Ridge LLC
UST = underground storage tank

Table 3.3. Regulatory oversight, assessments, inspections, and site visits at East Tennessee Technology Park, 2012

Date	Reviewer	Subject	Issues
February13–14	TDEC	Annual RCRA Compliance Inspection	0
September 25	TDEC-Knoxville	CNF NPDES Compliance Evaluation Inspection	0
October 25	TDEC	TSCA Incinerator—PCB Site Visit	0

Abbreviations
CAA = Clean Air Act
CNF = Central Neutralization Facility
EPA = US Environmental Protection Agency
NPDES = National Pollutant Discharge Elimination System
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
TDEC = Tennessee Department of Environment and Conservation
TSCA = Toxic Substances Control Act

Compliance with the National Historic Preservation Act (NHPA) at ETTP is achieved and maintained in conjunction with NEPA compliance. The scope of proposed actions is reviewed in accordance with the *Cultural Resource Management Plan* (DOE 2001). At ETTP there were 135 facilities eligible for inclusion on the National Register of Historic Places. To date, more than 220 facilities have been demolished. Artifacts of historical and/or cultural significance are identified before demolition and are cataloged in a database to aid in historic interpretation of ETTP.

Consultation for the development of an MOA for D & D of the K-25 and K-27 buildings started in 2001; the document, approved in 2003, required a third-party analysis of the preservation and interpretive strategies for those two buildings. In 2005 DOE, the Tennessee State Historical Preservation Office (SHPO), and ACHP entered into an MOA that included the retention of the north end tower (aka north wing, north end, north tower) of the K-25 Building and Portal 4 (K-1028-45), among other features, as the "best and most cost-effective mitigation to permanently commemorate, interpret, and preserve the significance" of ETTP. Another series of consultation meetings ensued in 2009, and DOE advised that prohibitive costs and safety considerations precluded fulfillment of three stipulations in the 2005 MOA, including the preservation of the north end tower. The parties offered a wide array of potential mitigation measures and, in the absence of consensus on how best to commemorate Building K-25, DOE, SHPO, and ACHP entered into a bridge MOA until the parties could reach a final agreement. After completing an evaluation of the structural integrity of the K-25 building and interpretative approaches for the site, DOE distributed a preferred mitigation plan to the consulting parties in October 2011. The DOE final mitigation plan, addressing comments submitted by consulting parties in November 2011, permitted demolition of the entire K-25 building and called for, among other mitigation measures, the designation of a commemorative area around the building's perimeter from which future surface development would largely be restricted; the retention, if possible, of the entire concrete slab or the demarcation of the building's footprint; the construction of a viewing tower and of a structure for equipment display; and the development of a history center within the ETTP Fire Station. A final MOA was signed in August 2012 finalizing the aspects set forth in the mitigation plan.

3.3.5 Clean Air Act Compliance Status

The Clean Air Act (CAA), passed in 1970 and amended in 1977 and 1990, forms the basis for the national air pollution control effort. This legislation establishes comprehensive federal and state regulations to limit air emissions and includes five major regulatory programs: the National Ambient Air Quality Standards, State Implementation Plans, New Source Performance Standards (NSPSs), Prevention of Significant Deterioration (PSD) permitting programs, and National Emission Standards for Hazardous Air Pollutants (NESHAPs). Airborne discharges from DOE Oak Ridge facilities, both radioactive and nonradioactive, are subject to regulation by EPA and the TDEC Division of Air Pollution Control.

3.3.6 Clean Water Act Compliance Status

The objective of CWA is to restore, maintain, and protect the integrity of the nation's waters. This act serves as the basis for comprehensive federal and state programs to protect the waters from pollutants (see Appendix C for water reference standards). One of the strategies developed to achieve the goals of CWA was EPA's establishment of limits on specific pollutants allowed to be discharged to US waters by municipal sewage treatment plants (STPs) and industrial facilities. EPA established the NPDES permitting program to regulate compliance with pollutant limitations. The program was designed to protect surface waters by limiting effluent discharges into streams, reservoirs, wetlands, and other surface waters. EPA has delegated authority for implementation and enforcement of the NPDES program to the State of Tennessee. ETTP discharges to the waters of the state of Tennessee under two individual NPDES permits:

- NPDES permit number TN0002950, which regulates storm water discharges, and
- NPDES permit number TN0074225, which regulates industrial discharges from the Central Neutralization Facility (CNF).

In 2012, compliance with ETTP NPDES storm water permit TN0002950 was determined by about 420 laboratory analyses, field measurements, and flow estimates. The NPDES permit compliance rate for all discharge points for 2012 was 100%.

In 2012, compliance with the ETTP NPDES permit for industrial wastewater from CNF was determined by more than 2,000 laboratory analyses and field measurements. The CNF NPDES permit compliance rate for 2012 was 100% with no noncompliances.

3.3.7 Safe Drinking Water Act Compliance Status

The ETTP water distribution system is designated as a nontransient, noncommunity water system by TDEC's Division of Water Supply. Chapter 0400-45-01 of the Tennessee regulations for public water systems (TDEC 2012) sets limits for biological contaminants and for chemical activities and chemical contaminants. TDEC requires sampling for the following constituents for compliance with state and federal regulations:

- chlorine residual levels,
- bacteriological (total coliform),
- lead and copper, and
- disinfectant by-products (trihalomethanes and haloacetic acids).

The City of Oak Ridge supplies potable water to the ETTP water distribution system. The water treatment plant, located on ORR, southwest of ETTP, is owned and operated by the City of Oak Ridge.

3.3.8 Resource Conservation and Recovery Act Compliance Status

ETTP is regulated as a large-quantity generator of hazardous waste because the facility generates more than 1,000 kg of hazardous waste per month. This amount includes hazardous waste generated under permitted activities (including repackaging or treatment residuals). At the end of 2012, ETTP had three generator accumulation areas for hazardous or mixed waste.

3.3.9 Resource Conservation and Recovery Act Underground Storage Tanks

Underground storage tanks (USTs) containing petroleum and hazardous substances are regulated under RCRA Subtitle I (40 CFR 280). EPA granted TDEC authority to regulate USTs containing petroleum under TDEC Rule 0400-18-01 *Underground Storage Tank Programs*; however, EPA still regulates hazardous-substance USTs.

3.3.10 Comprehensive Environmental Response, Compensation, and Liability Act Compliance Status

CERCLA, also known as Superfund, was passed in 1980 and was amended in 1986 by the Superfund Amendments and Reauthorization Act (SARA). Under CERCLA, a site is investigated and remediated if it poses significant risk to health or the environment. The EPA National Priorities List (NPL) is a comprehensive list of sites and facilities that have been found to pose a sufficient threat to human health and/or the environment to warrant cleanup under CERCLA.

3.3.10.1 East Tennessee Technology Park RCRA-CERCLA Coordination

The ORR FFA is intended to coordinate the corrective action processes of RCRA required under the Hazardous and Solid Waste Amendments permit with CERCLA response actions.

3.3.11 Toxic Substances Control Act Compliance Status—Polychlorinated Biphenyls

On April 3, 1990, DOE notified EPA headquarters (as required by 40 CFR 761.205) that ETTP is a generator with on-site storage, a transporter, and an approved disposer of PCB wastes.

PCB waste generation, transportation, disposal, and storage at ETTP are regulated under EPA ID number TN0890090004. In 2012, ETTP operated 10 PCB waste storage areas in ETTP generator buildings, and when longer-term storage of PCB/radioactive wastes was necessary, RCRA-permitted storage buildings were used. The continued use of authorized PCBs in electrical systems and/or equipment (e.g., transformers, capacitors, rectifiers) is regulated at ETTP. At this time, there is no PCB-contaminated electrical equipment in service at ETTP. Most Toxic Substances Control Act- (TSCA-) regulated equipment at ETTP has been disposed of. However, some ETTP facilities continue to use or store nonelectrical PCB-contaminated equipment for future reuse.

Because of the age of many ETTP facilities and the varied uses for PCBs in gaskets, grease, building materials, and equipment, DOE self-disclosed unauthorized use of PCBs to EPA in the late 1980s. As a result, the DOE Oak Ridge Office and EPA Region 4 consummated a major compliance agreement known as the *Oak Ridge Reservation Polychlorinated Biphenyl Federal Facilities Compliance Agreement* (DOE 2012b), which became effective December 16, 1996, and was last revised on May 23, 2012. The agreement specifically addresses the unauthorized use of PCBs in ventilation ducts and gaskets, lubricants, hydraulic systems, heat transfer systems, and other unauthorized uses; storage for disposal; disposal; cleanup and/or decontamination of PCBs and PCB items including PCBs mixed with radioactive materials; and ORR records and reporting requirements. A major focus of the agreement is the disposal of PCB waste. As a result of that agreement, DOE and UCOR continue to notify EPA when additional unauthorized uses of PCBs, such as PCBs in paint, adhesives, electrical wiring, or floor tile, are identified at ETTP.

ORNL 2010-G00444/chj

Fig. 3.9. Toxic Substances Control Act Incinerator.

ETTP is home to the TSCA Incinerator (Fig. 3.9). On December 2, 2009, the TSCA Incinerator ceased operations as a waste incinerator and transitioned to a facility closure and decommissioning mode. The RCRA and PCB closure certification report for the TSCA Incinerator RCRA Permitted Unit areas was submitted to EPA and TDEC on June 10, 2011. A Closure Certification Letter was issued by EPA Region

4 on June 14, 2012, and by TDEC on September 21, 2012. During 2012, the primary focus at the TSCA Incinerator was completing the decontamination of the Permit-by-Rule components of the TSCA Incinerator facility for RCRA and TSCA closure actions. The decontamination steps were completed in 2012, and the Permit-by-Rule components of the facility are no longer active.

During 2013, a postclosure TSCA Incinerator PCB Institutional Control Plan that requires monthly inspections of the facility will continue to be implemented and remain in effect as agreed upon in the closure certification while the facility is in a surveillance and maintenance mode pending demolition.

As described in detail in Section 2.4, an NOV with an associated consent agreement and civil penalty was issued to a subcontractor for a former ETTP contractor for failure to make the initial one-time notification of PCB waste activity as required by 40 CFR 761.205(b) for transporters of PCB waste. On March 6, 2013, EPA issued a consent agreement and final order to the subcontractor with an associated civil penalty of $2,840.

3.3.12 Emergency Planning and Community Right-to-Know Act Compliance Status

The Emergency Planning and Community Right-to-Know Act (EPCRA) and Title III of SARA require that facilities report inventories and releases of certain chemicals that exceed specific release thresholds. The reports are submitted to the local emergency planning committee and the state emergency response commission. ETTP complied with these requirements in 2012 through the submittal of reports under EPCRA Sections 302, 303, 311, and 312. ETTP had no releases of extremely hazardous substances, as defined by EPCRA, in 2012.

3.3.12.1 Material Safety Data Sheet/Chemical Inventory (EPCRA Section 312)

Inventories, locations, and associated hazards of hazardous and extremely hazardous chemicals were submitted in an annual report to state and local emergency responders as required by EPCRA Section 312. Of the ORR chemicals identified for 2012, 11 were located at ETTP. These chemicals were sodium hydroxide, nickel metal, lead metal (includes large lead acid batteries), sodium metal, diesel fuel, sulfuric acid (includes large lead acid batteries), Chemical Specialties Ultrapoles, creosote-treated wood, CCA Type C pressure-treated wood, unleaded gasoline, and Sakrete Type S or N mortar mix.

3.3.12.2 Toxic Chemical Release Reporting (EPCRA Section 313)

DOE submits annual toxic release inventory (TRI) reports to EPA and TDEC on or before July 1 of each year. The reports cover the previous calendar year and address releases of certain toxic chemicals to air, water, and land and waste management, recycling, and pollution prevention activities. Threshold determinations and reports for each of the ORR facilities are made separately. Operations involving TRI chemicals were compared with regulatory thresholds to determine which chemicals exceeded the reporting thresholds based on amounts manufactured, processed, or otherwise used at each facility. After threshold determinations were made, releases and off-site transfers were calculated for each chemical that exceeded one or more of the thresholds. In 2012, the only chemicals that met the reporting requirements were diisocyanates associated with foaming activity to stabilize deposits in pipes undergoing remediation actions.

3.4 Air Quality Program

The State of Tennessee has been relegated authority by EPA to convey the clean air requirements that are applicable to ETTP operations. New projects are governed by construction and operating permit regulatory requirements. The owner or operator of air pollutant emitting sources is responsible for ensuring full compliance with any issued permit or other generally applicable CAA requirement. During 2012, UCOR was responsible for ETTP DOE EM operations and regulatory compliance.

3.4.1 Construction and Operating Permits

During 2012, no UCOR ETTP operations were subject to permitting under the CAA and TDEC Air Pollution Control Rules. However, for ETTP operations that do emit low levels of air pollutants that are classified as insignificant under TDEC rules, emissions from these sources are evaluated and compared against applicable regulatory limits to document this classification. CAA, passed in 1970 and amended in 1977 and 1990, forms the basis for the national air pollution control effort. This legislation establishes comprehensive federal and state regulations to limit air emissions and includes five major regulatory programs: the National Ambient Air Quality Standards, State Implementation Plans, NSPSs, PSD permitting programs, and NESHAPs. Airborne discharges from DOE Oak Ridge facilities, both radioactive and nonradioactive, are subject to regulation by EPA and the TDEC Division of Air Pollution Control.

3.4.1.1 Generally Applicable Permit Requirements

ETTP is subject to a number of generally applicable requirements that involve management and control. Asbestos, ozone-depleting substances (ODSs), and fugitive particulate emissions are specific examples.

3.4.1.1.1 Control of Asbestos

ETTP's asbestos management program ensures all activities involving demolition and all other actions impacting asbestos-containing materials (ACMs) are fully compliant with 40 CFR 61, Subpart M. This includes using approved engineering controls and work practices, inspections, and monitoring for proper removal and waste disposal of ACMs. ETTP has numerous buildings and equipment that contain ACMs. Major demolition activities during 2012 involved the abatement of significant quantities of ACMs that were subject to the requirements of 40 CFR 61, Subpart M. Most demolition and ACM abatement activities are governed under CERCLA. Under this act, notifications of asbestos demolition or renovations as specified in 40 CFR 61.145(b) are incorporated into CERCLA document regulatory notifications. All other non-CERCLA planned demolition or renovation activities were individually reviewed for applicability of the TDEC notification requirements of the rule. During 2012, no individual non-CERCLA activity required a notification submittal. The rule also requires an annual notification for all nonscheduled minor asbestos renovations if the accumulated total amount of regulated or potentially regulated asbestos exceeds stipulated thresholds. For 2012 the total projected nonscheduled amounts were below thresholds that would require the submittal of an annual notification to TDEC. No releases of reportable quantities of ACMs occurred at ETTP during 2012.

3.4.1.1.2 Stratospheric Ozone Protection

The management of ODSs at ETTP is subject to regulations in 40 CFR Part 82, Subpart F, Recycling and Emissions Reduction; these regulations require preparation of documentation to establish that actions necessary to reduce emissions of Class I and Class II refrigerants to the lowest achievable level have been observed during maintenance activities at ETTP. The applicable actions include, but are not limited to, the service, maintenance, repair, and disposal of appliances containing Class I and Class II refrigerants, including motor vehicle air-conditioners. In addition, the regulations apply to refrigerant reclamation activities, appliance owners, manufacturers of appliances, and recycling and recovery equipment. Figure 3.10 illustrates the historical on-site ODSs inventory at ETTP.

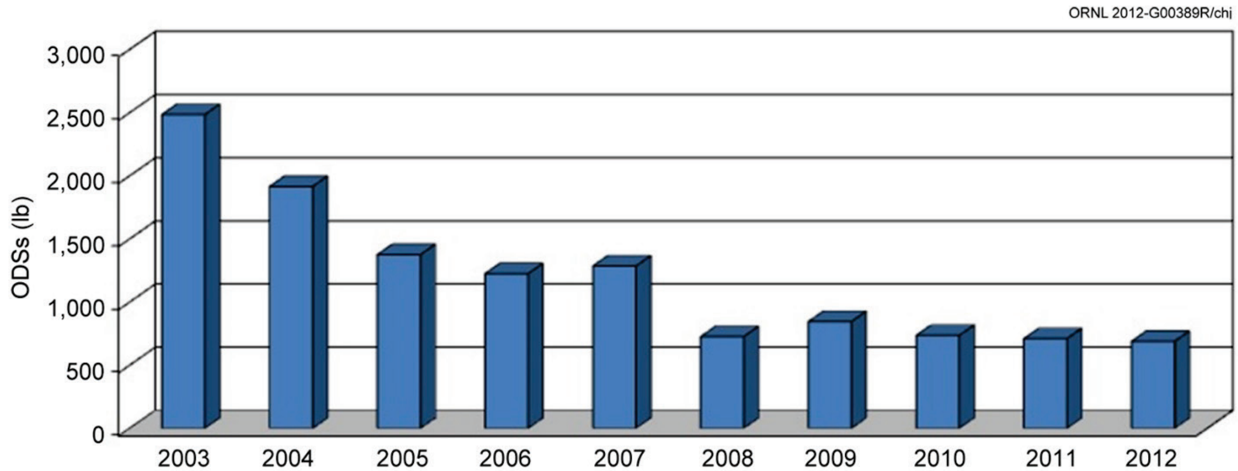


Fig. 3.10. East Tennessee Technology Park total on-site oxygen depleting substances (ODSs) inventory 10-year history.

3.4.1.1.3 Fugitive Particulate Emissions

ETTP has been the location of major building demolition and waste debris transportation activities with the potential for release of fugitive dust. All planned and ongoing activities include the use of dust control measures to minimize the release of visible fugitive dust beyond the project perimeter. This includes the use of specialized demolition equipment and water misters. Gravel roads in and around ETTP that are under DOE control are wetted as needed to minimize airborne dusts caused by vehicle traffic.

3.4.1.2 Radionuclide National Emission Standards for Hazardous Air Pollutants

Radionuclide airborne emissions from ETTP are regulated under 40 CFR 61, National Emission Standards for Hazardous Air Pollutants: Department of Energy Facilities (Rad-NESHAPs). Characterization of the impact on public health of radionuclides released to the atmosphere from ETTP operations was accomplished by conservatively estimating the dose to the maximally exposed member of the public. The estimated 2012 ETTP dose from airborne radionuclides was 0.01 mrem. The dose calculations were performed using the Clean Air Assessment Package (CAP-88) computer codes, which were developed under EPA sponsorship for use in demonstrating compliance with the 10 mrem/year effective dose (ED) Rad-NESHAPs emission standard for the entire DOE ORR. Source emissions used to calculate the dose are determined using EPA-approved methods that can range from continuous sampling systems to conservative estimations based on process and waste characteristics. Continuous sampling systems are required for radionuclide-emitting sources that have the potential dose impact of not less than 0.1 mrem per year to any member of the public. ETTP Rad-NESHAPs sources—the K-1407 CNF Volatile Organic Compound (VOC) Air Stripper; K-1407 Chromium Water Treatment System (CWTS) VOC Air Stripper; K-2527-BR Grouting Facility; and K-2500-H Segmentation Shops A, B, C, and D—are considered minor based on emissions evaluations using EPA-approved calculation methods. A minor Rad-NESHAPs source is defined as having a potential dose impact on the public not in excess of 0.1 mrem/year. Figure 3.11 provides a historical dose trend on the most impacted on-site member of the public. The results are based on actual ambient air sampling at a location conservatively representative of the on-site location.

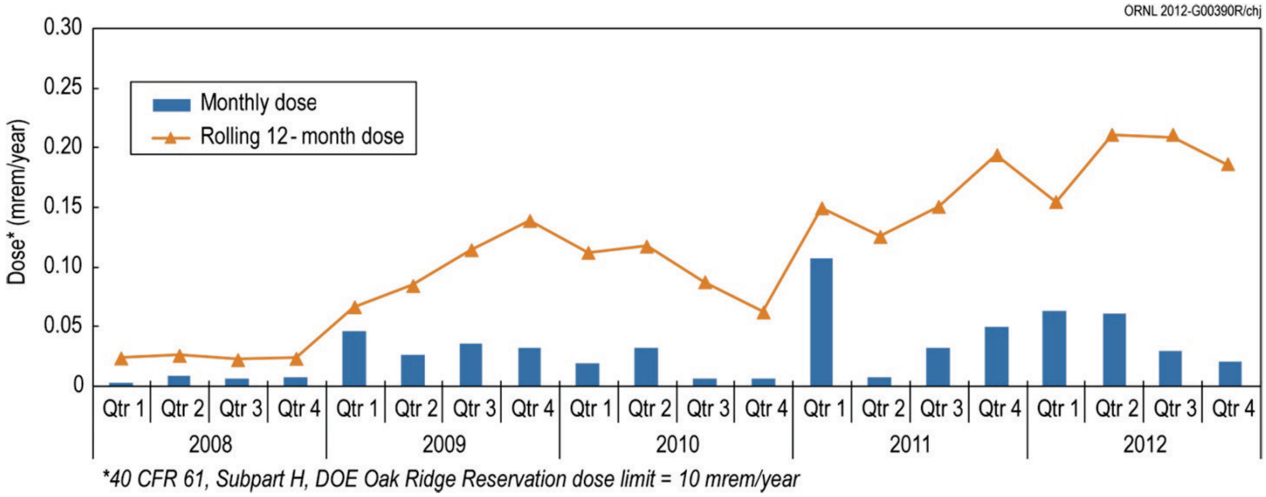


Fig. 3.11. East Tennessee Technology Park ambient air station K11 radionuclide monitoring results: 5-year rolling, 12-month dose history up through 2012.

3.4.1.3 Quality Assurance

Quality assurance (QA) activities for the Rad-NESHAPs program are documented in the *Quality Assurance Program Plan for Compliance with Radionuclide National Emission Standards for Hazardous Air Pollutants*. The plan satisfies the QA requirements in 40 CFR 61, Method 114, for ensuring that the radionuclide air emission measurements from ETTP are representative of known levels of precision and accuracy and that administrative controls are in place to ensure prompt response when emission measurements indicate an increase over normal radionuclide emissions. The requirements are also referenced in TDEC regulation 1200-3-11-08. The plan ensures the quality of ETTP radionuclide emission measurement data from continuous samplers and minor radionuclide release points. Only EPA preapproved methods are referenced through the *Rad-NESHAP Compliance Plan on the Oak Ridge Reservation* (DOE 2005).

3.4.1.4 Greenhouse Gas Emissions

The EPA Mandatory Reporting of Greenhouse Gases rule was enacted September 30, 2009, under Title 40 Code of Federal Regulations (CFR) Part 98.2. According to the rule, in general, the stationary source emissions threshold for reporting requirement is 25,000 metric tons or more of GHGs per year, reported as CO_2 equivalents (CO_2e) per year. The rule defines GHGs as

- carbon dioxide (CO_2),
- methane (CH_4),
- nitrous oxide (N_2O),
- hydrofluorocarbons,
- perfluorocarbons, and
- sulfur hexafluoride.

A 2012 review was performed of ETTP processes and equipment categorically identified under 40 CFR 98.2 whose emissions must be included as part of a facility annual GHG report starting with the calendar year 2010 reporting period. Based on total GHG emissions from all ETTP stationary sources during 2012, ETTP did not exceed the annual threshold limit and therefore was not subject to mandatory annual reporting under the GHG rule for the 2012 reporting period. The total GHG emissions for any continuous 12-month period beginning with CY 2008 have not exceeded 12,390 metric tons of GHGs. The decrease in stationary source emissions is due to the permanent cessation of waste processing at the TSCA Incinerator in 2009. The remaining sources are predominantly small comfort heating systems, hot water systems, and power generators. Figure 3.12 shows the historical trend of ETTP total GHG stationary emissions including contributions from the TSCA Incinerator. For the 2012 calendar year period, GHG emissions totaled only 230 metric tons.

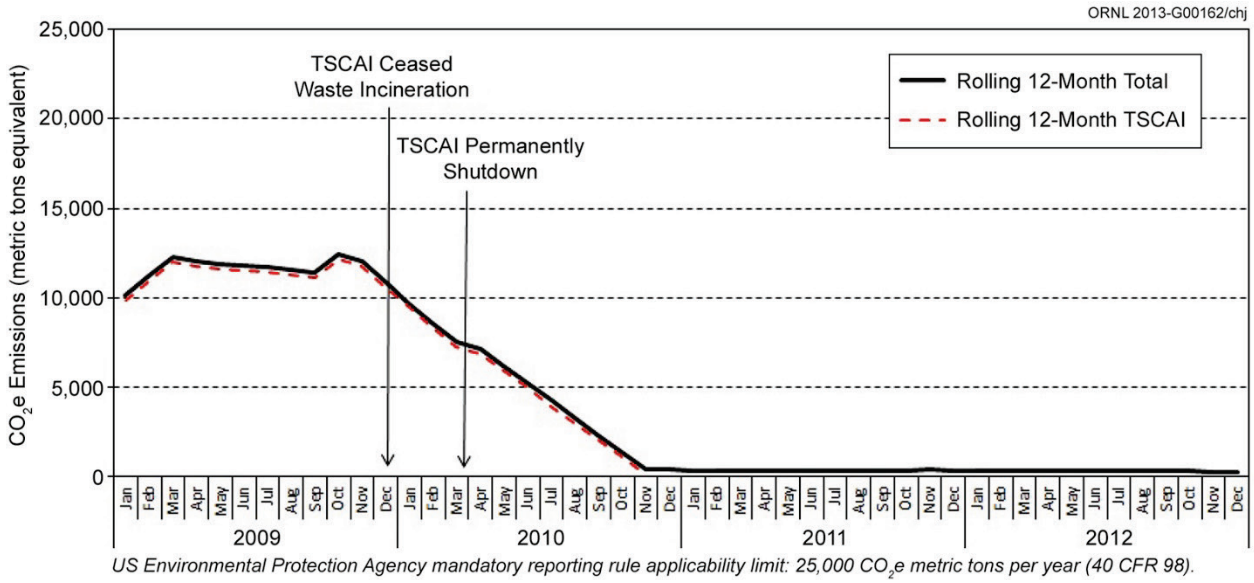


Fig. 3.12. East Tennessee Technology Park stationary source greenhouse gas emissions [in CO_2 equivalents (CO_2e)] tracking history (rolling 12-month total). (TSCAI = Toxic Substances Control Act Incinerator.)

EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, was signed by President Obama on October 5, 2009. The purpose of this order is to establish policies for federal facilities that will increase energy efficiency; measure, report, and reduce GHG emissions from direct and indirect activities; conserve and protect water resources through efficiency, reuse, and storm water management; eliminate waste; recycle; and prevent pollution at all facilities. While the order deals with a number of environmental media, only it's applicability to GHG is considered here. The EO defines three distinct scopes for purposes of reporting. Scope 1 is essentially direct GHG emissions from sources that are owned or controlled by the federal agency; Scope 2 encompasses GHG emissions resulting from the generation of electricity, heat, or steam purchased by a Federal agency; and Scope 3 involves GHG emissions from sources not owned or directly controlled by a Federal agency but related to agency activities such as vendor supply chains, delivery services, and employee business travel and commuting.

Figure 3.13 displays the trend toward meeting the 28% total Scope 1 and 2 GHG emissions reduction target by FY 2020 as stated in the DOE *Strategic Sustainability Performance Plan* (DOE 2012). For FY 2012 emissions totaled 19,593 metric tons CO_2e, which is a 56% reduction from the 2008 baseline year level of 44,232 metric tons and is roughly 39% below the target level of 31,847 metric tons CO_2e.

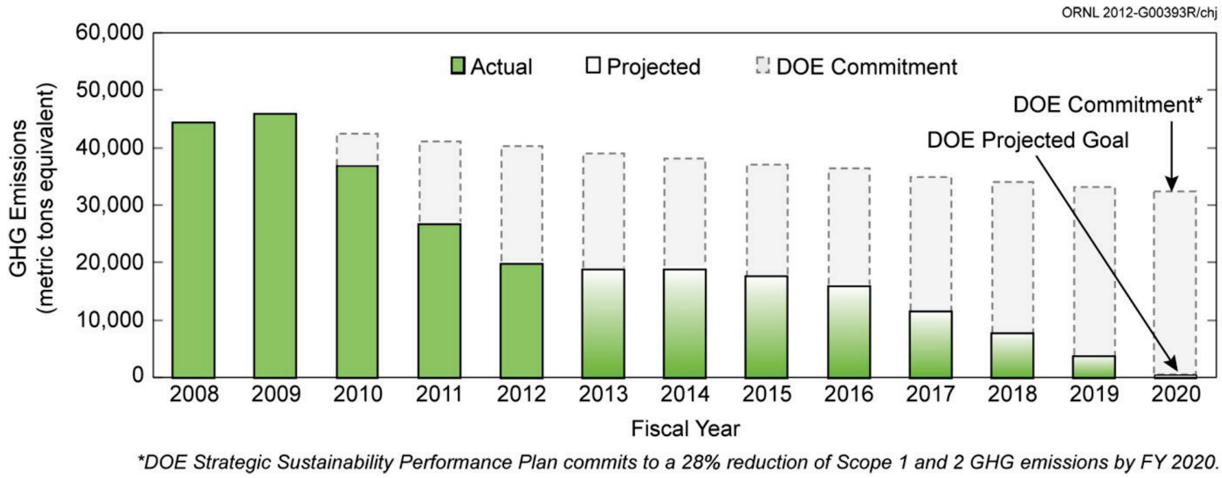


Fig. 3.13. East Tennessee Technology Park greenhouse gas (GHG) emissions trend and targeted reduction commitment.

Figure 3.14 shows the relative distribution of ETTP FY 2012 GHG emissions for Scopes 1, 2, and 3. Total GHG emissions continue to decline as demolition and remediation efforts continue at ETTP. Much of the reduction is due to lower on-site combustion of fuels (stationary and mobile sources), a drop in the consumption of electricity, and a smaller workforce.

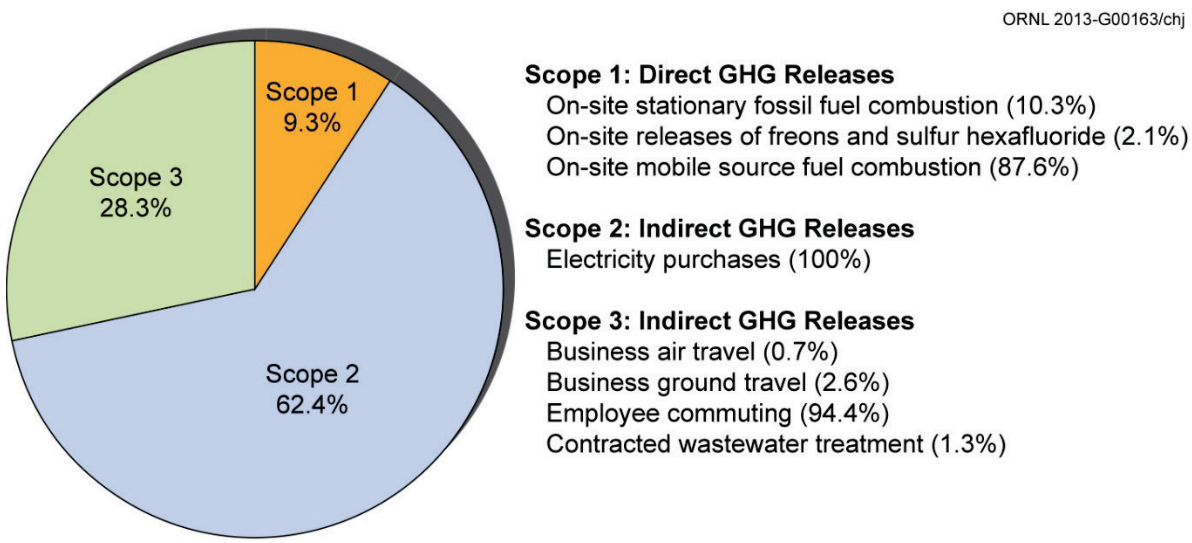


Fig. 3.14. Calendar year 2012 East Tennessee Technology Park greenhouse gas (GHG) percent contribution by scope.

