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 such operations as waste management, the cleanup of outdoor storage and disposal areas, the demolition and/or cleaning up 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 underutilized government facilities for use by the private sector) also became a major mission at ETTP. Reindustrialization allows private industry to lease underutilized facilities, thus providing both jobs and a new use for facilities that otherwise would have to be demolished. Bechtel Jacobs Company LLC (BJC) is the prime environmental contractor for the ETTP environmental monitoring and surveillance program, under which two main activities are performed: effluent monitoring and environmental surveillance. 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. Data from the monitoring 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 and plan remediation efforts, and to evaluate the efficacy of these remediation efforts. In 2010, there was better than 99% compliance with permit standards for emissions from ETTP operations.

3.1 Description of Site and Operations

Construction of ETTP, originally known as the K-25 site, began in 1943 as part of the World War II Manhattan Project (Fig. 3.1). 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 that operated for 1 year and the K-25 and K-27 gaseous diffusion process buildings. Later, the K-29, K-31, and K-33 buildings were built to increase the production capacity of the original facilities by raising the assay of the feed material entering K-27. Following the war years, the site became officially known as the Oak Ridge Gaseous Diffusion Plant (ORGDP).

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

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

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Fig. 3.1. East Tennessee Technology Park.

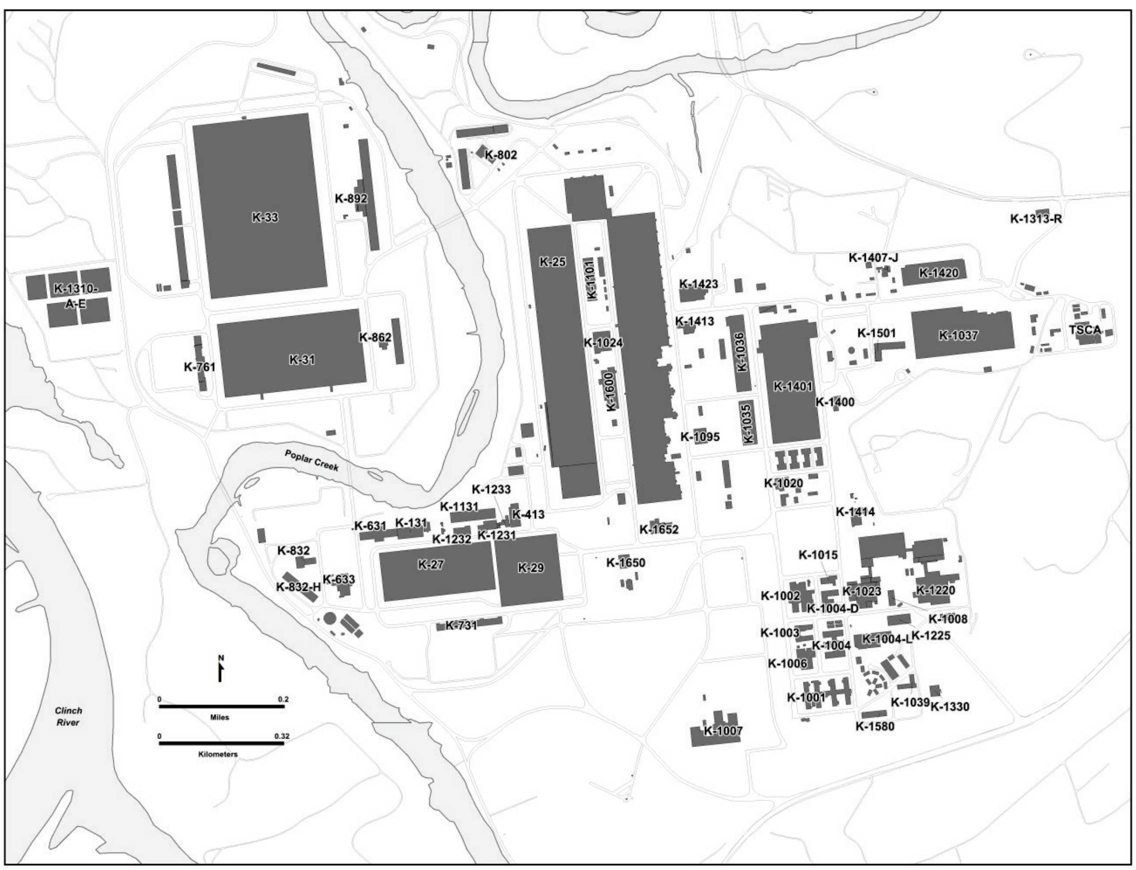

Fig. 3.2. ETTP prior to D&D activities (in 1991).

Figure 3.3 shows the ETTP areas for the D&D activities during 2010. The ETTP mission is to reindustrialize and reuse site assets through leasing excess or underutilized land and facilities and through incorporating commercial industrial organizations as partners in the ongoing environmental restoration, D&D, and waste treatment and disposal.

DOE's long-term goal for ETTP is to convert as much as possible of the site into a private mixed-use business and industrial park. The site is undergoing environmental cleanup of its land as well as D&D of most of its buildings. The reuse of key facilities through title transfer is part of the site's closure plan. The cleanup approach makes land and various types of buildings (e.g., office, manufacturing) suitable for private industrial use and for title transfer to 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.

Bechtel Jacobs Company LLC (BJC), the environmental management contractor for ETTP, supports DOE in the reindustrialization program that transferred three building and two land parcels to the CROET as it continued its effort to transform ETTP into a private-sector industrial park. In 2010, two buildings and two land parcels at ETTP were transferred to private companies. Construction was also completed on speculative buildings on two of the parcels. Unless otherwise noted, information on non-DOE entities located on the ETTP site is not provided in this document.

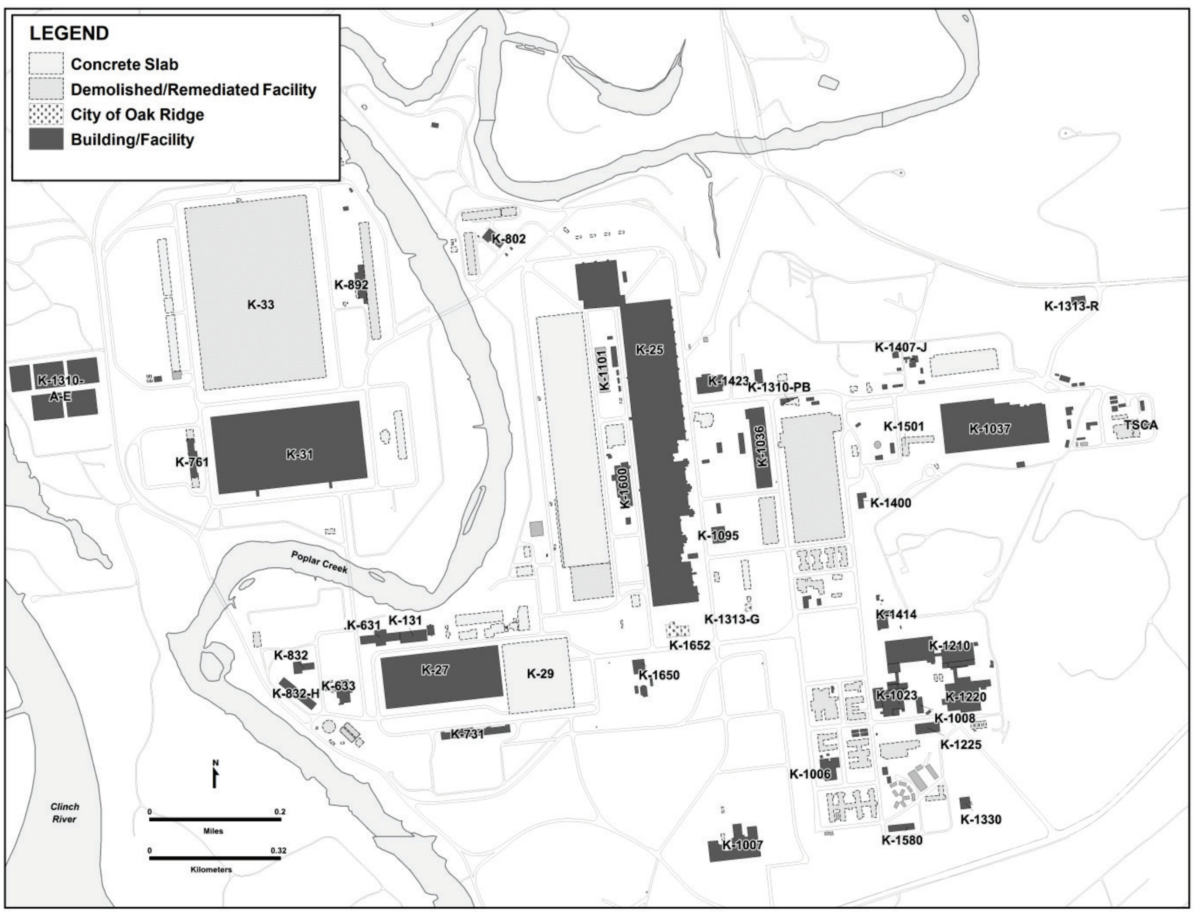

Fig. 3.3. ETTP in 2010.

3.2 Environmental Management System

As required by DOE Order 450.1A, the BJC Environmental Management System (EMS) is integrated with the Integrated Safety Management System (ISMS). BJC'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 14001:2004 (ISO 14001:2004). BJC is committed to incorporating sound environmental management, protection, and sustainability practices in all work processes and activities that are part of the DOE environmental management (EM) program in Oak Ridge, Tennessee. BJC's environmental policy states, "…it is inherent in our mission to complete environmental cleanup safely with reduced risks to the public, workers, and the environment." In order to achieve this, BJC's environmental policy adheres to the following principles:

- **Management Commitment**—Integrate responsible environmental practices into project operations.
- **Environmental Compliance and Protection**—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 (P2).
- **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 progress in EMS progress, performance, and successes. During 2010, BJC received green scores for EMS performance and 2010 Pollution Prevention Performance Measures. Figure 3.4 shows BJC's recycling data by types and quantities for 2010.

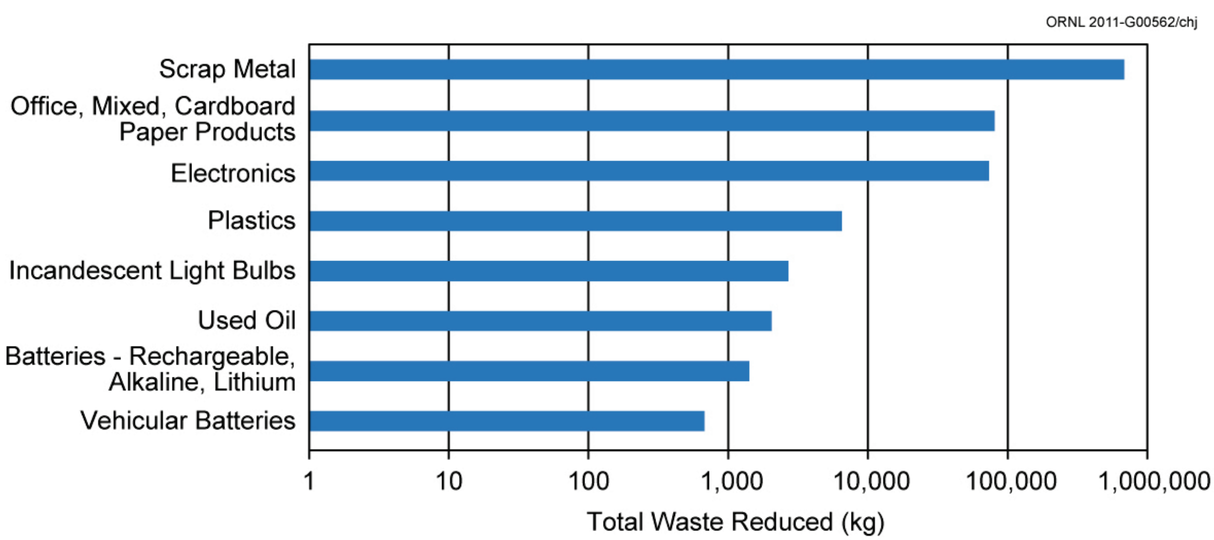

Fig. 3.4. Pollution prevention recycling activities at ETTP related to solid waste reduction in 2010.

Additionally, in July 2010, BJC donated 25 wooden utility poles that had been removed from service at ETTP to the Boy Scouts of America, a nonprofit agency. DOE approved the donation, a work package was developed by BJC, and the poles were surveyed and cleared for delivery The donation provided beneficial reuse of the poles for needed electrical improvements to Camp Pellissippi in Anderson County, Tennessee, in addition to freeing up short-term storage space for more utility poles being removed from service in the future, and eliminated the need for disposal of the poles in a landfill.

3.2.2 Environmental Compliance

BJC maintains various layers of oversight to ensure compliance with legal and other requirements. The methods of evaluations range from 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 Assessments*, BJC-PQ-1420, and *Independent Assessments*, BJC-PQ-1401. Assessments are scheduled in accordance with BJC-PQ-1420 on the BJC Assessments SharePoint Site. 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."

In addition, external assessments and regulatory inspections are performed by DOE and regulatory agencies such as the Tennessee Department of Environment and Conservation (TDEC) and the EPA.

As required by DOE Order 450.1A, an independent assessment of BJC's EMS in accordance with BJC-PQ-1401 will be conducted every 3 years. In addition, during years when an independent assessment is not conducted, a management assessment of the EMS program will be performed in accordance with BJC-PQ-1420. Also, routine functional environmental compliance management assessments evaluate the various elements of ISO 14001. Independent and management assessments are scheduled in advance, and the schedule is maintained on a SharePoint Site on BJC's intranet.

Results of all assessments are provided to management, and corrective actions are tracked in BJC Issues and Corrective Action Tracking System (I/CATS) in accordance with *Issues Management Program*, BJC-PQ-1210, as required by ISO 14001, Section 4.5.3, "Nonconformity, Corrective Action, and Preventive Action."

Initial validation of BJC's EMS occurred in December 2005. An internal independent assessment was performed in September 2007, and an evaluation by an outside party, as required by DOE Order 450.1A, was conducted in March 2009. BJC formally declared conformance with EMS requirements contained in DOE Order 450.1A on May 6, 2009. A DOE-led verification assessment of BJC's ISMS/EMS was conducted in December 2010. The assessment concluded that "the criteria and objectives for environmental protection are met through implementation of the ISO 14001-conforming and DOE Order 450.1A-compliant EMS. The BJC EMS follows the ISMS framework." No findings were identified during the assessment.

3.2.3 Environmental Aspects/Impacts

Using a graded approach appropriate for the Environmental Management Closure Contract, the 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 environmental, safety and health (ES&H) goals. BJC works continuously to improve the EMS in order to reduce impacts from activities and associated effects on the environment (i.e., environmental aspects) and to communicate and reinforce this policy to our internal and external stakeholders.

At the program/company level, environmental aspects are documented and are reviewed at least annually and updated as necessary. Significant environmental aspects are identified using a systematic process that considers various risk factors (e.g., regulatory risk, environmental risk, mission impact, and probability) in determining significance. This process is described in *Evaluation of BJC Activities and Ranking of Environmental Aspects/Impacts* (BJC 2008). BJC's work activities, services, and products were initially reviewed to determine the associated environmental aspects and impacts and are reevaluated on an ongoing basis as new work activities are initiated.

Continuous improvement opportunities are identified in a number of ways including, but not limited to, ongoing independent and management assessments, external DOE assessments, regulatory inspections, worker feedback, and senior management reviews of BJC's EMS components. Figure 3.5 provides a model that illustrates the components and key steps of BJC's EMS.

The BJC corporate policy emphasizes the company's core values by promoting a commitment to an ISMS. The objective of the ISMS is to systematically integrate ES&H, pollution prevention (P2), waste minimization, and quality assurance (QA) into management and work practices at all levels so that workers, the public, and the environment are protected while the missions are accomplished, in addition to obtaining feedback for continuous improvement.

The Environmental Compliance and Protection (EC&P) Oversight Program is an integral part of the BJC EMS mandated by Presidential Executive Order 13423, "Strengthening Federal, Environmental, Energy, and Transportation Management," and its implementing document, DOE Order 450.1A, *Environmental Protection Program*. This order requires each DOE operation to implement an EMS as part of the existing ISMS that was established pursuant to DOE Policy 450.4, *Safety Management System Policy*. BJC uses its ISMS to implement the EMS, including EC&P considerations, into the line oversight program at DOE sites managed by BJC. DOE Order 450.1A also requires implementation and development of P2 and sustainable environmental stewardship goals.

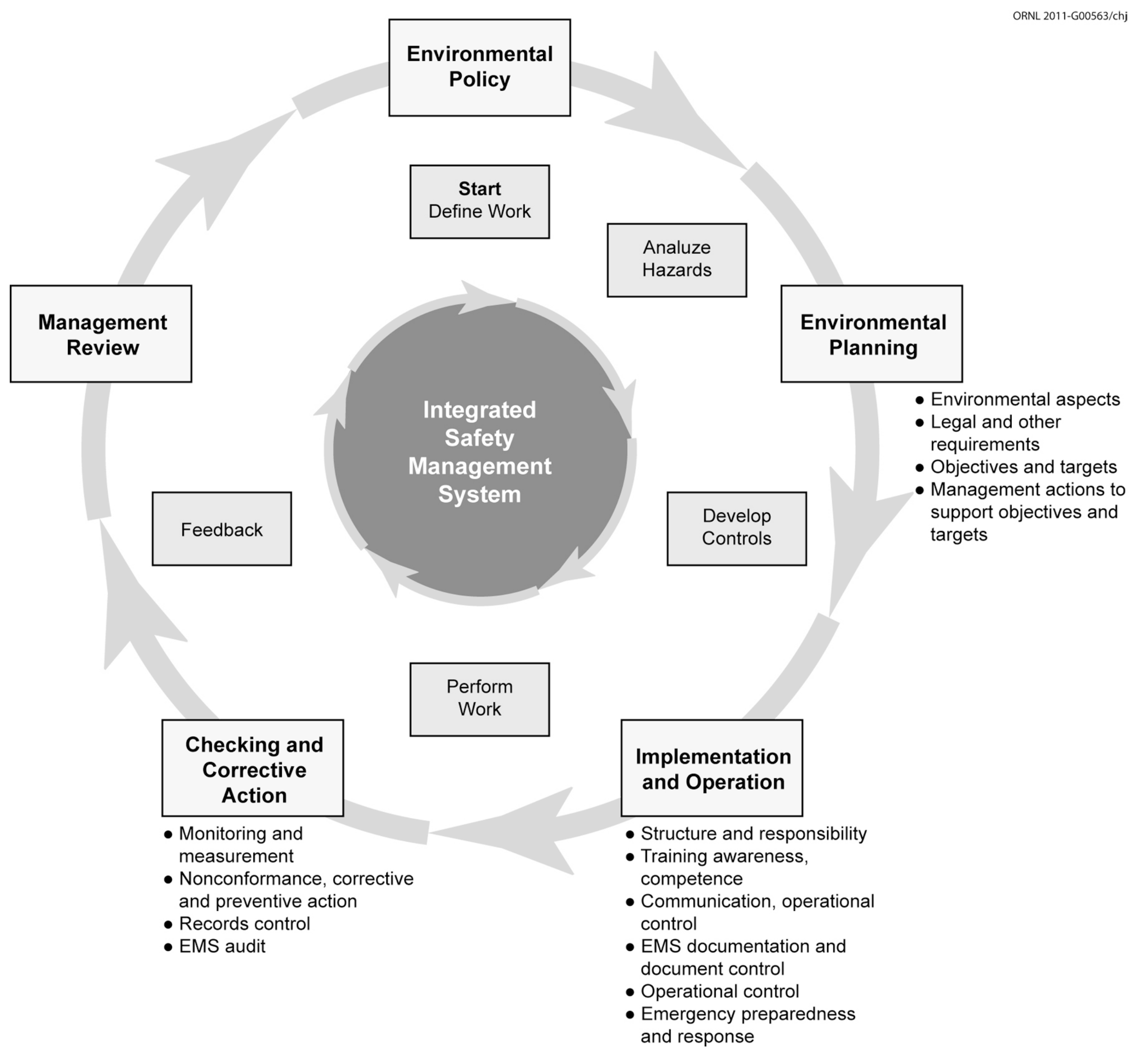

Fig. 3.5. BJC EMS key elements.

3.2.4 Environmental Performance Objectives and Targets

BJC 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 the ISMS; and, to the extent practicable, reduce waste generation, prevent pollution, maximize recycle and reuse potential, and encourage environmentally preferable procurement of materials with recycled and bio-based content.

BJC 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 BJC's work scope. The core environmental objectives are based on complying with applicable legal requirements and sustainable environmental practices contained in DOE Order 450.1A and include the following:

- comply with all environmental regulations, permits, and regulatory agreements;
- encourage reducing or eliminating the generation and/or toxicity of waste and other pollutants at the source through P2;
- encourage reducing or eliminating acquisition, use, and release of toxic, hazardous, and radioactive materials and greenhouse gases by acquiring environmentally preferable products and conduct of operations;
- reduce degradation and depletion of environmental resources through post-consumer material recycling and energy, fuel, and water conservation efforts, and the use or promotion of renewable energy;
- reduce or eliminate the environmental impact of electronics assets;
- reduce the environmental impact of BJC operations on surface water and groundwater resources.

In addition to the core objectives listed above, BJC establishes company-level ad hoc objectives and targets each year that are established based on changing priorities, changing legal requirements, and other areas of emphasis. Each year, the complete list of core and ad hoc environmental objectives and targets are distributed by the BJC president for the upcoming calendar year. The list also includes designation of responsibility and time frames by which actions are to be taken to facilitate achievement of the objectives and targets. The status of objectives and targets are periodically reviewed throughout the year at EC&P leads meetings and management reviews.

Project-specific EMS objectives and targets are developed annually near the beginning of each calendar year and are based on company-level objectives and targets, taking into consideration significant environmental aspects and legal requirements of their project operations. The status of the environmental objectives and targets at the project level are reviewed periodically by the EC&P lead with project management as well as with the EC&P Program Manager during EC&P leads meetings.

The EMS is part of the ISMS in that it relies on the existing ISMS five core functions, seven guiding principles, and worker participation to fully integrate EC&P considerations into all work processes. As previously stated, BJC's EMS is based on the elements and framework contained in ISO 14001. Each element is addressed in BJC's *EMS Implementation Description—General Requirements, Environmental Policy, Environmental Planning, Implementation and Operations, Checking, and Management Review.* For each element, this document provides the related implementing documents, implementation description, and roles and responsibilities. Depending on the scope of work involved, there are EMS attributes or actions related to the environment that an individual could apply at each of the five core functions. Such actions are specifically relevant to environmental compliance, protection of natural resources, prevention of pollution, and minimization of waste. When EMS attributes or actions are applied through the ISMS process, the elements of the EMS Program become an integral part of a continuing cycle of planning, implementing, evaluating, and improving processes and actions. The EMS is supported at each of the five core functions of ISMS, and the ISMS provides the framework for implementing EMS policies, processes, and tools in all phases of work. BJC's definition of "safety" embodies protection of workers and the public health as well as the environment.

3.2.5 Implementation and Operations

BJC protects the safety and health of workers and the public by identifying, analyzing, and mitigating aspects, hazards, and impacts and by implementing sound work practices. All BJC 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. BJC internal management assessments also provide a measure of how well EMS attributes are integrated into work activities through the ISMS. BJC has embodied its program for environmental compliance and protection of natural resources in a company-wide environmental management and protection policy. The policy is BJC's fundamental commitment to incorporating sound environmental management practices into all work processes and activities.

3.2.6 Pollution Prevention/Waste Minimization

BJC's work control process requires that source reduction be evaluated for all waste-generating activities and 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.

BJC recycles office and mixed paper, cardboard, phone books, newspapers, magazines, aluminum cans, antifreeze, engine oils, batteries (lead acid, universal waste, and alkaline), universal waste bulbs, plastic bottles, all types of #1 and #2 plastics, and surplus electronic assets such as computers (CPUs and laptops) and monitors (CRT and LCD). Other recycling opportunities include unique structural steel, stainless steel structural members, transformers, and electrical breakers. Figure 3.4 shows the P2 recycling activities at ETTP related to solid waste reduction.

BJC's electronic stewardship is award winning. For 2010, BJC and ETTP were recognized by the Office of Federal Environmental Executive and the EPA with the 2010 Federal Electronics Challenge Award (Silver) at the White House Conference Center in Washington, D.C. (Fig. 3.6). The award was given, in part, for the Radio Frequency Identification Device (RFID), which is utilized for the electronic waste management tracking system that provides a paperless and otherwise enhanced transportation logistics to track and monitor onsite waste shipments to the Environmental Management Waste Management Facility (EMWMF). An electronic tracking station is shown in Fig. 3.7. The system eliminated errors associated with manual data entry, improved cycle times by 25 minutes per truck shipment (i.e., saving large quantities of fuel and paper and significantly reducing greenhouse gas emissions), improved performance of vehicle searches at truck stations when exiting controlled areas, and has centralized logistics for all shipments to EMWMF. The overall project cost savings of $9.8 million from utilizing the RFID is shown in Table 3.1.

Additionally, BJC was recognized for six projects for P2, the Radio Frequency Information Device (RFID) technology was expanded beyond BJC, the use of "green" products was increased, and EMS and P2 employee awareness was raised through an increase in communications.

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Fig. 3.6. BJC and ETTP win the 2010 Federal Electronics Challenge Award (Silver).

ORNL 2011-G00565/chj

Fig. 3.7. A waste shipment passing an electronic tracking station as it prepares to enter the haul road from ETTP, en route to EMWMF.

Table 3.1. Radio Frequency Identification Device (RFID) sustainable results

Sustainable Factor	Results
Diesel fuel use avoidance	50,509 liters
NO_x and SO_x emissions avoidance	2,312 and 132,031 kilograms
Paper and trees saved	1.5 metric tons and 40 trees
Electricity saved	24,750 megajoules
Water use avoided	44,433 liters
Air pollution avoided	45.4 kilograms
Total project cost savings	**$9.8 million**

3.2.7 Competence, Training, and Awareness

The BJC 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 the procedure "Training Program," BJC-HR-0702. Completion and documentation of training, including required reading, are managed by the Local Education Administration Requirements Network (LEARN).

A number of training modules and awareness tools have been developed and used to increase general knowledge and awareness of BJC's environmental policy and to communicate roles and responsibilities for all employees.

Additionally, employees and subcontractors involved in a work activity that may have a significant impact on the environment are provided additional information through review of work packages, procedures, pre-job briefings, and review of Safety Task Analysis Risk Reduction Talk (STARRT) cards, which address potential environmental issues and concerns.

In addition to the formal training modules and project-specific work briefings, BJC uses a number of tools and mechanisms to constantly reinforce awareness and knowledge of BJC's EMS.

3.2.8 Communication

BJC has a written communication plan that addresses both internal and external communication of important company information, including information related to EMS.

BJC has decided to communicate externally regarding environmental aspects on the BJC public website, which includes a summary environmental policy statement and a list of environmental aspects as well as a link to the ISMS Description (BJC 2010). A number of other documents and reports are also published and made available to the public that address environmental aspects and cleanup progress (e.g., the Annual Site Environmental Report, Annual Cleanup Progress Report). BJC participates in a number of public meetings related to environmental activities at the site [e.g., Site Specific Advisory Board meetings; permit review public meetings; and Comprehensive Environmental Response, Compensation, and Liability Act (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 EMS Implementation

BJC utilizes EMS objectives and targets, a P2 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 BJC's P2/Waste Minimization (WMin) Program Plan (BJC 2009d).

BJC has initiated energy conservation measures that saved money, energy, and subsequently, pollution from power generation or vehicle emissions as follows:

- The reindustrialization organization purchased and installed sensors that automatically turn lights off when people are not present, as well as reminding personnel to turn off lights when leaving a room.
- Energy Star appliances are purchased whenever possible. These appliances meet strict energy-efficient guidelines set by EPA and DOE. Energy Star is an international standard for energy-efficient consumer products.
- The information technology (IT) department purchases only Electronic Product Environmental Assessment Tool (EPEAT) silver- or gold-certified computers and monitors. EPEAT is an easy-to-use online tool that helps institutional purchasers evaluate, compare, and select electronic products based on their environmental attributes. Additionally, the IT department is creating awareness and is implementing desktop energy-saving measures for computers, monitors, printers, and copiers.
- The Space Consolidation/Utilization Project eliminated facility/trailer types resulting in an energy use avoidance.
- The RFID Shipping Project implemented during FY 2010 resulted in a 50,509 liter reduction in the use of diesel fuel, electricity savings of 24,750 megajoules, paper and tree savings of 1.5 metric tons and 40 trees, water use avoidance of 44,433 liters, and air pollution avoidance of 45.4 kilograms.
- General maintenance purchases WaterSense replacement parts when performing repairs. WaterSense is an EPA program designed to encourage water efficiency through the use of a special label on consumer products such as toilets, flushing urinals, bathroom sink faucets, and accessories.
- Garage personnel use recycled content coolant (ethylene glycol) that is a 50/50 blend of recycled/new coolant and several bio-based products including oils and cleaners, which result in less toxic or non-toxic waste generation.

3.2.10 Management Review

Senior management review of the EMS is performed at several layers and frequencies. A formal annual review/presentation with BJC senior management is conducted at least once per year that addresses the requirement elements contained in this section. BJC senior management includes the President/General Manager, Vice President/Deputy General Manager, and Manager of Safety Systems Integration. At least two of the senior managers are present for management reviews. Also, as part of the ISMS annual report, a narrative report of the EMS and its effectiveness is published that addresses each requirement element. The ISMS Description (BJC 2010) is updated annually and signed by the BJC president to address improvements, lessons learned, and to update objectives and targets as necessary. The environmental policy is also reviewed during the management review annually and revised as necessary.

In addition to the formal annual reviews, monthly reviews of key DOE metrics are submitted to DOE. These metrics relate to the compliance-based EMS objectives and targets. On a periodic basis, the status of EMS objectives and targets are reviewed at the monthly EC&P leads meetings and project meetings as appropriate.

ETTP achieved 24 of 26 environmental targets on schedule in 2010. Highlights included increased recycling and recycling initiatives, 100% purchase of EPEAT silver- or gold-certified computer equipment, zero reportable releases to the environment, zero unpermitted discharges, and zero environmental notices of violation.

3.3 Compliance Programs and Status

During 2010 ETTP operations were conducted in compliance with contractual and regulatory environmental requirements with one exception. A single National Pollutant Discharge Elimination System (NPDES) permit noncompliance attributable to an unpermitted discharge to the storm water drainage system occurred on January 20, 2010. A contractor maintenance worker for an on-site commercial firm poured the contents of two 5-gallon paint cans into a storm drain catch basin. Details of the NPDES noncompliance are provided in Section 3.3.6.

No Notices of Violation or penalties were issued to ETTP operations in 2010. The following sections provide more detail on each compliance program and the activities in 2010.

3.3.1 Environmental Permits

Table 3.2 contains a list of environmental permits that were effective in 2010 at ETTP.

3.3.2 Notices of Violations and Penalties

ETTP did not receive any notices of violations or penalties from regulators in 2010.

3.3.3 Audits and Oversight

Table 3.3 presents a summary of environmental audits conducted at ETTP in 2010.

3.3.4 National Environmental Policy Act/National Historic Preservation 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 establish NEPA as a key consideration in the formative stages of project planning.

During 2010, 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 exclusions (CXs) 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. BJC activities on the ORR are in full compliance with NEPA requirements, and procedures for implementing NEPA requirements have been fully developed and implemented. At ETTP, a checklist incorporating NEPA and EMS requirements has been developed as an aid for project planners. For routine operations,

Table 3.2. East Tennessee Technology Park Environmental Permits, 2010[a]

Regulatory driver	Permit title/description	Permit No.	Issue date	Expiration date	Owner	Operator	Responsible contractor
CAA	Operating permit—Tennessee Air Quality Act for K-1407-U VOC Air Stripper.	045253P	06-20-96	10-01-00	DOE	BJC	BJC
CAA	Operating permit—Tennessee Air Quality Act for K-1425 Waste Oil/Solvent Storage Tank Farm	029895P	09-21-90	10-01-95	DOE	BJC	BJC
CAA	Operating permit—Tennessee Air Quality Act for K-1435-C Liquid Waste Tank Farm	037460P	03-31-94	10-18-98	DOE	BJC	BJC
CAA	Permit to construct—Tennessee Air Quality Act for K-1423 TSCA Solids Waste Repack Facility	958435P	10-10-05	10-10-06	DOE	BJC	BJC
CAA	Permit to construct—Tennessee Air Quality Act for TSCA Incinerator	957808I	01-25-05	Permit surrendered 03-30-10	DOE	BJC	BJC
CWA	National Pollutant Discharge Elimination System (NPDES) permit for the Central Neutralization Facility Wastewater Treatment System	TN0074225	10-29-10	12-31-13	DOE	BJC	BJC
CWA	NPDES permit for storm water discharges	TN0002950	02-26-10	12-31-13	DOE	DOE	BJC
CWA	State operating permit—Waste Transportation Project; Blair Road and Portal 6 Sewage Pump and Haul Permit	SOP-05068	02-28-06	02-28-09	DOE	URS	URS
CWA	State operating permit—K-1310-DF and K-1310-HG Trailers	SOP-99033	04-29-05	04-29-10	DOE	BJC	BJC

Table 3.2. (continued)

Regulatory driver	Permit title/description	Permit No.	Issue date	Expiration date	Owner	Operator	Responsible contractor
CWA	State operating permit—K-1065 Facility; Trailer K-1310-BS added in March 2009	SOP-01042	11-30-06	05-31-10	DOE	BJC	BJC
CWA	State operating permit—EMWMF. 5000 gallon holding tank and trailers 998T-74 and 998T-75	SOP-01043	07-31-07	07-31-12	DOE	BJC	BJC
CWA	Authorized/certified USTs at K-1414 Garage	Customer ID 30166 Facility ID 073008	03-20-89	Ongoing	DOE	BJC	BJC
RCRA	K-25 Site TSCA Incinerator	TNHW-015	09-28-87	09-28-97	DOE	BJC	BJC
RCRA	ETTP Container and Tank Storage and Treatment Units	TNHW-133	09-28-07	09-28-17	DOE	BJC	BJC
RCRA	ETTP Container Storage and Treatment Units	TNHW-117	09-30-04	09-30-14	DOE	BJC	BJC
RCRA	Hazardous Waste Corrective Action Permit (encompasses the entire ORR)	TNHW-121	09-28-04	09-28-14	DOE	DOE/All[b]	DOE/All[b]
TSCA	TSCA Incinerator PCB treatment authorization	Not applicable	03-20-89	Ongoing	DOE	BJC	BJC

[a]In cases where permit renewal applications have been submitted to regulatory agencies in a timely manner but a new permit has not been issued, permission is granted by regulators to continue operating under the terms of the existing, but expired permit.

Abbreviations

CAA	Clean Air Act
CWA	Clean Water Act
EMWMF	Environmental Management Waste Management Facility
RCRA	Resource Conservation and Recovery Act
TSCA	Toxic Substances Control Act
PCB	polychlorinated biphenyl
UST	underground storage tank

[b]DOE and all Oak Ridge Reservation (ORR) co-operators of hazardous waste permits.

Table 3.3. Regulatory oversight, assessments, inspections, and site visits at East Tennessee Technology Park, 2010[a]

Date	Reviewer	Subject	Issues
January 14	TDEC	Annual CAA Inspection	0
February 8–10	TDEC	Annual RCRA Compliance Inspection	0
September 21	TDEC-Knoxville	CNF NPDES compliance evaluation inspection	0
October 7	EPA	TSCA Incinerator – PCB site visit	0

[a] CAA = Clean Air Act; EPA = Environmental Protection Agency; PCB = polychlorinated biphenyl; RCRA = Resource Conservation and Recovery Act; TDEC =Tennessee Department of Environment and Conservation; TSCA= Toxic Substances Control Act

generic CXs have been issued. During 2010, one CX was issued (storage of TRU and mixed TRU waste at ORNL), and six review reports (five for reindustrialization projects and one for storage of reusable uranium material) were prepared. A review report is generated when a NEPA review is conducted and the activity is found to fall within one of the DOE-ORO generic CXs.

Compliance with the National Historic Preservation Act (NHPA) at ETTP is achieved and maintained in conjunction with NEPA compliance. The scope of proposed actions is reviewed in accordance with the *Cultural Resource Management Plan* (DOE 2001). At ETTP, there are 135 facilities eligible for inclusion on the National Register of Historic Places. A memorandum of agreement states that two of these facilities will be maintained (the north end of K-25 and Portal 4). The other facilities are scheduled to be demolished as part of the site-wide remediation project. To date, more than 220 facilities have been demolished. Artifacts of historical and/or cultural significance are identified prior to demolition and are cataloged in a database to aid in historic interpretation of the ETTP.

3.3.5 Clean Air Act Compliance Status

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

In 2010, there was one permitted source requiring tracking of criteria pollutants, and one permitted major radionuclide source that required continuous environmental sampling, seven minor radionuclide sources, and numerous demonstrations of compliance with generally applicable air quality protection requirements (asbestos, stratospheric ozone, etc.). TDEC personnel performed one inspection of ETTP CAA permitted operations in 2010. No issues or concerns were noted by the TDEC inspector. In summary, there were no ETTP CAA violations or exceedances in 2010. Section 3.4 provides detailed information on 2010 ETTP activities conducted in support of the CAA.

3.3.6 Clean Water Act Compliance Status

The objective of the Clean Water Act (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 D for water reference standards). One of the strategies developed to achieve the goals of the CWA was EPA's establishment of limits on specific pollutants allowed to be discharged to U.S. waters by municipal sewage treatment plants and industrial facilities. The EPA established the NPDES permitting program to regulate compliance with pollutant limitations. The program was designed to protect surface waters by limiting effluent discharges into streams, reservoirs, wetlands, and other surface waters. EPA has delegated authority for implementation and enforcement of the NPDES program to the state of Tennessee. ETTP discharges to the waters of the state of Tennessee under two individual NPDES permits:

- NPDES Permit No. TN0002950, which regulates storm water discharges, and
- NPDES Permit No.TN0074225, which regulates industrial discharges from the Central Neutralization Facility (CNF).

In 2010, compliance with the ETTP NPDES storm water permit was determined by approximately 420 laboratory analyses, field measurements, and flow estimates. The NPDES permit compliance rate for all discharge points for 2010 was nearly 100%. A single NPDES permit noncompliance attributable to an unpermitted discharge to the storm water drainage system occurred on January 20, 2010. A contractor maintenance worker from an on-site commercial firm poured the contents of two 5-gallon paint cans into a storm drain catch basin that is part of the storm water outfall 100 drainage network. The material that was poured into the catch basin was dilute cleanup water from office painting that was being conducted inside an ETTP building. No harm to aquatic species was seen during investigation of the incident. The exceedance did not result in any discernable ecological impact. Section 3.5 contains detailed information on the activities and programs carried out at 2010 by ETTP in support of the CWA.

In 2010, compliance with the ETTP NPDES permit for industrial wastewater from the Central Neutralization Facility (CNF) was determined by more than 2000 laboratory analyses and field measurements. The CNF NPDES permit compliance rate for 2010 was 100% with no noncompliances.

3.3.7 Safe Drinking Water Act Compliance Status

ETTP's water distribution system is designated as a non-transient, non-community water system by TDEC's Division of Water Supply. The *Tennessee Regulations for Public Water Systems and Drinking Water Quality*, Chap. 1200-5-1 (TDEC 2009a), sets limits for biological contaminants and for chemical activities and chemical contaminants. TDEC requires sampling for the following constituents for compliance with state and federal regulations:

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

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

3.3.8 Resource Conservation and Recovery Act Compliance Status

ETTP is regulated as a large-quantity generator of hazardous waste because the facility generates more than 1,000 kg of hazardous waste per month. This amount includes hazardous waste generated under permitted activities (including repackaging or treatment residuals). At the end of 2010, ETTP had four generator accumulation areas for hazardous or mixed waste.

ETTP is also regulated as a handler of universal waste (e.g., fluorescent lamps, batteries, and other items regulated under 40 CFR 273). Mercury-containing equipment at ETTP is managed as universal waste.

