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 2014, 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 (HEU) 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 ETTP 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. Fig. 3.3 shows the ETTP areas designated for D&D activities through 2014.

Fig. 3.1. East Tennessee Technology Park.

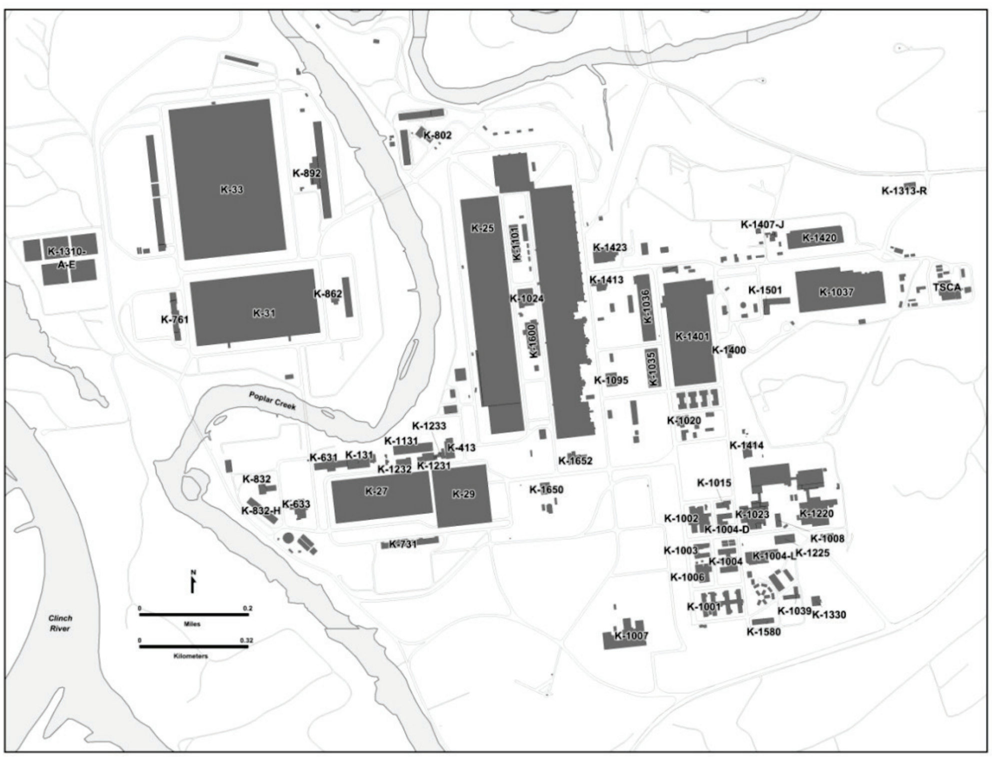

Fig. 3.2. East Tennessee Technology Park before the start of decontamination and decommissioning activities in 1991.

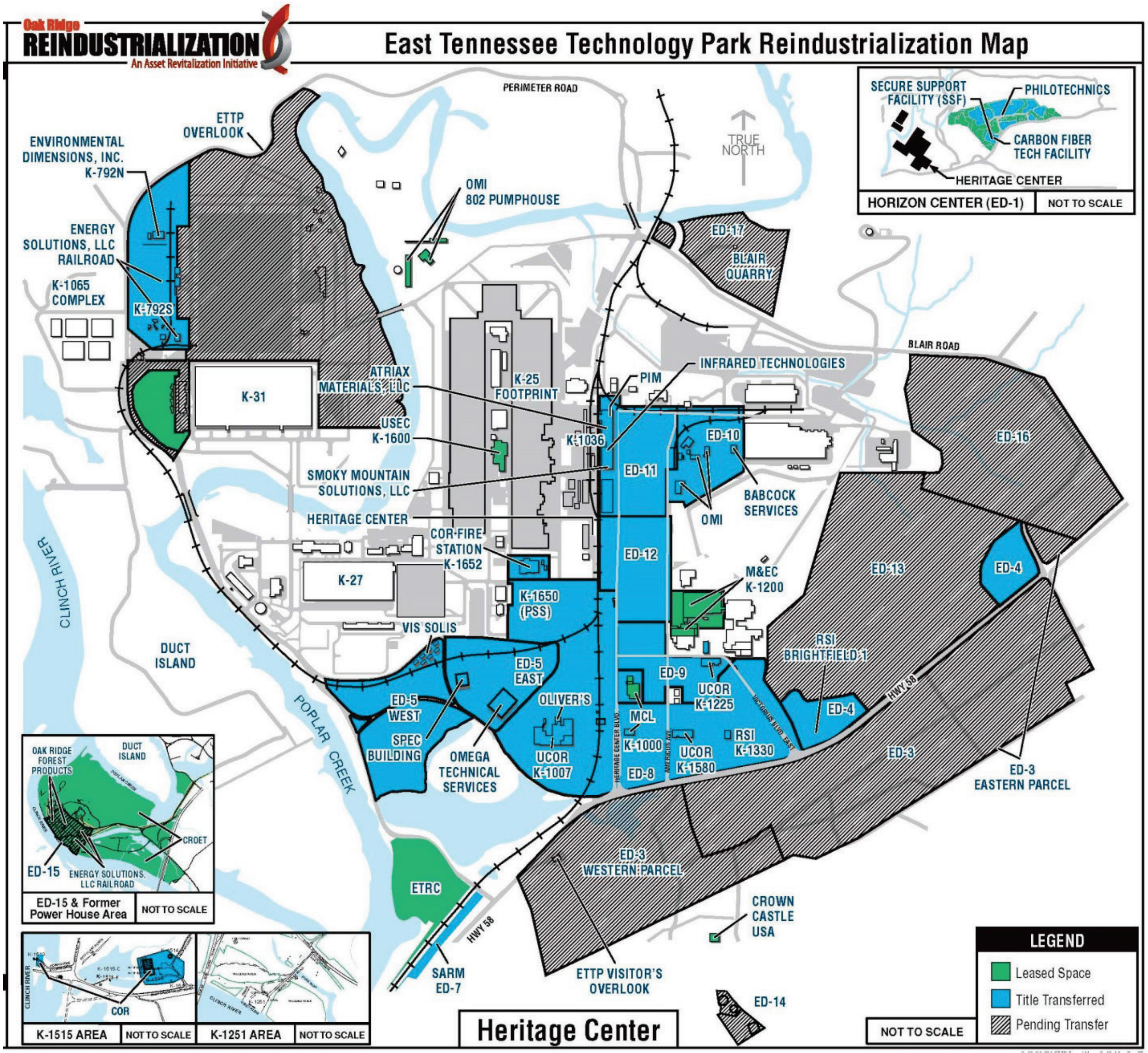

Fig. 3.3. East Tennessee Technology Park in 2014, showing progress in reindustrialization.

The ETTP mission is to reindustrialize and reuse site assets through leasing or transferring 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 of the site as possible into a private 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 the Community Reuse Organization of East Tennessee (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 as part of the continuing effort to transform ETTP into a private-sector industrial park. 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 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 in part, "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 2014, UCOR received "green scores" for EMS performance. As an example, Fig. 3.4 presents information on UCOR's 2014 pollution prevention recycling activities related to solid waste reduction at ETTP. 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 (CRTs and LCDs). Other recycling opportunities include unique structural steel, stainless steel structural members, transformers, and electrical breakers.

UCOR's electronic stewardship is award winning. In 2014 UCOR received a DOE sustainability award in the category of Exceptional Service/Sustainability Champion for implementation of managed print services.

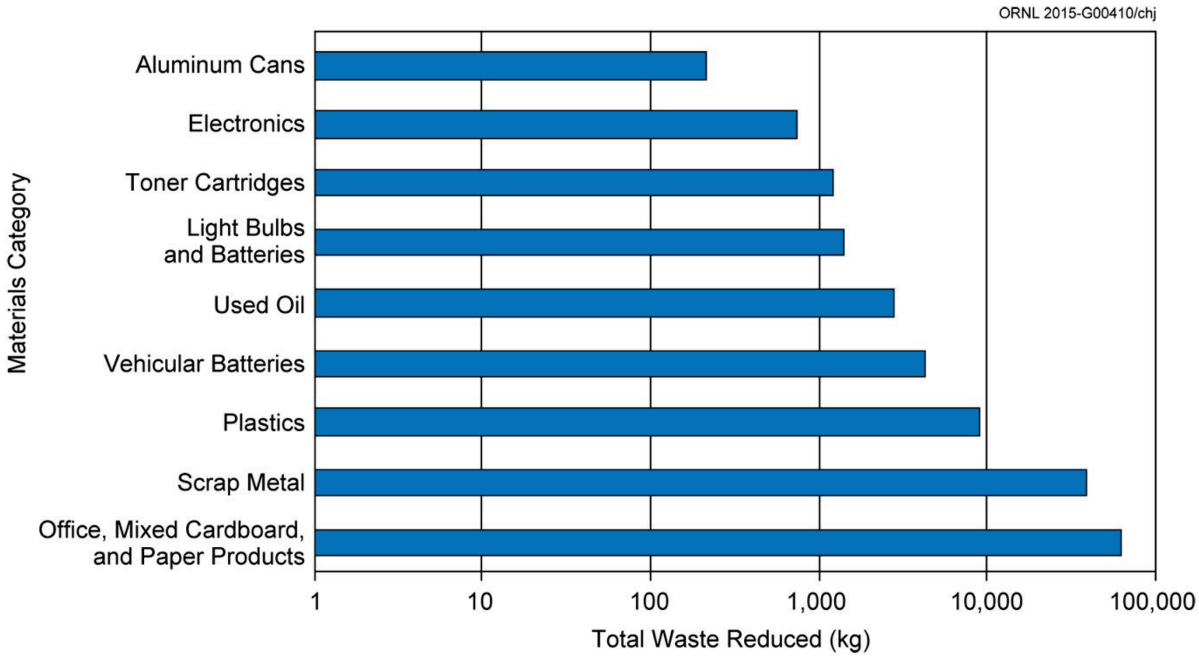

Fig. 3.4. Pollution prevention recycling activities related to solid waste reduction at East Tennessee Technology Park in CY 2014.

Additionally, UCOR internally recognized six projects for their pollution prevention/waste minimization accomplishments during the year. This included reuse of on-site construction debris, which avoided acquisition of more than 2,000 tons of virgin construction material, and reuse of more than 50,000 lb of metal and equipment at a total cost savings from all nominated projects of more than $2 million. In the area of alternative energy, Restoration Services, Inc. (RSI), in concert with UCOR, continued operation of ETTP's first solar farm on the east end of the plant property. Brightfield 1 (Fig. 3.5), as it is known, 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.

Fig. 3.5. Brightfield 1 Solar Farm.

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. In CY 2014 Brightfield 1 produced 272,500 kWh of energy. 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.

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 biobased 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 2011), 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. 3.6. 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.

Fig. 3.6. Truck carrying a waste shipment passing through an electronic tracking station, *part of the Radio Frequency Identification Transportation System, en route to the Environmental Management Waste Management Facility.*

Table 3.1. Radio Frequency Identification Transportation System sustainable results

Sustainable factor	Results
Diesel fuel use avoidance	289,050 (0.33 gal/shipment)
CO_2 emissions avoidance	870 tons (2.01 lb/shipment)
NO_X emissions avoidance	31.8 tons (0.073 lb/shipment)
Paper and trees saved	867,150 sheets of paper; 100 trees

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.

3.2.8 Communication

UCOR communicates 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., ASER and the annual cleanup progress report (UCOR 2014)]. UCOR participates in a number of public meetings related to environmental activities at the site (e.g., ORSSAB 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 2013). In 2012 the UCOR EMS program underwent the independent program verification required triennially by EO 13423 (CEQ 2007), which resulted in zero findings and five opportunities for improvement (mostly related to documentation). Further, the report noted several practices worthy of benchmarking. In 2014 UCOR conducted an internal management review of the EMS program that resulted in one finding and three opportunities for improvement, all of which were closed. In addition, two proficiencies were identified.

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 2014, ETTP operations were conducted in compliance with contractual and regulatory environmental requirements, and there were no NPDES permit or Clean Air Act (CAA) noncompliances. Figure 3.7 shows the trend of NPDES compliance at ETTP since 1999. No environmental notices of violation (NOVs) or penalties were issued to ETTP operations in 2014. The following sections provide more detail on each compliance program and the related activities in 2014.

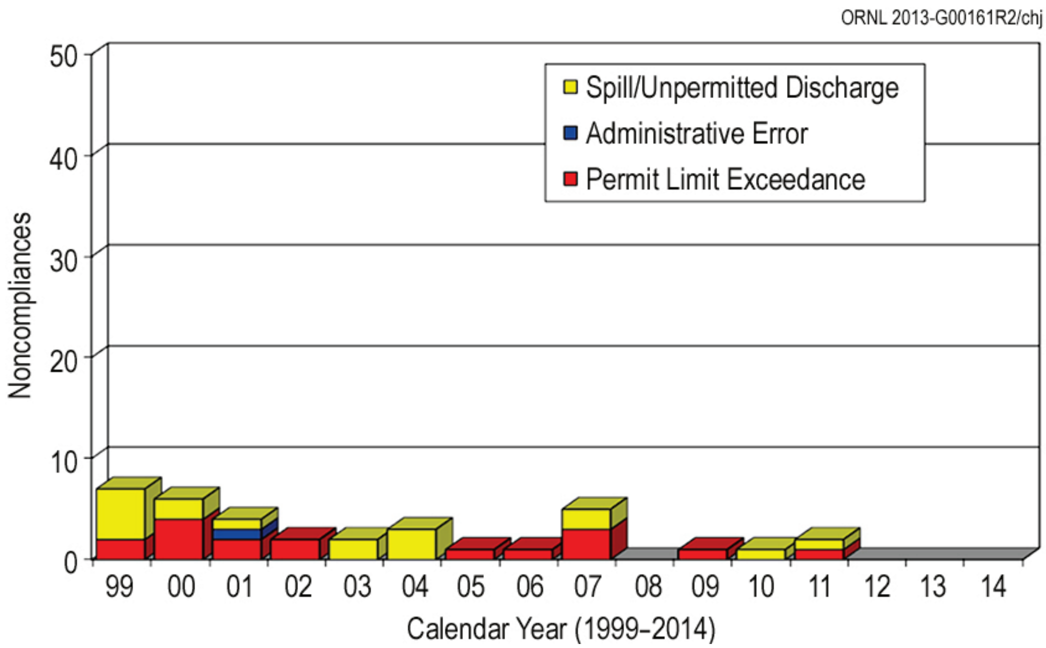

Fig. 3.7. East Tennessee Technology Park National Pollutant Discharge Elimination System permit compliance since 1999.

3.3.1 Environmental Permits

Table 3.2 contains a list of environmental permits that were in effect at ETTP in 2014.

3.3.2 Notices of Violation and Penalties

ETTP did not receive any environmental NOVs or penalties from regulators in 2014.

3.3.3 Audits and Oversight

Table 3.3 presents a summary of environmental audits and oversight visits conducted at ETTP in 2014.

Table 3.2. East Tennessee Technology Park Environmental Permits, 2014

Regulatory driver	Permit title/description	Permit number	Issue date	Expiration date	Owner	Operator	Responsible contractor
CAA	State permit to construct or modify an air contaminant source—internal combustion engine–powered emergency generators and fire water pump	967220P	08-22-2013 Amended 07-26-2014	08-23-2015	DOE	UCOR	UCOR
CWA	NPDES permit for storm water discharges	TN0002950	02-26-10	12-31-13[a]	DOE	UCOR	UCOR
CWA	State operating permit—waste transportation project; Blair Road and Portal 6 sewage pump and haul permit	SOP-05068	07-01-14	02-28-19	DOE	TFE	TFE
CWA	State operating permit—ETTP holding tank/haul system for domestic wastewater	SOP-99033	04-30-10	04-30-15	UCOR	UCOR	UCOR
UST	Authorized/certified USTs at K-1414 Garage	Customer ID 30166 Facility ID 073008	03-20-89	Ongoing	DOE	UCOR	UCOR
RCRA	ETTP container storage and treatment units	TNHW-117[b]	09-30-04	09-30-14	DOE	UCOR	UCOR
RCRA	Hazardous waste corrective action document (encompasses entire ORR)	TNHW-121[b]	09-28-04	09-28-14	DOE	DOE/All[c]	DOE/All[c]

[a]An NPDES permit renewal application has been submitted in a timely manner. 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. The new NPDES permit was issued in 2015.
[b]Operating under timely submittal of renewal permit.
[c]DOE and all ORR co-operators of hazardous waste permits.

Acronyms

CAA = Clean Air Act
CWA = Clean Water Act
DOE = US Department of Energy
ETTP = East Tennessee Technology Park
ID = identification (number)
NPDES = National Pollutant Discharge Elimination System
ORR = Oak Ridge Reservation
RCRA = Resource Conservation and Recovery Act
SOP = state operating permit
TFE = Technical and Field Engineering, Inc.
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, 2014

Date	Reviewer	Subject	Issues
January 23	TDEC	K-1423-A, B, and E Dikes Closure Inspection	0
February 24	TDEC	Annual RCRA Compliance Inspection	0
April 21	TDEC	Container Processing Facility Closure Inspection	0
May 14	EPA	Rad-NESHAPs Site Visit (^{99}Tc)	0
September 24	TDEC	Inspection of ETTP USTs	0

Acronyms
EPA = Environmental Protection Agency
ETTP = East Tennessee Technology Park
Rad-NESHAPs = National Emissions Standards for Hazardous Air Pollutants for Radionuclides
RCRA = Resource Conservation and Recovery Act
TDEC = Tennessee Department of Environment and Conservation
UST = underground storage tank

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. Many of the current operations at ETTP are conducted under CERCLA. NEPA reviews are part of the CERCLA planning process to ensure that NEPA values are incorporated into CERCLA projects and documentation.

During 2014, 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, recurring activities, DOE generic CX determinations are used. During 2014, no new CX determinations for activities at ETTP were issued by DOE.

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 ORR cultural resource management plan (Souza et al. 2001). At ETTP there were 135 facilities eligible for inclusion on the NRHP, as well as numerous facilities that were not eligible for inclusion on the NRHP. 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 SHPO, and ACHP entered into an MOA that included the retention of the north end tower (also known as 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. During 2013, a request for proposal was issued for a "Professional Design Team and Museum Professional" as specified in the MOA. Nine firms were prequalified, and the selection and award were executed April 1, 2014. The procurement process for the K-25 "virtual museum" web design firm was also begun in 2013 and awarded September 2, 2014.

On December 14, 2014, Congress authorized the establishment of the Manhattan Project Historical Park to commemorate the history of the Manhattan Project. It will comprise the three major sites; Los Alamos, New Mexico; Oak Ridge, Tennessee; and Hanford, Washington, that were dedicated to accomplishing the Manhattan Project mission.

3.3.5 Clean Air Act Compliance Status

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 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.

Full compliance with CAA regulations and permit conditions was demonstrated for 2014. The ETTP ambient air monitoring program, permitted source operations tracking, and record keeping provided documentation fully supporting a 100% compliance rate.

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 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. In 2014, ETTP discharged to the waters of the state of Tennessee under individual NPDES permit TN0002950, which regulates storm water discharges.

In 2014, compliance with ETTP NPDES storm water permit TN0002950 was determined by more than 200 laboratory analyses, field measurements, and flow estimates. The NPDES permit compliance rate for all discharge points for 2014 was 100%.

3.3.7 National Pollutant Discharge Elimination System Permit Noncompliances

During 2014 ETTP and UCOR operations were conducted in compliance with contractual and regulatory environmental requirements. There were no NPDES permit noncompliances in 2014.

3.3.8 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).

On October 1, 2014, the City of Oak Ridge took over operational responsibilities for all the water distribution activities at the ETTP site, and an on-site ETTP intermediate distribution system is no longer needed.

The City of Oak Ridge supplies potable water to the ETTP water distribution system. The water treatment plant, located on ORR southwest of ETTP and owned and operated by the City of Oak Ridge, supplied water to the ETTP site until October 1, 2014. On October 1, 2014, the water treatment plant on the DOE ORR was shut down, and all water at the ETTP site is now supplied by the City of Oak Ridge drinking water plant in Oak Ridge, Tennessee. The City of Oak Ridge water plant is located north of the DOE Y-12 Complex.

3.3.9 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 2014, ETTP had three generator accumulation areas for hazardous or mixed waste.

In addition, ETTP is permitted to store and treat hazardous and mixed waste under Resource Conservation and Recovery Act (RCRA) Part B Permit TNHW-117. Hazardous waste may be treated and stored at permitted locations in Building K-1423 and at the K-1065 complex. This hazardous waste permit was scheduled to expire in September 2014. Because a permit renewal application was submitted to TDEC in a timely and sufficient manner in February 2014, the existing permit will not expire until a final determination on issuance is made by the commissioner. On January 29, 2014, a public meeting was held at the DOE Information Center in Oak Ridge to solicit any comments the public might have on the Part B permit renewal application for hazardous waste permit TNHW-117 for ETTP and the TNHW-121, hazardous waste corrective action document renewal. A presentation was given that explained the permitting process and the ETTP permitted units; information was also provided on the hazardous waste corrective action document, which covers the ORR CERCLA areas of concern and solid waste management units. In addition, a community impact statement was distributed to provide greater detail on how hazardous waste will be characterized, stored, and treated.

There were no RCRA generator or permit noncompliances in 2014.

3.3.10 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.

3.3.11 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. ORR is on the NPL.

3.3.12 East Tennessee Technology Park RCRA-CERCLA Coordination

The Federal Facility Agreement for the Oak Ridge Reservation (FFA; DOE 2014b) is intended to coordinate the corrective action processes of RCRA required under the Hazardous and Solid Waste Amendments permit with CERCLA response actions.

3.3.13 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 2014, ETTP operated 9 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, no PCB-contaminated electrical equipment is 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, DOE ORO and EPA Region 4 consummated a major compliance agreement known as the “Oak Ridge Reservation Polychlorinated Biphenyl Federal Facilities Compliance Agreement” (DOE 2012a)

(ORR-PCB-FFCA), which became effective December 16, 1996, and was last revised on May 23, 2012. The modification in 2012 incorporated institutional controls at the Toxic Substances Control Act Incinerator where limited areas of contamination remain in place at the facility after the facility closure actions were completed. The institutional controls will remain in place until future PCB cleanup actions, which will be addressed during CERCLA demolition actions.

The ORR-PCB-FFCA 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. This notification process is routinely incorporated into the CERCLA documentation for demolition and remedial actions (RAs).

3.3.14 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 hazardous and toxic chemicals that exceed threshold planning quantities. The reports are submitted to the local emergency planning committee and the state emergency response commission and the local fire department. ETTP complied with these requirements in 2014 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 2014.

3.3.14.1 Chemical Inventories (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 2014, 11 were located at ETTP. These chemicals were 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, unleaded gasoline, Sakrete Type S or N mortar mix, CCA Type C pressure-treated wood, and New Pig Lite-Dri loose absorbent.

3.3.14.2 Toxic Chemical Release Reporting (EPCRA Section 313)

Section 313 requires facilities to complete and submit a toxic chemical release inventory (TRI) form (Form R) annually. Form R must be submitted for each TRI chemical that is manufactured, processed, or otherwise used in quantities above the applicable threshold quantity. A Form R for each chemical must be submitted by July 1 of each year. DOE electronically submits annual TRI reports to EPA on or before July 1 of each year. The reports 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 the threshold quantity. In 2014, the only chemicals that met the reporting requirements were diisocyanates associated with foaming activity to stabilize deposits in pipes undergoing remediation actions.

3.4 Quality Assurance Program

3.4.1 Integrated Assessment and Oversight Program

Quality assurance (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 and QA 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.

3.5 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 2014, ETTP DOE EM operations were under UCOR responsibility for regulatory compliance

3.5.1 Construction and Operating Permits

During 2014, UCOR ETTP operations became subject to amended CAA regulations and permitting under TDEC Air Pollution Control rules. The regulations were specific to stationary fossil-fueled reciprocating internal combustion engines (RICEs) for emergency use. UCOR has responsibility for five RICE units subject to permitting and therefore prepared and submitted permit applications. TDEC issued a Permit to Construct or Modify (967220P) with an effective date of August 22, 2013. The permit covers compliance demonstration requirements for four emergency generators and one fire water pump system. Compliance for all units is demonstrated by following specified maintenance schedules, limiting hours of operations for nonemergencies to 100 h per year, and record keeping. Regulations exempt any operating hours of these units during nonscheduled (emergency) power outages. All other ETTP operations that do emit low levels of air pollutants have been classified as insignificant under TDEC rules. Any planned stationary sources that may emit air pollutants are evaluated and compared against applicable pollutant emission limits to document this classification and pursue permitting if required under TDEC regulations.

3.5.1.1 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.

3.5.1.1.1 Control of Asbestos

ETTP's asbestos management program ensures all activities involving demolitions 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 2014 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 2014, no individual non-CERCLA ETTP 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 2014 the total ETTP 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 2014.

3.5.1.1.2 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 may not be 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 3.8 illustrates the historical on-site ODSs inventory at ETTP.

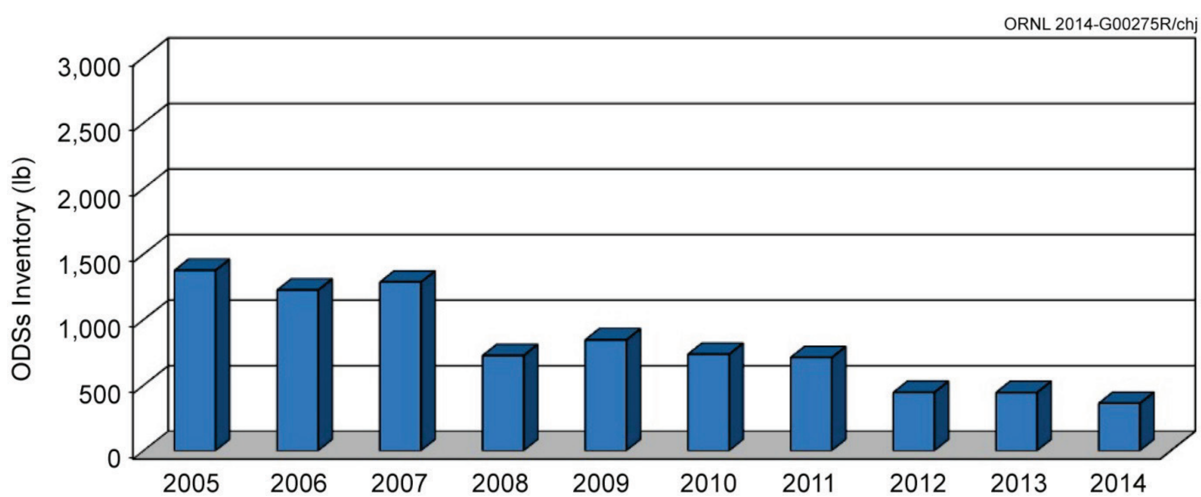

Fig. 3.8. East Tennessee Technology Park total on-site ozone-depleting substances (ODSs) inventory, 10-year history.

3.5.1.2 Fugitive Particulate Emissions

ETTP has been the location of major building demolition activities and waste debris transportation with the potential for the 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.

3.5.1.3 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 (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 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 a 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 Chromium Water Treatment System (CWTS) Volatile Organic Compound (VOC) Air Stripper 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 3.9 provides a historical dose trend for the most impacted on-site member of the public. The results are based on actual ambient air sampling in a location conservatively representative of the on-site location.

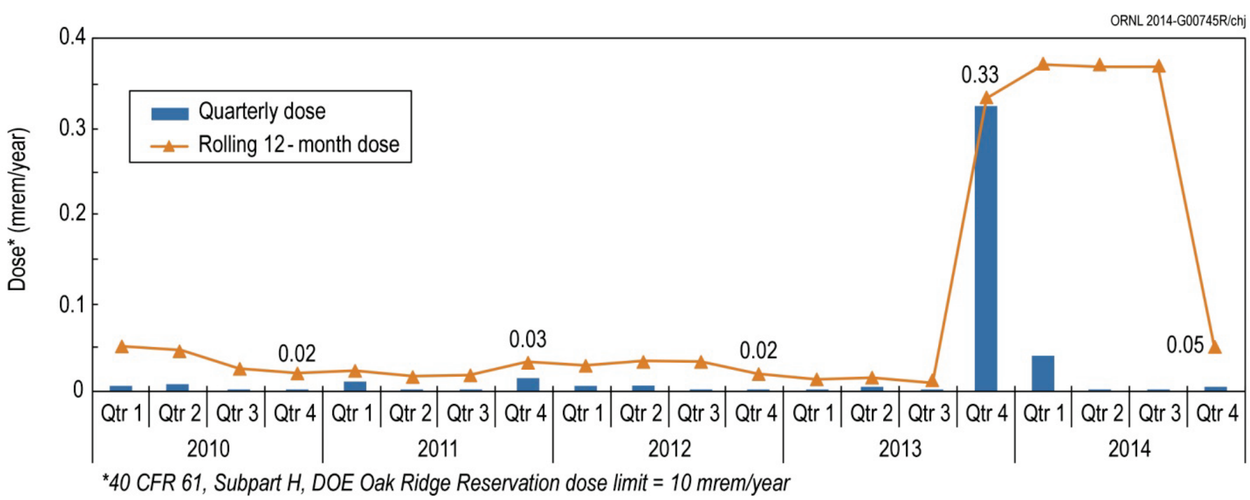

Fig. 3.9. East Tennessee Technology Park ambient air station K11 radionuclide monitoring results: 5-year rolling 12-month dose history up through 2014.

3.5.1.4 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* (UCOR 2012). 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).

3.5.1.5 Greenhouse Gas Emissions

The EPA rule for mandatory reporting of GHGs (also referred to as the "Greenhouse Gas Reporting Program") was enacted October 30, 2009, under 40 CFR Part 98. According to the rule in general, the stationary source emissions threshold for reporting is 25,000 metric tons or more of GHGs per year, reported as metric tons of CO_2 equivalent (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 (SF_6).

A 2014 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 CY 2010 reporting period. Based on total GHG emissions from all ETTP stationary sources during 2014, ETTP did not exceed the annual threshold limit and therefore was not subject to mandatory annual reporting under the GHG rule during this performance 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 most significant decrease in stationary source emissions was due to the permanent cessation of waste processing at the TSCA Incinerator in 2009 and ongoing facility demolitions. The remaining sources are predominantly small comfort heating systems, hot water systems, and power generators. Figure 3.10 shows the historical trend of ETTP total GHG stationary emissions, including contributions from the TSCA Incinerator. For the 2014 calendar year period, GHG emissions totaled only 201 metric tons.

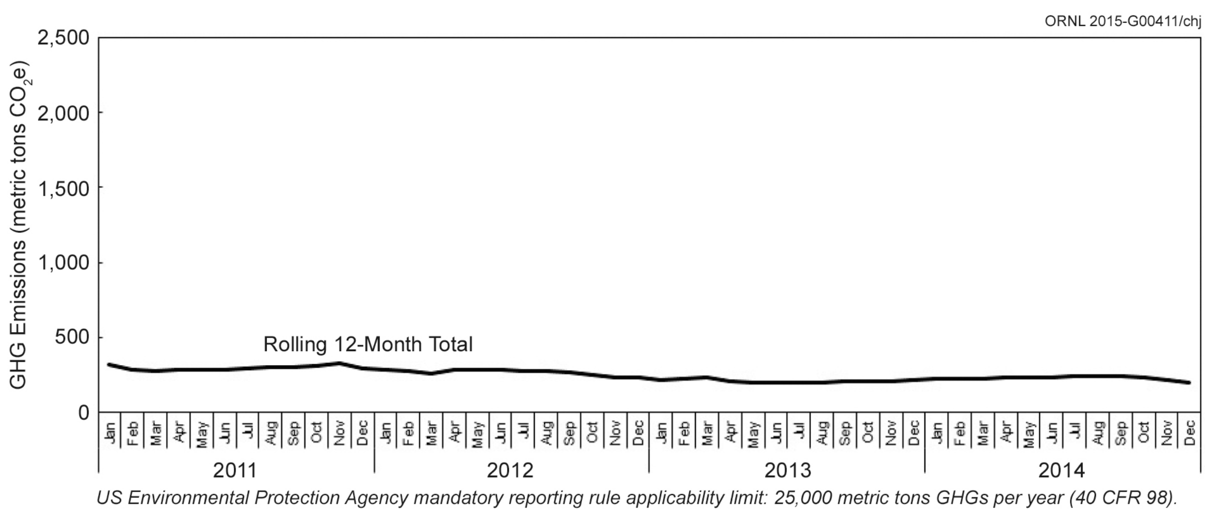

Fig. 3.10. East Tennessee Technology Park stationary source greenhouse gas (GHG) emissions tracking history *[in carbon dioxide equivalent (CO_2e)].*

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 such 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 a 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.

The information reported here includes GHG emissions from the industrial landfills at Y-12 that are managed by UCOR. The landfills are not part of the contiguous ETTP site; however, DOE requested that UCOR include landfill GHG emissions with ETTP reporting in the Consolidated Energy Data Report. To be consistent with reporting this information, the landfill emissions are also included with ETTP ASER data. Figure 3.11 shows the trend toward meeting the 28% total Scope 1 and 2 GHG emissions reduction target by FY 2020 as stated in the DOE *2014 Strategic Sustainability Performance Plan* (SSPP; DOE 2014a). Emissions for FY 2014 totaled 25,468 metric tons CO_2e, roughly 35% below the FY 2020 target level of 39,237 metric tons CO_2e and a 53% reduction to date compared to the 2008 baseline year level of 54,495 metric tons.