3.4.1.5 Source-Specific Criteria Pollutants

ETTP operations up until July 1, 2011, included only one functioning stationary source with permit restrictions for any form of criteria air pollutant emissions: the CNF VOC air stripper. This permit was surrendered following an updated potential to emit review that identified air pollutant emissions to be below any regulatory requirement for permitting. During December 2011, the new CWTS began operations. This unit is equipped with an air stripper to remove VOCs from the effluent stream. All process data records and the calculated potential maximum VOC emission rates for the CNF and CWTS air strippers were well below levels that would require permitting. The calculated maximum VOC hourly emission rates for CNF and CWTS were only 0.16 lb/h and 0.01 lb/h, respectively, as compared to an emission limit of 1.0 lb/h. The annual potential emissions for these facilities would also be well below the 5 ton/year limit assuming both operated at the maximum hourly emission rates continuously for the entire year. All other stationary sources were evaluated and determined to have emissions levels below the levels that require permitting.

ETTP operations released airborne pollutants from a variety of minor pollutant-emitting sources such as stacks, vents, and fugitive and diffuse activities. The emissions from all stack and vent emissions are calculated following approved methods to establish their low emissions potential. This is done to document the verification of their minor source permit exempt status under all applicable state and federal regulations.

3.4.1.6 Hazardous Air Pollutants (Nonradionuclide)

Unplanned releases of hazardous air pollutants (HAPs) are regulated through risk management planning regulations. ETTP personnel have determined that there are no processes or facilities containing inventories of chemicals in quantities exceeding thresholds specified in rules pursuant to CAA, Title III, Sect. 112(r), “Prevention of Accidental Releases.” Therefore, activities at ETTP are not subject to the rule. Procedures are in place to continually review new processes, process changes, or activities with the rule thresholds.

3.4.2 Ambient Air

Compliance of fugitive and diffuse sources is demonstrated based on environmental measurements. The ETTP Ambient Air Quality Monitoring Program is designed to provide environmental measurements to accomplish the following:

- track long-term trends of airborne concentration levels of selected air contaminant species;
- measure the highest concentrations of the selected air contaminant species that occur in the vicinity of ETTP operations; and
- evaluate the impact of air contaminant emissions from ETTP operations on ambient air quality.

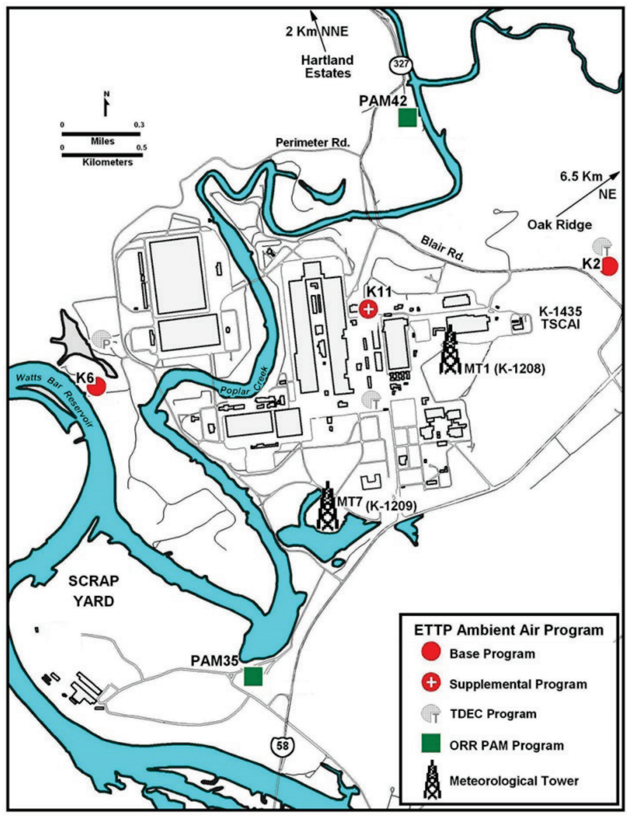


Fig. 3.15. East Tennessee Technology Park ambient air monitoring station locations.

The monitoring stations in the ETTP area are designated as base, supplemental, or ORR perimeter air monitoring (PAM) stations. Figure 3.15 shows the locations of all ambient air monitoring stations in and around ETTP that were active during the 2012 reporting period. The base program consists of two locations using high volume ambient air samplers. Supplemental locations are typically temporary, project-specific stations that use samplers specific to a type of potential emissions. Samplers typically include high volume systems, depending on the source emission evaluation of the project. All base, supplemental, and PAM samplers operate continuously with exposed filters collected weekly.

The radiological monitoring results for samples collected at the two ETTP area PAM stations were provided by UT-Battelle staff and are included in the ETTP network for comparative purposes. Figure 3.16 shows an example of a typical ETTP air monitoring station.

Fig. 3.16. East Tennessee Technology Park ambient air monitoring station.

The analytical parameters were selected with regard to existing and proposed regulations and with respect to activities at ETTP. Supplemental station K11 is located to demonstrate compliance with requirements for dose impacts to on-site members of the public from radiological emissions from demolition and remediation activities. Changes of emissions from ETTP will warrant periodic reevaluation of the parameters being sampled. Ongoing ETTP reindustrialization efforts also introduce new locations for members of the public that may require adding or relocating monitoring site locations. To ensure understanding of the potential impact on the public and to establish any required emissions monitoring and emissions controls, a survey of all on-site tenants is reviewed every 6 months.

All base and supplemental stations collect continuous samples for radiological and selected metals analyses. Inorganic analytical techniques are used to test samples for the following nonradiological pollutants and total uranium: As, Be, Cd, Cr, and Pb. Radiological analyses of samples from the ETTP stations test for the isotopes ^{237}Np, ^{238}Pu, ^{239}Pu, ^{99}Tc, ^{234}U, ^{235}U, and ^{238}U; ORR station sampling results for ^{234}U, ^{235}U, and ^{238}U, provided by UT-Battelle, are included with ETTP results.

Figures 3.17 through 3.21 illustrate the ambient air concentrations of As, Be, Cd, Cr, and Pb for the past 5 years based on quarterly composites of weekly continuous samples. All samples were analyzed by the inductively coupled plasma–mass spectrometer (ICP-MS) analytical technique. The results are compared with applicable air quality standards for each pollutant. The annualized levels of As, Be, Cd, and Pb were well below the indicated annual standards. With the exception of chromium and lead results for monitoring station K11, 2012 annual averages are all generally similar to the data trends during the last two quarters of 2011 at all monitoring stations. Station K11 is in close proximity to major demolition and remediation activities on the site. The K11 sampling results as compared to the results for all other stations showed higher ambient air concentrations. Stations K2 and K6 are representative of ambient air conditions at the ETTP boundary, with very similar measurement results. Variations of chromium data during 2012 follow historical trends that were coincidental to the demolition of large amounts of concrete, which was rubblized during demolition of ETTP structures. All chromium results are compared to the more conservative hexavalent chromium annual risk-specific dose standard. The large variation of lead concentration levels is coincidental to a large increase in diesel-powered motor vehicles and equipment used in the vicinity of station K11.

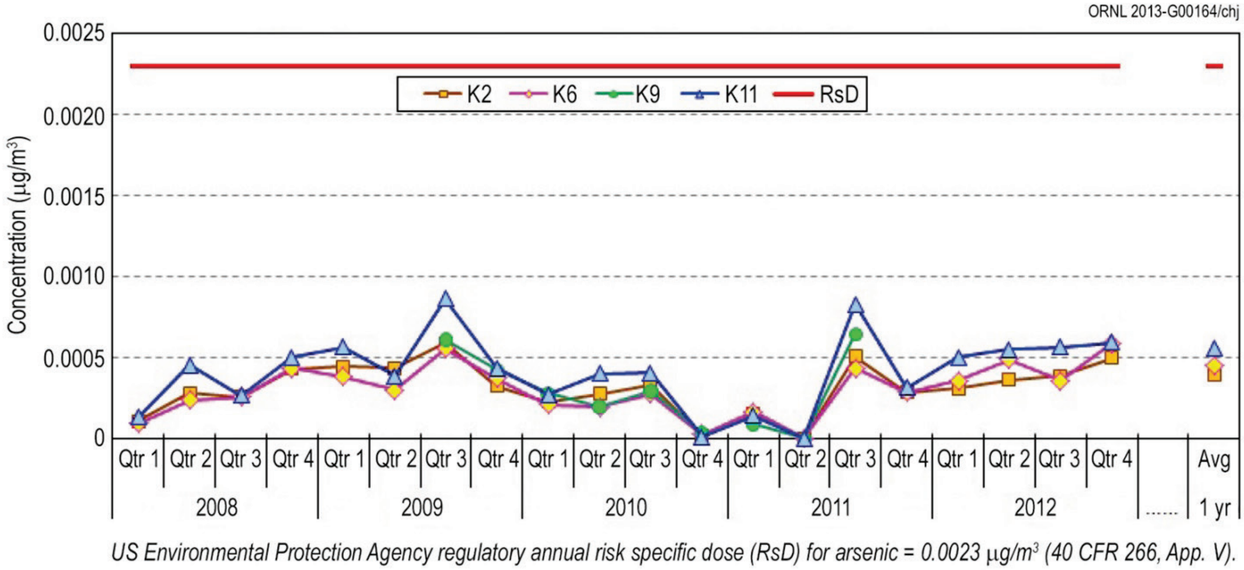


Fig. 3.17. Ambient air monitoring results for arsenic: 5-year history through December 2012.

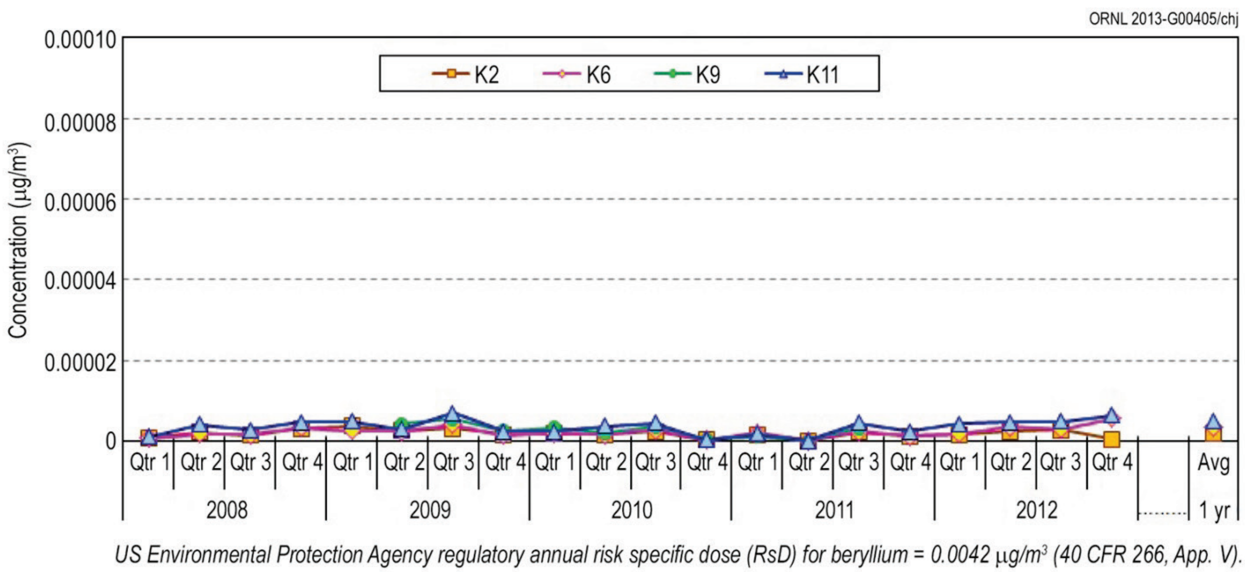


Fig. 3.18. Ambient air monitoring results for beryllium: 5-year history through December 2012.

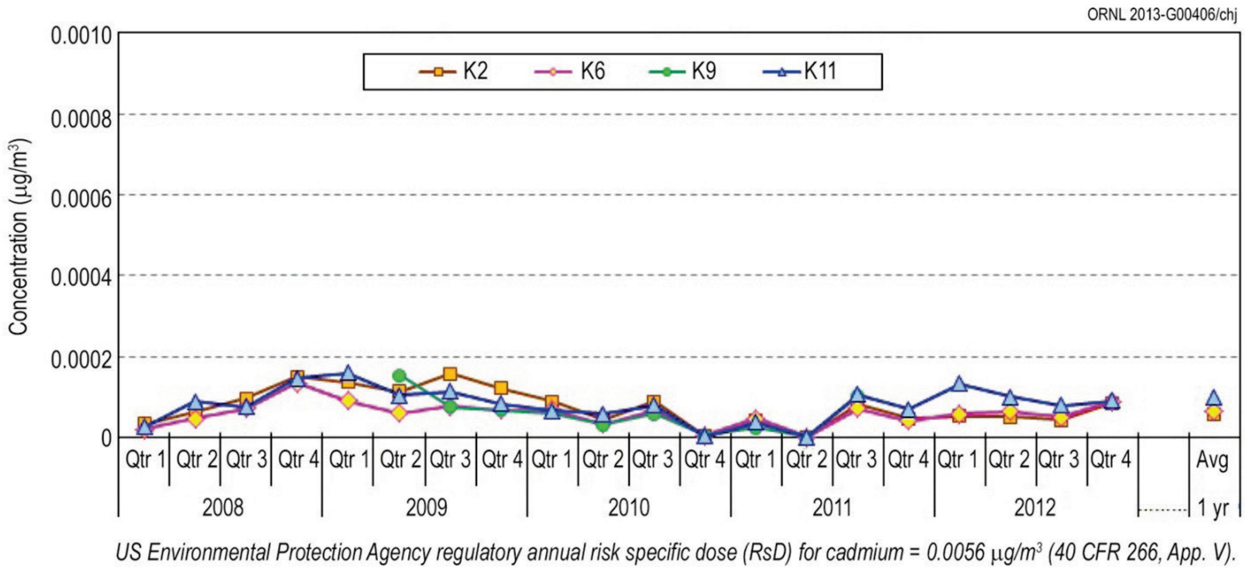


Fig. 3.19. Ambient air monitoring results for cadmium: 5-year history through December 2012.

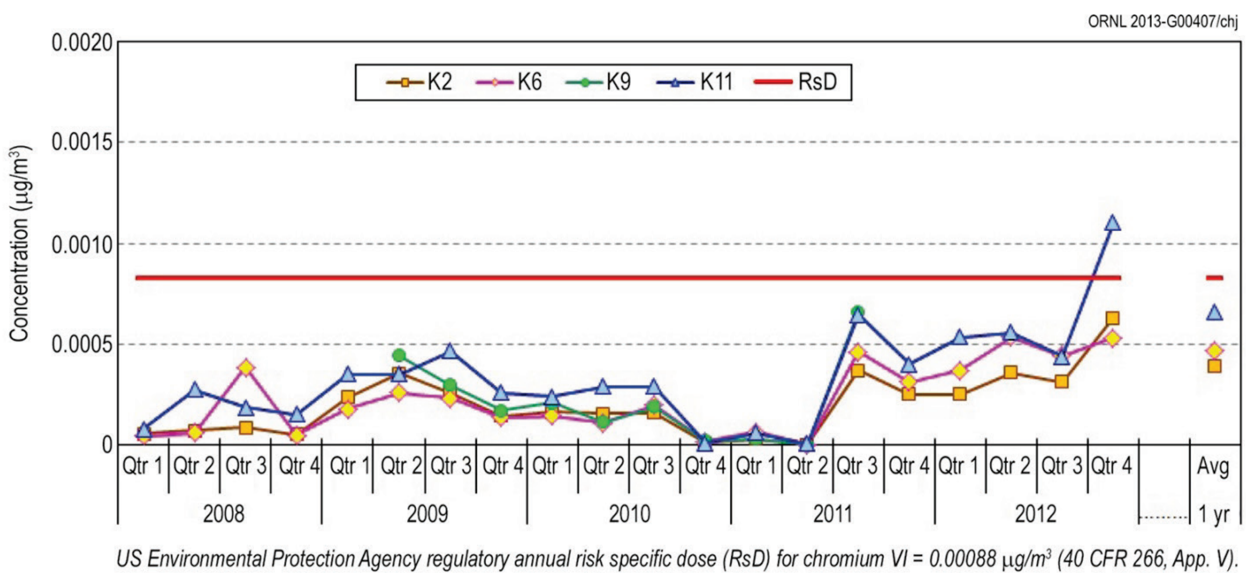
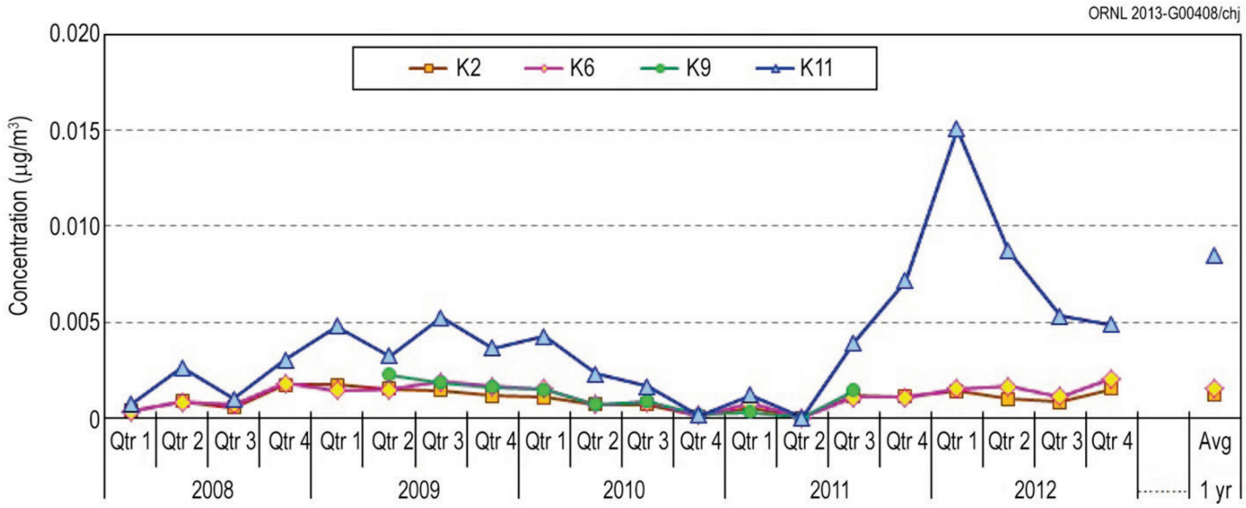


Fig. 3.20. Ambient air monitoring results for chromium: 5-year history through December 2012.



National Ambient Air Quality Standard (NAAQS) for lead = 1.5 µg/m³ per quarter through September 2008.
Beginning October 2008 NAAQS for lead = 0.15 µg/m³ per quarter.

Fig. 3.21. Ambient air monitoring results for lead: 5-year history through December 2012.

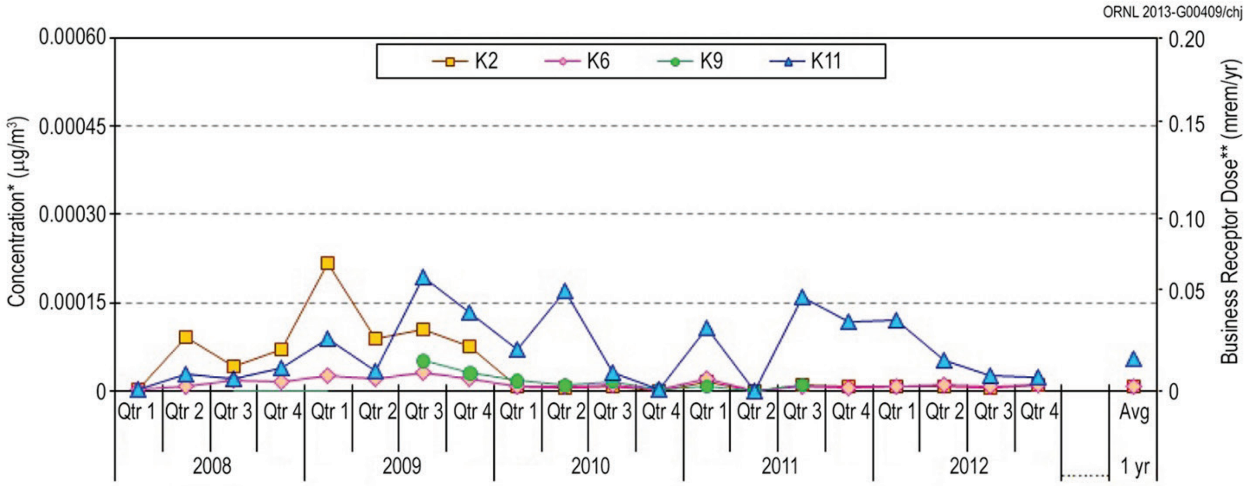
Total uranium was measured as a quarterly composite of continuous weekly samples from stations K2, K6, and K11 during 2012. The total uranium mass for each sample was determined by ICP-MS. Sampling at station K9 was discontinued during 2011, but K9 data are included in the historical trend information. The uranium concentration measurements for all sites are presented in Table 3.4. Figure 3.22 illustrates the air concentrations of uranium for the past 5 years based on quarterly composites of weekly continuous samples. The highest 12-month average result (0.000054 µg/m^3) was measured at station K11. The location of station K11 is in close proximity to the K-25 gaseous diffusion building, which is being demolished, and the K-1070-B burial ground area, which is undergoing remediation.

Table 3.4. Total uranium in ambient air by inductively coupled plasma–mass spectrometer analysis at East Tennessee Technology Park

Station	Number of samples	Concentration[a] (µg/m^3)		Concentration[a] (µCi/mL)		Percentage of DCG[b] (%)	
		Avg	Max[c]	Avg	Max	Avg	Max
K2	4	0.000007	0.000009	4.58E-18	6.05E-18	<0.01	<0.01
K6	4	0.000008	0.000010	5.61E-18	6.89E-18	<0.01	<0.01
K11	4	0.000054	0.000119	3.63E-17	7.96E-17	0.04	0.08
ETTP total	12	0.000023		1.15E-17		0.02	

[a]Mass-to-curie concentration conversions conservatively assume a natural uranium assay of 0.717% ^{235}U.
[b]DOE O 5400.5 DCG for naturally occurring uranium is an annual concentration of 1E-13 µCi/mL, which is equivalent to a 100 mrem annual dose.
[c]Maximum individual sample analysis result with dose calculations conservatively assuming the value to be an annual concentration.

Abbreviations
DCG = derived concentration guide
ETTP = East Tennessee Technology Park



40 CFR 61, Subpart H, dose limit for uranium = 10 mrem per year.
**Derived concentration guide for natural uranium resulting in 100n mrem/year dose is 1.03E-13 µCi/m³ = 0.15 µg/m³.*
***US Environmental Protection Agency approved Oak Ridge Reservation on-site business receptor dose assumed 50% annual occupancy.*

Fig. 3.22. Ambient air monitoring results for uranium: 5-year history through December 2012.

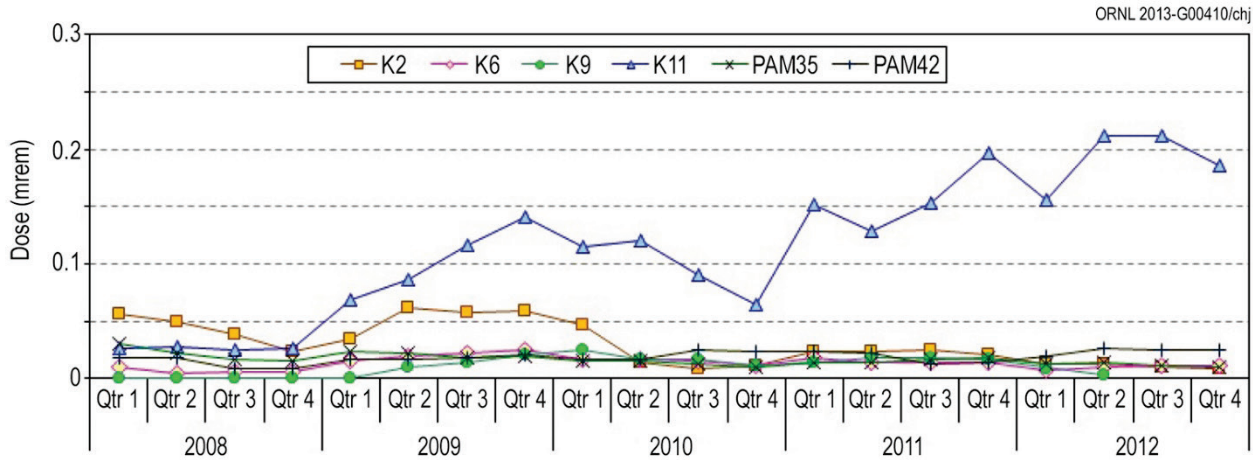
Quarterly radiochemical analyses are performed on composite samples collected at all stations. The selected isotopes of interest were ^{237}Np, ^{238,239}Pu, ^{99}Tc, and isotopic uranium (^{234,235,238}U). The concentration and dose results for each of the nuclides are presented in Table 3.5 for the 2012 reporting period.

Table 3.5. Radionuclides in ambient air at East Tennessee Technology Park, July 2011 through June 2012

Station	Concentration (µCi/mL)							
	^{237}Np	^{238}Pu	^{239}Pu	^{99}Tc	^{234}U	^{235}U	^{238}U	Total
K2	ND	ND	ND	1.30E-17	1.68E-17	ND	ND	2.98E-17
K6	ND	ND	ND	9.36E-18	2.10E-17	ND	1.65E-18	3.21E-17
K11	ND	ND	ND	8.60E-17	3.07E-16	2.68E-17	1.96E-17	4.39E-16
Station	**40 CFR 61, Effective Dose (mrem/year)**							
	^{237}Np	^{238}Pu	^{239}Pu	^{99}Tc	^{234}U	^{235}U	^{238}U	Total
K2	ND	ND	ND	<0.001	0.009	ND	ND	0.009
K6	ND	ND	ND	<0.001	0.011	ND	<0.001	0.012
K11	ND	ND	ND	0.004	0.163	0.013	0.009	0.186

Abbreviations
ND = Not Detected

Figure 3.23 is a historical summary chart of dose calculation results. Each data point represents the accumulated dose over the previous four quarterly sampling periods. The highest potential dose impact for an individual working on-site in the vicinity of station K11 would only be 0.186 mrem, and the annual limit is 10 mrem. Monitoring station K11 is in close proximity to major demolition and remediation activities that are impacting radiologically contaminated materials. All data show potential exposures are well below the 10 mrem annual dose limit.



40 CFR 61, Subpart H, dose limit for radionuclides = 10 mrem per year.

Fig. 3.23. Ambient air monitoring results: 5-year rolling, 12-month dose history through December 2012.

3.5 Water Quality Program

3.5.1 NPDES Permit Description—New NPDES Permit

Currently there are 108 NPDES-permitted storm water outfalls at ETTP. As part of the current NPDES permit, these storm water outfalls are listed in two groups based on the types of flows being discharged through the outfalls. A total of 32 storm water outfalls are sampled as being representative of these groups.

3.5.2 East Tennessee Technology Park Storm Water Pollution Prevention Program

The current ETTP NPDES permit includes a requirement to review and update, if necessary, the Storm Water Pollution Prevention Plan (SWPPP) at least annually. This requirement is met by publishing the ETTP Storm Water Pollution Prevention (SWPP) Program Annual Update Report, which includes monitoring results, site inspection summaries, and other information from the fiscal year that is ending. Additionally, the SWPP Program baseline document serves as a reference document for implementing and conducting the required elements of the ETTP SWPPP. This document will continue to be used as part of the ETTP SWPP Program specified in the current ETTP NPDES permit. The baseline document is reviewed annually and updated as necessary.

3.5.2.1 Sampling for CY 2013 NPDES Permit Renewal Application

The application for the ETTP NPDES permit renewal is required to be submitted to TDEC by July 4, 2013. The effort is ongoing to collect the analytical data required to complete the EPA 2E and 2F forms that are to be submitted as part of the NPDES permit renewal application.

The status of the NPDES permit renewal sampling effort is shown in Table 3.6. Data collected as part of the SWPP Program Sampling and Analysis Plan will be used in the completion of the EPA 2E and 2F forms. All samples that are bolded in the table were collected in CY 2012.

The sample collection method for each parameter is specified. Parameters that are designated to be collected as composite samples were collected by use of ISCO samplers or by manual grab if they could not be collected by ISCO sampler due to location, volume, or time constraints. Parameters designated to be collected by manual grab only were not collected by ISCO compositor under any circumstances; however, other parameters that are designated as grab samples may have been collected either manually or with ISCO samplers.

Table 3.6. Status of National Pollutant Discharge Elimination System permit renewal sampling

	Manual grab only (VOCs, SVOCs, TOC, O&G, acetone, acetonitrile, MEK)	Manual grab or grab-by-compositor (KJL, phenol, total phosphorus, nitrate/nitrite, cyanide)	Composite-by-compositor (Hg, PCBs, TSS, pest/herb, anions, BOD, COD, metals, gross alpha/beta, isotopic U, total U, ^{99}Tc, sulfide	Field readings (pH, temperature, TRC)
Outfall	Date Sampled[a]	Date Sampled[a]	Date Sampled[a]	Date Sampled[a]
05A	4/20/2010	4/20/2010	6/10/2010	**2/22/2012**
100	11/23/2010	**4/17/2012**	**2/29/2012**	11/23/2010
142	5/3/2011	9/26/2011	9/20/2010	9/26/2011
150	4/27/2011	4/27/2011	4/20/2011	4/27/2011
170	11/15/2010	11/16/2010	11/4/2010	11/15/2010
180	4/20/2010	6/29/2010	6/10/2010	11/21/2011
190	9/22/2010	11/4/2010	9/22/2010	9/22/2010
195	11/23/2010	10/19/2011	10/30/2011	11/23/2010
198	9/26/2011	10/11/2011	9/26/2011	9/26/2011
230	9/22/2010	9/22/2010	8/12/2010	9/22/2010
250	4/27/2011	2/24/2011 and 4/5/2011	2/2/2011	4/27/2011
280	4/27/2011	4/5/2011	2/24/2011	4/27/2011
294	9/26/2011	2/24/2011	2/2/2011	9/26/2011
334	**11/12/12**	**11/12/12**	**4/26/2012**	**11/12/12**
340	does not flow	does not flow	does not flow	does not flow
350	**11/12/12**	11/4/2010	10/25/2010	**11/12/12**
380	1/18/2011	3/12/2010	2/10/2010	1/18/2011
382	3/25/2010	3/25/2010	3/12/2010	
410	3/11/2010	3/12/2010	2/22/2010	11/3/2011
430	2/9/2010	3/12/2010	3/3/2010	10/11/2011
490	10/11/2011	**8/14/2012**	**6/5/2012**	10/11/2011
510	11/3/2011	11/28/2011	11/15/2011 and 11/21/11	11/3/2011
560	**9/17/2012**	**9/17/2012**	**9/17/2012**	**9/17/2012**
660		4/28/2011	4/12/2011	
690	1/18/2011	2/2/2011	1/19/2011	1/18/2011
694	5/3/2011	2/24/2011	11/30/2010	1/18/2011
700	4/27/2011	8/12/2010	8/5/2010	4/27/2011
710	2/9/2010	12/13/2009	12/18/2009	11/3/2011
724	3/25/2010	3/25/2010	3/12/2010	**2/16/2012**
890[b]	**2/16/2012**	**2/16/2012**	**2/16/2012**	**2/16/2012**
930	11/21/2011	11/21/2011	11/15/2011	11/21/2011
992	3/11/2010	3/25/2010	3/12/2010	**4/16/2012**

[a]Bolding indicates samples collected in CY 2012.
[b]All samples to be collected by manual grab.

Abbreviations

BOD = biological oxygen demand
COD = chemical oxygen demand
KJL = author pls. define this acronym
MEK = methyl ethyl ketone
O&G = oil and gas
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound
TOC = total organic carbon
TRC = total residual chlorine
TSS = total suspended solids
VOC = volatile organic compound

All storm water samples were collected from discharges resulting from a storm event greater than 0.1 in. in 24 h or less and which occurred at least 72 h after a discharge from any previous rainfall greater than 0.1 in. in 24 h.