Additionally, some batteries are managed according to 40 CFR Part 266.80. This applies to the management of spent lead-acid batteries that are being reclaimed.

ETTP is registered as a large-quantity generator under EPA ID No. TN 0890090004 and is permitted to transport hazardous wastes and to operate Resource Conservation and Recovery Act (RCRA)–permitted hazardous waste treatment and storage units. During 2010, 20 units operated as permitted units.

ETTP's RCRA storage and treatment facilities (or units) operate under three permits: TNHW-117, TNHW-133, and TNHW-015. The permits are modified when necessary. TDEC approved two permit modifications in 2010. Combustion operations at the Toxic Substance Control Act Incinerator ceased in

December 2009. Operations in 2010 centered on decontamination and decommissioning activities (see Section 3.8.1). All RCRA operations at ETTP were in compliance with permit requirements during 2010.

3.3.9 RCRA Underground Storage Tanks

Underground storage tanks (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA (40 CFR 280). EPA granted TDEC authority to regulate USTs containing petroleum under TDEC Rule 1200-1-15; however, EPA still regulates hazardous-substance USTs.

ETTP has two USTs registered with TDEC under Facility ID Number 0730088. All RCRA UST operations at ETTP were in compliance with permit requirements during 2010.

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

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

In 1989, the ORR was placed on the NPL. In 1992, the ORR Federal Facility Agreement among EPA, TDEC, and DOE became effective and established the framework and schedule for developing, implementing, and monitoring remedial actions on the ORR. ETTP's primary mission is D&D of surplus facilities. The on-site CERCLA Environmental Management Waste Management Facility (EMWMF), located in Bear Creek Valley, is used for disposal of contaminated waste resulting from CERCLA cleanup actions on the ORR. The EMWMF is an engineered landfill that accepts low-level radioactive, hazardous, asbestos, and polychlorinated biphenyl (PCB) wastes and combinations of the aforementioned wastes in accordance with specific waste acceptance criteria under an agreement with state and federal regulators. Uncontaminated CERCLA waste is disposed of at the ORR sanitary landfill.

3.3.10.1 ETTP RCRA-CERCLA Coordination

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

RCRA groundwater monitoring data are reported yearly to TDEC and EPA in the annual CERCLA Remediation Effectiveness Report (DOE 2010a) for the ORR.

Periodic updates of proposed construction and demolition activities and facilities at ETTP have been provided to managers and project personnel from the TDEC DOE Oversight Division and EPA Region 4. A CERCLA screening process is used to identify proposed construction and demolition projects and facilities that warrant CERCLA oversight. The goal is to ensure that modernization efforts do not adversely impact the effectiveness of previously completed CERCLA environmental remedial actions or future CERCLA environmental remedial actions.

3.3.11 Toxic Substances Control Act Compliance Status

3.3.11.1 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 is regulated under the EPA ID number TN0890090004. In 2010, ETTP operated approximately 36 PCB waste storage areas in ETTP generator buildings and, when longer-term storage of PCB/radioactive wastes was necessary, RCRA-permitted storage buildings. The continued use of authorized PCBs in electrical systems and/or equipment (e.g., transformers, capacitors, rectifiers) is regulated 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 for future reuse) PCB-contaminated equipment (i.e., transformers).

Because of the age of many of ETTP's facilities and the varied uses for PCBs in gaskets, grease, building materials, and equipment, DOE self-disclosed unauthorized use of PCBs to EPA in the late 1980s. As a result, the DOE Oak Ridge Office and EPA Region 4 consummated a major compliance agreement known as the Oak Ridge Reservation Polychlorinated Biphenyl Federal Facilities Compliance Agreement, which became effective December 16, 1996. The agreement specifically addresses the unauthorized use of PCBs in ventilation ducts and gaskets, lubricants, hydraulic systems, heat transfer systems, and other unauthorized uses; storage for disposal; disposal; cleanup and/or decontamination of PCBs and PCB items including PCBs mixed with radioactive materials; and records and reporting requirements on the ORR. A major focus of the agreement is the disposal of PCB waste. As a result of that agreement, DOE and BJC 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.

ETTP is home to the TSCA Incinerator (Fig. 3.8). On December 2, 2009, the TSCA Incinerator ceased operations as a waste incinerator and transitioned to a facility closure and decommissioning mode.

In 2010, the primary focus at the TSCA Incinerator was preparing it for RCRA and TSCA closure, so the facility could go into a surveillance and maintenance mode in 2011.

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Fig. 3.8. TSCA Incinerator.

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

The Emergency Planning and Community Right-to-Know Act (EPCRA) and Title III of SARA require that facilities report inventories and releases of certain chemicals that exceed specific release thresholds. The reports are submitted to the local emergency planning committee and the state emergency response commission. ETTP complied with these requirements in 2010 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 2010.

3.3.12.1 Material Safety Data Sheet/Chemical Inventory (Sect. 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 the Sect. 312 requirements. Of the chemicals identified for 2010 on the ORR, 16 were located at ETTP.

Private-sector lessees associated with the reindustrialization effort were not included in the 2010 submittals. Under the terms of their lease, lessees must evaluate their own inventories of hazardous and extremely hazardous chemicals and must submit information as required by the regulations. In 2010, the reported materials include Sakrete (type “N” or type “S”), rock salt (for road maintenance), sand (for road maintenance), and lead metal (largely in the form of lead-acid batteries). BJC submitted its EPCRA 312 Report in February 2010.

3.3.12.2 Toxic Chemical Release Reporting (Sect. 313)

DOE submits annual toxic release inventory reports to EPA and TDEC on or before July 1 of each year. The reports cover the previous calendar year and address releases of certain toxic chemicals to air, water, and land as well as waste management, recycling, and pollution prevention activities. Threshold determinations and reports for each of the ORR facilities are made separately. Operations involving toxic release inventory chemicals were compared with regulatory thresholds to determine which chemicals exceeded the reporting thresholds based on amounts manufactured, processed, or otherwise used at each facility. After threshold determinations were made, releases and off-site transfers were calculated for each chemical that exceeded one or more of the thresholds. In 2010, the only chemicals that met the reporting requirements were diisocyanates associated with foaming activity to stabilize deposits in pipes undergoing remediation actions. BJC submitted its Toxic Release Inventory (TRI) Report in June 2010.

3.4 Air Quality Program

The state of Tennessee has relegated authority to convey the clean air requirements that are applicable to ETTP operations. New projects are governed by construction permits, and eventually, the conditions for operating are incorporated into a site-wide Title V operating permit. To date ETTP operations under Bechtel Jacobs Company LLC (BJC) responsibility have not been issued a site-wide Title V operating permit by TDEC. Until such time that TDEC issues a Title V permit or ongoing reductions of ETTP operations no longer require one, all existing sources continue to operate compliantly under their most recently issued permits, as allowed under Tennessee Air Pollution Control Regulations (TAPCR) 1200-3-9-.02(11)(e)6. All operations are still subject to applicable regulations as specified in the individual permits and all generally applicable requirements. Examples include requirements associated with asbestos controls, control of stratospheric ozone-depleting chemicals, and control of fugitive emissions. Other major requirements include 40 CFR 61 National Emission Standards for Hazardous Air Pollutants for radionuclides (Rad NESHAP) requirements and the numerous requirements associated with emissions of criteria pollutants and other hazardous nonradiological air pollutants.

Ambient air monitoring, while not generally required by a condition of a permit, is conducted at ETTP to satisfy DOE order requirements, as a best-management practice and/or provide evidence of sufficient programmatic control of certain emissions. Ambient air monitoring conducted at ETTP is supplemented by additional monitoring conducted by UT-Battelle and by both on-site and off-site monitoring conducted by TDEC. In addition, compliance with the Clean Air Act is ensured using a management program that includes internal audits and external audits, such as the annual inspection conducted by the state of Tennessee personnel.

3.4.1 Construction and Operating Permits

In 2010, ETTP had only one construction air permit. The construction permit for the TSCA Incinerator was surrendered in March 2010 following the permanent shutdown of the facility in December 2009.

There were four active operating permits for ETTP air emission sources under BJC operations during 2010. Two of the permits are for tank farms used to receive, store, blend, and feed liquid wastes into the TSCA Incineration. Following the permanent shutdown of TSCA, other than liquids used to flush and clean these tanks, no new wastes were processed through these facilities during 2010. The K-1423 Solid Waste Repacking Facility is permitted due to potential radionuclide emission levels. Compliance is demonstrated using the EPA-approved use of ambient air monitoring. Waste processing in this facility ceased in September 2009, but the facility remained available for use. The K-1407 Central Neutralization Facility volatile organic compound (VOC) air stripper is permitted for total VOC emissions. Compliance is demonstrated by monitoring total wastewater processed and the results of wastewater influent sampling. All permitted facilities operated in full compliance of their associated permits during 2010.

3.4.1.1 Generally Applicable Permit Requirements

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

3.4.1.1.1 Control of Asbestos

ETTP's asbestos management program ensures all activities involving demolitions and all other actions impacting asbestos-containing materials (ACM) 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 ACM. ETTP has numerous buildings and equipment that contain ACM. Major demolition activities during 2010 involved the abatement of significant quantities of ACM that were subject to the requirements of 40 CFR 61, Subpart M. Most demolition and ACM abatement activities are governed under the 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. 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 2010 the total projected nonscheduled amounts were below thresholds that would require the submittal of an annual notification to TDEC. No releases of reportable quantities of ACM occurred at ETTP during 2010.

3.4.1.1.2 Stratospheric Ozone Protection

The management of ozone-depleting substances (ODS) 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 belimited 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.

A review is conducted annually that documents the use of ODS at ETTP, the regulatory requirements for management of ODS, and the mechanisms that demonstrate compliance with 40 CFR 82.166. This review does not address the private entities on the ETTP.

There were four purchase requisitions of Class I and Class II refrigerants [3–30 lb cylinders of R-22, 2–30 lb cylinders of R-12] for servicing of chiller units and small appliances that totaled 150 lb for ETTP for the period of January 1, 2010, to December 31, 2010. There were no alternative refrigerants (e.g., R-134-A) purchased during 2010.

The inventory as of December 31, 2010, from the Hazardous Materials Information System (HMIS), included 586 lb of Class I and Class II refrigerants and 150 lb of alternative refrigerants. Figure 3.9 demonstrates the effect of ongoing actions that are eliminating the use of Class I and Class II refrigerants at ETTP. Upon completion of current and future major facility demolition and remediation actions, this inventory should decline as refrigeration equipment in these facilities that use class I and II refrigerants are permanently removed from service.

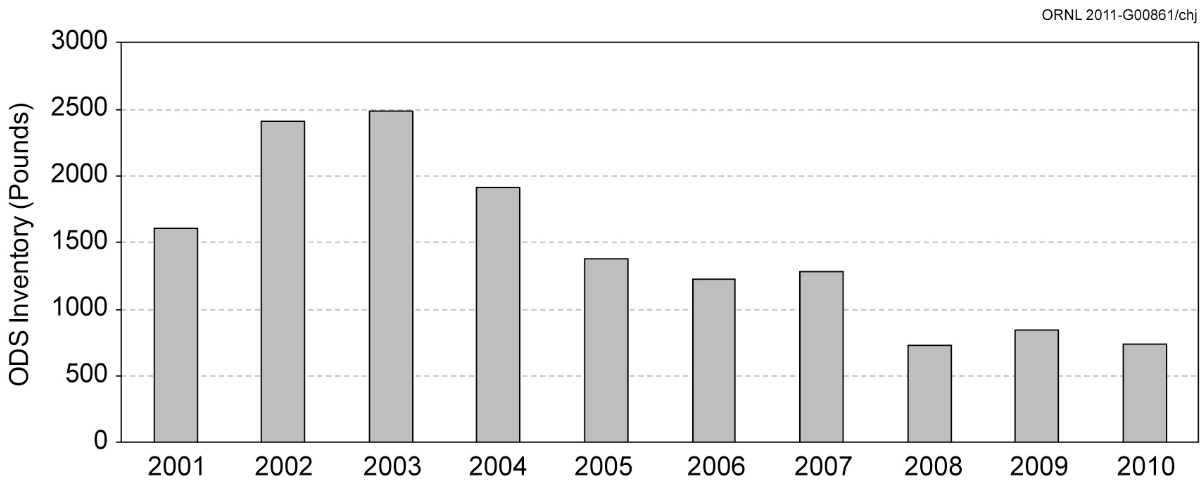

Fig. 3.9. ETTP total on-site ODS inventory history.

3.4.1.1.3 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.

3.4.1.2 Radionuclide National Emission Standard for Hazardous Air Pollutants

Radionuclide airborne emissions from ETTP are regulated under 40 CFR 61 National Emission Standards for Hazardous Air Pollutants: Department of Energy Facilities (Rad NESHAP). 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 NESHAP emission standard for the entire DOE ORR. Source emissions used to calculate the dose are determined using EPA-approved methods ranging from continuous sampling systems to conservative estimations based on process and waste characteristics. Continuous sampling systems are required for radionuclide-emitting sources that have the potential dose impact of not less than 0.1 mrem per year to any member of the public. The K-1423 Solid Waste Repack Facility (K-1423) is the only ETTP source remaining that requires a continuous sampling system. With EPA approval, ambient air sampling is used for K-1423 Rad NESHAP compliance in lieu of in-stack continuous sampling. Historically, the only ETTP unit that required an in-stack continuous sampling system was the TSCA Incinerator that ceased operations in December 2009. ETTP Rad NESHAP sources—the Waste Water Treatment Facility Sludge Press, K-413 Pipe Cutting, K-1407 CNF Air Stripper, K-2527-BR Grouting Facility, and the K-2500-H Segmentation Shops A, C, and D—are considered minor based on emissions evaluations using EPA-approved calculation methods. A minor Rad NESHAP source is defined as having a potential dose impact on the public not in excess of 0.1 mrem/year.

The K-1423 air permit does not require direct monitoring of stack radionuclide emission. Compliance is demonstrated using environmental sampling methodology as allowed in the EPA approved DOE ORR Rad-NESHAP Compliance Plan (DOE/ORO/2196) for determining the dose impacts on members of the public. Figure 3.10 displays the K11 historical dose impact that would represent impact to an onsite member of the public. The small increased dose trend during 2009 and into 2010 is coincidental to demolition and remediation of radiologically contaminated buildings and burial grounds located nearby. For 2010, the dose at this location was 0.06 mrem. This station collects samples that are potentially impacted by all ETTP sources of radionuclide emissions, including both stack and fugitive emissions. This ensures reporting a conservative dose impact to an actual on-site member of the public.

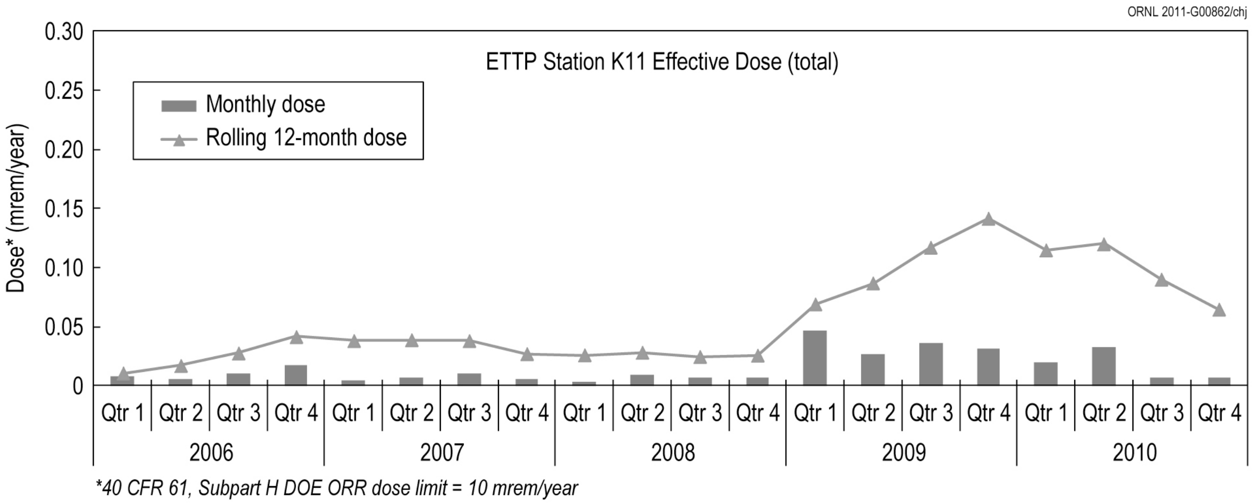

Fig. 3.10. Station K11 radionuclide monitoring results: 5-year rolling 12-month dose history through 2010.

All ETTP sources combined are far below the 10 mrem/year ED, which is the Rad NESHAP regulatory limit and the applicable standard for combined radionuclide emissions from all ORR facilities. Emissions from all ETTP stationary sources of radionuclides are included in the annual dose assessment report submitted June 29, 2011, as required under Rad NESHAP regulations. For the 2010 reporting year, the total ORR ED was 0.4 mrem. The total ED contribution from all ETTP stationary source radionuclide emissions was 5.7E-03 mrem or 1.4% of the total ORR dose.

3.4.1.3 Quality Assurance

Quality assurance activities for the Rad NESHAP program are documented in the *Quality Assurance Program Plan for Compliance with Radionuclide National Emission Standards for Hazardous Air Pollutants*. The plan satisfies the QA requirements in 40 CFR 61, Method 114, for ensuring that the radionuclide air emission measurements from ETTP are representative of known levels of precision and accuracy and that administrative controls are in place to ensure prompt response when emission measurements indicate an increase over normal radionuclide emissions. The requirements 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 pre-approved methodologies are referenced through the *Compliance Plan National Emission Standards for Hazardous Air Pollutants for Airborne Radionuclides on the Oak Ridge Reservation*, DOE/ORO/2196 (DOE 1994a).

3.4.1.4 Greenhouse Gas Emissions

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

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)

- Perfluorocarbons (PFCs) and
- Sulfur Hexafluoride (SF_6)

A review was performed of ETTP processes and equipment categorically identified under 40 CFR 98.2 whose emissions must be included as part of a facility annual GHG report starting with the calendar year 2010 reporting period. Based on total GHG emissions from all ETTP stationary sources, ETTP did not exceed the annual threshold limit and therefore was not subject to mandatory annual reporting under the GHG Rule beginning with the 2010 calendar year. The total GHG emissions for any continuous 12-month period beginning with calendar year 2008 have not exceeded 12,390 metric tons of GHG. The decrease in emissions is due to the permanent shutdown of the TSCA Incinerator. Figure 3.11 shows the historical trend of ETTP total GHG stationary emissions including contributions from the TSCA Incinerator. For the 2010 calendar year period, GHG emissions totaled only 365 metric tons.

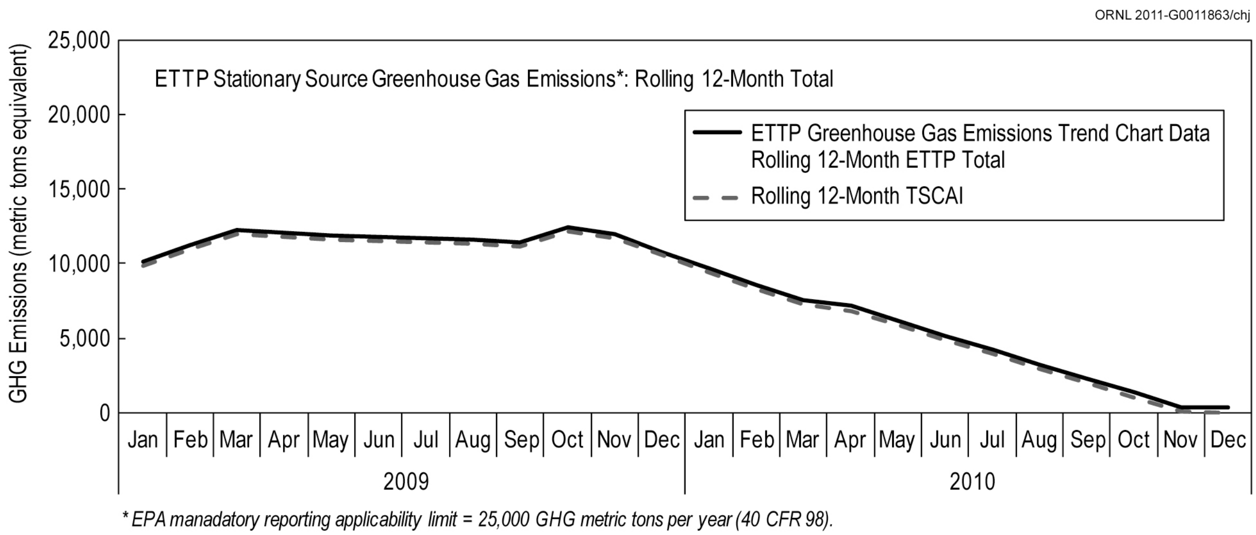

Fig. 3.11. ETTP stationary source GHG emissions tracking history.

Executive Order (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 stormwater management; and eliminate waste, recycle, and prevent pollution at all federal facilities. While the order deals with a number of environmental media, only its applicability to GHG is considered here. The EO defines three distinct scopes for purposes of reporting. Scope 1 is essentially direct greenhouse gas emissions from sources that are owned or controlled by the federal agency; Scope 2 encompasses greenhouse gas emissions resulting from the generation of electricity, heat, or steam purchased by a federal agency; and Scope 3 involves greenhouse gas emissions from sources not owned or directly controlled by a federal agency but related to agency activities such as vendor supply chains, delivery services, and employee business travel and commuting. Figure 3.12 displays the fiscal year trend toward the 28% total Scope 1 and 2 GHG emissions reduction target by 2020, as stated in the DOE *Strategic Sustainability Performance Plan* (DOE 2010b). Figure 3.13 shows the relative contribution of ETTP FY 2010 GHG emissions for each scope.

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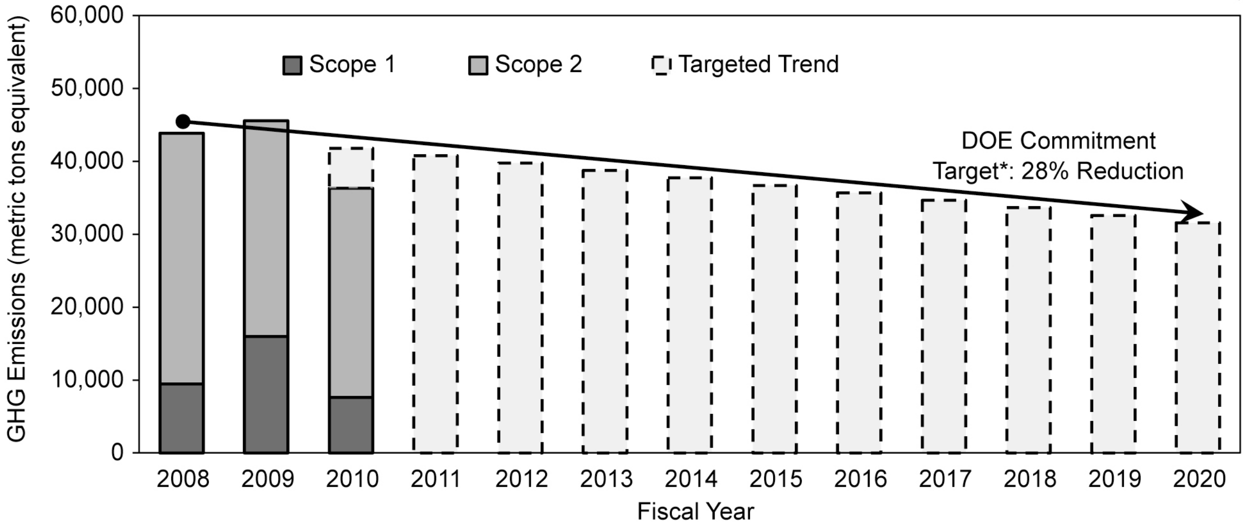

*DOE Strategic Sustainability Performance Plan commits to a 28% reduction of Scope 1 and 2 GHG emissions by FY 2020.

Fig. 3.12. ETTP GHG emissions trend and targeted reduction commitment.

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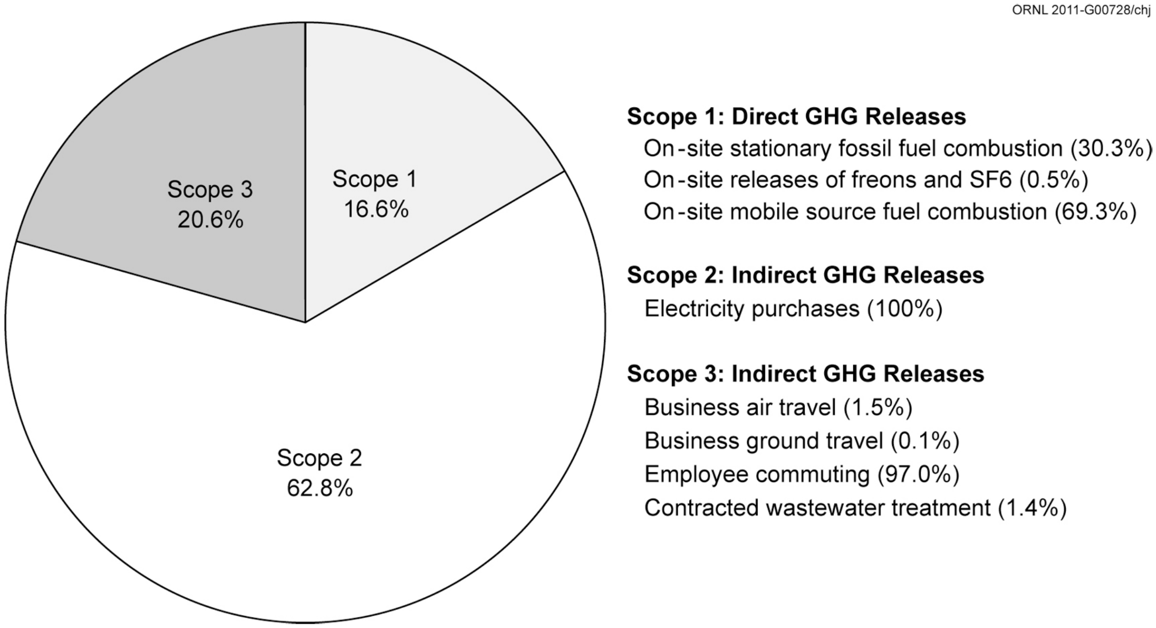


Fig. 3.13. Fiscal year 2010 ETTP GHG percent contribution by scope.

3.4.1.5 Source-Specific Criteria Pollutants

ETTP operations during 2010 included only one stationary source with permit restrictions for nonradiological emissions: the CNF volatile organic compound (VOC) air stripper. All process data records and the calculated maximum VOC emission rate for the CNF air stripper were within permit limits for 2010. The calculated maximum VOC emission rate was 0.3 lb/hr as compared to the permit limit of 1.0 lb/hr. All other stationary sources were evaluated and determined to have emissions levels below the levels that require permitting.

ETTP operations released airborne pollutants from a variety of other minor pollutant-emitting sources, such as stacks, vents, and fugitive and diffuse activities. With the exception of the CNF air stripper, all stack and vent emissions are calculated as allowed based on their low emissions. This is done to document the verification of their minor source permit exempt status under all applicable state and federal regulations.

3.4.1.6 Hazardous Air Pollutants (Nonradionuclide)

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

3.4.2 Ambient Air

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

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

The sampling stations in the ETTP area are designated as base, supplemental, or ORR perimeter air monitoring (PAM) stations. Figure 3.14 illustrates the locations of all ambient air samplers in and around ETTP. The base program consists of two locations using high-volume ambient air samplers. Supplemental locations are typically temporary, project-specific stations that utilize samplers specific to a type of potential emissions. Samplers typically include high-volume systems, depending on the source emission evaluation of the project. All base, supplemental, and PAM samplers operate continuously with exposed filters collected weekly.

The radiological monitoring results for samples collected at the two ETTP area PAM stations were provided by UT-Battelle staff and are included in the ETTP network for comparative purposes. Figure 3.14 shows the location of all ambient air sampling stations that were active during the 2010 reporting period. Figure 3.15 shows an example of a typical ETTP air monitoring station.

The analytical parameters were chosen with regard to existing and proposed regulations and with respect to activities at ETTP. Supplemental station K9 covered the remediation activities in the K-770 Scrap yard area that have the potential to produce fugitive airborne emissions. Supplemental station K11 is located to demonstrate compliance with permitted radiological emissions from K-1423. Changes of emissions from ETTP will warrant periodic reevaluation of the parameters being sampled. Ongoing ETTP reindustrialization efforts also introduce new locations for members of the public that may require adding or relocating monitoring site locations. To ensure understanding of the potential impact on the public and to establish any required emissions monitoring and emission controls, a survey of all on-site tenants is conducted at least every 6 months.

All base and supplemental stations collect continuous samples for radiological and selected metals analyses. Inorganic analytical techniques are used to test samples for the following nonradiological pollutants: As, Be, Cd, Cr, Pb, and total uranium. Radiological analyses of samples from the ETTP stations test for the isotopes ^{237}Np, ^{238}Pu, ^{239}Pu, ^{99}Tc, ^{234}U, ^{235}U, ^{236}U, and ^{238}U; samples from ORR stations are analyzed for ^{234}U, ^{235}U, and ^{238}U.

Figures 3.16a through 3.16e illustrate the air concentrations of As, Be, Cd, Cr, and Pb for the past 5 years based on quarterly composites of weekly continuous samples. All samples were analyzed by the inductively coupled plasma–mass spectrometer (ICP-MS) analytical technique. The results are compared with applicable air quality standards for each pollutant. The annualized levels of As, Be, Cd, and Pb were well below the indicated annual standards. Results for 2010 are all generally lower than results reported for 2009.

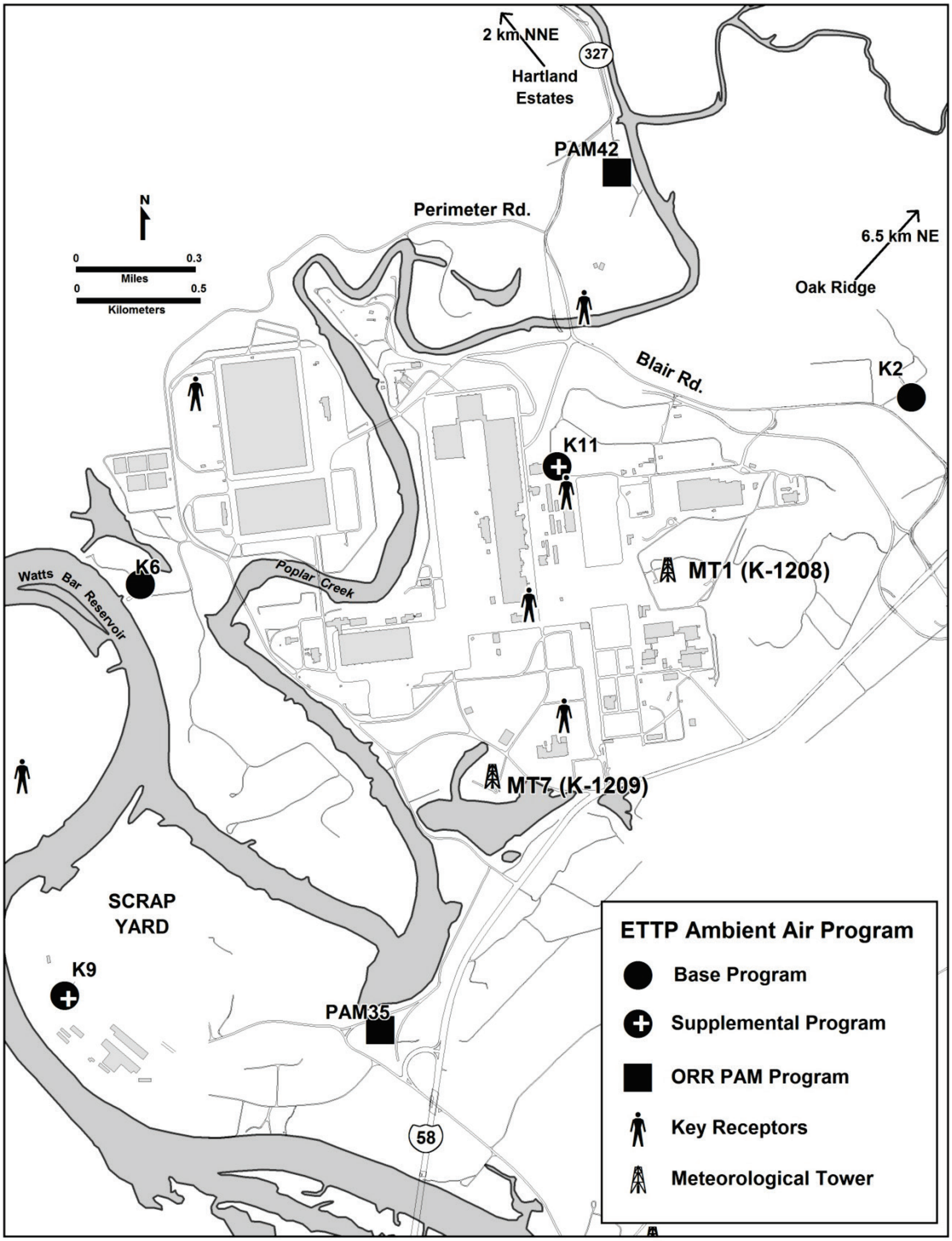
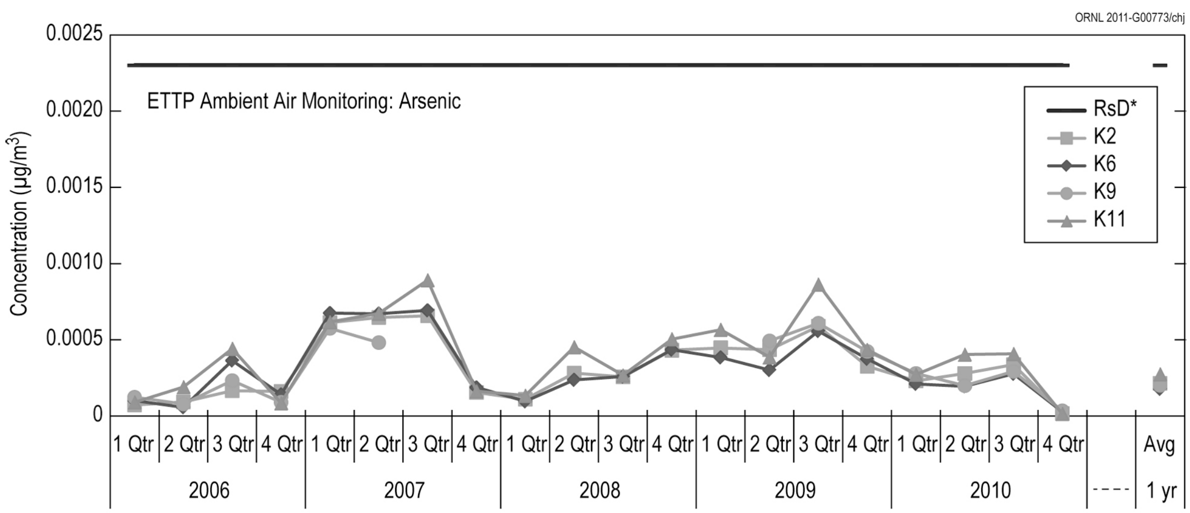


Fig. 3.14. ETTP ambient air monitoring station locations.

ORNL 2010-G00449/chj

Fig. 3.15. ETTP ambient air monitoring station.



*RsD - Risk-specific dose. EPA acceptable RsD for arsenic = 0.0023 µg/m^3

Fig. 3.16a. Arsenic monitoring results: 5-year history through 2010.

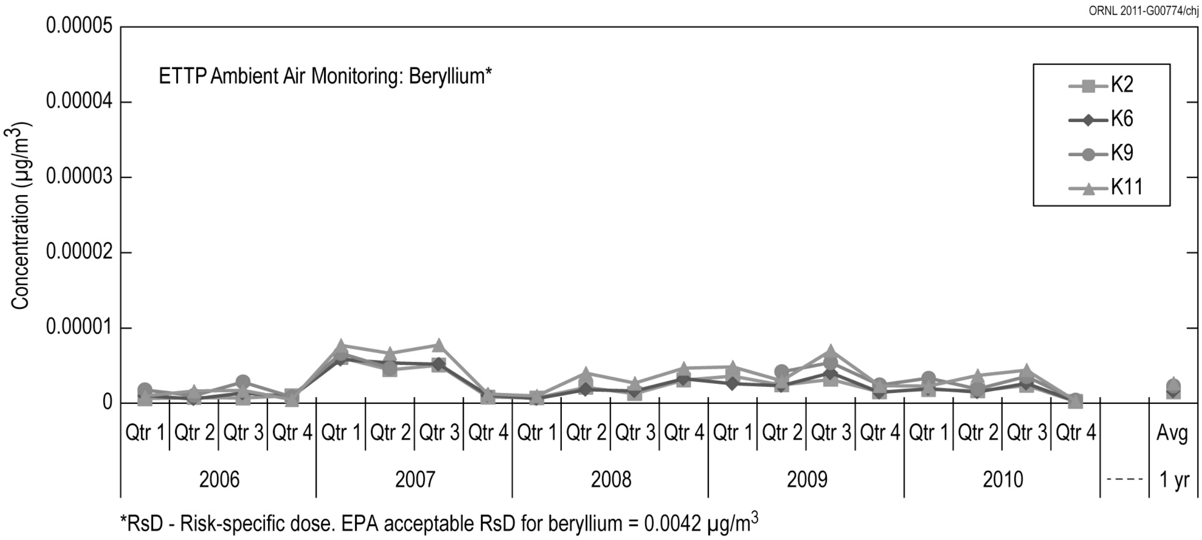


Fig. 3.16b. Beryllium monitoring results: 5-year history through 2010.

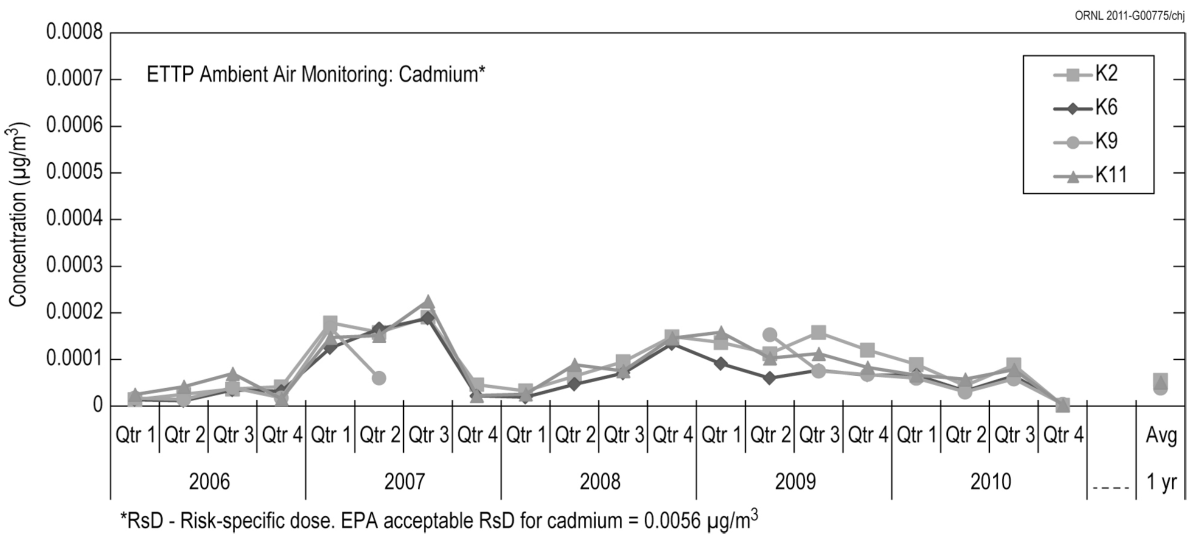


Fig. 3.16c. Cadmium monitoring results: 5-year history through 2010.