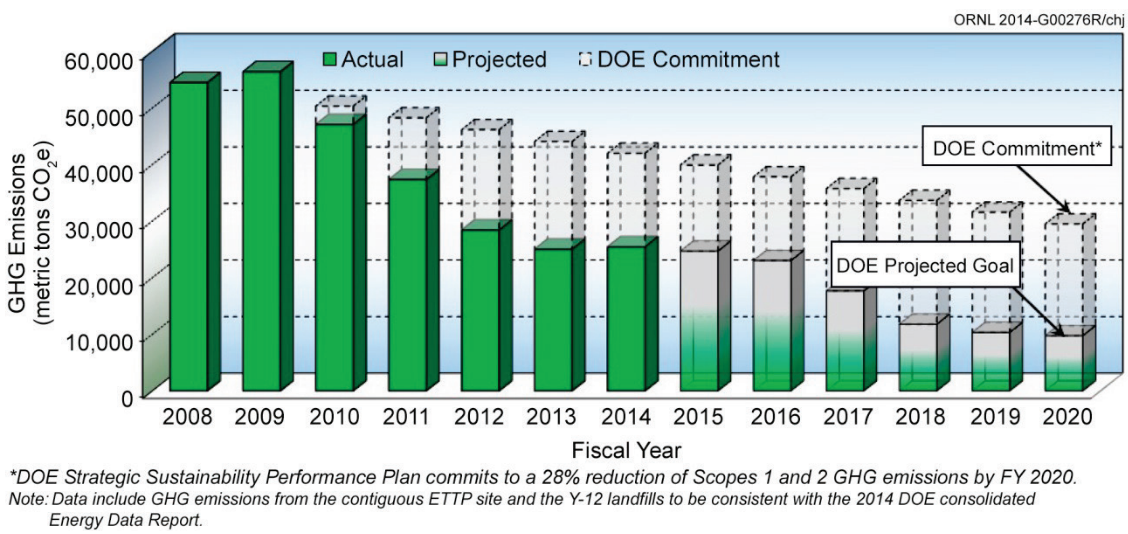

Fig. 3.11. East Tennessee Technology Park (ETTP) greenhouse gas (GHG) emissions trend and targeted reduction commitment *[in metric tons carbon dioxide equivalent (CO_2e)].*

Figure 3.12 shows the relative distribution and amounts of all ETTP FY 2014 GHG emissions for Scopes 1, 2, and 3. Total GHG emissions remain well below the levels first reported in the 2008 baseline year as demolition and remediation efforts continue at ETTP. Many of the early reductions were due to lower on-site combustion of fuels (stationary and mobile sources), lower consumption of electricity, and a smaller workforce. The total amount of GHG emissions for FY 2014 was 30,662 tons, a small upswing compared to the 29,944 tons for FY 2013. The upswing was due to small increases in all energy and motor vehicle fuel use categories coincident with major building demolition and debris removal activities.

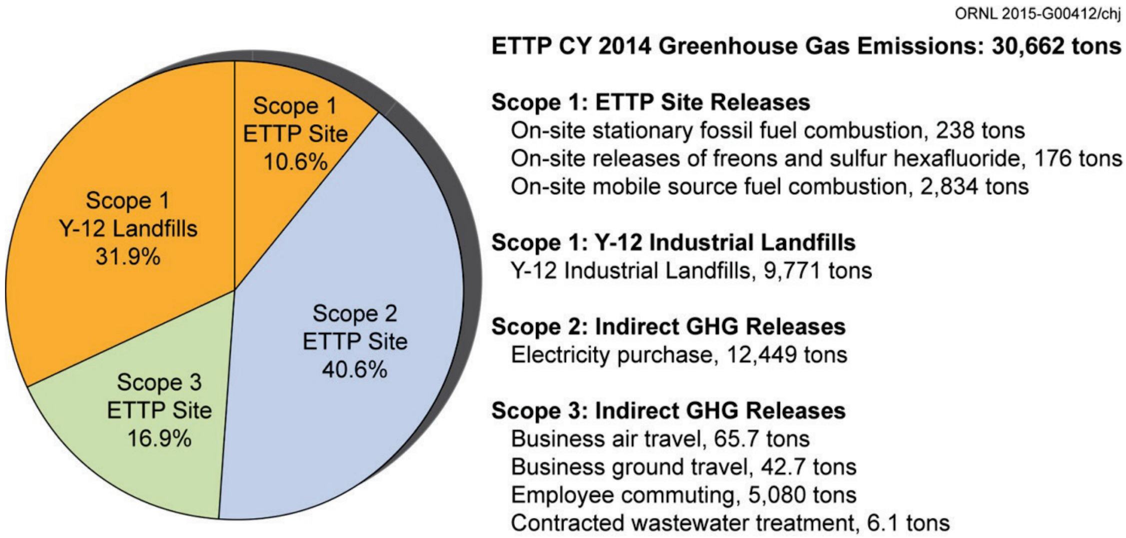

Fig. 3.12. CY 2014 East Tennessee Technology Park (ETTP) greenhouse gas (GHG) emissions by scope, as defined in Executive Order 13514.

3.5.1.6 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 Central Neutralization Facility (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 CWTS air stripper was were below levels that would require permitting. The calculated maximum VOC annual emission for CWTS was only 0.0136 ton/year as compared to an emission limit of 5 ton/year. The annual potential emissions for this facility would be well below the 5 ton/year limit assuming it operated at the maximum hourly emission rate continuously for the entire year.

Federal regulations amended in January of 2013 require permitting for existing and new stationary emergency generators powered by RICEs (i.e., emergency or e-RICEs). These amendments apply only to non-CERCLA e-RICEs. TDEC originally issued a construction permit for the five on-site units. Four of the units are emergency generator engines (K-1007, K-1039, K-1095, and K-1652), and the fifth unit is a fire water pump engine (K-1310-RW). The effective date of the permit was August 22, 2013, with an expiration date of August 23, 2014. During this reporting period, a request to extend the current permit for 1 year was submitted to TDEC on June 6, 2014. This activity was to ensure sufficient time to include an additional emergency fire water pump engine (K-802) in the request for an operating permit for all units. TDEC reissued a construction permit that extended the expiration date to August 23, 2015. An application for an operating permit was prepared and submitted to TDEC dated September 26, 2014. TDEC had not initiated any action to process the permit request as of December 31, 2014.

Regulations limit e-RICE nonemergency and maintenance operations to 100 h of operations per 12-month rolling total (i.e., 100 h of running the engines for testing and maintenance purposes per year). Additionally, nonemergency operations are limited to 50 h of the 100 h annual limit. The current permit specifies conditions that must be met to demonstrate compliance. These requirements include performing scheduled maintenance, record keeping, and tracking the runtimes of each of the five permitted units. Copies of all maintenance activities are provided for permit compliance review, and the runtimes are entered into spreadsheets to track against annual limits. Table 3.4 provides the number of hours of operations for each unit, up through December 31, 2014.

Table 3.4. East Tennessee Technology Park UCOR emergency reciprocating internal combustion engine air permit compliance demonstration, 2014

e-RICE Unit	Permit limits: Total hours/year = 100 Nonemergency hours/year = 50			
	PM Testing (hours/year)	Nonemergency (hours/year)	Total (hours/year)	Emergency (hours/year)
K-802	0.8	0	0.8	0
K-1007	5.7	33.3	39.1	3.6
K-1039	5.9	0.7	6.6	3.8
K-1095	1.2	0.1	1.3	0.0
K-1310-RW	0.7	0.0	0.7	0.0
K-1407[a]	6.0	2.0	8.0	3.8
K-1652	6.0	0.8	6.8	1.0

[a]K-1407 e-RICE operating under CERCLA and exempt from Tennessee Department of Environment and Conservation air emission permitting.

Acronyms
e-RICE = emergency reciprocating internal combustion engine
PM = particulate matter
UCOR = URS | CH2M Oak Ridge LLC

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 stacks and vents are evaluated following approved methods to establish their low emissions potential. This is done to verify and document their minor source permit exempt status under all applicable state and federal regulations.

3.5.1.7 Hazardous Air Pollutants (Nonradionuclide)

Unplanned releases of hazardous air pollutants (HAPs) are regulated through the risk management planning regulations under 40 CFR Part 68. To ensure compliance, periodic inventory reviews of ETTP operations were performed that used monthly data obtained through the ECPRA Section 311 reporting program. This program applies to any facility at which a hazardous chemical is present in an amount exceeding a specified threshold. A comparison of the ECPRA 311 monthly Hazardous Materials Inventory System chemical inventories at ETTP with the risk management plan (RMP) threshold quantities listed in 40 CFR 68.130 was conducted. This is an ongoing action that documents the potential applicability for maintaining and distributing an RMP and to ensure threshold quantities are not exceeded.

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.” The results of this review indicated that all RMP-listed chemicals were less than 1% of their specific trigger thresholds. 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.

3.5.2 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:

- tracking of long-term trends of airborne concentration levels of selected air contaminant species,
- measurement of the highest concentrations of the selected air contaminant species that occur in the vicinity of ETTP operations, and
- evaluation of the potential impact of air contaminant emissions from ETTP operations on ambient air quality.

The sampling stations in the ETTP area are designated as base, supplemental, or ORR perimeter air monitoring (PAM) stations. Figure 3.13 shows the locations of all ambient air sampling stations in and around ETTP that were active during the 2014 reporting period. Figure 3.14 shows an example of a typical ETTP air monitoring station.

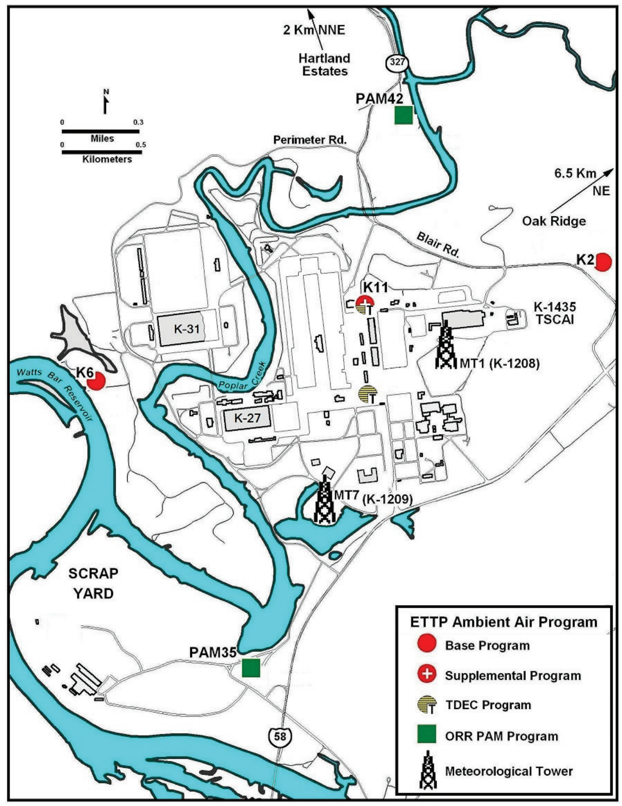

Fig. 3.13. East Tennessee Technology Park ambient air monitoring station locations. *(ETTP = East Tennessee Technology Park, MT = meteorological tower, ORR = Oak Ridge Reservation, PAM = perimeter air monitoring, TDEC = Tennessee Department of Environment and Conservation, and TSCAI = Toxic Substances Control Act Incinerator.)*

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 particular 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.

The analytical parameters were chosen with regard to existing and proposed regulations and with respect to activities at ETTP. Supplemental station K11 has been deployed to demonstrate that radiological emissions from demolition and remediation activities are in compliance with DOE dose limits to on-site members of the public. Changes of emissions from ETTP will warrant periodic reevaluation of the parameters being sampled. Ongoing ETTP reindustrialization efforts will also introduce new locations for members of the public that may require adding or relocating monitoring site locations. To ensure understanding of the potential impacts 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.

Fig. 3.14. East Tennessee Technology Park ambient air monitoring station.

All base and supplemental stations collected continuous samples for radiological and selected metals analyses during 2014. Inorganic analytical techniques were used to test samples for chromium and lead. Radiological analyses of samples from the ETTP stations test for the isotopes ^{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 3.15 and 3.16 illustrate the ambient air concentrations of chromium and lead for the past 5 years based on quarterly composites of weekly continuous samples. All samples were analyzed by the inductively coupled plasma–mass spectrometer analytical technique. The results are compared with applicable air quality standards for each pollutant. The annualized levels of chromium and lead during 2014 were well below the indicated annual standards. Station K11 was in close proximity to major demolition and remediation activities on the site and showed slightly higher annual chromium and lead ambient air concentrations during the first quarter of 2014 as compared to the other sampling locations. The downward trend through 2014 approached typical background levels for these pollutants. K11 sampling results for chromium and lead have historically trended higher and have been more variable compared to the other stations due to its close proximity to major demolition and remediation sites. The locations of stations K2 and K6 are representative of ambient air conditions at the ETTP boundary, with very similar measurement results. All chromium results are compared to the more conservative hexavalent chromium annual risk-specific dose standard.

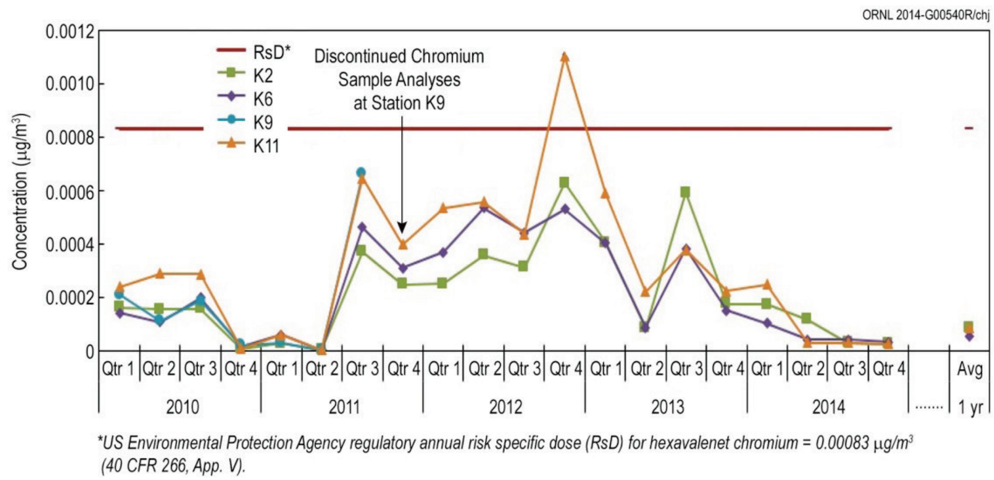

Fig. 3.15. Chromium monitoring results: 5-year history through December 2014.

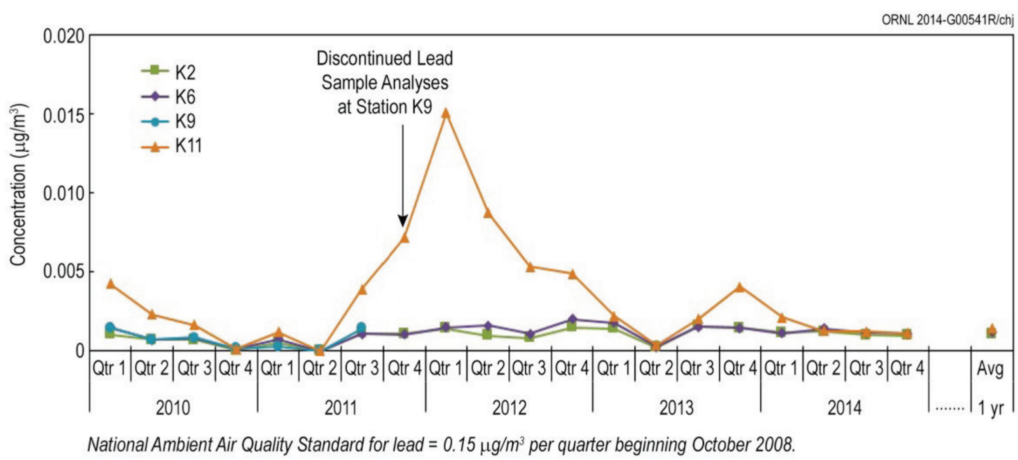

Fig. 3.16. Lead monitoring results: 5-year history through December 2014.

Quarterly radiochemical analyses are performed on composite samples collected at all stations. The selected isotopes of interest were ^{99}Tc and isotopic uranium (^{234}U, ^{235}U, and ^{238}U). The concentration and dose results for each of the nuclides are presented in Table 3.5 for the 2014 reporting period.

Table 3.5. Radionuclides in ambient air at East Tennessee Technology Park, January 2014 through December 2014

Station	Concentration (µCi/mL)				
	^{99}Tc	^{234}U	^{235}U	^{238}U	Total
K2	2.80E-16	9.82E-19	4.57E-19	8.83E-19	2.83E-16
K6	2.34E-16	7.91E-18	ND[a]	8.63E-18	2.51E-16
K11	3.18E-15	1.79E-17	ND	4.22E-18	3.20E-15
	40 CFR 61, Effective Dose (mrem/year)				
K2	0.008	<0.001	<0.001	<0.001	0.009
K6	0.007	0.001	ND	0.001	0.009
K11[b]	0.047	0.003	ND	0.001	0.050

[a]ND = Not detected.
[b]On-site business receptor location.

Figure 3.17 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 the site in the vicinity of Station K11 would only be 0.047 mrem as compared to the annual limit of 10 mrem. The on-site location of Station K11 is in close proximity to major demolition and remediation activities that are impacting radiologically contaminated materials. All data show potential exposures are all well below the 10 mrem annual dose limit.

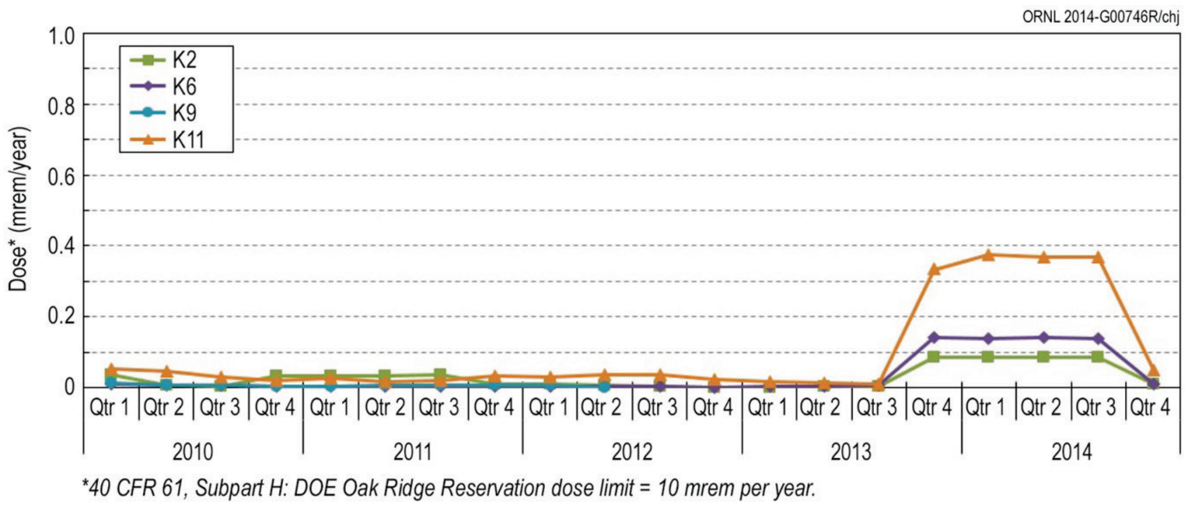

Fig. 3.17. Dose impact results: 5-year history through December 2014.

3.6 Water Quality Program

3.6.1 NPDES Permit Description

Under the permit effective in CY 2014, there were 108 NPDES-permitted storm water outfalls at ETTP. As part of the 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 were sampled as being representative of these groups.

The Group I storm water outfalls flow on an intermittent basis. These outfalls receive storm water runoff from minor site industrial operation areas that do not have a significant potential to contain contaminants. They may also receive runoff from minor D&D and RA activities. These areas do not have outside material storage that poses a risk of contaminating runoff. These outfalls also receive storm water runoff from remote areas of the site, including drainage from fields, grassy areas, and forested areas that have not been used for industrial purposes; administration and other nonindustrial operation areas; site roads and railways; employee access roads and parking areas; and internal site transportation routes. These outfalls may also discharge uncontaminated groundwater from infiltration or sumps. In addition, these outfalls may periodically receive sanitary and fire suppression system water from maintenance and testing activities, lawn watering, and routine external wash down of administration buildings without detergent and uncontaminated pavement wash waters without detergent. Effluent from Group I outfalls poses little or no threat of containing significant pollutants.

Many of the Group II storm water outfalls flow on a continuous basis. These outfalls receive storm water runoff from site industrial operations where there is a higher potential for contamination. These areas include soil storage yards, outside radiological areas, and other areas that pose a risk of potential contamination. Group II outfalls may also receive industrial and administrative area roof drainage, cooling tower blowdown, railroad runoff, runoff from areas undergoing D&D and soil remediation activities, drainage from fields and grassy areas, and fire suppression system water from maintenance and testing activities. Group II outfalls may also discharge potentially contaminated groundwater from infiltration or sumps, burial ground seeps, and cooling tower blowdown. These outfalls may also receive effluents described for Group I storm water outfalls.

3.6.2 East Tennessee Technology Park Storm Water Pollution Prevention Program

The ETTP NPDES permit includes a requirement to review and update, if necessary, the Storm Water Pollution Prevention (SWPP) Plan (SWPPP) at least annually. This requirement is met by publishing the ETTP SWPP Program Annual Update Report, which includes monitoring results, site inspection summaries, and other information for each fiscal year. 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.

3.6.2.1 Radiological Monitoring of Storm Water Discharges

ETTP conducts radiological monitoring of storm water discharges to determine compliance with applicable dose standards. ETTP also applies the “as low as reasonably achievable” (ALARA) process to minimize potential exposures to the public. Sampling for gross alpha and gross beta radioactivity, as well as specific radionuclides, is conducted as part of the SWPP Program sampling efforts. Analytical results are used to estimate the total discharge of each radionuclide from ETTP via the storm water discharge system.

Radiological monitoring of storm water discharges was planned as part of the FY 2014 and FY 2015 SWPP Program sampling efforts in order to obtain current radiological results for calculating total radiological discharge. Table 3.6 shows the storm water outfalls and parameters sampled during CY 2014. Table 3.7 shows the results of radiological monitoring completed in CY 2014. Table 3.8 shows the total activity of the detected radionuclides released to the surface water through the ETTP storm water outfalls during 2014.

Table 3.6. Storm water composite sampling for radiological discharges at East Tennessee Technology Park storm water outfalls, 2014

Storm water outfall	Gross alpha/gross beta (composite sample)[b]	Transuranics[a] (composite sample)[b]	Isotopic uranium (composite sample)[b]	^{99}Tc (composite sample)[b]
158	X	X	X	X
160	X	X	X	X
180	X	X	X	X
190[c]	X	X	X	X
292	X	X	X	X
380	X	X	X	X

[a]Includes ^{237}Np, ^{238}Pu, and $^{239/240}$Pu.
[b]All samples must be time-weighted composites collected during the first 60 min of a qualifying storm event discharge.
[c]At outfall 190, two separate Isco composite samplers will be installed and set up identically. Samples will be collected from each composite sampler for all parameters listed in this table. Results from the two composite samples will be compared as a quality check.

Table 3.7. Analytical results for radiological monitoring at East Tennessee Technology Park storm water outfalls, 2014

Parameter	Screening level	Outfall 158	Outfall 160	Outfall 180	Outfall 190	Outfall 292	Outfall 380
Alpha activity (pCi/L)	10	**31.5**	**56**	**11.9**	4.51	**92.8**	**30.35**
Beta activity (pCi/L)	30	**60.3**	**54.4**	9.06	20.6	**40.5**	25
Technetium-99 (pCi/L)	1,760	59.8	82.2	4.76 U	55.4	46.2	19.8
Total Uranium (µg/L)	none	29.1	58.4	9.47	2.75	211	32.45
Uranium-233/234 (pCi/L)	28	15.4	**28.9**	7.46	1.87	**102**	12.7
Uranium-235/236 (pCi/L)	29	1.37	1.52	0.588	0.185 U	7.75	0.578
Uranium-238 (pCi/L)	30	9.57	19.4	3.09	0.895	**69.8**	10.8

BOLD indicates screening level exceeded.
U indicates parameter was not detected above detection limit. All results for transuranics were nondetects.

Table 3.8. Radionuclides released to surface waters from the East Tennessee Technology Park storm water system, 2014

Radionuclide	Amount (Ci)
^{99}Tc	8.2E-01
^{234}U	3.7E-03
^{235}U	3.1E-04
^{238}U	1.9E-03

1 Ci = 3.7E+10 Bq.

3.6.2.2 Decontamination and Decommissioning of the K-25 Building

Demolition of the last section of the K-25 building was completed in FY 2014. A portion of the east wing of the K-25 building was contaminated with a slow-decaying radioactive isotope called technetium-99 (^{99}Tc). Most of the previous demolition debris was shipped to the on-site EMWMF for disposal, but because of the ^{99}Tc contamination, many of the components in this remaining section were not eligible for disposal there. Instead, they were shipped to NNSS.

During demolition, a major concern was the rain or dust control water that fell directly onto the debris pile during the demolition. As runoff water flowed through the debris piles, it could have transported radiological and chemical contaminants, sediments, and other particulates away from the demolition area and into previously uncontaminated areas and/or waters of the state if storm water controls did not function as designed and installed.

Outfalls 210 and 490 and manholes 18102 and 17006 were monitored for contamination associated with the K-25 building demolition and storm water runoff (see Table 3.9). Sampling was conducted following a 1 in. or greater rainfall event. Initial sampling of outfalls 210 and 490 and manholes 18102 and 17006 was conducted on September 21, 2013, to provide baseline data for conditions present before demolition began on the ^{99}Tc contaminated portion of the east wing of the K-25 building. To closely monitor the storm water runoff from the building demolition activities, sampling was performed at regular intervals during the demolition process. Monitoring was also performed at these locations during the completion of demolition activities. Additional monitoring was performed at manholes 18102 and 17006 and at outfalls 210 and 490 at the end of demolition waste shipment.

Table 3.9. Storm water sampling for decontamination and decommissioning activities at the K-25 building
(east wing of the K-25 building—building units K-309-2 through K-311-1)

Sampling events for all locations	Sampling location	Gross alpha/beta	Isotopic uranium, ^{99}Tc, transuranics[a]	PCBs[b]	Metals[c]/ mercury	Asbestos	Pesticides[d]
Before demolition	Outfall 210	X	X	X	X	X	X
During demolition activities	Outfall 490	X	X	X	X	X	X
	Manhole 18102	X	X	X	X	X	X
Through completion of waste shipment	Manhole 17006	X	X	X	X	X	X
	Manhole 18126		^{99}Tc Only				
After waste shipment completion	Manhole 18112		^{99}Tc Only				
	K-1007-P1 pond weir		^{99}Tc Only				

[a]Transuranics analysis includes ^{237}Np, ^{238}Pu, and $^{239/240}$Pu.
[b]PCB analysis includes Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, and 1268.
[c]Metals analysis includes Al, Ag, As, Ba, Be, B, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn.
[d]Pesticide analysis includes 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Aldrin, Chlordane, Dieldrin, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, Toxaphene, alpha-BHC, beta-BHC, delta-BHC, and gamma-BHC.

Final D&D activities for the K-25 building were completed in July 2014. To assess any ongoing impacts the remaining building slab has on the quality of the storm water runoff, monitoring will be performed on an annual basis (Table 3.10). Runoff samples will be collected at outfall 490 to monitor east wing slab runoff; runoff from outfall 334 will be sampled to monitor west wing slab runoff, and runoff from outfall 230 will be sampled to monitor north-end slab runoff.

The first of the annual post-D&D sampling efforts was completed at outfalls 230, 334, and 490 in November 2014. Analytical results that exceeded screening criteria are shown in Table 3.11.

Table 3.10. Storm water sampling for the K-25 building slab runoff

Sampling events for all locations	Sampling location	Gross alpha/beta	Isotopic uranium, $^{99}Tc^{a}$	PCBs[b]	Metals[c]/mercury
Annually	West wing (outfall 334)	X	X	X	X
	East wing (outfall 490)	X	X	X	X
	North tower (outfall 230)	X	X	X	X

[a]Isotopic uranium analysis includes $^{233/234}U$, $^{235/236}U$, and ^{238}U.
[b]PCB analysis includes Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, and 1268.
[c]Metals analysis includes Al, Ag, As, Ba, Be, B, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn.

For all K-25 D&D sampling activities, sampling was initiated on the next working day following a rainfall event of 1 in. or more. Samples were collected during or immediately following a qualifying storm event. A period of at least 72 h of dry weather (defined in this instance only as having no rain events that exceed 0.1 in.) was required between storm events of 1 in. or more or samples were not collected.

Table 3.11 lists the applicable water quality criteria, the standards for gross alpha and gross beta, the derived concentration guide (DCG) values listed in DOE O 5400.5 (DOE 1990), and the derived concentration standards (DCSs) listed in DOE Standard 1196 (DOE 2011a)for parameters that have exceeded the applicable screening criteria. The DCSs are shown for comparison with the DCG values. The applicable water quality criteria are listed in TDEC Rule 0400-40-03-.03. The reference standards for gross alpha and gross beta are in the National Primary Drinking Water regulations (40 CFR 141).

As shown in Table 3.11, the analytical results from outfalls 210 and 490 during the K-25 building demolition were below TDEC notification levels and DCG values. Table 3.11 shows that some analytical results occasionally exceeded the water quality criteria; however, there were no observed impacts to receiving streams or levels elevated above the ambient water quality criterion (AWQC) in the mixing zone waterways.

On December 5, 2013, water was observed flowing from three electrical duct system manholes at the southwest corner of the Portal 4 parking area. The water from the duct system then flowed across the paved parking area and into a nearby storm water catch basin. The water was then discharged to the K-1007-P1 pond via storm water outfall 490. This flow from the duct system manholes occurred after a significant amount of rainfall.

Discharges from the electrical duct system manholes in the Portal 4 parking area were also noted after heavy rainfall events on at least two additional occasions. Preliminary radiological surveys indicate fixed contamination (attached to asphalt pavement and concrete surrounding the manholes) in the parking lot at the water discharge area. Supplemental sampling within the electrical duct system indicated the presence of elevated levels of ^{99}Tc. Access to the parking area where water was discharging was restricted after the discovery of the elevated ^{99}Tc levels.

Table 3.11. Analytical data from K-25 building post-decontamination and decommissioning sampling that exceeded screening levels

	Gross alpha (pCi/L)	Gross beta (pCi/L)	^{99}Tc (pCi/L)	Arsenic (µg/L)	Copper (µg/L)	Lead (µg/L)	Mercury (µg/L)	Selenium (µg/L)	Silver (µg/L)	Thallium (µg/L)	Zinc (µg/L)	Endosulfan I (µg/L)	Endrin (µg/L)	4,4'-DDT (µg/L)	Heptachlor (µg/L)	PCB-1254 (µg/L)	PCB-1260 (µg/L)	PCB-1268 (µg/L)
Reference standard	***15***	***50***	**100000/44000**	**10**	**9**	**2.5**	**0.051**	**5**	**3.2**	**0.47**	**100**	**0.056**	**0.036**	**0.001**	**0.00079**	**0.00064**	**0.00064**	**0.00064**
Reference standard source[a]	**40 CFR 141**	**40 CFR 141**	**DCG/DCS**	**REC OO**	**CCC**	**CCC**	**REC OO**	**CCC**	**CMC**	**REC OO**	**Permit**	**CCC**	**CCC**	**CCC**	**REC OO**	**REC OO**	**REC OO**	**REC OO**
Screening level	**10**	**30**	**1,760**	**7.5**	**7**	**1.8**	**0.025**	**3.8**	**2.4**	**0.35**	**75**	**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**
Minimum TDEC notification level[b]				**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
OUTFALL 210																		
9/21/2013					*10.8*	*70.1*												
11/18/2013	14.1	*57.9*				*11.5*										*0.0575*		
11/26/2013	13.8	12			8.08	*73.3*		*9.58*								*0.073*		
12/9/2013						*36.3*										*0.0712*		
12/23/2013		*116*													*0.0163*			
12/30/2013	13.4	*86.3*		*11*						*8.67*				*0.024*	*0.031*			
1/13/2014		*68*				*6.25*				*7.16*								
2/3/2014		30.9			8.76	*14.3*										*0.0485*		
3/3/2014	11	36.9			*12.5*	*92.9*								*0.0231*		*0.26*	*0.154*	*0.0522*
5/15/2014		*200*						*17.4*										
OUTFALL 230																		
11/17/2014								*6.23*									*0.055*	
OUTFALL 490																		
9/21/2013				*13.5*		*9.27*		*10.3*	2.43									
11/18/2013		*6,510*	10,600															
11/26/2013		*835*				*5.46*												
12/9/2013		*36,200*	56,900	10		*22.5*							0.0269					
12/23/2013		*39,700*	59,200		*10.5*										*0.0699*			
12/30/2013		*27,500*	57,400							*6.96*								
1/13/2014	*423*	*7,710*	11,300			*4.26*				*5.09*								
2/3/2014		*4,450*	6,040															
3/3/2014		*3,760*	4,560															
3/10/2014		*9,220*	14,400															
4/7/2014			2,260															
4/30/2014		*425*		8.44														
5/15/2014		*644*																
5/19/2014		*531*																
11/17/2014		*171*																
MANHOLE 17006																		
9/21/2013		*87.7*				*7.51*												
11/18/2013	*15*	*191*				*5.6*			*28.6*									
11/26/2013		*4,800*	6,350			*11.9*		*9.38*									*0.0681*	
12/9/2013	*17.2*	*207*																
12/23/2013	*22.3*	*334*												*0.0119*	*0.0305*			
12/30/2013	*18.2*	*370*																
1/13/2014		37.3				*45.7*				*6.12*	83.3					*0.141*		

Table 3.11 (continued)

	Gross alpha (pCi/L)	Gross beta (pCi/L)	^{99}Tc (pCi/L)	Arsenic (µg/L)	Copper (µg/L)	Lead (µg/L)	Mercury (µg/L)	Selenium (µg/L)	Silver (µg/L)	Thallium (µg/L)	Zinc (µg/L)	Endosulfan I (µg/L)	Endrin (µg/L)	4,4'-DDT (µg/L)	Heptachlor (µg/L)	PCB-1254 (µg/L)	PCB-1260 (µg/L)	PCB-1268 (µg/L)
Reference standard	***15***	***50***	**100000/44000**	**10**	**9**	**2.5**	**0.051**	**5**	**3.2**	**0.47**	**100**	**0.056**	**0.036**	**0.001**	**0.00079**	**0.00064**	**0.00064**	**0.00064**
Reference standard source[a]	**40 CFR 141**	**40 CFR 141**	**DCG/DCS**	**REC OO**	**CCC**	**CCC**	**REC OO**	**CCC**	**CMC**	**REC OO**	**Permit**	**CCC**	**CCC**	**CCC**	**REC OO**	**REC OO**	**REC OO**	**REC OO**
Screening level	**10**	**30**	**1,760**	**7.5**	**7**	**1.8**	**0.025**	**3.8**	**2.4**	**0.35**	**75**	**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**
Minimum TDEC notification level[b]				**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
MANHOLE 17029																		
2/3/2014		*457*																
3/3/2014	11.3	*220*																
5/15/2014	14.8	*112*		8.65				*13.4*										
MANHOLE 18102																		
9/21/2013		*112*				*7.16*						0.0149						
11/18/2013	*33.7*	*29,100*	47,900		*10.5*	*5.4*			*5.23*									
11/26/2013		*1,300*	2,020			*14*					81.4	0.0322						
12/9/2013		*25,000*	42,600			*30*							*0.0476*					
12/23/2013		*78,700*	*16,3000*		*17.5*	*36.5*				*7.28*								
12/30/2013		*69,600*	*16,3000*		*11.2*	*12.6*												
1/13/2014		*5,450*	9,800			*6.08*				*7.39*								
1/28/2014			3,720															
2/3/2014		*14,400*	21,700	9.86	*10.3*	*11.4*												
3/3/2014		*12,100*	14,400			*5.55*												
5/15/2014		*519*									*133*							
MANHOLE 18112																		
1/13/2014	*117*	*19,300*	28,700															
1/28/2014			3,160															
2/3/2014		*23,700*	37,900															
3/3/2014			40,600															
5/15/2014			4,070															
MANHOLE 18126-1																		
2/3/2014		37.2																
K-1007-B																		
11/18/2013		*136*																
12/9/2013		*802*																
12/23/2013	*23.9*	*765*																
12/30/2013		*1,510*	2,780															
1/13/2014		*319*				*3.46*				*5.27*								
2/3/2014		*135*																
4/24/2014		*130*																
K-1700																		
11/4/2013							0.0297											
2/18/2014		*145*																
4/29/2014							0.027									*0.0401*		
5/6/2014		*62.1*					0.0283				*130*							
7/14/2014		40					0.03											
10/21/2014							0.0259											

Table 3.11 (continued)

	Gross alpha (pCi/L)	Gross beta (pCi/L)	^{99}Tc (pCi/L)	Arsenic (µg/L)	Copper (µg/L)	Lead (µg/L)	Mercury (µg/L)	Selenium (µg/L)	Silver (µg/L)	Thallium (µg/L)	Zinc (µg/L)	Endosulfan I (µg/L)	Endrin (µg/L)	4,4'-DDT (µg/L)	Heptachlor (µg/L)	PCB-1254 (µg/L)	PCB-1260 (µg/L)	PCB-1268 (µg/L)
Reference standard	*15*	*50*	**100000/44000**	**10**	**9**	**2.5**	**0.051**	**5**	**3.2**	**0.47**	**100**	**0.056**	**0.036**	**0.001**	**0.00079**	**0.00064**	**0.00064**	**0.00064**
Reference standard source[a]	**40 CFR 141**	**40 CFR 141**	**DCG/DCS**	**REC OO**	**CCC**	**CCC**	**REC OO**	**CCC**	**CMC**	**REC OO**	**Permit**	**CCC**	**CCC**	**CCC**	**REC OO**	**REC OO**	**REC OO**	**REC OO**
Screening level	**10**	**30**	**1,760**	**7.5**	**7**	**1.8**	**0.025**	**3.8**	**2.4**	**0.35**	**75**	**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**	**Detectable**
Minimum TDEC notification level[b]				**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
K-716																		
6/3/2013						2.4	*0.0771*											
4/29/2014							*0.0688*											
5/8/2014							0.03											

NOTES

Only results exceeding screening criteria are shown. Nondetect results are not shown.