Table 3.7 contains nonradiological results from the FY 2012 SWPP Program sampling effort that exceeded screening levels. Outfalls with results that exceeded screening criteria are incorporated into the SWPP Program for future investigations and follow-up sampling as warranted in future evaluations

Table 3.7. 2012 NPDES permit renewal sampling exceedances from representative outfalls

Sampling location	Copper (µg/L)	Lead (µg/L)	Mercury (µg/L)	Zinc (µg/L)	PCB-1254 (µg/L)	PCB-1260 (µg/L)
SCREENING LEVEL	**7**	**2.5**	**detectable**	**75**	**detectable**	**detectable**
Storm water outfall 100			0.0516	80.3		
Storm water outfall 195			0.102			
Storm water outfall 334		12.4	0.0107			
Storm water outfall 490	11.5	26.1	0.0207	108	0.124	0.11
Storm water outfall 510			0.00704			
Storm water outfall 890			0.0127		0.0948	0.0971
Storm water outfall 930			0.00525			

3.5.2.2 Monitoring Storm Water Runoff from K-25 D&D Activities

D&D of the K-25 building is ongoing and is expected to continue through FY 2013. The demolition of the west wing of the building was completed in FY 2010. Initial demolition activities for the east wing of the K-25 building began in July 2011. To closely monitor the storm water runoff from the building demolition activities on the east side of the K-25 building, sampling was performed at regular intervals during the demolition process. Initial sampling was performed to provide baseline data for conditions present before demolition began. Additional monitoring was performed at about 3 months and 6 months after demolition began. When required, modifications to storm water controls were made based on the results of this sampling effort.

In December 2011, sampling was performed at storm water outfall 210 to provide information on the conditions present at the northern portion of the east wing of Building K-25 before the building was demolished. In addition, sampling was performed at outfall 490, which receives storm water runoff from the southern portion of the east wing of Building K-25. Sampling was performed at these two outfalls again in May 2012, about 6 months after demolition of the east wing of the building had been initiated, to determine the effect of the demolition on the quality of the storm water runoff.

All samples collected as part of this sampling effort were manual grab samples. Manual grab samples were collected according to the guidelines specified in Sections 3.1.2 and 3.3.1 of the *NPDES Storm Water Sampling Guidance Document* (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor.

Table 3.8 contains information on the locations and parameters that were sampled as part of this effort. Table 3.9 contains information on parameters that exceeded screening levels. As shown in Table 3.9, although screening level exceedances existed in the data collected as part of the May 2012 sampling event, overall levels of many of the contaminants of concern (COCs) had dropped considerably since the initial sampling was performed in December 2011, which was before D&D of Building K-25 was initiated.

Table 3.8. Monitoring performed as part of D&D of the east wing of Building K-25

RA or D&D activity	Sampling location	Sampling frequency	Gross alpha/beta	Isotopic U, ^{99}Tc	PCBs	VOCs	Metals/ Mercury
East Wing of Building K-25	Outfall 210	Before demolition of the east wing and 6 months after initiation of demolition	X	X	X		X
	Outfall 490	Before demolition of the east wing and 6 months after initiation of demolition	X	X	X	X	X

Abbreviations
D&D = decontamination and decommissioning
RA = remedial action
PCB = polychlorinated biphenyl
VOC = volatile organic compound

Table 3.9. Analytical results over screening levels for D&D monitoring at the east wing of Building K-25

Sampling location	Copper (µg/L)	Lead (µg/L)	Mercury (µg/L)	PCB-1254 (µg/L)	PCB-1260 (µg/L)	Zinc (µg/L)
SCREENING LEVEL	**7**	**2.5**	**Detectable**	**Detectable**	**Detectable**	**75**
Storm water outfall 210 12/6/11	13.3	171	0.0609	0.37	0.36	105
Storm water outfall 490 12/6/11	—	3.43	0.00809	—	—	—
Storm water outfall 210 5/14/12	16.6	9.16	0.0222	—	—	—
Storm water outfall 490 5/14/12	—	—	0.00645	—	—	—

Abbreviations
D&D = decontamination and decommissioning
PCB = polychlorinated biphenyl

In addition, sampling was performed at outfalls 230 and 240 in November–December 2012 as the north tower portion of Building K-25 was being demolished. Table 3.10 contains information on the locations and parameters that were sampled as part of this effort. Table 3.11 contains information on parameters that exceeded screening levels.

Table 3.10. Monitoring performed as part of D&D of the north tower of Building K-25

RA or D&D activity	Sampling location	Sampling frequency	Gross alpha/beta	Isotopic U, ^{99}Tc	PCBs	VOCs	Metals/ Mercury
North Tower of Building K-25	Outfall 230	During demolition of the north tower	X	X	X	X	X
	Outfall 240	During demolition of the north tower	X	X	X	X	X

Abbreviations
D&D = decontamination and decommissioning
RA = remedial action
PCB = polychlorinated biphenyl
VOC = volatile organic compound

Table 3.11. Analytical results over screening levels for D&D monitoring of the north tower of Building K-25

Sampling location	$^{233,234}U$ (pCi/L)	$^{235,236}U$ (pCi/L)	Lead (µg/L)	Mercury (µg/L)	PCB-1254 (µg/L)	PCB-1260 (µg/L)
SCREENING LEVEL	**20**	**20**	**2.5**	**Detectable**	**Detectable**	**Detectable**
Storm water outfall 230 11/27/12	361	21.8		0.0105		
Storm water outfall 240 12/10/12			8.52	0.0816	0.0754	0.0541

Abbreviations
D&D = decontamination and decommissioning
PCB = polychlorinated biphenyl

At outfall 230, water from the north tower in the K-25 area travels through a small concrete settling basin/oil-water separator before it discharges from outfall 230. While looking for possible sources for the elevated rad results observed at outfall 230, a white substance was observed on the bottom surface of this concrete structure. In tracing the piping system upstream from the concrete basin, a previously unidentified 12 in. diameter pipe was discovered. The pipe did not appear on any of the site drawings or other information available to the project team. All sources of discharge from the north tower of Building K-25 were thought to have been plugged before demolition began. The white substance, which was described as looking somewhat like finely crushed gypsum, appeared to be coming from this pipe. This pipe was plugged with an expandable plug upon discovery. Samples of water and sediment were collected from the concrete basin to determine whether the white powder was the source of the elevated rad results recently obtained. Results from this sampling effort indicated that the powder was, in all likelihood, the source of the contamination noted at outfall 230. The concrete basin was pumped out and the sediment and white powder were removed and disposed. Analytical results from subsequent sampling of the water in the basin showed that there were no parameters that exceeded screening levels in the basin after the white powder was removed.

Discharges from outfall 240 originate from inside the K-25 building area, including portions of the former west wing of Building K-25, the Building K-1030 area, and the Building K-1024 area. The storm water inlets for the entire outfall 240 drainage area were inspected after the screening level exceedances were identified. Demolition debris, including clay, brick, wood and metal, was located in proximity to some of the catch basins. However, no obvious potential sources of mercury such as light bulbs, instrumentation, etc. were observed near the catch basins. Therefore, demolition activities for the facilities in the outfall 240 drainage area were not thought to be the source of the mercury at the outfall. The most likely source of the mercury in the outfall 240 piping system is believed to be operations that were once conducted at the facilities that have been demolished in this drainage area. Building K-1024 was once the site of the instrument maintenance shop before it was moved to K-1035. In addition, a dilution pit for the instrument maintenance shop was also once located in the K-1024 area. It is likely that mercury was used in this instrument shop. Also, mercury may have been used in operations conducted in the west wing of Building K-25. Additional investigation will be required to identify the sources of mercury at outfall 240.

3.5.2.3 Storm Water Outfall 992 Investigation

A total of 5.97 million tons of coal were burned at the K-701 powerhouse during its operation from 1944 to 1962. Bottom ash, coal fines, slag, and other by-products of coal combustion were buried at the K-720 coal ash pile. The K-720 coal ash pile is about 3.65 ha (9 acres) in size. In the mid-1990s, the coal ash pile was spread out, covered with soil, limed, and seeded.

Runoff and leachate from the K-720 coal ash pile have resulted in occasional low pH readings at storm water outfall 992 for several years. A number of violations of the ETTP NPDES permit have occurred as a result of the low pH of the discharge from storm water outfall 992. In addition, elevated levels of metals that are often found in coal, including arsenic and selenium, have been detected in storm water samples from the area.

The pH readings collected at numerous locations in the storm water outfall 992 watershed in April 2011 and September 2011 indicated that the primary concern with pH at storm water outfall 992 was the channel that receives drainage from the coal ash sluice pond. (Monitoring locations are indicated in Figure 3.24.) This channel also receives drainage from a portion of the coal ash pond that was not completely covered with soil during the remedial actions that were conducted in the mid-1990s.

Several areas were identified where remedial actions were needed. There were several areas along the coal ash sluice channel where the ash had not been adequately covered with soil when the original remediation of the area was performed. Ash had also been pushed into the coal ash sluice channel and was in direct contact with the runoff flowing through the channel.

The following corrective actions were implemented to address these concerns:

- exposed ash was pulled back from the edge of the drainage channel with a backhoe and was spread onto the flat area immediately adjacent to the sluice channel;
- rip-rap was placed along the bank of the coal ash sluice channel to cover the area where the ash was exposed;
- the flat area of the coal ash pile located adjacent to the coal ash sluice channel was covered with clay to limit storm water infiltration into the ash;
- topsoil was placed over the area that was covered with clay; and
- the area adjacent to the coal ash sluice channel was treated with agricultural lime, seeded, and strawed.

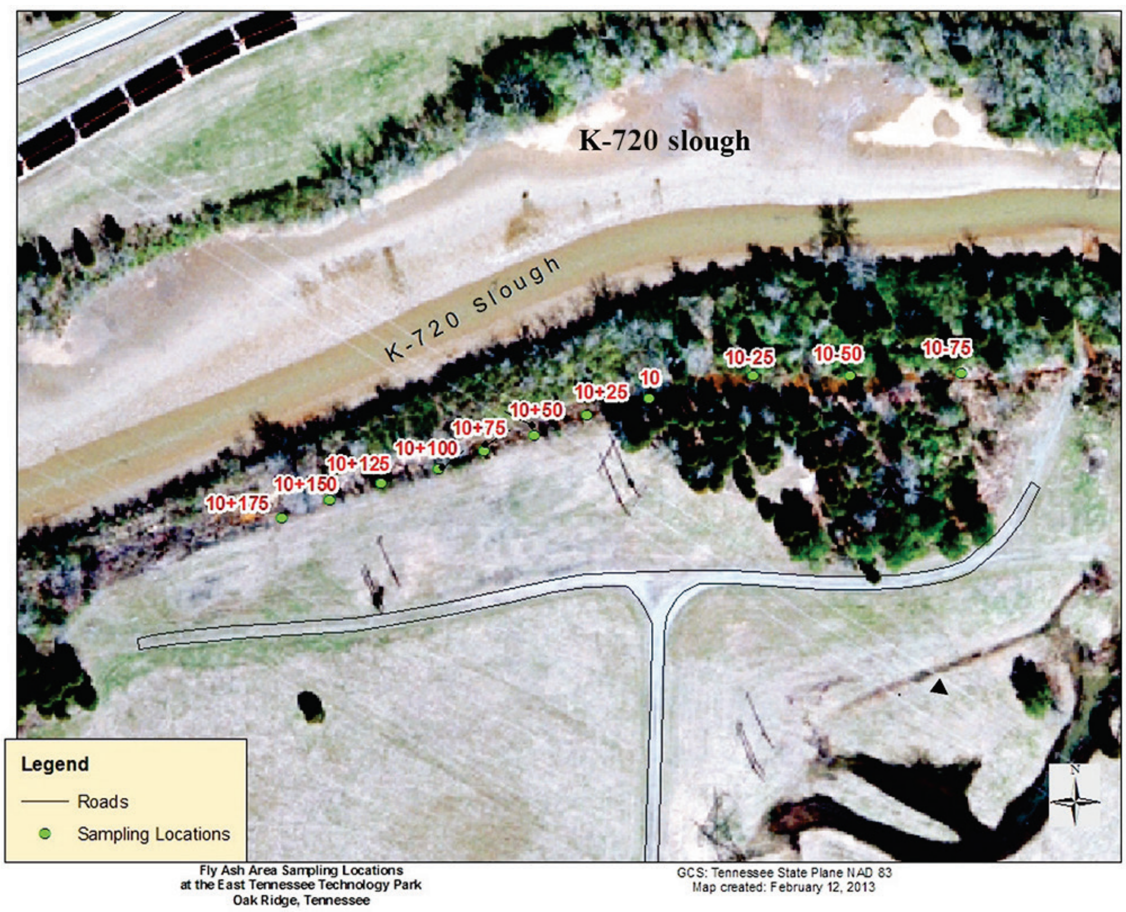


Fig. 3.24. K-720 monitoring locations.

A pH profile was conducted in January 2012 in an effort to determine what effect the remedial work at the coal ash area and the ash sluice channel may have had on the pH of the flow in the ash sluice channel. Once again, field readings for pH were collected using the same method that was used in the profile performed in April 2011 and September 2011. The results of the pH profiles conducted in April 2011, September 2011, and January 2012 are shown in Table 3.12.

Table 3.12. Comparison of April 2011, September 2011, and January 2012 pH data from ash sluice channel

Monitoring location	pH— April 2011	pH— September 2011	pH— January 2012
992-4	5.5	—	7.0
10-75	—	—	6.5
10-50	—	—	6.4
10-25	—	—	6.3
992-10	5.7	6.2	6.8
10+25	5.9	6.2	6.8
10+50	6.0	4.6	6.7
10+75	5.7	6.4	6.9
10+100	6.1	6.4	7.3
10+125	6.2	6.5	7.1
10+150	6.1	6.5	7.1
10+175	6.0	6.6	7.1
10+200	5.6	6.5	—
10+225	6.2	6.6	—
992-8	6.4	—	7.1

As indicated in Table 3.12, the remedial actions may have been successful in raising the pH of the flow in the ash sluice channel. All pH measurements in January 2012 were between 6.3 and 7.1 standard units. In September 2011, all of the pH readings except for one were between 6.2 and 6.6 standard units. The pH readings collected in April 2011 ranged from 5.5 to 6.4 standard units. The water in the ash sluice channel appeared to be clearer and contain less discoloration during the September 2011 and January 2012 profiles than had been observed before the corrective actions were undertaken.

The corrective actions that were performed at the coal ash pile and the ash sluice channel ended immediately upstream of sampling location 992-10. As part of the January 2012 profile, pH readings downstream of 992-10 were between 6.3 and 6.5 standard units. While these measurements are not problematic by themselves, they contrast fairly dramatically with the higher pH readings taken upstream of 992-10. It is possible that a seep with a low pH may have been redirected toward this location by the remedial actions conducted at the ash pile area and the ash sluice channel. Additional monitoring of the ash sluice channel will be conducted in the future to determine the additional impacts of the corrective actions and to determine whether additional corrective actions may be required.

3.5.2.4 pH and Chromium Issues at the K-33 Demolition Area

Building K-33 was more than 1.4 million ft^2 of concrete and steel. The facility was constructed in 1954 as a uranium enrichment facility and operated from 1954 to 1985. A majority of the D&D was performed as part of a reindustrialization effort that began in 1997. Afterward, however, the remaining facility still contained radiological, chemical, hazardous waste, asbestos, and PCB contamination. In April

2010, DOE awarded the contract for the demolition and disposition of Building K-33 to LATA-Sharp Remediation Services. Demolition of the building and disposition of the waste materials generated during the demolition activities were completed by March 1, 2012.

Demolition and disposition activities at Building K-33 included

- siding removal,
- building demolition to the slab, and
- packaging and transportation of all associated wastes to on-site waste disposal facilities operated by DOE.

Periodic sampling was initiated in the fall of 2010 and continued into the winter of 2011 to measure discharges from storm water outfalls potentially impacted by the K-33 demolition project activities. The results of this sampling indicated the presence of elevated levels of chromium.

As part of an agreement between DOE and TDEC, hexavalent chromium and total chromium samples were collected twice per month from storm water outfalls 690, 700, and 710, an instream location downstream of outfall 690, the K-901-A pond weir, and the K-1250-4 bridge (see Figure 3.25). This monitoring provided information on the levels of hexavalent and total chromium in discharges from the K-33 pad and how these discharges may be affecting the levels of hexavalent and total chromium in the receiving waters. In September 2011, TDEC granted permission to discontinue sampling at the instream location downstream of outfall 690 because all analytical results for total chromium and hexavalent chromium were below detection levels. In addition, TDEC granted permission to reduce the sampling frequency for these locations from twice per month to once per month. This sampling effort was initiated in April 2011 and was discontinued in April 2012. Total and hexavalent chromium monitoring data for CY 2012 are presented in Table 3.13.

Table 3.13. Hexavalent and total chromium results from K-33 storm water outfalls and receiving waters, CY 2012

	01-09-12	01-09-12	02-02-12	02-02-12	03-25-12	03-25-12	04-26-12	04-26-12
Poplar Creek locations	**Cr(VI) (µg/L)**	**Total Cr (µg/L)**	**Cr(VI) (µg/L)**	**Total Cr (µg/L)**	**Cr(VI) (µg/L)**	**Total Cr (µg/L)**	**Cr(VI) (µg/L)**	**Total Cr (µg/L)**
SD 690	11	18.2	7	11.8	—	—	<6	6.15
Downstream from all storm water outfalls Poplar Creek (bridge K-1250-4)	<6	<2	<6	<2	<6	<2	<6	<2
SD 700	8	12.5	<6	5.96	<6	11.5	<6	12.3
SD 710	10	13.3	6	9.84	<6	4.7	<6	2.27
K-901-A pond	<6	2.64	<6	9.12	<6	5.39	<6	4.91
Rainfall events (inches)	0.34	0.34	0.64	0.64	0.62	0.62	0.53	0.53

Abbreviations
Cr(VI) = hexavalent chromium
SD = storm water outfall

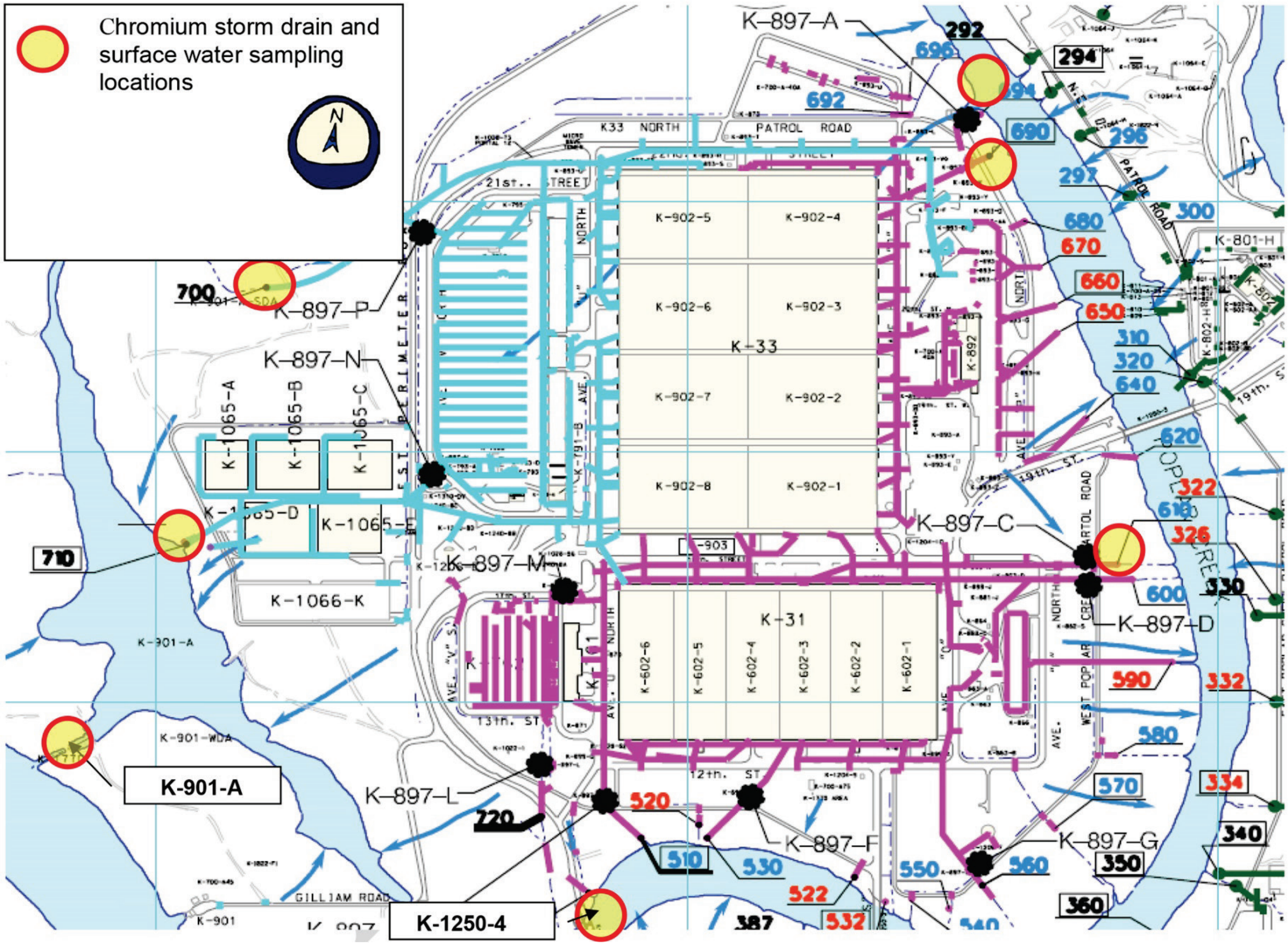


Fig. 3.25. Total and hexavalent chromium sampling locations near Building K-33.

To provide some information on the effects of the remedial action work at K-33 on the storm water runoff from the area, a final set of samples was collected at the K-33 area storm water outfalls in May 2012. All samples collected as part of this SWPP Program sampling effort were manual grab samples. Manual grab samples were collected according to the guidelines specified in Sections 3.1.2 and 3.3.1 of the *NPDES Storm Water Sampling Guidance Document* (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor. These samples were collected during a storm event, but they were not first-flush samples. The parameters and locations that were sampled are indicated in Table 3.14.

Table 3.14. Sampling K-33 area storm water outfalls after remedial actions were completed

Storm water outfall	Gross alpha/ gross beta	Metals	PCBs	Mercury
690	X	X	X	
700	X	X	X	
710	X	X	X	
694				X

Abbreviations
PCB = polychlorinated biphenyl

PCBs were identified at detectable levels at each of the three outfalls sampled for PCBs as part of this sampling effort. Table 3.15 shows these analytical results. Storm water passes through oil-water separators at each of these three outfalls before it discharges to the receiving waters. It is possible that storm water flow may have transported PCB contamination from the oil-water separators. Additional monitoring for PCBs will be conducted at these outfalls. No other analytes were detected above screening levels at these outfalls.

Table 3.15. Results exceeding screening levels at K-33 area storm water outfalls

Sampling location	PCB-1242 (µg/L)	PCB-1254 (µg/L)	PCB-1260 (µg/L)
SCREENING LEVEL	**Detectable**	**Detectable**	**Detectable**
690	0.19	0.197	
700		0.194	0.19
710			0.198

Abbreviations
PCB = polychlorinated biphenyl

3.5.2.5 Sampling of Legacy Chromium Groundwater Plume Discharge

The release of hexavalent chromium into Mitchell Branch from the storm drain 170 outfall and from seeps at the headwall of the storm drain 170 discharge point resulted in levels of hexavalent chromium that exceeded State of Tennessee ambient water quality criteria (AWQC). Immediately below storm drain 170, hexavalent chromium levels were measured at levels as high as 0.78 mg/L, which exceeded the State of Tennessee hexavalent chromium water quality chronic criterion of 0.011 mg/L for the protection of fish and aquatic life. The levels of total chromium were at about the same value, indicating that the chromium was almost completely hexavalent chromium at the release point. The fact that the chromium was still in a hexavalent state is surprising because hexavalent chromium has not been used in ETTP operations in more than 30 years. On July 20, 2007, TDEC sent an NOV to DOE for the hexavalent chromium release, and DOE responded on August 3, 2007.

Because chromium has not been used at ETTP for more than 30 years, the release of hexavalent chromium into Mitchell Branch was a legacy problem and not an ongoing operations problem. Therefore, DOE determined that the appropriate response to this release was a CERCLA time-critical removal action. On November 5, 2007, DOE notified EPA and TDEC of its intent to conduct a CERCLA time-critical removal action to install a grout barrier wall and groundwater collection system to intercept the chromium-contaminated water discharging from the storm drain 170 outfall and headwall seeps into Mitchell Branch.

The purpose of the *Action Memorandum for Reduction of Hexavalent Chromium Releases into Mitchell Branch at the East Tennessee Technology Park, Oak Ridge, Tennessee*, was to abate an immediate potential threat to public health and the environment from hexavalent chromium releases into Mitchell Branch. The potential for a chronic impact on the fish and aquatic life in Mitchell Branch may have increased in the future if the hexavalent chromium release had been allowed to continue.

The biological monitoring results did not indicate that the chromium had had a significant, acute impact on fish or aquatic life in Mitchell Branch in the time since the elevated levels of chromium had been identified. However, there was a concern that the elevated levels could have had a chronic impact on the fish and aquatic life in Mitchell Branch if the hexavalent chromium releases had not been addressed in a timely manner.

The time-critical removal action was undertaken by DOE, as lead agency, pursuant to CERCLA Section 1049 (a) and the *Federal Facility Agreement for the Oak Ridge Reservation*, Section XIII (DOE 1994). In accordance with 40 *CFR* 300.415(j) and DOE guidance, on-site removal actions conducted under CERCLA are required to meet applicable or relevant and appropriate requirements (ARARs) to the extent practicable considering the exigencies of the situation. The AWQC for hexavalent chromium for the designated uses for Mitchell Branch are ARARs for the limited scope of this action and were included in the action memorandum.

DOE complied with the ARARs and "to-be-considered" guidance, as set forth in the action memorandum, to the extent practicable. The ambient water quality chronic criteria for hexavalent chromium during dry weather base flow periods were not met with the initial action. The action reduced the level of hexavalent chromium in Mitchell Branch by about 98% from 0.78 mg/L to levels as low as 0.014 mg/L during worst-case dry weather base flow periods. During wet weather periods, the level of hexavalent chromium in Mitchell Branch was reduced from 0.025 mg/L to levels that are below method detection thresholds of 0.012 mg/L. The time-critical removal action is documented in the *Removal Action Report for the Long-Term Reduction of Hexavalent Chromium Releases into Mitchell Branch at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2012c).

Traditionally the water from the chromium collection system has been treated at CNF, which has provided adequate treatment to reduce levels of hexavalent chromium in Mitchell Branch to the extent mentioned previously. During 2012 treatment of the chromium collection system water was transitioned to a smaller system, CWTS, that replaced CNF. CWTS was declared operational in August 2012 and consists of bag filters, steel wool for the reduction of hexavalent chromium to trivalent chromium, and an air stripper for the treatment of VOCs. Figure 3.26 is a process flow diagram for CWTS.

Periodic monitoring was performed in CY 2012 to monitor both the continued effectiveness of the collection system and the effectiveness of CWTS. Samples were collected at monitoring well 289, the chromium collection system wells, storm drain 170, and Mitchell Branch kilometer (MIK) 0.79. Samples collected at monitoring well 289 directly monitor the concentrations of chromium in the contaminated groundwater plume. Samples collected from the chromium collection system wells monitor the chromium in the water recovered by the groundwater collection system and pumped to CWTS. Samples collected at storm drain 170 monitor the concentrations of chromium being discharged directly to Mitchell Branch. Samples at MIK 0.79 are collected to allow monitoring of chromium concentrations in Mitchell Branch after water discharged from outfall 170 has had a chance to mix with other flow in the branch. Requirements for this sampling effort are listed in Table 3.16.

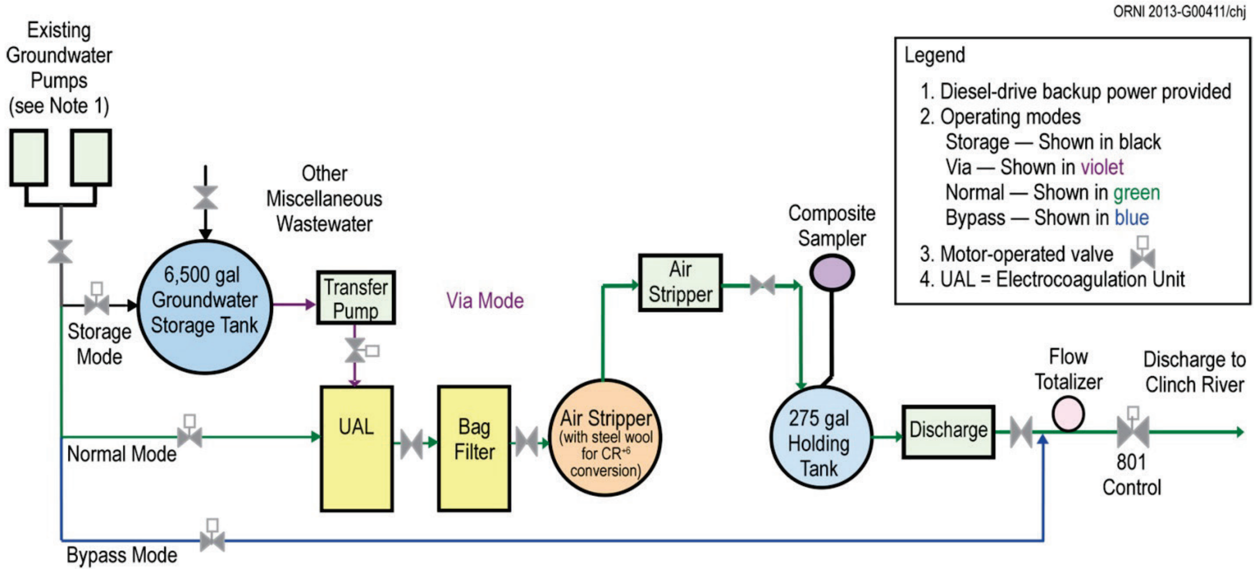


Fig. 3.26. Process flow diagram for the Chromium Water Treatment System.

Table 3.16. Monitoring requirements—Mitchell Branch watershed sampling locations

Location	Parameter	Measurement frequency	Sample type
MIK 0.79	Total chromium	1/quarter	Grab
MIK 0.79	Hexavalent chromium	1/quarter	Grab
Storm drain 170	Total chromium	1/quarter	Grab
Storm drain 170	Hexavalent chromium	1/quarter	Grab
Monitoring well 289	Total chromium	1/quarter	Grab
Monitoring well 289	Hexavalent chromium	1/quarter	Grab
Cr collection system wells	Total chromium	1/quarter	Grab
Cr collection system wells	Hexavalent chromium	1/quarter	Grab

Abbreviations
MIK = Mitchell Branch kilometer

Samples at these locations are collected on a quarterly basis during alternating wet and dry weather conditions. All of the samples collected as part of this effort are taken using the manual grab sampling method. Manual grab samples are collected according to the guidelines specified in Sections 3.1.2 and 3.3.1 of the EPA *NPDES Storm Water Sampling Guidance Document* (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor. All guidelines in the *East Tennessee Technology Park Storm Water Pollution Prevention Program Sampling and Analysis Plan* (UCOR 2011) are followed as part of this sampling effort. Figures 3.27 and 3.28 are graphs of the analytical data from this sampling effort.

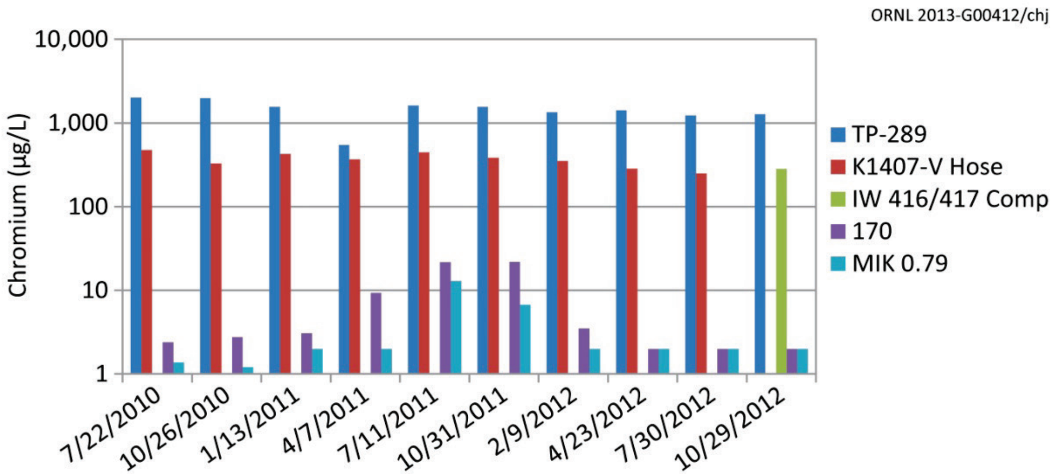


Fig. 3.27. Total chromium sample results from sampling upstream and downstream of the chromium collection system.