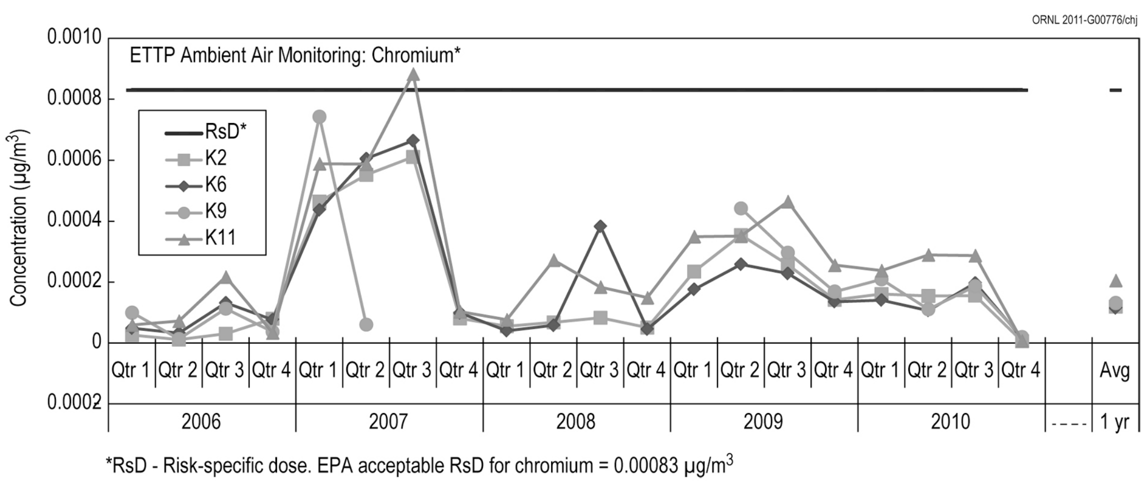
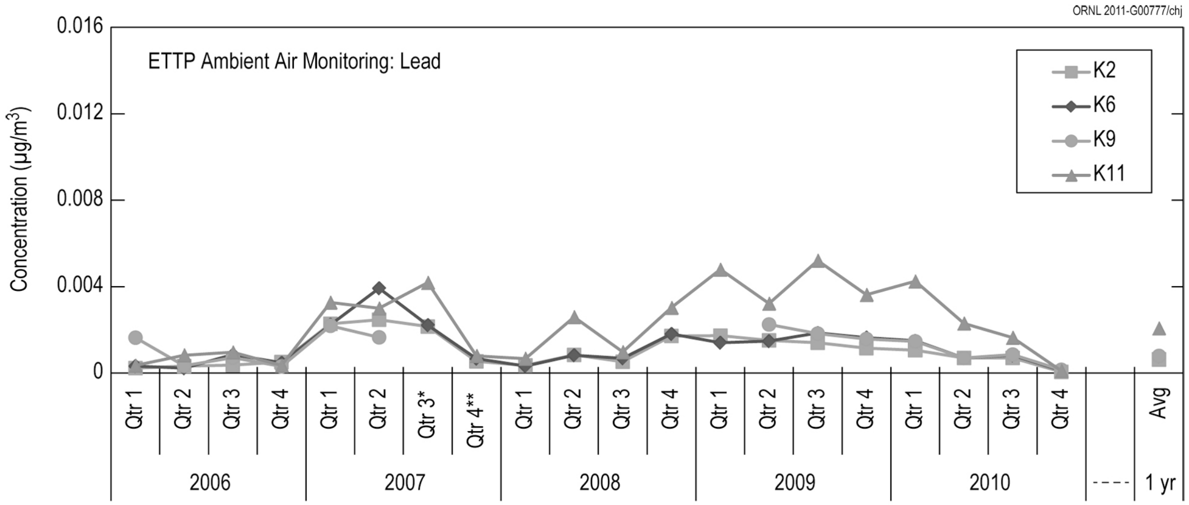


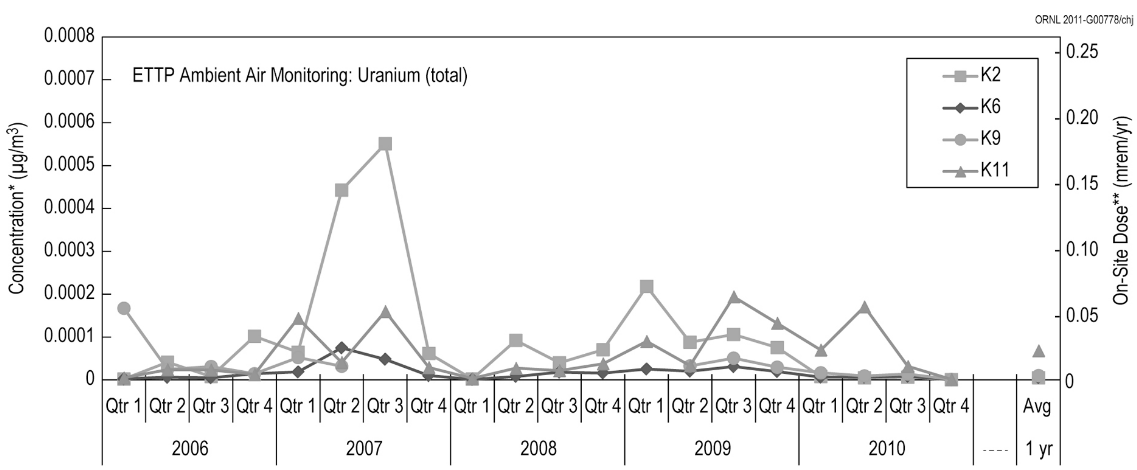
Fig. 3.16d. Chromium monitoring results: 5-year history through 2010.



*National Ambient Air Quality Standard (NAAQS) for lead = 1.5 µg/m^3 per quarter through Sept. 2008.
**NAAQS for lead = 0.15 µg/m^3 per quarter beginning Oct. 2008.

Fig. 3.16e. Lead monitoring results: 5-year history through 2010.

Total uranium was measured as a quarterly composite of continuous weekly samples from stations K2, K6, K9 and K11. The total uranium mass for each sample was determined by ICP-MS. Figure 3.17 illustrates the air concentrations of uranium for the past 5 years based on quarterly composites of weekly continuous samples. The uranium averages and maximum individual concentration measurements for all sites are presented in Table 3.4. The averaged results ranged from 0.000005 µg/m^3 to 0.000068 µg/m^3. The highest 12-month average result (0.000068 µg/m^3) was measured at Station K11. The annual average uranium value for all stations was 0.000022 µg/m^3.



*Derived Concentration Guide (DCG) for natural uranium resulting in 100 mrem/year is 1.03E-13 µCi/m^3 = 0.15 µg/m^3.
**EPA approved ORR on-site business receptor dose assumes a 50% annual occupancy.

Fig. 3.17. Uranium monitoring results: 5-year history through 2010.

Table 3.4. Total uranium in ambient air by ICP-MS at the ETTP

Station	Analyzed Samples	Concentration[a] ($\mu g/m^3$) Avg	Max[c]	Concentration[a] ($\mu Ci/mL$) Avg	Max	Percent of DCG[b] (%) Avg	Max
K2	4	0.000005	0.000007	3.26E-18	4.96E-18	0.00	0.00
K6	4	0.000006	0.000009	3.69E-18	5.67E-18	0.00	0.01
K9	4	0.000010	0.000016	6.70E-18	1.09E-17	0.01	0.01
K11	4	0.000068	0.000170	4.54E-17	1.14E-16	0.05	0.11
ETTP Total	16	0.000022	0.000170	1.48E-17	1.14E-16	0.01	0.11

[a] Mass-to-curie concentration conversions assume a natural uranium assay of 0.717% ^{235}U

[b] DOE Order 5400.5 Derived Concentration Guide (DCG) for naturally occurring uranium is an annual concentration of 1×10^{-13} µCi/mL, which is equivalent to a 100-mrem annual dose.

[c] Maximum individual sample analysis result with dose calculations conservatively assuming the value to be an annual concentration.

The ICP-MS results are compared with the derived concentration guide (DCG) for natural uranium as listed in DOE Order 5400.5. The DCG is based on an annual air concentration exposure that would give a dose of 100 mrem. The highest annual result (K11) corresponds to 0.05% of the DCG. The single sampling location with the highest quarterly concentration (0.000170 $\mu g/m^3$) during 2010 was at station K11. If this concentration were extrapolated to a 12-month exposure, it would only represent 0.11% of the DCG.

Radiochemical analyses were initiated during 2000 on quarterly composite samples collected at all stations. The selected isotopes of interest were ^{237}Np, ^{238}Pu, ^{239}Pu, ^{99}Tc, and isotopic uranium (^{234}U, ^{235}U, ^{236}U, and ^{238}U). Table 3.5 presents the concentration and dose results for each of the radionuclides for 2010.

Table 3.5. Radionuclides in ambient air at ETTP, 2010

Station	^{237}Np	^{238}Pu	^{239}Pu	^{99}Tc	^{234}U	^{235}U	^{238}U	Total U
	Concentration (µCi/mL)							
K2	ND[a]	7.57E-18	6.99E-18	4.78E-17	1.26E-17	4.54E-19	1.94E-17	3.25E-17
K6	ND	1.86E-18	5.56E-19	6.21E-17	1.52E-17	ND	5.32E-18	2.05E-17
K9	ND	2.16E-18	6.67E-19	5.37E-17	2.55E-17	ND	1.04E-17	3.58E-17
K11	ND	4.48E-18	4.46E-18	3.16E-16	1.43E-16	6.05E-18	3.33E-17	1.82E-16
	40 CFR 61, Effective Dose (mrem/year)[b]							
Station	**^{237}Np**	**^{238}Pu**	**^{239}Pu**	**^{99}Tc**	**^{234}U**	**^{235}U**	**^{238}U**	**Total U**
K2	ND	0.0161	0.0148	0.0002	0.0067	0.0002	0.0091	0.0160
K6	ND	0.0039	0.0012	0.0003	0.0088	ND	0.0027	0.0116
K9	ND	0.0046	0.0014	0.0002	0.0135	ND	0.0049	0.0184
K11	ND	0.0095	0.0095	0.0013	0.0759	0.0030	0.0157	0.0946

[a]ND = not detected

[b]40 CFR 61, Subpart H limit = 10 mrem/year for DOE ORR combined radionuclide airborne emissions to the most exposed member of the public.

The EPA requires facilities to utilize approved computer models to determine the ED. The potential for public exposure to radionuclide emissions as measured at all ETTP area ambient air stations is assessed using the EPA's CAP88-PC (Version 3) model. Figure 3.18 is a 5-year historical summary chart of CAP88-based dose-calculation results of ETTP ambient air isotopic radionuclide analyses. Each quarterly result is the total dose from all measured radionuclides during the applicable measurement period. The 12-month rolling dose total is the summation of the previous four quarterly results. All data show potential doses well below the 10-mrem annual dose limit.

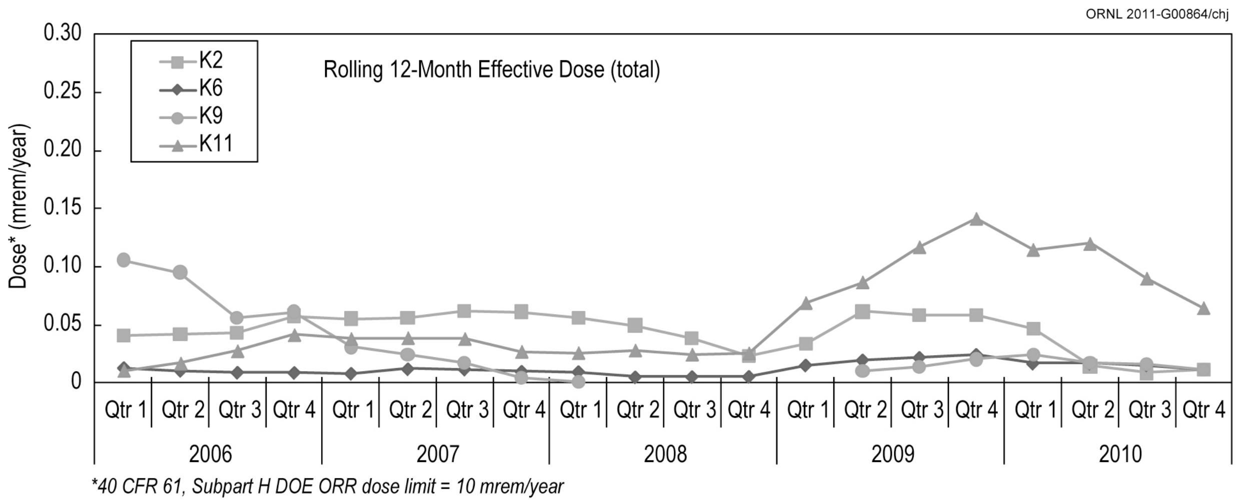


Fig. 3.18. Radionuclide monitoring results: 5-year rolling 12-month dose history through 2010.

3.5 Water Quality Program

3.5.1 ETTP NPDES Permit History

The CWA/NPDES Program at ETTP ensures compliance with applicable state and federal regulations, DOE orders, and site-specific policies and procedures for ETTP activities that produce discharges to waters of the United States. It also provides management, oversight, and guidance to ETTP organizations to ensure compliance with applicable regulations and requirements.

Because the ETTP is an operating facility that discharges wastewater to several bodies of surface water, it is required to have an NDPES permit. EPA issued ETTP its first NPDES permit in 1975; the permit was to remain in effect until 1980. This permit established technology-based effluent limitations for nine outfalls.

In 1980, the site submitted an application for renewal of the permit within the required 180 days of the expiration date of the permit. The permit was not renewed, and the site operated under the expired permit until 1984. EPA issued the site a new NPDES permit in 1984 that remained in effect until February 1989. Under this permit, ETTP had eight NPDES monitoring locations, including the K-1700 weir, K-1203 Sewage Treatment Plant (STP), K-1007-P1 Pond, K-901-A Pond, K-710 STP, K-1515-C Holding Lagoon, K-1407-E/F Ponds, and the CNF.

EPA granted the state of Tennessee primacy for administration of the NPDES permitting program in 1986. The ETTP submitted an application for renewal of the NPDES permit to TDEC in August 1988. Because of staffing shortages at TDEC, permit negotiations were delayed until early 1992. Written approval was granted by TDEC to allow the site to continue operating under the conditions of the expired permit until a renewed permit could be issued.

On October 1, 1992, NPDES Permit TN0002950 became effective. Several of the eight monitoring locations specified in the previous ETTP NPDES permit were re-designated as ambient surface water monitoring locations. Effluent limitations in the 1992 NPDES permit were water quality based, which reflected the trend toward considering the effects of industrial discharges on the quality of the receiving streams. In accordance with the federal regulations requiring the inclusion of storm water discharges in the NPDES permitting program, each of the 137 storm water outfalls that had been identified at ETTP were included in this permit, in addition to several other major treatment facility outfalls. Also, the development of a Storm Water Pollution Prevention Program (SWP3) sampling and analysis plan was required. TDEC issued a major modification to this NPDES permit that became effective June 1, 1995. This modification included (1) removal of outfalls 010 and 012 to reflect shutdown treatment operations; (2) changes to monitoring requirements for outfall 014 to allow for treatment of contaminated groundwater; (3) changes to outfall 005 permit limits to make them more consistent with other sewage treatment plants; (4) clarification of some ambiguous permit language; and (5) updating of storm water outfall numbers.

ETTP NPDES Permit TN0002950 expired on September 29, 1997. An application for renewal of the ETTP NPDES permit was submitted to TDEC in March 1997. To facilitate the privatization of ETTP facilities, separate permits were requested for the K-1203 STP, the CNF, the K-1515 Sanitary Water Plant, and the ETTP storm water outfalls. A general permit for the K-1515 Sanitary Water Plant (permit number TN0074233) was issued by TDEC and became effective on March 1, 2000. A permit for the K-1203 STP (permit number TN0074241) was issued by TDEC and became effective on August 1, 2003. The prior permit for the CNF (permit number TN0074225) was issued by TDEC and became effective on November 1, 2003. The newly issued permit for CNF became effective on December 1, 2010, with an expiration date of December 31, 2013.

The prior ETTP NPDES storm water permit expired on March 31, 2008. The NPDES Permit renewal application was submitted to TDEC by September 30, 2007. On September 8, 2008, a letter was issued by TDEC – Division of Water Pollution Control acknowledging the receipt of the permit application. The letter authorized continued discharges from the ETTP storm drain system via administrative extension of the current NPDES permit. ETTP operated under NPDES permit TN0002950 that was issued by TDEC and became effective on April 1, 2004, for the ETTP storm water outfalls. Although this permit expired on March 31, 2008, submission of the application for a new permit in September 2007 allowed ETTP to continue to discharge storm water under the expired NPDES permit until issuance of a new permit.

For the first quarter of 2010, the ETTP operated under NPDES permit TN0002950 that was effective on April 1, 2004, for the ETTP storm water outfalls. The new NPDES permit for ETTP was issued by TDEC on February 26, 2010, with an effective date of April 1, 2010, and an expiration date of December 31, 2013.

Management of the sanitary sewer system at ETTP has been turned over to the city of Oak Ridge as part of an agreement among DOE, CROET, and the city of Oak Ridge. Under this agreement, sewage from ETTP is now being piped to the Rarity Ridge sanitary sewage treatment plant located approximately 1 mile west of ETTP. The NPDES permit for this facility is assigned to the city of Oak Ridge, which performs all monitoring and reporting required by the permit.

All BJC connections to the sewage collection system are covered by a “No Discharge Certification” process derived from the city of Oak Ridge wastewater control requirements in accordance with the city Sewage Treatment Plant NPDES permit. The No Discharge Certification states that ETTP Site Operaiton will only discharge waste associated with normal quantities of material associated with normal human habitation to the city of Oak Ridge sewage collection system. These discharges primarily include waste from break rooms, restrooms, change houses, etc. As part of the No Discharge Certification process, notification is provided to the city of Oak Ridge by BJC when planned operational changes are made to BJC facilities that could affect the city of Oak Ridge sewage collection system. ETTP is also subject to the provisions of the city of Oak Ridge’s sewer use ordinance, which defines the terms and conditions under which the city of Oak Ridge accepts discharges to its sewage collection system.

3.5.2 ETTP NPDES Permit Description – Previous NPDES Permit

ETTP NPDES Permit No. TN0002950 that was issued in 2004 remained in effect for the first quarter of 2010 before the new NPDES permit became effective on April 1, 2010. The former permit regulated the discharge of storm water runoff, groundwater infiltration, groundwater from sumps, non-contact cooling water, and steam condensate from ETTP to Mitchell Branch, Poplar Creek, and the Clinch River. There were 121 permitted storm water outfalls at ETTP under the former NPDES Permit No. TN0002950. A total of 38 storm water outfalls and one alternate outfall were required to be sampled as being representative of the groups. The outfalls were grouped into four categories based on the types of flows being discharged through the outfalls.

- **Group IV storm water outfalls** (Table 3.6) generally flow continuously. They may discharge storm water runoff, groundwater infiltration, and groundwater from sumps. These outfalls receive storm water runoff from site industrial operations that have the greatest potential for contamination. The representative outfalls in this group must be monitored weekly for flow and pH and quarterly for oil and grease and total suspended solids (TSS).

- **Group III storm water outfalls** (Table 3.7) flow continuously or intermittently. They may discharge storm water runoff, groundwater infiltration, and groundwater from sumps. These outfalls receive storm water runoff from site industrial operations with potential for contamination. The representative outfalls in this group must be monitored monthly for flow and pH and quarterly for oil and grease and TSS.
- **Group II storm water outfalls** (Table 3.8) flow intermittently. They may discharge storm water runoff, groundwater infiltration, and groundwater from sumps. These outfalls do not have a significant potential to discharge contaminants. The representative outfalls in this group must be monitored quarterly for flow and pH and annually for TSS.
- **Group I storm water outfalls** (Table 3.9) flow intermittently. They receive flow from remote areas of the site, from administrative and other nonindustrial operation areas, and from site roads and railways. They may discharge storm water runoff, groundwater infiltration, and groundwater from sumps. These outfalls pose little or no threat of discharging significant amounts of contaminants. The representative outfalls in this group must be monitored semiannually for flow and pH.

3.5.3 NPDES Permit Description – New NPDES Permit

As part of the NPDES permit that became effective on April 1, 2010, several of the storm water outfalls from the previous NPDES permit were recategorized. In general outfalls that were included as part of the Group I and Group II outfalls in the previous NPDES permit were combined into a single group. This group is designated as Group I. Generally, outfalls that were included as part of the Group III and Group IV outfalls in the previous NPDES permit have also been combined into a single group. This group is designated as Group II.

Some of the Group I and Group II outfalls in the previous NPDES permit that flow on a continuous or almost continuous basis became Group II outfalls. Several outfalls that were in Group II or Group III in the previous NPDES permit have been designated as Group I outfalls. They will no longer be monitored as frequently as in the previous permit. Also, several of the outfalls that were monitored as part of the previous NPDES permit are no longer monitored as part of this NPDES permit. These modifications were made due to the flow characteristics of the outfalls, their history of compliance with the previous NPDES permit, and remediation of the areas drained by the outfalls.

There are currently 108 NPDES-permitted storm water outfalls at ETTP. The previous NPDES storm water permit covered 121 storm water outfalls. Thirteen of these outfalls are no longer permitted and were removed from coverage under the NPDES permit that became effective on April 1, 2010.

As part of the current NPDES permit, the 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 will be sampled as being representative of these groups. Several changes were made in the parameters for each group, and the monitoring frequencies are lower than in the previous NPDES permit. These modifications were based on the long-term sample result trends that have been established over the past 15 years. The groups are briefly described as follows. Tables 3.10 and 3.11 show the outfall groupings and the monitoring requirements for the representative outfalls in each group.

Table 3.6. Group IV storm water outfalls[a]

The following storm water outfall was sampled as being representative of Group IV as specified below:
Outfall 100

Parameter	Method	Frequency	Sample type	Minimum	Maximum	Screening level
Flow (MGD)	Estimated[b]	1/Week	NA	NA	NA	NA
pH (standard units)	EPA-150.1	1/Week	Grab[c]	6.0	9.0	<6.4 or >8.4
TSS (mg/L)	EPA-160.2	1/Quarter	Grab	NA	NA	70
Oil and Grease (mg/L)	EPA-1664A	1/Quarter	Grab	NA	NA	8.0

[a]The following Group IV storm water outfalls were not sampled: 128 and 130.

[b] TR55 method with rainfall data was used by the Environmental Compliance and Protection Organization to estimate flows. Flow was reported in million gallons per day (MGD) as estimated daily maximum values. No flow field measurements were required. TR55 is a computer code used to calculate stream flow based on raqinfall and associated runoff.

[c] The pH analyses were performed within 15 minutes of sample collection.

Table 3.7. Group III storm water outfalls[a,b]

The following storm water outfalls were sampled as being representative of Group III as specified below:
Outfalls 05A, 154, 158, 170, 180, 190, 195, 210, 230, 280, 294, 340, 350, 360, 382, 390, 430, 490, 710, 724/760a, 992

Parameter	Method	Frequency	Sample type	Minimum	Maximum	Screening level
Flow (MGD)	Estimated[c]	1/Month	NA	NA	NA	NA
pH (standard units)[d]	EPA-150.1	1/Month	Grab[b]	4.0	9.0	<6.0 or >8.4
TSS (mg/L)	EPA-160.2	1/Quarter	Grab	NA	NA	70
Oil and Grease (mg/L)	EPA-1664A	1/Quarter	Grab	NA	NA	8.0

[a]The following Group III storm water outfalls were not sampled: 156, 160, 162, 168, 200, 240, 270, 292, 330, 362, 387, 440, 700, 720, 730, 740, 750, 770, and 970.

[b]Outfall 724 will be sampled as being representative of this group, if possible. However, if seasonal fluctuations in the depth of the Clinch River cause this storm water outfall to become flooded, which will preclude sample collection efforts, storm water outfall 760 will be sampled as the representative of this group.

[c] TR55 method with rainfall data was used by the EC&P Organization to estimate flows. Flow waste reported in MGD as estimated daily maximum values. No flow field measurements were required.

[d] The pH analyses were performed within 15 minutes of sample collection.

Table 3.8. Group II storm water outfalls[a]

The following storm water outfalls were sampled as being representative of Group II as specified below:
Outfalls 124, 142, 150, 250, 380, 510, 570, 690 and 890

Parameter	Method	Frequency	Sample type	Minimum	Maximum	Screening Level
Flow (MGD)	Estimated[b]	1/Quarter	NA	NA	NA	NA
pH (standard units)[c]	EPA-150.1	1/Quarter	Grab[b]	4.0	9.0	<6.0 or >8.4
TSS (mg/L)	EPA-160.2	1/Year	Grab	NA	NA	70

[a]The following Group II storm water outfalls were not sampled: 120, 129, 140, 144, 146, 148, 262, 296, 297, 300, 310, 320, 530, 540, 550, 560, 580, 600, 610, 620, 640, 680, 692, 694, 696, 780, 800, 820, 830, 860, 870, 880 and 892.

[b] TR55 method with rainfall data was used by the EC&P Organization to estimate flows. Flow was reported in MGD as estimated daily maximum values. No flow field measurements were required.

[c]The pH analyses were performed within 15 minutes of sample collection.

Table 3.9. Group I storm water outfalls[a]

The following storm water outfalls were sampled as being representative of Group I as specified below:
Outfalls 198, 334, 410, 532, 660, 900 and 996

Parameter	Method	Frequency	Sample type	Minimum	Maximum	Screening level
Flow (MGD)	Estimated[b]	2/Year	NA	NA	NA	NA
pH (standard units)[c]	EPA-150.1	2/Year	Grab[b]	4.0	9.0	<6.0 or >8.4

[a]The following Group I storm water outfalls were not sampled: 196, 197, 220, 322, 326, 332, 400, 420, 450, 460, 470, 500, 520, 522, 590, 650, 670, 897, 910, 920, 929, 930, 934, 940, 950, 960, 980 and 990.

[b] TR55 method with rainfall data was used by the EC&P Organization to estimate flows. Flow was reported in MGD as estimated daily maximum values. No flow field measurements were required.

[c] The pH analyses were performed within 15 minutes of sample collection.

Table 3.10. Group I storm-water outfalls permit information
Outfalls 195, 198, 250, 280, 410, 660, 930, and 992

Effluent characteristic (units)	Method	Effluent limitations	Screening level	Monitoring requirements	
				Measurement frequency	Sample type
Flow (MGD)	Estimate[a]	Report	NA	2/Year	Estimate[a]
pH (standard units)	SM-4500-H^+ B or EPA-150.2	Within range 6.0 – 9.0	<6.4 or >8.4	2/Year	Grab[b]
TSS (mg/L)	SM-2540 D	Report daily maximum concentration	70	2/Year	Grab

The following Group I storm water outfalls will not be sampled: 146, 156, 162, 168, 196, 197, 262, 270, 296, 297, 300, 310, 320, 387, 390, 400, 420, 500, 520, 522, 532, 540, 550, 570, 580, 620, 640, 650, 670, 680, 692, 696, 780, 800, 820, 830, 860, 870, 880, 892, 934, 940, 950, 960, 970, 980, 990, and 996.

[a]Flow shall be reported in MGD as estimated daily maximum values. Flow will be calculated by EC&P personnel using the Soil Conservation Service TR-55 storm water runoff model.

[b]The pH analyses were performed within 15 min of sample collection.

Table 3.11. Group II storm-water outfalls permit information
Outfalls 05A, 100, 142, 150, 170, 180, 190, 230, 294, 334, 340, 350, 380, 382, 430, 490, 510, 560, 690, 694, 700, 710, 724, 890

Effluent characteristic (units)	Method	Effluent limitations	Screening level	Monitoring requirements	
				Measurement frequency	Sample type
Flow (MGD)	Estimate[a]	Report	NA	2/Year	Estimate[a]
pH (standard units)	SM-4500-H^+ B or EPA-150.2	Within range 6.0 – 9.0	<6.4 or >8.4	2/Year	Grab[b]
TSS (mg/L)	SM-2540 D	Report daily maximum concentration	70	2/Year	Grab
Oil and grease (mg/L)	EPA-1664 A	Report daily maximum concentration	8.0	2/Year	Grab

The following Group II outfalls will not be sampled: 140, 144, 148, 154, 158, 160, 200, 210, 220, 240, 292, 322, 326, 330, 332, 360, 362, 440, 530, 590, 600, 610, 720, 730, 740, 750, 760, 770

[a]Flow shall be reported in MGD as estimated daily maximum values. Flow will be calculated by EC&P personnel using the Soil Conservation Service TR-55 storm water runoff model.

[b]The pH analyses were performed within 15 min of sample collection.

Table 3.12. Mercury monitoring at specified outfalls
Outfalls 05A, 170, 180, and 190

Effluent characteristic (units)	Method	Effluent limitations	Screening level	Monitoring requirements	
				Measurement frequency	Sample type
Total mercury[a] (mg/L)	EPA-1631E or EPA-245.7	Report daily maximum concentration	0.000035	Quarterly	Grab

[a]Following four quarterly samples, a reevaluation of the need for further monitoring will be considered.

Table 3.13. Hexavalent chromium and total chromium monitoring at specified outfalls
Outfall 170

Effluent characteristic (units)	Method	Effluent limitations	Screening Level	Monitoring requirements	
				Measurement frequency	Sample type
Total chromium[a] (mg/L)	EPA-200.8	Report daily maximum concentration	0.008	Quarterly	Grab
Hexavalent chromium[a] (mg/L)	SM-3500-Cr D or ASTM D 5257	Report daily maximum concentration	0.008	Quarterly	Grab

[a]Following four quarterly samples, a reevaluation of the need for further monitoring will be considered.

3.5.3.1 Group I Storm Water Outfalls

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 decontamination and decommissioning (D&D) and remedial action (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, 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. Table 3.10 contains information on the Group I outfalls.

3.5.3.2 Group II Storm Water Outfalls

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 than Group I. 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, fire suppression system water from maintenance and testing activities, and radiological area runoff. 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. Table 3.11 contains information on the Group II outfalls.

The storm water outfalls will be sampled as representative of Group II as specified in Table 3.11.

Additional monitoring of selected Group II outfalls will be performed for specific parameters as part of the newly issued NPDES permit. Outfall monitoring is specified in Tables 3.12 and 3.13.

3.5.4 Outfalls Grouped by Sub-watershed

ETTP is divided into seven distinct sub-watersheds. Each of these sub-watersheds is drained by several storm water outfalls. Representative outfalls have been chosen for each sub-watershed, and these representative outfalls will be sampled as part of this NPDES permit.

Tables 3.14–3.20 contain information on all of the outfalls in each designated sub-watershed, whether the outfall is a Group I or Group II outfall, and which of these outfalls will be sampled as representative of the outfalls in the sub-watershed.

Table 3.14. Storm water outfalls that discharge to Mitchell Branch (sub-watershed MB1)

Outfall	Group I	Group II	Deleted Outfalls
140	--	X	--
142[a]	--	X	--
144	--	X	--
146	X	--	--
148	--	X	--
150[a]	--	X	--
154	--	X	--
156	X	--	--
158	--	X	--
160	--	X	--
162	X	--	--
168	X	--	--
170[a]	--	X	--
180[a]	--	X	--
190[a]	--	X	--
195[b]	X	--	--
196	X	--	--
197	X	--	--
198[b]	X	--	--
200	--	X	--
210	--	X	--
220	--	X	--

[a]These storm water outfalls will be sampled as representative of Group II.
[b] These storm water outfalls will be sampled as representative of Group I.

Table 3.15. Storm water outfalls that discharge to Poplar Creek (sub-watershed PC1)

Outfall	Group I	Group II	Deleted Outfalls
929	--	--	X
930[a]	X	--	--
934	X	--	--
940	X	--	--
950	X	--	--
960	X	--	--
970	X	--	--
980	X	--	--
990	X	--	--
992[a]	X	--	--
996	X	--	--

[a] These storm water outfalls will be sampled as representative of Group I.

Table 3.16. Storm water outfalls that discharge to the east side of Poplar Creek (sub-watershed PC2)

Outfall	Group I	Group II	Deleted Outfalls
05A[a]	--	X	--
230[a]	--	X	--
240	--	X	--
250[b]	X	--	--
262	X	--	--
270	X	--	--
280[b]	X	--	--
292	--	X	--
294[a]	--	X	--
296	X	--	--
297	X	--	--
300	X	--	--
310	X	--	--
320	X	--	--
322	--	X	--
326	--	X	--
330	--	X	--
332	--	X	--
334[a]	--	X	--
340[a]	--	X	--
350[a]	--	X	--
360	--	X	--
362	--	X	--
380[a]	--	X	--
382[a]	--	X	--
387	X	--	--
390	X	--	--
400	X	--	--
410[b]	X	--	--
420	X	--	--
430[a]	--	X	--
440	--	X	--
450	--	--	X
460	--	--	X
470	--	--	X

[a]These storm water outfalls will be sampled as representative of Group II.
[b]These storm water outfalls will be sampled as representative of Group I.

Table 3.17. Storm water outfalls that discharge to the west side of Poplar Creek (sub-watershed PC3)

Outfall	Group I	Group II	Deleted Outfalls
500	X	--	--
510[a]	--	X	--
520	X	--	--
522	X	--	--
530	--	X	--
532	--	X	--
540	X	--	--
550	X	--	--
560[a]	--	X	--
570	X	--	--
580	X	--	--
590	--	X	--
600	--	X	--
610	--	X	--
620	X	--	--
640	X	--	--
650	X	--	--
660[b]	X	--	--
670	X	--	--
680	X	--	--
690[a]	--	X	--
692	X	--	--
694[a]	--	X	--
696	X	--	--
720	--	X	--

[a]These storm water outfalls will be sampled as representative of Group II.
[b] These storm water outfalls will be sampled as representative of Group I.

Table 3.18. Storm water outfalls that discharge to Poplar Creek via the K-1007-P1 Pond (sub-watershed PC4)

Outfall	Group I	Group II	Deleted Outfalls
100[a]	--	X	--
120	--	--	X
124	--	--	X
128	--	--	X
129	--	--	X
130	--	--	X
490[a]	--	X	--

[a] These storm water outfalls will be sampled as representative of Group II.

Table 3.19. Storm water outfalls in the Powerhouse area that discharge to the Clinch River (sub-watershed CR1)

Outfall	Group I	Group II	Deleted Outfalls
724[a]	--	X	--
730	--	X	--
740	--	X	--
750	--	X	--
760	--	X	--
770	--	X	--
780	X	--	--
800	X	--	--
820	X	--	--
830	X	--	--
860	X	--	--
870	X	--	--
880	X	--	--
890[b]	--	X	--
892	X	--	--
897	--	--	X
900	--	--	X
910	--	--	X
920	--	--	X

[a]These storm water outfalls will be sampled as representative of Group II.
[b]These storm water outfalls will be sampled as representative of Group I.

Table 3.20. Storm water outfalls that discharge to the Clinch River via the K-901-A Pond (sub-watershed CR2)

Outfall	Group I	Group II	Deleted Outfalls
700[a]	--	X	--
710[a]	--	X	--

[a]These storm water outfalls will be sampled as representative of Group II.

3.5.5 ETTP Storm Water Pollution Prevention Program

The development of the ETTP Storm Water Pollution Prevention Program (SWP3) was required by Part IV of the ETTP NPDES Permit No. TN0002950. The purpose of the SWP3 sampling program is to evaluate and characterize storm water runoff from ETTP. The sampling effort incorporates an increased emphasis on the identification of specific sources of pollutants that may be transported by storm water. This information is used to support the site cleanup program that is being conducted in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements. In addition, data collected as part of the ETTP SWP3 sampling effort will be used to complete the application for the next ETTP NPDES Permit renewal.

Analytical parameters to be monitored at each storm water outfall are chosen based on the following criteria:

- a review of available analytical data from previous storm water sampling efforts;
- knowledge of various processes and functions that have been conducted at ETTP;
- current and past material storage and handling practices; and
- current and past waste disposal practices employed at ETTP.

The ETTP SWP3 was originally implemented in 1993 as part of the requirements of the ETTP NPDES Permit that became effective in October 1992. An ETTP SWP3 was also included as a requirement in both the former ETTP NPDES Permit for storm water discharges that became effective on April 1, 2004, and the current ETTP NPDES Permit for storm water discharges that became effective April 1, 2010. Since the basic requirements for the SWP3 stated in the ETTP NPDES Permit that became effective in April 2010 are mostly the same as the requirements for the SWP3 defined in the ETTP NPDES Permit that became effective in April 2004, the format for documenting and reporting modifications to the SWP3 will be largely unchanged.

The ETTP NPDES Permit issued in April 2010 includes a requirement to review and update, if necessary, the SWP3 Plan, at least annually. This requirement is met by publishing the ETTP SWP3 Annual Update Report, which includes SWP3 monitoring results, site inspection summaries, and other information from the fiscal year that is ending.

Additionally, the SWP3 Baseline Document, which was originally created in September 1994 to serve as a reference document for implementing and conducting the required elements of the ETTP SWP3, will continue to be utilized as part of the ETTP SWP3 specified in the ETTP NPDES Permit that became effective on April 1, 2010. The SWP3 Baseline Document contains

- background information on ETTP and the ETTP storm water drainage network,
- best management practices used at the ETTP,
- guidance on conducting inspections that are required by the SWP3,
- organizational roles and responsibilities for conducting the SWP3, and
- general information on storm water sampling and analysis.

Much of the information presented in the baseline document changes very little from year to year. Therefore, the baseline document is reviewed annually and updated as necessary.

3.5.5.1 Comparison of the Storm Water Pollution Prevention Program Sampling Results to Screening Levels

The SWP3 sampling provides information required as part of the ETTP NPDES permit renewal process. The sampling effort also incorporates an increased emphasis on the identification of specific sources of pollutants that may be transported by storm water. This information is used to support the site cleanup program that is being conducted in accordance with CERCLA requirements.

Analytical results from the SWP3 sampling effort conducted in 2010 were compared with applicable screening levels to identify locations where storm water runoff could be contributing pollutants to receiving waters. These screening levels were applied to all data collected as part of the 2010 SWP3 sampling effort. In general, the most stringent criterion that could be identified in the references given for a particular parameter was chosen as the screening level for that parameter. Applicable screening levels for data collected as part of the SWP3 sampling program are listed in Table 3.21.