Use of italics indicates exceedance of a reference standard for gross alpha or gross beta, exceedance of a DCG value at a location other than a permitted outfall, or exceedance of the TDEC water quality criteria.

BOLD indicates exceedance of a DCG value for a radionuclide at a permitted outfall or exceedance of a notification level for metals, volatile organics, polychlorinated biphenyls, or pesticides at a permitted outfall.

[a]Reference standard sources are defined as follows.

- CMC TDEC Rule 0400-40-03-.03(3)(g) Criterion Maximum Concentration
- CCC TDEC Rule 0400-40-03-.03(3)(g) Criterion Continuous Concentration
- REC OO TDEC Rule 0400-40-03-.03(4)(j) Organisms Only Criteria
- Permit NPDES Permit TN0002950 Part III
- No Criteria Sources not listed in the TDEC General Water Quality Criteria or NPDES Permit No. TN0002950

DCG values for ingested water [DOE O 5400.5, Chapter III (DOE 1990)] are listed because they remain in effect for certain CERCLA activities. Reference standards for radionuclides equal DCSs for ingested water (DOE 2011a), and screening levels equal 4% of DCS values. Reference standards and screening levels for gross alpha and gross beta measurements correspond to the national primary drinking water standard (40 CFR 141 National Primary Drinking Water Regulations Subparts B and G).

[b]Actual TDEC notification levels vary by outfall, parameter, and frequency of discharge. If the minimum notification level is exceeded, additional requirements in NPDES Permit No. TN0002950, Part III, may apply.

Acronyms

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
DCG = derived concentration guide
DCS = derived concentration standard
NPDES = National Pollutant Discharge Elimination System
TDEC = Tennessee Department of Environment and Conservation

The electrical duct system manholes in the Portal 4 parking area are part of an underground electrical duct network that once carried electrical power lines from the former powerhouse area to portions of ETTP. A large portion of the electrical duct network was filled with grout in CY 2010; however, the placement of grout into this system was stopped immediately downslope of the Portal 4 parking area manholes where the water discharge was observed. This portion of the duct system remained susceptible to inflow from groundwater and storm water.

It was determined that ^{99}Tc-contaminated storm water from the demolition of the southeastern portion of the K-25 building entered the electrical duct system through cracks or breaks in the concrete structure of the system. The duct system eventually filled with ground water and storm water runoff, and then overflowed during heavy rainfall events.

In January 2014, the remainder of the electrical duct system in the vicinity of the K-25 ^{99}Tc demolition activities was filled with grout. This corrective action eliminated the discharges from the electrical duct system into the storm drain system.

After ^{99}Tc was identified in the electrical duct system, additional investigations were conducted in early 2014 in the adjacent utilities, which included the sanitary sewer system located to the east of the demolition area. Based on the elevated results that were measured, all connections to the sanitary sewer system around the Building K-25 demolition area were isolated, and the sanitary sewer trunk line was plugged. Sampling of the sanitary sewer network confirmed the effectiveness of the plugging action.

As a follow-up to the sanitary sewer network sampling, ^{99}Tc samples were collected from the City of Oak Ridge Rarity Ridge STP (RRSTP) influent, treatment basins, and effluent. These results showed increased values of ^{99}Tc at all locations, but the values in the influent and effluent were below DOE O 5400.5 DCG values (DOE 1990). The sewage plant discharge values were also below the State of Tennessee effluent reference standards.

During the sampling effort, it was observed that ^{99}Tc became concentrated in the digester sludge. DOE has taken responsibility for cleaning up that facility and removing the sludge for off-site disposal. The sludge is removed on a frequency of every 30 to 55 days depending upon the sludge generation rate at the plant. The sludge is incinerated at the Perma-Fix Northwest Incinerator, and the residual ash is sent to the Energy Solutions facility at Clive, Utah, for disposal. The periodic sludge pumping of the sewage plant digester will continue into CY 2015. Because the ^{99}Tc contamination occurred as part of a CERCLA demolition action, this topic for all media was documented in a CERCLA report to TDEC, EPA, and DOE titled *Technetium-99 Removal Site Evaluation at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2014c). This information was also incorporated into the FY 2015 CERCLA remediation effectiveness report. The conclusions in the removal site evaluation are that measured levels of ^{99}Tc in site surface water releases are in compliance with applicable regulatory requirements and DOE orders and do not pose a threat to human health and the environment.

3.6.2.3 Decontamination and Decommissioning of the K-31 Building

Removal of the transite siding from the exterior of the K-31 building began in April 2014. Demolition of the structure will proceed after the transite removal has been completed. To closely monitor the storm water runoff from the building demolition activities, sampling will be performed at regular intervals during the demolition process. Initial sampling was performed to provide baseline data for conditions present before demolition began. Additional monitoring will be performed at about 3 months and at about 6 months after demolition begins. Table 3.12 contains information on the locations and parameters to be sampled as part of the K-31 D&D monitoring effort.

Table 3.12. Storm water sampling to support decontamination and decommissioning activities at the K-31 building

Sampling location	Sampling frequency	Gross alpha/beta	Isotopic uranium, ^{99}Tc, transuranics[a]	PCBs[b]/ Pesticides[c]	Metals[d]/ mercury	Hexavalent chromium
SD 510	1. Before demolition 2. 3 months after demolition start 3. 6 months after demolition start	X	X	X	X	X
SD 560	1. Before demolition 2. 3 months after demolition start 3. 6 months after demolition start	X	X	X	X	X
SD 610	1. Before demolition 2. 3 months after demolition start 3. 6 months after demolition start	X	X	X	X	X

[a]Transuranics analysis includes ^{237}Np, ^{238}Pu, and $^{239/240}$Pu.
[b]PCB analysis includes Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, and 1268.
[c]Pesticide analysis includes 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Aldrin, Chlordane, Dieldrin, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, Toxaphene, alpha-BHC, beta-BHC, delta-BHC, and gamma-BHC.
[d]Metals analysis includes Al, Ag, As, Ba, Be, B, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn.

SD = storm water outfall/storm drain.

The only result from predemolition samples collected in April 2014 at outfalls 510, 560, and 610 that was above screening levels was a copper result at outfall 510 of 8.32 µg/L, which exceeded the screening level of 7 µg/L.

Additional D&D sampling was conducted at outfall 610 in November 2014. This sample was collected after a storm event produced a rainfall of around 1.5 in. over a 2-day period. The results that exceeded screening levels are shown in Table 3.13. Several modifications were made to the sediment control measures that were in place at the K-31 D&D site based on the results from this sampling event.

Table 3.13. Analytical results exceeding screening levels for Building K-31 decontamination and decommissioning monitoring

Parameter	Screening level	Outfall 610
Beta activity (pCi/L)	30	39.2
PCB-1260 (µg/L)	Detectable	0.0469
PCB-1268 (µg/L)	Detectable	0.361
Hexavalent chromium (µg/L)	8	440
Total chromium	75	452
Lead (µg/L)	1.8	8.74
Selenium (µg/L)	3.8	11.2
Copper (µg/L)	7	21
Zinc (µg/L)	75	107

3.6.2.4 SAMPLING OF THE K-761 SWITCH HOUSE BASEMENT SUMP

The K-761 building, also known as the K-31 substation, operated from 1952 through 1985. It transferred electrical power from overhead transmission lines to the K-31 cascade. K-761 is a multistory building that includes a basement, first floor, mezzanine, and second floor. It measures about 306 ft by 57 ft with an 8 ft basement and is made of brick, tile wall, and reinforced concrete. The building has a flat, tar and gravel, built-up roof. Water that collects in the K-761 switch house eventually enters the building's basement sump, which is designated as sump S-068. This sump discharges to Poplar Creek via storm water outfall 510.

Because the building sump's pump has been out of service for some time, the basement of the K-761 building flooded. Initial sampling of the water from the K-761 basement was performed to provide PCB and radiological data to determine whether water that had collected in the K-761 basement could be discharged to the environment. Results of this sampling effort are presented in Table 3.14. Because gross alpha radiation and PCBs were not detected and gross beta radiation was not detected above the reference standard, the water from the K-761 basement was discharged to the environment. The defective sump pump in the basement sump has since been replaced and normal operation of the sump has been restored, which should prevent future flooding of the basement.

Predemolition sampling of the K-761 switch house will be performed in accordance with guidelines presented in the SWPP Program sampling and analysis plan (SAP) for FY 2015.

Table 3.14. Analytical results for K-761 switch house basement sump

Parameter	Reference standard[a]	K-761
Alpha activity (pCi/L)	15	0.638 U
Beta activity (pCi/L)	50	7.37
PCB-1016 (μg/L)	0.00064	0.032 U
PCB-1221 (μg/L)	0.00064	0.032 U
PCB-1232 (μg/L)	0.00064	0.032 U
PCB-1242 (μg/L)	0.00064	0.032 U
PCB-1248 (μg/L)	0.00064	0.032 U
PCB-1254 (μg/L)	0.00064	0.032 U
PCB-1260 (μg/L)	0.00064	0.032 U
PCB-1262 (μg/L)	0.00064	0.032 U
PCB-1268 (μg/L)	0.00064	0.032 U

[a]Alpha and beta activity from 40 CFR 141; PCBs from the Tennessee water quality criteria, TDEC Rule 0400-40-03-.03.

U—Indicates compound was analyzed for, but not detected above the reference values, PCB = polychlorinated biphenyl, and TDEC = Tennessee Department of Environment and Conservation.

3.6.2.5 Decontamination and Decommissioning of the K-1206-F Fire Water Tank

On August 3, 2013, the 382-ft-tall K-1206-F fire water tank was brought down through a controlled explosive demolition. The water tower was estimated to contain at least 1.5 million pounds of steel, which was disposed at the Y-12 sanitary landfill. The 400,000 gal structure was designed and built by the Chicago Bridge and Iron Company in 1958 to service the site's fire protection system. It operated until June 3, 2013, when the valves were turned off. It was drained, disconnected, and permanently taken out of service on July 15, 2013. With the tower gone, the site will rely on pumping stations to provide the necessary pressure for its fire water system.

Slightly elevated levels of PCBs were noted in interior paint coatings at maximum levels of 24 ppm, which is well below regulatory thresholds of 50 ppm. Additionally, elevated levels of lead were measured in the paint coatings. Any potential soil contamination that remains from the paints will be addressed in the CERCLA Zone 2 soil evaluations.

Table 3.15 contains information on the storm water sampling to be done as part of the D&D activities for the K-1206-F tank.

Table 3.15. Storm water sampling for decontamination and decommissioning activities at the K-1206-F fire water tank

Sampling location	Sampling frequency	Sampling events	PCBs	Metals[a]
SD 560	After demolition activities	1	X	X

[a]Metals analysis should include Al, Ag, As, Ba, Be, B, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn.

SD = storm water outfall/storm drain.

Runoff from the K-1206-F fire water tank area discharges to Poplar Creek via storm water outfall 560. Post-D&D sampling of the storm water runoff from the K-1206-F fire water tank area was performed at outfall 560 in January 2014. The analytical data from this sampling effort that exceeded screening levels are shown in Table 3.16. No detectable levels of PCBs or lead were noted in the storm water runoff sampling.

Table 3.16. Analytical results greater than screening levels for monitoring at storm water outfall 560

Parameter	Screening level (µg/L)	Outfall 560 (µg/L)
Selenium	3.8	14.3

3.6.2.6 Decontamination and Decommissioning of the K-892 Pump House

The K-892 pump house was constructed in 1954 to pump treated water for the K-33 recirculating cooling water (RCW) system. RCW was used to cool heat transfer systems. The K-892 facility consists of three sections. One section contained water treatment chemical tanks and feed equipment. Another section contained RCW pumps, piping, and valves. Another section contained electrical transformers and chemical storage tanks.

Chromates were known to have been present in some of the chemicals used for water treatment at the K-892 pump house. A zinc-chromate-phosphate treatment was used to prevent scaling in the RCW system. Due to the presence of electrical equipment in the facility, PCBs may also be a potential contaminant of concern (COC) for the K-892 pump house.

Demolition of the K-892 pump house will likely be initiated sometime in 2015 or 2016. Initial sampling has been conducted to provide baseline data for conditions present before demolition began. Additional sampling will be conducted at this facility as demolition activities are undertaken and after demolition has been completed.

Table 3.17 contains information on the locations and parameters to be sampled.

Table 3.17. Storm water sampling for decontamination and decommissioning of the K-892 pump house

Sampling location	Sampling frequency	pH	Gross alpha/beta	Isotopic uranium, ^{99}Tc, transuranics[a]	PCBs[b]	Metals[c]/ mercury	Hexavalent chromium
Outfall 690	Before initiation of building demolition activities After each rainfall event of 1 in. or more in a 24 h period Upon completion of D&D activities	X	X	X	X	X	X

[a]Transuranics analysis includes Np-237, Pu-238, and Pu-239/240.
[b]PCB analysis includes Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260, 1262, and 1268.
[c]Metals analysis includes Al, Ag, As, Ba, Be, B, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn.

Sampling was conducted at outfall 690 in November 2014 to provide the baseline conditions present before the initiation of D&D activities. No contaminants were present in the sample from outfall 690 at levels above the applicable screening criteria.

3.6.2.7 Monitoring Runoff from Oak Ridge Forest Products Area

Oak Ridge Forest Products LLC operates a wood yard and chipping facility at the K-722 site, in the former powerhouse area. The primary operation conducted is the conversion of low-grade forest products (pulpwood) into wood chips. These wood chips are used as a biomass fuel, in paper production, and for mulching and landscaping. Wood from local logging and clearing activities is purchased on-site. The wood is then processed into wood chips by a chipper.

One source of potential impact to storm water runoff from this facility is fuel storage. Double-walled aboveground storage tanks with a total storage capacity of about 2,500 gal have been installed on-site to contain both on-road and off-road diesel fuel. Sufficient containment has been constructed around the tanks to contain any runoff or spillage. Aboveground storage tanks also store water used for fire suppression and equipment cleaning. Portable restrooms are used for handling sanitary waste.

Sampling was performed at the storm water outfalls that receive drainage from this facility to assess any potential impact that the operation of this facility may be having on the quality of the storm water runoff from the area. Guidance on industrial activities found in the Tennessee Stormwater Multi-Sector General Permit (TMSP) was used in choosing the parameters that were sampled as part of this effort. Parameters required to be sampled under the TMSP for Standard Industrial Classification (SIC) code 2411 (log storage and handling areas) and SIC code 2421 (general sawmills and planing mills) were selected to be representative of the storm water discharges that may originate at Oak Ridge Forest Products.

As shown in Table 3.18, storm water runoff from outfalls 780 and 810 was sampled as part of this effort. The analytical results from this sampling effort will be used to determine whether additional sampling of these storm water outfalls will be necessary on a more frequent basis (e.g., quarterly, annually).

Field observations were also made at each of the outfalls when sampling of the storm water runoff from the Oak Ridge Forest Products facility was conducted. The discharge from these outfalls was observed for visible sheen, discoloration, foam, floating materials, suspended materials, and debris. If any debris was noted in the discharge from the outfall that did not appear as if it would fit through a 1 in. diameter round opening, EC&P personnel were contacted.

Table 3.18. Storm water sampling at the Oak Ridge Forest Products facility

Sampling location	Oil and grease	TSS	COD	Metals[a]	pH
Outfall 780	X	X	X	X	X
Outfall 810	X	X	X	X	X
Outfall 820	X	X	X	X	X

[a]Metals analysis includes Al, Ag, As, Ba, Be, B, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn.

Acronyms
TSS = total suspended solids
COD = chemical oxygen demand

Sampling at outfalls 780 and 810 was completed in December 2014. Sampling at outfall 820 was completed in January 2015. The only result from this sampling effort that was above screening levels was a copper result at outfall 810 of 7.31 µg/L, which exceeded the screening level of 7 µg/L. Additionally, no debris, solids, or oily sheen was noted in the storm water samples from the outfalls that serve this facility. Therefore, it is believed that this facility does not adversely affect the quality of the storm water runoff entering the Clinch River.

3.6.2.8 Sampling to Meet the Requirements of DOE O 458.1

UCOR must conduct activities to ensure that liquid discharges containing radionuclides from DOE activities do not exceed an annual average (at the point of discharge) of either of the following.

- 5 pCi (0.2 Bq) per gram above background of settleable solids for alpha-emitting radionuclides
- 50 pCi (2 Bq) per gram above background of settleable solids for beta-gamma–emitting radionuclides

To determine whether discharges in excess of these criteria are occurring at ETTP, screening criteria were used to determine which permitted storm water outfalls would be sampled for settleable solids during dry weather conditions (no storm water flow). The proposed screening criteria included the following:

- at least one radionuclide in the non-storm-water base flow exceeds 4% of the DCS for ingested water (DOE 2011a) and
- total suspended solids (TSS) in the non-storm-water base flow equal to or greater than 30 mg/L.

Several outfalls flow on a continuous basis and, therefore, have a non-storm-water base flow. The flow that occurs at these outfalls during dry weather conditions is attributable to groundwater infiltration into the storm drainage piping system. As noted in the ETTP SWPP Program baseline document, the outfalls that may flow on a continuous basis include outfalls 100, 142, 170, 180, 190, 230, 382, 430, 490, 710, and 992.

At each of these outfalls, it was determined whether the screening criteria were met before sampling for settleable solids. During dry weather conditions (no storm water flow), samples were collected for gross alpha/beta radiation, isotopic uranium, TRUs, ^{99}Tc, and TSS, as indicated in Table 3.19. If TSS in the non-storm-water base flow was less than 30 mg/L, no additional sampling would be required at that outfall per the screening criteria. However, if TSS was equal to or greater than 30 mg/L and at least one of the radionuclides exceeded 4% of the DCS for ingested water, the outfall would be sampled for settleable solids using the volumetric method. If settleable solids were found to be present in sufficient quantity (>0.1 mg/L), the sample would be filtered and the solid materials from the sample would be analyzed for gross alpha and gross beta/gamma radiation to determine whether the limits stated in DOE O 458.1 (DOE 2011b) had been exceeded.

Water samples taken as part of this investigation were collected as manual grab samples. Manual grab samples were collected according to the guidelines specified in Sections 3.1.2 and 3.3.1 of EPA's *NPDES Storm Water Sampling Guidance Document* (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor. Samples for this portion of the SWPP Program SAP were collected during dry weather conditions. For the purpose of this SWPP Program investigation, a dry weather period was defined as being at least 72 h after a storm event of 0.1 in. or more.

Table 3.19. East Tennessee Technology Park outfalls to be sampled for compliance with DOE O 458.1 (DOE 2011b)

Sampling location	Sampling event	Gross alpha/gross beta radiation (manual grab)	Isotopic uranium (manual grab)	Transuranics[a] (manual grab)	^{99}Tc (manual grab)	TSS (manual grab)
100	Dry weather	X	X	X	X	X
142	Dry weather	X	X	X	X	X
170	Dry weather	X	X	X	X	X
180	Dry weather	X	X	X	X	X
190	Dry weather	X	X	X	X	X
230	Dry weather	X	X	X	X	X
430	Dry weather	X	X	X	X	X
490	Dry weather	X	X	X	X	X
710	Dry weather	X	X	X	X	X
992	Dry weather	X	X	X	X	X

[a]Transuranics analysis includes ^{237}Np, ^{238}Pu, and $^{239/240}$Pu.
TSS = total suspended solids.

As shown in Table 3.20, the data collected as part of this sampling event showed that none of the outfalls sampled contained TSS at levels above the screening criteria of 30 mg/L. None of the radionuclides in the non-storm-water base flow exceeded 4% of the DCS for ingested water except ^{99}Tc at outfall 490.

Technetium-99 was detected at 14,400 pCi/L, which exceeds the screening level of 1,760 pCi/L for this analyte. Gross beta radiation was detected at outfall 490 at 9,220 pCi/L, which exceeds the reference standard of 50 pCi/L for this analyte. Both of these results are likely due to the release of ^{99}Tc to the outfall 490 drainage system as part of the demolition of the southeast portion of the K-25 building.

Based on these results, no settleable solids sampling will be required at any of these outfalls to determine whether the limits in DOE O 458.1 (DOE 2011b) have been exceeded.

Table 3.20. Analytical results from sampling performed for compliance with DOE O 458.1[a]

Outfall	Suspended solids (mg/L)	Alpha activity (pCi/L)	Beta activity (pCi/L)	^{237}Np (pCi/L)	^{238}Pu (pCi/L)	$^{239/240}$Pu (pCi/L)	^{99}Tc (pCi/L)	Total U (µg/L)	$^{233/234}$U (pCi/L)	$^{235/236}$U (pCi/L)	^{238}U (pCi/L)
100	0.6	−1.04	3.02	0.0112	0.0217	0.0435	0.713	0.313	0.484	0.121	0.0863
142	0.9	4.79	2.2	−0.052	0.0163	−0.0508	22.1	0.831	0.48	0.116	0.261
170	0.57	20.4	48.9	−0.00762	−0.000801	−0.0408	125	15.2	11.6	0.815	4.98
180	0.8	7.46	11.5	−0.0306	0	0.0218	10.7	7.49	5.48	0.29	2.47
190	1	30.5	26.1	0.0168	−0.0179	−0.0179	26.9	16.5	14.2	1.02	5.39
230	0.57	9.03	33.2	0.00409	−0.132	−0.0104	60.6	5.93	5.22	0.616	1.9
430	0.57	2.23	20.1	−0.0377	−0.0369	−0.0184	39.3	1.6	0.77	0.185	0.508
430 (dup)	0.57	1.56	21.6	−0.023	0.0509	0.0677	28.6	0.593	0.675	0.107	0.183
490	1.1	−5.16	9220	−0.0334	−0.0418	−0.063	14400	1.87	1.92	0.097	0.614
710	0.57	0.542	6.85	−0.0621	0.107	−0.116	7.45	2.84	1.21	0.0468	0.947
992	6.9	−0.284	2.91	0.0724	−0.0453	−0.0303	−1.02	0.603	0.234	0.176	0.175

[a]DOE. *Radiation Protection of the Public and the Environment*. DOE O 458.1. Approved 2-11-11. US Department of Energy, Washington, DC.

3.6.2.9 Sampling Legacy Chromium Groundwater Plume Discharge

During FY 2007, hexavalent chromium was detected in surface water in Mitchell Branch at levels exceeding the applicable AWQC of 0.011 mg/L for the protection of fish and aquatic life. At Mitchell Branch kilometers (MIKs) 0.71 and 0.79, locations in Mitchell Branch immediately downstream from the storm water outfall/storm drain (SD) 170 discharge point, hexavalent chromium levels were measured at levels as high as 0.78 mg/L. The source of the discharge was determined to be groundwater infiltration into the SD 170 piping as well as seep flows through the storm water outfall/storm drain headwall. Figure 3.18 shows the locations where hexavalent chromium releases to Mitchell Branch were identified.

Because hexavalent chromium has not been used in process operations at ETTP for more than 30 years, the release of hexavalent chromium into Mitchell Branch is a legacy problem and not an ongoing, current operations issue. Therefore, DOE in coordination with EPA and TDEC determined that the appropriate response to this release was a CERCLA time-critical removal action. A *Removal Action Report for the Reduction of Hexavalent Chromium Releases into Mitchell Branch at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2008) for the time-critical removal action was issued in July 2008. Subsequently a non-time-critical *Action Memorandum for the Long-Term Reduction of Hexavalent Chromium Releases into Mitchell Branch at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2010) was issued, which led to the construction of CWTS.

Construction of CWTS was initiated in the spring of 2011 with final process installation completed in 2012. CWTS treats chromium- and hexavalent-chromium-contaminated groundwater pumped from a groundwater plume near storm water outfall SD 170 in accordance with the non-time-critical action memorandum mentioned previously (DOE 2010). The chromium collection system wells operated during

100% of the days of CY 2014 with only short duration periods where collection system pumping volumes were limited due to treatment facility operational constraints. The total volume of wastewater that was treated in CY 2014 was about 5.57 million gal.

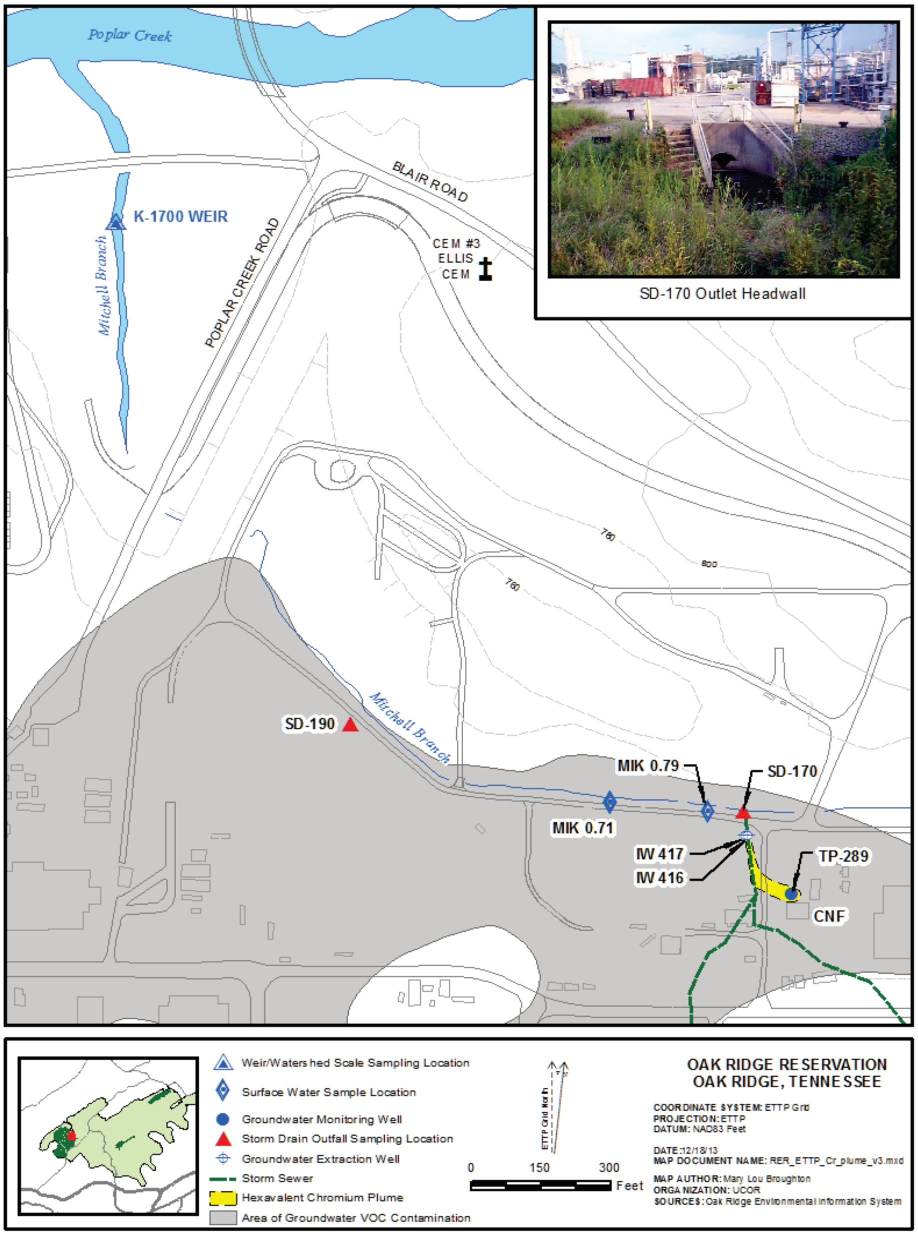

Fig. 3.18. Hexavalent chromium discharges into Mitchell Branch.
(CEM = cemetery, CNF = Central Neutralization Facility, IW = extraction well, MIK = Mitchell Branch kilometer, SD = storm water outfall/storm drain, TP = monitoring well, and VOC = volatile organic compound.)

To monitor both the continued effectiveness of the collection system and the effectiveness of CWTS, periodic monitoring was performed in CY 2014. Samples were collected at monitoring well-289, the chromium collection system wells, SD 170, and MIK 0.79. Samples collected at monitoring well 289 (TP-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. Samples collected at SD 170 monitor the concentrations of the chromium and hexavalent chromium plume being discharged directly to Mitchell Branch. Samples at MIK 0.79 are collected to allow monitoring of chromium and hexavalent chromium concentrations in Mitchell Branch. Requirements for this sampling effort are listed in Table 3.21. Figures 3.19 and 3.20 are graphs of the analytical data from this sampling effort.

The analytical data indicate that chromium levels at all locations have been relatively consistent over the long term.

Table 3.21. Monitoring requirements—Mitchell Branch subwatershed total and hexavalent chromium 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 (TP-289)	Total chromium	1/quarter	Grab
TP-289	Hexavalent chromium	1/quarter	Grab
Cr collection system wells	Total chromium	1/quarter	Grab
Cr collection system wells	Hexavalent chromium	1/quarter	Grab

NOTE: 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).

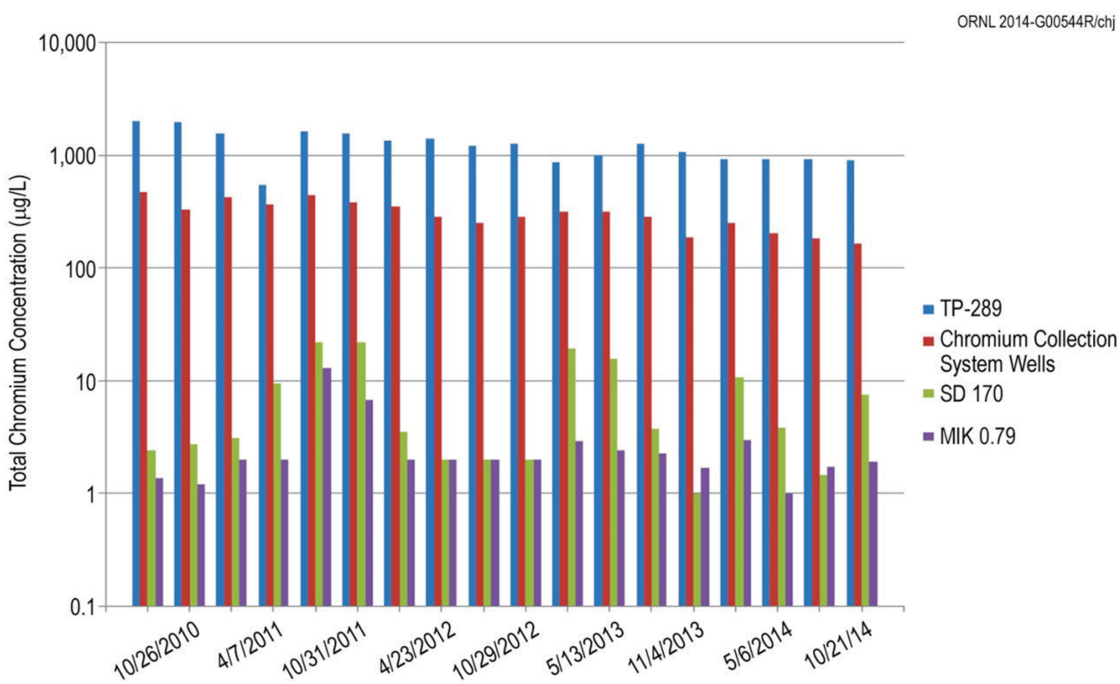

Fig. 3.19. Total chromium sample results for the chromium collection system. (*TP = monitoring well, SD = storm water outfall/storm drain, and MIK = Mitchell Branch kilometer*.)