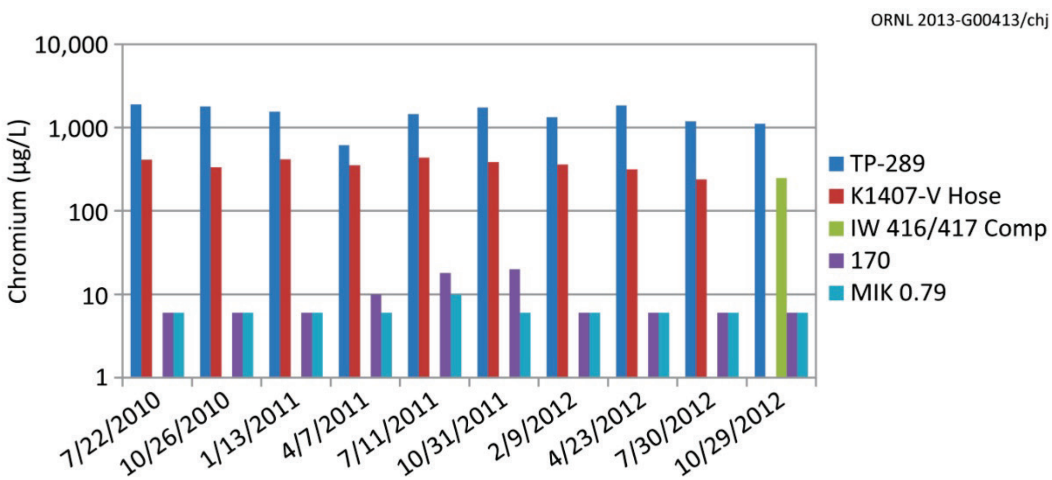


Fig. 3.28. Hexavalent chromium sample results from sampling upstream and downstream of the chromium collection system.

Initially, the water from the chromium collection system wells (IW 416/417) was pumped to CNF via the K-1407-V hose. Because CWTS is now online, water is being pumped directly from IW 416/417 to CWTS. Therefore, analytical results from the K-1407-V hose and IW 416/417 are from the same source of flow.

The analytical data indicate that chromium levels may fluctuate slightly at TP-289 and the K-1407-V hose/IW 416/417, but are relatively consistent over the long term. Chromium values at outfall 170 and MIK 0.79 have much more variability. This is most likely due to the greater variability in flow rates at these two locations. In July and October 2011, the collection system pumps were operating at a decreased pumping rate of 8 gal/min, which likely corresponds to the increase in chromium results at 170 and MIK 0.79.

In the future, additional monitoring of CWTS will include the Clinch River discharge sampling point as indicated in the *East Tennessee Technology Park Chromium Water Treatment System Sampling and Analysis Plan* (UCOR date).

Total chromium and hexavalent chromium will be collected during varying weather conditions (for example, samples will be collected during wet weather conditions one quarter and during dry weather conditions the following quarter.)

3.5.2.6 Investigation of Mercury at East Tennessee Technology Park

History of Mercury Use at ETTP

Mercury activities at ETTP included use, handling, and recovery operations. Mercury use and handling were common in such equipment as manometers, switches, mass spectrometers, mercury diffusion pumps, mercury traps, and laboratory operations. Process buildings contained many of these manometers, thermometers, and switches. Large quantities of mercury-bearing wastes from the on-site gaseous diffusion plant operations and support buildings, ORNL, and Y-12 were processed and stored at ETTP. Mercury from soils and spill cleanups were processed on-site as well.

Current NPDES Requirements for Mercury Monitoring

The current NPDES permit requires quarterly mercury sampling to be performed at storm water outfalls 05A, 170, 180, and 190. These four locations were selected because the permit application information indicated that mercury levels at these outfalls exceeded the AWQC level of 51 ng/L. Outfall 05A, which is located on the east side of ETTP, is the discharge point for the former STP drainage basin into Poplar Creek. Outfalls 170, 180, and 190 collect storm water from large areas on the north side of ETTP and discharge to Mitchell Branch.

Mercury results for outfall 170 and the associated catch basins have been well below AWQC since July 2009. For 2012, the results for outfall 170 ranged from 4.11 to 9.6 ng/L, which is well below AWQC. Outfalls 180 and 190 and the associated catch basins appear to be the primary sources of mercury discharges into Mitchell Branch. Both networks drain areas with historical mercury processes. For 2012, the results for outfall 180 varied significantly, ranging from 13.1 to 337 ng/L. For 2012, the results for 190 ranged from 44.2 to 166 ng/L. Results for storm water outfalls 170, 180, and 190 and the associated catch basins for each network are shown in Figs. 3.29 through 3.31.

Potential sources of mercury in the outfall 180 drainage system are from the former K-1401, K-1301, and K-1303 building areas and from the K-1407-B pond area. Potential sources of mercury in the outfall 190 drainage system are from the former K-1035, K-1401, and K-1413 building areas. Additional investigation of possible sources of mercury in Mitchell Branch is ongoing.

Figure 3.32 shows the mercury results in the effluent from outfall 05A from 2006 through 2012. As shown, all results are above AWQC. The highest mercury result in 2012 was 173 ng/L from a sample collected on October 11, 2012. Potential sources of mercury in the discharge from outfall 05A are currently under investigation.

Outfall 05A is the discharge point for the former STP overflow sump (K-1203-10) and a collection sump for storm water. The K-1203-10 sump receives water influent from both pipe flow and surface water sheet flow. During its years of operation, STP was piped to the K-1203-10 sump to allow discharge of treated effluent by the lift pumps in the event high water in Poplar Creek prevented gravity discharge. Operations at STP ceased in 2008.

Samples collected for compliance with the current NPDES permit were collected as manual grab samples. NPDES permit renewal application samples were collected as composite samples using automated sampling equipment. Composite samples consist of at least three aliquots taken during the first 60 min of a storm event discharge.

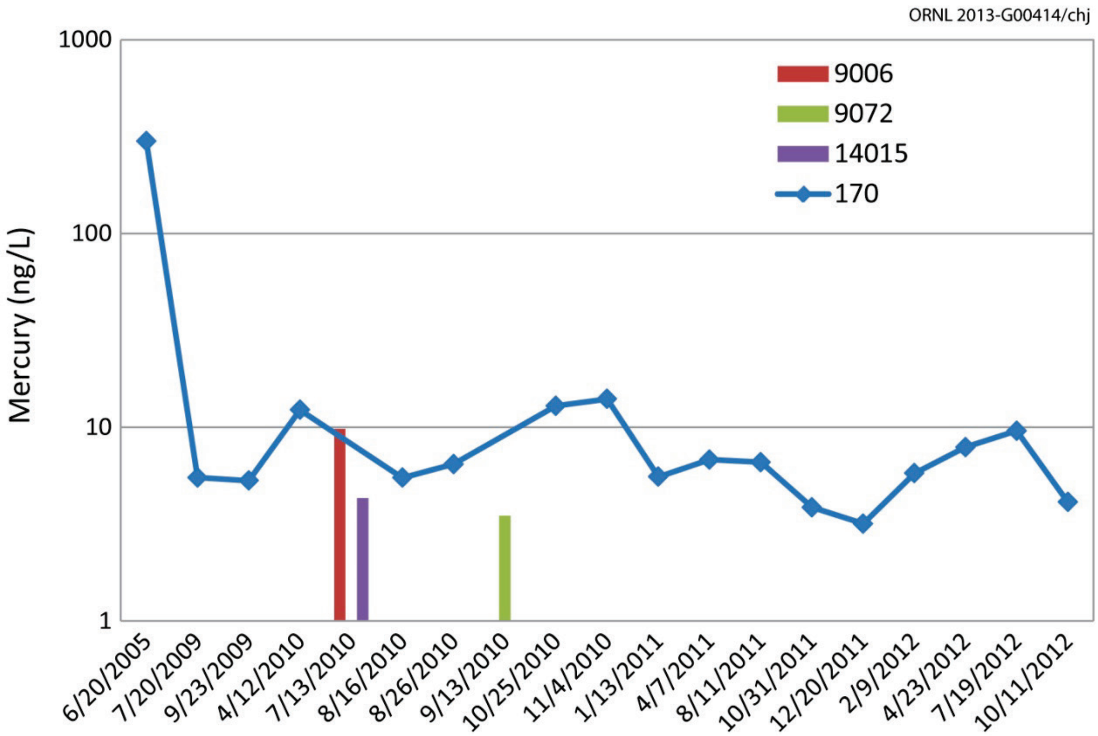


Fig. 3.29. Outfall 170 network water results for mercury.

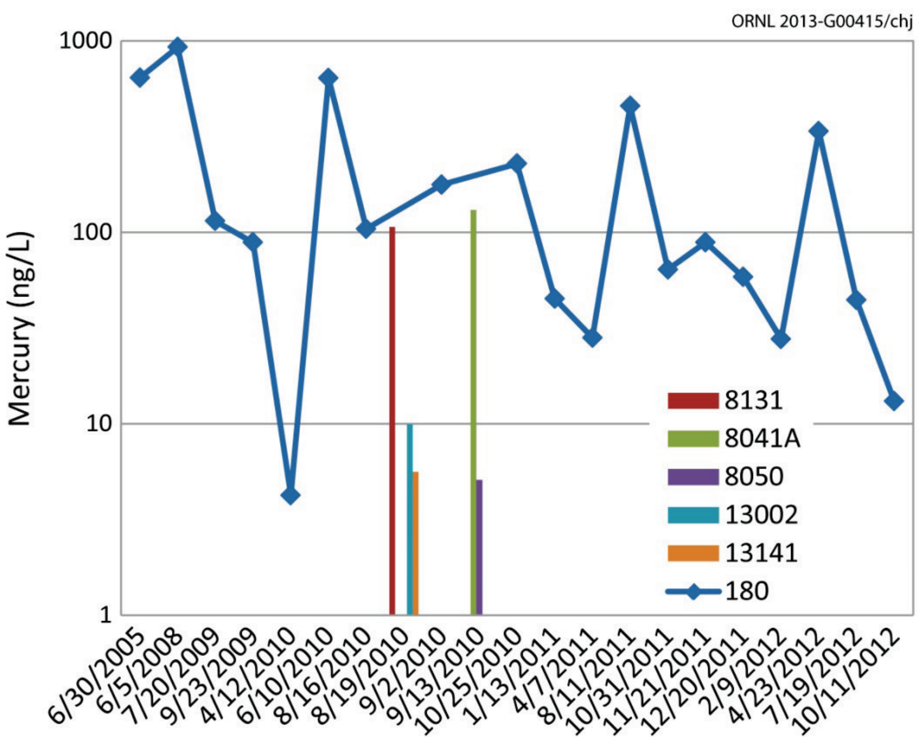


Fig. 3.30. Outfall 180 network water results for mercury.

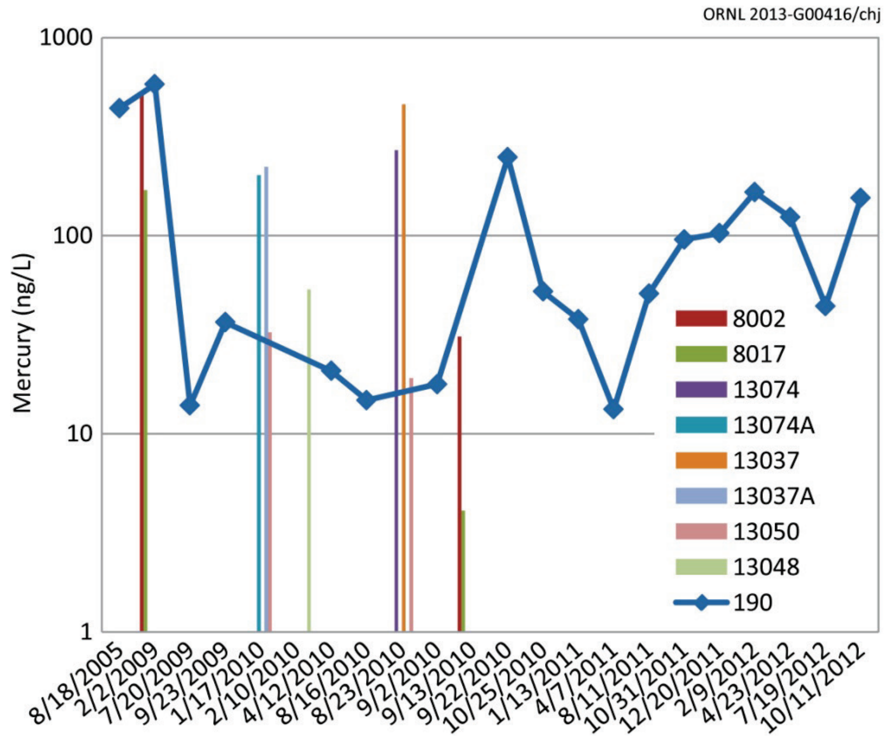


Fig. 3.31. Outfall 190 network water results for mercury.

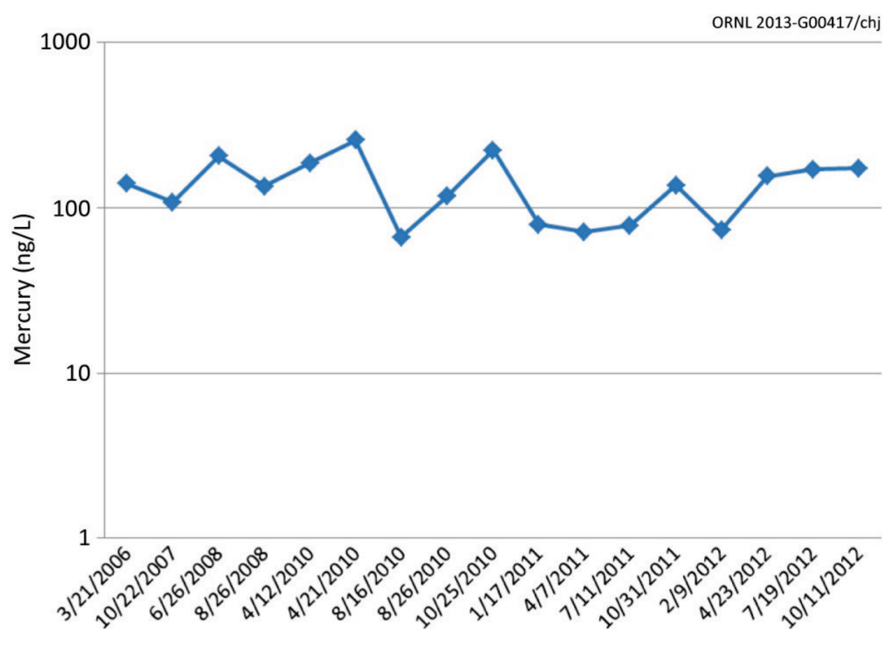


Fig. 3.32. Outfall 05A water results for mercury.

Additional Mercury Monitoring Activities

In an effort to obtain analytical data using a more sensitive method and to identify how the discharges from the storm water outfalls might be affecting the water quality of Mitchell Branch, Poplar Creek, and associated waterways, mercury sampling has been performed at numerous storm water outfalls where mercury activities may have occurred within their watersheds (Table 3.17). In addition, surface water sampling has been performed along Mitchell Branch as shown in Table 3.18 and Figure 3.37.

As stated previously, the applicable water quality criterion for total mercury is 51 ng/L (0.051 μg/L); therefore, total mercury samples were analyzed by a laboratory with a method detection limit for mercury below this criterion. For the storm water and surface water samples, the laboratory method used since 2010 for total mercury analysis is either the EPA 1631 or EPA 245.7 method (EPA 2002, 2005). These analytical methods have a detection limit that is below the water quality criterion.

All storm water outfalls monitored for mercury in CY 2012 (excluding those sampled for NPDES permit compliance) are shown in Table 3.17. There were five storm water outfalls at ETTP that had mercury results above the water quality criterion (WQC) in CY 2012: 100, 230, 240, 250, and 694. Outfall 100 drains much of the south side of ETTP and discharges into the K-1007-P1 pond. Outfalls 230, 240, and 250 are located north of Building K-25 and discharge into Poplar Creek. Outfall 694 is located on the northeast side of Building K-33. It also discharges into Poplar Creek.

Storm water samples were collected during both wet and dry weather conditions. Wet weather samples were collected from flows resulting from a storm event greater than 0.1 in. in magnitude within 24 h that occurred at least 72 h after any previous storm event of 0.1 in. or greater within 24 h. If an intermittent rainfall occurred over a period of 24 h and did not equal or exceed 0.1 in, it was not considered to be a storm event, and the 72 h delay until the next rainfall that can potentially be sampled was not in effect. Dry weather samples were collected at least 72 h after a storm event of 0.1 in. or greater. All dry weather samples were collected by the manual grab sampling technique.

A surface water mercury sample profile along Mitchell Branch was collected on September 6, 2012, as a part of the SWPP Program. The results of the September 6, 2012, sampling event are shown in Table 3.18 and graphically represented in Fig. 3.33. The sampling locations along Mitchell Branch are denoted by "MIK," with the kilometer values representing distance from the downstream confluence with Poplar Creek. Samples were collected at the Poplar Creek Road culvert influent and effluent for Mitchell Branch. A sample was collected at the northern side of the culvert effluent, the southern side of the culvert effluent, the northern side of the culvert influent, and the southern side of the culvert influent.

Figure 3.34 shows that Mitchell Branch instream mercury concentrations for the period 2008–2012 increased significantly moving downstream toward the K-1700 weir. Figure 3.35 shows the historic mercury concentrations measured from routine surface water sampling at the K-1700 weir. At the K-1700 weir there was a significant increase in mercury concentrations from December 2009 to March 2010. Near this time frame there were several activities under way with the potential to influence the mercury concentrations at the K-1700 weir such as the D&D activity at Building K-25, the remediation of the K-1070-B burial ground, and the D&D activity at Building K-1035.

Table 3.17. Mercury results from storm water monitoring conducted in CY 2012 (ng/L)

Outfall	1/12	2/12	4/12	5/12	6/12	9/12	11/12	12/12
100	5.8	**51.6**						
142							<0.5	
160								26.8
200				7				
210				22.2				
230	1.5			**61.6**			10.5	
240				28				**81.6**
250				**72.8**				
280				8.4				

Table 3.17. (continued)

Outfall	1/12	2/12	4/12	5/12	6/12	9/12	11/12	12/12
334			10.7					7.64
350				9.9				18.4
380								8.81
382	18.2			7.8				
410								16.9
430	1.8							
440								8.15
490	4.6			6.5	20.7			
510							2.22	
560						6.21		
610								5.41
694	**64.1**			21.9				
700	18							
710	4.8							
720								15.5
724							3.76	
780								20.9
890		12.7						
992							4.88	

Bolding indicates results above the water quality criterion of 51 ng/L.

Abbreviations
CY = calendar year

Table 3.18. Mitchell Branch surface water mercury results from September 6, 2012 (ng/L)

Mitchell Branch Location	Mercury[a]	Mitchell Branch Location	Mercury
K-1700 weir	**72.6**	Poplar Creek Road Culvert Influent, South Side	32.9
Mitchell Branch kilometer (MIK) 0.14[b]	**67.2**	MIK 0.33	36.3
MIK 0.23	**138.5**	MIK 0.38	36.2
Poplar Creek Road Culvert Effluent, North Side	35.8	MIK 0.45	41.5
Poplar Creek Road Culvert Effluent, South Side	34.9	MIK 0.59	16
Poplar Creek Road Culvert Influent, North Side	33.9	MIK 0.71	10.2

[a]Bolding indicates results above Tennessee water quality criteria.
[b]MIK values represent distance from the downstream confluence with Poplar Creek.

Abbreviations
MIK = Mitchell Branch kilometer

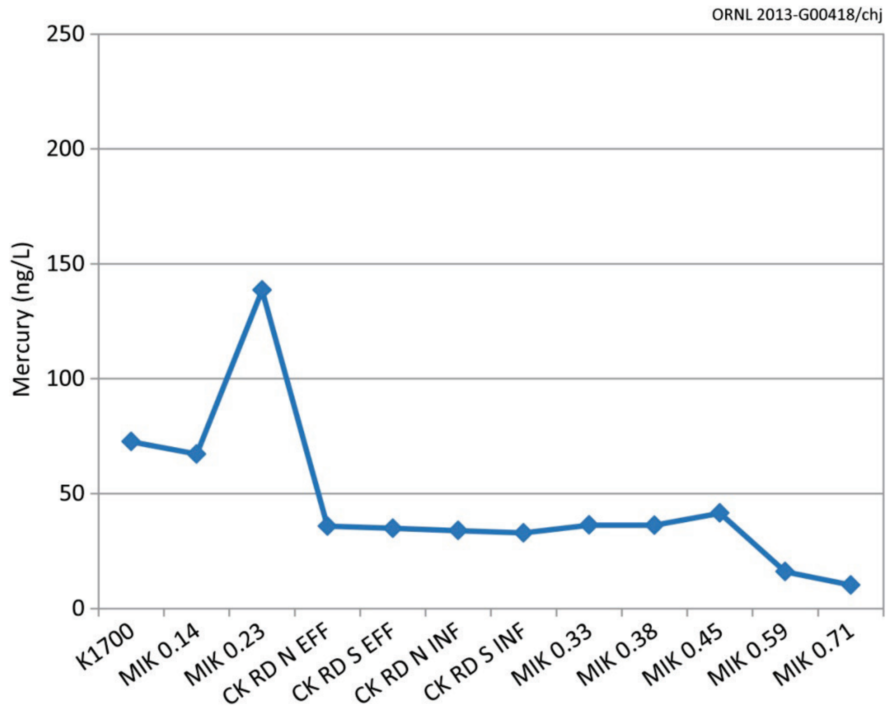


Fig. 3.33. Mitchell Branch surface water mercury results profile from September 6, 2012.

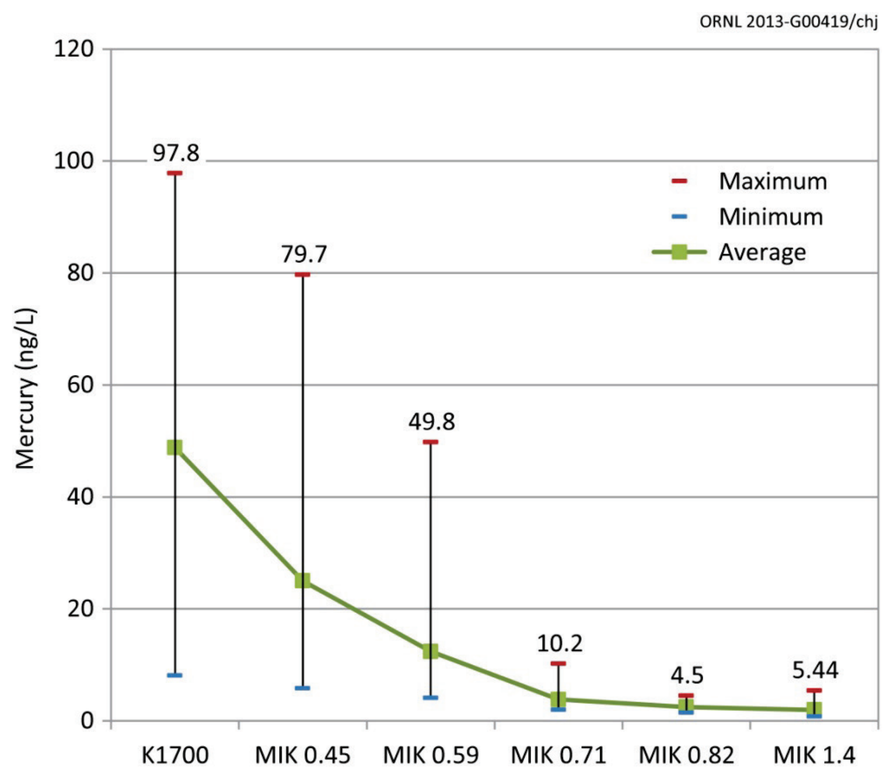


Fig. 3.34. Mitchell Branch instream mercury results, 2008–2012.

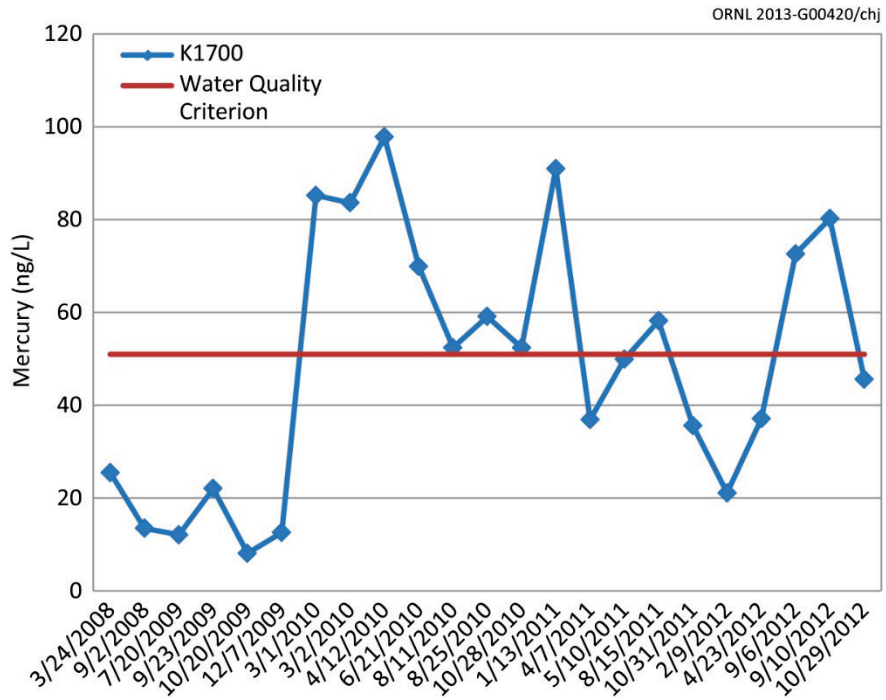


Fig. 3.35. Results for mercury from water samples collected at K-1700.

In 2012, fish and caged clams from various locations at ETTP were analyzed for mercury. For details of this study, please see Section 3.6.

For information regarding the monitoring of mercury in the groundwater at ETTP, please see Section 3.5.4.

Further monitoring for mercury has been proposed for 2013 for Mitchell Branch, the former K-1203 STP, and other locations as part of the NPDES permit compliance sampling program, SWPP Program, environmental monitoring program, groundwater program, and Biological Monitoring and Abatement Program (BMAP). Historical documents continue to be researched and future monitoring proposed as part of the ongoing mercury investigation.

3.5.2.7 NPDES Monitoring at the CNF Waste Water Treatment System

Wastewater from CNF is discharged through outfall 001 into the Clinch River. Nonradiological monitoring of CNF effluent is conducted according to the requirements of NPDES permit number TN0074225. Monitoring requirements, frequencies, and sample types required under the permit changed during 2010 with the reissuance of the permit on December 1, 2010. During the permit renewal process, CNF was reclassified from the “Metal Finishing” category into the “Centralized Wastewater Treatment” category by the permit writer. This change in point source category was mainly responsible for the change in parameters between the previous permit and the renewed permit. The requirements for the 2010 permit are listed in Table 3.19.

As of December 15, 2012, CNF no longer accepts any external wastewater for treatment. CNF will continue to discharge for some period of time after December 15, 2012, due to internal wastewater generated as decommissioning activities progress.

Table 3.19. NPDES permit number TN0074225 outfall 001 monitoring requirements

Parameter	Measurement frequency	Sample type
Flow	Continuous	Recorder
pH	Continuous	Recorder
^{137}Cs	1/month	Monthly composite
^{234}U	1/month	Monthly composite
^{235}U	1/month	Monthly composite
^{236}U	1/month	Monthly composite
^{237}Np	1/month	Monthly composite
^{238}Pu	1/month	Monthly composite
^{238}U	1/month	Monthly composite
^{239}Pu	1/month	Monthly composite
^{99}Tc	1/month	Monthly composite
COD	1/month	24 h composite
Gross alpha radioactivity	1/month	Monthly composite
Gross beta radioactivity	1/month	Monthly composite
Oil and grease	1/month	Grab
Other radionuclides contained in waste water[a]	1/month	Monthly composite
Total uranium	1/month	Monthly composite
2-4-6-trichlorophenol	1/quarter	24 h composite
Acetone	1/quarter	Grab
Acetophenone	1/quarter	24 h composite
ICP metals[b]	1/quarter	24 h composite
Methyl ethyl ketone (2-Butanone)	1/quarter	Grab
o-Cresol (2-methyl phenol)	1/quarter	24 h composite
p-Cresol (4-methyl phenol)	1/quarter	24 h composite
Phenol	1/quarter	24 h composite
Pyridine	1/quarter	24 h composite
Trichloroethylene	1/quarter	Grab
TSS	1/quarter	24 h composite
BOD	1/year	24 h composite
Chloroform	1/year	Grab
Methylmercury	1/year	Grab
Total mercury	1/year	24 h composite
PCBs	1/year	24 h composite

[a]No other radionuclides are currently being analyzed each month.

[b]ICP metals shall include, at a minimum, Sb, As, Cd, Cr, Co, Cu, Pb, Ni, Ag, Sn, Ti, V, and Zn per the permit and Al, Ba, Be, B, Ca, Fe, Mg, Mn, Mo, K, Se, Si, Na, and Tl.

Abbreviations

BOD = biochemical oxygen demand
COD = chemical oxygen demand
ICP = inductively coupled plasma
NPDES = National Pollutant Discharge Elimination System
PCB = polychlorinated biphenyl
TSS = total suspended solids

Radiological sampling of effluent from CNF is conducted weekly according to the requirements of NPDES permit number TN0074225. The weekly samples are then composited into a single monthly sample. Table 3.20 lists the total discharges in 2012 by isotope. The radiological results are compared with the derived concentration guides (DCGs). The sum of the fractions must be kept below 100% of the DCGs; in practice the effluent results from CNF were well below 100% of the DCGs until 2007. Figure 3.36 shows a rolling 12-month average for 2012. Monitoring results for 2012 showed a marked decrease in the rolling 12-month average of the sum of the fractions of the DCGs from a high of 1.1 in January 2008 to 0.17 in December 2012. In most of 2012, the rolling average of the sum of the fractions gradually decreased from 0.24 to 0.17. The cessation of waste-burning activities at the TSCA Incinerator may account for much of the decrease, as well as the start-up of CWTS to treat the chromium collection system influent that was previously sent to CNF.

Table 3.20. Isotopic discharges from the Central Neutralization Facility Wastewater Treatment System, 2012

Isotope	Discharge (Ci)	Isotope	Discharge (Ci)
^{137}Cs	1.3E−5	$^{233/234}U$	7.3E−4
^{237}Np	3.3E−6	^{235}U	7.3E−5
^{238}Pu	3.6E−7	^{236}U	7.3E−5
$^{239,240}Pu$	7.3E−7	^{238}U	6.1E−4
^{99}Tc	1.2E−2		

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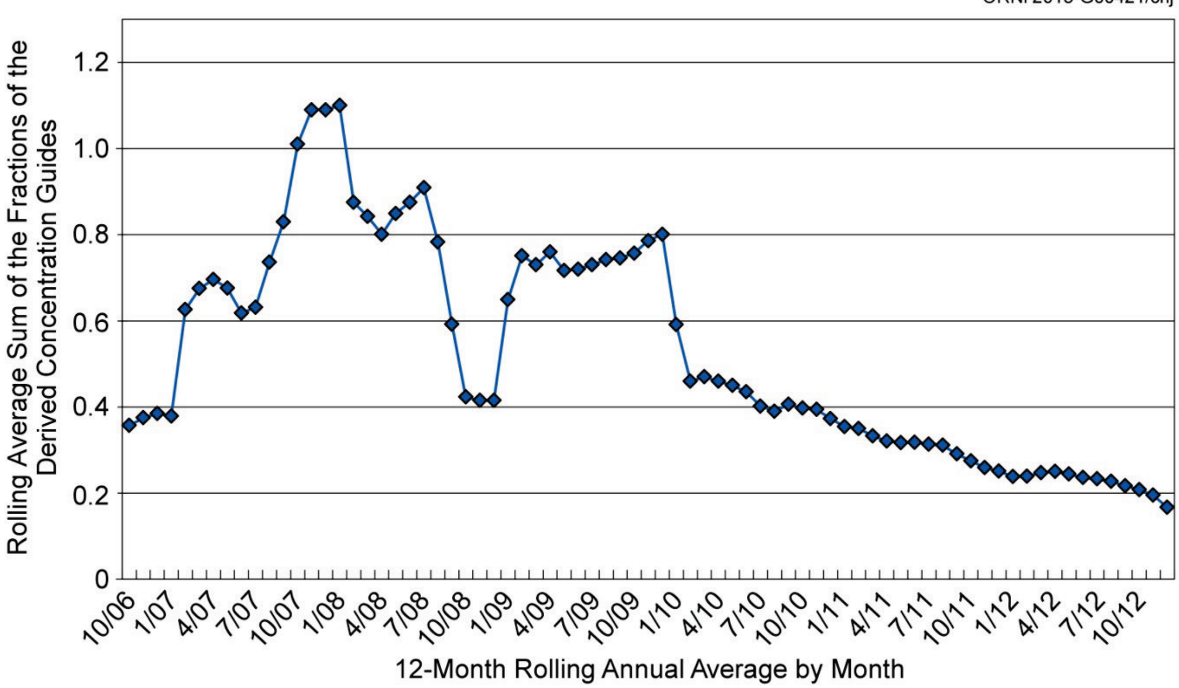

Fig. 3.36. Central Neutralization Facility/K-1435 Wastewater Treatment System radionuclide liquid discharges.