Table 3.21. Project quantitation[a] levels, screening levels, and reference standards for storm water monitoring at ETTP

Parameter	Project quantitation level	Screening level	Reference standard	Units
		Radionuclides		
Gross alpha	5	15	15	pCi/L
Gross beta	5	50	50	pCi/L
^{60}Co	10	200	5,000	pCi/L
^{90}Sr	4	40	1,000	pCi/L
^{99}Tc	12	4,000	100,000	pCi/L
^{228}Th	1	16	400	pCi/L
^{230}Th	1	12	300	pCi/L
^{232}Th	1	2	50	pCi/L

Table 3.21 (continued)

Parameter	Project quantitation level	Screening level	Reference standard	Units
^{226}Ra	0.3	4	100	pCi/L
^{3}H	300	80,000	2,000,000	pCi/L
^{234}U	1	20	500	pCi/L
^{235}U	1	24	600	pCi/L
^{236}U	1	20	500	pCi/L
^{238}U	1	24	600	pCi/L
Total U	1	31	770	µg/L
^{137}Cs	10	120	3,000	pCi/L
^{237}Np	0.4	1.2	30	pCi/L
^{238}Pu	1	1.6	40	pCi/L
$^{239/240}$Pu	1	1.2	30	pCi/L
Volatile organic compounds (VOCs)				
1,1,1-Trichloroethane	2	75	100	µg/L
1,1,2,2-Tetrachloroethane	2	30	40	µg/L
1,1,2-Trichloroethane	2	75	100	µg/L
1,1-Dichloroethane	2	75	100	µg/L
1,1-Dichloroethene	2	24	32	µg/L
1,2-Dichloroethane	2	75	100	µg/L
1,2-Dichloropropane	2	75	100	µg/L
2-Butanone	10	75	100	µg/L
2-Hexanone	10	75	100	µg/L
4-Methyl-2-pentanone	10	75	100	µg/L
Acetone (2-Propanone)	10	75	100	µg/L
Benzene	2	75	100	µg/L
Bromodichloromethane	2	75	100	µg/L
Bromoform	2	75	100	µg/L
Bromomethane (methyl bromide)	2	75	100	µg/L
Carbon disulfide	10	75	100	µg/L
Carbon tetrachloride	2	12	16	µg/L
Chlorobenzene	2	75	100	µg/L
Chloroethane	2	75	100	µg/L
Chloroform	2	75	100	µg/L
Chloromethane (methyl chloride)	2	75	100	µg/L
Cis-1,2-Dichloroethene	2	75	100	µg/L
Cis-1,3-Dichloropropene	2	75	100	µg/L
Dibromochloromethane	2	75	100	µg/L
Ethylbenzene	2	75	100	µg/L
Methylene chloride	2	75	100	µg/L
Styrene	2	75	100	µg/L
Tetrachloroethene	2	25	33	µg/L
Toluene	2	75	100	µg/L
Trans-1,2-Dichloroethene	2	75	100	µg/L
Trans-1,3-Dichloropropene	2	75	100	µg/L
Trichloroethene	2	75	100	µg/L
Vinyl chloride	2	18	24	µg/L
Xylenes (dimethyl benzene)	2	75	100	µg/L

Table 3.21 (continued)

Parameter	Project quantitation level	Screening level	Reference standard	Units
		Polychlorinated biphenyls (PCBs)		
PCBs	0.5	detectable	0.00064	µg/L
		Metals		
Aluminum	100	N A	NA	µg/L
Antimony	00	480	640	µg/L
Arsenic	6	7	10	µg/L
Barium	100	NA	NA	µg/L
Beryllium	5	75	100	µg/L
Boron	100	NA	NA	µg/L
Cadmium	1	Detectable	0.25	µg/L
Calcium	100	NA	NA	µg/L
Chromium, total	25	75	100	µg/L
Chromium, VI	5	8	11	µg/L
Cobalt	100	NA	NA	µg/L
Copper	3	6.8	9.0	µg/L
Iron	100	NA	NA	µg/L
Lead	2	2	2.5	µg/L
Lithium	5	75	100	µg/L
Magnesium	100	NA	NA	µg/L
Manganese	100	NA	NA	µg/L
Mercury	0.1	Detectable	0.051	µg/L
Nickel	5	39	52	µg/L
Potassium	100	NA	NA	µg/L
Selenium	2	3.8	5	µg/L
Silver	1	2.4	3.2	µg/L
Sodium	100	NA	NA	µg/L
Thallium	5	Detectable	0.47	µg/L
Vanadium	100	NA	NA	µg/L
Zinc	2	90	120	µg/L
		Field readings		
Dissolved oxygen (minimum)	4.0–8.0	<6.0	5.0	mg/L
pH (maximum)	14.0	>8.4	9.0	Standard units
pH (minimum)	1.0	<6.4	6.0	Standard units
Temperature	0–100	>27	NA	^{o}C

[a] Quantitation is defined as the lowest amount of analyte in a sample that can be quantitatively determined with suitable precision and accuracy.

Screening levels for which immediate notifications are required are provided to the analytical laboratories, in order to receive early notification that a result is approaching or has exceeded an effluent limitation. Early notification can lead to actions that prevent a noncompliance or multiple noncompliances with the permit. Notification of storm water screening level exceedances are sent automatically from designated subcontract laboratories to the Sample Management Office (SMO) upon completion of sample analysis and verification of analytical results. The SMO is responsible for immediately notifying ETTP EC&P personnel that the screening level exceedance has occurred so that an investigation can be initiated to determine if best management practices or other corrective measures may be required. When necessary, corrective actions will be implemented to ensure that an NPDES permit limit or other reference standard is not exceeded during subsequent sampling events.

The screening level for a specific radionuclide is equal to 4% of the derived concentration guide (DCG) for that radionuclide in water, as listed in DOE Order 5400.5, Chap. 3; the reference standard is the DCG for each radionuclide. Four percent of the DCG represents the DOE criterion of 4 millirem effective dose equivalent (EDE) from ingestion of drinking water. Screening levels and reference standards are 15 pCi/L for gross alpha and 50 pCi/L for gross beta per the National Primary Drinking Water regulations, Subparts B and G (40 CFR 141).

Screening levels and reference standards for other parameters are generally based on Tennessee water quality criteria (WQC), Rules of Tennessee Division of Water Pollution Control, Chap. 1200-4-3 (TDEC 2009), and the criteria listed in the ETTP NPDES Permit TN0002950, Part III, A, Toxic Pollutants.

3.5.5.2 Storm Water Monitoring Conducted for the Phased Construction Completion Report

On January 5, 2007, a meeting was held with TDEC personnel to discuss monitoring expectations for contaminated slabs awaiting remediation following building demolition. A review of the Balance of Site-Laboratory Phased Construction Completion Reports (PCCRs) (DOE 2007, 2007a, 2007b) by TDEC personnel raised issues about this monitoring. TDEC personnel expressed concern about the potential release of contaminants from the slabs and did not believe that the monitoring effort was sufficiently detailed in the PCCRs. TDEC agreed that DOE meets the requirements of 10 CFR 835 and DOE Order 5400.5 through the Radiation Protection Program, storm water compliance monitoring, and ambient watershed exit pathway sampling. However, TDEC personnel stated that the PCCRs needed to be more specific in describing the location and frequency of monitoring for the slabs in question.

To obtain additional analytical information to address some of TDEC's stated concerns with the PCCRs, sampling of storm water runoff has been conducted since 2007 at various locations where radiological contamination may be present on the concrete pads or footprints of buildings that have been demolished. Samples of storm water runoff were collected at nearby storm water catch basins or directly from the building pads. The samples were collected to obtain data that would be considered the worst-case radiological discharge from these areas. Runoff samples collected directly from the building pads were collected from areas where the flow was most prevalent or most concentrated into a distinct discharge.

Samples were collected when runoff from the pads was sufficient to allow all of the samples for the given analytical parameters to be collected, regardless of the amount or intensity of the rainfall event. Storm water outfalls were sampled as close as possible to the time that the building pads, or catch basins that drain to them, were sampled. This was done to allow some correlation of the contaminant levels in the runoff samples from the building pads with the levels of contaminants in the storm water outfall samples. Sampling locations were chosen based on the observed runoff characteristics for the building pad. The exact number of sampling locations was also changed in some instances based on runoff flow patterns.

As part of the 2010 SWP3 sampling effort, samples were collected at the north side of the K-1420 building footprint in an area near the former calciner room. Samples were also collected from storm water outfalls 158, 160, and 170 concurrently with the K-1420 pad samples. Samples of building pad runoff from the area were scheduled to be collected monthly during wet weather conditions. However, due to the lack of qualifying storm events, these samples were collected only during January 2010. Samples collected from each of the locations listed in Table 3.22 were analyzed for gross alpha/gross beta radiation, isotopic uranium, total uranium, and ^{99}Tc.

All of the runoff samples and outfall samples collected for this portion of the 2010 SWP3 sampling effort were taken using the manual grab method. Manual grab samples were collected according to the guidelines specified in Sections 3.1.2 and 3.3.1 of the EPA's "NPDES Storm Water Sampling Guidance Document" (EPA 833-B-92-001) and applicable procedures that have been developed by the sampling subcontractor. All guidelines stated in the ETTP SWP3 sampling and analysis plan (SAP) concerning sample documentation, analytical procedures, Quality Assurance/Quality Control, etc., were followed as part of this sampling effort. Analytical results exceeding screening levels in 2010 are also given in Table 3.22.

Table 3.22. Results exceeding screening levels for 2010 radiological monitoring performed in conjunction with PCCR RA and D&D activities

Sampling location	Date sampled	Gross alpha radiation (pCi/L)	Gross beta radiation (pCi/L)	$^{233}U/^{234}U$ (pCi/L)	$^{235}U/^{236}U$ pCi/L)	^{238}U (pCi/L)	Total uranium (μg/L)	^{99}Tc (pCi/L)
Screening Level[a]		15	50	20	24	24	31	4000
Outfall 158	1/2010	104	---	50.8	---	30.8	93.3	---
Outfall 160	1/2010	242	---	136	---	47	143	---
Outfall 170	1/2010	---	---	---	---	---	---	---
K-1420 Pad runoff	1/2010	110	---	77.3	---	---	33.6	---

[a]Screening levels are 15 pCi/L gross alpha radiation, 50 pCi/L gross beta radiation, 20 pCi/L $^{233/234}U$, 24 pCi/L ^{235}U-235 and ^{238}U, and 31 µg/L total uranium.

In 2010, gross alpha radiation was detected in the discharges from storm water outfalls 158 and 160 and the K-1420 pad at levels greater than 15 pCi/L, which is the screening level developed from the maximum contaminant level (MCL) established by the Safe Drinking Water Act (SDWA). Gross alpha radiation for outfall 170 was below the screening level. Compared to historical data (Fig. 3.19 and Tables 3.23–3.26), the results for the 2010 SWP3 sampling are representative of the levels of gross alpha radiation normally found at these locations.

Gross beta radiation was not detected in the discharges from outfalls 158 and 160 and at the K-1420 pad at levels that exceed the screening level of 50 pCi/L developed from the MCL compared to historical data (Fig. 3.20 and Tables 3.23–3.26). Gross beta radiation for outfall 170 was also below screening level.

No ^{99}Tc was detected at levels above the screening level of 4000 pCi/L in samples collected at outfalls 158, 160, and 170 and the K-1420 pad as part of the 2010 SWP3 (Tables 3.23–3.26).

Uranium-233/234 was detected in the discharge from outfalls 158, 160, and the K-1420 Pad in 2010 at levels that exceed 4% of DCG level of 20 pCi/L for this radionuclide, as seen in Fig. 3.21. Exceedances were not detected for outfall 170. Historical data for $^{233}U/^{234}U$ collected at this location (Tables 3.23–3.26) indicate that the $^{233}U/^{234}U$ data for 2010 were near the middle of the range of the historical results.

ORNL 2010-G00458R/chj

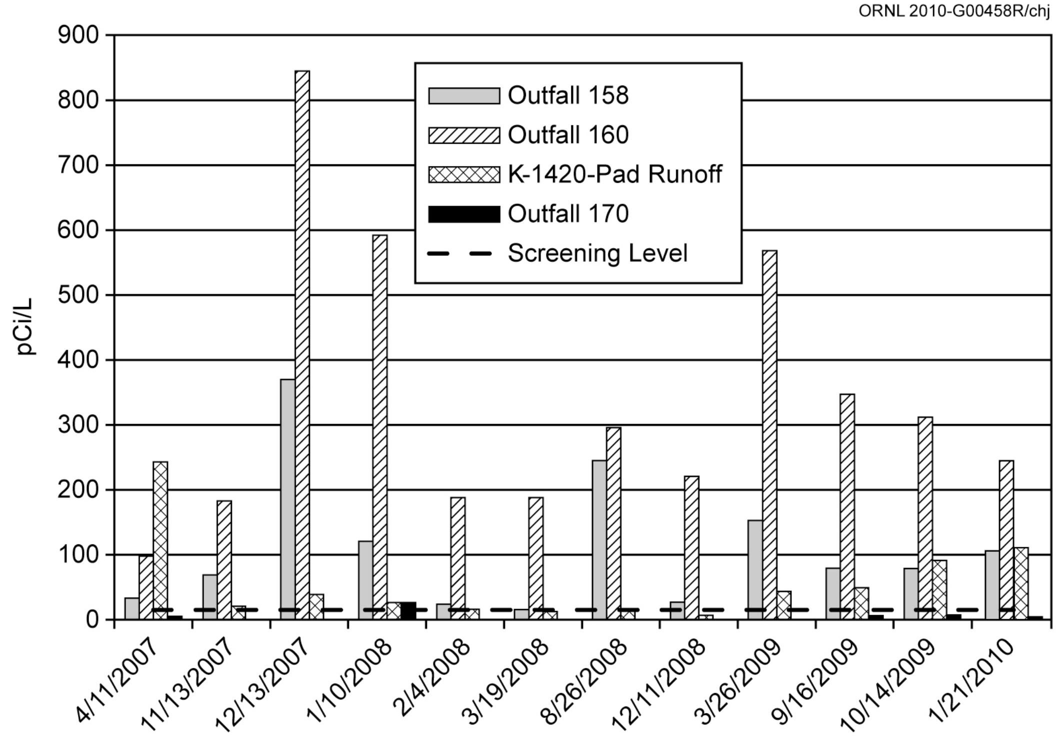


Fig. 3.19. Relative levels of gross alpha radioactivity in discharges from outfalls 158, 160, 170, and the K-1420 pad.

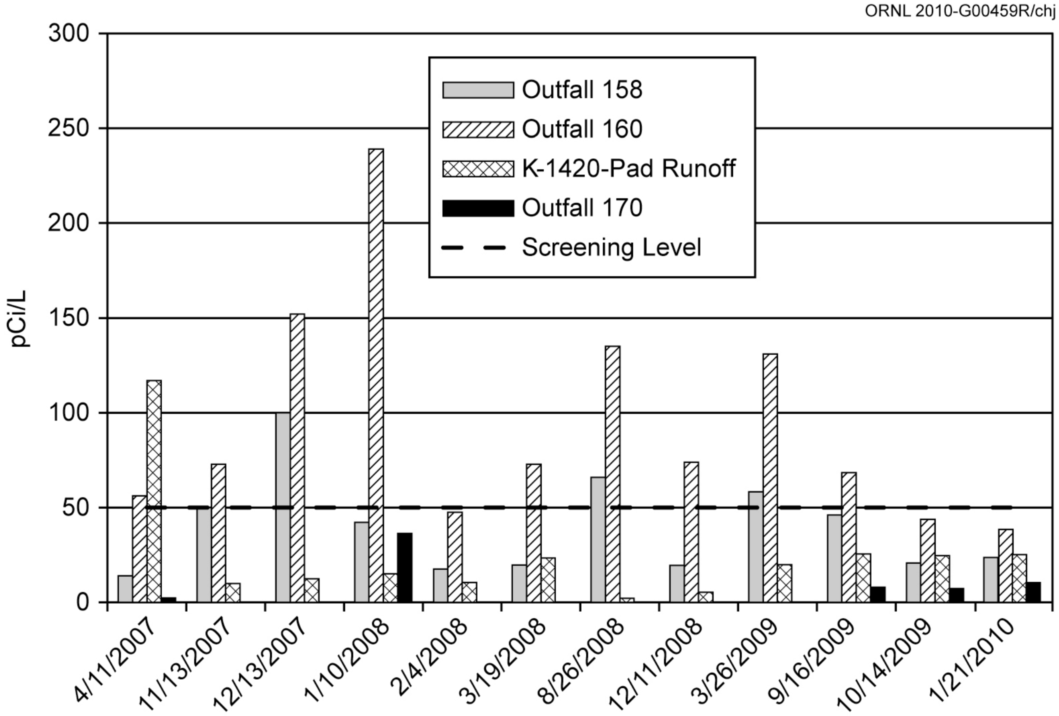


Fig. 3.20. Relative levels of gross beta radioactivity in discharges from outfalls 158, 160, 170, and the K-1420 pad.

Table 3.23. Analytical results from sampling performed at storm water outfall 158

	Gross alpha (pCi/L)	Gross beta (pCi/L)	$^{233}U/^{234}U$ (pCi/L)	$^{235}U/^{236}U$ (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (µg/L)
Screening Level	15	50	20	24	24	4000	31
July 2003	98.8	97.5	0.068 U[a]	–0.021	–0.034	No data	No data
May 2004	64.9	44.7	31.87	1.86	18.59	No data	No data
April 2007	33.2	14	19.9	1.94	12.3	No data	37.5
November 2007	69.2	50.1	37.1	1.91	23.1	47.4	69.6
December 2007	370	100	153	12	96.9	69.5	294
January 2008	121	42.3	48.3	3.55	32.4	26.2	98
February 2008	23.8	17.6	11.3	0.994	7.7	14.5	23.4
March 2008	15.8	19.7	8.71	0.041 U	5.44	13.7	16.2
July 2008	89.6	60.7	40.9	3.94	30.9	46.3	93.7
August 2008	245	66	121	7.36	68.2	55.7	206
December 2008	27.3	19.5	63 U	0.72	8.2	14.4	25.2
March 2009	153	58.4	75.6	5.18	47.3	32	145
September 2009	79.2	46.1	47	3.53	32.1	45.1	97.2
October 2009	79	20.8	38.1	2.29	23.8	23	71.8
January 2010	104	22.6	50.8	3.55	30.8	21.9	93.3

[a] U—analyte not detected in sample.

Note: Radiological results are reported after background activity has been subtracted. In cases where background activity exceeds the sample activity, this will result in negative values.

Table 3.24. Analytical results from sampling performed at storm water outfall 160

	Gross alpha (pCi/L)	Gross beta (pCi/L)	$^{233}U/^{234}U$ (pCi/L)	$^{235}U/^{236}U$ (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (μg/L)
Screening Level	**15**	**50**	**20**	**24**	**24**	**4000**	**31**
March 2001	114	49	66	4.32	38	84	No data
August 2001	48	49	37.38	1.78	7.42	54	No data
January 2002	1020	421	591.9	32.01	108.9	445	No data
February 2004	203	78.2	151.7	10.89	89.68	23.7	65.4
April 2007	98.2	56.3	85.9	5.04	21.2	78	37.5
November 2007	183	72.9	117	8.88	62.7	61.9	191
December 2007	845	152	547	30.3	202	96.2	615
January 2008	592	239	405	18.6	73.8	280	228
February 2008	188	47.5	130	6.31	21.1	54.1	65.7
March 2008	185/191	54.8/90.8	137/150	8.7/10.3	20.7/22.2	58.4/61.4	65.6/70.8
August 2008	296	135	216	10.3	59.7	213	182
December 2008	221	73.9	170	8.1	23.2	74.8	73.4
March 2009	568	131	491	22.7	73	174	230
September 2009	347	68.4	275	13.5	48	73.8	149
October 2009	312	43.9	205	14.9	60.2	41.5	186
January 2010	242	37.7	136	7.63	47	23.9	143

Table 3.25. Analytical results from sampling performed at storm water outfall 170

	Gross alpha (pCi/L)	Gross beta (pCi/L)	$^{233}U/^{234}U$ (pCi/L)	$^{235}U/^{236}U$ (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (μg/L)
Screening Level	**15**	**50**	**20**	**24**	**24**	**4000**	**31**
January 2002	2.77 U	9.09	1.10	0.03 U	0.44	2.96 U[a]	No data
July 2002	2.46 U	15.2	1.32	0.05 U	0.57	<8.24	No data
September 2005	1.28 U	4.68 J[a]	0.60 J	0.01 U	0.37 J	2.98U	No data
April 2007	5.07	2.46 U	7.17	0.44	2.93	27.2 U	8.92
January 2008	26.3	36.3	98.1	6.14	7.89	13.8	26.3
September 2009	6.11	8.11	2.96	0.19	0.67	10.3	2.09
October 2009	7.16	7.37	3.09	0.29 U	1.01	13.6	3.13
January 2010	2.82 U	9.89	3.62	0.0804 U	0.322 U	7.67 U	0.994U

[a] "U" is a sample result below the detection limit and "J" is a sample result that is above the sample detection limit, but below the sample quantitation limit.

Table 3.26. Analytical results from sampling performed at the K-1420 building pad

	Gross alpha (pCi/L)	Gross beta (pCi/L)	$^{233}U/^{234}U$ (pCi/L)	$^{235}U/^{236}U$ (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (μg/L)
Screening Level	**15**	**50**	**20**	**24**	**24**	**4000**	**31**
April 2007	243	117	94	12	24.8	22	79.4
November 2007	20.8	9.94	5	0.923	2.95	0.04 U[a]	9.2
December 2007	39.1	12.5	28.6	1.66	5.11	4.97 U	16
January 2008	26.7	15.1	17.3	1.03	3.3	1.7	10.3
February 2008	16.1	10.6	11.6	0.426	1.69	2	5.23
March 2008	12.6	23.4	11.2	0.73	1.69	4.7	5.37
August 2008	13.6	2.11 U	11.2	0.766	2.07	09 U	6.51
December 2008	6.9	5.34	63 U	0.23	1.2	.9 U	3.9
March 2009	43.6	19.9	63 U	1.8	6	13.9	19
September 2009	49.1	25.5	35.9	2.13	7.22	8.2	22.5
October 2009	91.4	24.7	69.1	5.02	13.2	7.3	41.5
January 2010	110	25.1	77.3	3.12	10.8	.33	33.6

[a] "U" is a sample result below the detection limit

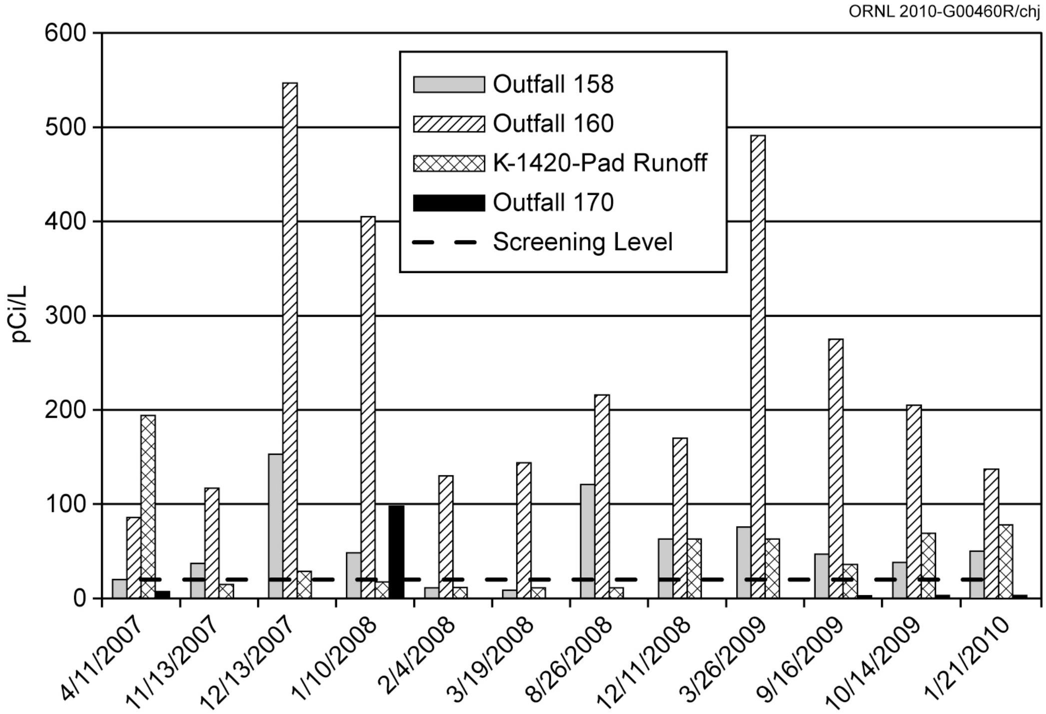


Fig. 3.21. Relative levels of $^{233/234}$U in discharges from outfalls 158, 160, 170, and the K-1420 pad.

Uranium-235/236 was not detected at levels above 4% of the DCG level of 24 pCi/g for the 2010 SWP3 sampling (Tables 3.23–3.26).

Uranium-238 was detected in discharges from outfalls 158 and 160 at levels that exceeded 4% of the DCG level of 24 pCi/L. Exceedances were not detected for outfall 170 or the K-1420 pad. Comparing the 2010 results to historical data for ^{238}U collected from these locations (Tables 3.23–3.26) indicates that ^{238}U results collected as part of the 2010 SWP3 sampling are near the middle of the range of the historical results.

Total uranium was detected in the discharge from storm water outfalls 158 and 160 and the K-1420 pad at levels that exceed the screening level of 31 μg/L. Exceedances of the screening level for total uranium were not detected for outfall 170. Total uranium results collected as part of the 2010 SWP3 sampling are several times higher than the screening level at outfalls 158 and 160. However, a comparison to historical results available for total uranium (Tables 3.23–3.26) indicates that total uranium results collected as part of the 2010 SWP3 sampling are within the range of historical results.

The acceptable dose rate in surface water for piscivorous wildlife is 100 millirad (mrad) per day. The total uranium activity on the slab that will result in a 100 mrad per day dose in Mitchell Branch is 2600 pCi/L. Analytical data collected since April 2007 (Table 3.26) indicate that total uranium concentrations are several orders of magnitude below the 2600 pCi/L level. Therefore, it can be concluded that the K-1420 pad is no longer a significant contributor of radioactive contaminants to the storm drain system. In April 2010, approval was granted by TDEC and EPA CERCLA Core Team representatives to discontinue monitoring of the K-1420 pad.

3.5.5.3 Radiological Monitoring of Storm Water Discharges

The ETTP conducts radiological monitoring of storm water discharges to determine compliance with applicable dose standards. It 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 periodically as part of the SWP3. In 2010, new radiological sampling results were obtained for seven storm water outfalls (Table 3.27). These results were used with radiological results for other storm water outfalls from other years, along with calculated flows based on rain events in 2010, to estimate the total discharge of each radionuclide from ETTP via the storm water discharge system (Table 3.28).

Table 3.27. Storm water sampling for radiological discharges,[a] 2010

Storm water outfall	Date sampled
180	06/10/10
190	09/22/10
230	08/12/10
350	10/25/10
382	03/12/10
430	03/03/10
724	03/12/10

[a] Including gross alpha, gross beta, transuranics (^{237}Np, ^{238}Pu, and $^{239/240}$Pu), isotopic uranium, and ^{99}Tc.

Table 3.28. Radionuclides released to off-site surface waters from the East Tennessee Technology Park storm water system, 2010 (Ci)[a]

Radionuclide	Amount
^{99}Tc	1.7E–2
^{234}U	4.8E–3
^{235}U	3.0E–4
^{238}U	3.1E–3

[a] 1 Ci = 3.7×10^{10} Bq

Storm water samples were collected from discharges resulting from storm events producing greater than 0.1 in. of rainfall within a period of 24 hr or less and at least 72 hr after any previous rainfall greater than 0.1 in. in 24 hr. Composite samples were collected at each outfall using ISCO automated sampling equipment. The composite samples consisted of at least three aliquots taken during the first 60 min of a storm event discharge. Samples composited by time (equal volume aliquots collected at a constant interval) were used. In situations where the use of an ISCO sampler was infeasible or impractical, a series of at least three manual grab samples of equal volume were collected during the first 60 min of a storm event discharge and combined into a composite sample.

Radiological monitoring was conducted in 2010 as part of the SWP3 for different purposes. Results of all SWP3 radiological monitoring that exceeded screening levels in 2010 are shown in Table 3.29. Comparisons of historical analytical results to those from the 2010 sampling effort are given in Tables 3.30 and 3.31.

Table 3.29. Storm water radiological results exceeding screening levels for radiological discharges, 2010 (pCi/L)[a,b]

Storm water outfall	Gross alpha radiation (pCi/L)	Gross beta radiation (pCi/L)	^{233}U/^{234}U (pCi/L)	^{238}U (pCi/L)	Total uranium (µg/L)
350	57.1	--[c]	34.9	24.8	75.7
724	89.1	--	45.1	37.7	66.2

[a] 1 pCi = 0.037 Bq

[b] Screening levels are 15 pCi/L gross alpha radiation, 50 pCi/L gross beta radiation, 20 pCi/L ^{233}U/^{234}U, 24 pCi/L ^{234}U and ^{238}U, and 31 µg/L total uranium.

[c] Dashed line indicates no exceedances.

Table 3.30. Analytical results from sampling performed at storm water outfall 350

	Gross alpha (pCi/L)	Gross beta (pCi/L)	$^{233}U/^{234}U$ (pCi/L)	$^{235}U/^{236}U$ (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (μg/L)
Screening level	**15**	**50**	**20**	**24**	**24**	**4000**	**31**
May 2001	162	76.5	70.31	4.36	54.65	26.5	No data
May 2002	25.2	14.8	16.83	1.25	13.3	0.69 U[a]	No data
February 2005	242	76.5	139	7.39	106	4.87 U	No data
December 2006	171	30.4	91.4	6.87	71.8	20.2	217
July 2009	187	62.4	79.1	4.77	63.9	13.7	192
October 2010	57.1	35	34.9	2.66	24.8	6.1	75

[a] U—analyte not detected in sample.

Table 3.31. Analytical results from sampling performed at storm water outfall 724

	Gross alpha (pCi/L)	Gross beta (pCi/L)	$^{233}U/^{234}U$ (pCi/L)	$^{235}U/^{236}U$ (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (μg/L)
Screening level	**15**	**50**	**20**	**24**	**24**	**4000**	**31**
January 2002	61	441	30.11	1.67	20.3	376	No data
March 2002	119	71.6	44.85/53.61	2.71/4.32	33.55/38.36	54.8	No data
December 2003	70.2	57.3	34.28	2.564	27.08	42.7	81.12
November 2005	99.4	47.4	77.3	5.66	59.8	83.9	No data
March 2007	134	64.5	65	5.78	50.8	82.1/80.4	154
March 2010	89.1	28.7	45.1	2.35	37.7	8.17	113

Gross beta radiation was detected in the discharges from storm water outfalls 350 and 724 at levels that exceed the MCL of 50 pCi/L for this analyte (Tables 3.30 and 3.31). Results for gross beta radiation collected at these locations since 2001 indicate that the gross beta radiation results collected during this portion of the 2010 SWP3 sampling are within the historical range.

Uranium-233/U-234 was detected in the discharges from outfalls 350 and 724 at levels that exceed the 4% of DCG level of 20 pCi/L for these radionuclides (Tables 3.30 and 3.31). Results for $^{233}U/^{234}U$ collected at these locations since 2001 indicate that the $^{233}U/^{234}U$ results collected during this portion of the 2010 SWP3 sampling are within the historical range.

Uranium-238 was detected in the discharges from outfalls 350 and 724 at levels that exceed the 4% of DCG level of 24 pCi/L for these radionuclides (Tables 3.30 and 3.31). Results for ^{238}U collected at these locations since 2001 indicate that the ^{238}U levels in data collected during this portion of the 2010 SWP3 sampling are within the historical range.

Total uranium was detected in the discharges from outfalls 350 and 724 at levels that exceed the screening level of 31 μg/L for these analytes (Tables 3.30 and 3.31). Results for total uranium collected at these location indicate that the total uranium levels in data collected during this portion of the 2010 SWP3 sampling is within the historical range.

3.5.5.4 Monitoring Conducted as Part of the Decontamination and Decommissioning/ Remedial Action Activities Conducted at Building K-1035

Building K-1035 was built in 1945 as a maintenance general stores warehouse. In the early 1960s it was converted to an instrument maintenance facility. Shop activities have included an instrument shop, metal cabinet fabrication, a photoelectroplating process, printed circuit board fabrication shop, acid cleaning area, line recorder cleaning, and pneumatic repair shop. To the south of the building are the K-1035 pits. Two of these pits, an acid pit and a neutralization pit, received acid and solvent wastes. These wastes came from two dedicated instrument shops within the building—the Printed Circuit Board Fabrication Facility and the Acid Cleaning Area. The third pit, a steam cleaning pit, was used for the removal of oil and dirt from parts and machinery. The contents of all three pits flowed to a single catch basin that discharges to the storm drain 190 network. The Acid Cleaning Area operated from the early 1960s to 1985, and the Printed Circuit Board Fabrication Facility operated from the early 1960s to 1977.

In April 2009, work began on the demolition of Building K-1035 (Fig. 3.22). Siding, pipe insulation, roofing material, etc., were removed prior to general demolition activities. The remainder of the building was demolished using heavy equipment. By June 2009, the building was reduced to rubble. Removal of the building rubble was completed in July 2009. The building footers were removed in early 2010, and the area was backfilled with clean clay and topsoil. The vegetative cover over the area was established in the fall of 2010.

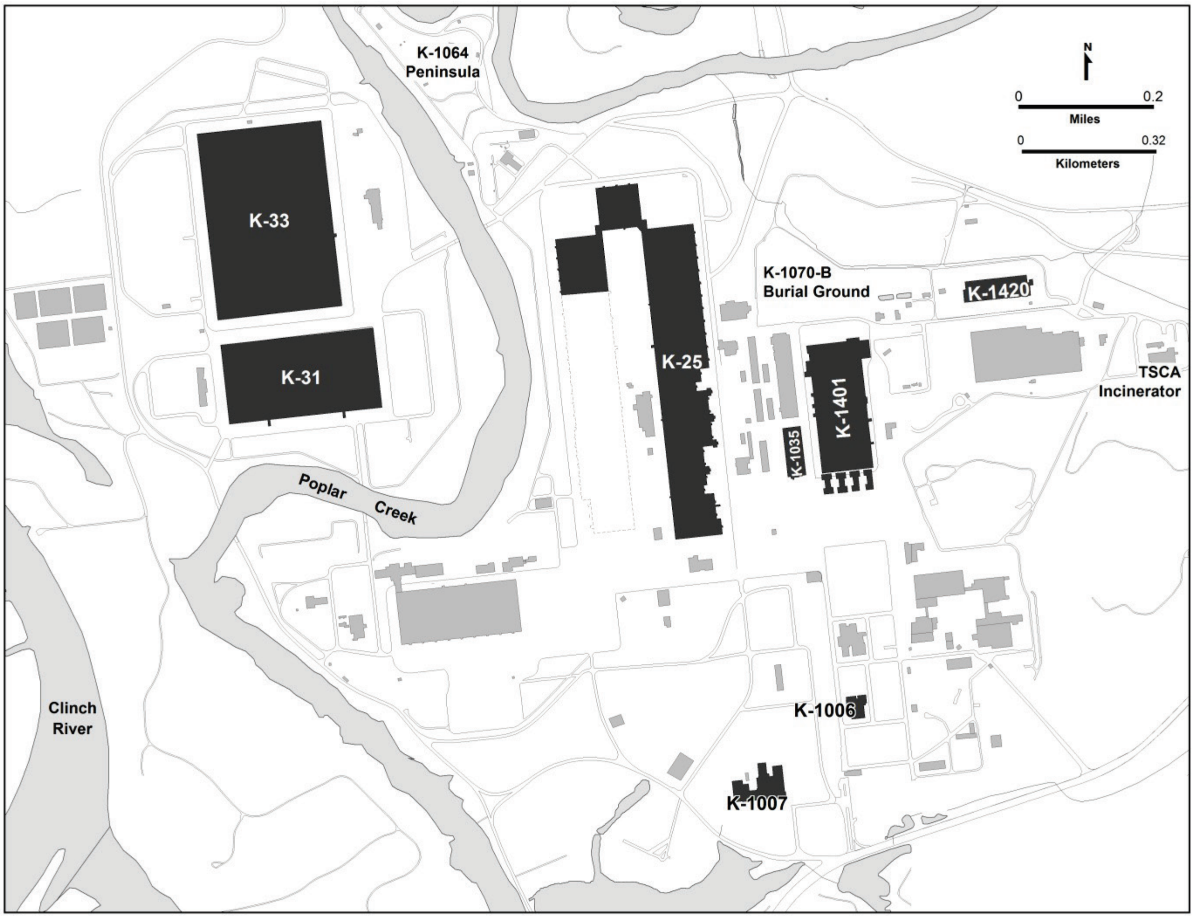


Fig. 3.22. Map of ETTP areas involved in 2010 sampling activities.

In November 2008, before the demolition of Building K-1035 began, the water in nearby storm drain inlets and at storm water outfall 190 was sampled as part of the 2008 SWP3 sampling effort. Samples were collected for analysis for gross alpha/gross beta radiation, isotopic uranium, ^{99}Tc, metals, mercury, VOCs, and PCBs. This provided a baseline for determining if contaminants might be present in the runoff from the K-1035 area. Sampling was also performed in May and August 2009, during the demolition of the building as part of the 2009 SWP3 sampling effort. This was done to determine the efficacy of the protective measures that were installed around storm drain inlets to prevent any demolition materials from entering the storm drain system. Specified manholes and outfalls were also sampled in January 2010 as part of the 2010 SWP3 sampling effort. These samples were collected after most of the demolition activities at Building K-1035 had been completed. Samples were collected for analysis for gross alpha/gross beta radiation, isotopic uranium, ^{99}Tc, metals, mercury, VOCs, and PCBs.

Sampling locations were chosen by EC&P personnel and sampling subcontractor personnel based on their proximity to the area that was remediated, their accessibility, and ease of sampling. Due to fact that many of the storm drains in the area are inaccessible, sampling locations were chosen where flow could be observed and ISCO sampling equipment could be installed with minimal complications.

All samples collected as part of this portion of the 2010 SWP3 sampling effort were grab samples that were collected manually or by the use of ISCO samplers. For the purposes of the ETTP SWP3 sampling, a grab sample is defined as a discrete, individual sample that can be collected manually or by the use of an ISCO sampler that is taken within a short period of time, usually 15 minutes or less. Both manual grab samples and grab samples collected using an ISCO sampler were collected within the first 30 minutes of a discharge. All samples collected in conjunction with the D&D/RA activities conducted at Building K-1035 were collected in accordance with the guidelines presented in the *East Tennessee Technology Park Storm Water Pollution Prevention Program Sampling and Analysis Plan* (BJC 2009b). All guidelines stated in the ETTP SWP3 SAP concerning sample documentation, analytical procedures, quality assurance/quality control, etc., were followed as part of this sampling effort.

The metals results from the sampling performed in conjunction with the Building K-1035 D&D/RA are presented in Figures 3.23–3.26.

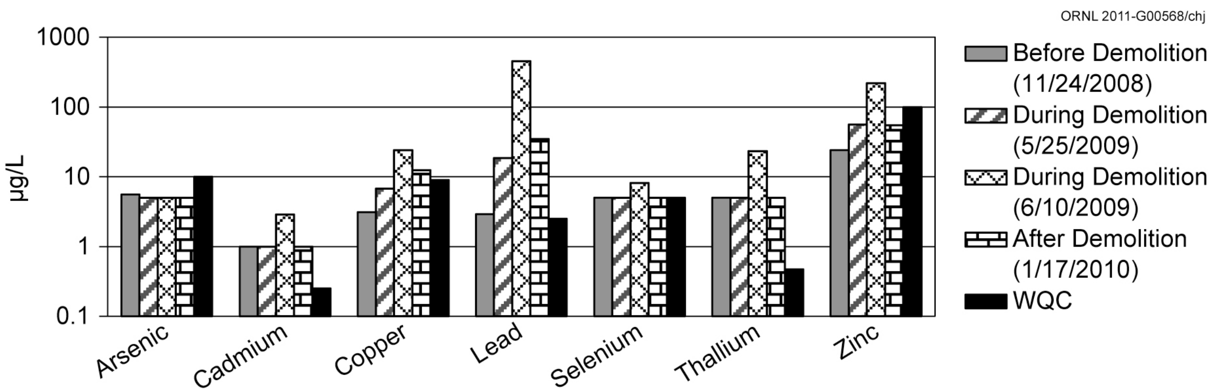


Fig. 3.23. Metals results at manhole 13050.

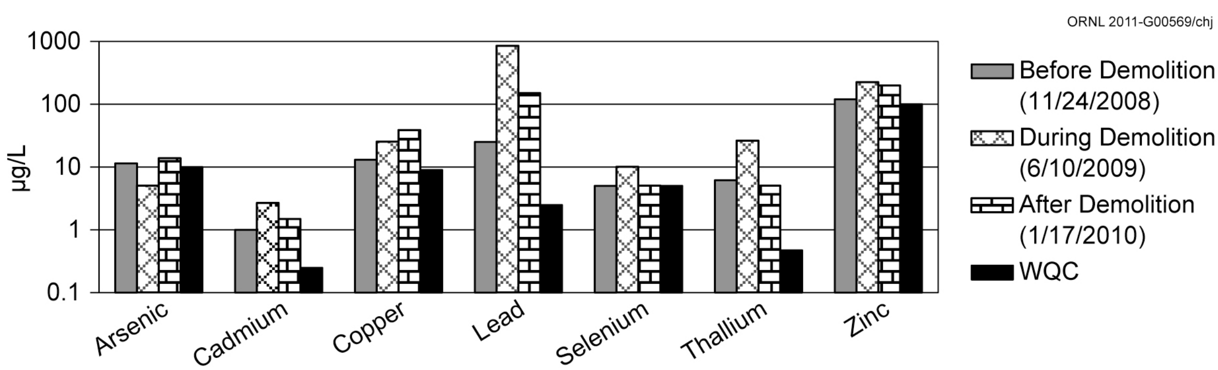


Fig. 3.24. Metals results at manhole 13037A.