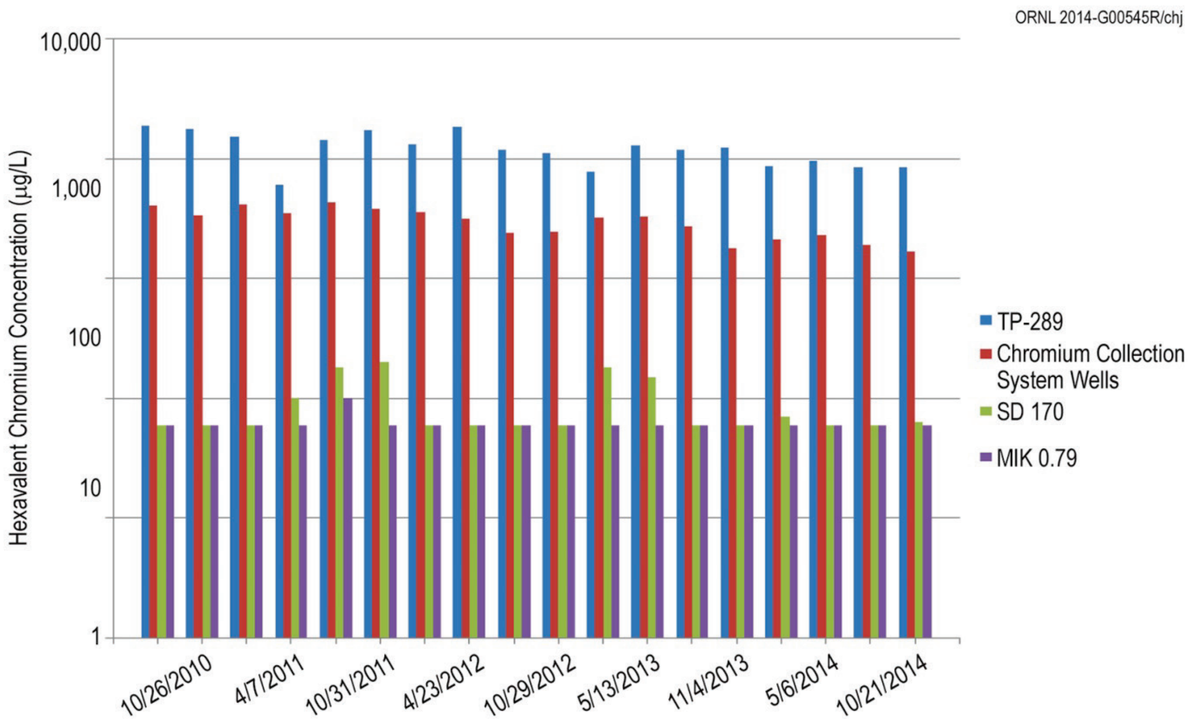

Fig. 3.20. Hexavalent chromium sample results for the chromium collection system.
(TP = monitoring well, SD = storm water outfall/storm drain, and MIK = Mitchell Branch kilometer.)

3.6.3 Investigation of Mercury at East Tennessee Technology Park

3.6.3.1 History of Mercury Use at East Tennessee Technology Park

Legacy 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. The legacy mercury cleanup actions at the ETTP site are being conducted as CERCLA actions. The information that is generated from the NPDES permitting program is documented in the annual CERCLA remediation effectiveness report (DOE 2014) and the 5-year CERCLA review document (DOE 2012) to help provide information that will support future CERCLA cleanup actions.

3.6.3.2 National Pollutant Discharge Elimination System Permit Requirements for Mercury Monitoring

The NPDES permit effective in CY 2014 requires quarterly mercury sampling to be performed at storm water outfalls 170, 180, 190, and 05A. 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. Outfalls170, 180, and 190 collect storm water from large areas on the north side of ETTP and discharge to Mitchell Branch. Outfall 05A, which is located on the east side of ETTP, is the discharge point for the former STP drainage basin into Poplar Creek. The quarterly mercury monitoring results as reported to TDEC are shown in Table 3.22.

Table 3.22. Quarterly National Pollutant Discharge Elimination System mercury monitoring results as reported for CY 2014

Sampling location	First quarter (ng/L)	Second quarter (ng/L)	Third quarter (ng/L)	Fourth quarter (ng/L)
Outfall 170	2.22	2.65	3.87	5.17
Outfall 180	1.74	32	45	90
Outfall 190	8.45	15	11	20
Outfall 05A	78	208	238	194

Mercury results for outfall 170 have been well below AWQCs since July 2009. Outfalls 180 and 190 appear to be the primary sources of mercury discharges into Mitchell Branch. Both the outfall 180 network and the outfall 190 network drain areas with historical mercury processes. 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.

The storm water outfall 05A compliance sampling point is the K-1203-10 sump. This sump was the discharge point for the former STP overflow during its years of operation. The 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 the STP ceased in 2008. The K-1203-10 sump also serves as a collection sump for storm water. Currently, the K-1203-10 sump receives water influent from storm water flow as well as flow through the existing out of service STP piping. Potential sources of mercury in the discharge from outfall 05A are currently under investigation.

Results for outfalls 170, 180, 190, and 05A are shown in Figs. 3.21 through 3.24. Samples collected for compliance with the current NPDES permit were collected as manual grab samples. The results at outfall 170 are well below the AWQC. The results at outfalls 180 and 190 indicate an overall decreasing trend, with many recent sample results at both outfalls being below the AWQC.

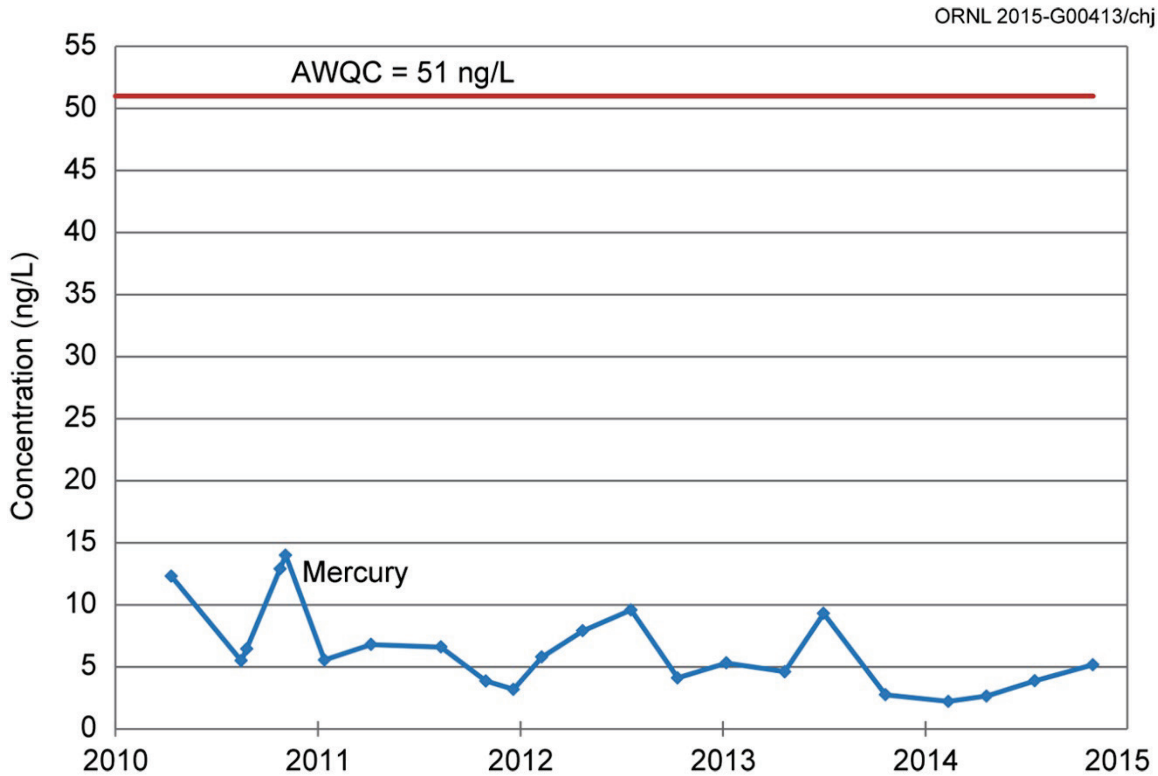

Fig. 3.21. Storm water outfall 170 mercury monitoring results. *(AWQC = ambient water quality criterion.)*

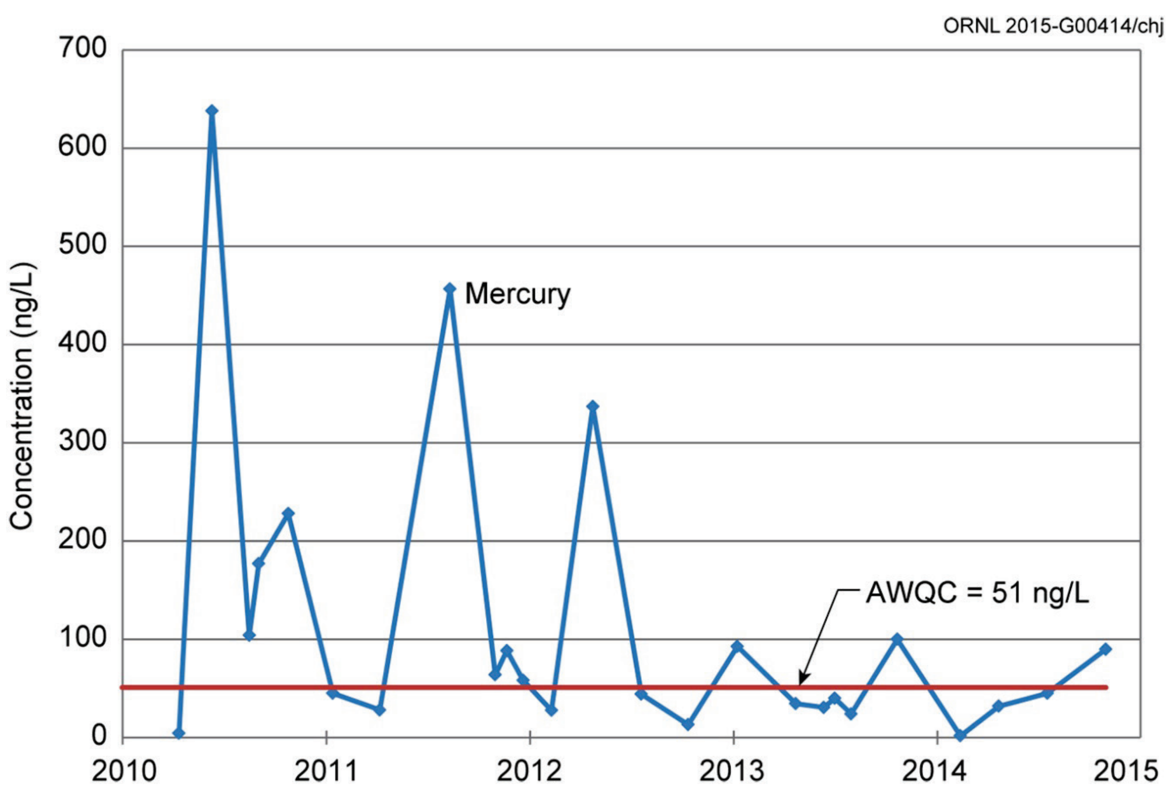

Fig. 3.22. Storm water outfall 180 mercury monitoring results. *(AWQC = ambient water quality criterion.)*

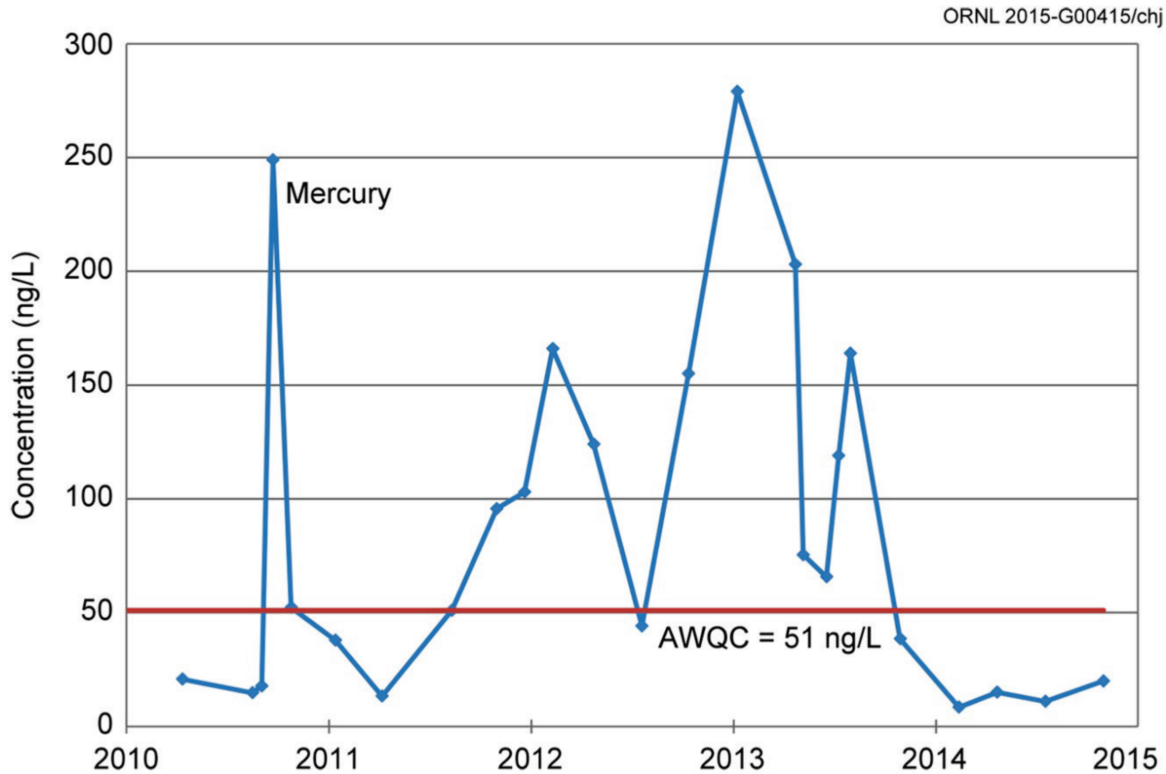

Fig. 3.23. Storm water outfall 190 mercury monitoring results. *(AWQC = ambient water quality criterion.)*

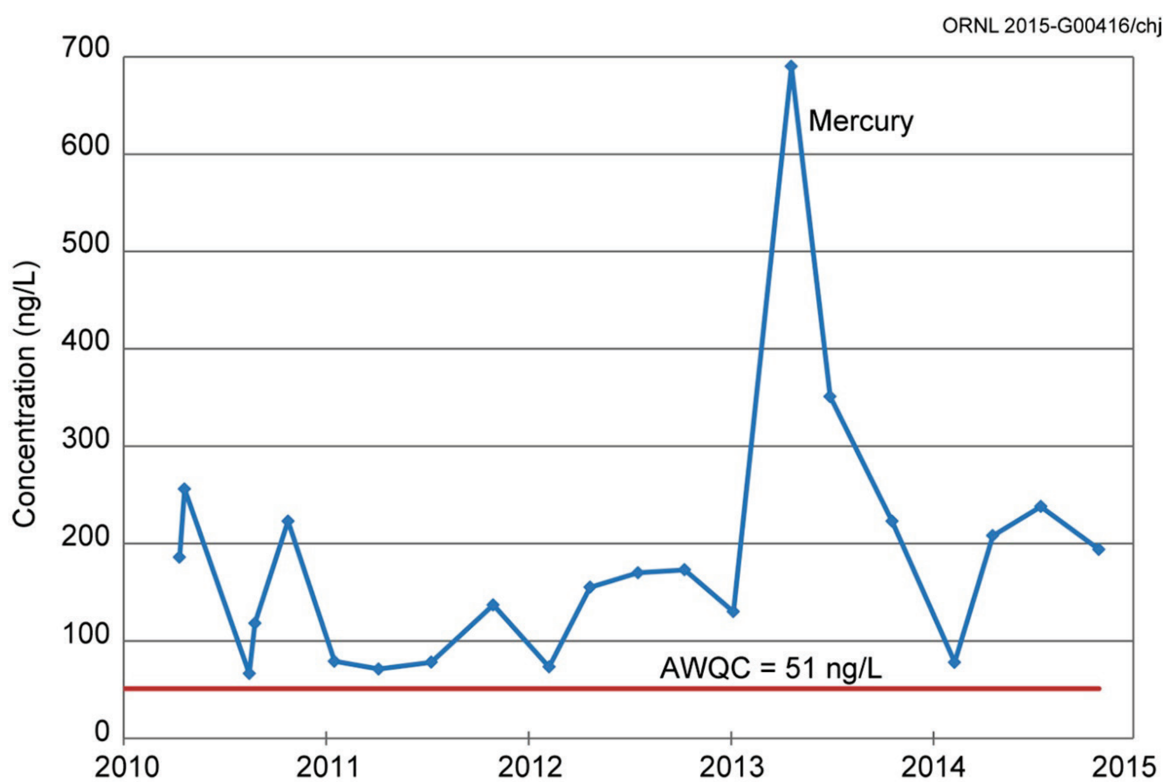

Fig. 3.24. Storm water outfall 05A mercury monitoring results. *(AWQC = ambient water quality criterion.)*

3.6.3.3 Additional Mercury Monitoring Activities

In an effort to obtain analytical data 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. This information will support the CERCLA cleanup actions for the legacy mercury operations across the site. To identify specific areas of mercury contamination, sampling was performed in the storm water outfall networks in the Mitchell Branch subwatershed.

Mercury at levels above the screening criteria has been identified at multiple outfalls during past sampling events. To evaluate whether the discharge of mercury from these outfalls is part of an ongoing trend or whether it is an isolated occurrence, additional sampling at the outfalls will be conducted in FY 2015 to allow for a sufficient number of data points for trend analysis. Table 3.23 shows the results of this mercury sampling effort conducted in CY 2014.

Table 3.23. Investigative mercury results from wet weather monitoring conducted at outfalls during 2014

Sampling location	Mercury (ng/L)
Outfall 250	89.4

3.6.3.4 Decontamination and Decommissioning of the Technetium-99–Contaminated Portion of the East Wing of Building K-25

In 2014, storm water outfalls affected by the demolition cleanup of the southeast portion of the K-25 building were monitored for ^{99}Tc, mercury, and other contaminants. Table 3.24 shows the results of the mercury monitoring at outfall 490; manholes 17006, 17029, and 18102; and the K-1007-B weir at the K-1007-P1 pond. As noted in the table, all the ETTP on-site surface water results were below the AWQC value with the one off-site result in Poplar Creek K-716 at a higher level. The off-site Poplar Creek location is influence by the EFPC discharges.

Table 3.24. Mercury results from storm water sampling activities associated with decontamination and decommissioning activities at the K-25 building

Date	Outfall 490 Hg results (ng/L)	K-1007-B Hg results (ng/L)	Manhole 18102 Hg results (ng/L)	Manhole 17006 Hg results (ng/L)	Manhole 17029 Hg results (ng/L)	K-1700 Hg results (ng/L)	K-716 Hg results (ng/L)
1/13/2014	5.52	5.54	8.29	16.8	NA[a]	NA[a]	NA[a]
2/3/2014	9.15	7.03	9.27	NA[a]	15	NA[a]	NA[a]
3/3/2014	8.27	NA[a]	7.4	NA[a]	11.9	NA[a]	NA[a]
4/29/2014	NA[a]	NA[a]	NA[a]	NA[a]	NA[a]	27	68.8
5/15/2014	10.7	NA[a]	2.9	NA[a]	9.96	NA[a]	NA[a]

[a]Samples were not collected for mercury analysis at this location on this date during the sampling period.

3.6.3.5 Post-Demolition Sampling for the K-25 Building

Final D&D activities were completed for the K-25 building in July 2014. To assess any ongoing impacts the remaining building slab has on the quality of the storm water runoff, monitoring will be performed on an annual basis for multiple contaminants, including mercury. Table 3.25, shows the mercury portion of this sampling at outfall 490 (to monitor east wing slab runoff), outfall 334 (to monitor west wing slab runoff), and outfall 230 (to monitor north end slab runoff)—all at levels below AWQC values.

Table 3.25. Mercury results from storm water sampling activities associated with post-demolition monitoring at the K-25 slab

Date	Outfall 490 mercury results (ng/L)	Outfall 334 mercury results (ng/L)	Outfall 230 mercury results (ng/L)
11/17/2014	6.44	4.21	15.6

3.6.3.6 Sampling to Support Decontamination and Decommissioning of the K-31 Building

Demolition of the K-31 building began in 2014. To monitor the storm water runoff from the building demolition activities, sampling was performed during the demolition process. Outfalls 510 and 560, which discharge to the south into Poplar Creek, and outfall 610, which discharges to the east into Poplar Creek, were monitored for multiple contaminants, including mercury. Table 3.26 shows the results of the mercury monitoring portion of this sampling effort, which are at levels below AWQC values.

Table 3.26. Mercury results from storm water sampling activities associated with decontamination and decommissioning activities at the K-31 building

Date	Outfall 510 mercury results (ng/L)	Outfall 560 mercury results (ng/L)	Outfall 610 mercury results (ng/L)
4/7/2014	11.7	9.01	7.47
11/17/2014	NA[a]	NA[a]	15.6

[a]Samples were not collected for mercury analysis at this location on this date during the sampling period.

3.6.3.7 Sampling to Support Decontamination and Decommissioning of the K-892 Pump House

Demolition of the K-892 pump house began in 2014. To monitor the storm water runoff from the building demolition activities, sampling was performed during the demolition process. Outfall 690, which discharges to Poplar Creek, was monitored for multiple contaminants, including mercury. Table 3.27 shows the results of the mercury monitoring portion of this sampling effort at levels below AWQC values.

Table 3.27. Mercury results from storm water sampling activities associated with decontamination and decommissioning activities at the K-892 pump house

Date	Outfall 690 mercury results (ng/L)
11/17/2014	5.7

3.6.3.8 Storm Water Outfall Sampling

The mercury investigation scope was broadened to encompass areas that have not been investigated before, have not been sampled recently, and/or warrant additional investigation due to operational history. Table 3.28 lists these mercury storm water sampling results by storm water outfall. These outfalls were selected for sampling because they drain areas where mercury may have been used as part of past site operations or because recent mercury analytical results are not available for them. The only location with levels above AWQC values was at outfall 694. Additional monitoring for mercury will be conducted at this outfall and network as part of future investigations.

Table 3.28. Mercury results from storm water monitoring conducted in CY 2014

Storm water outfall	July (ng/L)	August (ng/L)	September (ng/L)
230	4.49		
100	8.78		
280		19.2	
240		22.3	
694			910
195			10.3

3.6.3.9 Mercury Monitoring Conducted Under the Environmental Monitoring Program

As part of the UCOR environmental monitoring program (EMP), mercury samples are collected at select surface water locations throughout ETTP. These mercury results are reported as part of the EMP as well as incorporated into the sitewide mercury investigation. The quarterly Mitchell Branch EMP sample results shown in Table 3.29 were all below AWQC values. The semiannual EMP sample results are shown in Table 3.30 with the only result elevated above AWQC values being at the K-702-A slough location, which is impacted by Poplar Creek mercury levels. Figure 3.25 shows the EMP sampling locations. In addition, sediment samples are collected from EMP monitoring locations about every 5 years. Table 3.31 shows the results of this sampling. For additional information on the EMP, please refer to the surface water monitoring section (Section 3.6.4).

Table 3.29. East Tennessee Technology Park Environmental Monitoring Program quarterly surface water mercury results for CY 2014

Mitchell Branch location	First quarter (ng/L)	Second quarter (ng/L)	Third quarter (ng/L)	Fourth quarter (ng/L)
K-1700 weir	19.5	28.3	30	25.9
MIK 0.45	5.32	8.15	9.54	7.15
MIK 0.59	5.08	4.53	5.28	4.75
MIK 0.71	2.93	2.8	2.96	2.27
MIK 1.4	1.39	1.46	1.38	1.06

MIK values represent distance in Mitchell Branch from the downstream confluence with Poplar Creek.

Acronyms
MIK = Mitchell Branch kilometer

Table 3.30. East Tennessee Technology Park Environmental Monitoring Program semiannual surface water mercury results for CY 2014

Sampling location	January–June (ng/L)	July–December (ng/L)
K-1007-B	12.1	Not Sampled
K-702-A	**73.9**	49.6
K-901-A	4.58	Not Sampled
K-1710	50.1	4.96
K-716	30	12.6
CRK 16	4.26	1.19
CRK 23	0.796	0.671

Bold indicates results above Tennessee water quality criteria.

Acronyms
CRK = Clinch River kilometer.

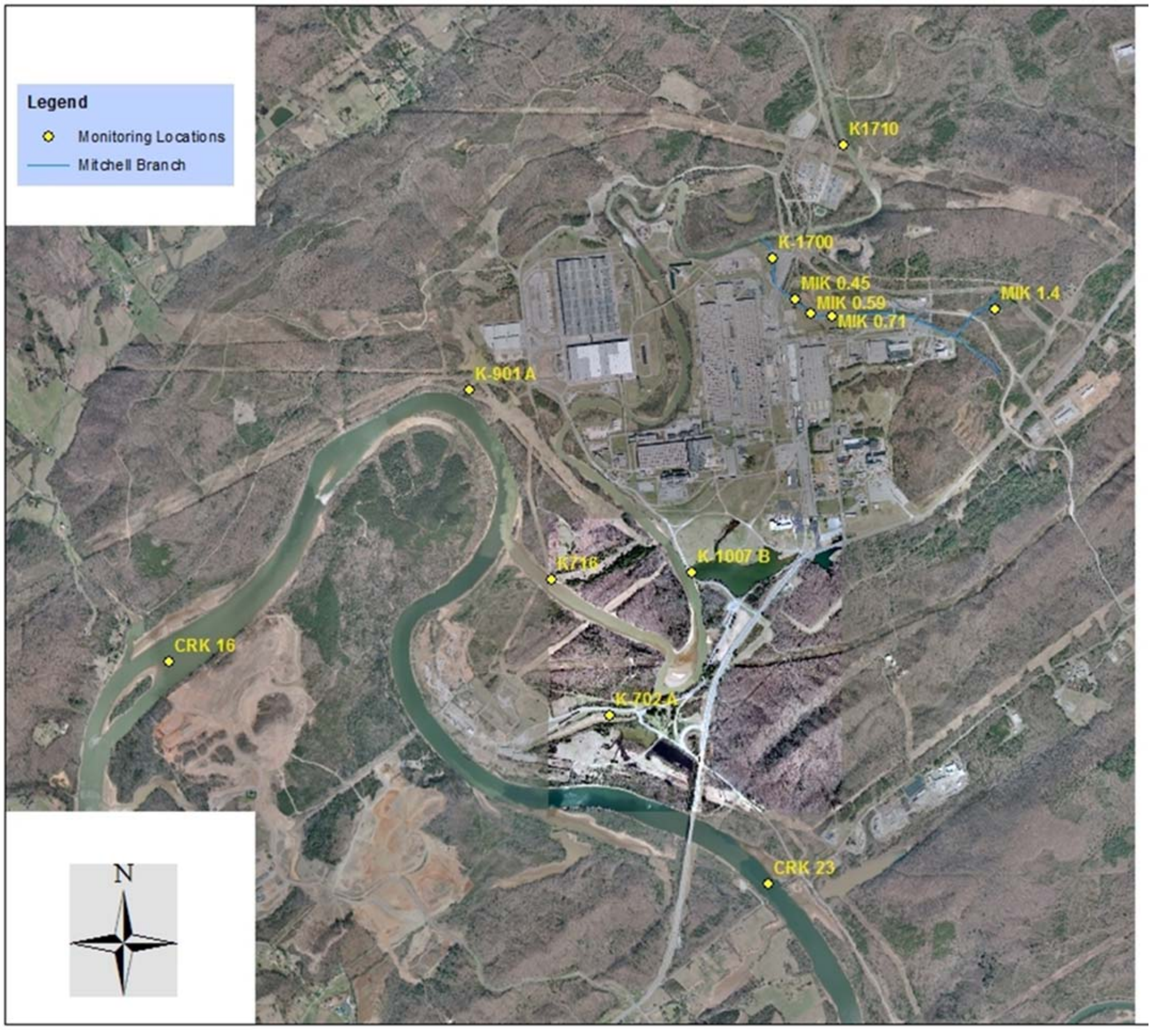

Fig. 3.25. East Tennessee Technology Park Environmental Monitoring Program surface water monitoring locations. *(CRK = Clinch River kilometer and MIK = Mitchell Branch kilometer.)*

Table 3.31. East Tennessee Technology Park Environmental Monitoring Program periodic sediment and soil sampling mercury results for CY 2014

Sampling location	Date	Results (ng/g)
K-1700 sediment	9/9/2014	2,500
MIK 0.45 sediment	9/9/2014	240
MIK 0.59 sediment	9/9/2014	770
MIK 0.71 sediment	9/9/2014	140
MIK 1.4 sediment	9/9/2014	36
K-901-A sediment	9/11/2014	320
K-1007-B sediment	9/11/2014	530
K-702-A sediment	9/11/2014	7,600
K-11 soil	9/15/2014	40
K-2 soil	9/15/2014	100
K-6 soil	9/15/2014	86

Bold indicates results above Tennessee water quality criteria.

Acronyms

CRK = Clinch River kilometer.

3.6.3.10 Additional Mitchell Branch Instream Sampling

Figure 3.26 shows that Mitchell Branch instream mercury concentrations for the period 2008–2014 increase significantly moving downstream toward the K-1700 weir. Figure 3.27 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 several activities were 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 Buildings K-1035 and K-1401. Figure 3.27 combines mercury sampling data from the Water Resources Restoration Program (WRRP) sampling events with results from EMP monitoring. In CY 2014, results were all below AWQC values, and going back to 2012, 18 of 21 results were below AWQC values as the general trend continues to improve.

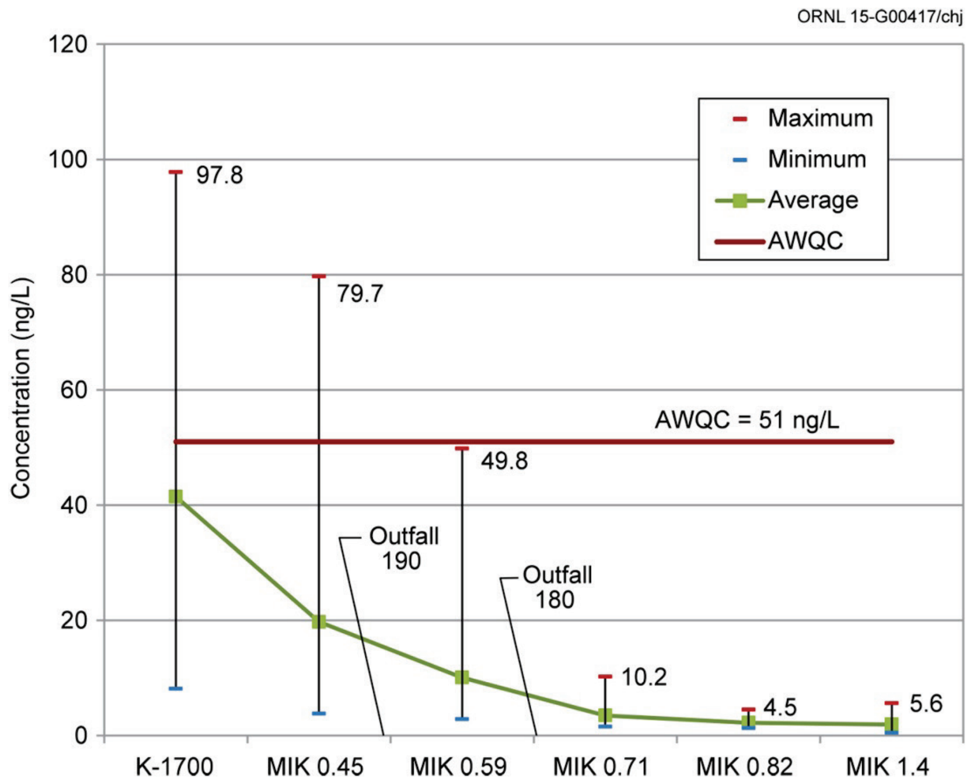

Fig. 3.26. Mitchell Branch instream mercury sampling results, 2008–2014.
(AWQC = ambient water quality criterion, MIK = Mitchell Branch kilometer.)

In 2014, fish and caged clams from various locations at ETTP were analyzed for mercury. For details of this study, please see Section 3.7.

Further monitoring for mercury has been proposed for 2015 as part of the NPDES permit compliance sampling program, SWPP Program, ETTP EMP, groundwater program, and Biological Monitoring and Abatement Program (BMAP).

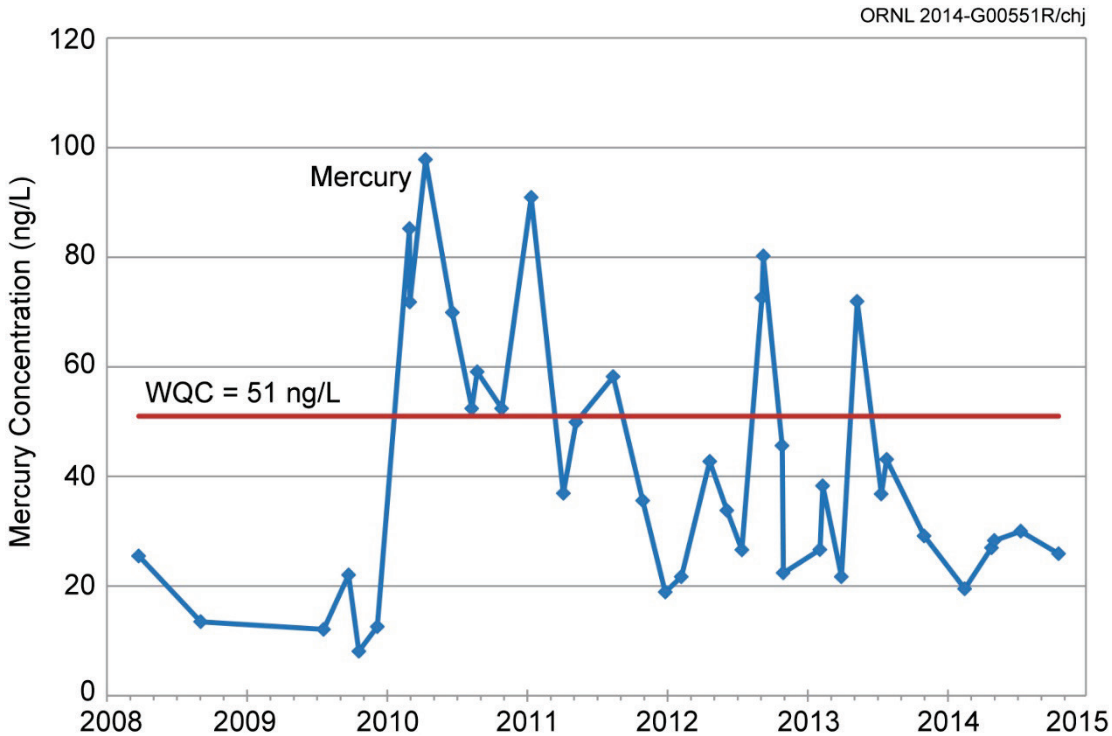

Fig. 3.27. K-1700 weir surface water mercury sampling results, 2008–2014.
(WQC = water quality criterion.)