Although uranium isotopes constitute a greater mass of radionuclides discharged from CNF, ^{99}Tc accounts for the greatest activity due to its much higher specific activity. Transuranic isotopes constitute a small fraction of the total in the rolling 12-month average of the sum of the fractions of the DCGs.

3.5.2.8 NPDES Permit Noncompliances

During 2012 ETTP and UCOR NPDES operations were conducted in compliance with contractual and regulatory environmental requirements. There were no NPDES permit noncompliances in 2012.

3.5.3 Surface Water Monitoring

During 2012 ETTP environmental monitoring program personnel conducted environmental surveillance activities at 13 surface water locations (Fig. 3.37) to monitor groundwater and storm water runoff (K-1700, K-1007-B, and K-901-A) or ambient stream conditions (CRK 16; CRK 23; K-1710; K-716; K-702-A slough; and MIK 0.45, 0.59, 0.71, 0.82, and 1.4). Depending on the location, samples were collected and analyzed for radionuclides quarterly (K-1700 and MIK 0.45, 0.59, 0.71, 0.82, and 1.4) or semiannually (remainder of locations). Results of radiological monitoring are compared with the DCGs. Radiological data are reported as fractions of DCGs for reported radionuclides. If the sum of DCG fractions for a location exceeds 100% for the year, a source investigation is required. Sources exceeding DCG requirements would need an analysis of the best available technology to reduce the sum of the fractions of the radionuclide concentrations to their respective DCGs to less than 100%. Comparisons with DCGs are updated regularly to maintain an annual average. The monitoring results at several locations were less than 1% of the allowable DCG (Fig. 3.38). The exceptions are K-1700 and four locations on Mitchell Branch, as indicated by the sums of the fractions of the DCGs for these locations: K-1700—1.0%, MIK 0.45—1.4%, MIK 0.59—1.3%, MIK 0.71—1.0%, and MIK 0.82—1.5%. The percentage of the DCGs at K-1700 (1.0%) was below the percentage of the 2011 monitoring results (1.9%). The percentage of the DCGs at MIK 0.45, MIK 0.59, and MIK 0.71 also decreased from the 2011 results.

Depending on the monitoring location, water samples may be analyzed for pH, selected metals, and VOCs. In 2012, results for most of these parameters were well within the appropriate Tennessee state WQC.

The WQC for dissolved oxygen in streams and ponds is a minimum level of 5 mg/L. On five occasions during the 2012 monitoring dissolved oxygen levels at several of the surface water monitoring locations fell below this level. The lowest levels (3.4 mg/L and 3.5 mg/L) were measured at K-1700 in September and October, respectively. Levels at MIK 0.82 (4.6 mg/L in September), K-1710 (4.8 mg/L in June) and CRK-23 (3.6 mg/L in June) were also measured at less than 5 mg/L at some point during 2012. No obvious signs of distress (e.g., dead fish) were observed to be associated with any of these measurements in 2012. Low levels of dissolved oxygen are not uncommon in area streams and are usually associated with higher temperatures (and the associated elevated levels of biological activity) and low rainfall and stream flow. Late summer and fall of 2012 had very low rainfall.

The WQC for mercury is 0.051 µg/L. On three occasions in 2012 levels of mercury were measured above this level in water collected from MIK 0.45 and once in water collected from K-1700. Both locations are within Mitchell Branch. For details, please see the discussion of the sitewide mercury investigation given in Section 3.5.2.6.

Figures 3.39 and 3.40 illustrate the concentrations of trichloroethene (TCE) and total 1,2-dichloroethene (1,2-DCE) from the K-1700 weir (which is used to monitor Mitchell Branch), the only surface water monitoring location where VOCs are regularly detected. Concentrations of TCE and total 1,2-DCE are below the Tennessee WQCs for recreation, organisms only (300 µg/L for TCE and 10,000 µg/L for trans 1,2-DCE, Appendix C, Table C.2), which are appropriate standards for Mitchell Branch. Moreover, the standards for 1,2-DCE apply only to the "trans" form of 1,2-DCE; almost all of the 1,2-DCE is in the cis-isomer. In addition, vinyl chloride has sometimes been detected in Mitchell Branch water (Fig. 3.41). VOCs have been detected in groundwater in the vicinity of Mitchell Branch and in building sumps discharging into storm water outfalls that discharge into the stream; however, storm drain network monitoring generally has not detected these compounds in the storm water discharges. When detected, the concentrations are lower than in the stream. Therefore, it appears that the primary source of these compounds is contaminated groundwater.

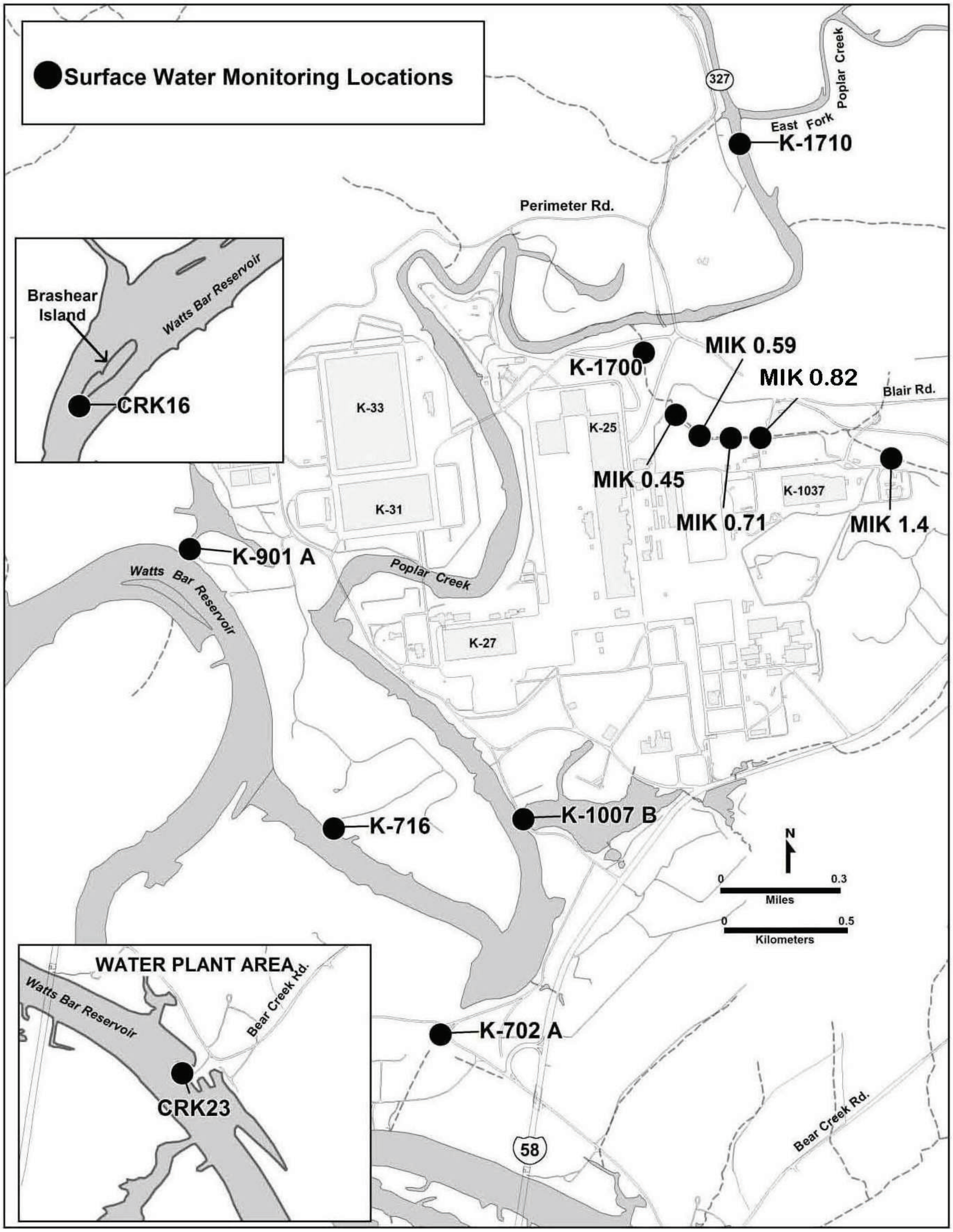

Fig. 3.37. Environmental monitoring program surface water monitoring locations.

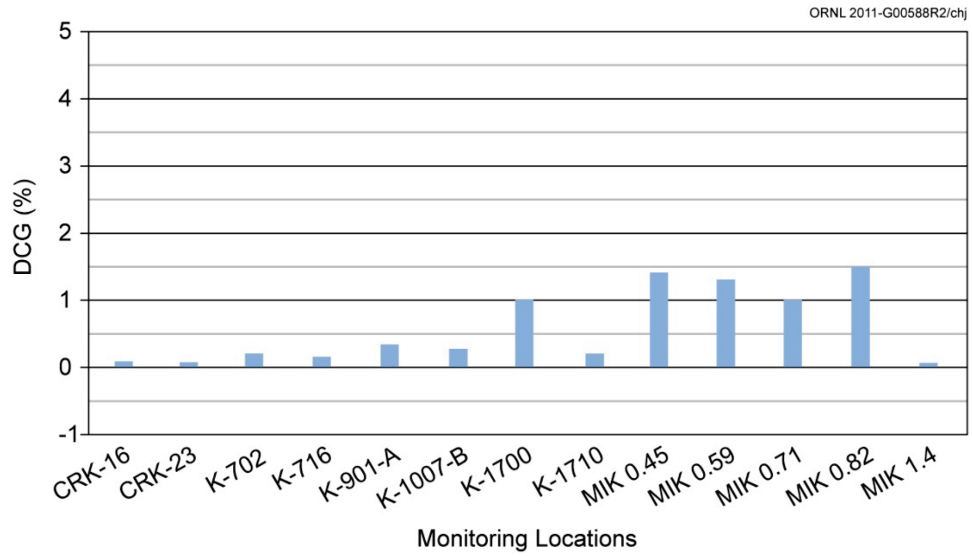

Fig. 3.38. Percentage of derived concentration guides (DCGs) at surface water monitoring locations, 2012. (CRK = Clinch River kilometer, MIK = Mitchell Branch kilometer.)

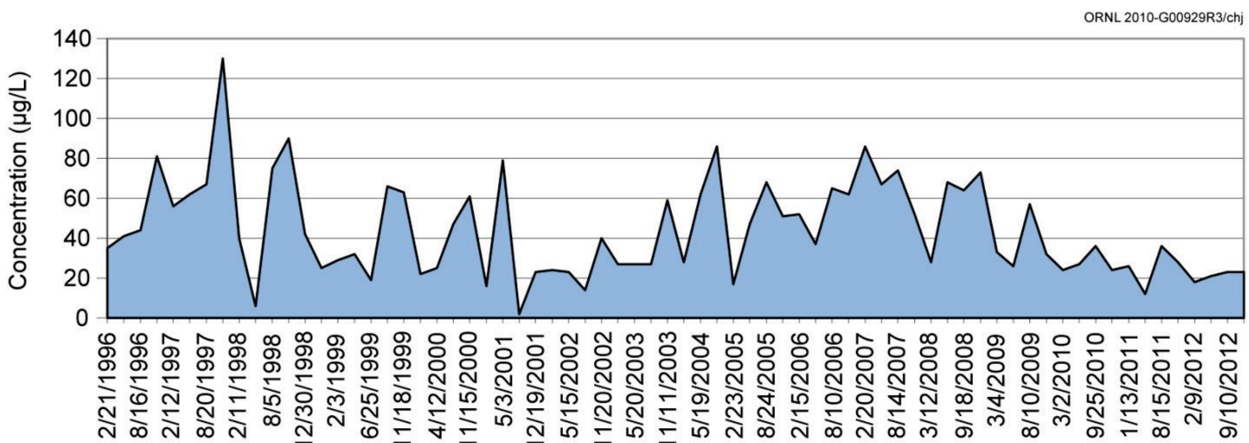

Fig. 3.39. Trichloroethene concentrations at K-1700. (The water quality criterion is 300 µg/L.)

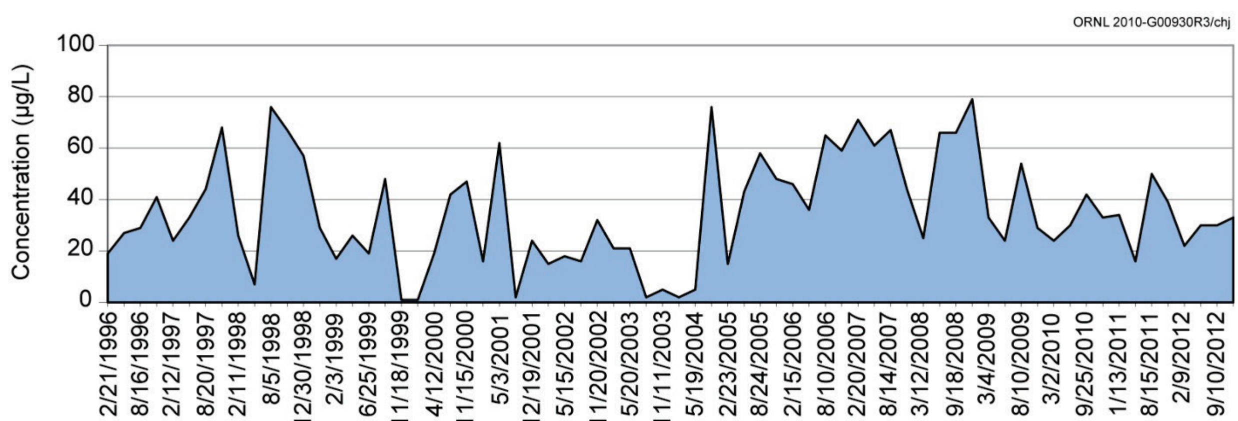

Fig. 3.40. 1,2-dichloroethene concentrations at K-1700. (The water quality criterion is 10,000 µg/L.)

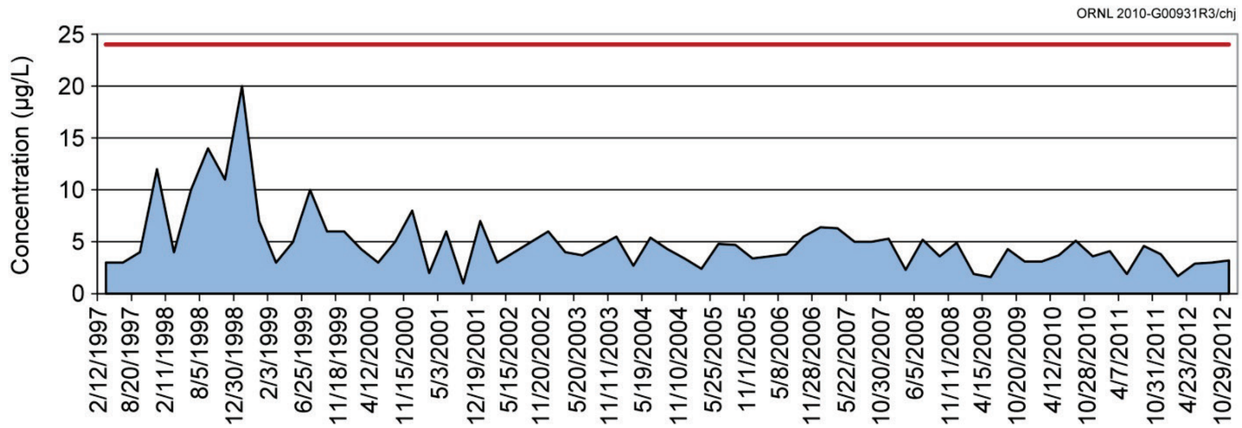

Fig. 3.41. Vinyl chloride concentrations at K-1700. [The water quality criterion (horizontal red line) is 24 μg/L.]

Surface water has been routinely sampled by DOE contractors and TDEC for several years as part of environmental monitoring programs. The DOE contractor surface water sampling program is conducted in accordance with DOE order surveillance program guidance. In data collected as part of the DOE contractors' sampling efforts, dry weather levels of total chromium over the past 10 years (Fig. 3.42) have been shown to be generally less than 0.01 mg/L or, in some instances, at nondetectable levels. Results from routine surface water monitoring conducted in fall 2006 showed a significant increase in the total chromium level in Mitchell Branch, but it was still below the WQC for total chromium. Sampling performed in the spring of 2007 by DOE contractors and TDEC indicated that chromium levels had increased above the levels found in the fall 2006 sampling. A chromium collection system using two extraction wells and pumps was installed to pump water from the vicinity of storm water outfall 170 for treatment at CNF. Since this system was installed, chromium levels in Mitchell Branch have dropped dramatically, with levels being routinely measured at less than 3 μg/L. Hexavalent chromium levels in Mitchell Branch were all below the detection limit in 2012.

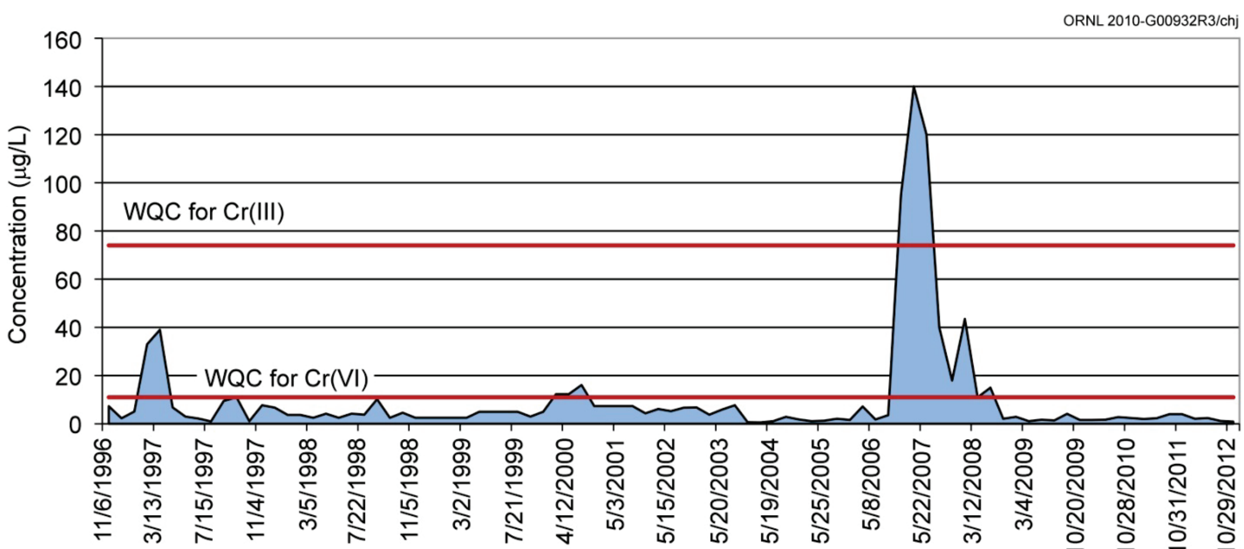

Fig. 3.42. Total chromium concentrations at K-1700. [The water quality criterion for Cr(III), which is hardness dependent, is 74 μg/L, based on a hardness of 100 mg/L. The water quality criterion for Cr(VI) is 11 μg/L.]

3.5.4 East Tennessee Technology Park Groundwater

3.5.4.1 Introduction

Groundwater at the ETTP site occurs in residual soils, fill, alluvial soils, and bedrock. Because of the extensive terrain modification that occurred during site construction, large areas of the main industrial site were subjected to cut and fill activities that modified site hydrology. Most of the ETTP site is underlain by carbonate bedrock of the Chickamauga Group, with subordinate areas underlain by carbonates of the Knox Group and clastic dominated sandstones, shales, and siltstones of the Rockwood formation. The geologic structure of bedrock beneath the ETTP site is the most complex of the ORR facilities because of structural rock deformation associated with the White Oak Mountain thrust fault and footwall deformation associated with motion along that fault.

3.5.4.2 Background

The groundwater monitoring program at ETTP is focused primarily on investigating and characterizing sites for remediation under CERCLA, monitoring groundwater contaminant trends, and monitoring groundwater exit pathways. As a result of the FFA and certification of closure of the K-1407-B and K-1407-C ponds, the principal driver at ETTP is CERCLA. ETTP Groundwater Protection Program requirements are incorporated into the DOE EM Water Resources Restoration Program (WRRP), established to provide a consistent approach to watershed monitoring across ORR and responsible for groundwater surveillance monitoring at ETTP, which includes groundwater exit pathway monitoring. This groundwater monitoring is conducted to assess the performance of completed CERCLA actions. Groundwater monitoring wells have been placed downgradient of potential contamination sources. Groundwater discharges into Poplar Creek; the Clinch River; and the three main surface water bodies at ETTP, the K-901 pond, the K-1007 pond, and Mitchell Branch. Groundwater contaminants at ETTP migrate toward these surface water bodies. Groundwater monitoring wells have been placed near these exit points, and groundwater monitoring is supplemented by the ETTP Environmental Monitoring Plan surface water surveillance program.

3.5.4.3 East Tennessee Technology Park Groundwater Monitoring at Major Site Contaminant Plumes

Extensive groundwater monitoring at the ETTP site has identified VOCs as the most significant groundwater contaminant on the site. To analyze the groundwater contaminant issues at ETTP, the remedial investigation/feasibility study (RI/FS) subdivided the site into several distinct areas—Mitchell Branch watershed, K-1004 and K-1200 area, K-27 and K-29 area, and K-901 area. Each of these areas has significant VOC contamination in groundwater. The principal chlorinated hydrocarbon chemicals that were used at ETTP were tetrachloroethene (PCE), TCE, and 1,1-dichloroethane (1,1-DCA).

Several plume source areas have been 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 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 about 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 and the 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.

3.5.4.4 Exit Pathway Monitoring

Groundwater exit pathway monitoring sites are shown in Fig. 3.43. Groundwater monitoring results for the exit pathways are discussed below starting with the Mitchell Branch exit pathway and then progressing in a counterclockwise fashion.

Mitchell Branch. 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 3.44 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 2012. These contaminants are the major contaminants in Mitchell Branch, although low concentrations of carbon tetrachloride, chloroform, and trichloroethane are sometimes detected. VOC concentrations measured during FY 2012 were consistent with previous years' results at the K-1700 weir.

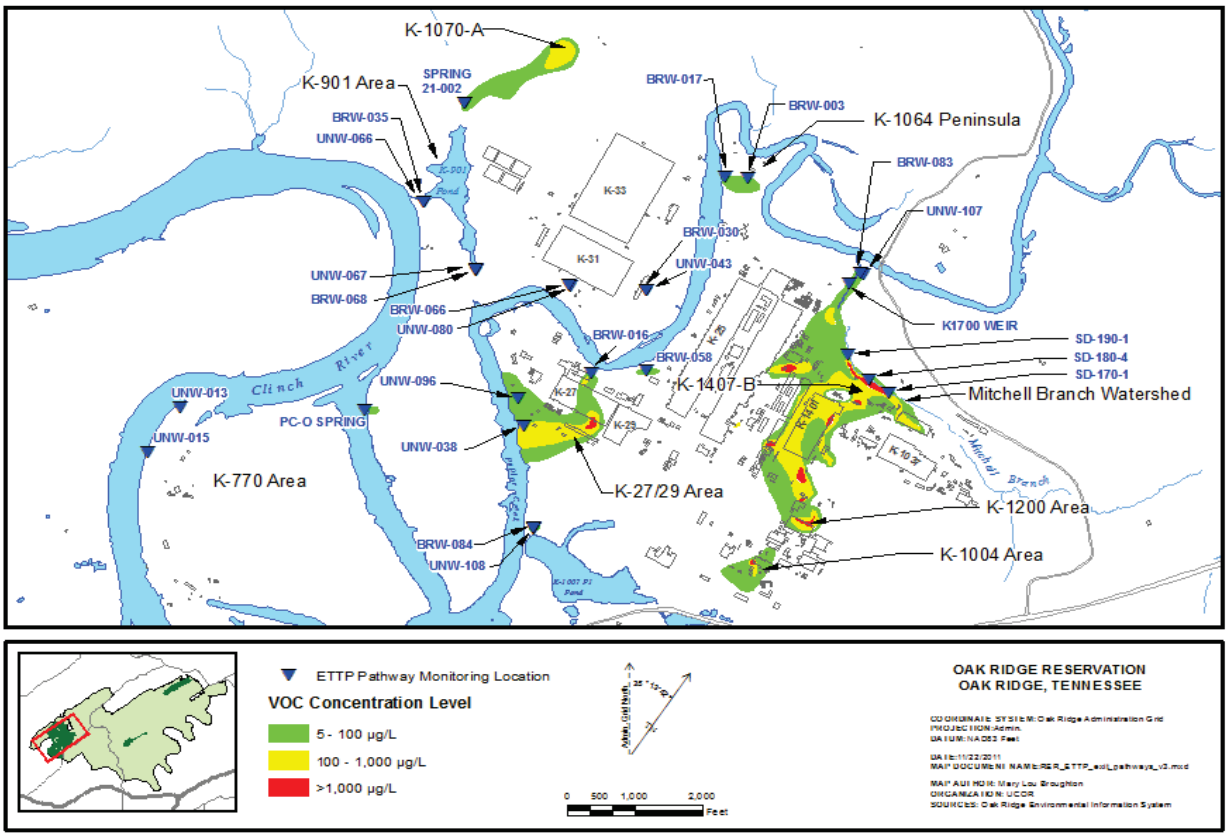

Fig. 3.43. East Tennessee Technology Park exit pathway monitoring locations.

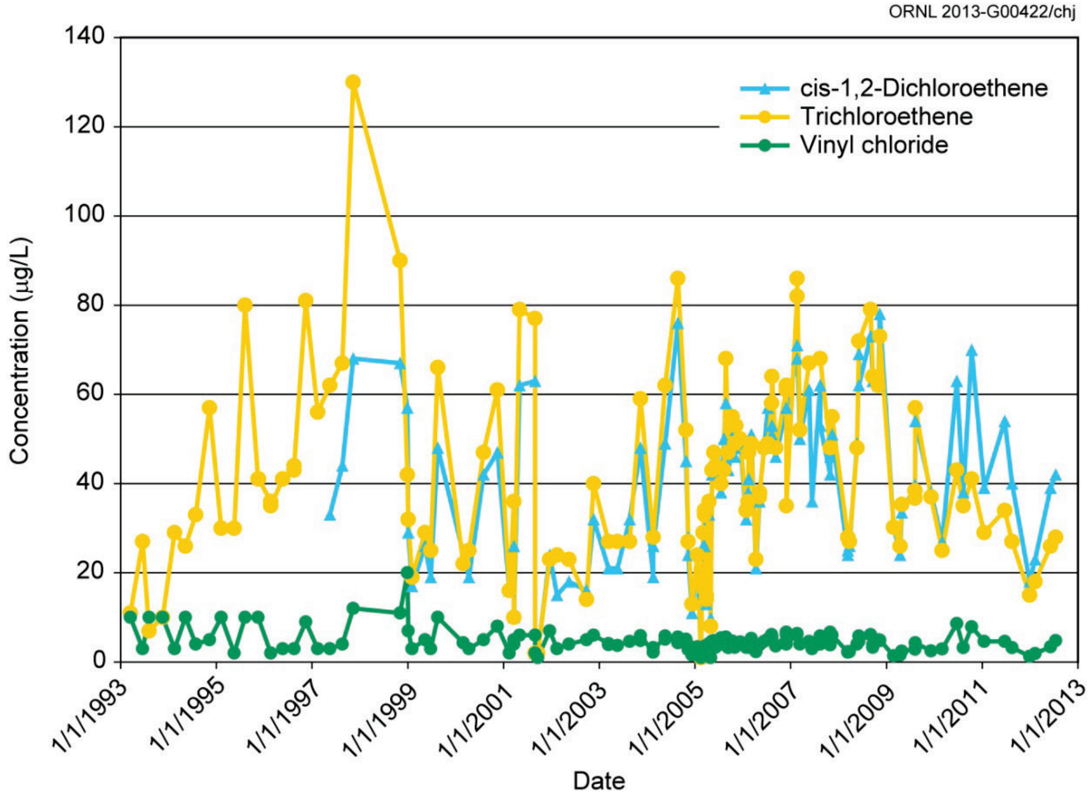

Fig. 3.44. K-1700 weir volatile organic compound concentrations.

Wells BRW-083 and UNW-107, located near the mouth of Mitchell Branch (Fig. 3.43), have been monitored since 1994. Table 3.21 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. The intermittent detection of VOCs in this exit pathway is thought to be a reflection of variations in groundwater flowpaths that can fluctuate with seasonal hydraulic head conditions and are strongly affected by rainfall. No chlorinated VOCs were detected in BRW-083 or UNW-107 during FY 2012.

Table 3.21. Volatile organic compounds detected in groundwater in the Mitchell Branch exit pathway (µg/L)[a]

Well	Date	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
BRW-083	8/29/2002	ND	**5**	**28**	ND
	3/16/2004	0.69	2.2	**9.9**	ND
	8/26/2004	2	4.7	**20**	ND
	3/14/2007	5	**9**	**28**	ND
	3/20/2008	ND	ND	ND	ND
	8/21/2008	ND	ND	ND	ND
	3/12/2009	ND	ND	1.31[b]	ND
	8/3/2009	ND	2.66	**14.2**	ND
	3/3/2010	ND	ND	ND	ND
	8/30/2010	3.6	**5.1**	**18**	ND
	3/15/2011	2.8	**6.7**	**22**	ND
	8/10/2011	ND	ND	**ND**	ND
	3/1/2012	ND	ND	ND	ND

Table 3.21. (continued)

Well	Date	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
	8/16/2012	ND	ND	ND	ND
UNW-107	8/3/1998	ND	ND	3	ND
	8/26/2004	4.7	ND	3.6	ND
	8/21/2006	3.4	**14**	2	1.2
	3/13/2007	25	2[b]	**23**	2[c]
	8/21/2007	17	ND	**30**	0.3[b]
	3/5/2008	ND	ND	ND	ND
	8/18/2008	ND	ND	ND	ND
	3/12/2009	ND	ND	ND	ND
	7/30/2009	ND	ND	ND	ND
	3/4/2010	ND	ND	ND	ND
	7/28/2010	ND	ND	ND	ND
	3/16/2011	ND	ND	ND	ND
	8/11/2011	ND	ND	ND	ND
	3/20/2012	ND	ND	ND	ND
	9/12/2012	ND	ND	ND	ND

[a]Bolding indicates results that exceed Safe Drinking Water Act maximum contaminant level screening values (tetrachloroethene, trichloroethene = 5 µg/L; cis-1,2-dichloroethene = 70 µg/L; vinyl chloride = 2 µg/L).

[b]Estimated value.

[c]Detection occurred in a field replicate. Constituent not detected in regular sample.

Abbreviations

BRW = bedrock well
ND = Not Detected
UNW = unconsolidated well

K-1064 peninsula area. Wells BRW-003 and BRW-017 monitor groundwater at the K-1064 peninsula burn area. Figure 3.45 shows the history of VOC concentrations in groundwater from FY 1994 through FY 2012. TCE concentrations have declined in both wells over that period of time. One of the two samples from BRW-017 contained TCE at concentrations slightly greater than the maximum contaminant level (MCL) during FY 2012, while at BRW-003 both analytical results were much less than the MCL. In well BRW-003, 1,1,1-TCE has declined to undetectable concentrations. In both semiannual samples in well BRW-017, cis-1,2-DCE was detected at concentrations much less than its MCL.