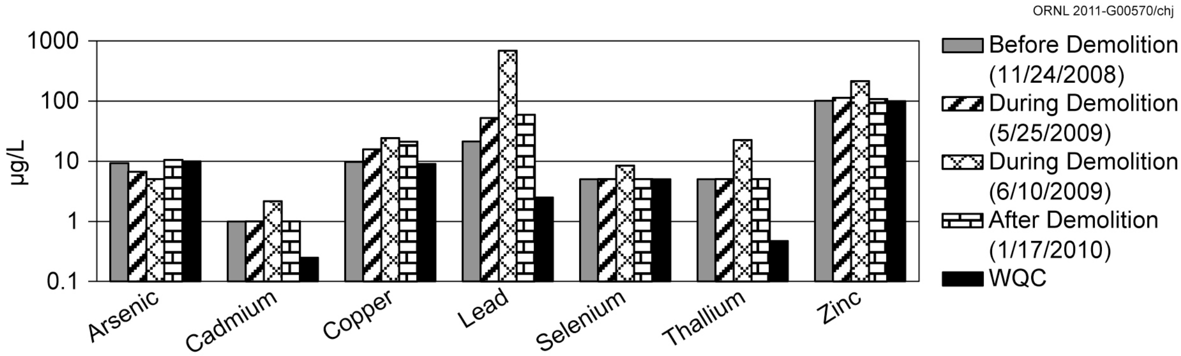


Fig. 3.25. Metals results at manhole 13074A.

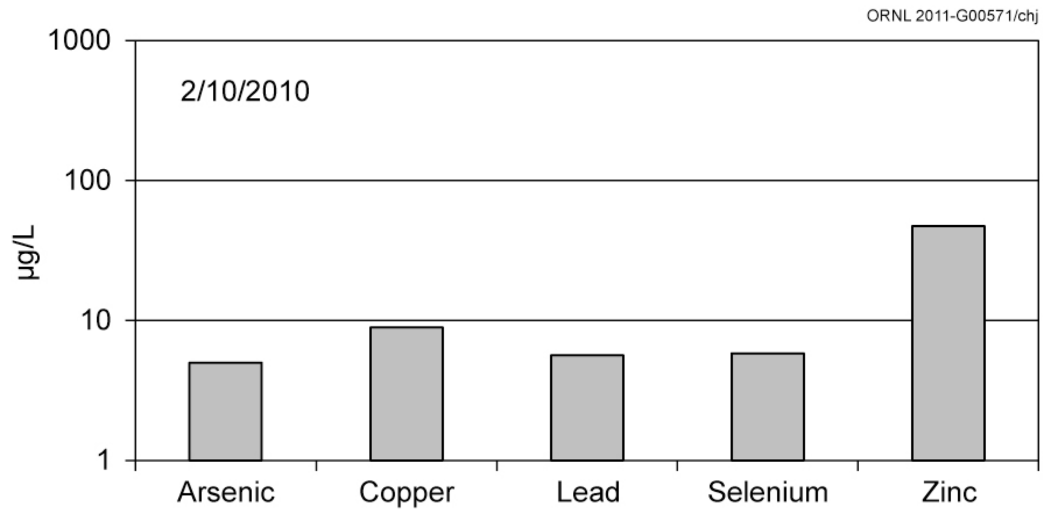


Fig. 3.26. Metals results at manhole 13048.

Metals samples were collected at manhole 13048 in February 2010. This manhole had not been sampled for metals prior to this sampling effort. Levels of Cu, Pb, Se, and Zn exceeded the applicable screening levels indicated in Table 3.21.

Figures 3.23–3.26 indicate the following.

- In most instances, the levels of metals detected in the samples taken after demolition were completed are below the levels in samples collected during demolition.
- In most instances, metals levels in samples collected after demolition activities were completed are equal to or higher than the levels detected in samples collected before demolition activities began.
- Most metals were present at concentrations greater than the WQC in samples collected before, during, and after demolition activities.
- Metal results were relatively consistent between the manholes that were sampled.
- Improvements in the sediment controls in the Building K-1035 demolition area may have been needed to provide more effective removal of contaminants from the storm water runoff from the area while demolition was under way.
- Discharge of metals presumably by sediment transport appears to have decreased since demolition activities have concluded.

The PCB results from the sampling performed in conjunction with the Building K-1035 D&D are presented below in Figures 3.27–3.29.

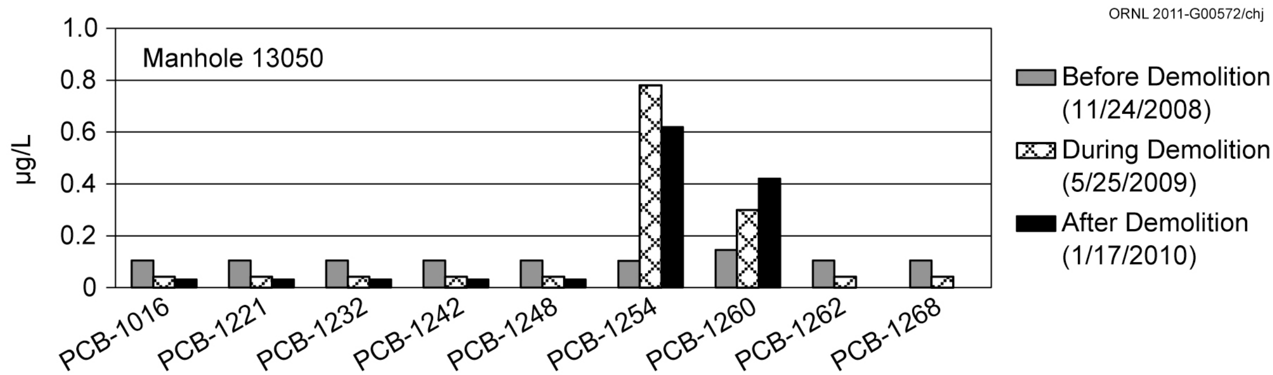


Fig. 3.27. PCB results at manhole 13050.

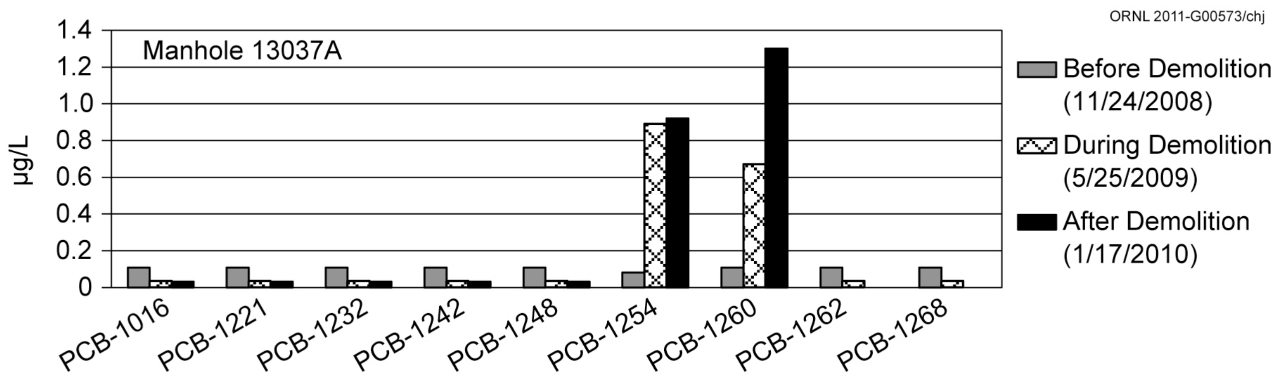


Fig. 3.28. PCB results at manhole 13037A.

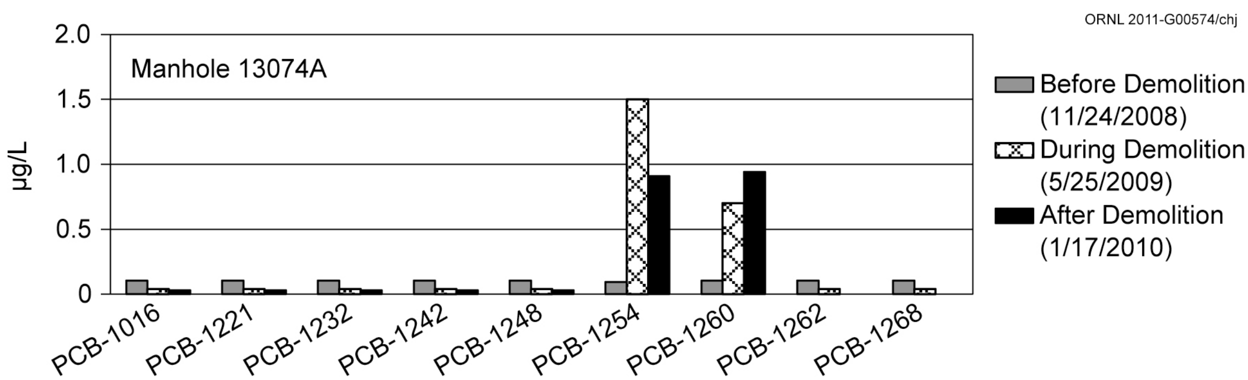


Fig. 3.29. PCB results at manhole 13074A.

Figures 3.27–3.29 indicate the following.

- Concentrations of PCB-1254 and PCB-1260 were higher in samples collected during demolition than levels detected before demolition activities began.
- Concentrations of PCB-1254 decreased after demolition activities were completed but were still above historical levels measured before demolition began.
- Concentrations of PCB-1260 increased in samples collected after demolition activities were completed and are considerably higher than the levels detected before demolition activities began.
- No other concentrations of PCBs appear to have been affected by the demolition of Building K-1035.
- No PCBs were detected in sampling performed at manhole 13048.

In February 2010, samples were collected at manhole 13048 in order to determine whether mercury from the area of the neutralization pits might be present in the storm water runoff from this area. In

August 2010, mercury samples were also collected at manholes 13037, 13050, and 13074 to determine if mercury was present in the storm drain system near the K-1035 D&D area.

The mercury results from sampling performed in conjunction with the Building K-1035 D&D are presented in Fig. 3.30.

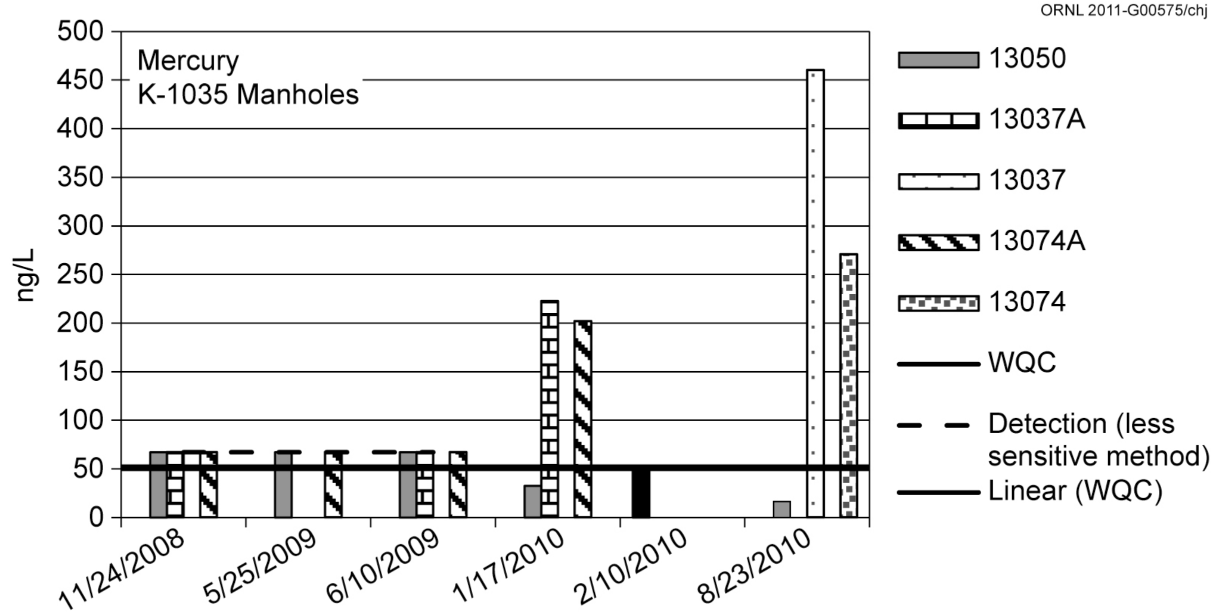


Fig. 3.30. Mercury results for K-1035 manholes.

Mercury was not found to be present above the detection level of 67 ng/L in sampling performed in area manholes sampled in November 2008 (before demolition of Building K-1035 began) or in manholes sampled in May and June 2009 (during demolition of K-1035). However, it should be noted that a less sensitive analytical method was used for mercury analysis for these samples (EPA-245.1). The detection limit of 67 ng/L for this method is above the WQC for mercury, which is 51 ng/L. Therefore, no conclusions about the presence of mercury above WQC at these locations before and during the demolition of K-1035 can be made. In samples collected at manholes in January and February 2010, after demolition of K-1035 was completed, mercury was analyzed using a much more sensitive analytical method (EPA-1631). Mercury was detected in manholes 13037A and 13074A at levels that exceeded the WQC (212 ng/L and 210 ng/L, respectively). Figure 3.30 indicates these analytical results. In addition, samples were collected in February 2010 at manhole 13048 after the demolition of K-1035 had been completed. This manhole is located near the south end of Building K-1035. Mercury was detected at this manhole at a level of 53.6 ng/L, which is above the WQC of 51 ng/L. As part of sampling that was conducted in August 2010, mercury was again found at levels that exceeded WQC at manholes 13037 and 13074A (460.4 ng/L and 270.8, respectively). It is believed that the source of mercury in these manholes may be from the operation and removal of the waste neutralization pits that were located at the south end of the K-1035 Building. When the pits were removed, visible mercury beads were observed at the bottom of drain lines that served the pits. The amount of time the mercury beads may have been present and the amount of mercury that may have been released to the environment as part of the operation of the neutralization pits is unknown.

None of the radiological samples collected in manholes 13048, 13050, 13037A, and 13074A before, during, or after demolition of Building K-1035 had results that were above the applicable screening levels.

3.5.5.5 Monitoring of Storm Water Runoff from D&D Activities in the K-1131 Area

As part of the D&D activities for Building K-27, waste materials, equipment, and other items stored in K-27 will be sorted, segregated, and containerized for shipment. Waste materials, including equipment, machinery, scrap metals, etc., will be moved to the K-1131 building pad area, where the size of the waste materials will be reduced by shearing, cutting, or other physical methods. Other D&D activities to be conducted on the K-1131 pad include the downsizing and repackaging of waste materials from the Building K-25 demolition project and the storage of process tieline piping from the K-413 building area.

As part of the 2010 SWP3 sampling effort, sampling was performed at outfall 380, which receives storm water runoff from the K-1131 pad area. Analytical results from this sampling effort will also be used to complete the EPA 2F forms for outfalls 380 and 430 as part of the 2013 NPDES permit renewal application. Screening level exceedances for outfalls 380 and 430 are presented in Table 3.32. Outfalls 380 and 430 were sampled for all of the parameters listed in Table 3.33. Additional sampling will be conducted as other activities are started or completed on the K-1131 pad.

Table 3.32. Screening level exceedances at outfalls receiving drainage from the K-1131 Pad area, 2010

Sampling location	Gross alpha (pCi/L)	Chromium (µg/L)	Copper (µg/L)	Lead (µg/L)	Mercury (µg/L)	Selenium (µg/L)	Total Uranium (µg/L)	Zinc (µg/L)	Arsenic (µg/L)
Screening Level	**15**	**8**	**7**	**2.5**	**Detectable**	**5**	**31**	**75**	**7**
380	58.2	9.8	14.2	21.1	0.0165	6.66 J[a]	34.9	155	---
430	---	---	---	---	---	---	---	---	15.9 J

[a] J is a sample result that is above the sample detection limit but below the sample quantitation limit.

Table 3.33. Samples collected in 2010 in support of the NPDES permit renewal application

Storm water outfall	Mercury, PCBs, TSS, pesticides, herbicides, anions, BOD, COD, ICP metals,[a] gross alpha/beta, isotopic U, total U, ^{99}Tc, ^{238}Pu, $^{239/240}$Pu, ^{237}Np, sulfide (composite sample)	VOC, SVOC, TOC,[b] oil and grease, acetone/ acetonitrile/ methyl ethyl ketone (Grab sample-manual grab only)	Kjeldahl nitrogen, phenol, total phosphorus, nitrate/nitrite, cyanide, ammonia (as N) (Grab sample – manual grab or grab by compositor)	Temperature, pH, TRC (field readings)
170	X	X	X	X
180	X	X	X	X
230	X	X	X	X
380	X	X	X	X
382	X	X	X	X
410	X	X	X	X
430	X	X	X	X
700	X	X	X	X
710	X	X	X	X
724	X	X	X	X
992	X	X	X	X
05A	X	X	X	X

[a] Metals analysis should include Al, Ag, As, Ba, Be, B, Ca, Cd, Co, Cr, Cu, Fe, K, Mo, Mg, Mn, Na, Ni, Pb, Sb, Se, V, Zn, Ti, and Tl. BOD = biochemical oxygen demand, COD = chemical oxygen demand, ICP = inductively coupled plasma.

[b] VOC = volatile organic compound, SVOC = semi-volatile organic compound, TOC = total organic carbon.

3.5.5.6 Sampling for 2013 NPDES Permit Renewal Application

Even though a new NPDES permit became effective on April 1, 2010, preparations for the NPDES permit that is to be issued in 2013 are being made. The permit application for this permit renewal is required to be submitted to TDEC by June 2013, to allow TDEC 180 days to review it. Only about 3 years remain to collect all of the analytical data that is required to complete the EPA 2E and 2F forms that are required to be submitted in the next NPDES permit renewal application. In order for all of the required monitoring to be conducted in time for the permit application to be prepared and submitted, approximately eight to ten outfalls must be sampled each year.

The 2010 SWP3 sampling effort focused on the 32 representative outfalls indicated in the ETTP NPDES Permit No. TN0002950 that was issued in April 2010. The outfalls that were selected to be sampled as part of the 2010 SWP3 SAP are listed in Table 3.33. Data collected from sampling conducted as part of the SWP3 SAP will be used in the completion of EPA 2E or 2F forms, as applicable.

The sample collection method for each parameter is specified by the analytical method for that parameter. Parameters that are designated to be collected as composite samples were collected by use of ISCO samplers or by manual grab if they cannot be collected by ISCO sampler due to location, volume, or time constraints. No parameters designated in Table 3.33 to be collected by manual grab were collected by ISCO compositor under any circumstances; however, other parameters that are designated in Table 3.33 as grab samples may have been collected either manually or with ISCO samplers.

All samples were collected from discharges resulting from storm events producing greater than 0.1 in. of rainfall within a time period of 24 hr or less and which occurred at least 72 hr after any previous rainfall greater than 0.1 in. in 24 hr. Some variance in the 72-hr time frame was allowed due to unforeseeable circumstances such as weather conditions and sampling equipment problems.

Table 3.34 contains nonradiological results from this portion of the 2010 SWP3 sampling effort that exceeded screening levels. Table 3.35 contains the radiological results from this effort that exceeded screening levels.

Table 3.34. Screening level exceedances from 2013 permit renewal application sampling for 2010, nonradiological

	Copper (µg/L)	Lead (µg/L)	Mercury (µg/L)	Zinc (µg/L)	Cadmium (µg/L)	Chromium (µg/L)	Selenium (µg/L)	PCB-1260 (µg/L)
Screening level	**7**	**2.5**	**Detectable**	**75**	**Detectable**	**8**	**5**	**Detectable**
Outfall 180	4.9	6.9	0.638	76.5	--	--	--	--
Outfall 380	4.2	1.1	0.0165	155	--	9.8	6.66 J[a]	--
Outfall 230	8.2	3.9	0.0117	158	--	--	--	--
Outfall 382	--	--	0.0177	--	4.81 J	--	--	--
Outfall 410	51 J	--	0.0229	--	--	11.3	--	--
Outfall 430	--	--	--	--	--	--	--	--
Outfall 700	1	--	0.0426	77.9	--	--	--	--
Outfall 724	--	--	0.00213	--	--	--	--	--
Outfall 992	--	--	0.0129	--	--	--	--	--
Outfall 05A	--	--	1.28/0.232	--	--	--	--	--
Outfall 170	--	--	0.014	--	--	--	--	--
Outfall 190	--	0.76	0.249	--	--	--	--	0.479
Outfall 350	0.66	0.5	0.0773	--	15	--	--	--
Outfall 694	--	--	0.299	--	--	--	--	--

[a]J is a sample result that is above the sample detection limit but below the sample quantitation limit.

Table 3.35. Screening level exceedances from 2013 permit renewal application sampling for 2010, radiological

	Total Uranium (µg/L)	Gross Alpha (pCi/L)	U-233/234 (pCi/L)	U-238 (pCi/L)
Screening level	**31**	**15**	**20**	**24**
Outfall 380	34.9	58.2	---	---
Outfall 350	75	---	34.9	24.8
Outfall 724	113	89.1	45.1	37.7

3.5.5.7 Sampling of K-1037 Sumps

Approximately 104 sumps were once located in various building basements, switchyards, and other facilities around ETTP. Many of the sumps no longer discharge because the sump pump has been removed or de-energized, or the building served by the sump has been demolished or abandoned and the sumps have been filled. Water from the sumps that are still active may be discharged to the ETTP storm water drainage system or the ETTP sanitary sewer system.

Sumps were sampled as part of the ETTP accumulated water discharge program from 1994 until 1998. During 1998, ETTP Clean Water Act Program personnel analyzed the historical data from the previous year's sampling events and determined that the sump program would be suspended. A few selected sumps were sampled as part of the 2002 SWP3 sampling program, and the sumps located in the K-732 switchyard were sampled in August 2009.

In 1997, building operators were requested to register all sumps located within their buildings. Two sumps were identified and registered for Building K-1037.

1. Sump S-093 is located in the southwest corner of the basement of Building K-1037 adjacent to column T-21. It was stated on the registration form that the sump discharged "behind K-1037 to SD-170." It is believed that the sump may discharge through a pipe that empties into the concrete ditch located south of Building K-1037.
2. Sump S-094 is located near the southwest wall of Building K-1037 adjacent to column L-34. It was stated on the sump registration form that the sump discharged "behind K-1037 to SD-170." As with sump S-093, it is believed that the sump may discharge through a pipe that empties into the concrete ditch located south of K-1037. It is believed that sumps S-093 and S-094 discharge to the concrete drainage ditch through separate pipes. It is believed that both of these sumps remain active.

The monitoring of these sumps was performed to accomplish several objectives.

1. The last data available for these sumps were collected in 1998. Therefore, more up-to-date analytical data were needed from the sumps.
2. As stated in the registration forms, the sumps were believed to discharge to the concrete channel located south of Building K-1037. However, it was also possible that the sumps discharge to an underground storm drain pipe that passes underneath the southwest portion of the building. Sampling the sumps was performed to help verify the actual discharge location.
3. During past sampling activities in the storm drain network downstream of the sumps, a pulsing of the flow was noted. It was hypothesized that the pulsing could be due to the periodic activation of the sumps. Sampling was performed to determine the possible reason for the pulsing of the flow.

Sampling of the sump discharges as they enter the concrete channel south of K-1037 was not considered to be a feasible option. It required that sampling personnel observe the discharge pipes during times when they might flow in order to collect samples from them. The sump pumps may have required several minutes or several hours between discharge cycles. Unless sampling personnel were there at the exact time the pumps are operating and a discharge is occurring, sampling of the sumps would not be possible at the discharge pipes. In addition, accessing the concrete channel by walking down the hill south of K-1037 may have presented a safety hazard. The vegetation (kudzu, etc.) on the side of the hill could have caused tripping and slipping hazards as well as hide potential hazards such as groundhog holes, debris, etc.

Security concerns exist that are related to past operations in Building K-1037. Due to security and logistical concerns, sampling in the storm drain system downstream of the pipes the sumps in the building may be discharging from was preferable to trying to sample the sumps themselves. Therefore, samples were collected from the following locations.

1. Basin 14015 is located downstream of the western end of the concrete channel near the K-1501 steam plant footprint. It receives all of the water that collects in the portion of the concrete channel located southwest of Building K-1037. This includes drainage from the hill south of K-1037 as well as any discharges that may be routed from the southwest corner of Building K-1037. If the sumps located in

K-1037 discharge into the concrete channel, samples from this basin will indicate whether there are concerns with the discharge.

2. Manhole 9006 is located in the CNF area near the southwest corner of Building K-1419. Due to access concerns with other manholes further upstream, this is the first manhole that can be sampled that isolates portions of the north, west, and south sides of Building K-1037. In addition to carrying runoff from the concrete channel after it enters basin 14014, basin 9006 also collects runoff and building discharges from the west side of K-1037.

Samples at catch basin 14015 and 9006 were collected for the parameters specified in Table 3.36.

Table 3.36. Building K-1037 sump sampling parameters, 2010

Sampling location	Gross alpha/gross beta	VOCs	ICP metals	Total mercury
Catch basin 9006	X	X	X	X
Catch basin 14015	X	X	X	X

Detectable levels of mercury were identified in both catch basins. Samples from catch basin 9006 had a mercury level of 9.83 ng/L. Samples from catch basin 14015 had a mercury level of 4.31 ng/L. Neither of these results are above the ambient water quality standard for mercury, which is 51 ng/L. Since both of these basins received runoff from the former K-1501 Steam Plant, it is possible that these traces of mercury could be due to the combustion of coal in that facility. No other analytes were detected above screening limits as part of this sampling event.

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

A pulsing in the flow pattern was observed downstream of Building K-1037 during past sampling events in the outfall 170 drainage system. It was believed that the pulsing of the flow was related to the cycling of the sump pumps in Building K-1037. In an effort to determine if these sump pumps were the reason for the pulsing of the flow downstream, flow observations were made at both basins over a period of approximately 15 min. No noticeable change in the flow at either of these catch basins was observed during the observations. This could be due to any of the following reasons:

- lack of discharge from the sumps during the time the flow was being observed,
- masking of the flow variation due to increased flow in the piping system from storm water runoff, or
- absence of other unknown conditions that caused the flow pulsations during previous observations.

At the time of the flow observations, sampling personnel heard water trickling into the piping system immediately below manhole 14015. There was no way to access this inflow for sampling, so no confirmation of the source of this flow could be made. The flow was discharging at a very low rate, so it was most likely storm water or groundwater entering the piping by moving through the soil to a crack or joint in the piping.

Since no variations in the flow were observed, it appears unlikely that water from the cycling of the sumps is causing any pulsing of the flow. However, it is unknown as to whether the water that was heard entering the piping system could be affecting the flow in some way.

3.5.5.8 Sampling of Legacy Chromium Groundwater Plume Discharge

The release of hexavalent chromium into Mitchell Branch from the storm drain 170 outfall and from seeps at the headwall of the storm drain 170 discharge point resulted in levels of hexavalent chromium that exceeded state of Tennessee ambient WQC. Immediately below storm drain 170, hexavalent chromium levels were measured at levels as high as 0.78 mg/L, which exceeded the state of Tennessee hexavalent chromium water quality chronic criterion of 0.011 mg/L for the protection of fish and aquatic life. The elevated hexavalent chromium levels at the storm water 170 outfall were first detected in October 2007.

The levels of total chromium were at approximately the same value, indicating that the chromium was almost completely hexavalent chromium at the release point. On July 20, 2007, TDEC sent a Notice of Violation to DOE for the hexavalent chromium release, and DOE responded on August 3, 2007.

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

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

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

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

DOE complied with the ARARs and “to-be-considered” guidance, as set forth in the Action Memorandum, to the extent practicable. The ambient water quality chronic criteria for hexavalent chromium during dry weather base flow periods were not met with the initial action. The action reduced the level of hexavalent chromium in Mitchell Branch by approximately 98% from 0.78 mg/L to levels as low as 0.014 mg/L during worst-case dry weather base flow periods. During wet weather periods, the level of hexavalent chromium in Mitchell Branch was reduced from 0.025 mg/L to current levels that are below method detection thresholds of 0.012 mg/L. The time-critical removal action is documented in the *Removal Action Report for the Reduction of Hexavalent Chromium Releases into Mitchell Branch at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2001a).

Since the Removal Action Report was issued, additional improvements to the collection system have been implemented. The original pneumatic groundwater collection system pumps had a maximum capacity of approximately 8 to 9 gal/min, and the pumps required frequent field maintenance to keep them operating at the maximum rate. In January 2009 electric pumps were installed as replacements for the pneumatic pumps, and the new pumps have a combined maximum pump rate in excess of 20 gal/min. The new pumps have been set at an operational rate of 12 gal/min, which is a rate at which the hexavalent chromium levels in Mitchell Branch consistently have been below the ambient water quality criterion of 0.011 mg/L.

To monitor the continued effectiveness of the collection system, periodic monitoring continued as part of the 2010 SWP3. Samples were collected at piezometer TP-289, K-1407-V hose, outfall 170, and Mitchell Branch Kilometer (MIK)-0.79. Samples collected at TP-289 directly monitor the concentrations of chromium in the contaminated groundwater plume. Samples collected from the K-1407-V hose monitor the chromium in the water recovered by the groundwater collection system. Samples collected at outfall 170 monitor the concentrations of chromium being discharged directly to Mitchell Branch. Samples at MIK-0.79 monitor chromium concentrations in Mitchell Branch after water discharged from outfall 170 has had a chance to mix with other flow in the branch.

Samples at these locations were collected on a monthly basis during either wet weather or dry weather conditions on an alternating basis. Samples were monitored each month for total chromium and on an “as requested basis” for hexavalent chromium at least two times during the year. All of the samples collected as part of this effort were collected using the manual grab sampling method. Manual grab samples were collected according to the guidelines specified in Sects. 3.1.2 and 3.3.1 of the EPA’s *NPDES Storm Water Sampling Guidance Document* (EPA 1992), and applicable procedures that have been developed by the sampling subcontractor. All guidelines stated in this SAP concerning sample documentation, analytical procedures, quality assurance/quality control, etc., were followed as part of this sampling effort. Figure 3.31 is a graph of the analytical data from this sampling effort.

The analytical data indicate that chromium levels may fluctuate slightly at the TP-289 and K-1407-V hose but are relatively consistent over the long term. Chromium values at outfall 170 and MIK 0.79 have much more variability. This is most likely due to the greater variability in flow rates at these two locations.

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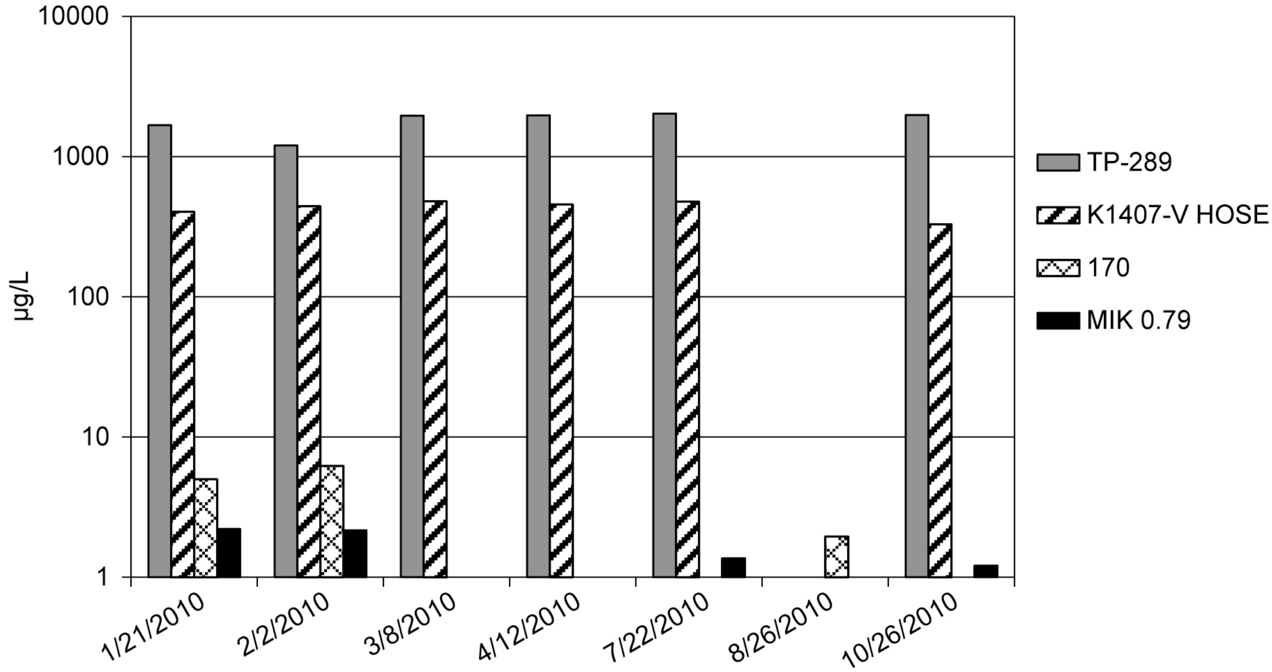

Fig. 3.31. Results from sampling conducted for the chromium collection system.

3.5.5.9 Investigation of Mercury at ETTP

Mercury activities at ETTP included usage, handling, and recovery operations. Mercury usage 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 onsite as well. Mercury recovery operations were conducted in a number of buildings, as shown on Fig 3.32. Many buildings were located in watersheds that discharged primarily to Mitchell Branch.

The 2010 NPDES permit requires quarterly mercury sampling to be performed at storm water outfalls 05A, 170, 180, and 190. These four locations were selected because the permit application information indicated that mercury levels at these outfalls exceeded the ambient water quality criteria (AWQC) level of 51 ng/L. Outfall 05A is the discharge point for the former sewage treatment plant drainage basin. Outfalls 170, 180, and 190 collect storm water from large areas on the north side of ETTP and discharge to Mitchell Branch.

In an effort to obtain analytical data utilizing a more sensitive method and to identify how the discharges from the storm water outfalls may be affecting the water quality of Mitchell Branch and associated waterways, mercury sampling was performed at numerous storm water outfalls with known historical mercury activities as well as surface water and sediment sampling being performed.

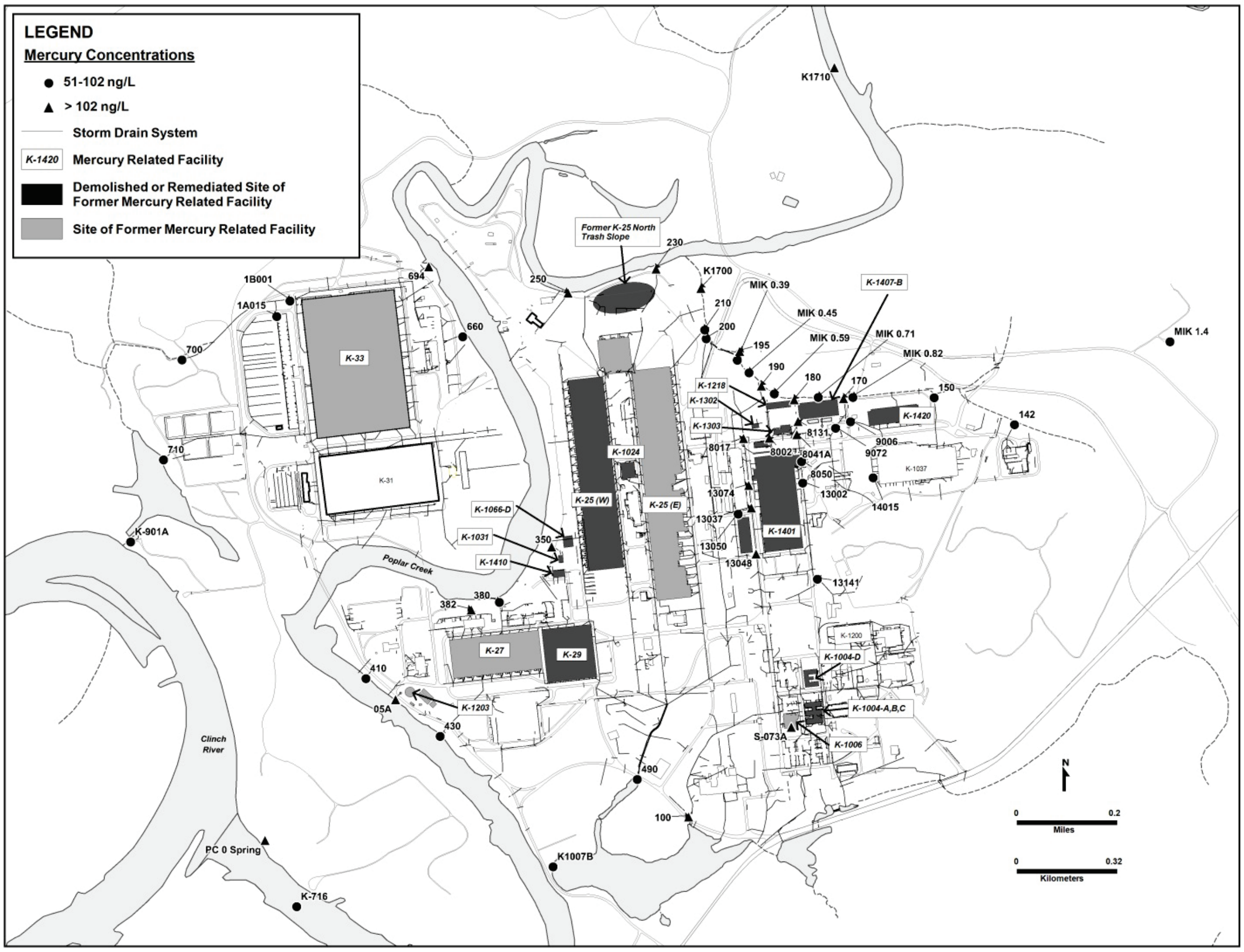

Fig. 3.32. ETTP area plan showing mercury-related facilities and mercury levels in water samples.

As stated above, the applicable water quality criterion for mercury is 0.051 μg/L; therefore, total mercury samples were analyzed by a laboratory with a method detection limit (MDL) for mercury below this criterion. For the storm water and surface water samples, the laboratory methods used for total mercury analysis are the EPA 1631 and 245.7 methods because their use results in detection levels below the water quality criterion. Depending on the laboratory that performs the analysis, the EPA 1631 method has a detection limit as low as 0.2 ng/L. Surface water samples are collected in dry weather conditions, unless otherwise specified. Storm water samples are collected during both wet and dry weather conditions. Wet weather samples are collected from flows resulting from a storm event greater than 0.1 in. in magnitude in 24 hr and that occurs at least 72 hr after any previous storm event of 0.1 in. or greater in 24 hr. If an intermittent rainfall occurs over a period of 24 hr and did not equal or exceed 0.1 in., it is not considered to be a storm event, and the 72-hr delay until the next rainfall that can potentially be sampled is not in effect. Dry weather samples are collected at least 72 hr after a storm event of 0.5 in. or greater. All dry weather samples are collected by the manual grab sampling technique. Current permit and permit renewal application samples are collected using automated sampling equipment consisting of at least three aliquots taken during the first 60 min of a storm event discharge.

For sediment samples, the laboratory method used for total mercury is the EPA SW846-7471A method. Sediment samples are collected by the manual grab sampling technique.

Results for storm water outfalls 170, 180, and 190 and associated catch basins for each network are shown in Figs. 3.33–3.35. Mercury results for outfall 170 as well as the associated catch basins appear to be well below the WQC since July 2009. For 2010, the results for outfall 170 ranged from 5.49 to 14 ng/L, which are well below the water quality criteria. Outfalls 180 and 190, and associated catch basins, appear to be the primary sources of mercury discharges into Mitchell Branch in relation to the buildings in those drainage areas with historical mercury processes. For 2010, the results for outfall 180 varied significantly in range from 4.23 to 638 ng/L. For 2010, the results for 190 varied in range from 14.8 to 249 ng/L. Outfall 180 appears to have fluctuations in mercury levels that are significantly higher than outfalls 170 and 190. This may be due to infiltration within the drainage system primarily from catch basins 8131 and 8041A in relation to former mercury processes in Buildings K-1303 and K-1401.