3.6.3.11 K-1203 Sewage Treatment Plant

The mercury investigation at the K-1203 STP continued in CY 2104. The K-1203 STP was previously used to treat and process all sanitary sewage waste from ETTP. Sewage treatment for ETTP was transitioned to the City of Oak Ridge, and the K-1203 STP was shut down on May 29, 2008. The City of Oak Ridge expanded RRSTP to include capacity to treat the waste from ETTP, and CROET constructed a new ETTP lift station and force main to RRSTP. Table 3.32 shows the mercury results from soil and sediment sampling conducted at the K-1203 STP area. Figure 3.28 shows the sampling locations at the K-1203 STP.

Table 3.32. Mercury results from soil and sediment sampling conducted in the K-1203 sewage treatment plant area in 2014

Sampling location	Date	Result (ng/g)
K-1203-2 Imhoff tank—west	8/28/2014	36,500
K-1203-2 Imhoff tank—east	8/28/2014	6,020
K-1203-6 Sludge Drying Bed	8/26/2014	361
K-1203-14 Comminutor	8/25/2014	6,630
K-1203 Holding Tank	8/25/2014	40,100
K-1203 Clarifier	8/25/2014	4,670
K-1203 Aeration Basin	8/25/2014	45,800
K-1203-10 Sump	8/26/2014	267,000

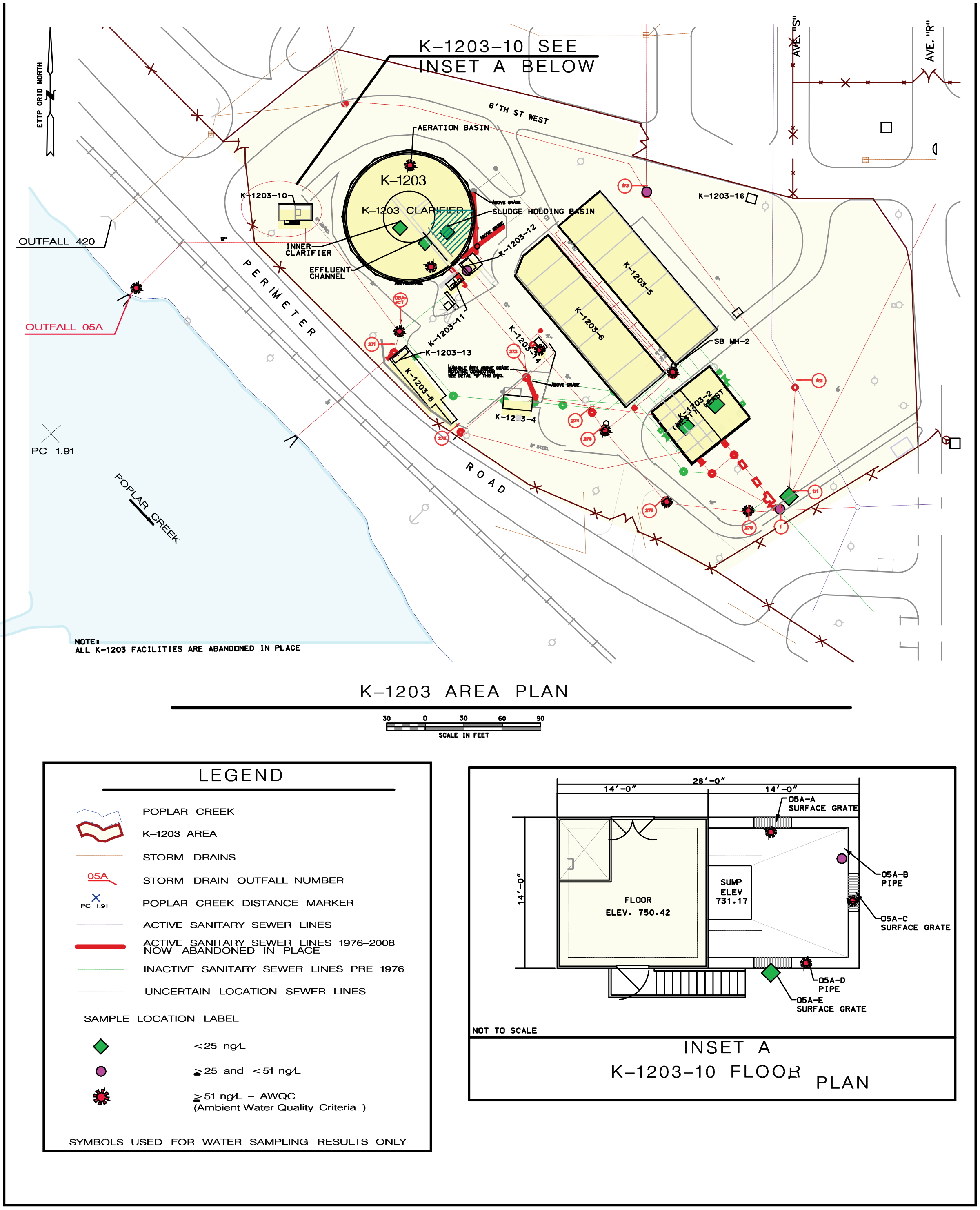

Fig. 3.28. Sampling locations at the K-1203 sewage treatment plant area.

3.6.4 Surface Water Monitoring

During 2014, ETTP EMP personnel conducted environmental surveillance activities at 12 surface water locations (Fig. 3.25) to monitor groundwater and storm water runoff (K-1700, K-1007-B, and K-901-A) or ambient stream conditions (CRKs 16 and 23; K-1710; K-716; the K-702-A slough; and MIKs 0.45, 0.59, 0.71, and 1.4). As part of monitoring the ambient stream conditions, K-1700 and MIKs 0.45, 0.59, 0.71, and 1.4 were sampled and analyzed quarterly for radionuclides, and CRKs 16 and 23, K-716, and the K-702-A slough were sampled semiannually.

Beginning with the fourth quarter of 2014, at MIKs 0.45, 0.59, and 0.71 quarterly monitoring for ^{99}Tc only was begun. Results of radiological monitoring were compared with the DCS values in DOE Standard 1196 (DOE 2011a). Radiological data are reported as fractions of DCSs for reported radionuclides, and the fractions for all of the isotopes are added together to produce the sum of fractions (SOF) and averaged to produce a rolling 12-month average. The average SOF is recalculated whenever new data become available. If the average SOF for a location exceeds the DCS requirement of remaining below 1.0 (100%) for the year, a source investigation is required. Sources exceeding DCS requirements would need an analysis of the best available technology to reduce the SOF of the radionuclide concentrations to less than 1.0 (100%). At the majority of locations, the monitoring results yielded SOF values of less than 0.01 (1% of the allowable DCS) (Fig. 3.29). The exception was K-1700 with an SOF of 0.012 (1.2% of the allowable DCS).

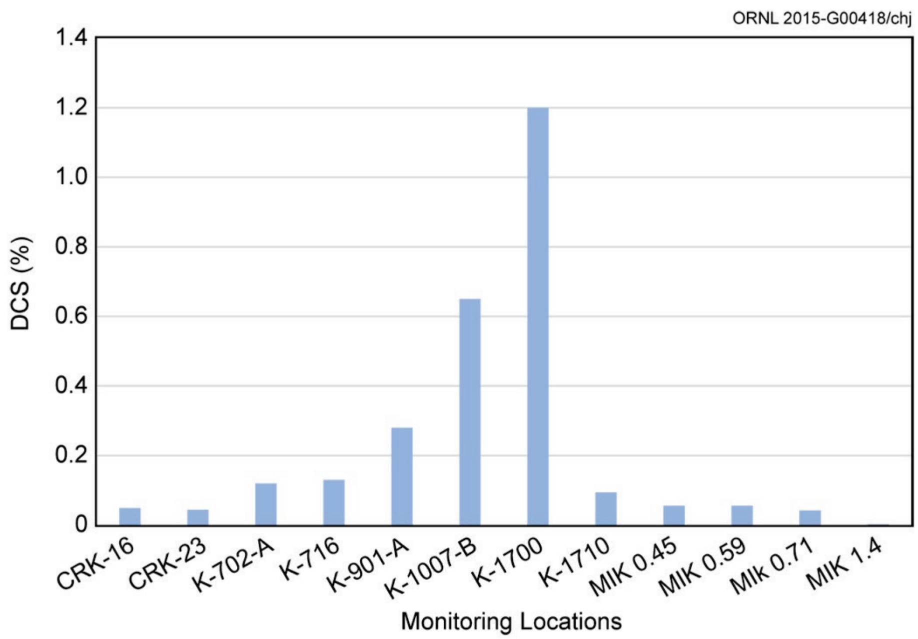

Fig. 3.29. Annual average percentage of derived concentration standards (DCSs) at surface water monitoring locations, 2014. *(CRK = Clinch River kilometer; MIK = Mitchell Branch kilometer.)*

Depending on the monitoring location, water samples may be analyzed for pH, selected metals, and VOCs. In 2014, results for most of these parameters were well within the appropriate Tennessee state water quality criteria (WQCs). The two exceptions were an exceedance of mercury at K-702-A and a failure to meet the minimum level for dissolved oxygen at K-1700 during the third quarter of 2014. The level of mercury during the second quarter at K-702-A was measured at 79 ng/L, which exceeded the WQC of 51 ng/L. While this level exceeded the WQC, it was within the range of historical results for this location. This location is connected with the Poplar Creek waterway, which impacts these results. The WQC for dissolved oxygen in streams and ponds requires a minimum level of 5 mg/L. On July 14, 2014, dissolved oxygen levels at K-1700 were measured at 4.8 mg/L. Low levels of dissolved oxygen are not uncommon in area streams and are usually associated with higher temperatures, resulting in elevated levels of biological activity, and low rainfall, resulting in low stream flow. Low amounts of rainfall were recorded at ETTP during the late summer and fall of 2014, and this is suspected to have contributed to the low dissolved oxygen measurement. No obvious signs of distress (e.g., dead fish) were observed to be associated with any of these exceedances in 2014.

Figures 3.30 and 3.31 illustrate the concentrations of TCE (trichloroethene/trichloroethylene) and cis-1,2-dichloroethylene (cis-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), 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. 3.32). 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.

Since CWTS was installed, chromium levels in Mitchell Branch have dropped dramatically, with levels of total chromium being routinely measured at less than 6 µg/L (Fig. 3.33). In 2014, hexavalent chromium levels in Mitchell Branch were all below the detection limit of 6 µg/L.

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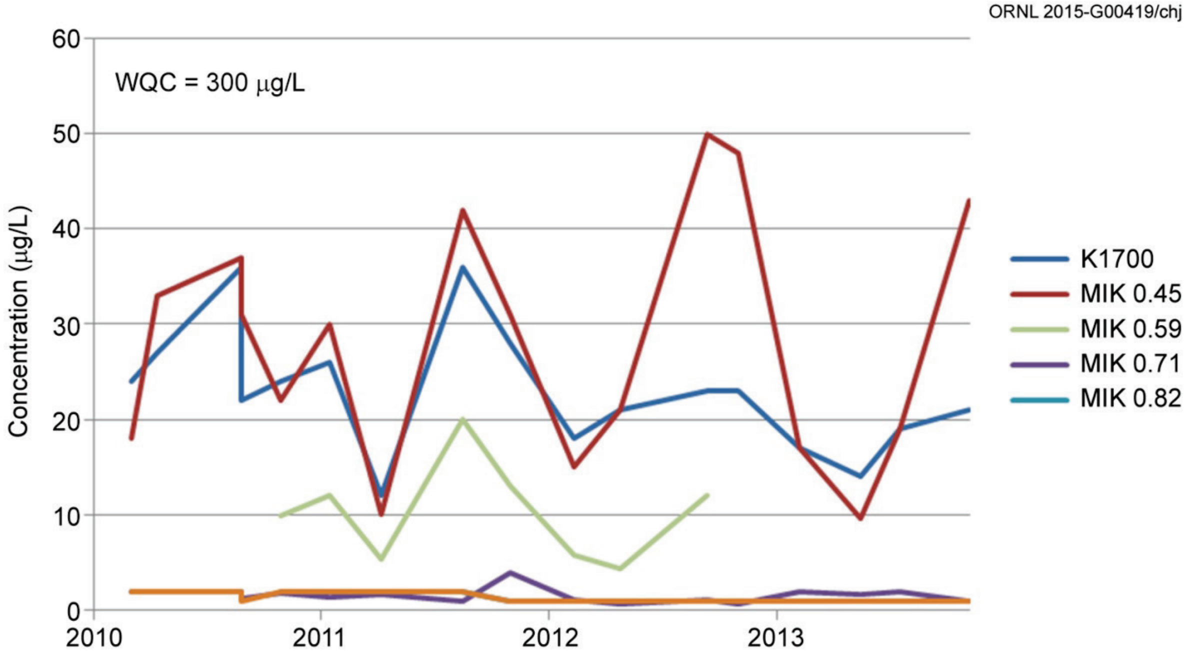

Fig. 3.30. Trichloroethene concentrations in Mitchell Branch. *(MIK = Mitchell Branch kilometer and WQC = water quality criterion.)*

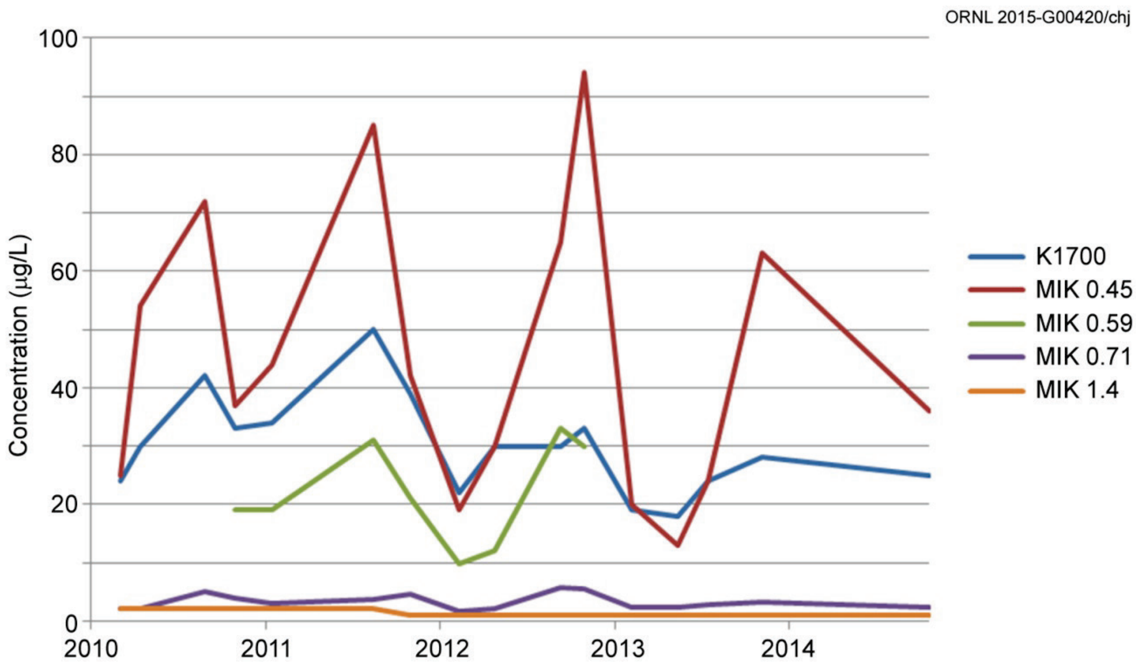

Fig. 3.31. Concentraions of cis-1,2-dichloroethene in Mitchell Branch. *(MIK = Mitchell Branch kilometer.)*

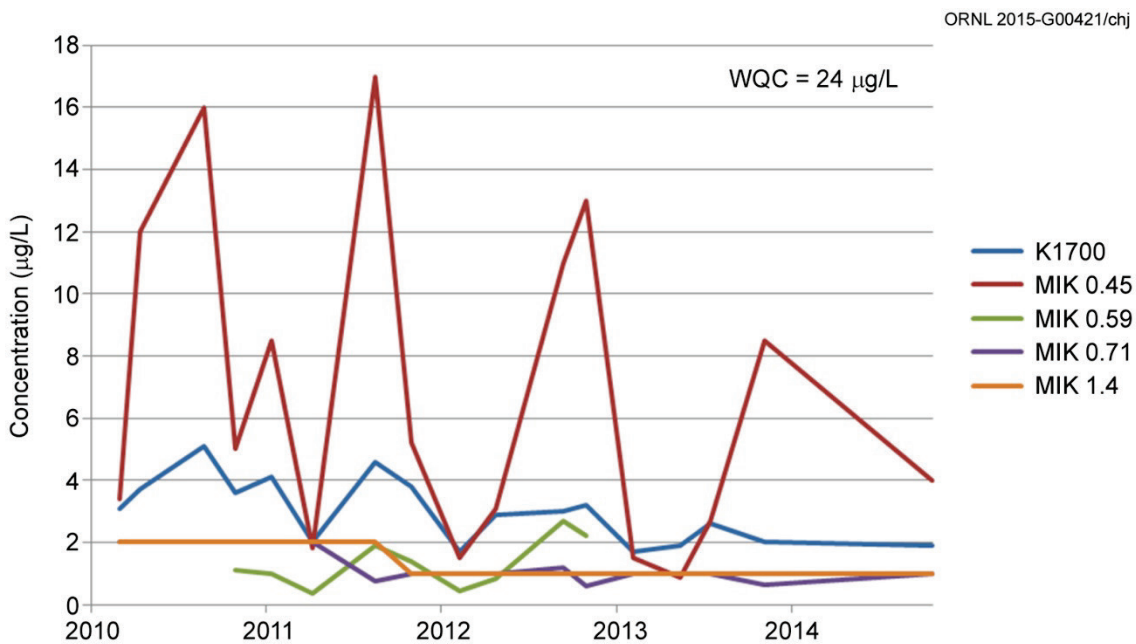

Fig. 3.32. Vinyl chloride concentrations in Mitchell Branch. *(MIK = Mitchell Branch kilometer and WQC = water quality criterion.)*

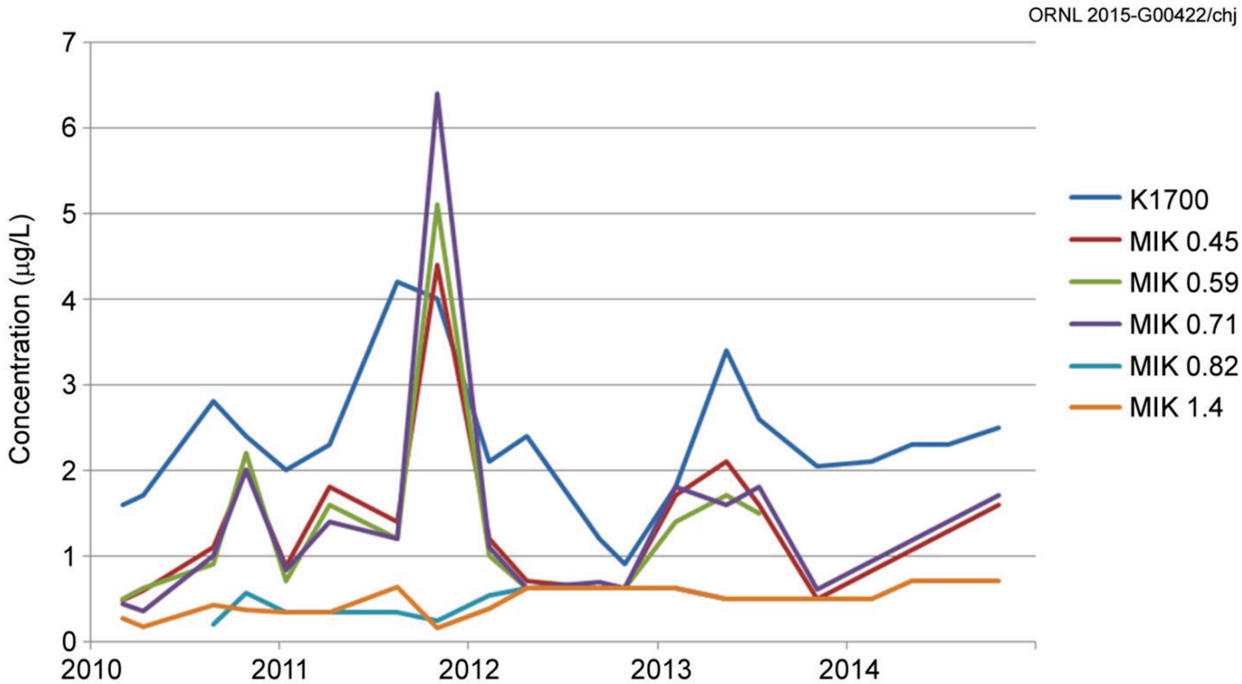

Fig. 3.33. Total chromium concentrations at K-1700. *[The water quality criterion for Cr(III), which is hardness dependent, is 74 μg/L, based on a hardness of 100 mg/L. The water quality criterion for Cr(IV) is 11 μg/L. (MIK = Mitchell Branch kilometer.)]*

Periodically, soil samples are collected from near the ambient air monitoring stations, and sediment samples are collected from near the surface water surveillance locations. These samples are analyzed for selected metals, radionuclides, and organic compounds. Soil and sediment samples were collected in September of 2014. Results from this monitoring were broadly similar to those from previous monitoring efforts.

3.6.5 Groundwater Monitoring

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

Extensive groundwater monitoring at the ETTP site, using Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs) as groundwater screening values, has identified VOCs as the most significant groundwater contaminant on the site. The principal chlorinated hydrocarbon chemicals that were used at ETTP were PCE, TCE, and 1,1,1-TCA (1,1,1-trichloroethane). For purposes of analyzing the groundwater contaminant issues at ETTP, the *Final Sitewide Remedial Investigation and Feasibility Study for East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2007) subdivided the site into several distinct areas—Mitchell Branch watershed, K-1004 and K-1200 areas, the K-27–K-29 area, and the K-901 area (Figure 3.34). Each of these areas has significant VOC contamination in groundwater.

Figure 3.34 shows the distribution and generalized concentrations of the sum of the primary chlorinated hydrocarbon chemicals and their transformation products, respectively. Specific compounds included in the summation of chlorinated VOCs include chloroethenes (PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and vinyl chloride), chloroethanes [1,1,1-TCA, 1,1,2-TCA, 1,2-DCA (1,2-dichloroethane), 1,1-DCA, and chloroethane)], and chloromethanes (carbon tetrachloride, chloroform, and methylene chloride). Several plume source areas are identified within the regions of the highest VOC concentrations.

In these areas, the primary chlorinated hydrocarbons have been present for decades, and mature contaminant plumes have evolved. The degree of transformation, or degradation, of the primary chlorinated hydrocarbon compounds is highly variable across the site. In the vicinity of the K-1070-C–K-1070-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 gal 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 areas, 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.

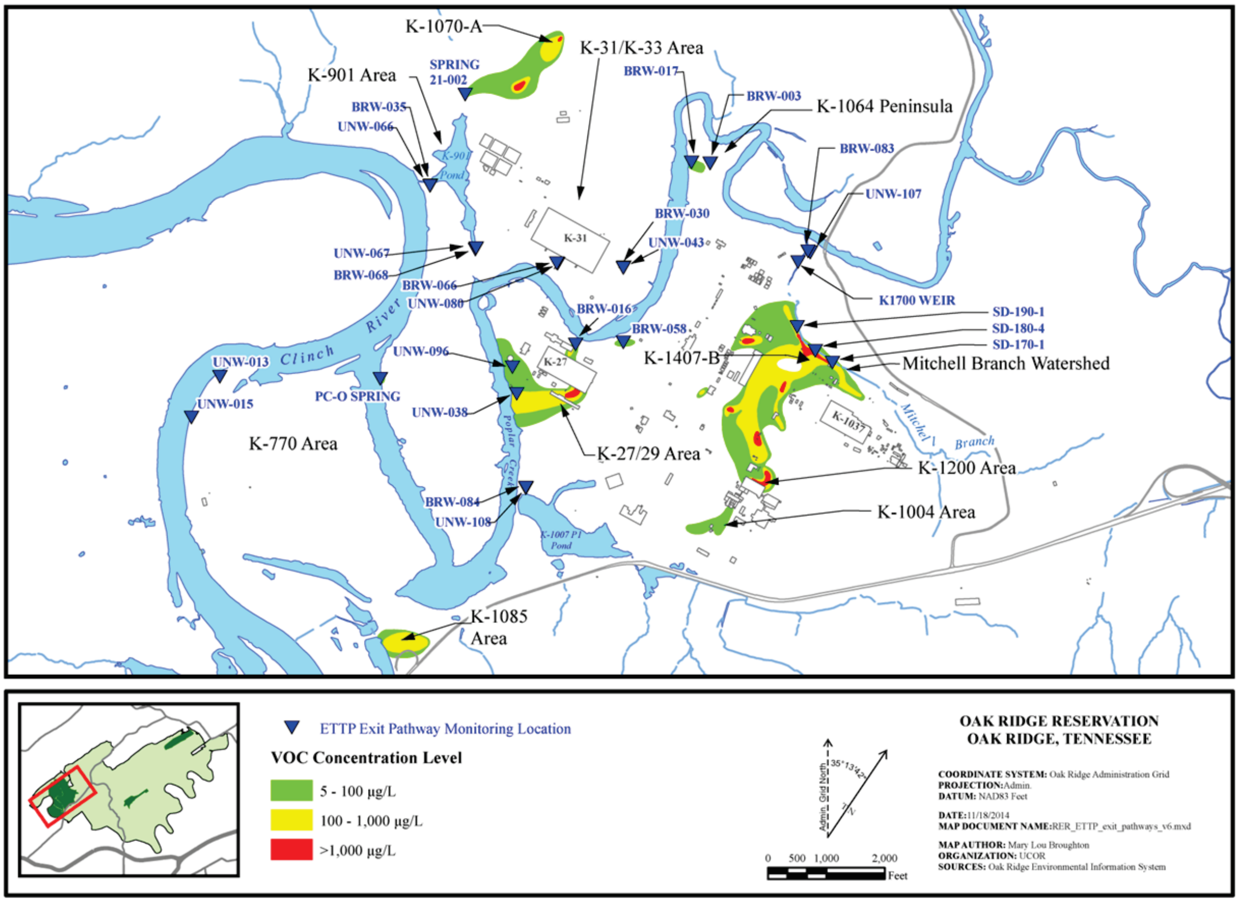

Fig. 3.34. East Tennessee Technology Park (ETTP) exit pathway monitoring locations and associated volatile organic compound (VOC) concentration levels. *(BRW = bedrock well, SD = storm water outfall/storm drain, and UNW = unconsolidated well.)*

3.6.5.1.1 Technetium-99 in East Tennessee Technology Park Site Groundwater

The environmental fate of some metal contaminants in groundwater is strongly dependent on the pH and redox state of the water. A summary review of the environmental behavior of ^{99}Tc in the environment related to tank wastes at Hanford was published by Pacific Northwest National Laboratory (Deutsch et al. 2005). Background information from that report was used in preparing the following interpretation of potential ^{99}Tc mobility in groundwater at the ETTP site.

Under electrochemically oxidizing conditions technetium forms the negatively charged pertechnetate ion (TcO_4^-) with technetium assuming a valence of 7+. The pertechnetate ion is quite mobile in aqueous settings as negatively charged ions do not tend to adsorb to soil or rock surfaces, which inherently tend to have negatively charged to neutrally charged surfaces. Under electrochemically reducing conditions the pertechnetate ion is not stable and technetium may assume a 4+ valence. In the 4+ valence state technetium may form ionic combinations with oxygen and hydroxyl groups, which may be amorphous solids with lower solubilities than the pertechnetate ion. In the 4+ valence, in the absence of complexing ligands, technetium may adsorb to mineral and organic matter surfaces and may become bound in low solubility technetium oxyhydroxides. In the 4+ valence technetium may also form soluble complexes with carbonate/bicarbonate ions as well as sulfate. Thermodynamic and directly measured speciation and solubility relationships for technetium carbonate and sulfate complexes have not been established although these complexes may be important to technetium mobility in reducing electrochemical environments.

In addition to standard physical chemical conditions, microbial processes are important as potential mediators that can lead to reduction of technetium from the highly soluble and mobile 7+ valence in the pertechnetate ion to the 4+ valence in the lower solubility forms. Microbial processes often occur in very localized regions in the subsurface, where chemical conditions are favorable. This fact is evident in groundwater at the ETTP site where intrinsic microbial communities are known to slowly degrade chlorinated organic compounds in some areas but not in others. Factors that may favor microbial reduction of dissolved compounds include relatively slow groundwater movement, which limits influx of dissolved oxygen via groundwater recharge; presence of organic carbon that can serve as electron donor material; and presence of microbes capable of affecting the required molecular transformations.

Data from groundwater, springwater, and surface water sampling and analyses conducted at the ETTP site as part of the ETTP Water Quality Program during FY 2014 have been reviewed for parameters pertinent to understanding the potential for ^{99}Tc mobility in site groundwater. During collection of all groundwater samples at ETTP, field measurements of pH and redox potential are made and recorded. The field measurements of pH and redox potential from all groundwater, springwater, and surface water samples collected in FY 2014 have been plotted and superimposed over the technetium Eh-pH diagram excerpted from the Pacific Northwest National Laboratory report (Figure 3.35). Individual data points are posted, and for samples analyzed for ^{99}Tc the detection/nondetection status is indicated by colored symbols. As shown, some of the locations from which ^{99}Tc was detected had Eh–pH conditions that plot below the pertechnetate ion stability field. Review of turbidity data from those sampling events at those locations indicates the presence of turbidity ranging from 1 NTU (spring 21-002) to 307 NTU [unconsolidated piezometer 008 (UNP-008)]. Although filtered samples were not collected and analyzed to verify particle association of ^{99}Tc, the presence of some level of turbidity opens the possibility that at least a portion of the ^{99}Tc was adsorbed to solids in the samples. The data shown in Figure 3.35 suggest that ^{99}Tc is quite mobile in site groundwater.

In addition to physicochemical data, major dissolved anions including bicarbonate, carbonate, and sulfate are measured on a subset of groundwater samples. Bicarbonate concentrations ranged from a low of 5 mg/L in bedrock well (BRW)-118, which monitors groundwater in the siliceous bedrock of the lower Rome Formation near Highway 58, to a high of 290 mg/L in BRW-003, which monitors groundwater in the limestone-rich Chickamauga Group within Zone 2. The bicarbonate concentration in site groundwater samples averaged about 110 mg/L. Sulfate concentrations ranged from a low of not detectable at unconsolidated well (UNW-)121, which monitors groundwater in the soils at the K-1070-A site, to a high of 98 mg/L at BRW-017, which monitors groundwater in bedrock in a portion of the Chickamauga Group. Sulfate concentrations averaged about 16 mg/L in site groundwater. These data indicate that ^{99}Tc could form soluble complexes with bicarbonate and sulfate ions under some conditions that would allow contaminant mobility via groundwater transport.

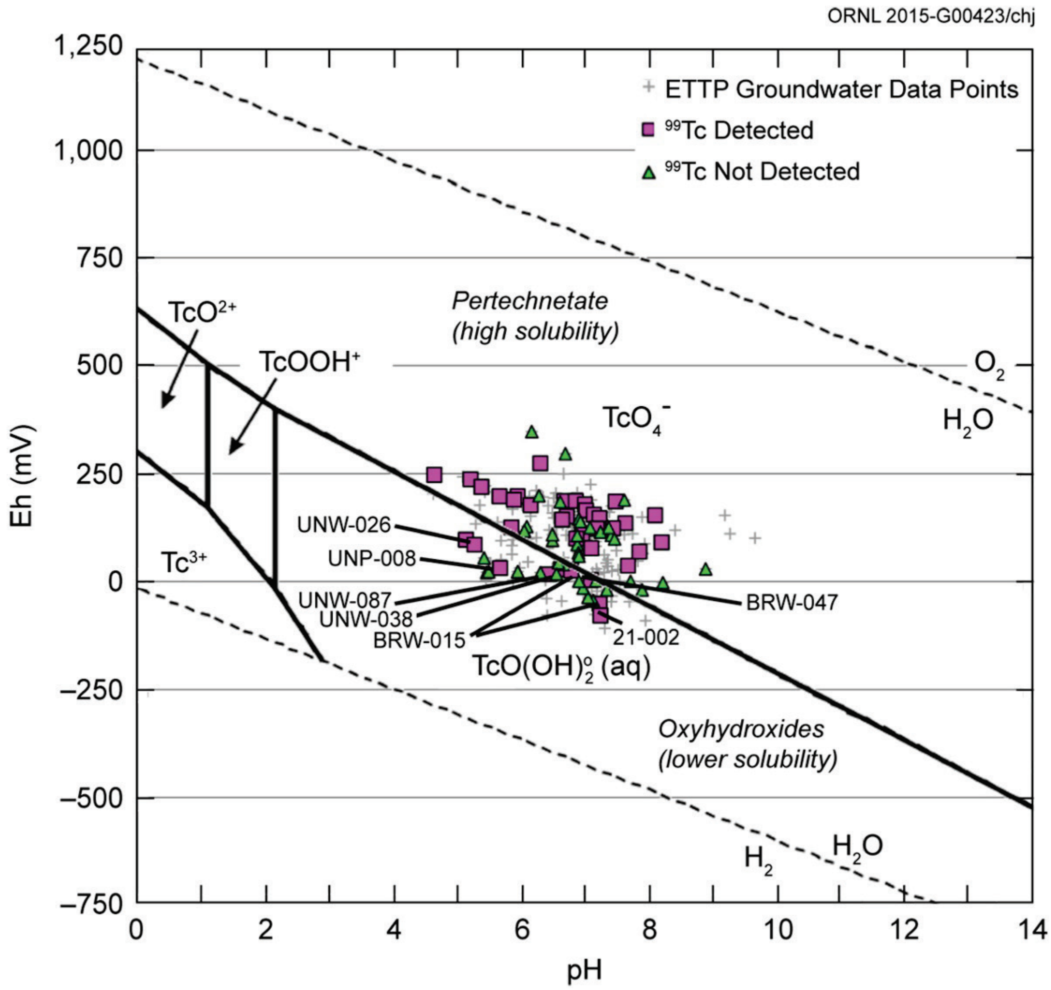

Fig. 3.35. Eh-pH region in which East Tennessee Technology Park (ETTP) groundwater, springwater, and surface water lie in relation to the technetium (^{99}Tc) Eh-pH speciation regions at 25ºC and 900 pCi/L ^{99}Tc. *(BRW = bedrock well, UNP = unconsolidated piezometer, and UNW = unconsolidated well.)*

Much of the ETTP physicochemical data suggests that ^{99}Tc mobility would generally be fairly high. Under this condition dilution and dispersion processes during groundwater transport would be the only concentration reduction processes that would reduce ^{99}Tc activities as adsorption of pertechnetate ion is negligible. Site groundwater chemical and microbial conditions in some areas may provide attenuation processes that will reduce ^{99}Tc geochemical mobility in the groundwater system. If ^{99}Tc is present where these conditions occur, these processes would be additive to dilution and dispersion processes expected to reduce contaminant levels with increasing transport distances.