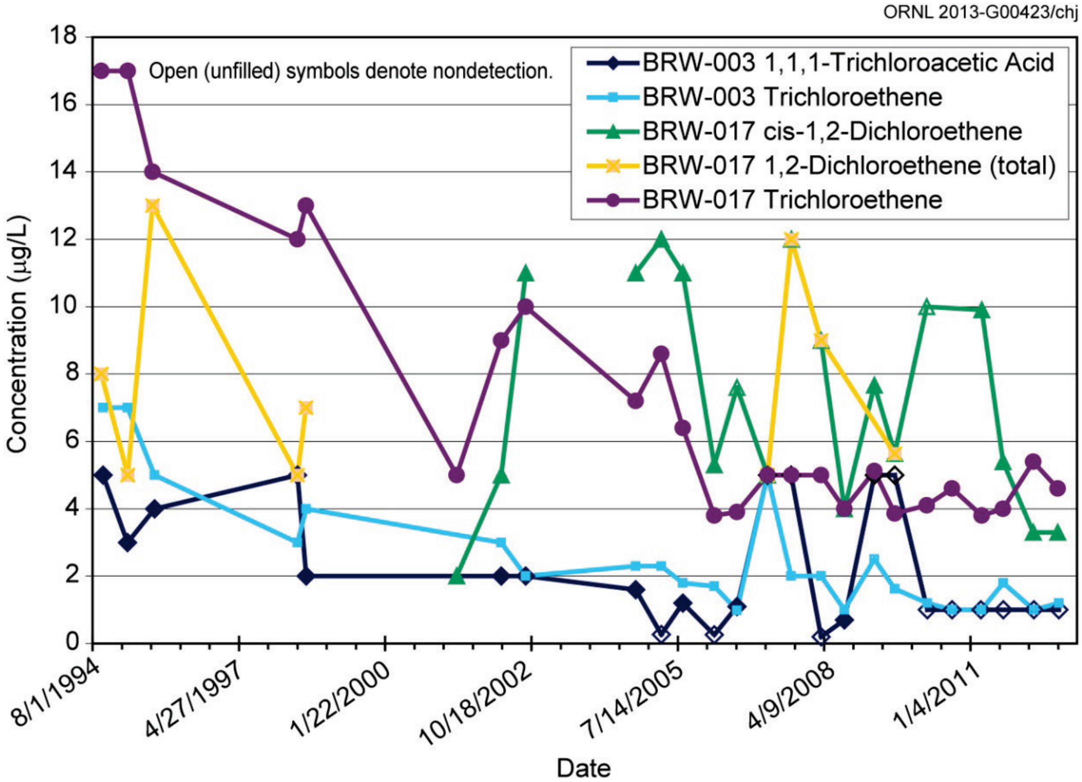

Fig. 3.45. Volatile organic compound concentrations in groundwater at K-1064 peninsula area.

K-31–K-33 area. Groundwater is monitored in four wells (BRW-066, BRW-030, UNW-080, and UNW-043) that lie between the K-31–K-33 area and Poplar Creek, as shown on Figure 3.43. VOCs are not COCs in this area; however, leaks of recirculated cooling water in the past have left residual subsurface chromium contamination. Figure 3.46 shows the history of chromium detection in wells in the K-31–K-33 area. 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 addition of acid preservative releases metals that are adsorbed to the solid particles at the normal groundwater pH. During FY 2006, an investigation was conducted to determine whether groundwater in the vicinity of the K-31 and K-33 buildings contained residual hexavalent chromium from recirculated cooling water leaks. The data indicated all the chromium in groundwater near the leak sites was essentially the less toxic trivalent species. From FY 2008 through FY 2012, field-filtered (i.e., dissolved) and unfiltered samples were collected from UNW-043. Chromium concentrations in the field-filtered samples are consistently much less than the MCL. During FY 2012, both field-filtered and unfiltered samples were collected from wells BRW-066, UNW-043, and UNW-080. In FY 2012 the chromium concentrations in unfiltered samples from well UNW-080 decreased significantly and were nearly the same as concentrations in the filtered sample. Chromium was not detected in any samples from well BRW-066.

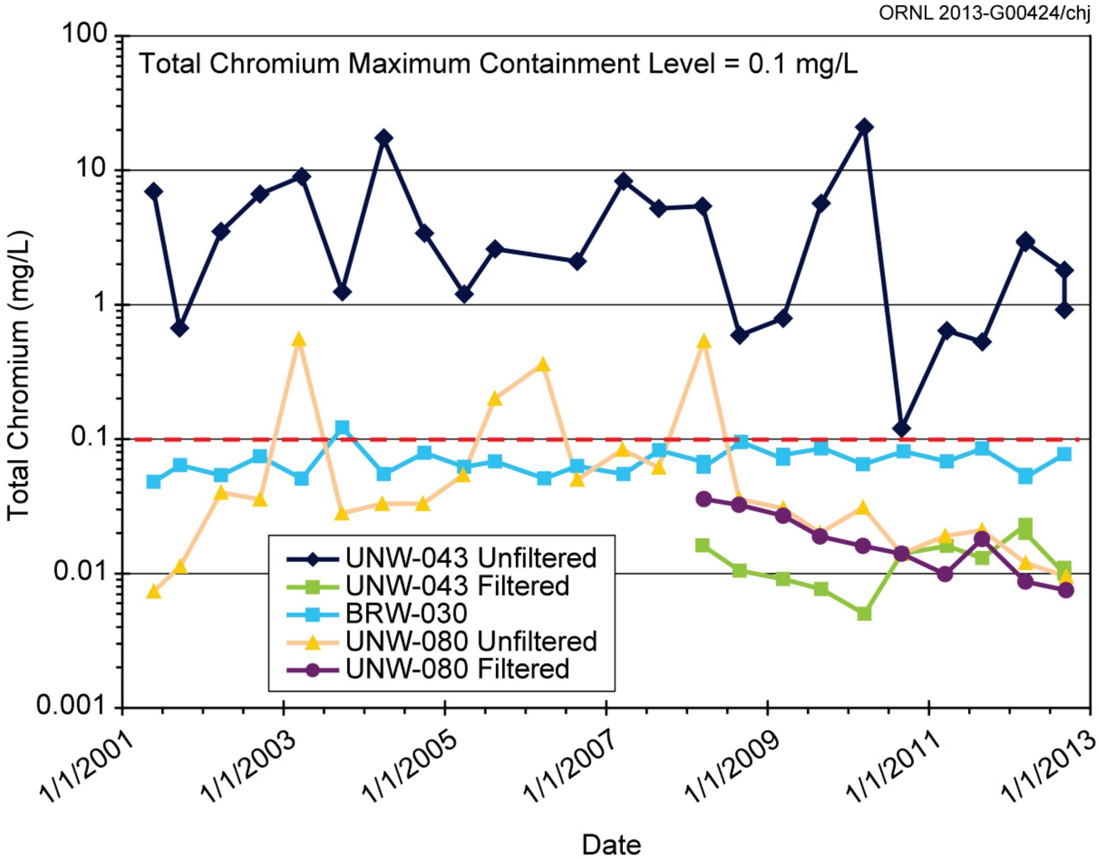

Fig. 3.46. Chromium concentrations in groundwater in the K-31–K-33 area.

K-27–K-29 area. Several exit pathway wells are monitored in the K-27–K-29 area, as shown on Figure 3.43. Figure 3.47 shows concentrations of detected VOCs in wells both north and south of K-27 and K-29 through FY 2012. The source of VOC contamination in well BRW-058 is not suspected to be from K-27–K-29 area operations. With the exception of cis-1,2-DCE in well BRW-058, which appears stable to slightly increasing but remains less than its MCL, the VOC concentrations in this area show slowly declining concentrations. TCE levels in well UNW-038 fluctuate between 10 and 20 times the MCL but show a gradually decreasing trend.

K-1007-P1 holding pond area. Wells BRW-084 and UNW-108 are exit pathway monitoring locations at the northern edge of the K-1007-P1 holding pond (see Figure 3.43). These wells were monitored intermittently from 1994 through 1998 and semiannually from FY 2001 through FY 2012. The first detections of VOCs in these wells occurred during FY 2006 with detection of low concentrations (~10 µg/L or less) of TCE and cis-1,2-DCE. The source area for these VOCs is not known. VOCs were not detected in either of these wells during FY 2012. Metals were detected and associated with the presence of high turbidity in the samples. Iron exceeded its secondary drinking water standard in the unfiltered aliquots from both semiannual sampling events but was not detectable in the field-filtered aliquots. Manganese exceeded its secondary drinking water standard in both the filtered and unfiltered samples from UNW-108 in the fourth quarter sampling event. Aluminum exceeded its secondary drinking water standard in the unfiltered aliquots from well UNW-108 during both FY 2012 sampling events but did not exceed the limit in the field-filtered aliquots. No other primary or secondary MCLs for metals were exceeded in sample aliquots that were field-filtered before acid preservation during FY 2012.

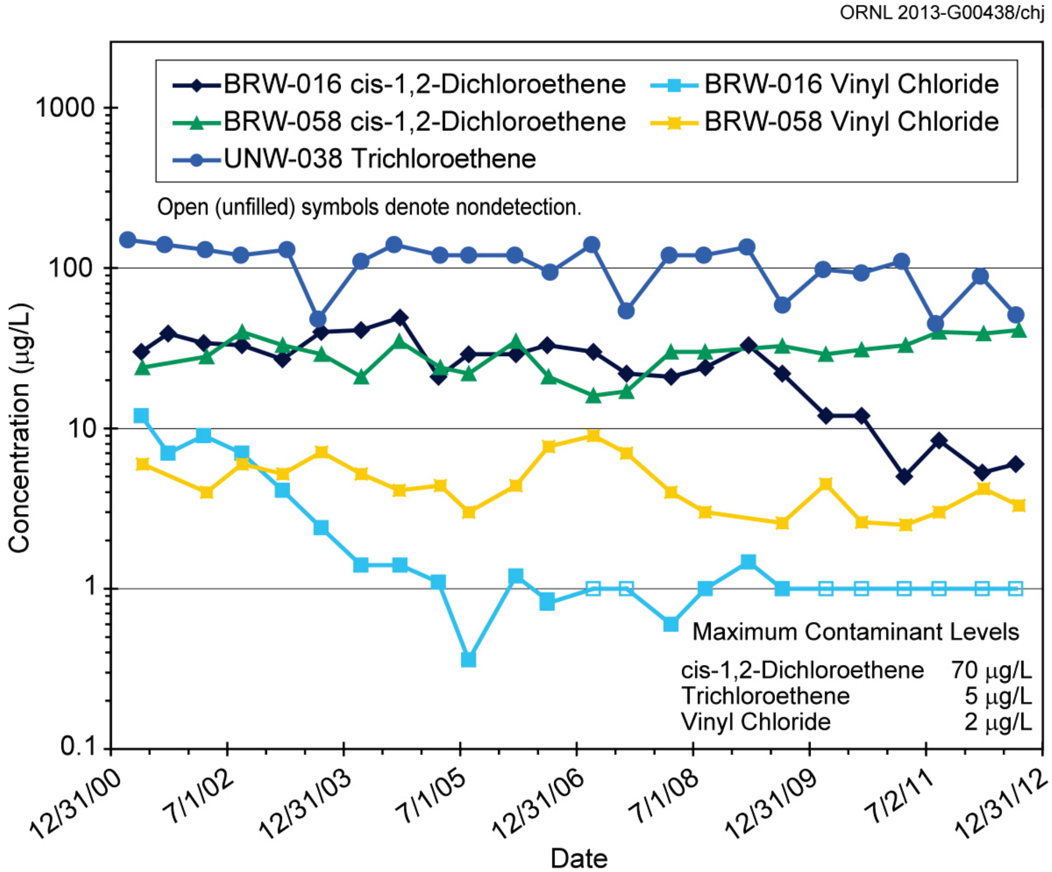

Fig. 3.47. Detected volatile organic compound concentrations in groundwater exit pathway wells near K-27 and K-29.

K-901-A holding pond area. Exit pathway groundwater in the K-901-A holding pond area (see Figure 3.43) is monitored by four wells (BRW-035, BRW-068, UNW-066, and UNW-067) and two springs (21-002 and PC-0). Very low concentrations (<5 µg/L) of VOCs are occasionally detected in wells adjacent to the K-901-A holding pond. However, these contaminants are not persistent in groundwater west and south of the pond. No VOCs were detected in the K-901-A holding pond exit pathway wells during FY 2012. Alpha and beta activity levels were less than 5 pCi/L and 15 pCi/L, respectively, for all wells.

TCE is the most significant groundwater contaminant detected in the springs, and the historic TCE concentrations are shown in Figure 3.48. 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. The contaminant source for the PC-0 spring is presumed to be disposed waste at the K-1070-F site. The TCE concentrations in the PC-0 spring have varied between about 9 and 26 µg/L and appear to have decreased from their highest measured value in 2006 to concentrations between about 2 to 3 times the drinking water standard. At spring 21-002, 1,1,1-trichloroethane, 1,2-DCE, carbon tetrachloride, and PCE are sometimes present at concentrations typically less than 5 µg/L. The TCE concentration at spring 21-002 tends to vary between 5 and about 25 µg/L, and this variation appears to be related to variability in rainfall, which affects groundwater discharge from the K-1070-A VOC plume. During FY 2012, TCE was detected above its MCL in both semiannual samples. In addition, low levels of alpha and beta activity were detected, as was ^{99}Tc, in the fourth quarter sample.

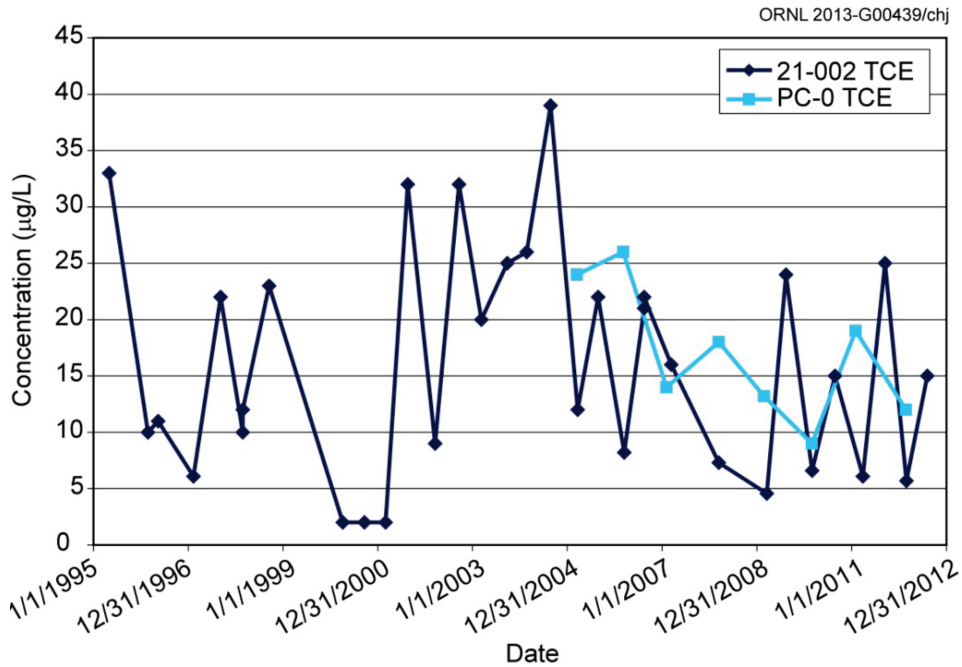

Fig. 3.48. Trichloroethene (TCE) concentrations in K-901 area springs.

K-770 area. Exit pathway groundwater monitoring is also conducted at the K-770 area, where wells UNW-013 and UNW-015 are used to assess radiological groundwater contamination along the Clinch River (see Fig. 3.43). Well UNW-015 could not be sampled in FY 2012 because of construction activities. Beta activity was detected at 19.8 and 61.4 pCi/L, respectively, for second and fourth quarter sampling of well UNW-013. Figure 3.49 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, which is a strong beta-emitting radionuclide responsible for the elevated beta activity in that well. The alpha and beta activity levels in the area groundwater exhibit stable but variable conditions.

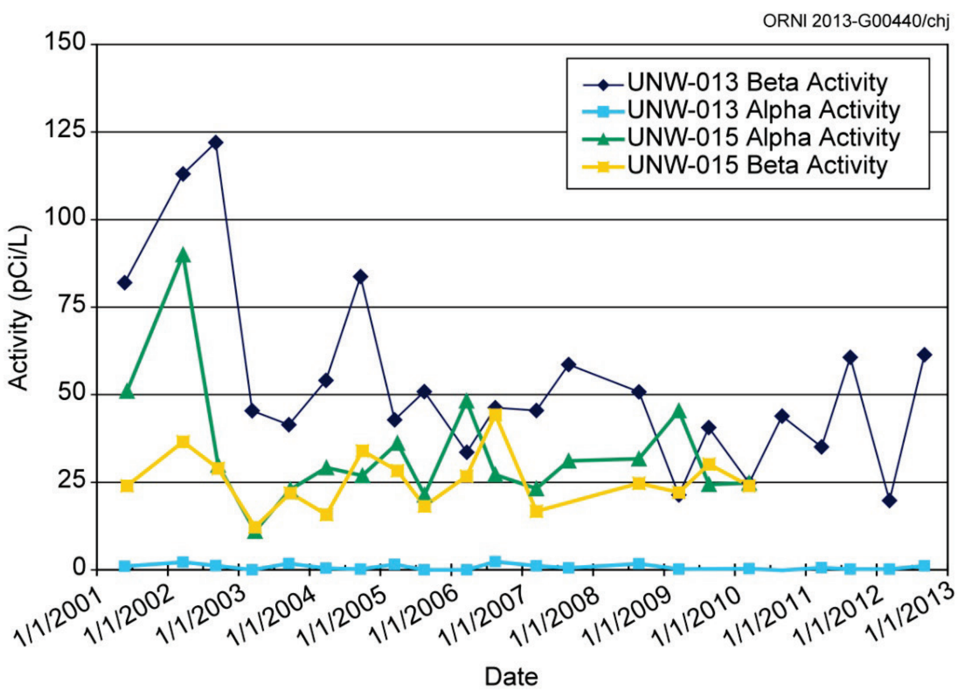

Fig. 3.49. History of measured alpha and beta activity in the K-770 area.

3.5.4.5 Groundwater Sampling Adjacent to Potential Source Areas

Additional monitoring of groundwater adjacent to potential sources of groundwater contamination, including the K-1070-C/-D burial ground, was conducted to monitor trends (DOE 2005). Monitoring will continue until a final Zone 2 ROD is approved.

3.5.4.6 Groundwater Sampling in the K-1407-B and K-1407-C ponds area at East Tennessee Technology Park

The *Remedial Action Report for the K-1407-B Holding Pond and the K-1407-C Retention Basin, Oak Ridge, Tennessee* (DOE 1995) proposes semiannual 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 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. 3.50.

Groundwater samples were collected at UNW-003 and UNW-009 during March and September 2012. Monitoring results for FY 2012 at the wells are consistent with results from previous years. Gross alpha activity was detected at 5.42 pCi/L in March and at 3.67 pCi/L in September at UNW-003 and was not detected at UNW-009 in March or August. Gross beta activity ranged from 9.55 to 29.3 pCi/L at UNW-003. Gross beta activity was detected at 5.9 pCi/L in March but was not detected in September at UNW-009. The radionuclide ^{99}Tc was detected at 12.5 pCi/L in March and at 36.8 pCi/L in September at UNW-003 and was not detected in either sampling round at UNW-009. Uranium-234 was not detected in UNW-009 but was detected at 4.17 pCi/L in March and 4.33 pCi/L in September in UNW-003.

None of the metals having primary drinking water standards exceeded those levels. Iron was elevated above its secondary drinking water standard in both filtered and unfiltered samples from UNW-009 and from only the unfiltered samples from UNW-003. The secondary standard for aluminum was exceeded in unfiltered samples from UNW-009 but was not detected in the field-filtered samples from either well. Manganese exceeded its secondary drinking water standard in both filtered and unfiltered aliquots from both wells during both sampling events. The elevated manganese and iron levels are likely caused by chemical reduction in the local groundwater induced by reductive dehalogenation of VOCs.

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. In FY 2012 significant concentrations of parent compounds PCE (150–520 µg/L) and TCE (1,700–5,500 µg/L) and the degradation products 1,1-DCE (300–920 µg/L), 1,1-DCA (410–1,100 µg/L), cis-1,2-DCE (1,100–3,000 µg/L), and vinyl chloride (23–150 µg/L) were detected at UNW-003. 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 nonaqueous phase liquids (DNAPLs) in the vicinity of this well. The Zone 2 final ROD will address groundwater contamination present in the area of the former ponds.

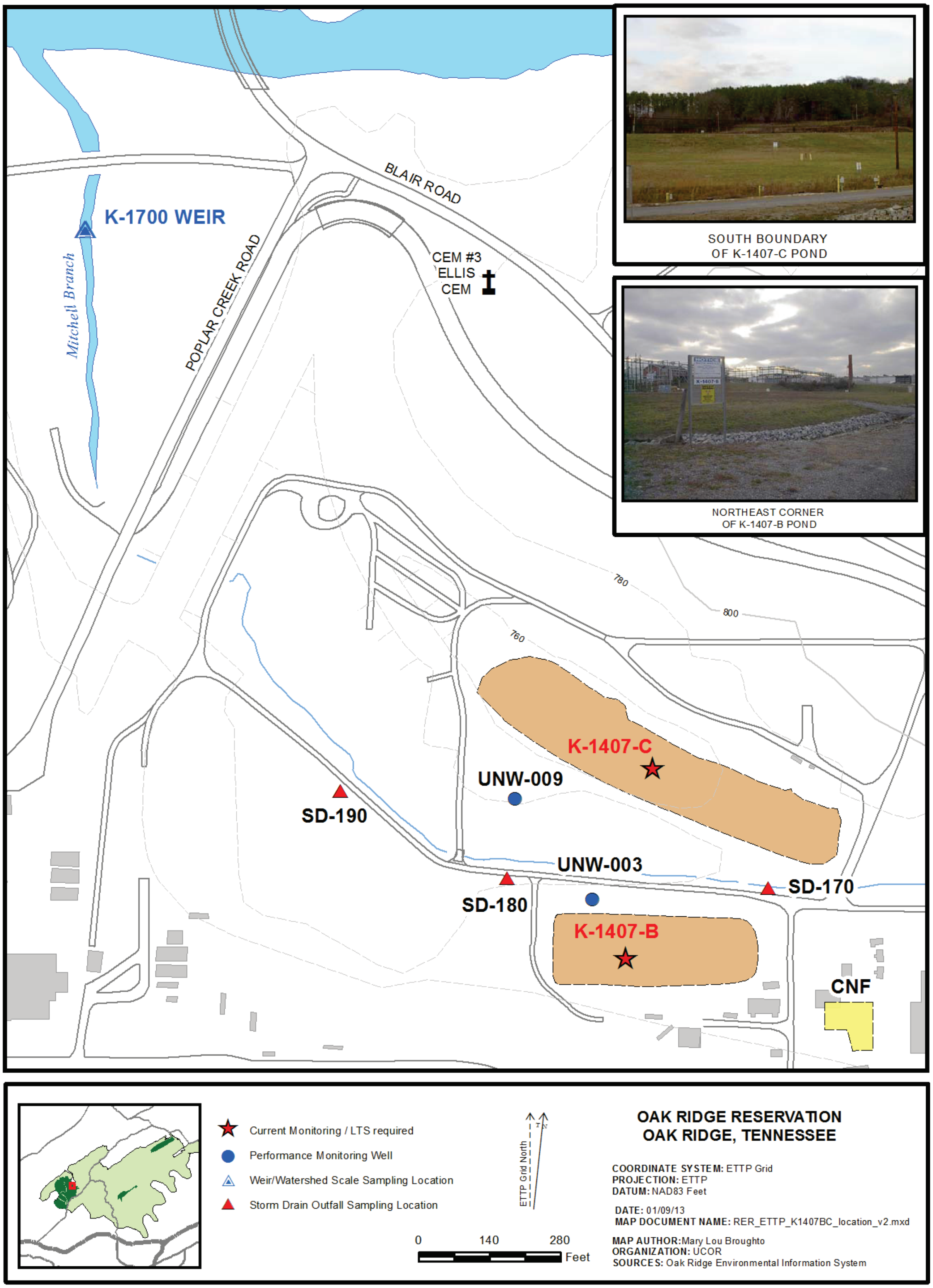

Fig. 3.50. Location of K-1407-B and K-1407-C ponds.

3.5.4.7 Groundwater Sampling Summary

During FY 2012, monitoring results for the groundwater locations indicated that contaminant levels are generally stable to decreasing in most instances. Collection and treatment of groundwater containing hexavalent chromium is ongoing and is protective of water quality in Mitchell Branch. Mercury detections at storm drain outfalls and the K-1700 weir indicate the need for additional investigation to identify potential mercury sources.

3.6 Biological Monitoring

The ETTP BMAP consists of three tasks designed to evaluate the effects of ETTP operations on the local environment, identify areas where abatement measures would be most effective, and test the efficacy of the measures. These tasks are (1) toxicity monitoring of effluent and ambient waters from several locations within Mitchell Branch, (2) bioaccumulation studies, and (3) instream monitoring of biological communities. Figure 3.51 shows the major water bodies at ETTP, and Fig. 3.52 shows the BMAP monitoring locations along Mitchell Branch.

In spring (April) and fall (October) of 2012, survival and reproduction toxicity tests using the water flea *Ceriodaphnia dubia* [(C. dubia); Fig. 3.53] were conducted at five ambient locations in Mitchell Branch. At the same time, survival and reproduction toxicity tests using *C. dubia* were conducted on effluent from storm water outfalls 170 and 190. In none of the 2012 tests was toxicity demonstrated (Table 3.22).

In 2012 caged clams *(Corbicula fluminea)* were placed at several locations around ETTP. The clams (Fig. 3.54) were allowed to remain in place for 4 weeks and were then analyzed for PCBs (Table 3.23) and total mercury and methylmercury. The spatial patterns of PCB concentrations in clams were generally consistent with those of previous years, although the concentration of PCBs in clams from almost all locations (the K-1007-P1 pond being the sole exception) decreased substantially from the concentrations found in the 2011 monitoring. While the concentrations of PCBs in clams from MIK 0.3, the K-1007-P1 pond, and storm water outfall 100 remain the highest of any tested at ETTP, and the concentrations of PCBs in the clams from the K-1007-P1 pond increased slightly from last year, the overall trend in the last several years has been of decreasing concentrations. Concentrations of PCBs in clams from the K-901-A pond remained considerably lower than those found in and around the K-1007-P1 pond. While three Aroclors (Aroclor 1248, 1254, and 1260) were detected in clams from the K-1007-P1 pond and the K-901-A pond, the primary Aroclor detected in clams from Mitchell Branch was Aroclor 1254.

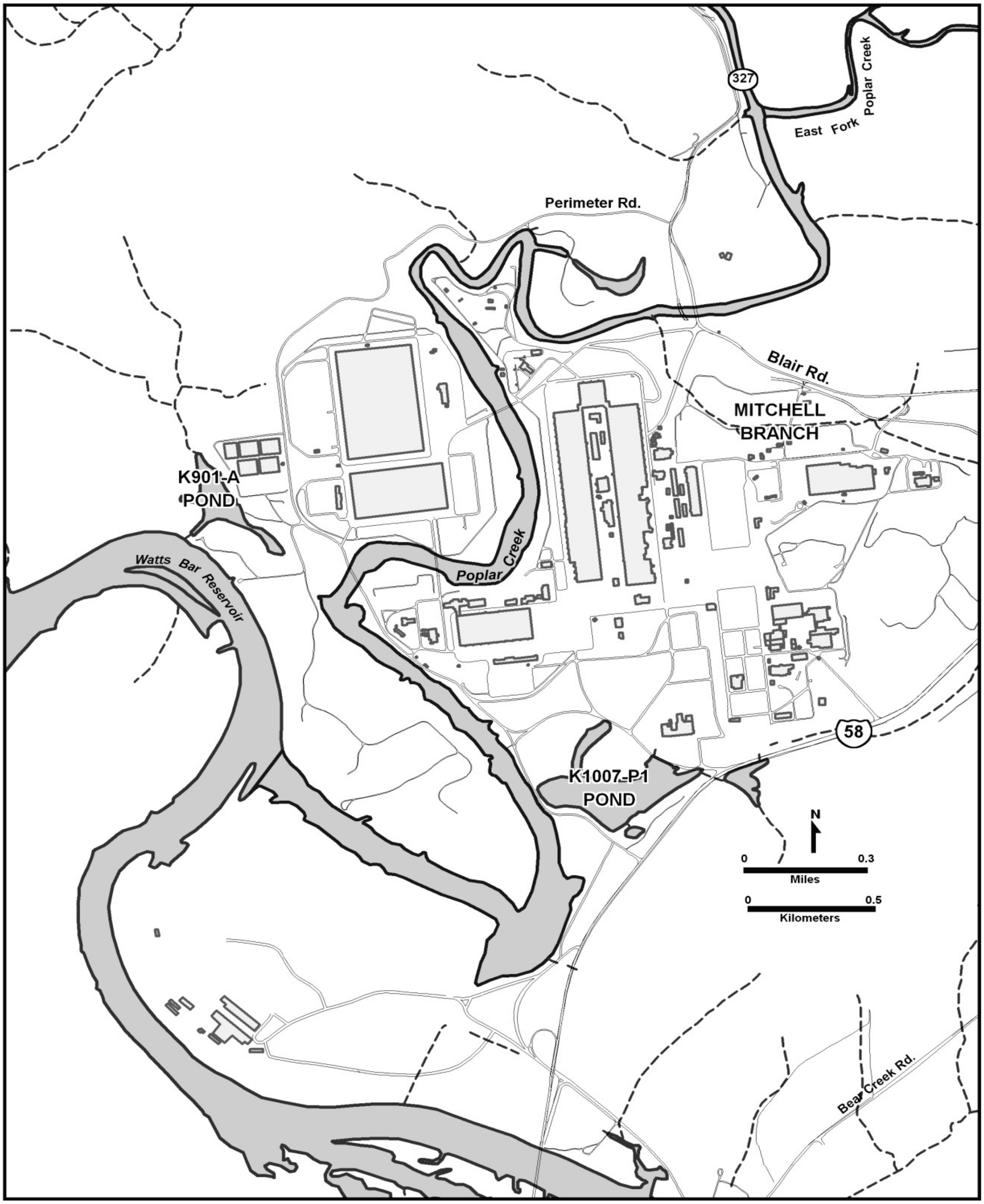

Fig. 3.51. Water bodies at the East Tennessee Technology Park.