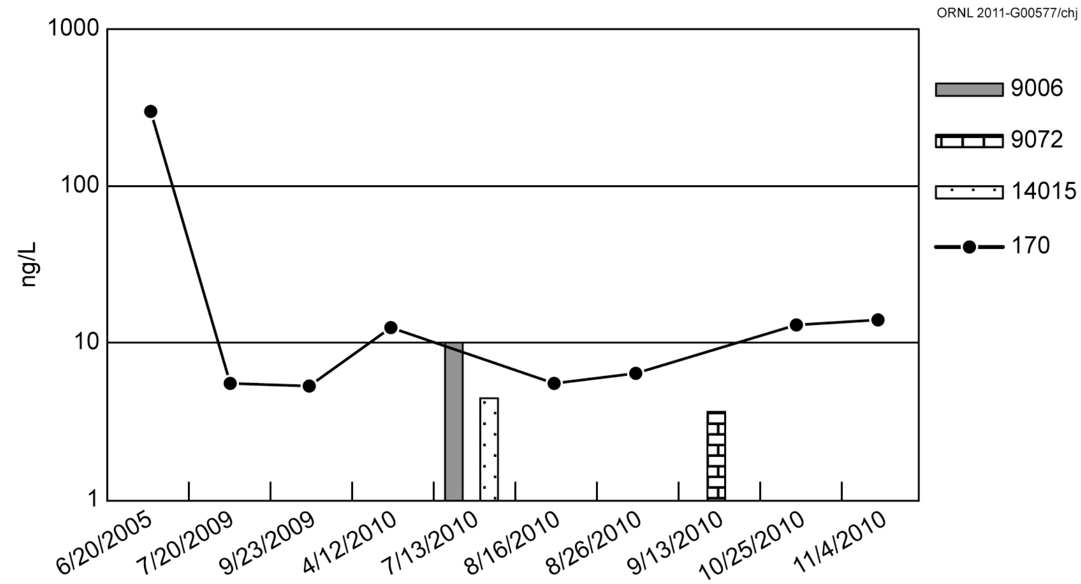

Fig. 3.33. Outfall 170 network water results for mercury.

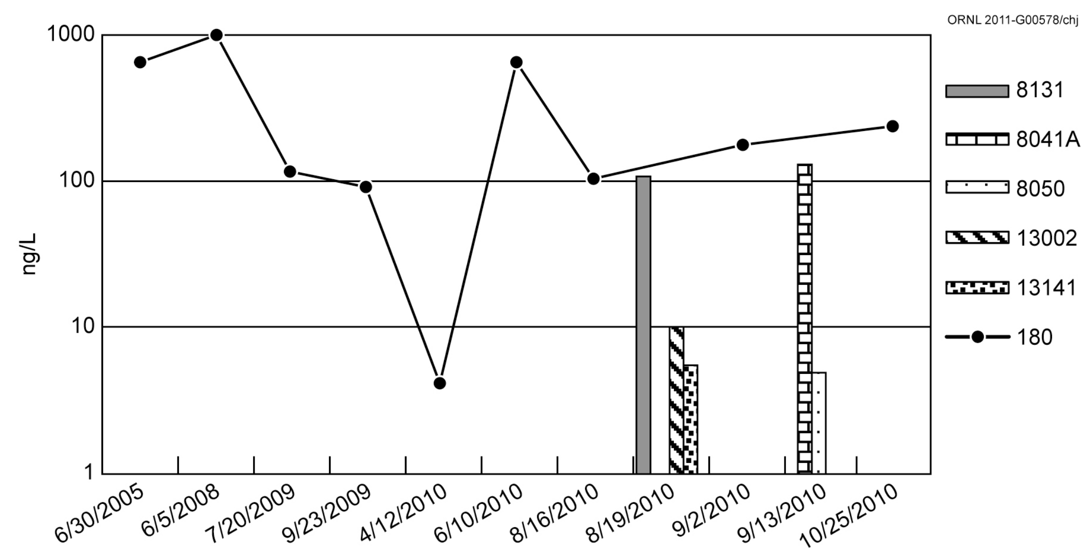

Fig. 3.34. Outfall 180 network water results for mercury.

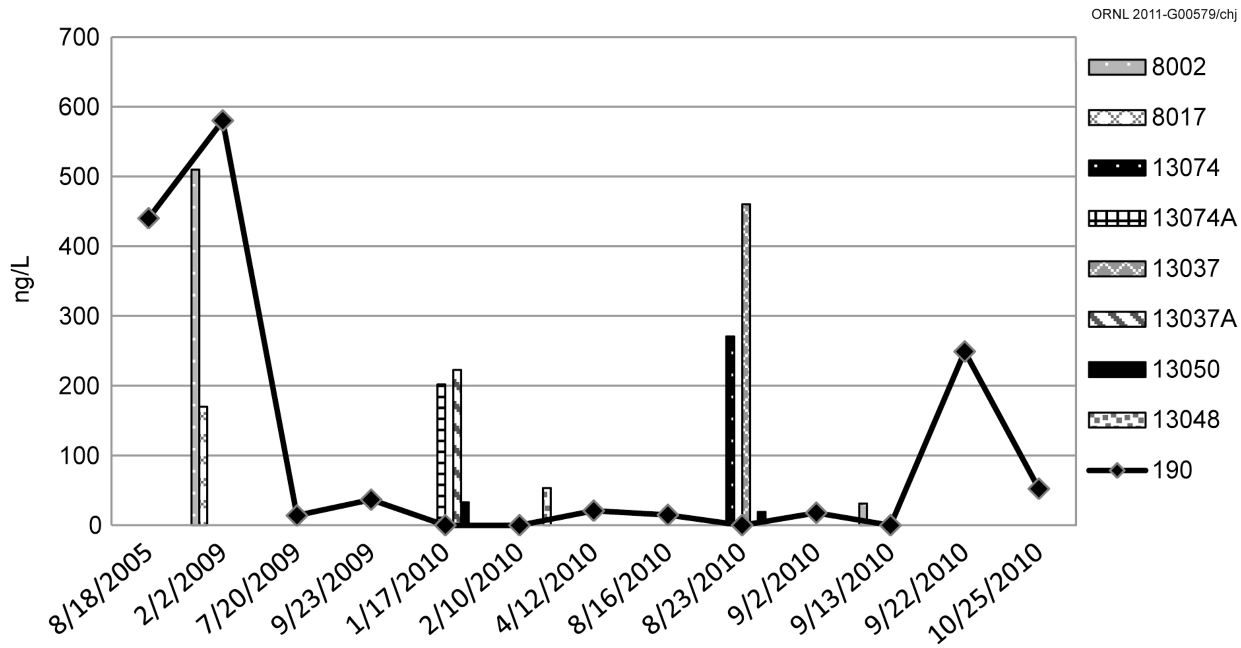

Fig. 3.35. Outfall 190 network water results for mercury.

Likely sources of mercury discharges in the outfall 180 drainage system are from Buildings K-1401, K-1405-7, and K-1407-B pond. The most likely sources of mercury discharges in the outfall 190 drainage system are from operations conducted in Buildings K-1035, K-1218, K-1301, K-1302, K1303, K-1401, and K-1413. By contrast, the mercury discharges in the outfall 170 drainage system would be from K-1420; however, the remediation of this area appears to have resulted in mercury levels below the WQC in contrast to the other two outfalls of Mitchell Branch.

Figure 3.36 shows the location and mercury data ranges for the Mitchell Branch storm water outfalls 170, 180, and 190 networks; however, the elevated result shown for outfall 170 was from a sample taken in June 2005, and by comparison, the 2010 results were well below the water quality criteria. Catch basin 13040 in the network for outfall 190 is shown on Fig. 3.36 in relation to Building K-1035, located directly to the west with known mercury processes. This catch basin is shown for future reference and was not sampled in 2010 but will be sampled in 2011.

The Mitchell Branch storm water outfall and in-stream water results for mercury are collectively shown in Fig. 3.37 and indicate the mercury results from in-stream at MIK 1.4 to downstream at the K-1700 weir. Outfall 180 indicates a significantly higher result in October 2010 in comparison to outfalls 170 and 190. As explained previously, this may be due to infiltration within the drainage system.

Figure 3.38 shows the Mitchell Branch sediment results for mercury. There are noticeably lower mercury levels in the upper areas of Mitchell Branch from the reference location, MIK 1.4, downstream toward outfall 170. There appears to be a seep from the nearby K-1070 burial grounds in the area of MIK 0.39 and MIK 0.45, downstream of outfall 190, to which the elevated levels of mercury may be attributed. Investigations will be conducted to determine if there is a seep in the vicinity of MIK 0.39 to MIK 0.45. Additionally, there appears to be another seep in the area of MIK 0.13 and MIK 0.24, noted by the significant rise in mercury levels at MIK 0.24 as compared to the significantly lower mercury levels at MIK 0.27. Further downstream at the K-1700 weir, there may be the deposition of sediment containing mercury levels noted by the significant rise in mercury levels at this location.

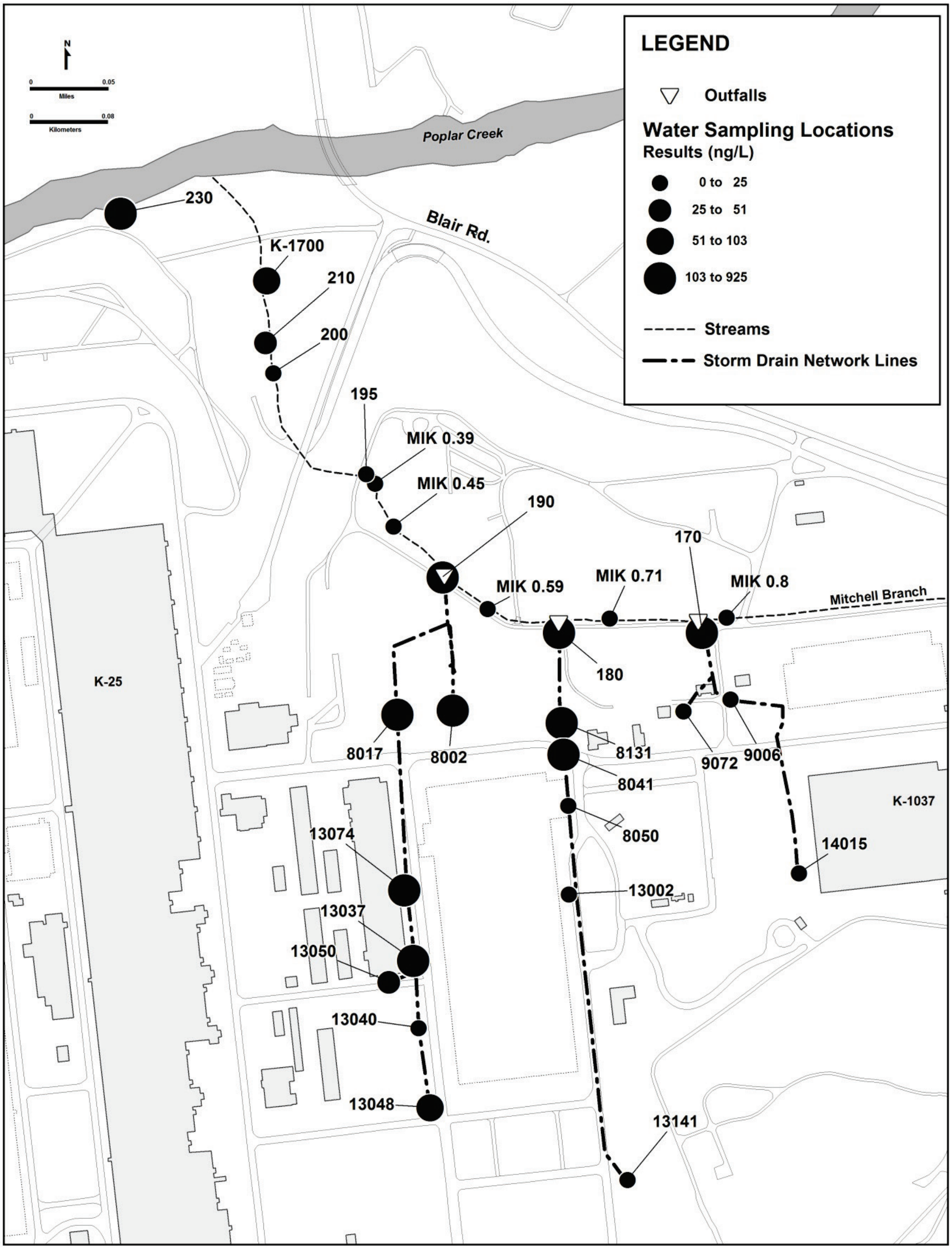

Fig. 3.36. Mitchell Branch water sampling locations and results for mercury.

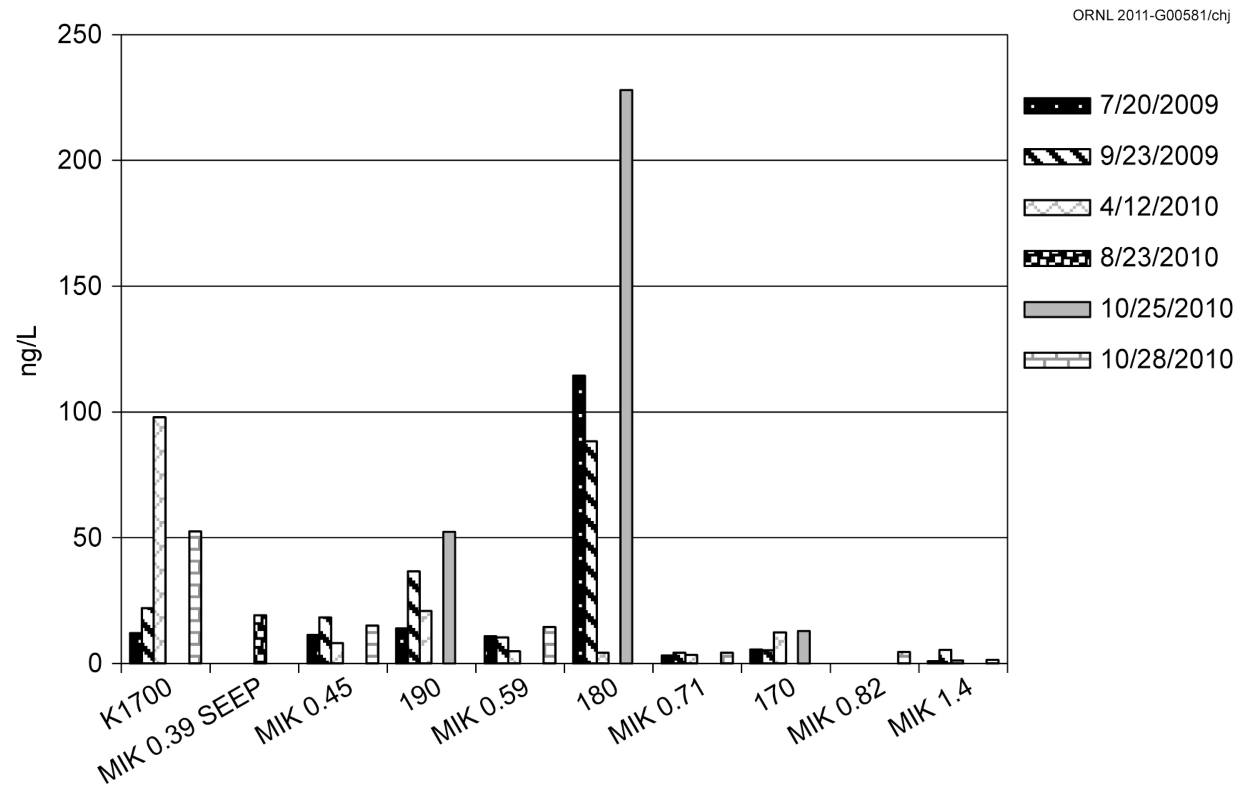

Fig. 3.37. Mitchell Branch storm water outfall and in-stream water results for mercury.

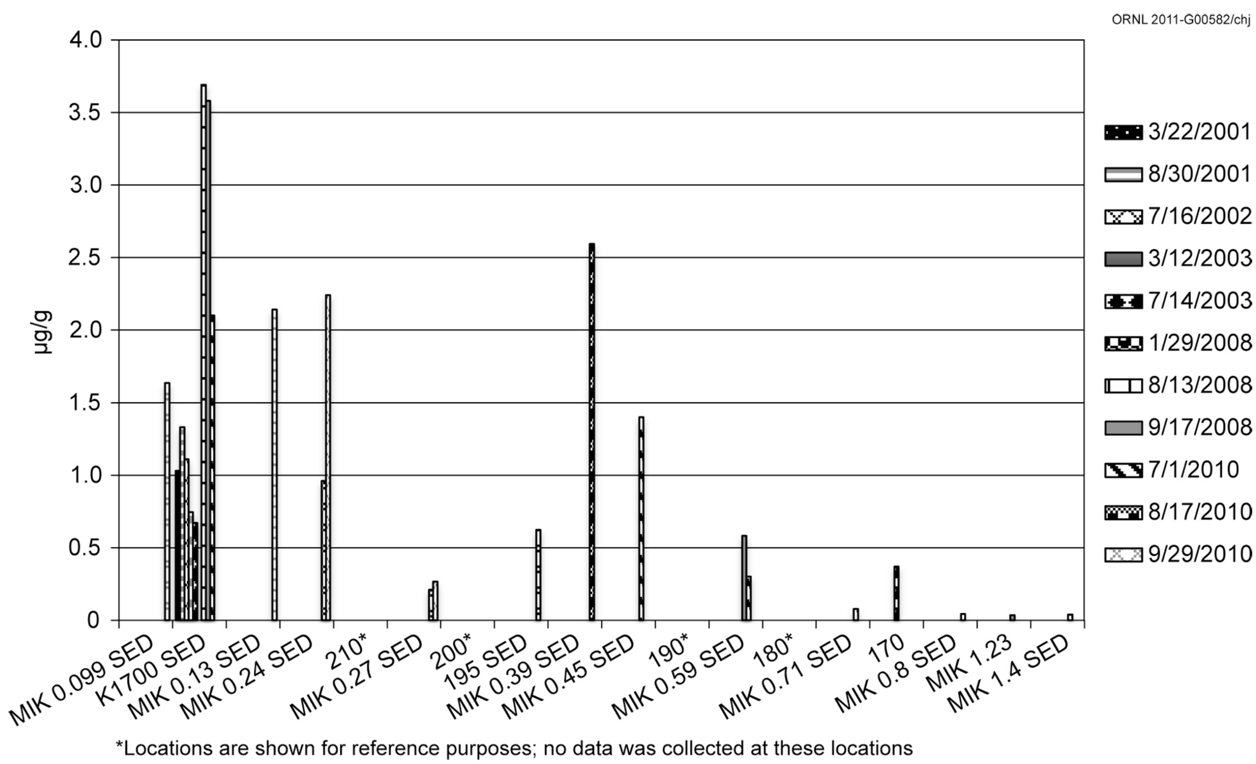

Fig. 3.38. Mitchell Branch storm water outfall and in-stream sediment results for mercury.

Figures 3.39 and 3.40 indicate the water and sediment results for mercury, respectively, at the K-1700 weir location, specifically. The K-1700 water results for mercury appear to be fairly steady from 2008 through 2009 but become elevated above water quality criteria in March and April of 2010, before decreasing toward water quality criteria levels by the end of October 2010. Water results for mercury samples taken as part of the K-1700 groundwater program substantiate the elevated mercury levels from early March to mid-August 2010. The K-1700 sediment results for mercury follow a similar trend but for a slightly different time period. Sediment levels for mercury appear steady from March 2001 to July 2003 at lower levels until sampled again in mid-August 2008 when noticeably higher mercury levels are apparent through early July 2010. These higher levels, quite possibly, were due to the accumulation of sediment at this location resulting from storm water discharges and seeps containing mercury that are depositing into Mitchell Branch.

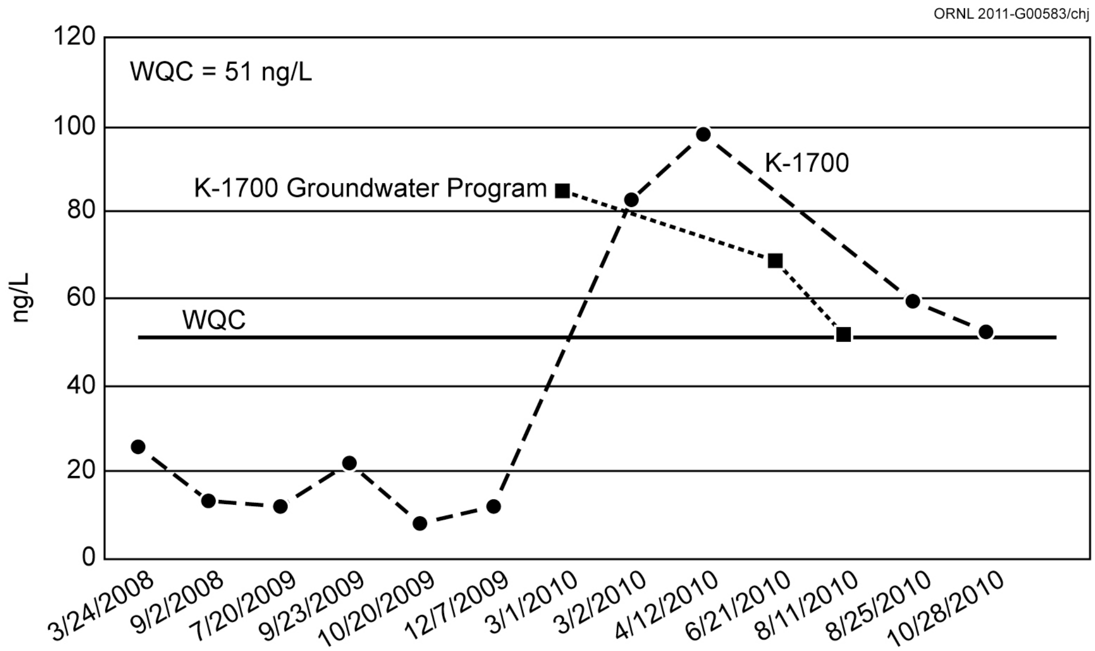

Fig. 3.39. The K-1700 water results for mercury.

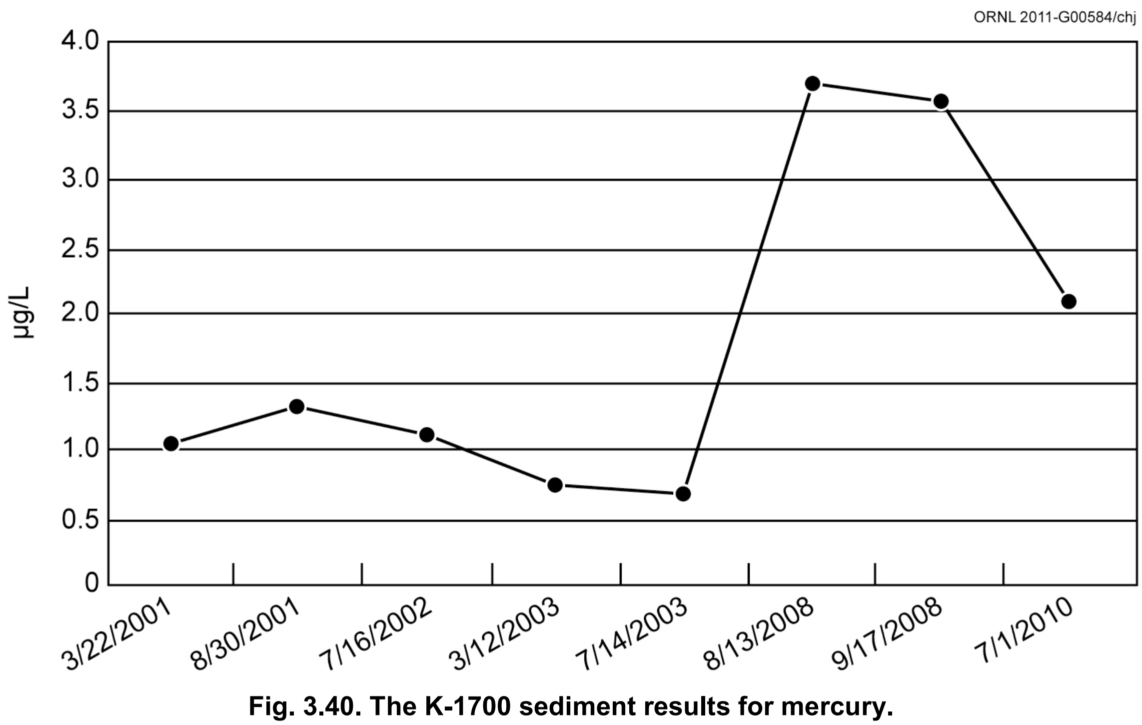

Fig. 3.40. The K-1700 sediment results for mercury.

Another area of elevated mercury levels is the site of the former sewage treatment plant and associated storm water outfall 05A. As stated above, storm water outfall 05A requires quarterly mercury sampling because the permit application information indicated that mercury levels at this location exceeded the water quality criteria level of 51 ng/L. Outfall 05A is the discharge point for the former sewage treatment plant drainage basin. Operations at the plant ceased in 2008. Figure 3.41 indicates the locations of the storm water outfall 05A, the K-1203-10 sump, and four groundwater wells that have been monitored for mercury. Table 3.37 shows the comparison of mercury levels between the influent and effluent sources as well as the sediment sample taken from the sump.

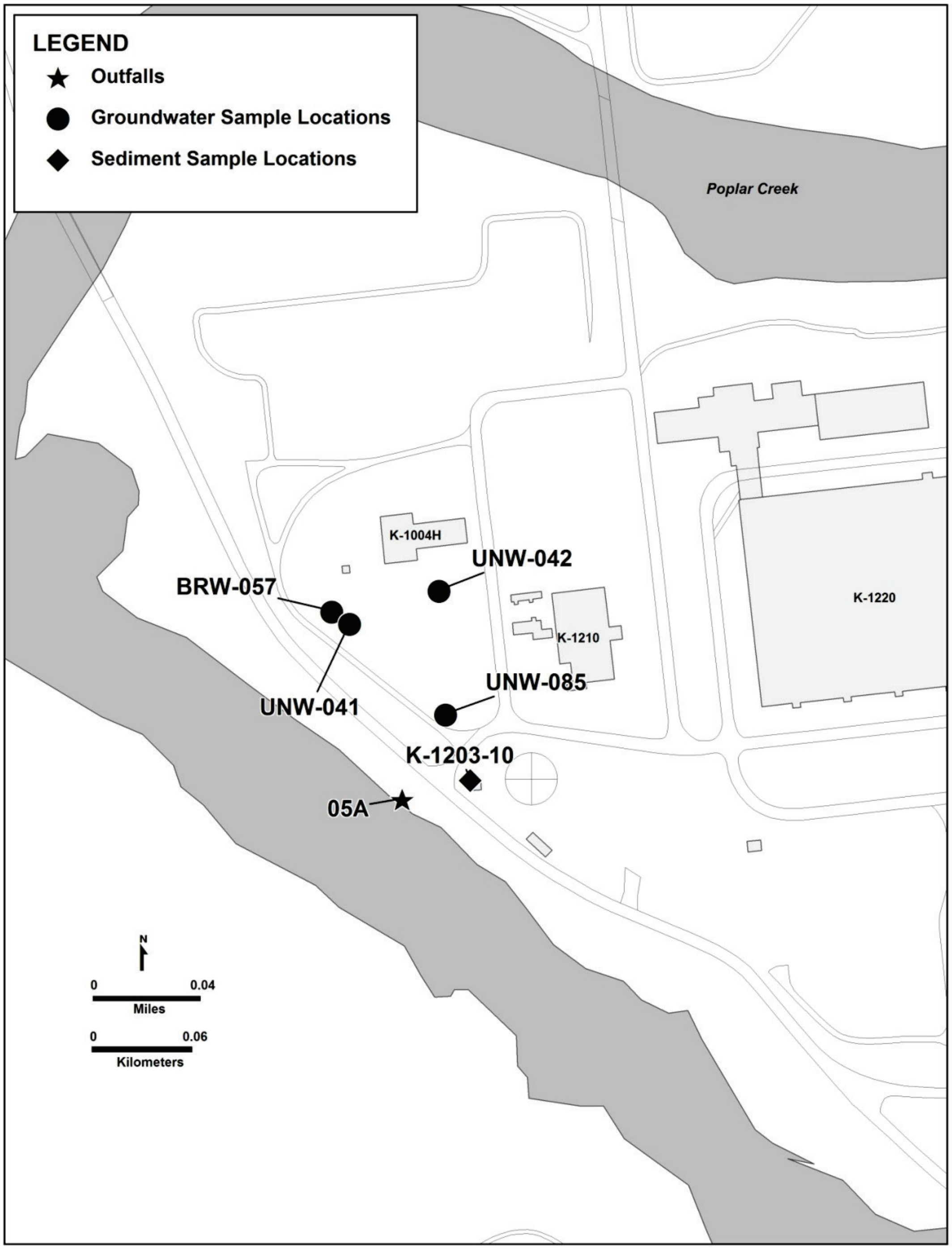

Fig. 3.41. The former sewage treatment plant monitoring locations for mercury.

Table 3.37. Mercury water and sediment results for the former sewage treatment plant

Water influent into K-1203-10 sump (ng/L)			Water effluent at outfall 05A (ng/L)		Sediment from K-1203-10 sump (µg/g)	
11/16/2010	05A-A	82.7	3/21/2006	140	8/17/2010	546.8
11/16/2010	05A-B	37.5	10/22/2007	108		
11/16/2010	05A-C	12.8	6/26/2008	205		
11/16/2010	05A-D	294.8	8/26/2008	135		
			4/12/2010	186		
			8/16/2010	66.4		
			8/26/2010	118		
			10/25/2010	223		

The influent water coming into K-1203-10 sump was monitored from four sources in 2010. Two sources (05A-A and 05A-C) are naturally occurring sheet flows coming into the sump. The other two sources (05A-B and 05A-D) are pipe flow sources. The pipeline for 05A-B is abandoned and runs from the clarifying basin located immediately next to the sump. The pipeline for 05A-D is labeled on historical drawings as being partially abandoned and runs approximately 65–70 ft from the chlorine contact basin (K-1203-8). Two of the influent sources coming into the sump were above WQC (05A-A and 05A-D) in 2010; the highest mercury result was 294.8 ng/L at 05A-D. All four influent sources are to be resampled for mercury in 2011.

Figure 3.42 indicates the mercury results in the effluent water at outfall 05A since 2006. As shown, all results for the past 5 years are above WQC. In 2010, specifically, outfall 05A was monitored four times; the highest mercury result was 223 ng/L on October 25, 2010. Additional monitoring was performed for the former sewage treatment plant area in 2010. Sediment was taken from the sump with a result of 546.8 µg/g, as shown on Table 3.37. Four groundwater wells were also monitored—three unconsolidated wells (UNW-041, UNW-042, UNW-085) and one bedrock well (BRW-057). The results are shown in Table 3.38. One groundwater well had a result above WQC (BRW-057) with a result of 68.7 ng/L; however, the origin of the mercury is not known due to the karst topography of the area.

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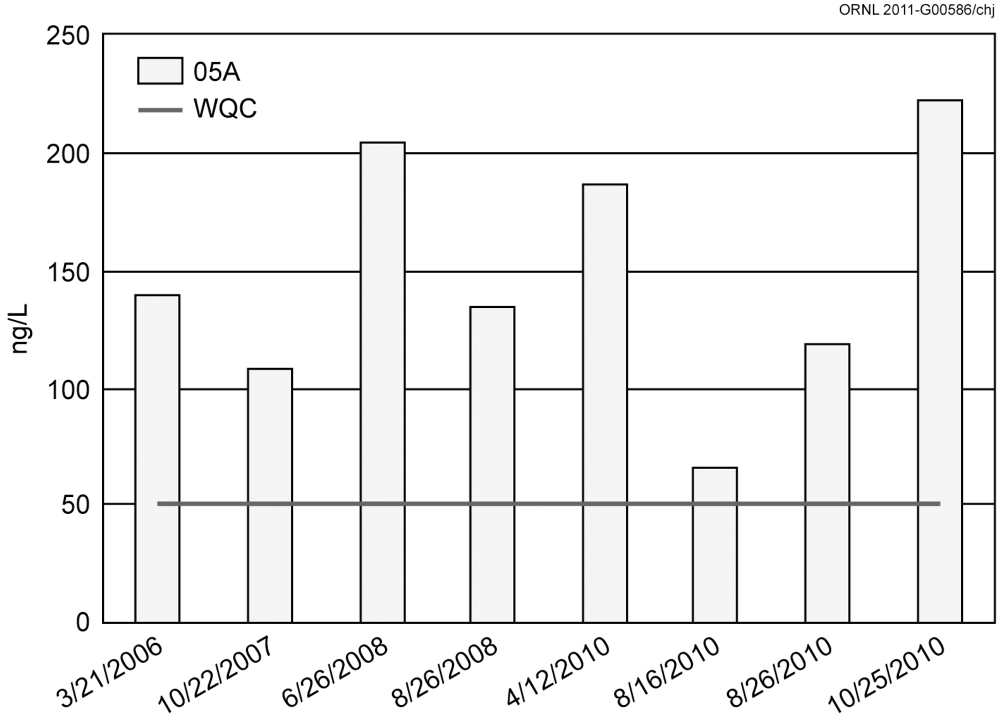

Fig. 3.42. Storm outfall 05A water results for mercury.

Table 3.38. Mercury results of groundwater monitoring performed in 2010 at the former sewage treatment plant area

Groundwater well	Date	Mercury result (ng/L)
UNW-085	11/2/2010	4.6
UNW-042	11/3/2010	5.4
UNW-041	11/4/2010	2.5
BRW-057	11/4/2010	68.7

Other storm water monitoring that was performed at outfalls at ETTP in 2010 with mercury results above WQC are shown in Table 3.39. Storm water outfall 230 is located downstream of Mitchell Branch and the K-1700 weir prior to Poplar Creek and receives storm water discharges from the east side of Building K-25 where it is possible mercury contamination may have occurred from a historically known area described as the K-25 North Trash Slope. Storm water outfall 350 is located on the west side of Building K-25 and receives storm water discharges from a relatively small area. Although historical references do not list mercury specifically as being stored, it may be possible that mercury-contaminated equipment was stored or leaked in this location. Storm water outfall 694 is located in the former powerhouse area and receives storm water discharge from a relatively large area. Several buildings are documented as having mercury processes or operations; therefore, it is likely that the mercury contamination originates from these areas.

Table 3.39. Storm water results of mercury monitoring in 2010 at other ETTP locations above WQC

Storm water outfall	Date	Mercury result (ng/L)
230	8/12/2010	109
350	10/25/2010	77.3
694	11/30/2010	229

Further monitoring for mercury is proposed in 2011 for the Mitchell Branch, former sewage treatment plant, and other locations as part of the NPDES permit program, storm water pollution prevention program, environmental monitoring program, groundwater program, and biological monitoring and abatement program (BMAP). Historical documents continue to be researched, and future monitoring is proposed as part of the ongoing mercury investigation.

3.5.5.10 NPDES Monitoring at the CNF Waste Water Treatment System

Nonradiological monitoring of CNF effluent is conducted according to the requirements of NPDES Permit No. TN0074225. Monitoring requirements, frequencies, and sample types required under the permit changed during 2010 with the reissuance of the permit on December 1, 2010. During the permit renewal process, the CNF was reclassified from the Metal Finishing category into the Centralized Wastewater Treatment category by the permit writer. This change in point source category largely effected the change in parameters between the previous permit and the renewed permit. The requirements prior to December 1, 2010, are listed in Table 3.40, and the requirements post-December 1, 2010, are listed in Table 3.41. There was also an overall decrease in the sampling frequency between the previous permit and the renewed permit that was based on sampling results from CNF for the previous 3 years. Wastewater from CNF is discharged through outfall 001 into the Clinch River.

Radiological sampling of effluent from the CNF is conducted weekly according to the requirements of NPDE's Permit No. TN0074225. The weekly samples are then composited into a single monthly sample. Table 3.42 lists the total discharges in 2010 by isotope. The radiological results are compared with the DCGs. The sum of the fractions must be kept below 100% of the DCGs; in practice the effluent results from the CNF were well below 100% of the DCGs until 2007. Figure 3.43 shows a rolling 12-month average for 2010. Monitoring results for 2010 showed a marked decrease

Table 3.40. NPDES Permit No. TN0074225 outfall 001 monitoring requirements (prior to December 1, 2010)

Parameter	Collection frequency	Sample type
Flow	Continuous	Recorder
pH	Continuous	Recorder
Total suspended solids (TSS)	Weekly	24-hr composite
Chemical oxygen demand (COD)	Weekly	24-hr composite
Benzene	Bimonthly	Grab
Ethylbenzene	Bimonthly	Grab
Toluene	Bimonthly	Grab
Methylene chloride	Bimonthly	Grab
Bromoform	Monthly	Grab
Carbon tetrachloride	Monthly	Grab
Chlorodibromomethane	Monthly	Grab
Chloroform	Monthly	Grab
Dichlorobromomethane	Monthly	Grab
Tetrachloroethylene	Monthly	Grab
1,1,1-Trichloroethane	Monthly	Grab
Trichloroethylene	Monthly	Grab
Vinyl chloride	Monthly	Grab
Naphthalene	Monthly	Grab
Oil and grease	Monthly	Grab
Total petroleum hydrocarbons (TPH)	Monthly	Grab
Chloride, total	Monthly	24-hr composite
Polychlorinated biphenyls (PCBs)	Monthly	24-hr composite
Uranium, total	Monthly	Monthly composite
Gross alpha radioactivity	Monthly	Monthly composite
Gross beta radioactivity	Monthly	Monthly composite
^{234}U	Monthly	Monthly composite
^{235}U	Monthly	Monthly composite
^{236}U	Monthly	Monthly composite
^{238}U	Monthly	Monthly composite
^{99}Tc	Monthly	Monthly composite
^{137}Cs	Monthly	Monthly composite
^{238}Pu	Monthly	Monthly composite
^{239}Pu	Monthly	Monthly composite
^{237}Np	Monthly	Monthly composite
Other radionuclides—determined monthly	Monthly	Monthly composite
Cadmium, total	Quarterly	24-hr composite
Chromium, total	Quarterly	24-hr composite
Copper, total	Quarterly	24-hr composite
Lead, total	Quarterly	24-hr composite
Nickel, total	Quarterly	24-hr composite
Silver, total	Quarterly	24-hr composite
Zinc, total	Quarterly	24-hr composite
Mercury, total	Quarterly	24-hr composite
Acetone	Quarterly	Grab
Acetonitrile	Quarterly	Grab
Methyl ethyl ketone	Quarterly	Grab
Chlordane	Quarterly	Grab
Total toxic organics (TTO)[a]	Quarterly	Grab
Settleable solids[b]	Biannually	Grab
Cyanide, total	Annually	Grab

[a] TTOs include, at a minimum, chloroform, bromoform, dichlorobromomethane, chlorodibromomethane, carbon tetrachloride, tetrachloroethylene, methylene chloride, naphthalene, benzene, ethylbenzene, toluene, and PCB. Other parameters listed in 40 CFR Part 433 are analyzed if their presence is suspected based on process knowledge.

[b] To comply with DOE Order 5400.5, Chap. II, 3.a.(4), the presence of settleable solids greater than 0.1 mg/L must be determined. If settleable solids are present, the sample will be filtered and the solids will be analyzed for total uranium, gross alpha radioactivity, and gross beta radioactivity. Sufficient volume shall be collected and held for radiological analyses. “Settleable solids” is not a NPDES permit parameter, and the result is not reported with the discharge monitoring report.