Technetium-99 has been known to occur in groundwater at the ETTP site for many years. Various phases of remedial investigations (RIs) have sampled and analyzed for ^{99}Tc in groundwater. In the past, the highest ^{99}Tc activity levels (as high as 6,000+ pCi/L) have been observed beneath the K-1070-A burial ground. The area along Mitchell Branch near the former K-1407 ponds has residual ^{99}Tc-contaminated groundwater from the operational era of the ponds, and possibly from K-1420, with much lower activity levels (< 100 pCi/L).

During demolition of the K-25 east wing in the winter of 2014 fugitive dust suppression misting and rainfall carried ^{99}Tc off the work area. Contaminated runoff apparently percolated through soil and into subsurface utility lines and probably into backfill surrounding the buried utilities. Groundwater sampling for ^{99}Tc was increased in wells in the general vicinity of the east wing and where wells were available along potential groundwater transport pathways. The area where detected ^{99}Tc is highest is in the vicinity of UNP-008, BRW-015, and UNW-026. These wells are located near the K-1413 neutralization pit facility. Before the K-25 east wing demolition ^{99}Tc was not detected in these wells. The conceptual model that explains the elevated ^{99}Tc in this area is that percolation water from the contaminated slab area probably entered the backfill around the electrical duct bank and other utilities that run north–south along the east side of the building. Rapid transport along these utilities must have carried the high concentrations of ^{99}Tc into the vicinity of these wells. Multiple samples from the wells near K-1413 have been collected for ^{99}Tc analysis. At UNW-026 ^{99}Tc was measured at 8,760, 16,200, and 7,860 pCi/L in February, April, and September, respectively. At UNW-027 the ^{99}Tc activities were 17.3, 81, and 10.3 pCi/L in February, April, and September, respectively. UNP-008 was sampled in April and September, with results of 13,900 and 24,000 pCi/L, respectively. BRW-015 was also sampled in April and September, with activities of 105 and 1,580 pCi/L, respectively. These data indicate much lower levels in bedrock than in the groundwater in the base of the unconsolidated zone just above the bedrock surface. The plume trajectory for ^{99}Tc from this area has been evaluated based on hydraulic gradient direction as well as temporal changes in ^{99}Tc activities. The result of this evaluation indicates that the plume trajectory is to the northeast through UNW-089 and on toward UNP-005, which is located very near Mitchell Branch. At UNW-089 the ^{99}Tc activities were nondetect at 9.86 pCi/L in February, with a result of 408 pCi/L in September. At UNP-005 ^{99}Tc was not detected in the March sample but was measured at 12.3 pCi/L in the September sample, suggesting arrival of contamination in that area. As indicated by the piezometric surface, there is a trough in the water table surface that is formed in a now-filled valley that led from the K-1413 area northward toward Mitchell Branch, suggesting a plume trajectory arrow from the contaminated area near K-1413 toward UNP-005. It is also noted that during construction activities in the 1940s and ’50s the culverts for the storm drain 190 network were laid in the preexisting valley beneath the contour fill. Infiltration of ^{99}Tc plume water into the SD 190 culvert is expected. Groundwater sampling and analysis for ^{99}Tc in all the wells where it has been detected will continue.

3.6.5.2 Exit Pathway Monitoring

Groundwater exit pathway monitoring sites are shown in Figure 3.34. Groundwater monitoring results for the exit pathways are discussed in the following subsections.

Mitchell Branch—The Mitchell Branch groundwater exit pathway is monitored using surface water data from the K-1700 weir on Mitchell Branch and BRW-083 and UNW-107. Table 3.33 gives the results of the monitoring of VOCs along Mitchell Branch. Section 3.6.4 includes discussion of the detected concentrations of VOCs in Mitchell Branch.

BRW-083 and UNW-107—BRW-083 and UNW-107, located near the mouth of Mitchell Branch (Fig. 3.34), have been monitored since 1994. Table 3.33 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, which are strongly affected by rainfall. No chlorinated VOCs were detected in BRW-083 or UNW-107 during FY 2014.

Table 3.33. Volatile organic compounds detected in groundwater in the Mitchell Branch exit pathway

Well	Date	cis-1,2-DCE	PCE	TCE	VC
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 J	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
	8/16/2012	ND	ND	ND	ND
	8/6/2013	ND	ND	ND	ND
	3/13/2013	ND	ND	ND	ND
	3/13/2014	ND	ND	ND	ND
	8/7/2014	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 J	**23**	2[a]
	8/21/2007	17	ND	**30**	0.3 J
	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

[a]Detection occurred in a field replicate. Constituent not detected in regular sample.
Bold table entries exceed SDWA MCL screening values (PCE, TCE = 5 µg/L, cis-1,2-DCE = 70 µg/L, VC = 2 µg/L)
All concentrations µg/L.

Acronyms
BRW = bedrock well
DCE = dichloroethene
J = estimated value
MCL = maximum contaminant level
ND = Not Detected
PCE = tetrachloroethene
SDWA = Safe Drinking Water Act
TCE = trichloroethene
UNW = unconsolidated well
VC = vinyl chloride
VOC = volatile organic compound

K-1064 peninsula area—BRW-003 and BRW-017 (Fig. 3.34) monitor groundwater at the K-1064 peninsula burn area. Figure 3.36 shows the history of VOC concentrations in groundwater from FY 1994 through FY 2014. TCE concentrations have declined in both wells over that time period. TCE was present at concentrations less than the MCL during FY 2014 at BRW-017 and was not detected in either sample from BRW-003. Methyl chloroform (1,1,1-TCA) has declined to undetectable concentrations in BRW-003. Dichloroethene (cis-1,2-DCE) was detected at concentrations much less than its MCL in both semiannual samples in BRW-017.

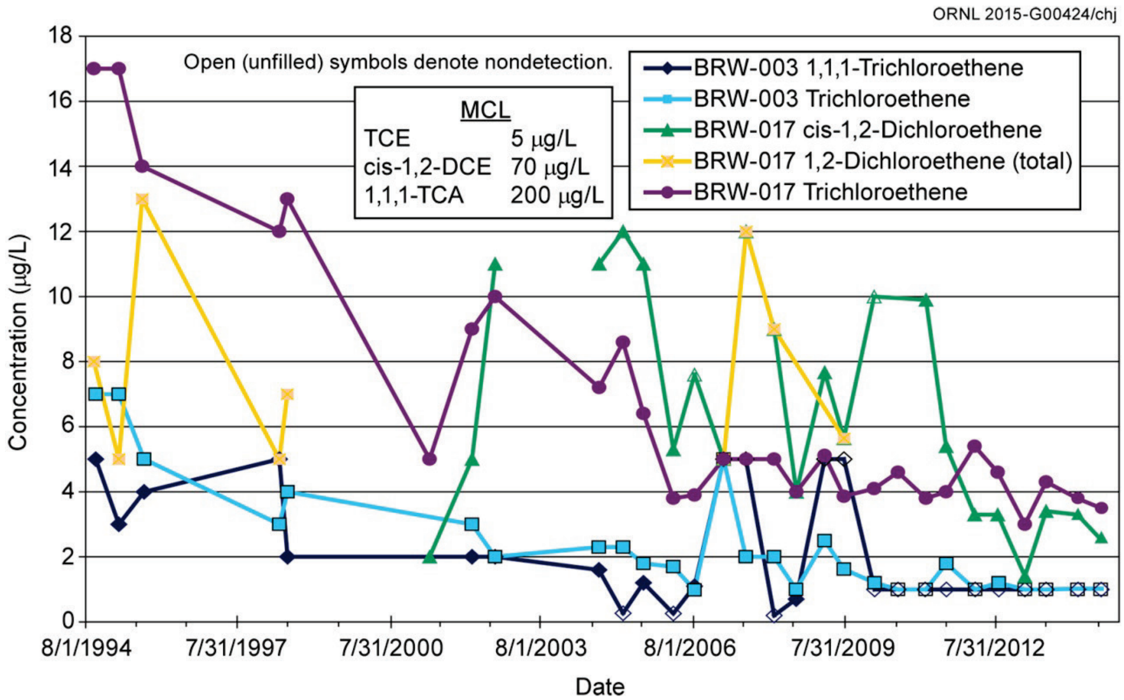

Fig. 3.36. Volatile organic compound concentrations in groundwater at the K-1064 peninsula area. *(BRW = bedrock well, DCE = dichloroethene/dichloroethylene, MCL = maximum contaminant level, TCA = trichloroethane, TCE = trichloroethene/ trichloroethylene.)*

K-31–K-33 area—Groundwater is monitored in four wells that lie between the K-31–K-33 area and Poplar Creek (BRW-066, BRW-030, UNW-080, and UNW-043), as shown on Fig. 3.34. VOCs are not COCs in this area; however, leaks of recirculated cooling water in the past have left residual subsurface chromium contamination. Figure 3.37 shows the history of chromium detection in wells at K-31–K-33. UNW-043 exhibits the highest residual chromium concentrations of any in the area. Chromium concentrations in 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–K-33 buildings contained residual hexavalent chromium from recirculated cooling water leaks. The data indicated the chromium in groundwater near the leak sites was essentially all the less toxic trivalent species. During FY 2008 through FY 2014, 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 2014, both field-filtered and unfiltered samples were collected from BRW-066, UNW-043, and UNW-080. Chromium was a nondetect in all samples from BRW-066 during FY 2014.

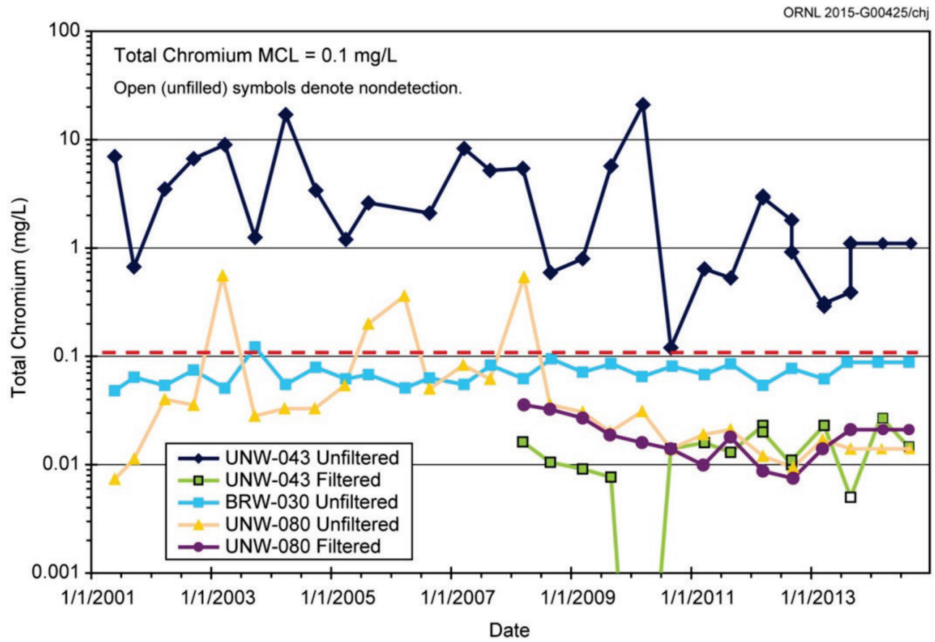

Fig. 3.37. Chromium concentrations in groundwater in the K-31–K-33 area. *(BRW = bedrock well, MCL = maximum contaminant level, and UNW = unconsolidated well.)*

K-27–K-29 area—Several exit pathway wells are monitored in the K-27–K-29 area, as shown on Fig. 3.34. Figure 3.38 provides concentrations of detected VOCs in wells both north and south of K-27 and K-29 through FY 2014. The source of VOC contamination in BRW-058 is not suspected to be from K-27–K-29 area operations. With the exception of cis-1,2-DCE in BRW-058, which appears stable to slightly increasing but remains less than its MCL, the VOC concentrations in this area show very slowly declining concentrations. TCE levels in UNW-038 fluctuate between 10 to 20 times the MCL and appear to be in a nearly stable fluctuation range since about 2011.

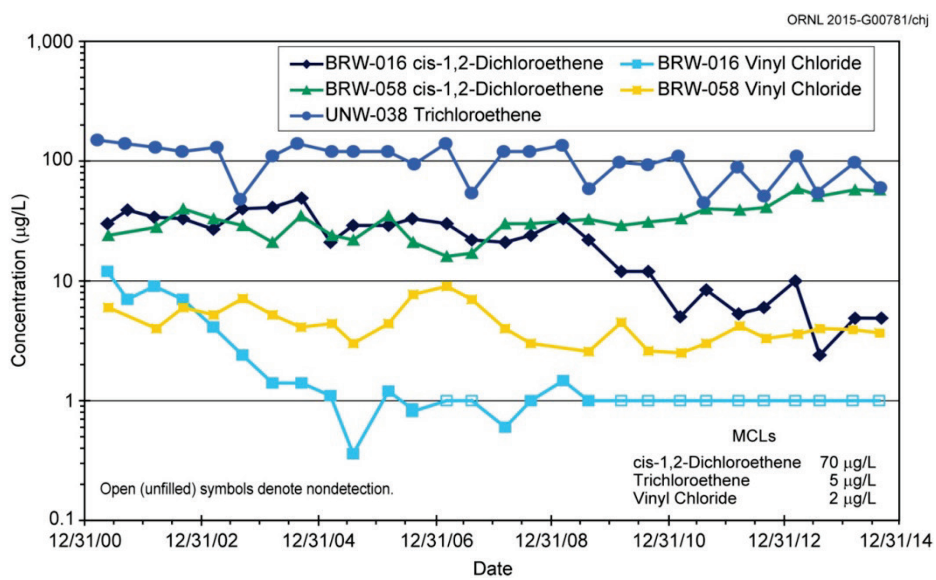

Fig. 3.38. Detected volatile organic compound concentrations in groundwater exit pathway wells near K-27 and K-29. *(BRW = bedrock well, MCL = maximum contaminant level, and UNW = unconsolidated well.)*

K-1007-P1 holding pond area—BRW-084 and UNW-108 are exit pathway monitoring locations at the northern edge of the K-1007-P1 holding pond (Fig. 3.34). These wells were monitored intermittently from 1994 through 1998 and semiannually from FY 2001 through FY 2014. The first detections of VOCs in these wells occurred during FY 2006 with detection of low (~10 µg/L or less) concentrations of TCE and cis-1,2-DCE. The source area for these VOCs is not known. VOCs were not detected in either of these wells during FY 2014. Metals have been detected in the past, associated with the presence of high turbidity in the samples. Arsenic was not detected in either well during FY 2014. A single detection of cadmium at a concentration below the MCL and the AWQC levels occurred at UNW-108 in the unfiltered aliquot collected in August. Chromium was detected at concentrations below its MCL and AWQC levels in the filtered sample from BRW-084 in March and from the unfiltered samples from both wells collected in August. Aluminum exceeded its secondary MCL in the unfiltered sample from BRW-084 in August and from the unfiltered aliquots from both sample dates at UNW-108. Aluminum was detectable in the filtered aliquot from the March sample from UNW-108 at 0.15 mg/L, which is within the range of the secondary MCL. Iron exceeded its secondary drinking water standard in both of the unfiltered aliquots from UNW-108 but was not detected in the filtered aliquots. Manganese exceeded its secondary drinking water standard in both the filtered and unfiltered samples from UNW-108 in the August sampling event. No other primary or secondary MCLs for metals were exceeded in sample aliquots that were field-filtered before acid preservation during FY 2014. Zinc was detected (21 µg/L) in the unfiltered aliquot from UNW-108 at a concentration far below its secondary drinking water standard (5 mg/L).

K-901-A holding pond area—Exit pathway groundwater in the K-901-A holding pond area (Fig. 3.34) 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 2014. Alpha activity was detected at about 3 pCi/L in both semiannual samples from UNW-066. Alpha activity was not detected in samples from the other three wells. Beta activity levels were less than the 50 pCi/L screening level, with the highest measured activity (15.8 pCi/L) occurring in BRW-035.

TCE is the most significant groundwater contaminant detected in the springs, and the historic TCE concentrations are shown in Fig. 3.39. 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. In late winter 2012 DOE installed a sampling pump in the spring mouth to allow year-round sampling. The contaminant source for the PC-0 spring is presumed to be disposed waste at the K-1070-F site. The TCE concentrations in PC-0 have varied between nondetectable levels and 26 µg/L and have decreased from their highest measured value in 2006 to concentrations less than or just slightly greater than the drinking water standard.

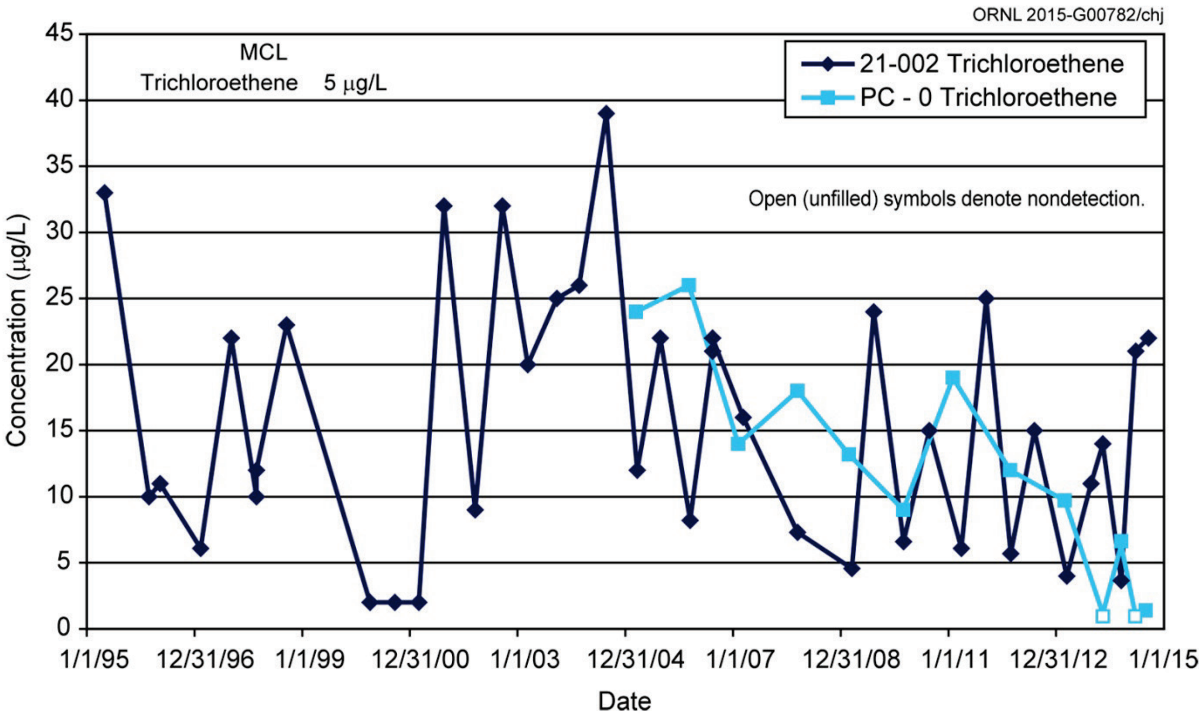

Fig. 3.39. Trichloroethene concentrations in K-901 area springs. *(MCL = maximum contaminant level.)*

Although TCE is the principal contaminant detected at spring 21-002, 1,1-DCE and carbon tetrachloride were present at concentrations less than 3 and 4 µg/L, respectively. The TCE concentration at spring 21-002 tends to vary between less than 5 and up to 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 2014 TCE was detected below its MCL in the March sample and at about 4 times the MCL in the June and August samples. Arsenic was detected at 7.3 µg/L in the November 2013 sample but was not detected in any of the other three samples collected during FY 2014. Alpha activity was detected at 2.26 pCi/L in the June sample, and the highest detected beta activity was 11.3 pCi/L, measured in the June sample. Technetium-99 was detected in all the samples collected during FY 2014, with the maximum detected activity of 21.4 pCi/L, which is much lower than the 900 pCi/L drinking water standard for this radionuclide. Uranium-234 and Uranium-238 were detected at less than 1 pCi/L.

K-770 area—Exit pathway groundwater monitoring is also conducted at the K-770 area, where UNW-013 and UNW-015 are used to assess radiological groundwater contamination along the Clinch River (Fig. 3.34). Measured alpha and beta activity levels were below screening levels during FY 2014 except the August beta activity in UNW 013, which was 57 pCi/L. Figure 3.40 shows the history of measured alpha and beta activity in this area. Historic analytical results indicate that the alpha activity is largely attributable to uranium isotopes, and UNW-013 historically contained ^{99}Tc, which is a strong beta-emitting radionuclide responsible for the elevated beta activity in that well. Much lower alpha and beta activity levels have been measured in UNW-015 since sampling was resumed in FY 2013 following an interruption in sampling during site remediation activities.

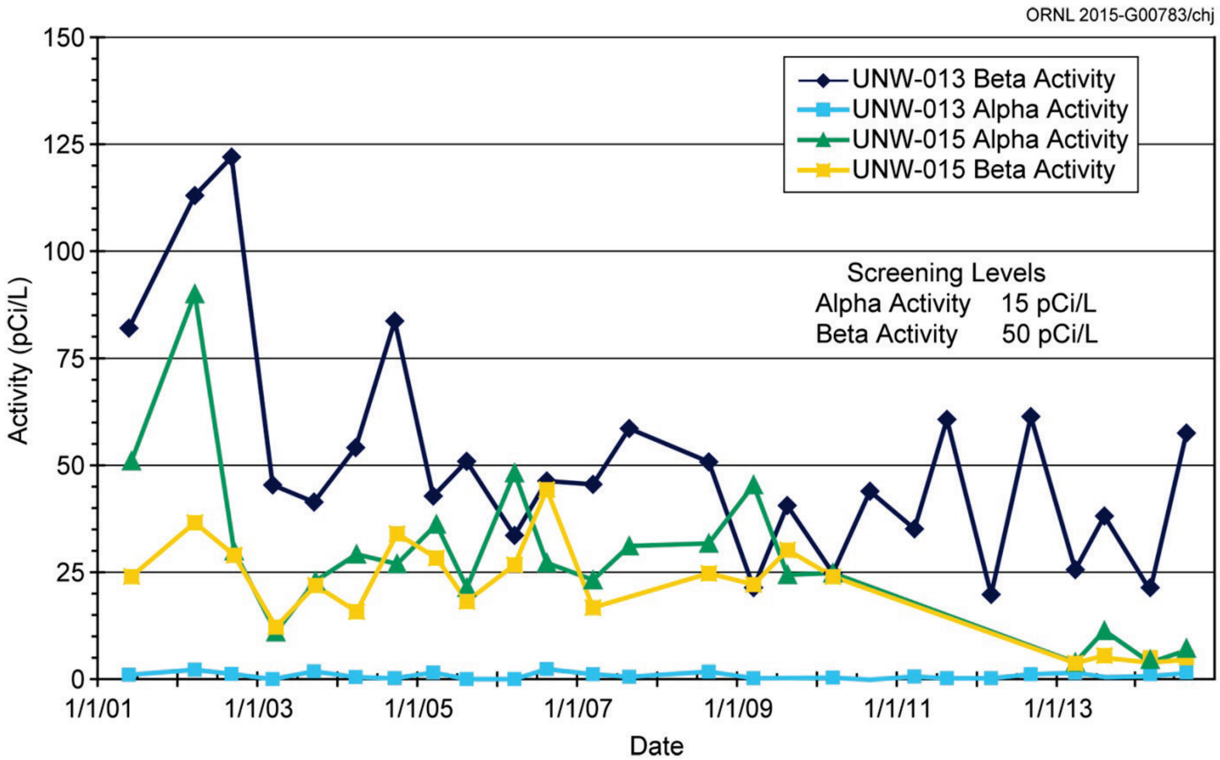

Fig. 3.40. History of measured alpha and beta activity in the K-770 area. *(UNW = unconsolidated well.)*

3.6.5.3 Performance Monitoring

3.6.5.3.1 Performance Monitoring Goals and Objectives

The objective of the K-1407-B and C ponds remediation was to reduce potential threats to human health and the environment posed by residual metal, radiological, and VOC contamination within the pond soils (DOE 1993).

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. Target concentrations for these parameters were not established in the CERCLA documents (DOE 1993, DOE 1995) for use in post-remediation monitoring to evaluate effectiveness. 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. 3.41.

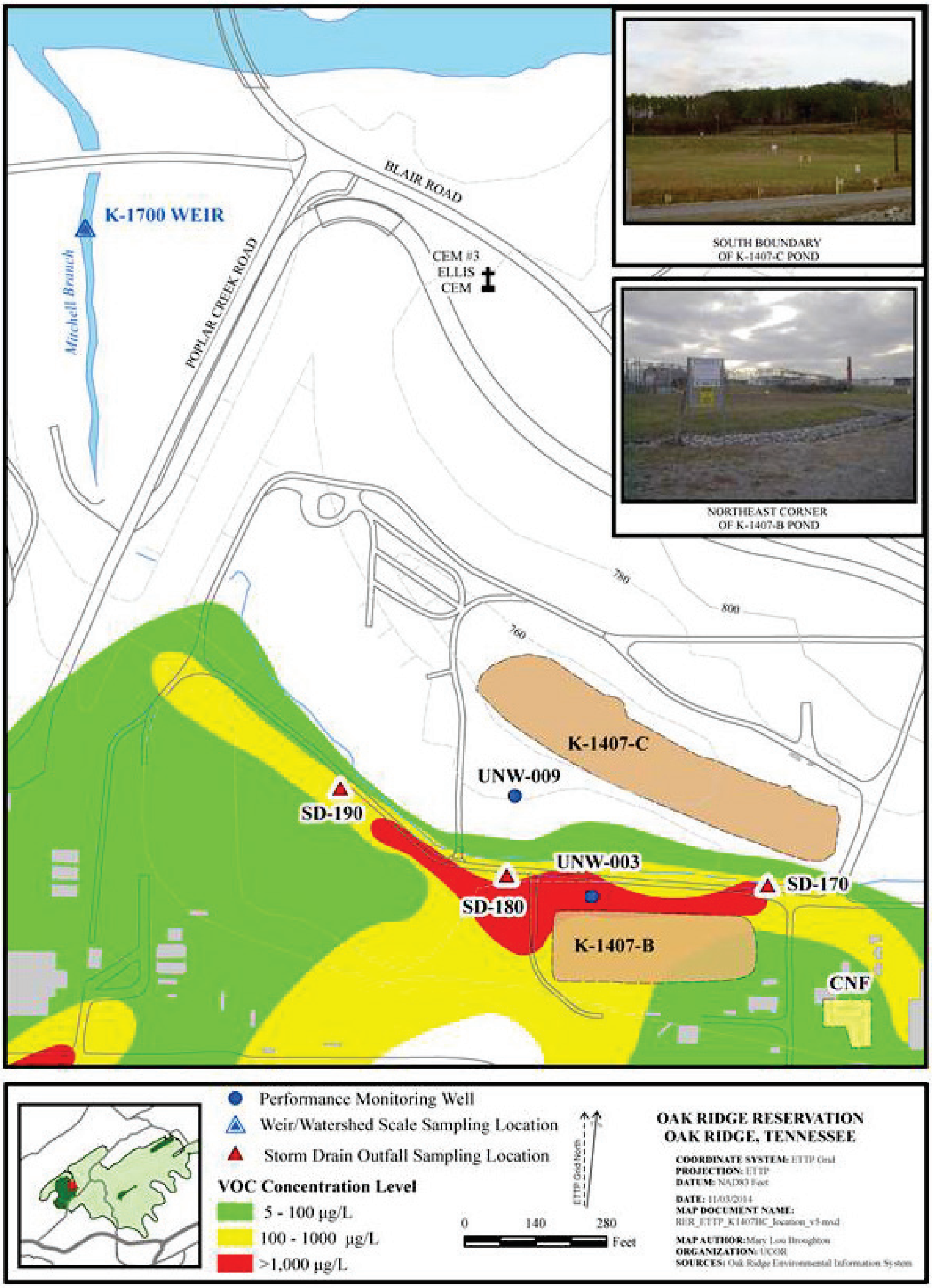

Fig. 3.41. Location of K-1407-B and K-1407-C Ponds. *(CEM = cemetery, CNF = Central Neutralization Facility, SD = storm water outfall/storm drain, UNW = unconsolidated well, and VOC = volatile organic compound.)*

3.6.5.3.2 Evaluation of Performance Monitoring Data

The primary groundwater contaminants in the K-1407-B and C ponds area are VOCs. VOCs are widespread in this portion of ETTP, including contaminant sources upgradient of the ponds (Fig. 3.41). Groundwater samples were collected at UNW-003 and UNW-009 in March and August/September 2014. VOCs are not detected in shallow groundwater north of Mitchell Branch in UNW-009. VOC concentration data for UNW-003 for the time span 2001 through 2014 are shown in Fig. 3.42. Monitoring results for FY 2014 at the wells are generally consistent with results from previous years. The detection of VOCs at concentrations well above 1,000 µg/L and the steady concentrations over recent years suggest the presence of dense nonaqueous phase liquids (DNAPLs) in the vicinity of UNW-003. The sitewide ROD will address groundwater contamination present in the area of the former ponds.

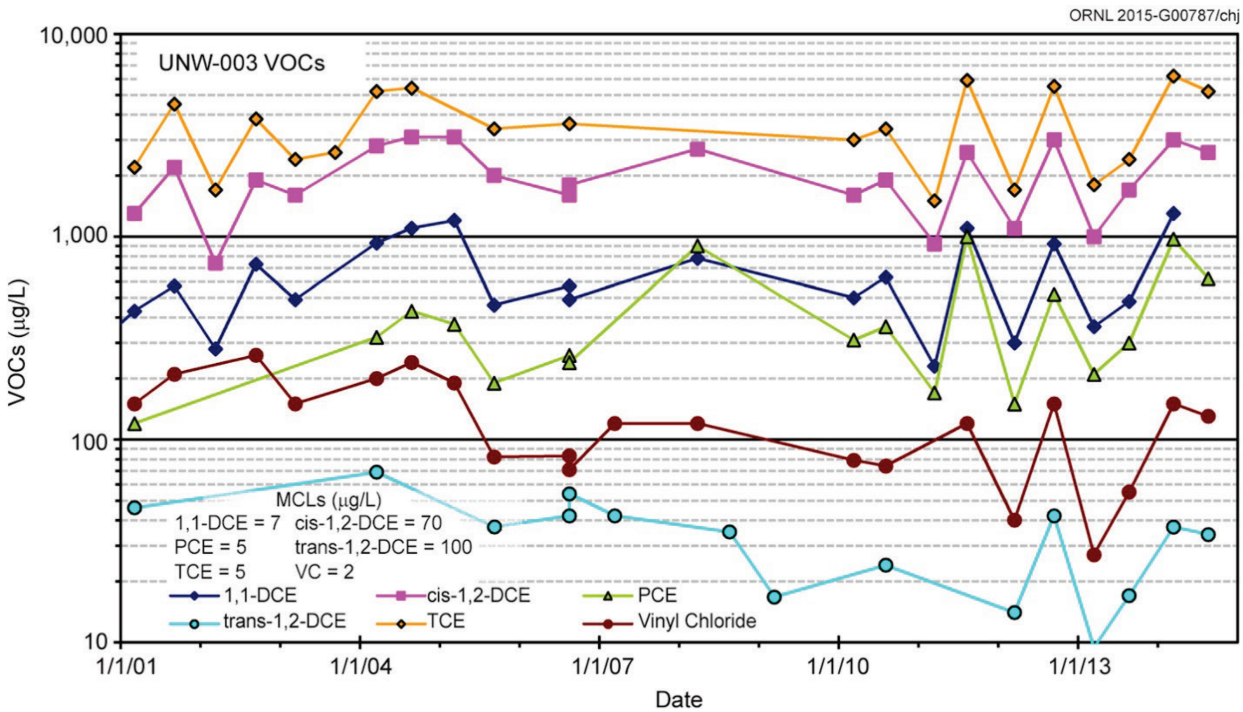

Fig. 3.42. Volatile organic compound (VOC) concentrations in UNW-003, 2001–2014. *(DCE = dichloroethene, MCL = maximum contaminant level, PCE = tetrachloroethene, TCE = trichloroethene, and UNW = unconsolidated well.)*

3.6.5.4 Groundwater Sampling Summary

Groundwater monitoring results in FY 2014 are generally consistent with the results from previous years. VOC concentrations well above 1,000 µg/L and the steady concentrations over recent years suggest the presence of DNAPLs in the vicinity of UNW-003. None of the metals having primary drinking water standards exceeded those values. Some of the iron and manganese concentrations exceeded secondary drinking water standards, possibly the result of chemical reduction induced by reductive dehalogenation of VOCs.