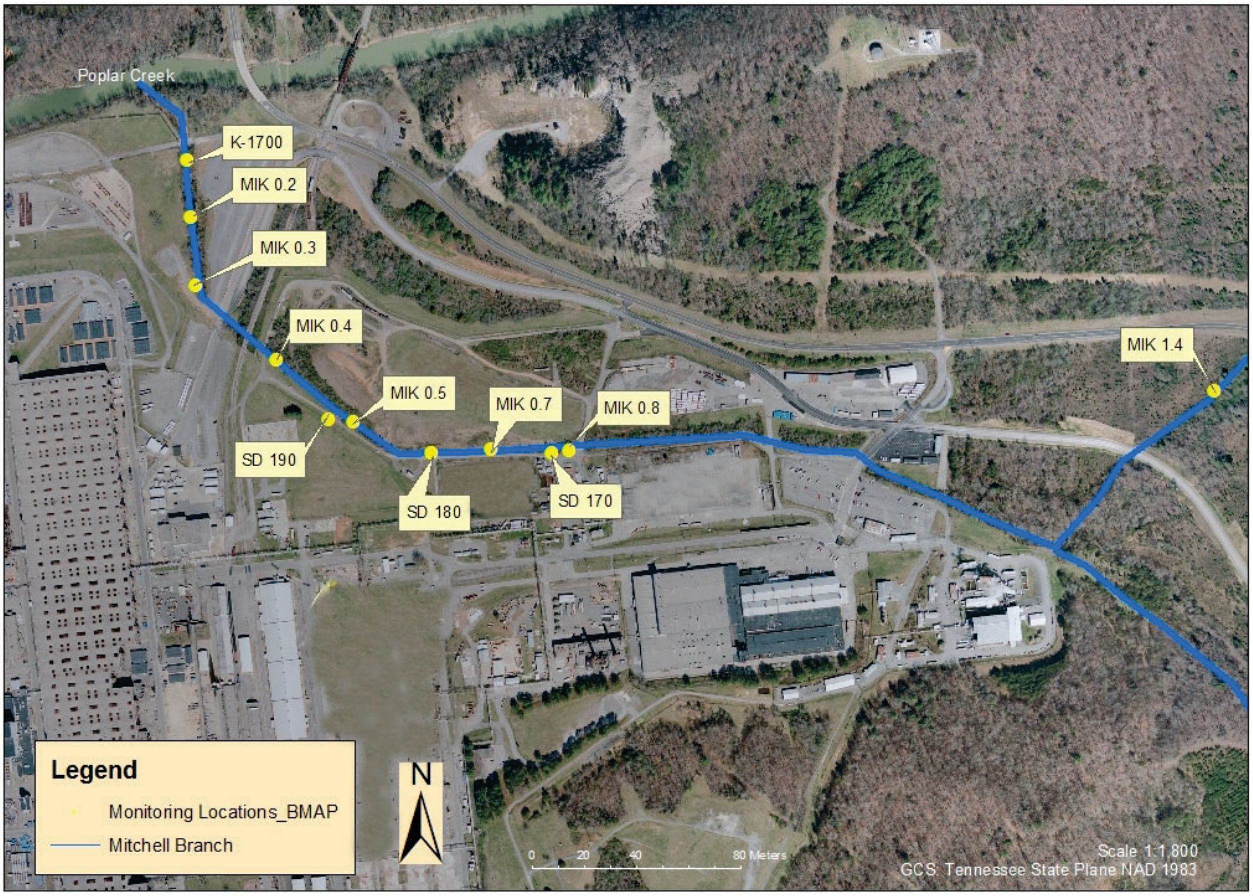

Fig. 3.52. Major storm water outfalls and biological monitoring locations on Mitchell Branch.

ORNL 2010-G00933/chj

Fig. 3.53. Water flea *(Ceriodaphnia dubia)*.

Table 3.22. Mitchell Branch and associated storm water outfall toxicity test results, 2012 (no-observed-effects concentrations)[a]

Season	Test	MIK 1.4	MIK 0.8	SD 170	MIK 0.7	SD 190	MIK 0.4	MIK 0.2
Spring	*Ceriodaphnia dubia* survival (%)	100	100	100	100	100	100	100
	C. dubia reproduction (%)	100	100	100	100	100	100	100
Fall	*C. dubia* survival (%)	100	100	100	100	100	100	100
	C. dubia reproduction (%)	100	100	100	100	100	100	100

[a]Highest tested concentrations of effluent or stream water which had no effect on either survival or reproduction of *C. dubia* in three-brood static renewal tests [EPA test method 1002.0, as cited in EPA/821-R-02-013 (EPA 2002a)].

Abbreviations
MIK = Mitchell Branch kilometer
SD = storm water outfall

Fig. 3.54. Asiatic clam (*Corbicula fluminea)*.

Table 3.23. Compiled data of PCB concentrations (µg/g, wet weight) in caged Asiatic clams (*Corbicula fluminea*), 2009–2012

Site	Basket[a]	2009	2010	2011	2012
		Mitchell Branch			
MIK 0.8 (above SD 170)	A	0.09	0.12	0.11	0.04
	B	0.11	0.13	0.15	0.04
SD 170	A	0.27	0.21	0.16	0.08
	B	0.25	0.28	0.16	0.15
MIK 0.7 (below SD 170)	A	0.18	0.15	0.13	0.08
	B	0.15	0.13	0.17	0.07
MIK 0.5 (below SD 180)	A	0.25	0.15	0.13	*b*
	B	0.20	0.17	0.16	*b*
SD 190	A	2.07	1.22	2.36	0.84
	B	1.98	1.09	1.70	*b*

Table 3.23. (continued)

Site	Basket[a]	2009	2010	2011	2012
MIK 0.4 (below SD 190)	A	0.90	1.28	1.71	0.41
	B	0.78	2.69	1.82	0.5
SD 195	A	—	—	—	0.37
	B	—	—	—	0.31
MIK 0.3	A	—	2.93	6.74	2.52
	B	—	3.42	4.56	2.74
MIK 027	A	—	—	4.42	—
	B	—	—	4.94	—
MIK 0.2	A	2.43	2.15	5.33	0.96
	B	2.42	2.13	4.82	1.41
SD 992	A	—	2.93	—	—
	B	—	3.42	—	—
Poplar Creek					
K-1203 Sump	A	—	—	—	0.34
	B	—	—	—	0.29
K1007-P1 Pond					
SD 100 (upper)	A	0.96	0.29	2.25	1.69
	B	0.69	0.22	1.75	1.70
SD 100 (lower)	A	1.32	0.72	5.95	*b*
	B	1.72	0.80	4.50	1.92
SD 120	A	0.34	3.06	0.75	0.11
	B	0.57	1.18	0.97	0.16
SD 490	A	0.40	0.37	0.39	0.19
	B	0.46	0.47	0.46	0.17
K1007 P1 outfall	A	0.91	—	—	—
	B	0.85	—	—	—
P1	A	0.86	0.99	1.38	1.48
	B	1.17	0.91	1.68	1.57
K-901-A Pond					
K-901-A outfall	A	0.14	0.06	0.30	0.07
	B	0.16	0.05	0.20	0.07
Reference Site					
Sewee Creek	A	0.02	0.01	0.00	0.01
	B	0.02	0.01	0.01	0.003

[a]Sample result is the reported concentration in the composited clam sample from each cage, where A and B denote replicates. Data are extracted from tables within the 2009, 2010, 2011, and 2012 East Tennessee Technology Park Biological Monitoring and Abatement Program fiscal year reports.

[b]Insufficient numbers of clams survived to provide a suitable sample size for analysis.

Abbreviations

MIK = Mitchell Branch kilometer

SD = storm water outfall

Clams from the Mitchell Branch watershed were analyzed for mercury (both total and methylmercury) in 2012 (Table 3.24). Although mercury was detected in all clams, the highest mercury concentrations for the Mitchell Branch watershed were found in the clams from the section between MIK 0.2 and storm water outfall 190, with concentrations of total mercury in the clams ranging from 85 ng/g to 323 ng/g. Results from the 2012 monitoring at storm water outfall 190 were significantly higher than those from previous years. The highest concentration of total mercury (472.3 ng/g) was found in the basket of clams placed at K-1203-10, near the site of the former ETTP STP. This location is the subject of more intensive investigation (see Section 3.5.2.6 for more details).

Bioaccumulation monitoring in the K-1007-P1 pond, K-901-A pond, K-720 slough, and Mitchell Branch involves sampling fish (Fig 3.55) and analyzing the tissues for PCB concentrations (Table 3.25). Typically, fillets of game fish are used as a monitoring tool to assess human health risks, while whole body composites of forage fish are used to assess ecological risks associated with exposure to PCBs. Target species vary from site to site depending upon the ecological conditions, and thus the available species. The target species for bioaccumulation monitoring in 2012 in the K1007-P1 pond was bluegill sunfish (*Lepomis macrochirus*) (Fig. 3.56). In Mitchell Branch, the target species was the redbreast sunfish (*Lepomis auritus*). In the K-901-A pond and the K-720 slough the target species were the gizzard shad (*Dorosoma cepedianum*) and largemouth bass (*Micropterus salmoides*). Because there were not enough largemouth bass, common carp (*Cyprinus carpio*) and smallmouth buffalo (*Ictiobus bubalus*) were also collected.

Whole body composites (six composites of 10 bluegill per composite) and fillets from 20 individual bluegill were analyzed for PCBs to assess the ecological and human health risks associated with PCB contamination in the K-1007-P1 pond. Average PCB levels in whole body composites from the K-1007-P1 pond averaged 9.25 mg/kg. Fillets averaged 2.16 mg/kg total PCBs, comparable to levels seen in 2011 (1.85 mg/kg). Average PCB concentrations in fillets of redbreast sunfish collected in Mitchell Branch were 1.67 mg/kg, slightly higher than the levels seen in 2011 (1.12 mg/kg). These levels are higher than the concentrations observed in fillets of largemouth bass from the K-901-A pond (0.72 mg/kg). In addition to being analyzed for PCBs, the redbreast sunfish collected from Mitchell Branch (MIK 0.2) were analyzed for total mercury (Table 3.26). Previous studies have shown that methylmercury accounts for more than 95% of the total mercury in fish, so a separate analysis for methylmercury was not conducted. The EPA recommended limit for mercury in fish fillets is 0.3 mg/kg. Levels of mercury in fish collected at MIK 0.2 were 0.37 mg/kg, slightly exceeding this limit and roughly unchanged from last year (0.34 mg/kg).

In April 2012, the benthic macroinvertebrate community at four Mitchell Branch locations (MIKs 0.4, 0.7, 0.8, and 1.4) was sampled by the ORNL Environmental Sciences Division using standard quantitative techniques; MIK 1.4 was the reference location. After 4 to 6 years of gradual improvement following construction of the interceptor trench in late 1997, the benthic macroinvertebrate communities at MIK 0.7 and MIK 0.8 have shown no major persistent change in trends of either the mean number of taxa (taxonomic richness of all taxa) or the mean number of pollution-intolerant taxa [taxonomic richness of the Ephemeroptera, Plecoptera, and Trichoptera (EPT)] (Fig. 3.57). Although the trend in taxa richness at MIK 0.4 has been similar to those at MIK 0.7 and MIK 0.8, trends in taxa richness of the pollution-intolerant taxa at MIK 0.4 suggest that there has been a persistent reduction in the number of these taxa at that site since 2006. These results show that the benthic macroinvertebrate community at MIK 0.4 continues to be negatively impacted, while the results for MIKs 0.7 and 0.8 suggest that the macroinvertebrate communities at those sites are becoming more similar to that of the reference site at MIK 1.4.

Table 3.24. Compiled data of mercury concentrations (ng/g, wet weight) in caged Asiatic clams (*Corbicula fluminea*), 2010–2012

Site	Basket[a]	2010	2011	2012 Total Hg	2012 Methyl Hg
		Mitchell Branch			
MIK 0.8 (above SD 170)	A		37	31.9	11.3
	B		46.9	32.2	14.3
SD 170	A	41.8	67.2	88.7	17.5
	B	49.5	80.7	62.3	16.5
MIK 0.7 (below SD 170)	A		37.7	46.2	17.8
	B		64.8	48.8	19.6
MIK 0.5 (below SD 180)	A	65.7	97.2	51.4	12.1
	B	57.6	154.8	*b*	
SD 190	A	137.4	109.9	127.8	12.9
	B	142.3	80.7	270	17.2
MIK 0.4 (below SD 190)	A		114	85	12.5
	B		102.3	104.8	23.5
SD 195	A			88.1	42.5
	B			79.5	39
MIK 0.3	A	203.4		311.7	30.3
	B	224.8		322.6	40
MIK 0.2	A	106.3	166.3	115.9	22.7
	B	117.6	187.9	136.6	56.2
		Poplar Creek			
K-1203-10 Sump	A	—	—	472.3	19.6
	B	—	—	336.2	13.1
		K1007-P1 Pond			
P1	A		23	25.6	11.3
	B		22.6	14.5	6.9
		K-901-A Pond			
K-901-A outfall	A		33.1	17.4	6.8
	B		46.4	27.6	8.9
		K-1203-10			
05A	A			472.3	
	B			336.2	
SD 992	A	24.6			
	B	24.9			
		Reference Site			
Little Sewee Cr	A	20.8	19.6	25.2	8.5
	B	36.4	27.2	19.1	9.2

[a]Sample result is the reported concentration in the composited clam sample from each cage, where A and B denote replicates. Data are extracted from tables within the 2010, 2011, and 2012 East Tennessee Technology Park Biological Monitoring and Abatement Program fiscal year reports.

[b]Insufficient numbers of clams survived to provide a suitable sample size for analysis.

Abbreviations

MIK = Mitchell Branch kilometer

SD = storm water outfall

ORNL 2010-G00935/chj

Fig. 3.55. Fish bioaccumulation sampling at K-1007-P1 pond.

Table 3.25. Polychlorinated biphenyl levels (mg/kg) in fish fillet samples at East Tennessee Technology Park, 2009–2012[a]

Site	Fish species	2009	2010	2011	2012
Mitchell Branch	Redbreast sunfish	0.99 + 0.47	1.17 + 0.13	1.12 + 0.21	1.67+ 0.16
K-901-A pond	Largemouth bass	0.48 + 0.12	—	0.50 + 0.08	0.72+ 0.10
K-901-A pond	Common carp	—	0.71 + 0.20	2.06 + 0.25	3.08+ 0.20
K-1007-P1 pond	Largemouth bass	14.85 + 5.44	0.30 + 0.05	—	—
K-1007-P1 pond	Bluegill sunfish	—	2.13 + 0.16	1.85 + 0.31	2.16+ 0.26
Hinds Creek	Redbreast sunfish	0.0007 + 0.0004	0.09 + 0.05	0.06 + 0.001	<0.06
K-720 slough	Largemouth bass	—	—	0.24 + 0.02	0.22+ 0.10
K-720 slough	Smallmouth buffalo	—	—	0.77 + 0.19	0.68+ 0.19
K-720 slough	Common carp	—	—	0.96 + 0.21	0.31+ 0.03

[a]Data are extracted from tables within the 2009, 2010, 2011, and 2012 East Tennessee Technology Park Biological Monitoring and Abatement Program fiscal year reports.

ORNL 2011-G00782/chj

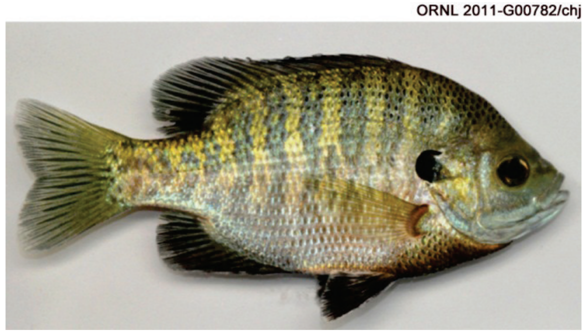

Fig. 3.56. Bluegill sunfish (*Lepomis macrochirus).*

Table 3.26. Total mercury levels (mg/kg) in fish fillet and whole body samples at East Tennessee Technology Park, 2009–2012[a]

Site	Fish species	2009	2010	2011	2012
Mitchell Branch	Redbreast sunfish	0.49 + 0.09	0.35 + 0.059	0.34 + 0.04	0.37 + 0.05
K-901-A pond	Gizzard shad (whole body)		0.086 + 0.021		
K-1007-P1 pond	Paddlefish (1 sample)		0.07		
K-1007-P1 pond	Bluegill sunfish		0.085 + 0.008		
Hinds Creek	Redbreast sunfish		0.08 + 0.01	0.07 + 0.01	0.058 + 0.005
K-720 slough	Gizzard shad (whole body)		0.067 + 0.006		

[a]Data are extracted from tables within the 2009, 2010, 2011, and 2012 East Tennessee Technology Park Biological Monitoring and Abatement Program fiscal year reports.

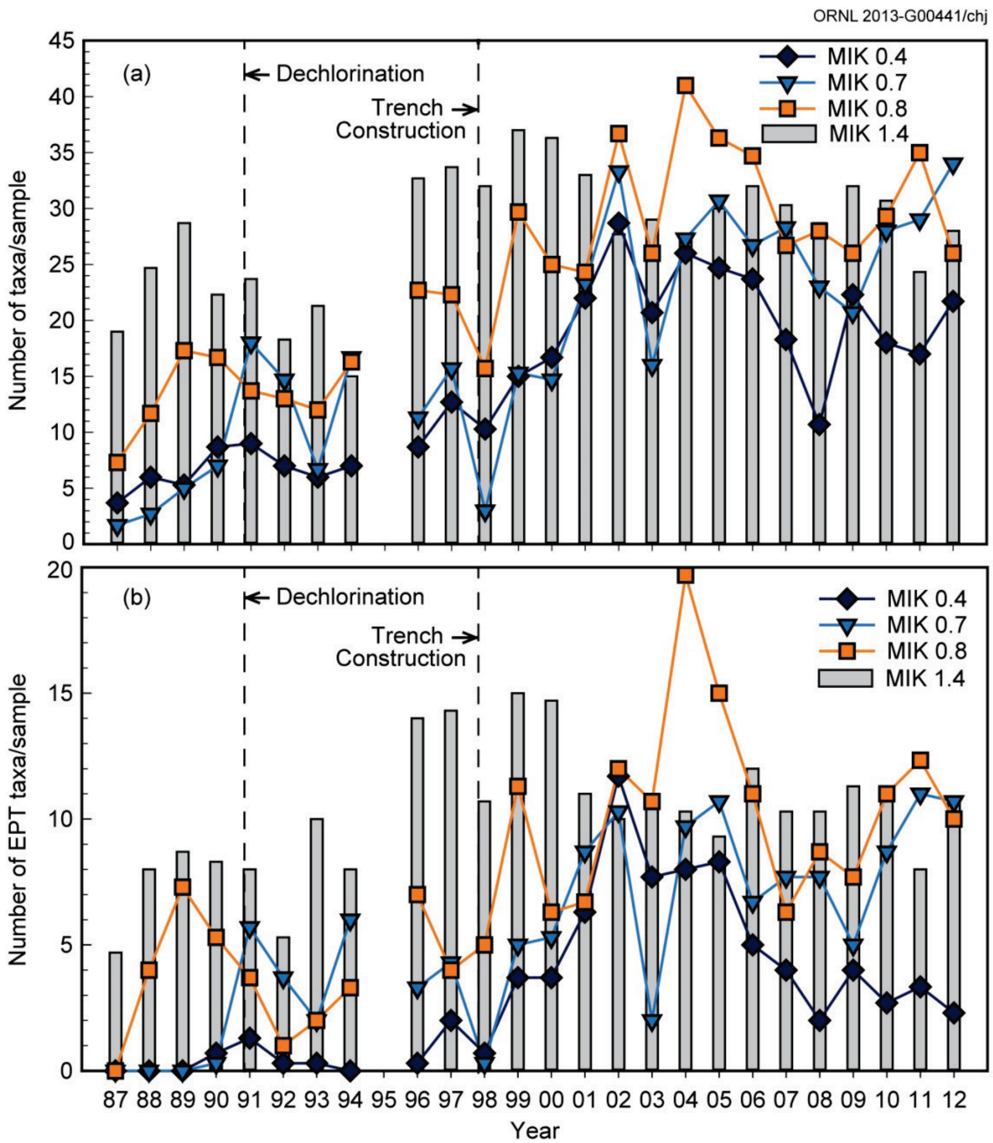

Fig. 3.57. Mean taxonomic richness in Mitchell Branch, 1987–2012: (a) number of all taxa and (b) number of the pollution-intolerant Ephemeroptera, Plecoptera, and Trichoptera (mayflies, stoneflies, and caddisflies or EPT). Samples were not collected in April 1995, as indicated by the gap in the bars. (MIK = Mitchell Branch kilometer.)

Since August 2008, TDEC protocols, which assess both community and habitat characteristics, have also been used at the MIK 0.4, 0.7, and 0.8 monitoring locations (Fig. 3.58). Beginning in August 2009, the use of TDEC protocols was expanded to include MIK 1.4 as well. In 2012, the biotic index (Fig. 3.59) indicated that the benthic macroinvertebrate communities at MIK 0.4, 0.7, and 0.8 were slightly impaired, while the community at MIK 1.4 was not impaired. Although the numbers of taxa at MIK 0.7 and 0.8 are similar to that of the community at MIK 1.4, the community at MIK 1.4 is richer in pollution-intolerant species. The habitat assessment (which primarily considers the physical aspects of the stream to determine its suitability to support biological communities) indicated that not all sampling locations along Mitchell Branch met the habitat goals for this region. In 2012, habitat at MIKs 0.7 and 0.8 met the habitat goals, while MIKs 0.4 and 1.4 scored as being moderately impaired. Overall, results using TDEC's semiquantitative protocols and ORNL's quantitative protocols since 2008 have been in general agreement that MIK 0.4 is moderately to severely impaired and that slight impairment remains at MIKs 0.7 and 0.8.

Fish communities in Mitchell Branch (MIK 0.4 and MIK 0.7) and at three local reference sites (Mill Branch kilometer 1.6, Scarboro Creek kilometer 2.2, and Ish Creek kilometer 1.1) were sampled in 2012. Species richness, density, and biomass were examined. Results for 2012 indicate a decrease in density and biomass and also a slight decrease in species richness from 2011 (Figs 3.60 through 3.62). Variations in these three parameters are typical of streams that have been severely impacted and are still recovering. While the condition of the fish communities over the last several years has been relatively stable, they have yet to reach conditions typical of less impacted streams in the area, and the stream is still dominated by more tolerant fish species.

Fig. 3.58. Benthic macroinvertebrate sampling using Tennessee Department of Environment and Conservation protocols.

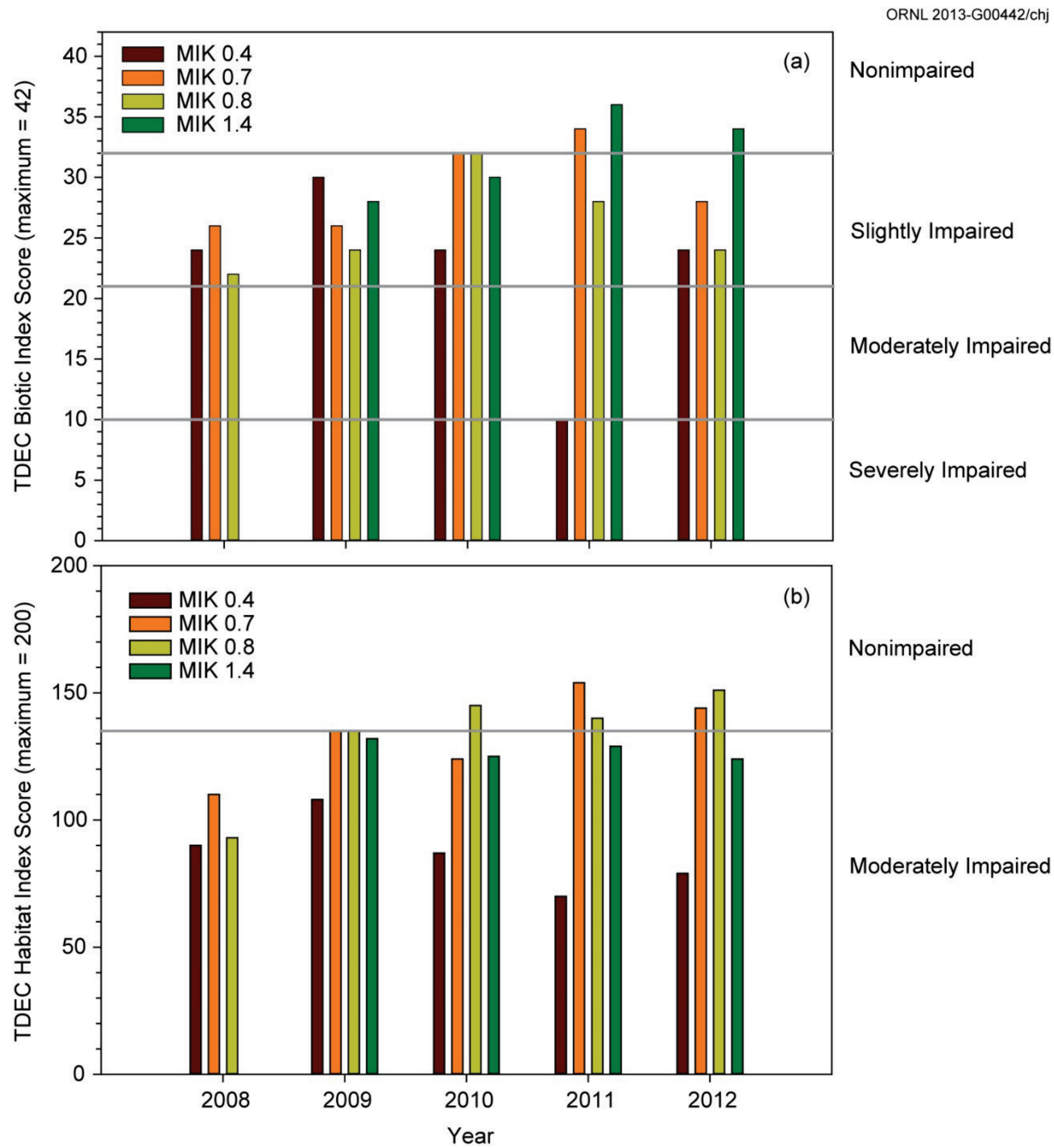

Fig. 3.59. Temporal trends in Tennessee Department of Environment and Conservation (TDEC) Benthic Macroinvertebrate Biotic Index (a) and Stream Habitat Index (b) scores for Mitchell Branch, August 2008–2012. Horizontal lines in both graphs show the lower thresholds for narrative index ratings; respective narrative ratings for each threshold are shown on the right side of each graph. (MIK = Mitchell Branch kilometer.)

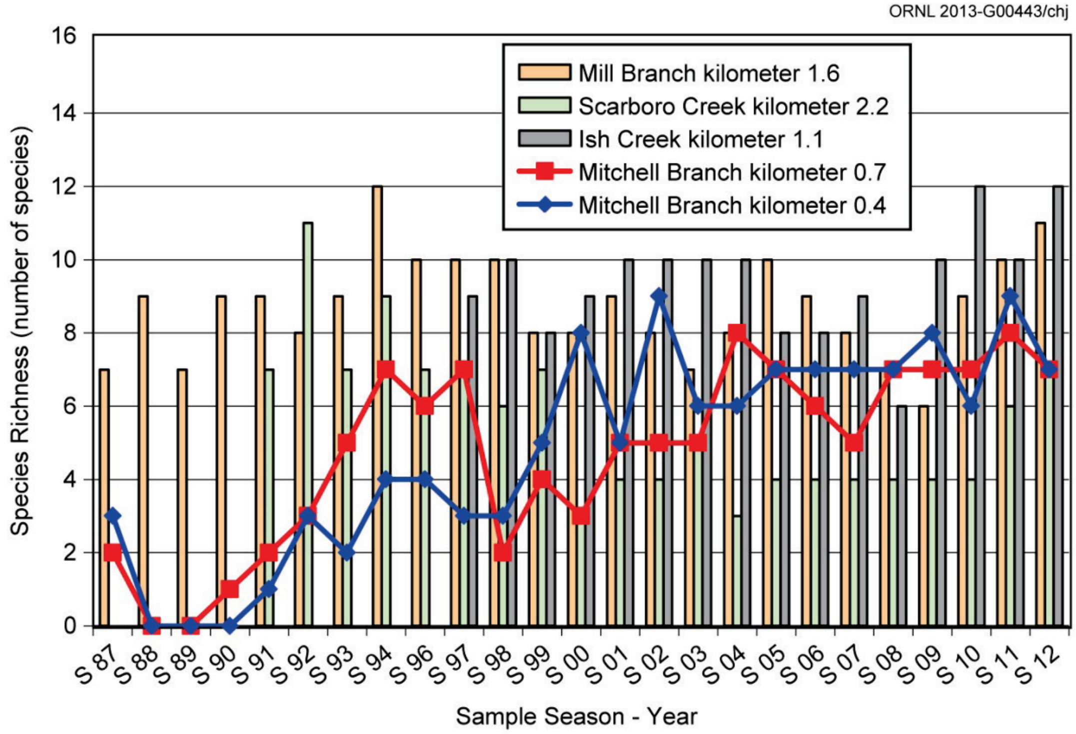

Fig. 3.60. Species richness for fish communities.

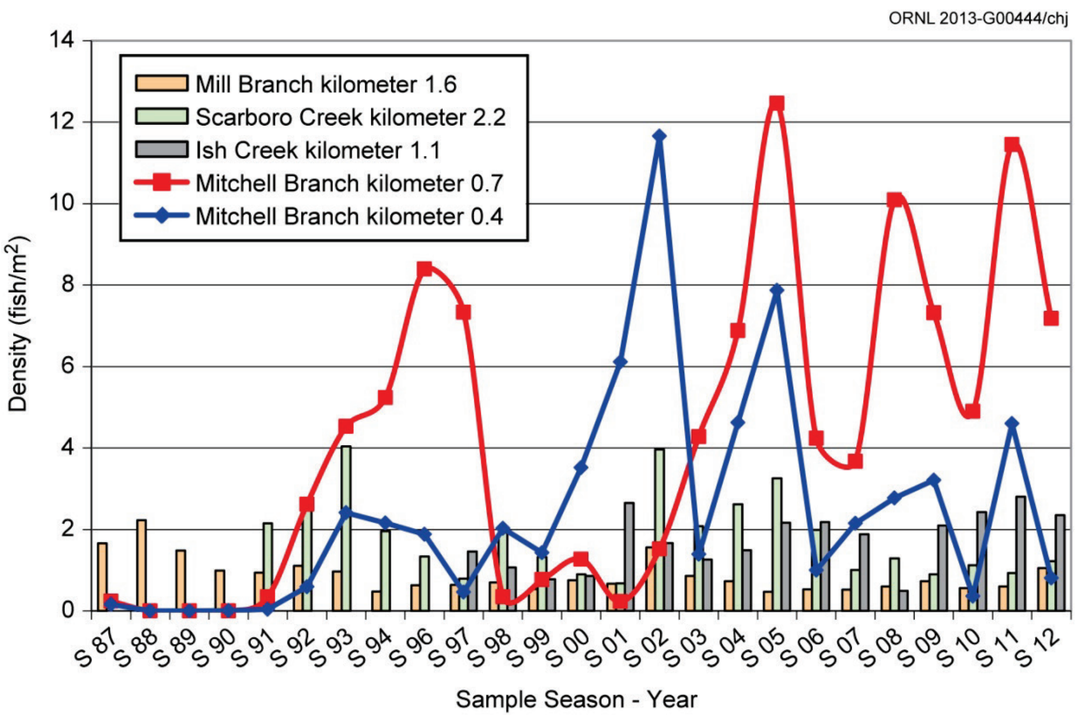

Fig. 3.61. Density for fish communities.

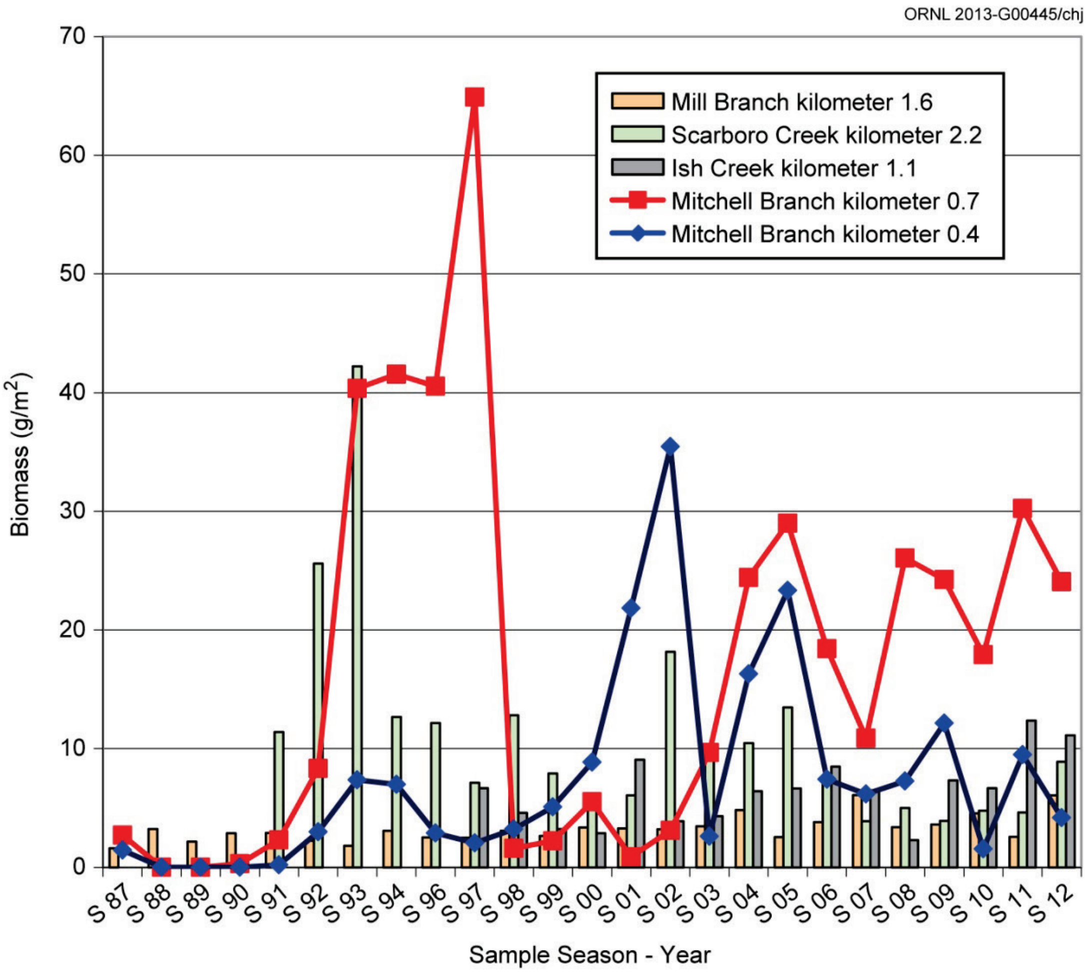

Fig. 3.62. Biomass of fish communities.