Table 3.41. NPDES Permit No. TN0074225 Outfall 001 monitoring requirements (since December 1, 2010)

Parameter	Measurement frequency	Sample type
Flow	Continuous	Recorder
pH	Continuous	Recorder
^{137}Cesium	1/month	Monthly composite
^{234}Uranium	1/month	Monthly composite
^{235}Uranium	1/month	Monthly composite
^{236}Uranium	1/month	Monthly composite
^{237}Neptunium	1/month	Monthly composite
^{238}Plutonium	1/month	Monthly composite
^{238}Uranium	1/month	Monthly composite
^{239}Plutonium	1/month	Monthly composite
^{99}Technetium	1/month	Monthly composite
COD	1/month	24-h composite
Gross alpha radioactivity	1/month	Monthly composite
Gross beta radioactivity	1/month	Monthly composite
Oil and grease	1/month	Grab
Other radionuclides contained in wastewater[a]	1/month	Monthly composite
Uranium, total	1/month	Monthly composite
2-4-6-Trichlorophenol	1/quarter	24-h composite
Acetone	1/quarter	Grab
Acetophenone	1/quarter	24-h composite
ICP metals[b]	1/quarter	24-h composite
Methyl ethyl ketone (2-Butanone)	1/quarter	Grab
o-Cresol (2-Methyl Phenol)	1/quarter	24-h composite
p-Cresol (4-Methyl Phenol)	1/quarter	24-h composite
Phenol	1/quarter	24-h composite
Pyridine	1/quarter	24-h composite
Trichloroethylene	1/quarter	Grab
TSS	1/quarter	24-h composite
Biochemical oxygen demand (BOD)	1/year	24-h composite
Chloroform	1/year	Grab
Mercury, Methyl	1/year	Grab
Mercury, total	1/year	24-h composite
PCBs	1/year	24-h composite

[a]Other radionuclides currently being analyzed each month are ^{241}Am, ^{3}H, ^{14}C, ^{230}Th, ^{234}Th, ^{60}Co, and ^{131}I.

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

Table 3.42. Isotopic discharges from the Central Neutralization Facility Waste Water Treatment System, 2010

Isotope	Curies	Isotope	Curies
^{241}Am	3.9E–6	^{239}Pu	2.2E–6
		^{99}Tc	3.3E–2
^{137}Cs	7.1E–5	^{230}Th	7.9E–6
^{60}Co	2.0E–5	^{234}Th	2.5E–3
^{3}H	5.6E–3	^{234}U	2.5E–3
^{131}I	1.7E-5	^{235}U	2.5E–4
^{237}Np	1.1E–5	^{236}U	2.5E–4
^{238}Pu	1.8E–6	^{238}U	2.5E–3

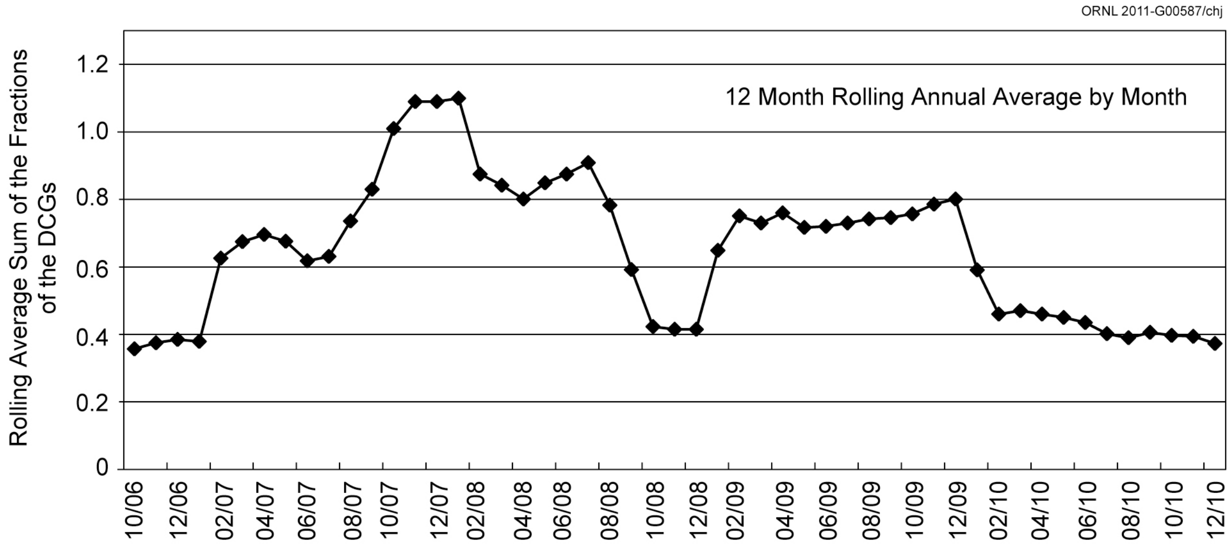

Fig. 3.43. CNF/K-1435 Waste Water Treatment System radionuclide liquid discharges.

in the rolling 12-month average of the sum of the fractions of the DCGs from a high of 1.1 in January 2008 to 0.4 in December 2010. In most of 2010, the rolling average of the sum of the fractions has remained steady at 0.4 to 0.5. The cessation of waste-burning activities at the TSCA Incinerator may account for much of the decrease. Other factors include changes in operations at the facility to enhance the removal efficiency.

Although uranium isotopes constitute the greatest mass (approximately 7.7 kg) of radionuclides discharged from CNF, ^{99}Tc and tritium account for the greatest activity, due to their much higher specific activities. Transuranic isotopes constitute a small fraction of the total.

3.5.5.11 NPDES Permit Noncompliances

During 2010 ETTP and Bechtel Jacobs operations were conducted in compliance with contractual and regulatory environmental requirements. A single NPDES permit noncompliance attributable to an unpermitted discharge to the storm water drainage system occurred on January 20, 2010. A contractor maintenance worker for an on-site commercial firm poured the contents of two 5-gal paint cans into a storm drain catch basin.

3.5.6 Surface Water Monitoring

During 2010 the ETTP environmental monitoring program personnel conducted environmental surveillance activities at 13 surface water locations (Fig. 3.44) to monitor groundwater and storm water runoff (K-1700, K-1007-B, and K-901-A) or ambient stream conditions [Clinch River kilometer (CRK) 16; CRK 23; K-1710; K-716; K-700 Slough; and MIK 0.5, 0.6, 0.7, 0.8 and 1.4]. Depending on the location, samples were collected and analyzed for radionuclides quarterly (K-1700 and MIK 0.5, 0.6, 0.7, 0.8, and 1.4) or semiannually (remainder of locations). Results of radiological monitoring are compared with the DCGs. Radiological data are reported as fractions of DCGs for reported radionuclides. If the sum of DCG fractions for a location exceeds 100% for the year, a source investigation is required. Sources exceeding DCG requirements would need an analysis of the best available technology to reduce the sum of the fractions of the radionuclide concentrations to their respective DCGs to less than 100%. Comparisons with DCGs are updated regularly to maintain an annual average. The monitoring results at several locations were less than 1% of the allowable DCG (Fig. 3.45). The exceptions are K-1700 and four of locations on Mitchell Branch, as indicated by the sums of the fractions of the DCGs for these locations as follows:

- K-1700: 2.2%,
- MIK 0.5: 2.7%,
- MIK 0.6: 1.9%,
- MIK 0.7: 1.9%, and
- MIK 0.8: 4.2%.

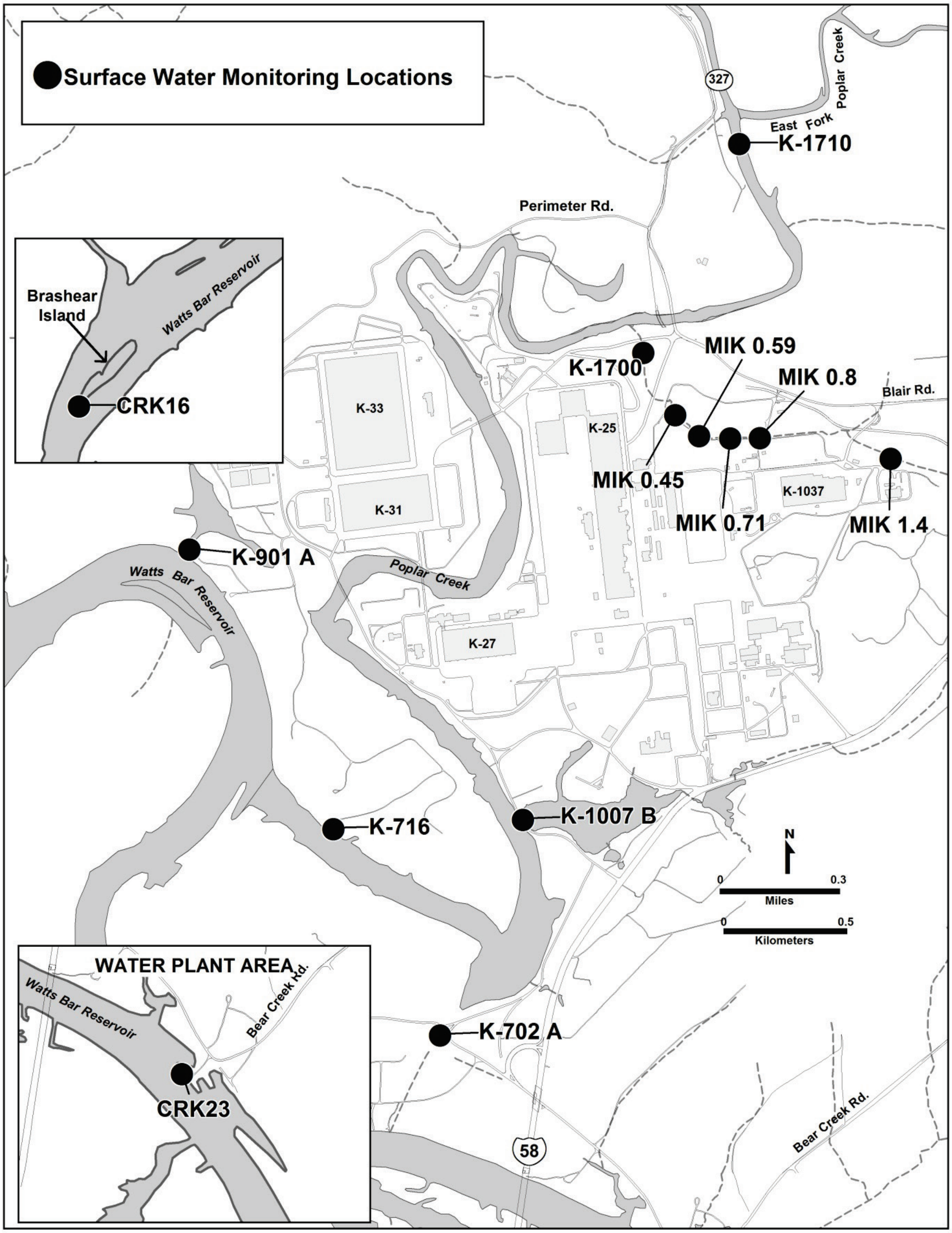

Fig. 3.44. Environmental monitoring program surface water monitoring locations.

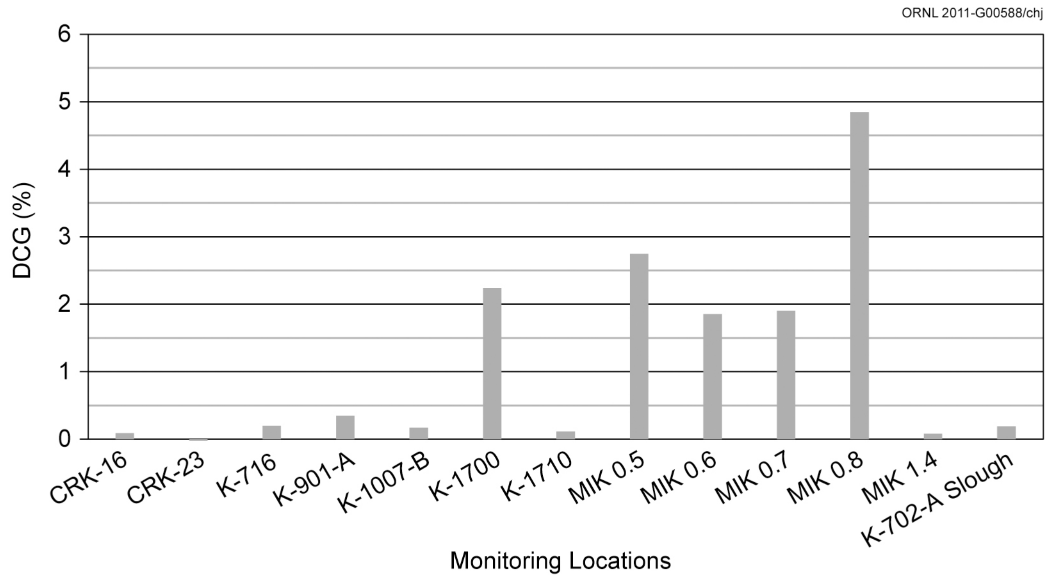

Fig. 3.45. Percentage of derived concentration guides (DCGs) at surface water monitoring locations, 2010.

The percentage of the DCGs at K-1700 (2.2%) was slightly below the percentage of the 2009 monitoring results (2.7%).

Depending on the monitoring location, water samples may be analyzed for pH, selected metals, and VOCs. In 2010, results for most of these parameters were well within the appropriate Tennessee state WQC.

The WQC for dissolved oxygen in stream and ponds is a minimum level of 5 mg/L. In the late summer and fall 2010 monitoring, dissolved oxygen levels at several of the surface water monitoring locations fell below this level. The lowest level (1.7 mg/L) was measured at K-901-A in August. Levels at the K-700 Slough, K-1007-B, K-1700, K-1710, and MIKs 0.5, 0.6, 0.7and 1.4 were also measured at less than 5 mg/L at some point during 2010. Low levels of dissolved oxygen are not uncommon in area streams and are usually associated with higher temperatures (and the associated elevated levels of biological activity) and low rainfall and stream flow. No obvious signs of distress (e.g., dead fish) were observed to be associated with any of these measurements in 2010.

The WQC for mercury is 0.051 µg/L. In 2010, levels of mercury were routinely measured above this level in water collected from K-1700. For details, please see the discussion of the site-wide mercury investigation given in Sect. 3.5.1.

Figures 3.46 and 3.47 illustrate the concentrations of TCE (trichloroethene, trichloroethylene) and total 1,2-DCE (dichloroethene, cis-1,2-dichloroethylene, trans 1,2-dichloroethylene) from K-1700 (which monitors 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 WQC for recreation, organisms only (300 µg/L for TCE and 10,000 µg/L for trans 1,2-DCE, Appendix D, Table D.2), which are appropriate standards for Mitchell Branch. Moreover, the standards for 1,2-DCE apply only to the "trans" form of 1,2-DCE; almost all of the 1,2-DCE is in the cis-isomer. In addition, vinyl chloride has sometimes been detected in Mitchell Branch water (Fig. 3.48). Volatile organic compounds have been detected in groundwater in the vicinity of Mitchell Branch and in building sumps discharging into storm water outfalls that discharge into the stream; however, storm drain network monitoring generally has not detected these compounds in the storm water discharges. When detected, the concentrations are lower than in the stream. Therefore, it appears that the primary source of these compounds is contaminated groundwater.

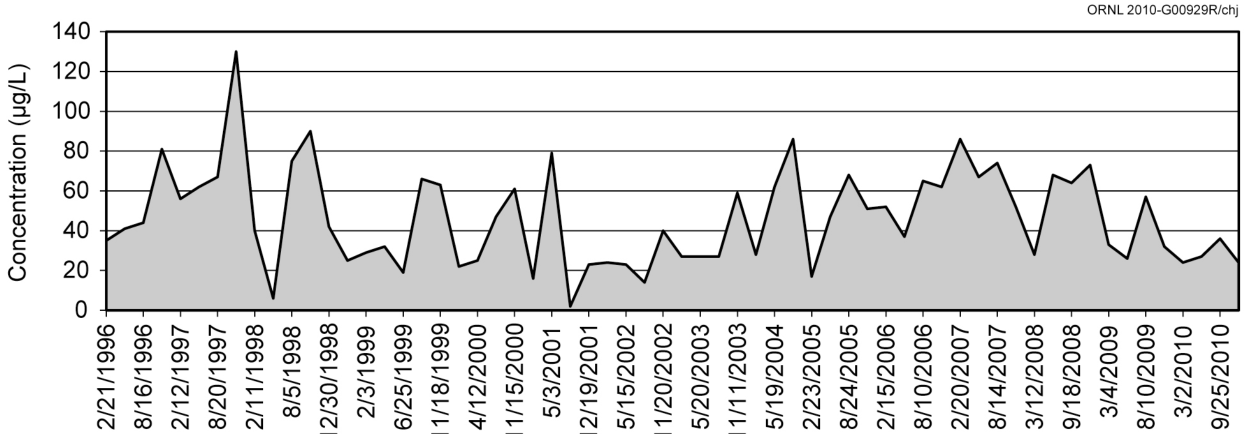

Fig. 3.46. TCE concentrations at K-1700.

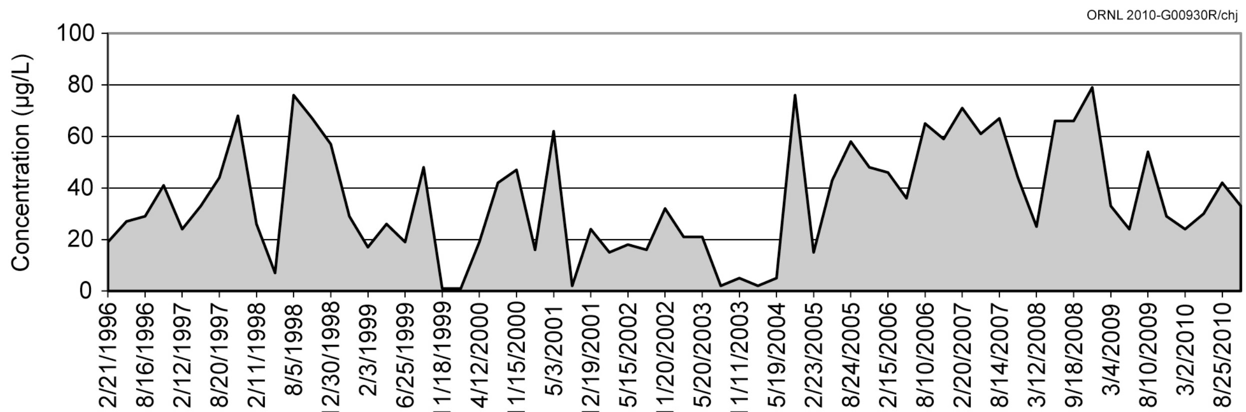

Fig. 3.47. 1,2-DCE concentrations at K-1700.

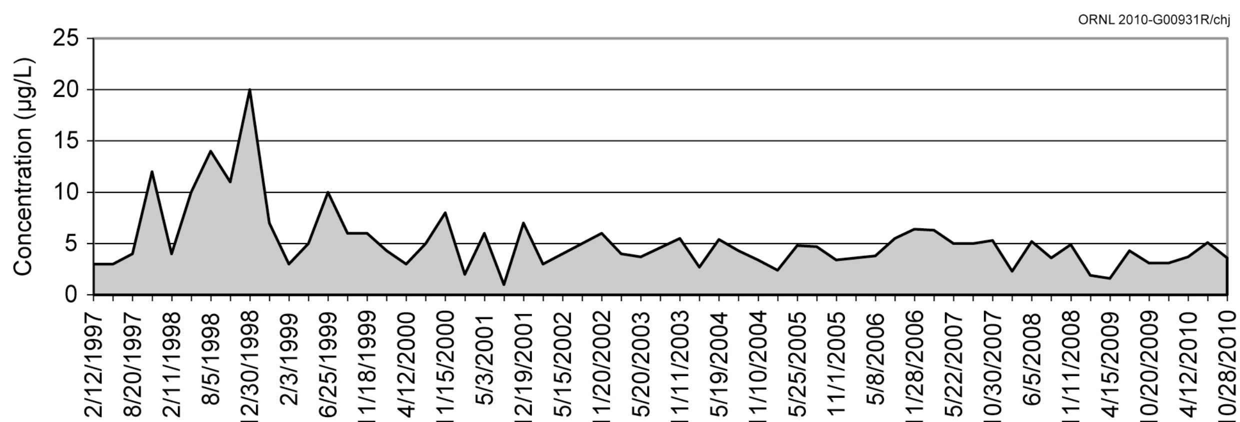

Fig. 3.48. Vinyl chloride concentrations at K-1700.

Surface water has been routinely sampled by DOE contractors and TDEC for several years as part of environmental monitoring programs. The DOE contractor surface water sampling program is conducted in accordance with DOE order surveillance program guidance. In data collected as part of the DOE contractor's sampling effort, dry weather levels of total chromium over the past 10 years (Fig. 3.49) have been shown to be generally less than 0.01 mg/L or, in some instances, at nondetectable levels. Results from routine surface water monitoring conducted in fall 2006 showed a significant increase in the total chromium level in Mitchell Branch but still below the WQC for total chromium. Sampling performed in the spring of 2007 by DOE contractors and TDEC indicated that chromium levels had increased above the levels found in the fall 2006 sampling. A chromium collection system employing two extraction wells and pumps was installed to pump water from the vicinity of storm water outfall 170 for treatment at the CNF. Since this system was installed, chromium levels in Mitchell Branch have dropped dramatically, with levels being routinely measured at less than 3 µg/L. Hexavalent chromium levels in Mitchell Branch were all below the detection limit in 2010.

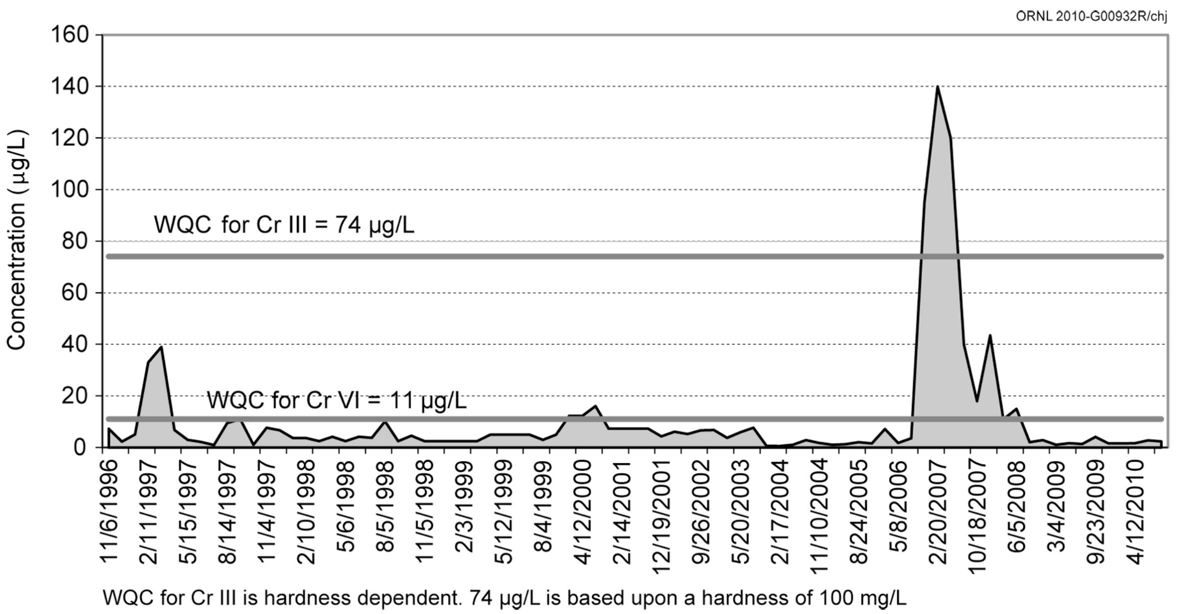

Fig. 3.49. Total chromium concentrations at K-1700.

3.5.7 ETTP Groundwater

3.5.7.1 Introduction

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

The ETTP groundwater program consists of (1) sitewide groundwater monitoring, primarily the monitoring of major site contaminant plumes and exit pathway contaminant migration, and (2) surface water monitoring for the analysis of ambient water quality criteria (AWQC). Also, an update on conditions as characterized by the biological monitoring in area surface water bodies is included.

3.5.7.2 Background

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

At ETTP, surface water and groundwater hydrologic conditions differ from those typical of the ORNL and Y-12 sites because of geologic and site development characteristics. At ETTP the surface water system involves several small, local streams that drain to Poplar Creek or directly to the Clinch River as well as extensive areas with dispersed surface runoff and groundwater seepage to the large water bodies. Groundwater is monitored primarily from constructed monitoring wells; however, sampling is also conducted at several springs or seeps where groundwater emanates to surface water bodies. Groundwater data pertaining to contaminant trends in the vicinity of CERCLA source areas and related to specific remedial actions are discussed in the 2011 RER (DOE 2011). Volatile organic compounds are the main contaminants of concern at most of the groundwater monitoring locations, as discussed in further detail as follows. Very few of the compounds are used currently at ETTP, and the contamination in the plumes is due to legacy materials. The degree of degradation that has occurred over time is highly variable depending on the local groundwater geochemical conditions and the ability of indigenous microbes to degrade the chlorinated compounds. Radionuclides are a minor concern at locations downgradient of the K-1407-B/C Ponds. The 2011 RER (DOE 2011) includes summaries of the groundwater monitoring required for individual cleanup activities at ETTP, as well as recommendations to modify any requirement that would ensure further protection of human health and environment.

3.5.7.3 ETTP Groundwater Monitoring at Major Site Contaminant Plumes

Extensive groundwater monitoring at the ETTP site has identified VOCs as the most significant groundwater contaminant on site. For purposes of analyzing the groundwater contaminant issues at ETTP, the Remedial Investigation/Feasibility Study (RI/FS) subdivided the site into several distinct areas–Mitchell Branch watershed, K-1004 and K-1200 area, the K-27/K-29 area, and the K-901 area (Fig. 3.50). Each of these areas has significant VOC contamination in groundwater. The principal chlorinated hydrocarbon chemicals that were used at ETTP were tetrachloroethene (PCE), trichloroethene (TCE), and 1,1-dichloroethane (1,1-DCA).

Figure 3.50 shows the distribution and concentrations of the primary chlorinated hydrocarbon chemicals and their transformation products, respectively. Several plume source areas are identified within the regions of the highest VOC concentrations. In these areas, the primary chlorinated hydrocarbons have been present for decades and mature contaminant plumes have evolved. The degree of transformation, or degradation, of the primary chlorinated hydrocarbon compounds is highly variable across the ETTP site. In the vicinity of the K-1070-C/D source, a high degree of degradation has occurred, although a strong source of contamination still remains in the vicinity of the "G-Pit," where approximately 9000 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 area, K-1035, K-1413, and

K-1070-A Burial Ground, and little transformation of TCE is observed in the K-27/K-29 source and plume area.

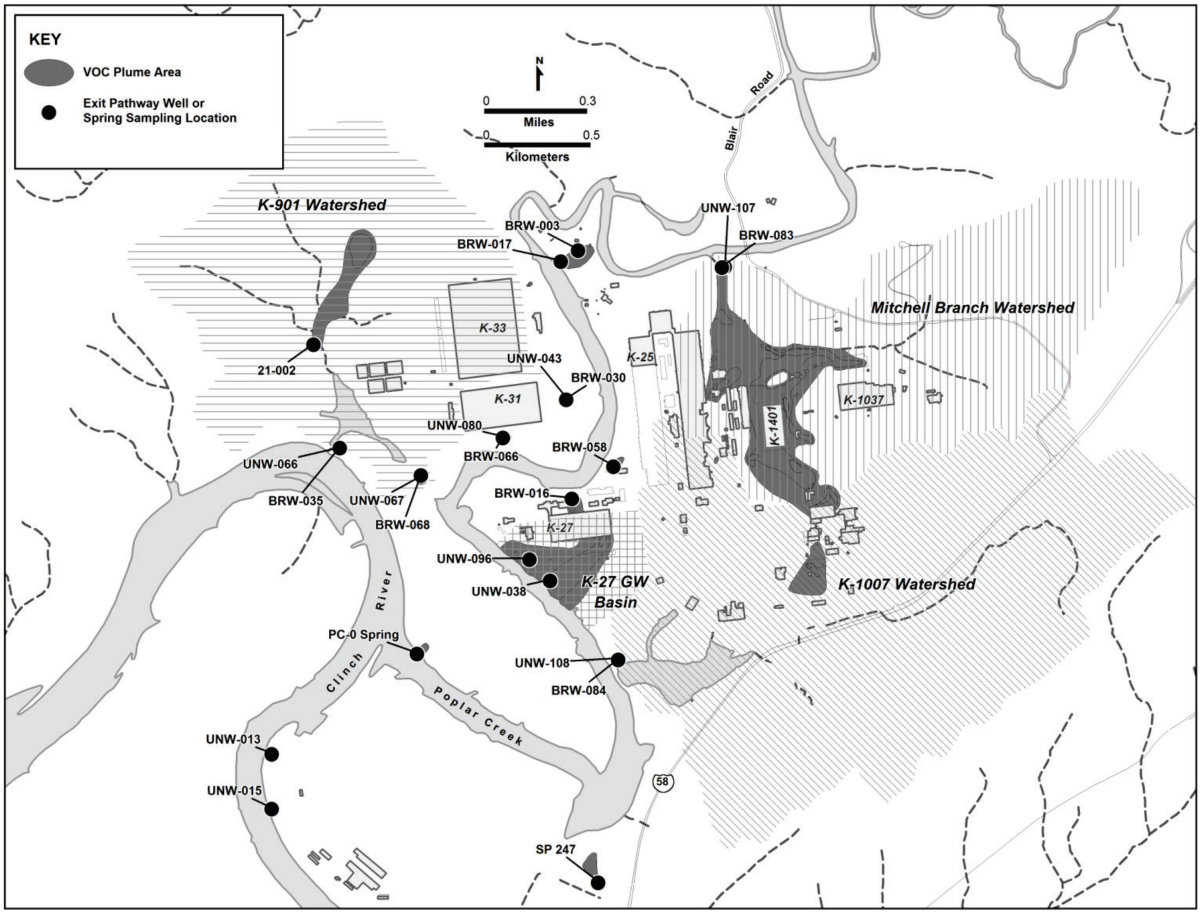

Fig. 3.50. ETTP site exit pathway groundwater monitoring locations.

3.5.7.4 Exit Pathway Monitoring

Groundwater exit pathway monitoring sites are shown in Fig. 3.50. Groundwater monitoring results for the exit pathways are discussed below starting with the Mitchell Branch exit pathway and then progressing in a counterclockwise fashion.

The Mitchell Branch exit pathway is monitored using surface water data from the K-1700 Weir on Mitchell Branch and wells BRW-083 and UNW-107. Figure 3.51 shows the detected concentrations of TCE, 1,2-dichloroethylene (1,2-DCE) (essentially all cis-1, 2-DCE), and vinyl chloride at the K-1700 Weir on Mitchell Branch from FY 1994 through FY 2010. These contaminants are the major contaminants in Mitchell Branch, although low concentrations of carbon tetrachloride, chloroform, and trichloroacetic acid (TCA) are sometimes detected. VOC concentrations measured during FY 2010 were below TDEC recreational organisms only AWQC levels at K-1700.

Wells BRW-083 and UNW-107, located near the mouth of Mitchell Branch (Fig. 3.50), have been monitored since 1994. Table 3.43 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 flow paths that can fluctuate with seasonal hydraulic head conditions, which are strongly affected by rainfall. PCE and TCE were detected at concentrations greater than their respective MCLs in BRW-083 during FY 2010 as a result of the above average rainfall during FY 2009 and 2010.

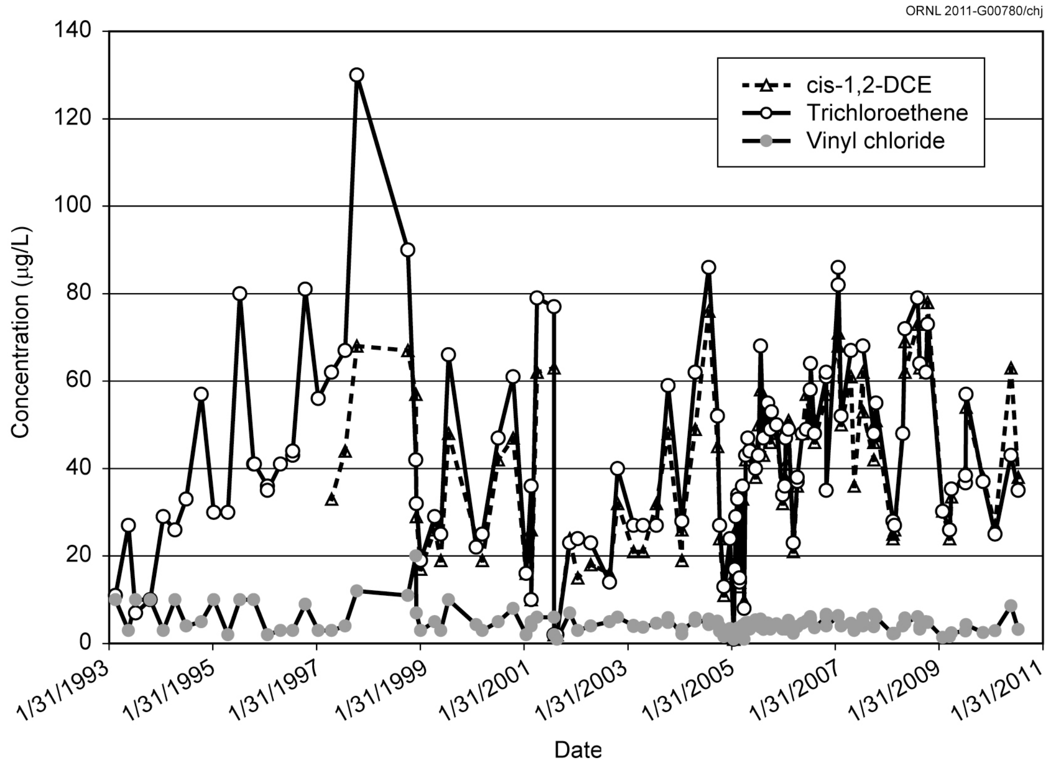

Fig. 3.51. K-1700 Weir VOC concentrations.

Table 3.43. VOCs detected in groundwater in the Mitchell Branch Exit Pathway (µg/L)[a]

Well	Date	cis-1,2-dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
BRW-083	8/29/2002	ND	**5**	**28**	ND
	3/16/2004	0.69	2.2	**9.9**	ND
	8/26/2004	2	4.7	**20**	ND
	3/14/2007	5	**9**	**28**	ND
	3/20/2008	ND	ND	ND	ND
	8/21/2008	ND	ND	ND	ND
	3/12/2009	ND	ND	1.31 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
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[b]
	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

[a] Bold table entries exceed primary drinking water MCL screening values (PCE, TCE = 5 µg/L, cis-1,2-DCE = 70 µg/L, vinyl chloride = 2 µg/L).

Abbreviations: BRW = bedrock wells; J = estimated value; ND = Not Detected; UNW = unconsolidated wells.

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

Wells BRW-003 and BRW-017 (Fig. 3.50) monitor groundwater at the K-1064 Peninsula burn area. Figure 3.52 shows the history of VOC concentrations in groundwater from FY 1994 through FY 2010. TCE concentrations have declined in both wells, and TCE was detected at concentrations slightly below the MCL in well BRW-017 during FY 2010. Both 1,1,1-TCA and cis-1,2-DCE have declined to undetectable concentrations in both wells.

Groundwater is monitored in four wells (BRW-066, BRW-030, UNW-080, and UNW-043) that lie between buildings K-31/K-33 and Poplar Creek, as shown on Fig. 3.50. VOCs are not contaminants of concern (COCs) in this area; however, leaks of recirculated cooling water in the past have left residual subsurface chromium contamination. Figure 3.53 shows the history of chromium detection in wells at K-31/K-33. Well UNW-043 exhibits the highest residual chromium concentrations of any in the area. Chromium concentrations in well UNW-043 correlate with the turbidity of samples, and acidification of unfiltered samples that contain suspended solids often causes detection of high metals content because the acid preservative dissolves metals that are adsorbed to the solid particles at the normal groundwater pH. During FY 2006, an investigation was conducted to determine if groundwater in the vicinity of the K-31/K-33 buildings contained residual hexavalent chromium from recirculated cooling water leaks. The data indicated the chromium in groundwater near the leak sites was essentially all the less toxic trivalent species. During FY 2008 through FY 2010, field-filtered (i.e., dissolved) and unfiltered samples were collected from UNW-043. As shown on Fig.3.53, the samples filtered in the field prior to acid preservation contained very little chromium, and the dissolved chromium levels did not exceed the MCL. This indicates that most of the chromium in this area is particle bound rather than dissolved in groundwater.

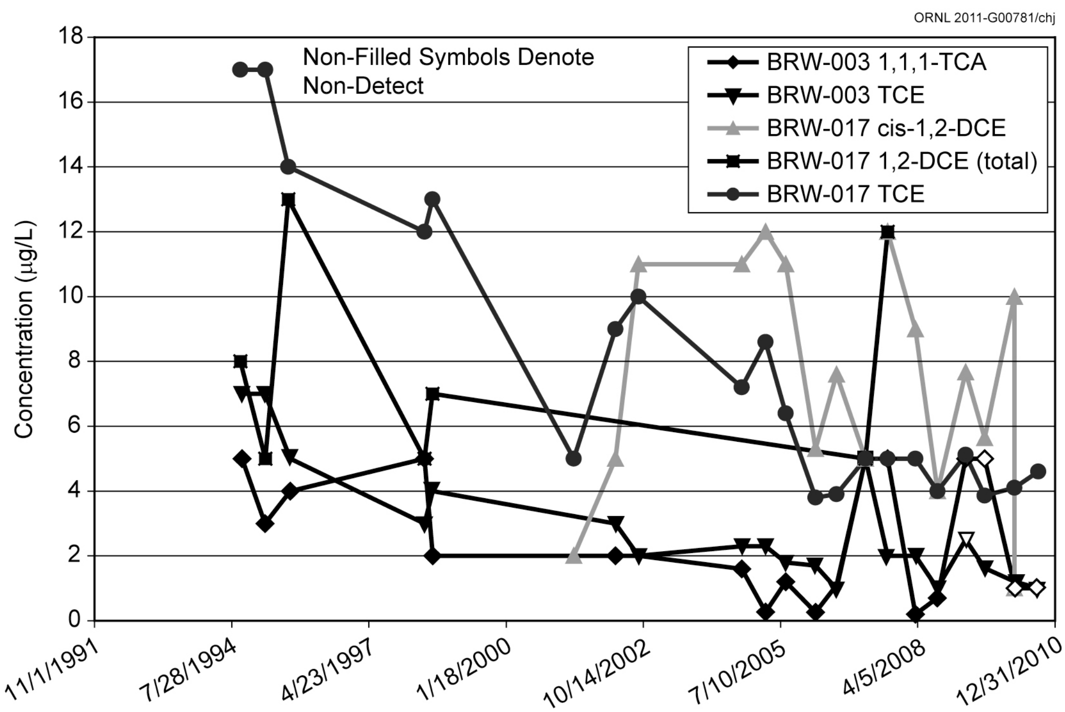

Fig. 3.52. VOC concentrations in groundwater at K-1064 Peninsula area.