3.7 Biological Monitoring

The ETTP BMAP consists of three tasks designed to evaluate the effects of ETTP historical legacy operations on the local environment, identify areas where abatement measures would be most effective, and test the efficacy of the measures. The results from this program will support future CERCLA cleanup actions. 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 3.43 shows the major water bodies at ETTP, and Fig. 3.44 shows the BMAP monitoring locations along Mitchell Branch.

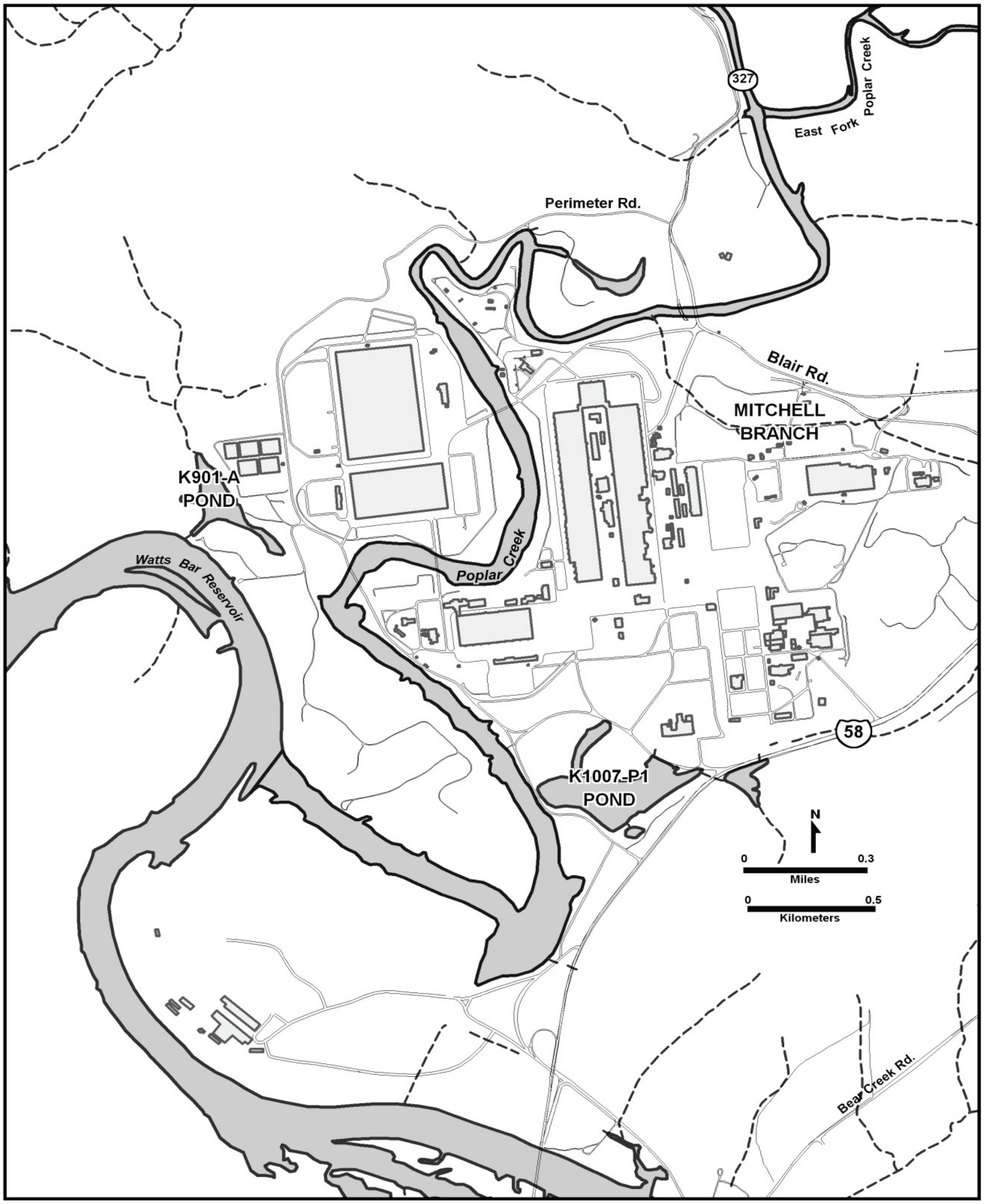

Fig. 3.43. Water bodies at the East Tennessee Technology Park.

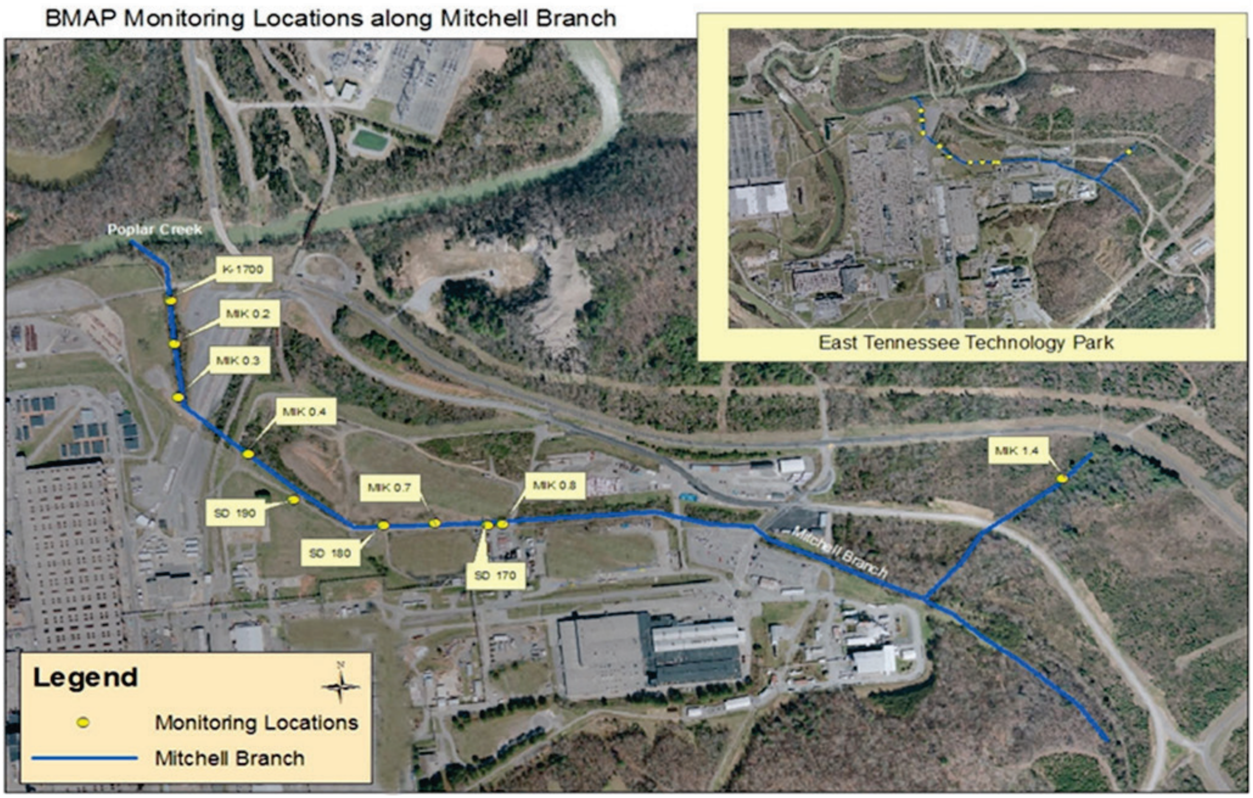

Fig. 3.44. Major storm water outfalls and biological monitoring locations on Mitchell Branch. *(BMAP = Biological Monitoring and Abatement Program, MIK = Mitchell Branch kilometer, and SD = storm water outfall/storm drain.)*

In October, 2014, survival and reproduction toxicity tests using the water flea Ceriodaphnia dubia 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 SD 170 and SD 190. In none of the 2014 tests was toxicity demonstrated (Table 3.34). This continues the trend of the last several tests, where toxicity has been greatly reduced or absent entirely.

Table 3.34. Toxicity test results for Mitchell Branch and associated storm water outfalls, 2014 (no-observed-effects concentrations)[a]

Test	MIK 1.4	MIK 0.8	SD 170	MIK 0.7	SD 190	MIK 0.4	MIK 0.2
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 that had no effect on either survival or reproduction of *C. dubia* in three-brood static renewal tests (EPA test method 1002.0).

Acronyms

MIK = Mitchell Branch kilometer.
SD = storm water outfall/storm drain.

The bioaccumulation task includes monitoring of caged clams (Corbicula fluminea) placed at selected locations around ETTP and the collection and analysis of fish from Mitchell Branch and three major ponds on the site. Both clams and fish from uncontaminated off-site locations are also analyzed as points of reference. While historically the primary COC for the bioaccumulation task at ETTP has been PCBs, in recent years mercury has been added to the list of legacy COCs at selected locations.

In 2014, the clams (Fig. 3.45) were allowed to remain in place for 4 weeks and were then analyzed for total PCBs (Table 3.35 and Fig. 3.46) and, in a subset of clams, for total mercury (Table 3.36 and Fig. 3.47). In 2014, the greatest concentrations of PCBs were found in the clams from storm water outfall SD 190 and downstream of that location in Mitchell Branch.

ORNL 2010-G00934/chj

Fig. 3.45. Asiatic clam (*Corbicula fluminea*).

Table 3.35. Compiled data for polychlorinated biphenyl concentrations in caged Asiatic clams (*Corbicula fluminea*), 2009 to 2014 *(μg/g, wet weight)*

Location	Basket[a]	2009	2010	2011	2012	2013	2014
MIK 0.8 (above SD 170)	A	0.09	0.12	0.11	0.04	0.05	0.079
	B	0.11	0.13	0.15	0.04	0.04	0.081
SD 170	A	0.27	0.21	0.16	0.08	0.12	0.121
	B	0.25	0.28	0.16	0.15	0.13	0.16
MIK 0.7 (below SD 170)	A	0.18	0.15	0.13	0.08	0.07	0.081
	B	0.15	0.13	0.17	0.07	0.09	0.088
SD 180	A						0.099
	B						0.096
MIK 0.5 (below SD 180)	A	0.25	0.15	0.13	*b*	0.09	0.099
	B	0.2	0.17	0.16	*b*	0.11	0.096
SD 190	A	2.07	1.22	2.36	0.84	2.13	1.329
	B	1.98	1.09	1.7	*b*	2.51	1.633
MIK 0.4 (below SD 190)	A	0.9	1.28	1.71	0.41	1.7	0.92
	B	0.78	2.69	1.82	0.5	2	0.929
SD 195	A				0.37		
	B				0.31		
MIK 0.3	A		2.93	6.74	2.52	1.8	1.56
	B		3.42	4.56	2.74	2.2	1.43

Table 3.35 (continued)

Location	Basket[a]	2009	2010	2011	2012	2013	2014
MIK 027	A			4.42			
	B			4.94			
MIK 0.2	A	2.43	2.15	5.33	0.96	2.2	1.61
	B	2.42	2.13	4.82	1.41	2.4	1.899
K-1700	A					2.1	
	B					2.3	
SD 992	A		2.93				
	B		3.42				
K-1203 sump	A				0.34	0.2	0.148
	B				0.29	0.23	0.149
SD 100 (upper)	A	0.96	0.29	2.25	1.69	0.1	0.181
	B	0.69	0.22	1.75	1.7	0.09	0.136
SD 100 (lower)	A	1.32	0.72	5.95	*b*	0.42	0.408
	B	1.72	0.8	4.5	1.92	1.35	0.239
SD 120	A	0.34	3.06	0.75	0.11	0.28	0.356
	B	0.57	1.18	0.97	0.16	0.34	0.353
SD 490	A	0.4	0.37	0.39	0.19	0.18	0.191
	B	0.46	0.47	0.46	0.17	0.18	0.181
K-1007-P1 outfall	A	0.91				1.29	1.264
	B	0.85				1.3	1.424
P1	A	0.86	0.99	1.38	1.48		
	B	1.17	0.91	1.68	1.57		
K-901-A outfall	A	0.14	0.06	0.3	0.07	0.11	0.208
	B	0.16	0.05	0.2	0.07	0.16	0.239
SD 710	A						0.282
	B						0.321
Sewee Creek	A	0.02	0.01	0	0.01	0.004	ND
	B	0.02	0.01	0.01	0.003	0.002	ND

[a]Sample result is the reported concentration in the composited clam sample from each cage, where A and B denote replicates. Data were extracted from tables within the 2009–2014 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.

Acronyms

MIK = Mitchell Branch kilometer.
SD = storm water outfall/storm drain.
ND = nondetect.

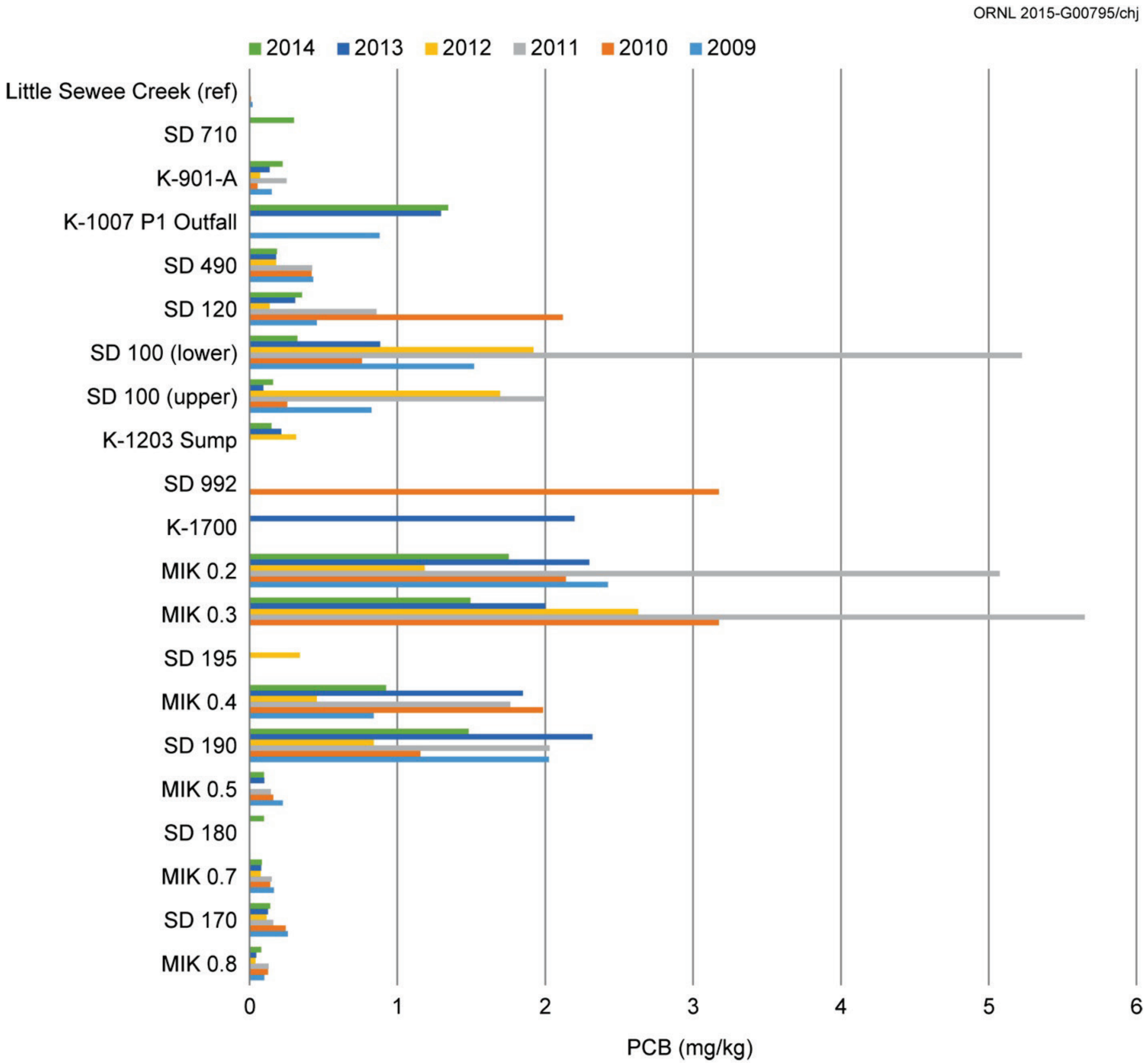

Fig. 3.46. Trend of polychlorinated biphenyls (PCBs) in caged clams. *(MIK = Mitchell Branch kilometer and SD = storm water outfall/storm drain.)*

Table 3.36. Compiled data for mercury concentrations in caged Asiatic clams (*Corbicula fluminea*), 2011 to 2014 *(ng/g, wet weight)*

Location	Basket	2011	2012	2013	2014
MIK 0.8 (above SD 170)	A	37	31.9	33.5	34.4
	B	46.9	32.2	32.1	44.1
SD 170	A	67.2	88.7	34.2	36.5
	B	80.7	62.3	38.9	43.2
MIK 0.7 (below SD 170)	A	37.7	46.2	33.5	34.8
	B	64.8	48.8	33.3	38
MIK 0.5 (below SD 180)	A	97.2	51.4	48.7	
	B	154.8	*B*	49.6	

Table 3.36 (continued)

Location	Basket	2011	2012	2013	2014
SD 190	A	109.9	127.8	187.8	93.7
	B	80.7	270	210.7	103
MIK 0.4 (below SD 190)	A	114	85	113.1	46.3
	B	102.3	104.8	107.1	56
SD 195	A		88.1		
	B		79.5		
MIK 0.3	A		311.7	116.6	148
	B		322.6	125.8	132
MIK 0.2	A	166.3	115.9	100.1	88.4
	B	187.9	136.6	105.9	83.4
K-1700	A			87.7	
	B			88.3	
K-1203-10 sump	A	—	472.3	298.8	392
	B	—	336.2	337.8	455
P1	A	23	25.6	19	19.5
	B	22.6	14.5	22.4	17
K-901-A outfall	A	33.1	17.4	18.9	16.9
	B	46.4	27.6	25.8	18.5
SD 05A	A		472.3		
	B		336.2		
Little Sewee Creek	A	19.6	25.2	24.4	18.6
	B	27.2	19.1	26.7	17.4

Acronyms
MIK = Mitchell Branch kilometer.
SD = storm water outfall/storm drain.

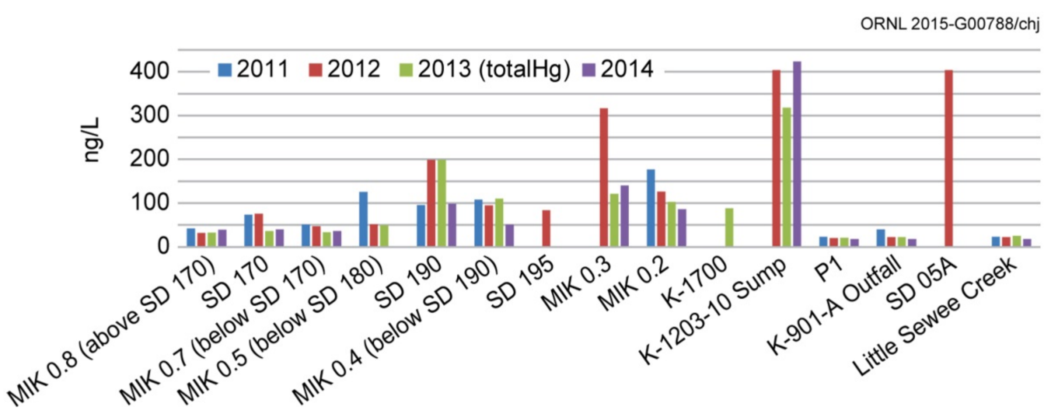

Fig. 3.47. Trend of mercury in caged clams. *(MIK = Mitchell Branch kilometer, SD = storm water outfall/storm drain.)*

Clams from the Mitchell Branch watershed, the K-901-A and K-1007-P1 ponds, storm water outfall 710, and the sump at the former K-1203 STP were analyzed for mercury (both total mercury and methyl mercury) in 2014. The highest mean total mercury concentrations were found in the clams from the K-1203-10 sump (423.5 ng/g). Clams from the section between K-1700 and storm water outfall SD 190 also had higher levels, with concentrations of total mercury in the caged clam composite samples ranging from a low of 51.2 ng/g to a high of 140.0 ng/g. At other sites mercury concentrations in clams ranged from at or near reference values to twofold higher (~18 to 41 ng/g).

Bioaccumulation monitoring in the K-1007-P1 pond, K-901-A pond, K-720 slough, and Mitchell Branch involves sampling of fish (Fig 3.48) and analyzing the tissues for PCB concentrations (Table 3.37 and Fig. 3.49). 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 2014 in the K-1007-P1 pond was bluegill sunfish (*Lepomis macrochirus*) (Fig. 3.50). 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*). As there were not enough largemouth bass, carp (*Cyprinus carpio*) and smallmouth buffalo (*Ictiobus bubalus*) were also collected.

ORNL 2010-G00935/chj

Fig. 3.48. Fish bioaccumulation sampling at K-1007-P1 pond.

Table 3.37. Polychlorinated biphenyl levels in fish samples at East Tennessee Technology Park, 2009 to 2014 *(mg/kg)*

Fish	Sampling location	2009	2010	2011	2012	2013	2014
Redbreast sunfish	Mitchell Branch	0.99	1.17	1.12	1.67	1.29	1.54
Largemouth bass	K-901-A Pond	0.48		0.5	0.72	1.4	0.45
Common carp	K-901-A Pond		0.71	2.06	3.08	2.94	1.41
Gizzard shad	K-901-A Pond				4.82	8.86	6.52
Largemouth bass	K-1007-P1 Pond	14.85	0.3				
Bluegill sunfish	K-1007-P1 Pond		2.13	1.85	2.16	0.7	0.62
Bluegill sunfish (whole body composites)	K-1007-P1 Pond				9.25	4.45	3.21
Redbreast sunfish	Hinds Creek	0.0007	0.09	0.06	0.06	0.06	0.03
Largemouth bass	K-720 Slough			0.24	0.22	0.14	0.15
Smallmouth buffalo	K-720 Slough			0.77	0.68	0.44	0.14
Common carp	K-720 Slough			0.96	0.31	0.45	0.27
Gizzard shad (whole body composites)	K-720 Slough					0.57	0.29

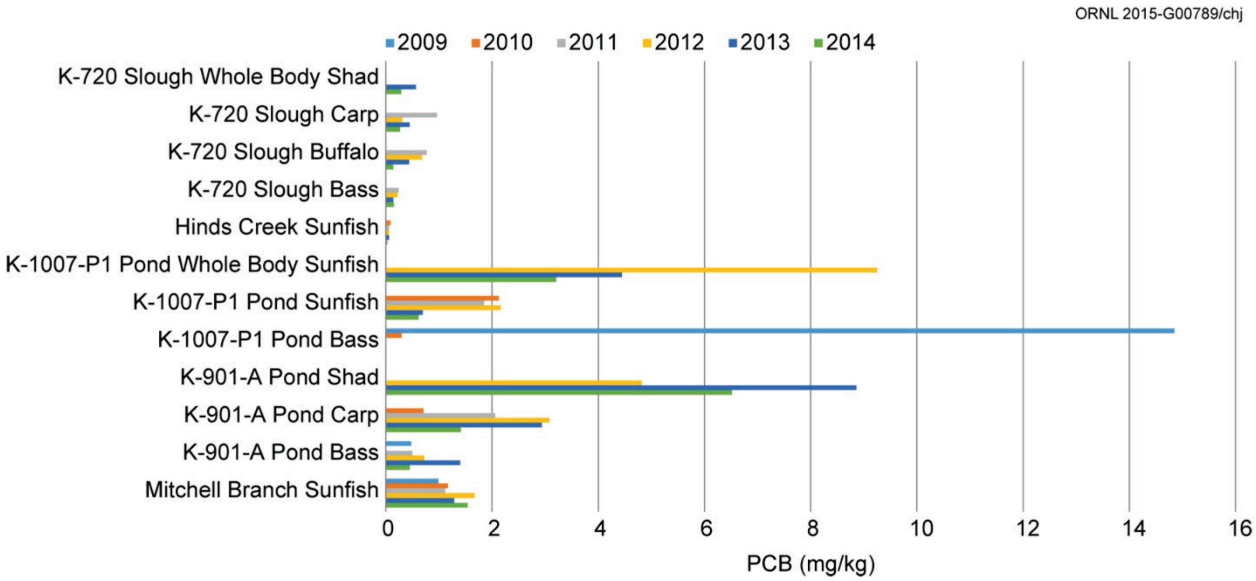

Fig. 3.49. Trend of polychlorinated biphenyls (PCBs) in fish.

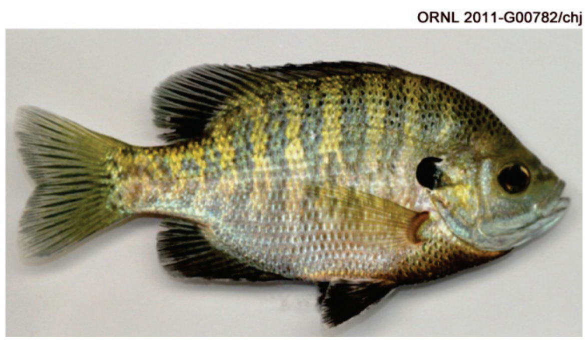

Fig. 3.50. Bluegill sunfish (*Lepomis macrochirus).*

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 3.21 µg/g, down from 4.45 µg/g in 2013. Fillets averaged 0.62 µg/g total PCBs, a slight decrease compared to levels seen in 2013 (0.7 µg/g). Average PCB concentrations in sunfish collected in Mitchell Branch were 1.54 µg/g, slightly higher than the levels seen in 2013 (1.29 µg/g). The concentrations observed in fillets of largemouth bass from the K-901-A pond (0.45µg/g) and gizzard shad whole body composite samples (6.52 g/g) decreased from the concentrations seen in the 2013 monitoring, 1.4 µg/g and 8.86 µg/g, respectively. Levels of PCBs in bass, gizzard shad, and carp from the K-720 slough (0.15 µg/g, 0.29 µg/g, and 0.27 µg/g, respectively) were considerably lower than for the same species from the K-901-A pond.

In addition to being analyzed for PCBs, the sunfish collected from Mitchell Branch (MIK 0.2) were analyzed for total mercury (Table 3.38 and Fig. 3.51). Previous studies have shown that methyl mercury accounts for more than 95% of the total mercury in fish, so a separate analysis for methyl mercury was not conducted. The EPA's recommended limit for mercury in fish fillets is 0.3 µg/g. The mean mercury concentration in fish collected at MIK 0.2 was 0.46 µg/g in 2014, slightly lower than 2013 (0.52 µg/g).

However, mercury concentrations in fish in Mitchell Branch in recent years have averaged about 0.3 to 0.5 µg/g with about 10%–20% variability within the annual collection (Table 3.38). Consequently, it is not certain there has been a significant change in fish mercury concentrations in 2014, and changes in sampling season (from spring to fall) starting in 2012, as well as fish size differences between years, may also be factors affecting mercury levels. Future monitoring efforts are necessary to evaluate whether the recent indication of higher mercury concentrations is a long-term trend.

Table 3.38. Mercury levels in fish fillets and whole body samples at East Tennessee Technology Park, 2009 to 2014 *(mg/kg)*

Fish	Sampling location	2009	2010	2011	2012	2013	2014
Redbreast sunfish	Mitchell Branch	0.49	0.35	0.34	0.37	0.52	0.46
Gizzard shad (whole body)	K-901-A Pond		0.086				
Paddlefish (1 sample)	K-1007-P1 Pond		0.07				
Bluegill sunfish	K-1007-P1 Pond		0.085				
Redbreast sunfish	Hinds Creek		0.08	0.07	0.058	0.07	0.09
Gizzard shad (whole body)	K-720 Slough		0.067				

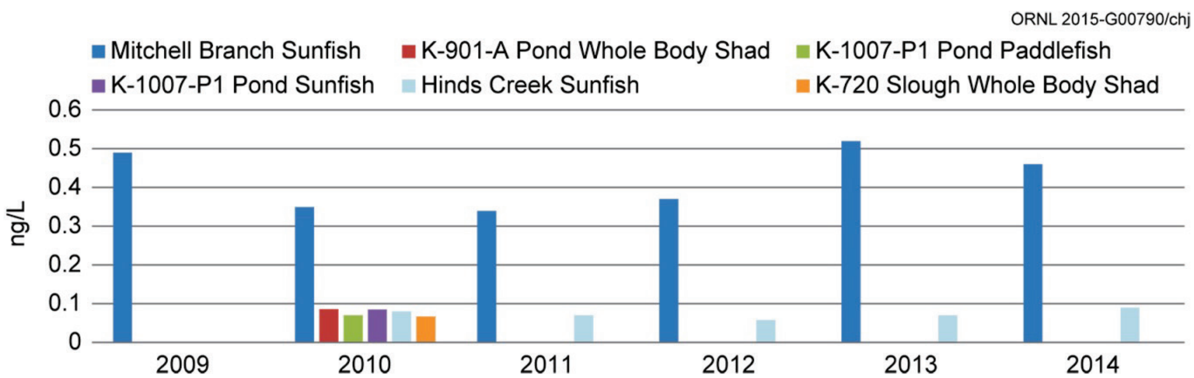

Fig. 3.51. Trend of mercury in fish.

In April and May of 2014, the benthic macroinvertebrate community at four Mitchell Branch locations (MIKs 0.4, 0.7, 0.8, and 1.4) was sampled using standard quantitative techniques (Fig. 3.52); MIK 1.4 was the reference location. Results of monitoring in 2014 using the ORNL protocols show little change at the three uppermost locations (MIKs 1.4, 0.8, and 0.7). The number of pollution intolerant species is highest at MIK 1.4 (Fig. 3.53). The number of pollution tolerant species makes up a much larger percentage of the total fauna at MIK 0.4 than at any of the other locations. Otherwise, results at MIK 0.4 generally mirrored those at MIKs 0.7 and 0.8. In recent years, the benthic macroinvertebrate community at MIK 0.7

Fig. 3.52. Benthic macroinvertebrate sampling using Tennessee Department of Environment and Conservation protocols.

and MIK 0.8 has 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 [i.e., the taxonomic richness of the Ephemeroptera, Plecoptera, and Trichoptera (EPT)]. These results show that the benthic community at MIK 0.4 continues to be negatively impacted while the results for MIKs 0.7 and 0.8 suggest that the macroinvertebrate community at those sites is also impacted but to a lesser degree.

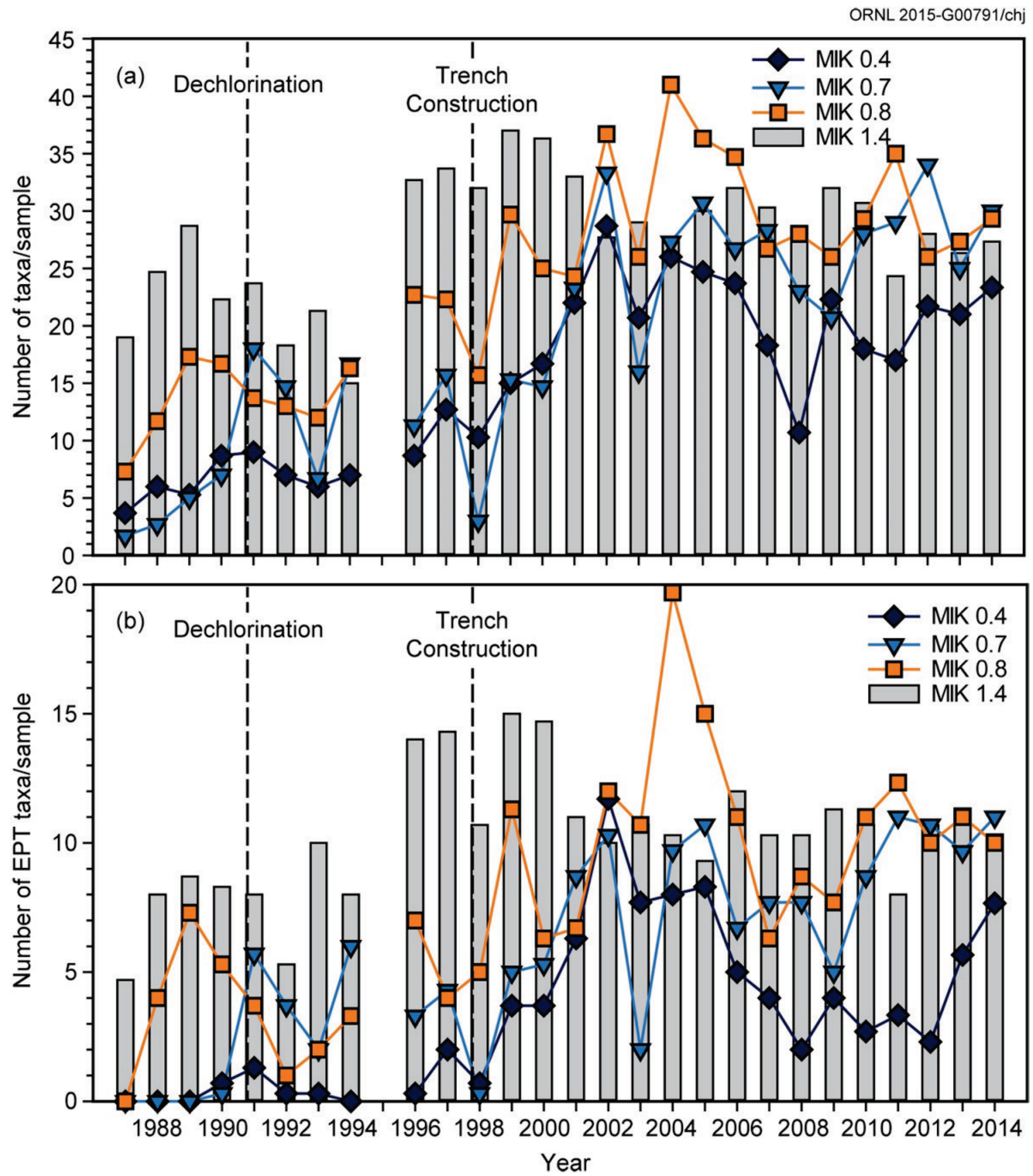

Fig. 3.53. Mean taxonomic richness in Mitchell Branch, 1987–2014: *(a) number of all taxa and (b) number of pollution-intolerant Ephemeroptera, Plecoptera, and Trichoptera (mayflies, stoneflies, and caddisflies or EPT) taxa per sample. Samples were not collected in April 1995, as indicated by the gap in the lines. (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. Beginning in August 2009, the use of TDEC protocols was expanded to include MIK 1.4 as well (Fig. 3.54). The biotic index indicated that the community at MIK 0.4 was slightly impaired, and the communities at MIKs 0.7, 0.8, and 1.4 were unimpaired. The habitat assessment (which primarily considers the physical aspects of the stream to determine its suitability to support biological communities) in 2014 indicated habitat impairment at all four sites. Overall, results using TDEC's semiquantitative protocols and ORNL's quantitative protocols since 2008 have been in general agreement that the macroinvertebrate community at MIK 0.4 scores from slightly to severely impaired, and the communities at MIKs 0.7 and 0.8 score from moderately impaired to unimpaired. Habitat shows evidence of some impairment at all sites.