3.7 Quality Assurance Program

3.7.1 Integrated Assessment and Oversight Program

QA program implementation and procedural and subcontract compliance are verified through the UCOR Integrated Assessment and Oversight Program. The program identifies the processes for planning, conducting, and coordinating assessment and oversight of UCOR activities, including both self-performed and subcontracted activities, resulting in an integrated assessment and oversight process. The program is composed of three key elements: (1) external assessments conducted by organizations external to UCOR, (2) independent assessments conducted by teams independently of the project/function being assessed, and (3) management assessments and surveillances conducted as self-assessments and surveillances by the organization or on behalf of the organization manager.

Self-assessments are performed by the organization/function with primary responsibility for the work, process, or system being assessed. Organizations and functions within the company plan and schedule self-assessments. Self-assessments encompass both formal and informal assessments. The formal self-assessments include management assessments and surveillances and subcontractor oversight. Informal self-assessments include weekly inspections and routine walkthroughs conducted by subcontractor coordinators, ES&H representatives, quality engineers, and line managers.

Conditions adverse to quality identified from internal and external assessments are documented, causal analyses are performed, and corrective actions are developed and tracked to closure. Analyses are conducted periodically to identify trends for management action. Senior management evaluates data from those processes to identify opportunities for improvement.

3.8 Environmental Management and Waste Management Activities

3.8.1 Waste Management Activities

Restoration of the environment, D&D of facilities, and management of the legacy wastes constitute the major operations at ETTP.

The TSCA Incinerator located at ETTP was shut down permanently on December 2, 2009, after treating 35.6 million lb of liquid and solid waste over a 19-year period. The TSCA Incinerator was a one-of-a-kind thermal treatment unit. It played a key role in treating radioactive PCBs and hazardous wastes (mixed wastes) from ORR and other facilities across the DOE complex, thus facilitating compliance with regulatory and site closure milestones. The certified closure report was submitted to TDEC and EPA in June 2011. Efforts to encapsulate remaining PCB and radioactive contamination, to minimize water management actions, and to reduce the cost of ongoing surveillance and maintenance continued through 2012. Other activities included cleaning, rinsing, and filling multiple sumps and removing and disposing carbon vessels that were part of the water management system. Upon completion of these activities, the facility will be under surveillance and maintenance until demolition.

EMWMF, located in Bear Creek Valley west of the Y-12 Complex, is an engineered landfill that accepts waste generated from cleanup activities on ORR. It currently consists of six disposal cells with a total disposal capacity of 2,180,000 yd^3. In addition, leachate storage tanks, contact water storage ponds, and contact water storage tanks provide the facility's water management capability. EMWMF accepts low-level radioactive and hazardous wastes that meet specific waste acceptance criteria developed in accordance with agreements with state and federal regulators. Waste types that qualify for disposal include soil, dried sludge and sediment, solidified waste, stabilized waste, building debris, scrap equipment, and personal protective equipment. During FY 2012, EMWMF operations collected, analyzed, and dispositioned about 5.6 million gal of leachate at the ORNL Liquid and Gaseous Waste Operations Facility. An additional 16.5 million gal of contact water was collected, analyzed, and released to the storm water retention basin after it was determined that the water met the release criteria. EMWMF received about 16,660 truckloads of waste accounting for about 185,000 tons during FY 2012. Projects that have disposed of waste at EMWMF during fiscal year 2012 include the following:

- K-25 Building Demolition Project;
- K-33-Building Demolition Project;
- ETTP Decontamination and Decommissioning Project, including the K-1070-B burial ground;
- Y-12 Old Salvage Yard Project;
- Alpha 5 Project; and
- several ORNL demolition projects.

EMWMF began operations in 2002 to provide on-site waste disposal capacity from remediation efforts across ORR. Although it has been expanded to its maximum capacity, EMWMF will not be able to handle all of the waste expected to be generated from reservation cleanup activities.

Further expansion at EMWMF is constrained by physical limitations of the site. Therefore, DOE began evaluating disposal alternatives in FY 2010 for future reservation waste cleanup. In September 2012 DOE issued an RI/FS that evaluated the following alternatives:

- no action,
- on-site disposal (constructing and operating a new disposal facility on the reservation), and
- off-site disposal (shipping to an off-site facility).

The on-site disposal alternative would provide consolidated disposal of most future-generated CERCLA waste in a newly constructed, engineered facility referred to as the Environmental Management Disposal Facility. This would require permanent commitment of land and has the potential to impact environmental resources, but it would be less costly than the off-site disposal alternative and would provide a greater level of certainty that long-term disposal capacity would be available.

The off-site disposal alternative would involve transporting future CERCLA waste for disposal in approved disposal facilities in Nevada and Utah. The alternative would isolate waste more effectively due to the arid climate and fewer receptors.

CNF ceased accepting waste in December 2012 to begin the decommissioning process. The facility was ETTP's primary wastewater treatment facility and processed both hazardous and nonhazardous waste streams arising from multiple waste treatment facilities and remediation projects. The facility removed heavy metals and suspended solids from the wastewater, adjusted pH, and discharged the treated effluent into the Clinch River. Sludge from the treatment facility was treated, packaged, and disposed of off-site. The main waste streams in 2012 were the hexavalent-chromium-contaminated groundwater collected from the chromium collection system near Mitchell Branch and wastewaters generated at the TSCA Incinerator, including remediation and investigation projects to support the TSCA Incinerator closure activities. CWTS is a smaller water treatment unit that sits within the existing CNF footprint. CWTS came online in late 2012 and will handle purge water from groundwater monitoring as well as the chromium collection system water.

At ORNL, about 117 million gal of wastewater was treated and released at the Process Waste Treatment Complex. In addition, the liquid low-level waste (LLW) evaporator at ORNL treated 163,610 gal of such waste, and the ORNL 3039 Stack Facility treated a total of 2.2 billion m^3 of gaseous waste.

These waste treatment activities supported both EM and Office of Science mission activities in a safe and compliant manner during FY 2012. NNSA at the Y-12 Complex treated 134 million gal of contaminated ground/sump water at the Groundwater Treatment Facility, Central Mercury Treatment System, Big Springs Water Treatment System, and East End Volatile Organic Compounds Treatment System.

The Big Springs Water Treatment System treated 116 million gal of mercury-contaminated groundwater. The East End Volatile Organic Compound Treatment System treated 12 million gal of VOC-contaminated groundwater. The West End Treatment Facility and the Central Pollution Control Facility at the Y-12 Complex processed more than 950,000 gal of wastewater primarily in support of NNSA operational activities. The Central Pollution Control Facility also down-blended more than 64,000 gal of enriched wastewaters using legacy and newly generated uranium oxides from on-site storage.

The ORR landfills are located near the Y-12 Complex and are designed for the disposal of sanitary, industrial, construction, and demolition wastes that meet the waste acceptance criteria for each landfill. In FY 2012, about 44,351 yd^3 of waste was disposed of at these facilities, and about 1.2 million gal of leachate was collected, monitored, and discharged to the Y-12 Complex sanitary sewer system.

3.8.2 Environmental Restoration Activities

ETTP operated as an enrichment facility for four decades during which time many of the buildings became contaminated to some degree with radionuclides, heavy metals, and toxic organic compounds. In addition, large quantities of wastes were generated, much of which was stored on the site.

ETTP's Environmental Management Program was created with the goal of demolishing all unnecessary facilities and restoring the site to a usable condition. The safety and health of employees and the public is a constant focus. Cost-effectiveness is also a major consideration in the cleanup operations.

DOE has signed two of three key CERCLA RODs with the State of Tennessee and EPA authorizing environmental restoration of about 890 ha (2,198 acres) of land at ETTP. The area encompasses about 567 ha (1,401 acres) outside the main plant security fence (Zone 1) and about 324 ha (800 acres) inside the fence within the former plant production area (Zone 2). The main objectives of the two decisions are to protect future industrial workers and the underlying groundwater from contamination in soil, slabs, and subsurface structures. The Zone 1 interim ROD was signed in November 2002 and covers the 567 ha area surrounding ETTP outside the main plant perimeter. The Zone 2 ROD was signed in April 2005 and covers the roughly 324 ha in the main plant area. The final sitewide ROD for groundwater, surface water, sediment, and ecological soil risk is in development.

From the time cleanup operations began through FY 2012, 374 facilities have been demolished, 1.77 million yd^3 of waste has been removed from the site, and 567 ha (1,400 acres) of land has been cleared for unrestricted use. In addition, about 7,000 old UF_6 cylinders were removed from the site.

When ORR was established, in addition to the three major facilities, a buffer zone was also included between the three facilities and areas open to the public. This area, about 8,140.5 ha (20,100 acres) in extent, has little or no process-related history. However, with the listing of ORR on the National Priority List in 1989, the possibility of contamination had to be investigated. Beginning in 2008, DOE initiated a process to achieve FFA party consensus that the buffer parcels require no further investigation and to modify the FFA appendixes to better represent the known contaminated areas. ORAU was contracted to complete the verification activities (initiated in the late 1990s as a footprint reduction project), including review of historical documents; sampling and analysis; risk analysis; and reporting of study results, with recommendations for no further investigation where appropriate. The first Environmental Baseline Survey Report (EBSR), addressing five parcels around ETTP totaling about 1,863 ha (4,600 acres), was submitted in September 2011, and regulator comments were received in 2012. The second EBSR, addressing 14 parcels of about 6,278 ha (15,500 acres) total around ORNL and Y-12, was submitted in September 2012. Based upon these reports, a total of 7,817 ha (19,300 acres) could be approved for no further investigation.

3.8.2.1 K-25 Building Demolition

Building K-25 (Fig. 3.63), built during the Manhattan Project, occupied about 16 ha (40 acres) and contained more than 3,000 stages of gaseous diffusion and associated auxiliary equipment. Each stage consisted of a converter, two compressors, two compressor motors, and associated piping. In 2011, demolition of the east wing began. Demolition work continued through 2012. Workers completely cut through a portion of the east wing to segregate a portion of the building contaminated with ^{99}Tc from the rest of the demolition area. Predemolition activities in that area included characterization, vent, purge, drain, and inspection; foaming of components to stabilize contaminants in place; asbestos removal; and draining lubricants and coolants. As a cost saving initiative, equipment for the demolition is being borrowed from other DOE sites wherever practical. These materials, with an initial purchase cost of $2,450,000, were obtained for use at ETTP for less than $100,000. Debris from the demolition project is largely being sent to EMWMF for disposal.

ORNL 2011-G00821/chj

Fig. 3.63. Building K-25 after demolition of the west wing.

3.8.2.2 K-33 Building Demolition

Building K-33 was a multistory building that was built in 1954 as a uranium enrichment process building. The building covered 13 ha (32 acres) and contained more than 1.4 million yd^3 of concrete and steel. The building had been largely decontaminated under an earlier project. In 2011, the building was completely demolished and the debris removed to EMWMF. In FY 2012 the building's 13 ha (32-acre) slab was excavated and removed. Contaminated soil was removed and the area was backfilled and seeded.

3.8.2.3 K-27 Building Demolition

Building K-27 is a multistory building that was built as a uranium enrichment process building. The building is about 900 ft long, 400 ft wide, and 58 ft high. In 2012, predemolition work included inventory management; collection of nondestructive assay measurements of process pipe; vent, purge, drain, and inspection of process equipment; removal of high-hazard sodium fluoride traps; and installation of safety controls.

3.8.2.4 Groundwater Treatability Study

A two-phase groundwater treatability study at ETTP began in FY 2009 to support selection of a sitewide groundwater remedy. The purpose of the study was to determine the feasibility of in situ treatment technologies to restore the groundwater. In the first phase of the study, to characterize and delineate suspected areas of solvent contamination, seven boreholes were installed to depths of 110 to 160 ft below ground surface in FY 2009. In FY 2010, DNAPL was detected in one of the boreholes in the vicinity of the former K-1401 vapor degreasing tank. DNAPLs are a group of organic substances that are relatively insoluble in water and denser than water. Seven additional boreholes were installed to further delineate the lateral extent of DNAPL contamination.

In 2012, the study was closed and the wells grouted to limit the spread of contamination until the treatability study is resumed.

3.8.2.5 Soil, Burial Ground, and Exposure Unit Remediation Activities

The soil at ETTP is to be remediated to a level that protects a future industrial workforce and the underlying groundwater. RODs detailing the selected cleanup methods are in place and address soil, slabs, subsurface structures, and burial grounds for both zones.

Remediation of the soils in Zone 1 was completed in 2011. In 2012, a final RI/FS was prepared to support development of a final Zone 1 ROD. Activities included conducting groundwater, soils, surface water, and land use control workshops to review data and develop an alternative for the feasibility study. The first draft RI/FS was transmitted to the regulators in March 2012; regulator comments were received in August 2012.

In Zone 2, remediation of the 2.6 ha (6.5-acre) K-1070-B burial ground was completed. In 2012, excavation of six trenches and two hotspots in the burial ground was completed. At the end of FY 2012, about 100,000 yd^3 was excavated from the K-1070-B burial ground and shipped for disposal at the appropriate disposal facilities. After excavation, the site was graded and contoured. A cover was placed in the burial ground that consisted of a combination of layers of riprap/concrete rubble, backfill, and topsoil for seeding. The project received more than 4,100 dump truck loads of concrete rubble, riprap, backfill, and topsoil to provide the final cover for the burial ground.

3.8.2.6 Mitchell Branch Chromium Collection System

Surveillance monitoring of water from Mitchell Branch indicated elevated levels of hexavalent chromium. While the source of this chromium has not been positively identified, it is believed to be the result of historical uses somewhere in the watershed. A collection system was installed to intercept the chromate water and pump it for treatment. In 2012, CWTS began operation and will provide long-term treatment of the collected chromium-contaminated water. Since the installation of this system and subsequent modifications to increase pumping rates, chromium levels in Mitchell Branch have been reduced to well below the WQC and near or below the detection limit.

3.8.3 Reindustrialization

The DOE Oak Ridge Reindustrialization Program continued the transformation of ETTP into a private sector business-industrial park in FY 2012 (Fig. 3.64).

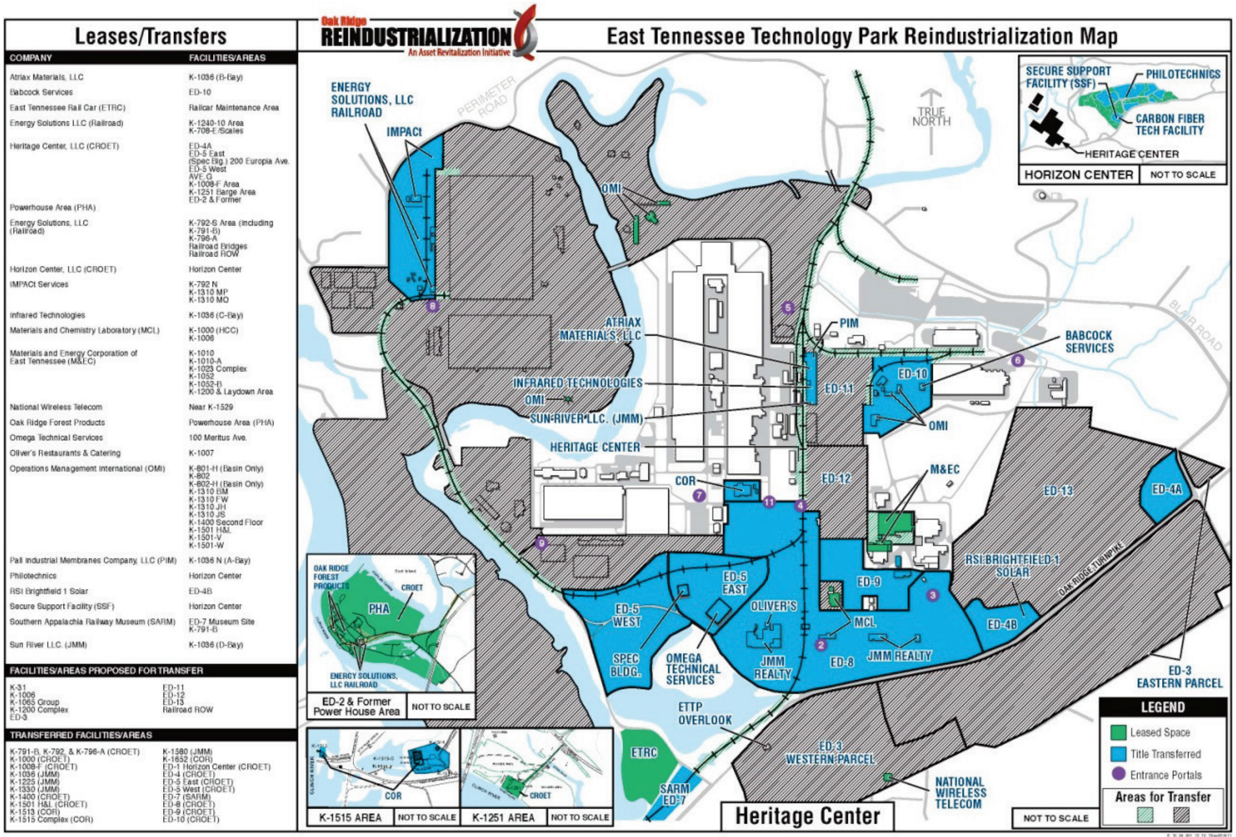

Fig. 3.64. East Tennessee Technology Park reindustrialization status, CY 2012.

With the transfer of Parcel ED-10 to CROET, an additional 5.3 ha (13 acres) in the central area of ETTP was made available for private use. Babcock Services purchased 1 ha (2.5 acres) of Parcel ED-10 and began construction of an 11,400 ft^2 facility. The property will be used to manage, recover, and refurbish radioactively contaminated components from commercial nuclear power plants and is projected to create more than 100 jobs.

An additional 12 ha (26.5-acre) parcel in the former powerhouse area along the Clinch River was made available via a lease to CROET for industrial development, increasing the total to 125 ha (308 acres). Oak Ridge Forest Products is leasing a portion of this site from CROET in support of its operations to supply wood chips that fuel a biomass gasification plant at ORNL.

In spring 2012, a 200 kW photovoltaic solar farm at the entrance to ETTP began generating enough electricity to power 22 homes. The land for the solar farm was purchased from CROET by RSI, the developer and operator of the system. This project required collaboration with TVA, DOE, UCOR, and the City of Oak Ridge.

The new $35 million Carbon Fiber Technology Facility (CFTF) at Oak Ridge's Horizon Center is nearing completion. This advanced materials facility will allow researchers to develop and demonstrate the commercial viability of low cost carbon fiber products for several industry sectors. Although carbon fiber has long been considered a desirable lightweight substitute for steel and other materials, its use has been limited due to its high production costs. The development of low cost production methods is expected to create new possibilities for carbon fiber use in a wide array of applications such as building structures, industrial products, and wind turbines.

DOE ORO hosted an Asset Revitalization Workshop in June 2012. The workshop brought together DOE officials, government contractors, and community stakeholders from across the nation to gain a better understanding of transitioning federal land and facilities for beneficial reuse. Asset revitalization experts from Oak Ridge were able to share their many years of experience, successes, and lessons learned in implementing this unique program.

3.8.4 Biosolids Program

Under the Biosolids Program, treated municipal sludge (biosolids) from the City of Oak Ridge (the city) publicly owned treatment works (POTW) is applied to six approved sites on ORR as a soil conditioner and fertilizer. UCOR provides oversight for the program (BJC 2006), which operates under a land license agreement between DOE and the city. This oversight plan is scheduled to be revised in 2013. The city has applied biosolids on ORR since 1983.

3.8.4.1 Biosolids Fields on the Oak Ridge Reservation

The biosolids land application sites are located on ORR in Oak Ridge, Tennessee (Fig. 3.65). Four of the active sites are in the vicinity of Bethel Valley Road, while the remaining active sites, Watson Road 1 and 2, are located on Highway 95 near the Horizon Center. Table 3.27 lists the six application sites and the tons of biosolids applied to each site in CY 2012.

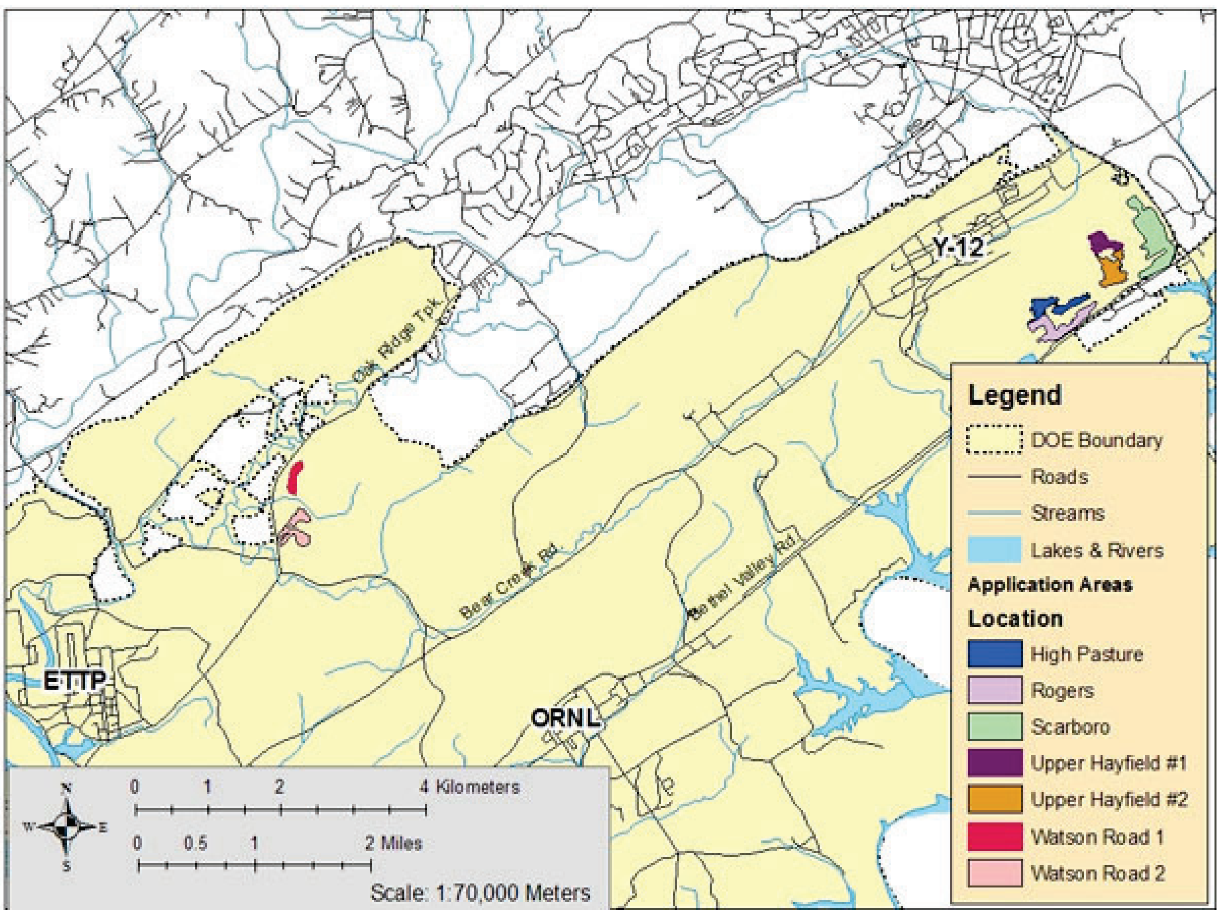

Fig. 3.65. Biosolids application areas on the Oak Ridge Reservation.

Table 3.27. Biosolids applied on the Oak Ridge Reservation in CY 2012 by the City of Oak Ridge (Tons)

Bethel Valley				Watson Road	
Upper Hayfield	High Pasture	Rogers	Scarboro	Watson Road 1	Watson Road 2
0	24.3	0	0	0	13.05

3.8.4.2 Current Program

The city POTW near Turtle Park in Oak Ridge, Tennessee, processes about 30 million gal/day of wastewater. The plant receives wastewater from a variety of industrial, commercial, and residential generators in the Anderson County–Roane County area. DOE contributes about 20% of the influent to the POTW directly from the Y-12 Complex, with lesser amounts from ETTP through the Rarity Ridge treatment plant through tanker delivery of sludge. All industrial generators are required by Oak Ridge city ordinance number 5-09 to obtain an industrial discharge permit from the city, which prescribes discharge limits and monitoring/reporting requirements.

3.8.4.3 Current Status

The public review phase for the draft environmental assessment (DOE 2012a) began in August of 2011, with completion and approval in January 2012. This environmental assessment documents application setbacks and radiological guidance levels that have been revised to reflect the latest field surveys and analytical data for biosolids. TDEC approved the UCOR land application approval request in October 2012, and it will be valid for 5 years. Following the receipt of the approval letter, UCOR resumed application of biosolids on both the Bethel Valley and Watson Road application sites. Table 3.27 presents the amount of product (about 15% solids) applied to each field during CY 2012.

As part of the surveillance program, UCOR successfully completed sampling the Rogers Site in CY 2012, with more sampling planned for 2013 on the High Pasture site. Cumulative metal loading is monitored for each site for compliance with limits set in 40 CFR 503. Tables 3.28 through 3.38 present these data for each site and the percentage of the regulatory limit that has been attained for each application area.

Table 3.28. High Pasture Field 1

Heavy metal	2012 (kg/ha)	Cumulative loading to date (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	Percentage of 503 limits attained
As	0.00	0.54	41	1.3%
Cd	0.00	0.94	39	2.4%
Cr	0.09	13.22	N/A	N/A
Cu	1.68	91.10	1,500	6.1%
Pb	0.09	7.78	300	2.6%
Hg	0.02	1.16	17	6.8%
Mo	0.02	1.68	N/A	N/A
Ni	0.07	11.95	420	2.8%
Se	0.04	2.92	100	2.9%
Zn	3.09	201.44	2,800	7.2%

Table 3.29. High Pasture Field 2

Heavy metal	2012 (kg/ha)	Cumulative loading to date (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	Percentage of 503 limits attained
As	0.00	0.49	41	1.2%
Cd	0.00	0.91	39	2.3%
Cr	0.05	13.12	N/A	N/A
Cu	0.86	90.00	1,500	6.0%
Pb	0.04	7.67	300	2.6%
Hg	0.01	1.15	17	6.8%
Mo	0.01	1.64	N/A	N/A
Ni	0.03	11.82	420	2.8%
Se	0.02	2.85	100	2.9%
Zn	1.58	198.15	2,800	7.1%

Table 3.30. Upper Hay Field 1

Heavy metal	2012 (kg/ha)	Cumulative loading to date (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	Percentage of 503 limits attained
As	0.00	0.26	41	0.6%
Cd	0.00	0.44	39	1.1%
Cr	0.00	7.80	N/A	N/A
Cu	0.00	36.03	1,500	2.4%
Pb	0.00	4.97	300	1.7%
Hg	0.00	0.77	17	4.5%
Mo	0.00	1.20	N/A	N/A
Ni	0.00	3.55	420	0.8%
Se	0.00	0.49	100	0.5%
Zn	0.00	105.36	2,800	3.8%

Table 3.31. Upper Hay Field 2

Heavy metal	2012 (kg/ha)	Cumulative loading to date (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	Percentage of 503 limits attained
As	0.00	0.29	41	0.7%
Cd	0.00	0.51	39	1.3%
Cr	0.00	8.55	N/A	N/A
Cu	0.00	38.87	1,500	2.6%
Pb	0.00	5.18	300	1.7%
Hg	0.00	0.88	17	5.2%
Mo	0.00	0.72	N/A	N/A
Ni	0.00	3.24	420	0.8%
Se	0.00	2.04	100	2.0%
Zn	0.00	118.27	2,800	4.2%

Table 3.32. Scarboro Field 1

Heavy metal	2012 (kg/ha)	Cumulative loading to date (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	Percentage of 503 limits attained
As	0.00	0.32	41	0.8%
Cd	0.00	0.54	39	1.4%
Cr	0.00	8.46	N/A	N/A
Cu	0.00	43.62	1,500	2.9%
Pb	0.00	5.01	300	1.7%
Hg	0.00	0.95	17	5.6%
Mo	0.00	1.06	N/A	N/A
Ni	0.00	4.63	420	1.1%
Se	0.00	1.95	100	2.0%
Zn	0.00	126.60	2,800	4.5%

Table 3.33. Scarboro Field 2

Heavy metal	2012 (kg/ha)	Cumulative loading to date (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	Percentage of 503 limits attained
As	0.00	0.32	41	0.8%
Cd	0.00	0.54	39	1.4%
Cr	0.00	8.46	N/A	N/A
Cu	0.00	43.62	1,500	2.9%
Pb	0.00	5.01	300	1.7%
Hg	0.00	0.95	17	5.6%
Mo	0.00	1.06	N/A	N/A
Ni	0.00	4.63	420	1.1%
Se	0.00	1.95	100	2.0%
Zn	0.00	126.60	2,800	4.5%

Table 3.34. Rogers Field 1

Heavy metal	2012 (kg/ha)	Cumulative loading to date (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	Percentage of 503 limits attained
As	0.00	0.45	41	1.1%
Cd	0.00	1.01	39	2.6%
Cr	0.00	22.51	N/A	N/A
Cu	0.00	100.59	1,500	6.7%
Pb	0.00	13.85	300	4.6%
Hg	0.00	1.97	17	11.6%
Mo	0.00	4.28	N/A	N/A
Ni	0.00	10.23	420	2.4%
Se	0.00	1.31	100	1.3%
Zn	0.00	249.62	2,800	8.9%

Table 3.35. Rogers Field 2

Heavy metal	2012 (kg/ha)	Cumulative loading to date (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	Percentage of 503 limits attained
As	0.00	0.47	41	1.2%
Cd	0.00	1.01	39	2.6%
Cr	0.00	22.55	N/A	N/A
Cu	0.00	101.25	1,500	6.7%
Pb	0.00	13.91	300	4.6%
Hg	0.00	1.97	17	11.6%
Mo	0.00	4.29	N/A	N/A
Ni	0.00	10.30	420	2.5%
Se	0.00	1.35	100	1.3%
Zn	0.00	251.41	2,800	9.0%

Table 3.36. Watson Road Field 1

Heavy metal	2012 (kg/ha)	Cumulative loading to date (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	Percentage of 503 limits attained
As	0.00	0.61	41	1.5%
Cd	0.00	0.82	39	2.1%
Cr	0.00	13.22	N/A	N/A
Cu	0.00	92.94	1,500	6.2%
Pb	0.00	8.97	300	3.0%
Hg	0.00	1.27	17	7.5%
Mo	0.00	1.88	N/A	N/A
Ni	0.00	10.93	420	2.6%
Se	0.00	2.83	100	2.8%
Zn	0.00	213.10	2,800	7.6%

Table 3.37. Watson Road Field 2

Heavy metal	2012 (kg/ha)	Cumulative loading to date (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	Percentage of 503 limits attained
As	0.00	0.61	41	1.5%
Cd	0.00	0.82	39	2.1%
Cr	0.04	13.22	N/A	N/A
Cu	0.72	92.94	1,500	6.2%
Pb	0.04	8.97	300	3.0%
Hg	0.01	1.27	17	7.5%
Mo	0.01	1.88	N/A	N/A
Ni	0.03	10.93	420	2.6%
Se	0.02	2.83	100	2.8%
Zn	1.33	213.10	2,800	7.6%

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