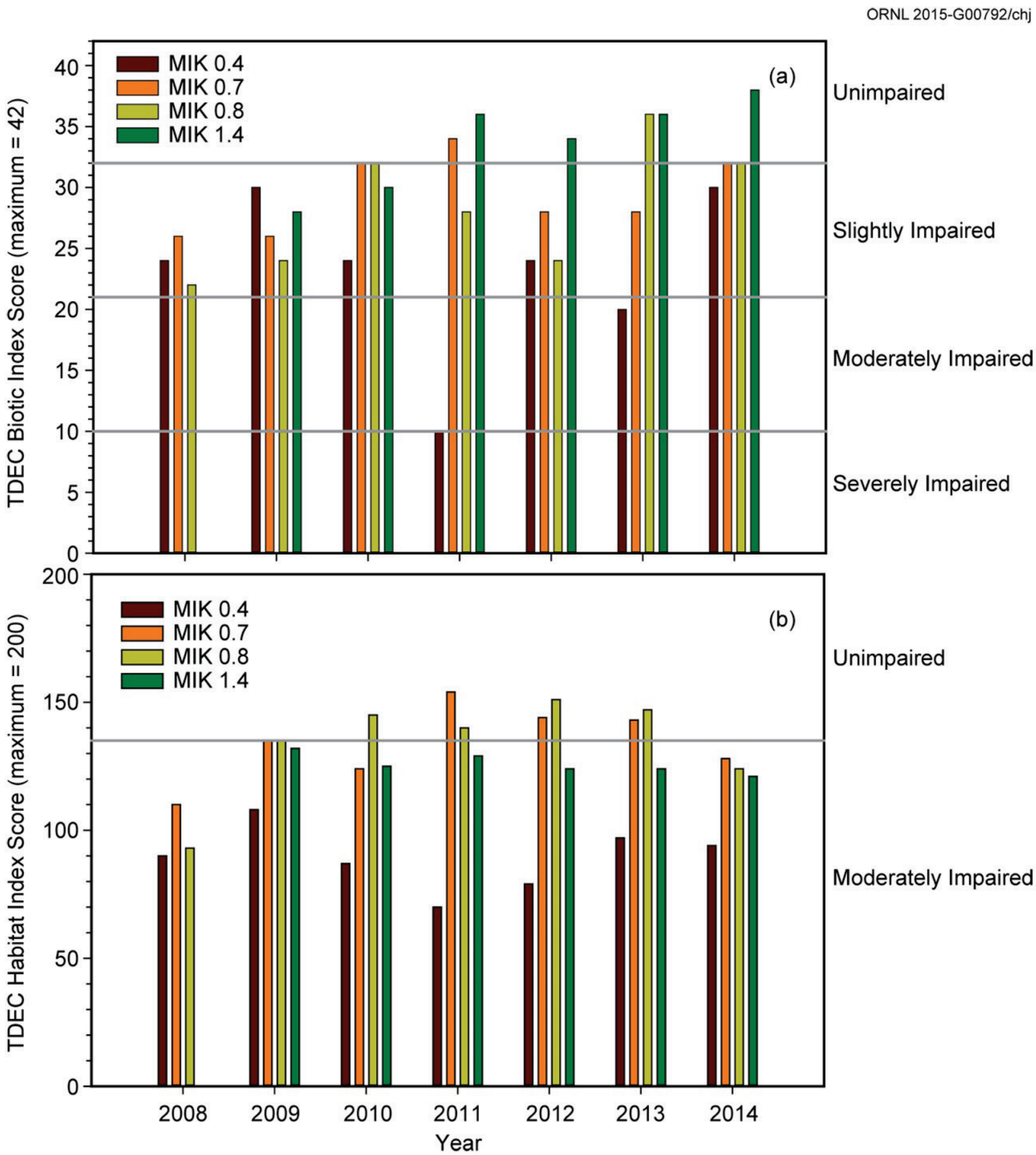

Fig. 3.54. Temporal trends in Tennessee Department of Environment and Conservation (TDEC) Benthic Macroinvertebrate Biotic Index (a) and Stream Habitat Index (b) scores for Mitchell Branch, August 2008 to 2014. *Horizontal lines in both graphs show the lower thresholds for narrative index ratings; respective narrative ratings for each threshold are shown on the right side of each graph. (MIK = Mitchell Branch kilometer.)*

Fish communities in Mitchell Branch (MIKs 0.4 and 0.7) and at local reference sites were sampled in 2014. Species richness, density, (Figs. 3.55 and 3.56), and biomass were examined. Results for 2014 showed changes within the normal range of variation. Most of the species found during the community studies sampling tend to be more tolerant of less than optimal conditions. All three metrics (species richness (Fig. 3.55), density (Fig. 3.56), and biomass decreased slightly at MIK 0.4, although the density of sensitive species increased very slightly. MIK 0.7 had a slight increase in species richness and a decrease in biomass and density from 2013. 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. However, during sampling for the bioaccumulation task at MIK 0.2, six species of fish were collected that have not been collected at the two upper fish community sites in Mitchell Branch. These included pollution sensitive species such as snubnose darter (*Etheostoma simoterum*), greenside darter (*E. blennioidess*), northern hogsucker (*Hypentelium nigricans*), and banded sculpin (*Cottus carolinae*). This seems to indicate that stream conditions may be able to support additional fish species (at least seasonally) in downstream sections and potentially upstream as well if water quality and habitat conditions improve.

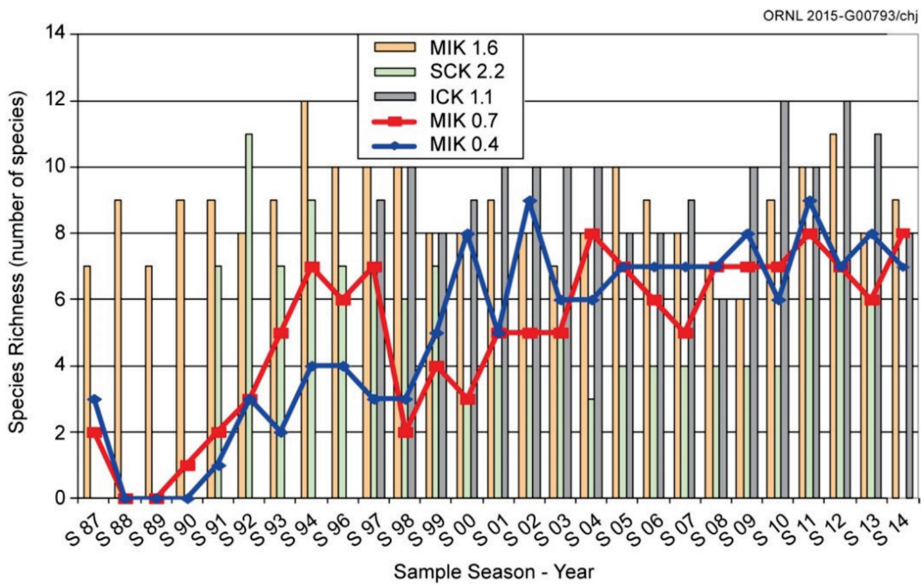

Fig. 3.55. Species richness for fish communities. *(ISK = Ish Creek kilometer, MBK = Mill Branch kilometer, MIK = Mitchell Branch kilometer, and SCK = Sewee Creek kilometer.)*

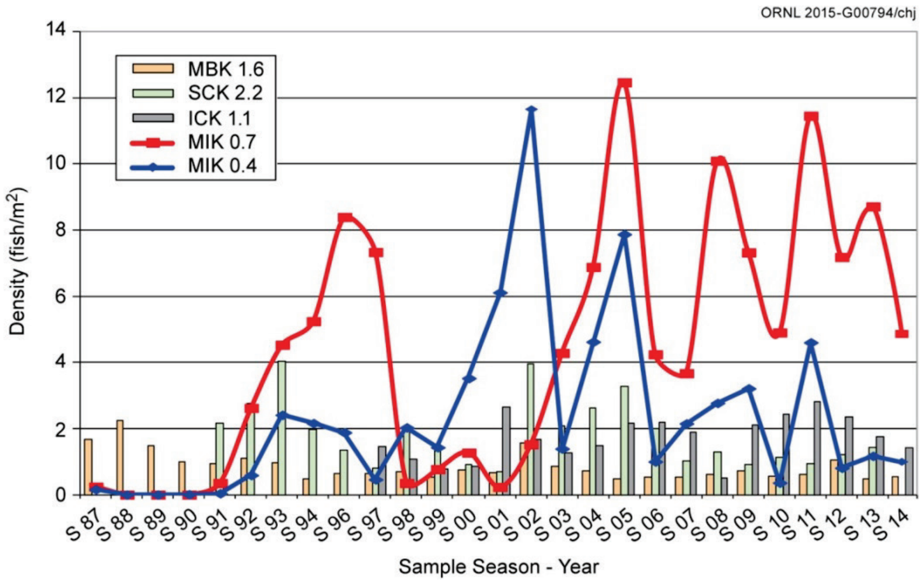

Fig. 3.56. Density for fish communities. *(ISK = Ish Creek kilometer, MBK = Mill Branch kilometer, MIK = Mitchell Branch kilometer, and SCK = Sewee Creek kilometer.)*

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 legacy wastes constitute the major operations at ETTP.

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 wastes, stabilized waste, building debris, scrap equipment, and personal protective equipment. During FY 2014, EMWMF operations collected, analyzed, and disposed of about 5.1 million gal of leachate at the ORNL Liquid and Gaseous Waste Operations Facility. An additional 9.8 million gal of contact water was collected, analyzed, and released to the storm water retention basin after it was determined that it met the release criteria. EMWMF received 6,059 truckloads of waste accounting for about 69,198 tons during FY 2014. Projects that have disposed of waste at EMWMF during the year include the following:

- K-25 Building Demolition Project;
- K-31 Building Demolition Project; and
- several smaller demolition projects at ETTP, ORNL, and Y-12.

EMWMF, the existing on-site disposal facility for low-level, mixed, and classified waste, is expected to reach capacity before all ORR cleanup waste has been generated and disposed. Therefore, it is important that planning begin for another landfill so that there is not an interruption of cleanup work once EMWMF is full.

During 2014, EM revised a remedial investigation/feasibility study (RI/FS) to include characterization data for a proposed new Environmental Management Disposal Facility (EMDF). The document, issued in FY 2012, analyzed three alternatives to support cleanup decisions: a no action alternative, an on-site disposal alternative, and an off-site disposal alternative.

Under the no action alternative, no coordinated ORR-wide strategy to manage wastes generated by future CERCLA actions would be implemented. The no action alternative provides a benchmark for comparison with the action alternatives.

The on-site disposal alternative would provide consolidated disposal of future-generated CERCLA waste in a newly constructed engineered facility referred to as the EMDF.

Under the off-site disposal alternative, future CERCLA waste would be transported off the site, primarily by rail, for disposal in approved disposal facilities.

The alternatives document concludes that both the on-site and off-site disposal alternatives would protect human health and the environment long-term by disposing the waste in a landfill designed for site-specific conditions; however, short-term risks are much higher for the off-site disposal alternative because of the significant transportation efforts required to dispose of the waste off-site. However, the off-site disposal alternative has the potential to isolate the wastes more effectively as off-site disposal facilities would be located in arid climates.

While the on-site disposal alternative requires a permanent commitment of additional ORR land for waste disposal and impacts environmental resources, it would be much less costly, would have lower transportation risk, and would provide a greater level of certainty that long-term disposal capacity would be available.

CWTS is a smaller water treatment unit for chromium-contaminated groundwater that sits within the existing CNF footprint. CWTS came online in late 2012 and handles purge water from groundwater monitoring, as well as the chromium collection system water. Effluent from CWTS discharges to the Clinch River through an existing CNF discharge line. In 2014, CWTS treated more than 5.5 million gal of water.

At ORNL, more than 92 million gal of wastewater was treated and released at the Process Waste Treatment Complex (PWTC). In addition, the liquid low-level waste evaporator at ORNL treated 122,200 gal of such waste. A total of 1.6 billion m^3 of gaseous waste was treated at the ORNL 3039 Stack Facility.

TWPC characterizes and packages TRU waste from ORR for disposition in underground salt caverns at the DOE WIPP near Carlsbad, New Mexico.

TRU waste contains man-made elements heavier than uranium, such as plutonium, hence the name “trans” or “beyond” uranium. TRU waste material is generally associated with the human manipulation of fissionable material dating back to the Manhattan Project. It consists primarily of clothing, tools, rags, residues, soil, and debris.

Two waste streams—contact-handled (CH) and remote-handled (RH)—are processed at TWPC. CH TRU waste can be safely handled without remote equipment, although workers never actually touch the waste without protective barriers such as special clothing or equipment. Higher energy radioactive TRU waste is processed by remote control equipment in special rooms called “hot cells.” Workers who process RH waste are protected by barriers such as thick concrete walls and leaded glass viewing windows.

In FY 2014, TWPC processed more than 90 yd^3 of CH waste, achieving an overall total of about 1,890 yd^3 of processed CH waste. In addition, employees at the facility processed about 150 yd^3 of RH waste for an overall total of 541 yd^3. These values represent about 96% of the legacy CH TRU waste and about 64% of the legacy RH TRU waste.

During the year, employees shipped a total of 245 yd^3 of CH TRU inventory, reaching a total of more than 1,500 yd^3 disposed. In addition, they shipped 235 yd^3 of RH TRU inventory, reaching a total of about 380 yd^3 disposed. These values represent about 77% of the legacy CH TRU waste disposed and about 45% of the legacy RH TRU waste disposed.

More than 350,000 gal of radioactively contaminated sludge are stored in tanks at ORNL. The sludge was produced as a result of the collection, treatment, and storage of liquid radioactive waste originating from ORNL radiochemical processing and radioisotope production programs. To eliminate long-term liability, EM will remove the sludge from the tanks and process the material for permanent off-site disposal in a new sludge processing facility. The project includes construction of a test facility to verify the technology associated with the sludge treatment process and support for the design and construction of the future sludge processing facility.

During the year, approval was received to update the project cost range and reaffirm the solidification and stabilization alternative. Solidification and stabilization is one of three alternatives DOE is considering to treat sludge contaminated with TRU constituents. Other alternatives include drying or dewatering the sludge. In FY 2014, progress continued toward acquiring architect and engineering services to design the facility.

These waste treatment activities supported both EM and Office of Science mission activities in a safe and compliant manner during FY 2013. NNSA at the Y-12 Complex treated almost 109 million gal of contaminated ground/sump water at the Groundwater Treatment Facility, Central Mercury Treatment System, Big Spring Water Treatment System, and East End Volatile Organic Compounds Plume Treatment System.

In FY 2014, about 29,661 yd^3 of industrial wastes and construction/demolition debris was disposed in the ORR landfills. Operation of ORR landfills generated about 1.6 million gal of leachate that was collected, monitored, and discharged to the Y-12 Complex sanitary sewer system, which discharges to the Oak Ridge sewer system under an industrial sewer user permit.

A total of almost 4,700 yd^3 of legacy waste was disposed—consisting of large transformers, shielding, waste containers that were emptied and reused, and various individual items of low-level radioactive waste. The waste came primarily from ETTP, ORNL, and the Fernald site in Ohio. Most of it was disposed in the ORR landfills and NNSS.

DOE's goal is to effectively manage waste from identification through disposal so the waste does not require on-site storage. Before starting waste-generating activities, EM and its cleanup contractors identify a disposition path, and together they make plans to dispose of the waste efficiently and effectively. Legacy waste is managed and disposed on a timetable that is consistent with regulatory requirements, programmatic priorities, and funding availability.

Legacy waste is actively managed by tracking, labeling, posting, and performing routine inspections. Legacy waste is prioritized for disposal based on its risk or an economy of scale associated with volumes, and it is disposed as funding is made available.

3.8.2 Environmental Restoration Activities

EM continued remediation activities to reduce ETTP soil contamination in 2014. The site is divided into two cleanup regions: Zone 1, a 1,400-acre area outside the main plant area, and Zone 2, the 800-acre area that comprises the main plant area.

3.8.2.1 Zone 1

The interim ROD, which documents the cleanup method for the site, required EM to remediate soil to a depth of 10 ft (suitable for the protection of an industrial work force) and remove sources of groundwater contamination. EM prepared an RI/FS to address groundwater, surface water, ecological protection, and final land use controls. EPA and TDEC provided comments on the RI/FS, and the agencies reached an agreement to initiate a Zone 1 final soils ROD and defer Zone 1 surface water and groundwater to a future decision. In FY 2014, TDEC prepared and approved a revised RI/FS. The initial draft of the Zone 1 final soils proposed plan was also prepared and transmitted to EPA and TDEC for review. Upcoming work includes addressing EPA and TDEC comments and finalizing the Zone 1 final soils proposed plan, conducting a public meeting on the proposed plan, and preparing the Zone 1 final soils ROD.

3.8.2.2 Zone 2

Remediating Zone 2 involves removing some contaminated soil so that the site is safe for industrial use and removing sources of groundwater contamination.

In FY 2014, EM initiated characterization of the footprints of Building K-25 and Building K-31. The roughly 40-acre footprint of Building K-25 has been declared the K-25 Preservation Footprint, and it is designated for historical commemoration and interpretation activities. To determine how to preserve this footprint, EM began characterization to determine whether cleanup is required, and it is also conducting a study to evaluate potential end states of the slab.

During predemolition activities on Building K-31, workers also performed characterization of the surrounding land to determine whether it required cleanup to support reindustrialization planning at the site.

3.8.2.3 Building K-25 Demolition

Demolition of the historic K-25 building (Fig.3.57), one of the original Manhattan Project facilities, was completed in December 2013, and workers removed the final debris in June 2014. The K-25 building was constructed in the mid-1940s to produce HEU for the atomic bombs that would end World War II. At 44 acres, the mile-long, U-shaped facility was once the largest building under one roof in the world.

Completing demolition of Building K-25 on schedule required creative solutions to several challenges; however, EM and its cleanup contractor, UCOR, worked together and completed the project 6 months ahead of schedule and nearly $300 million under its federal baseline budget.

During demolition of the building's west wing, material without a clear disposition path was placed in other parts of the building so that demolition could continue. This material included a collection of process equipment that had been disconnected and placed in the east wing. Enclosures were built around the equipment, the uranium was mined out, and the hulls stayed in place to be disposed as part of the building demolition.

Fig. 3.57. Building K-25 in late 2013.

Completing demolition of Building K-25 required crews to address and move a collection of high risk equipment, including items called monoliths—large blocks of uranium-containing components encased in concrete—and sodium fluoride traps. Sodium fluoride traps were used as part of the uranium separation process. The sodium fluoride pellets were used to trap the uranium, and the traps still contained uranium from when workers conducted operations in the facility. Each sodium fluoride trap was about the size of a household hot water heater and ranged in weight from 1,500 to 2,000 lb.

Employees opened, mined, and repackaged the high-risk equipment to meet disposal criteria. The concrete in the monoliths was chipped away, and the uranium content was mined out of the components in an on-site facility. The sodium fluoride traps, some of the highest risk equipment in the building, were removed before demolition.

Following demolition and debris removal, 99Tc, which is extremely mobile, was found in storm water and underground utilities associated with Building K-25. EM performed an extensive investigation of storm water sewers, underground electrical duct banks, sanitary sewers, and groundwater. Despite levels below regulatory compliance levels for any concern to human health, EM and UCOR worked to capture the material and dispose the waste off the site. A removal site evaluation was prepared that documented the findings.

3.8.2.4 Building K-27 Demolition

Predemolition work continues in Building K-27, one of the last remaining gaseous diffusion buildings at ETTP. The building is one of EM's highest priorities at the site due to its risk and severely deteriorated state. The K-27 building is similar in structure to the already demolished K-25 building. It spans more than 8 acres and is about 900 ft long, 400 ft wide, and 58 ft high.

In 2014, workers completed inventory management and nondestructive assay measurements; characterized process equipment; performed vent, purge, and drain operations on process equipment; and prepared necessary regulatory documents.

Building removal is expected to be completed in 2016. Completing this project will mark the end of all gaseous diffusion buildings at ETTP.

3.8.2.5 Building K-31 Demolition

Demolition of the K-31 building at ETTP began October 8, 2014, after months of preparation. This demolition marks the removal of the fourth of five gaseous diffusion buildings at the former uranium enrichment site.

The two-story building covers 750,000 ft^2 and spans a 17-acre footprint. The K-31 facility, which began operations in 1951, was used to enrich uranium for defense and power generation purposes until it was shut down in 1985. In 2005, EM removed most of the hazardous materials from the building's interior.

UCOR, EM's cleanup contractor for ETTP, is responsible for demolishing the facility. The company prepared it for demolition in 2014 by conducting asbestos abatement, removing the facility's exterior transite paneling, disconnecting the building's power sources, and completing pollution prevention efforts such as filling interior and exterior storm drains. EM and UCOR worked together to accelerate start-up of the K-31 demolition 5 months ahead of the original proposed baseline schedule. The early start was achieved through UCOR's work and EM's oversight on other projects such as the K-25 Building Demolition Project. EM selected the K-31 project to continue removing former gaseous diffusion facilities at the site and maintain the existing skilled workforce on-site.

Once the K-31 demolition is completed, the 383,000 ft^2 K-27 building will be the only remaining gaseous diffusion building at ETTP.

3.8.2.6 Commemoration of the K-25 Site

DOE achieved several major milestones in FY 2014 toward meeting the MOA commitment made with historic preservation agencies and interested parties. These measures will preserve the history of the K-25 Site and interpret the significance of ETTP. Milestones achieved in FY 2014 included the following.

- Demolished Building K-25 and removed all of the waste to prepare the slab for evaluation
- Awarded a professional site design team and museum professional design subcontract
- Facilitated inventory and review by a team of subject matter experts, historians, design experts, and historic preservation agencies of the equipment identified for preservation; the team also provided input for the conceptual design of the envisioned facility.
- Awarded a web design services firm the contract to develop and maintain a web-based K-25 virtual museum.

Conceptual design of the equipment building, viewing tower, K-25 history center, and wayside exhibits and K-25 slab delineation are progressing and will be submitted to the historic preservation consulting parties in 2016 for review and comment.

Employees completed numerous field activities in support of the conceptual design, including completing a field inventory of historic equipment and artifacts stored at ETTP. The inventory included inspecting; photographing; conducting radiological surveys; and, where necessary, performing minor decontamination activities to release items for potential use in the professional site design team's wayside exhibits.

3.8.3 Reindustrialization

DOE successfully completed the transfer of parcels ED-11 and ED-12 to CROET (Fig 3.58) on May 12, 2014. The combined acreage of these two parcels is 28.3 acres and will allow CROET to pursue commercial clients for this centrally located industrial area of the ETTP site. This flat parcel of land, which once housed a machine shop and other support facilities, has undergone environmental cleanup, and EPA and TDEC have approved it for reuse. With this successful property transfer, DOE has transferred a total of 721 acres to CROET for reuse, which increases potential economic development in the local community.

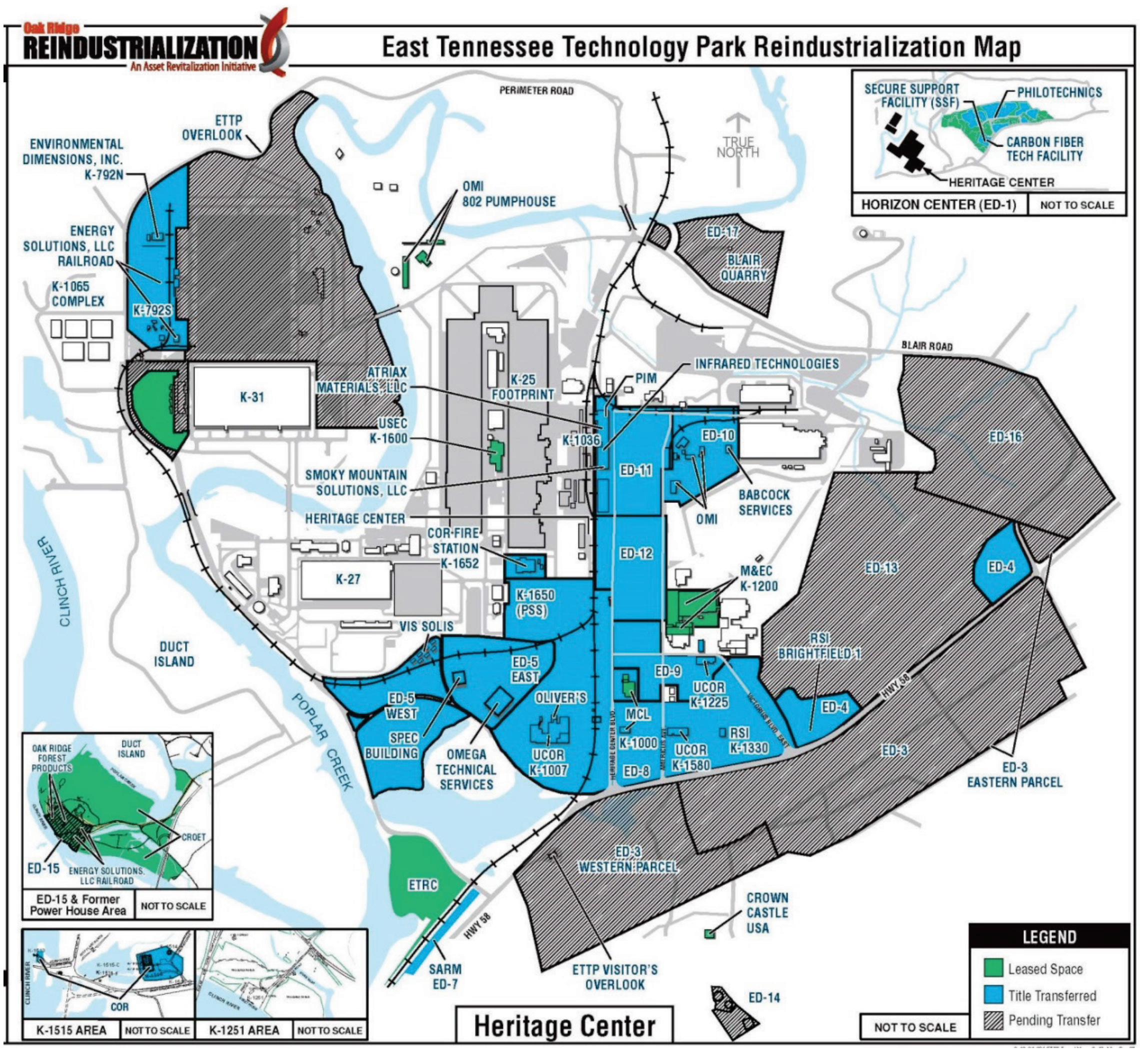

Fig. 3.58. East Tennessee Technology Park reindustrialization status, 2014.

DOE successfully transferred the balance of several thousand feet of the potable drinking water piping system to the City of Oak Ridge in September 2014. DOE facilities, as well as private businesses, are now set up on commercial metered water and sewer billing plans. Additionally, the reindustrialization program provided support to the Powerhouse 6 one-megawatt solar project, which was 80% complete at the end of CY 2014. This is a joint effort of the City of Oak Ridge; RSI; Vis Solis, Incorporated; DOE; CROET; and UCOR that is scheduled to be completed in early CY 2015.

These transfers also reduce maintenance costs for DOE, which frees up additional money for environmental cleanup.

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. The city has applied biosolids on ORR since 1983. After the October 1, 2014, application at the Rogers site, application on ORR was temporarily halted.

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. 3.59). 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. In 2014, biosolids were only applied to three sites, Rogers (7.3 dry tons), Scarboro 1 (14.1 dry tons), and Scarboro 2 (5.5 dry tons).

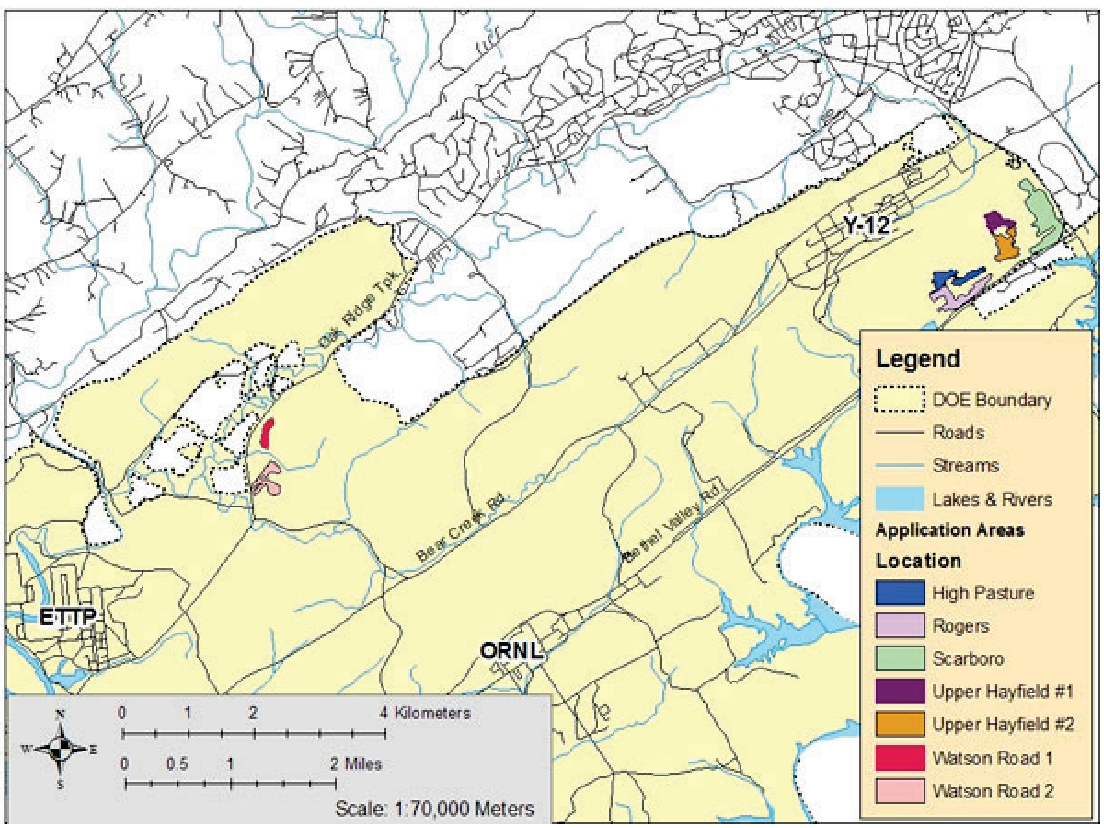

Fig. 3.59. Biosolids application areas on the Oak Ridge Reservation.

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. All industrial generators are required by Oak Ridge city ordinance 5-09 to obtain an industrial discharge permit from the city, which prescribes discharge limits and monitoring/reporting requirements.

3.8.4.3 2014 Status

In rulemaking effective June 30, 2013, TDEC enacted legislation governing the land application of Class B biosolids in the state of Tennessee under Chapter 0400-40-15, "Biosolids Management." Before this legislation, land application programs in Tennessee operated as self-implementing, without EPA permit, under the EPA 40 CFR 503 regulations. The TDEC regulations include all 40 CFR 503 requirements as well as specific agronomic limits and setbacks more protective of surface water and groundwater.

Tables 3.39 through 3.41 present data for each site to which biosolids were applied in 2014, including the percentage of the regulatory limit that was attained.

The site sampling effort was eliminated by DOE EM in favor of preapplication monitoring through analysis of the biosolids. UCOR has provided radiological analyses for biosolids since 2010. The radiological analyses were a feature of the new preapplication monitoring metric.

Table 3.39. Scarboro Field 1

Heavy metal	2014 (kg/ha)	Cumulative loading as of 12/31/2014 (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	503 limits attained (%)
As	0.00	0.33	41	0.8
Cd	0.00	0.55	39	1.4
Cr	0.03	8.53	N/A	N/A
Cu	0.72	45.01	1,500	3.0
Pb	0.03	5.06	300	1.7
Hg	0.00	0.95	17	5.6
Mo	0.01	1.08	N/A	N/A
Ni	0.03	4.68	420	1.1
Se	0.01	1.98	100	2.0
Zn	1.12	128.68	2,800	4.6

Table 3.40. Scarboro Field 2

Heavy metal	2014 (kg/ha)	Cumulative loading as of 12/31/2014 (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	503 limits attained (%)
As	0.00	0.33	41	0.8
Cd	0.00	0.55	39	1.4
Cr	0.02	8.48	N/A	N/A
Cu	0.34	44.03	1,500	2.9
Pb	0.01	5.03	300	1.7
Hg	0.00	0.95	17	5.6
Mo	0.01	1.07	N/A	N/A
Ni	0.01	4.65	420	1.1
Se	0.01	1.96	100	2.0
Zn	0.52	127.24	2,800	4.5

Table 3.41. Rogers Field

Heavy metal	2014 (kg/ha)	Cumulative loading as of 12/31/2014 (kg/ha)	40 CFR 503 cumulative loading limits (kg/ha)	503 limits attained (%)
As	0.00	0.47	41	1.2
Cd	0.00	1.01	39	2.6
Cr	0.02	22.55	N/A	N/A
Cu	0.36	101.25	1,500	6.7
Pb	0.01	13.91	300	4.6
Hg	0.00	1.97	17	11.6
Mo	0.01	4.29	N/A	N/A
Ni	0.01	10.30	420	2.5
Se	0.01	1.35	100	1.3
Zn	0.56	251.41	2,800	9.0

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