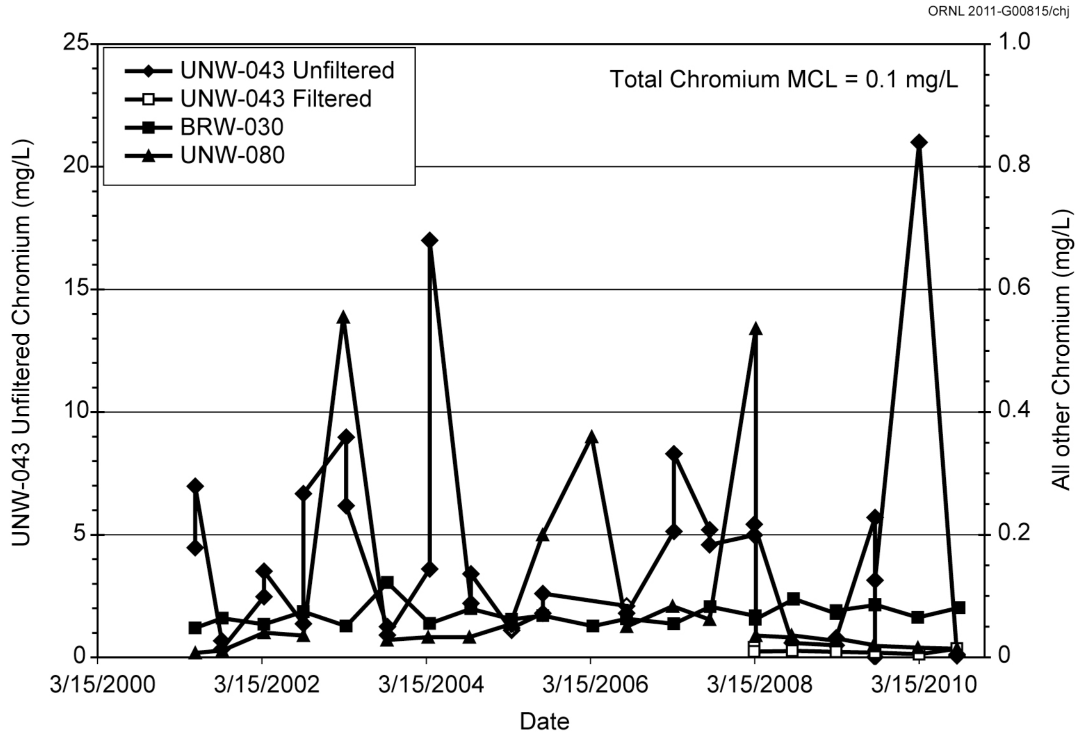

Fig. 3.53. Chromium concentrations in groundwater in the K-31/K-33 area.

Several exit pathway wells are monitored in the K-27/K-29 area, as shown on Fig. 3.50. Figure 3.54 provides concentrations of detected VOCs in wells both north and south of K-27 and K-29 through FY 2010. The source of VOC contamination in well BRW-058 is not suspected to be from K-27/K-29 area operations. VOC concentrations in this area show very slowly declining concentrations.

Wells BRW-084 and UNW-108 are exit pathway monitoring locations at the northern edge of the K-1007-P1 Pond (see Fig. 3.50). These wells have been monitored intermittently from 1994 through 1998 and semiannually from FY 2001 through FY 2010. The first detections of VOCs in these wells occurred during FY 2006 with detection of low (~10 µg/L or less) concentrations of TCE and cis-1,2-DCE. The source area for these VOCs is not known. Volatile organic compounds were not detected in either of these wells during FY 2010. Metals were detected and associated with the presence of high turbidity in the samples. Iron exceeded its secondary drinking water standard in the filtered sample from UNW-108 in the March sampling event. No other primary or secondary MCLs for metals were exceeded in sample aliquots that were field filtered prior to acid preservation during FY 2010.

Exit pathway groundwater in the K-901-A Holding Pond area (Fig. 3.50) 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 Pond exit pathway wells during FY 2010, and alpha and beta activity levels were less than 15 pCi/L and 25 pCi/L, respectively. TCE is the most significant groundwater contaminant detected in the springs, and the historic TCE concentrations are shown in Fig. 3.55. Spring PC-0 was added to the sampling program in 2004. During the spring through autumn seasons, spring PC-0 is submerged beneath the Watts Bar lake level, so this location is accessible for sampling only during winter when the lake level is lowered by TVA. The contaminant source for the PC-0 spring is presumed to be disposed waste at the K-1070-F site. The TCE concentrations are showing a decreasing trend. At spring 21-002, 1,1,1-TCA, 1,2-DCE, carbon tetrachloride, and PCE are sometimes present at concentrations typically less than 5 µg/L. The TCE concentration at spring 21-002 tend to vary between 5 and about 25 µg/L, and this variation appears to be related to variability in rainfall, which affects groundwater discharge from the K-1070-A VOC plume.

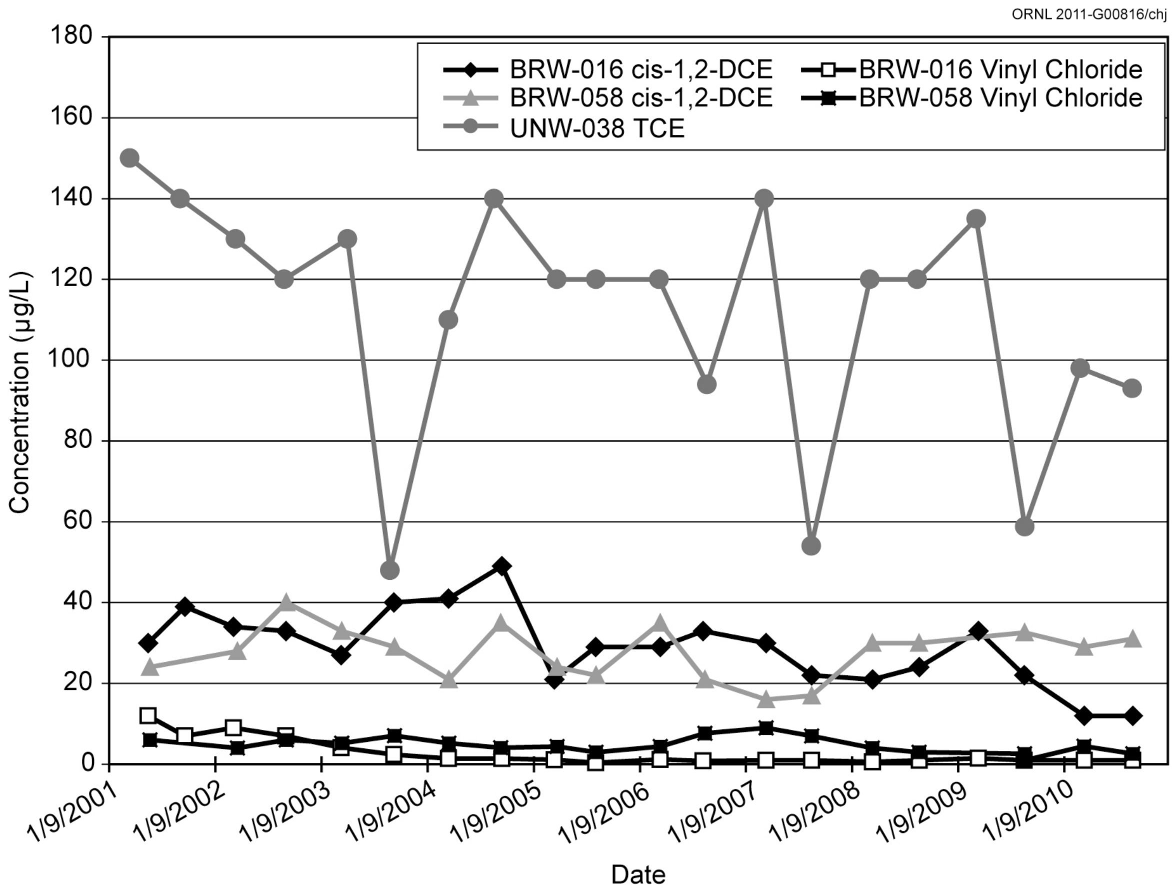

Fig. 3.54. Detected VOC concentrations in groundwater exit pathway wells near K-27 and K-29.

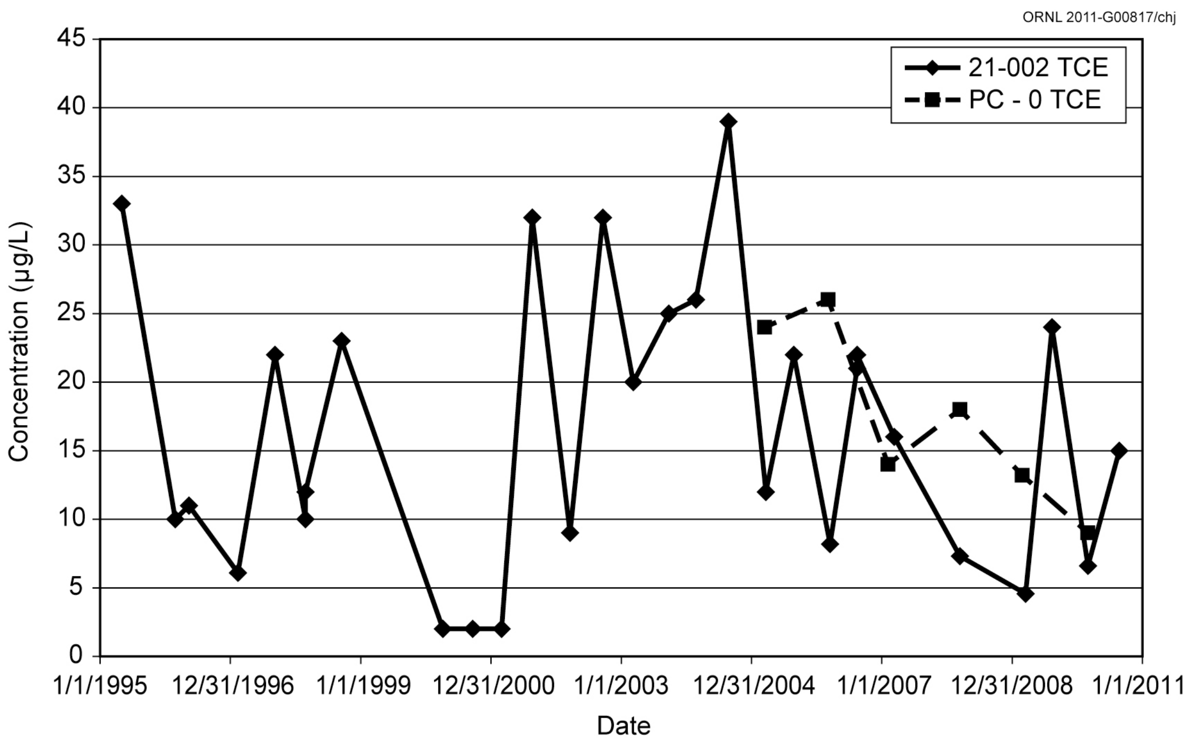

Fig. 3.55. TCE concentrations in K-901 area springs.

Exit pathway groundwater monitoring is also conducted at the K-770 area, where wells UNW-013 and UNW-015 are used to assess radiological groundwater contamination along the Clinch River (Fig. 3.50). Figure 3.56 shows the history of measured alpha and beta activity in this area. Analytical results indicate that the alpha activity is largely attributable to uranium isotopes, and well UNW-013 historically contained ^{99}Tc that is a strong beta-emitting radionuclide responsible for the elevated beta activity in that well. The alpha and beta activity levels in the area groundwater exhibit stable, but variable, conditions.

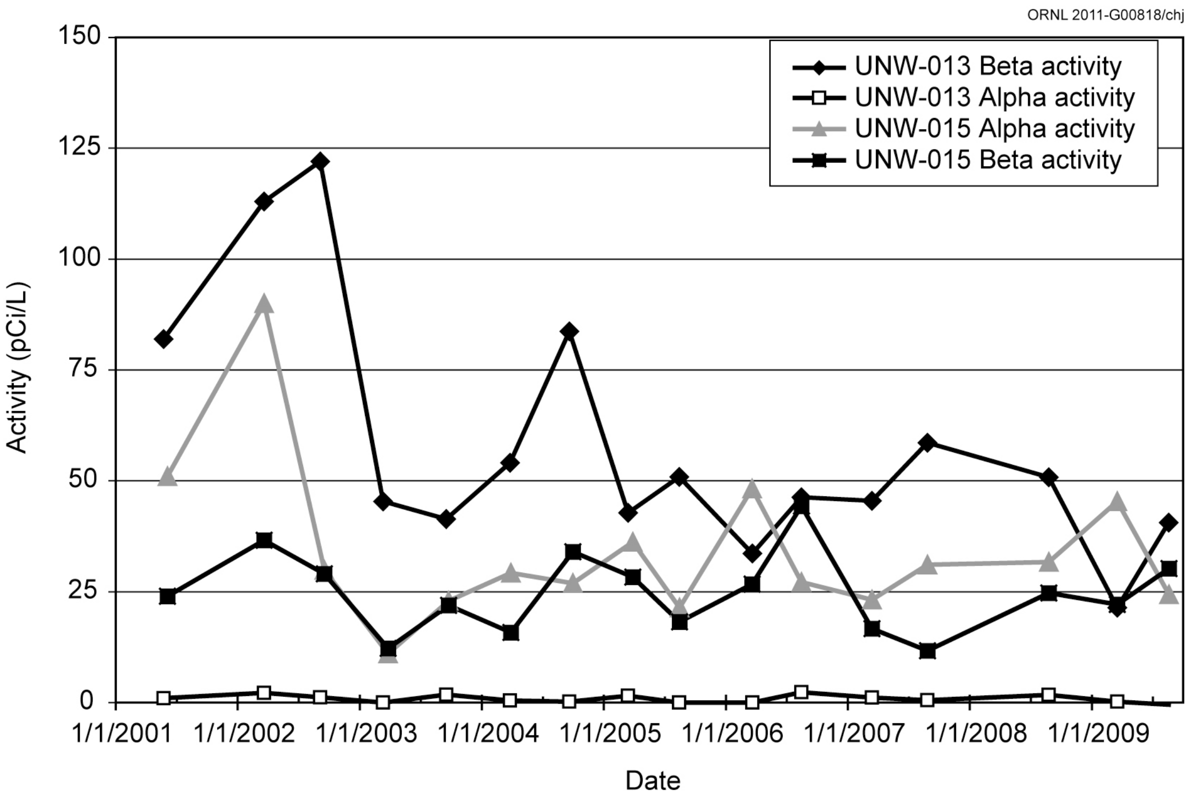

Fig. 3.56. History of measured alpha and beta activity in the K-770 area.

3.5.7.5 Ambient Water Quality Criteria Sampling

During FY 2010 surface water samples were collected at four locations for analysis of AWQC parameters. The sample locations included the three main surface water discharge points—the K-1700 weir on Mitchell Branch, the K-1007-P1 Pond weir, the K-901 Pond weir, and a fourth location. A field replicate sample was collected and analyzed at the K-901 weir during both sampling events. The 21-002 spring was sampled for AWQC parameters to evaluate potential contributions from the K-1070-A groundwater plume. Sample events occurred in late winter (March) and late summer (August). The analytical suite included metals, VOCs, semi-volatile organic compounds (SVOCs), pesticides, PCBs, and dioxins/furans.

The only metals exceedances were for mercury in samples collected at the K-1700 weir on Mitchell Branch. These results were discussed previously in Section 3.5.5.9. Arsenic, cadmium, and selenium were not detected in any of the samples. Although lead was detected in all samples at K-901 and K-1700 weirs, and in one sample at the K-1007 P1 weir, the levels were below the criteria. Copper was detected in one sample from the K-901 weir at a below-criterion level. Chromium was detected in all samples at the K-901 weir and in one sample at the K-1700 weir at levels below criteria, and hexavalent chrome was not detected in any of the samples. Nickel and zinc were detected at the K-1700 and K-901 weirs, but the levels were below criteria.

Although TCE (four samples), vinyl chloride (four samples), and carbon tetrachloride (one sample) exceeded the criteria for water and organisms (implying human consumption of the water) at the K-1700 weir, the criteria for organism-only protection were not exceeded. Similarly, at the 21-002 spring, TCE (two samples) and carbon tetrachloride (one sample) exceeded the water and organisms criteria but did not exceed the organism-only criteria. PCBs were not detected in surface water samples, although they are known to be present in water body sediment columns and are bioaccumulative in fish, as discussed in the following section. Polycyclic aromatic hydrocarbon (PAH) compounds were detected at the K-901 weir at levels below criteria. Several pesticides are detectable in surface water at the three weir locations. Criterion exceedances were measured for heptachlor at the K-901 and K-1700 weirs with measured concentrations of 0.002–0.003 μg/L at K-901 and 0.00085 and 0.00095 μg/L at K-1700 compared to the criterion concentration of 0.00079 μg/L for organism protection. Heptachlor epoxide exceeded its criterion of 0.00039 μg/L at the K-901 weir with measured concentrations of 0.00175 and 0.00185 μg/L. Traces of dioxin/furan compounds were estimated to be present in the samples; however, no criterion exceedances were measured.

3.6 Biological Monitoring

The ETTP BMAP SAP consists of three tasks designed to evaluate the effects of ETTP operations on the local environment, identify areas where abatement measures would be most effective, and test the efficacy of the measures. These tasks are (1) toxicity monitoring of effluent and ambient waters from several locations within Mitchell Branch, (2) bioaccumulation studies, and (3) in-stream monitoring of biological communities. Figure 3.57 shows the major water bodies at ETTP, and Fig. 3.58 shows the monitoring locations along Mitchell Branch.

In April and October to November of 2010, survival and reproduction toxicity tests using the water flea *Ceriodaphnia dubia* (Fig. 3.59) 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 (SDs)-170 and -190. In both the April tests and October to November tests (Table 3.44), none of the water from the ambient station or from SD-170 or SD-190 exhibited toxicity. While the absence of observable toxicity at the ambient locations is normal, and the absence of observable toxicity at SD-170 is consistent with recent trends, the absence of observable toxicity at SD-190 is a recent development. Until the 2010 tests, full-strength effluent from SD-190 typically reduced reproduction in *Ceriodaphnia dubia,* and prior to the fall 2007 test, survival also was often reduced. While the cause of the reduction in toxicity at SD-170 is not known definitively, the reductions coincide with the efforts to control the chromium seep near SD-170.

In June and July, 2010, caged clams *(Corbicula fluminea)* were placed at several locations around ETTP (Table 3.45). The clams (Fig. 3.60) were allowed to remain in place for 4 weeks and were then analyzed for PCBs and total and methylmercury. The spatial patterns of PCB concentrations in clams were generally consistent with those of previous years, although the concentration of PCBs in clams from storm water outfall 100 was lower than in 2009 and substantially lower than in the past 15 years. The highest PCB concentrations were found in the clams from the K-1007-P1 Pond, with lower concentrations found in the clams from Mitchell Branch. Clams from the K-901-A Pond contained detectable concentrations of PCBs, but the levels were considerably lower than those found in and around the K-1007-P1 Pond. While Arochlors-1248, -1254, and -1260 were detected in the clams from the K-1007-P1 Pond and the K-901-A Pond (in lower concentrations), the primary Aroclor detected in the clams from Mitchell Branch was Aroclor-1254. In general, the concentrations of PCBs at most locations from the 2010 monitoring exhibited similar distributions to those from the 2009 effort. For example, levels at MIK 0.7 averaged 0.17 μg/g in the 2009 samples and 0.14 μg/g in 2010. Levels in clams from MIK 0.8 display a similar pattern. Levels at MIK 0.2 have decreased slightly over the last 3 years (2.76 μg/g in 2008, 2.43 μg/g in 2009, and 2.14 μg/g in 2010). In contrast, PCB concentrations in clams deployed at MIK 0.4 were higher in 2010 (2.0 μg/g) than in 2009 (0.84 μ/g). A new monitoring location in Mitchell Branch was added in 2010 (MIK 0.3). Total PCBs in clams deployed at MIK 0.3 averaged 3.2 μg/g, the highest levels from any site along Mitchell Branch. Among the clams from the K-1007-P1 Pond area, clams from storm water outfall 120 had the highest average concentrations of PCBs in 2010

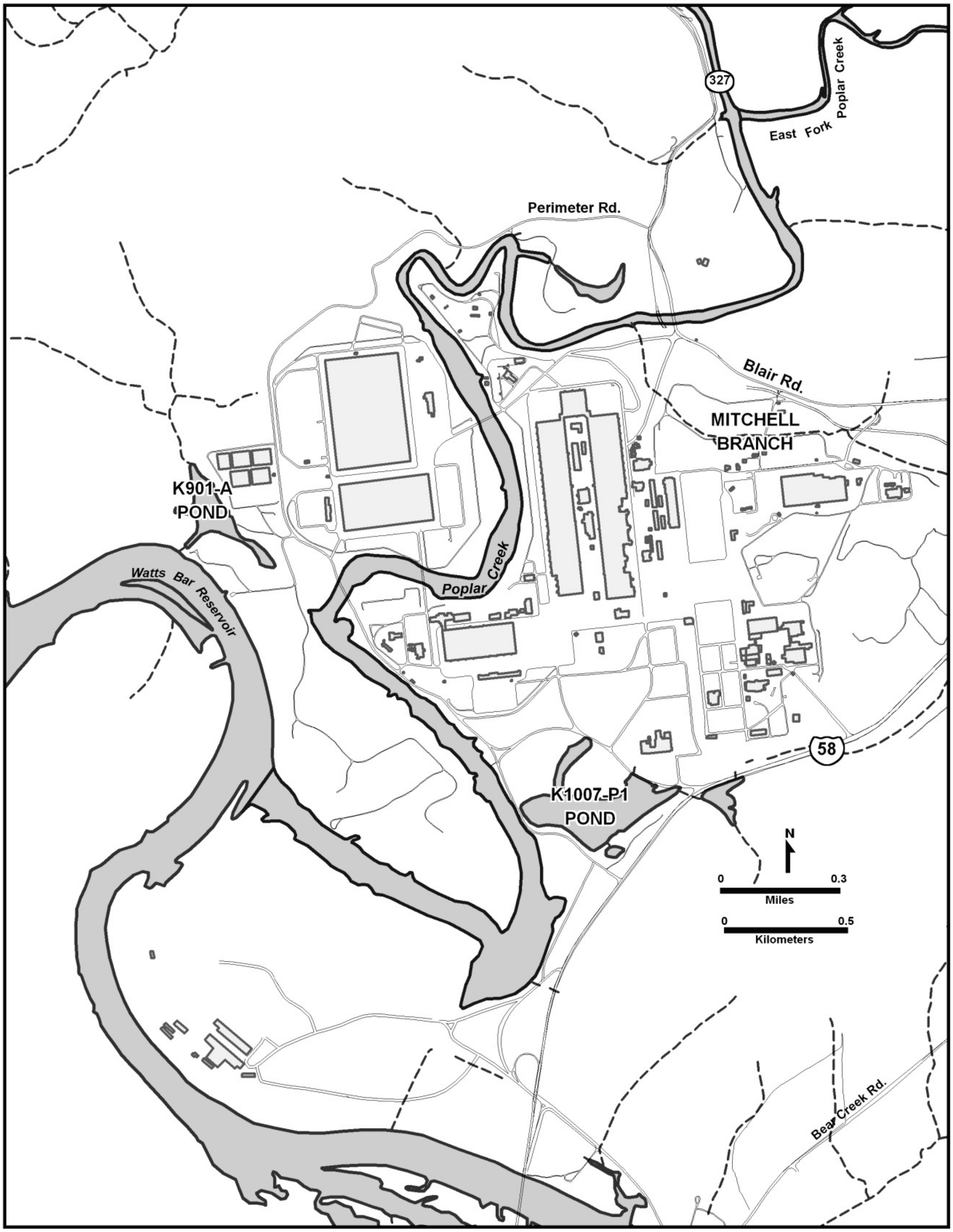

Fig. 3.57. Waterways at ETTP.

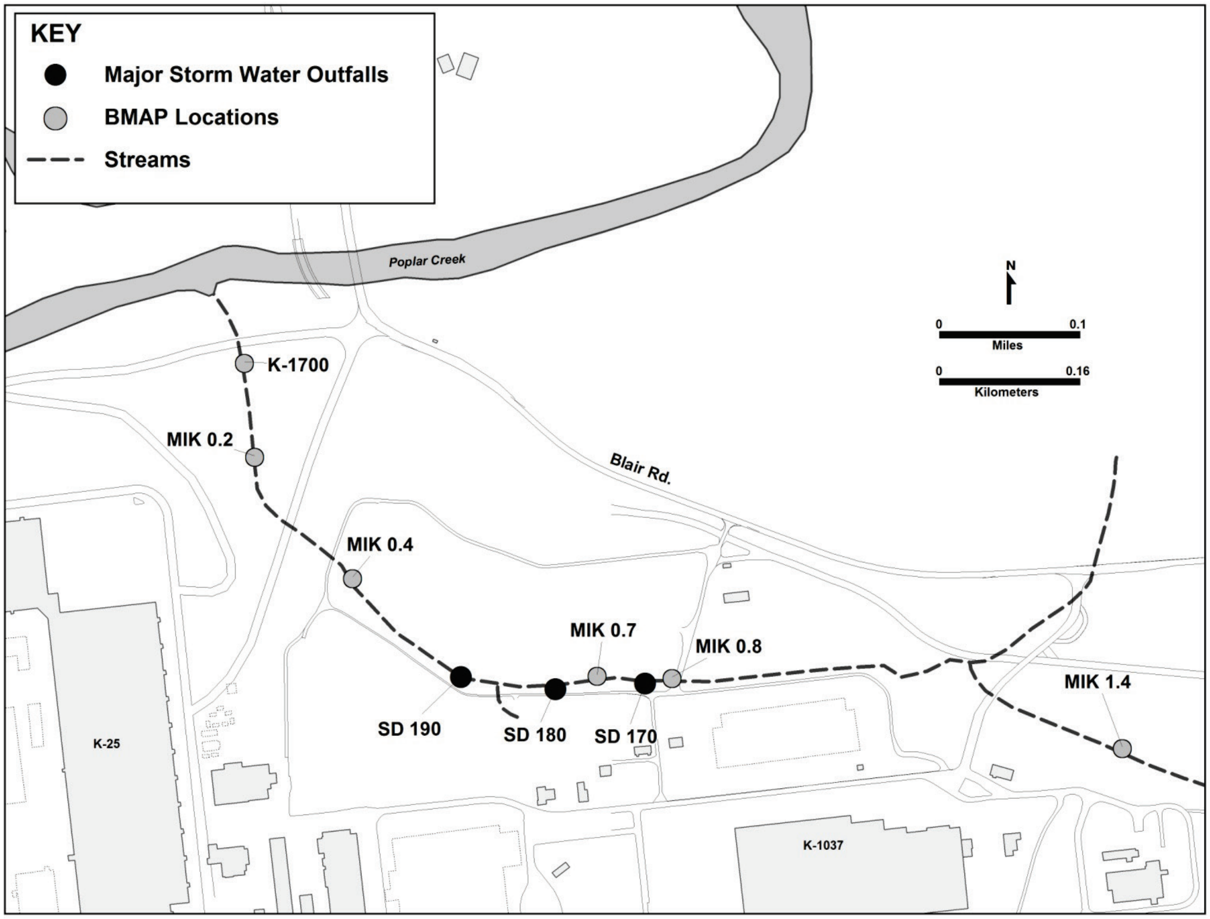

Fig. 3.58. Major storm water outfalls and biological monitoring locations on Mitchell Branch.

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Fig. 3.59. Water flea *(Ceriodaphnia dubia)*.

Table 3.44. Mitchell Branch and associated storm water outfall toxicity test results, 2010 (no-observed-effects concentrations)

Test	MIK 1.4	MIK 0.8	SD 170	MIK 0.7	SD 190	MIK 0.4	MIK 0.2
Ceriodaphnia survival (%)	100	100	100	100	100	100	100
Ceriodaphnia reproduction (%)	100	100	100	100	100	100	100

Table 3.45. Analytical results and locations of caged clams in June and July 2010[a]

Site	Sample ID	Aroclor-1248	Aroclor-1254	Aroclor-1260	Total Aroclors	Total Hg	MeHg
Reference Site:	15972A	ND	0 .005	ND	0.01	20.8	9.1
Sewee Creek	15972B	ND	0.011	ND	0.01	36.4	14.9
Mitchell Branch:							
MIK 0.8 (above SD 170)	15982A	ND	0.110	0.008	0.12		
	15982B	ND	0.120	0.011	0.13		
SD170	15983A	ND	0.190	0.022	0.21	41.8	9.3
	15983B	ND	0.250	0.026	0.28	49.5	10.9
M IK 0.7 (below SD170)	15984A	ND	0.130	0.017	0.15		
	15984B	ND	0.120	0.014	0.13		
M IK 0.5 (below SD 180)	15985A	ND	0.130	0.015	0.15	65.7	17.7
	15985B	ND	0.150	0.017	0.17	57.6	15.0
SD190	15986A	ND	0.930	0.290	1.22	137.4	85.5
	15986B	ND	0.870	0.220	1.09	142.3	88.2
M IK 0.4 (below SD190)	15987A	ND	1.100	0.180	1.28		
	15987B	ND	2.300	0.390	2.69		
M IK 0.3	15981A	0.910	1.900	0.120	2.93	203.4	17.7
	15981B	1.400	1.900	0.120	3.42	224.8	19.8
M IK 0.2	15980A	0.440	1.600	0.110	2.15	106.3	20.7
	15980B	0.420	1.600	0.110	2.13	117.6	19.1
SD 992	15978A	0.910	1.900	0.120	2.93		
	15978B	1.400	1.900	0.120	3.42		
K1007-P1 Pond:	15974A	0.210	0.078	ND	0.29	24.6	10.2
SD 100 (upper)	15974B	0.160	0.060	ND	0.22	24.9	10.4
SD 100 (lower)	15975A	0.530	0.190	ND	0.72 0.80		
	15975B	0.590	0.210	ND			
SD 120	15976A	ND	2.600	0.460	3.06 1.18		
	15976B	ND	1.000	0.180			
SD 490	15973A	ND	0.270 0.340	0.100	0.37 0.47		
	15973B	ND		0.130			
P1	15977A	0.560 0.520	0.430	ND	0.99 0.91		
	15977B		0.390	ND			
K901A Pond:	15979A	ND ND	0.042	0.017	0.06 0.05		
K901A outfall	15979B		0.037	0.014			

[a]PCBs (shown as Aroclors 1248, 1254, 1260, and total Aroclors; µg/g) and total and methyl mercury (ng/g) in caged Asiatic clams (*Corbicula fluminea*) placed near storm drains and pond outfalls for 4-week periods, June and July 2010. Results are reported on a wet weight basis for composite samples (of 10 clams) from each basket.

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Fig. 3.60. Asian clam (*Corbicula fluminea*).

(2.1 μg/g). Concentrations in clams from the lower storm water outfall 100 were higher in 2009 (1.5 μg/g) than in 2010 (0.76 μg/g), and in clams from the upper storm water outfall 100, levels dropped to an average of 0.255 μg/g in 2010. These concentrations were the lowest that have been recorded in outfall 100. It is too early to tell if these measurements reflect actual decreases in environmental PCB concentrations, or if they are just within the normal range of variations. PCB concentrations in clams from K-901-A Pond were very low, averaging 0.055 μg/g in 2010.

Clams from the Mitchell Branch watershed were analyzed for mercury (both total mercury and methyl mercury) in 2010 (Table 3.45). Although mercury was detected in all clams, the highest mercury concentrations were found in the clams from MIK 0.3 (214.1 ng/g total mercury) and below SD-190 (139.9 ng/g total mercury). Results from the 2010 monitoring were generally similar to those of the 2009 monitoring at the same locations with the exception of MIK 0.2, where mercury concentrations were roughly double those observed in 2009. Methyl mercury concentrations in clams from Mitchell Branch ranged from 20%–40% of the total mercury concentration at all locations.

Bioaccumulation monitoring in the K-1007-P1 Pond, K-901-A Pond, K-720 Slough, and Mitchell Branch also involves sampling of fish for PCB concentrations (Table 3.46). 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. The target species for bioaccumulation monitoring in 2010 in the K1007-P1 Pond was bluegill sunfish (*Lepomis macrochirus*) (Fig. 3.61). This is a shift from previous efforts that have focused on monitoring largemouth bass (*Micropterus salmoides*). Bass from this pond have historically shown PCB levels well above state and federal guidelines for assessing human health concerns. Among other actions, the remediation of this pond entailed removing predatory, upper trophic level fish such as bass and restocking the pond with smaller fish that are not expected to accumulate PCBs as readily.

While bluegill sunfish were already resident to the K1007-P1 pond, efforts were made to sustain the population by introducing additional bluegill collected from uncontaminated sites. Restocking occurred in February 2010, just 3 months before bioaccumulation sampling (Fig. 3.62). 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 (respectively) associated with PCB contamination in this pond. Average PCB levels in whole body composites were 5.11 μg/g, as shown in Table 3.46. Fillets averaged 2.13 μg/g total PCBs, significantly lower than levels seen in 2009 (3.11 μg/g). Average PCB concentrations in sunfish collected in Mitchell Branch were 1.2 μg/g, which is significantly higher than the concentrations observed in largemouth bass from the K901A pond (~ 0.3 μg/g). In addition to being analyzed for PCBs, the sunfish collected from Mitchell Branch (MIK 0.2) were analyzed for total mercury. Previous studies have shown that methyl mercury accounts for greater 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. Levels of mercury in fish collected at MIK 0.2 were 0.38 µg/g, slightly exceeding this limit.

Table 3.46. Average PCB concentrations in biota, 2010[a]

Site	Species	Sample type	Sample size (n)	Total PCBs (mean ± SE)	Range of PCB values	No. >1 ppm (PCBs)/N[b]	Total Hg (mean + SE)
1007-P1 Pond	Bluegill	Fillets					
		Resident fish	20	2.13 +/- 0.16	1.07–3.63	20/20	0.085 +/- 0.008
		Restocked fish	3	0.99 +/- 0.34	0.41–1.58	1/3	
		Whole body composites *Resident fish*	6	5.11 +/- 0.26	4.41–5.90		0.041 +/- 0.001
		Restocked fish	1	3.39			
	Paddlefish[c]	Fillet	1	107		1/1	0.07
K-901-A Pond	Largemouth bass	Fillet	10	0.30 +/- 0.05	0.12–0.62	0/10	
	Common carp	Fillet	10	0.71 +/- 0.20	0.20–2.33	3/10	
	Gizzard shad	Whole body composites	6	2.69 +/- 0.32	1.81–3.49		0.086 +/- 0.021
K-720 Slough	Largemouth bass	Fillet	6	0.17 +/- 0.33	0.06–0.37	0/6	
	Common carp	Fillet	7	0.38 +/- 0.07	0.20–0.64	0/7	
	Smallmouth buffalo	Fillet	7	0.99 +/- 0.41	0.20–3.35	2/7	
	Gizzard shad	Whole body composites	6	0.48 +/- 0.03	0.40–0.54		0.067 +/- 0.006
Mitchell Branch	Redbreast sunfish	Fillet	6	1.17 +/- 0.13	0.87–1.55	4/6	0.347 +/- 0.059
Hinds Creek	Redbreast sunfish	Fillet	5	0.09 +/- 0.05	0.05–0.28	0/6	0.08 +/- 0.01

[a]Total PCB (Aroclors 1248, 1254, and 1260) concentrations in fish from the K-1007-P1 Pond, the K-901 Pond, the K-720 Slough, Mitchell Branch, and the reference site, Hinds Creek, 2010. Values are mean concentrations (µg/g) ± 1 Standard Error (SE). Each whole body composite sample is comprised of 10 individual fish, except restocked fish from the K-1007-P1 Pond, where composite sample was comprised of five individual fish (see discussion of the K-1007-P1 Pond for details on resident vs restocked fish). Where available, data for mean total mercury concentrations (µg/g) are shown.

[b]N = Number of individuals in the sample.

[c]Paddlefish were collected in June 2009 during fish removal action but was not analyzed until 2010. Data for this fish are presented for comparison and discussion.

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Fig. 3.61. Bluegill sunfish (*Lepomis macrochirus*).

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Fig. 3.62. Fish bioaccumulation sampling at K-1007-P1 pond.

In April 2010, the benthic macroinvertebrate community at four Mitchell Branch locations (MIKs 0.4, 0.7, 0.8, and 1.4) was sampled by the UT-Battelle Environmental Sciences Division using standard quantitative techniques. MIK 1.4 was the reference location. Over the last several years, the condition of the benthic macroinvertebrate community at all locations in Mitchell Branch has generally improved. However in 2010 the metrics at MIK 0.8 showed the greatest change, with metric levels approaching those of the reference site at MIK 1.4. In 2010, total taxa richness and richness of the *Ephemeroptera, Plecoptera*, and *Trichoptera* (EPT) species was greatest at MIK 1.4 and decreased at the downstream locations (Fig. 3.63). EPT species are generally pollution intolerant, and lower values generally correlate to some degree of impact to the stream. Total density at MIKs 0.8 and 0.7 was greater than at MIK 1.4, but the density of pollution-intolerant species was generally lower at all of the locations downstream of MIK 1.4 with the exception of MIK 0.8. One possible explanation for the lower number of individuals at MIK 1.4 when compared to MIKs 0.7 and 0.8 may be that Mitchell Branch is shallower at MIK 1.4, and the lower flows may inhibit the population size. Higher densities downstream of MIK 1.4 may also indicate nutrient enrichment, which commonly leads to increases in density.

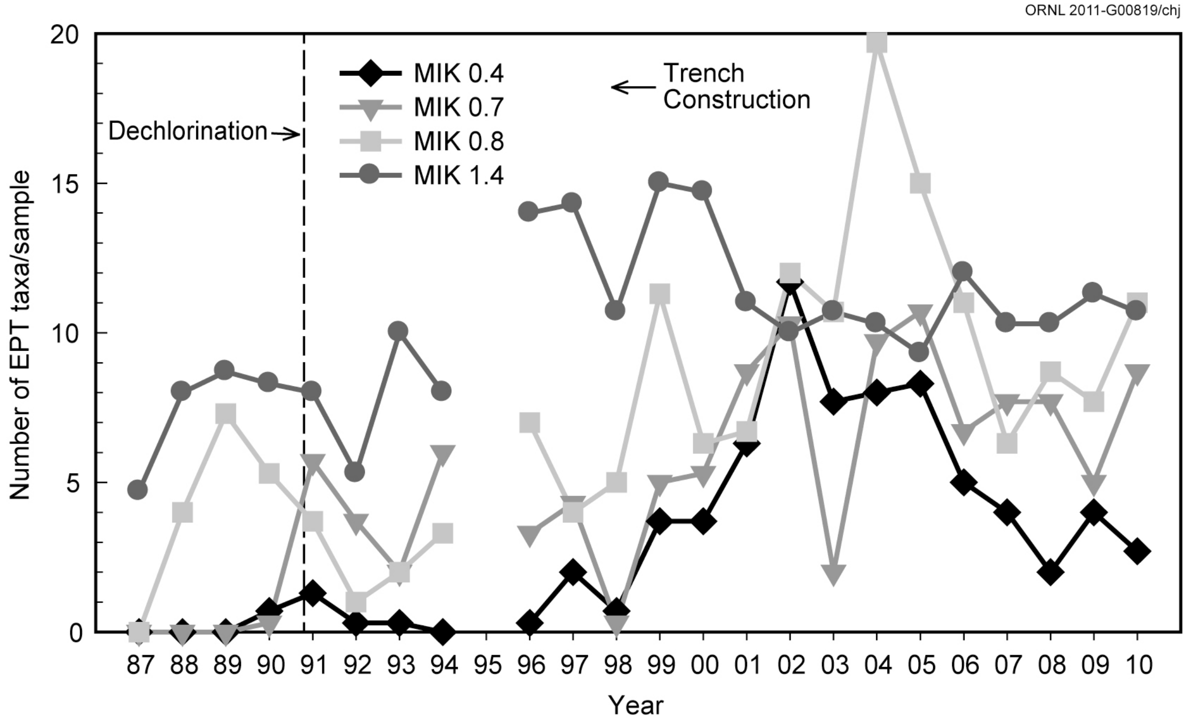

Fig. 3.63. Mean taxonomic richness of the pollution-intolerant *Ephemeroptera*, *Plecoptera*, and *Trichoptera* (mayflies, stoneflies, and caddisflies, or EPT) taxa per sample for the benthic macroinvertebrate community in Mitchell Branch, 1987–2010. Samples were not collected in April 1995, as indicated by the gap in the lines. MIK = Mitchell Branch kilometer.

Since August 2008, TDEC protocols, which assess both community and habitat characteristics, also have been used at monitoring location MIKs 0.4, 0.7, and 0.8. Beginning in August 2009, the use of TDEC protocols was expanded to include MIK 1.4 as well (Fig. 3.64). In the 2010 study, the biotic indices (Fig. 3.65) indicate that the communities at locations MIKs 0.4 and 1.4 were slightly impaired, while the communities at MIKs 0.7 and 0.8 were not impaired. However, the total scores at MIKs 0.7 and 0.8 were only slightly greater than the scores at MIK 1.4, and overall trends indicate that the communities at all three downstream locations (MIKs 0.4, 0.7, and 0.8) are still slightly impaired. The habitat assessment (which primarily considers the physical aspects of the stream to determine its suitability to support invertebrate communities) indicated that not all sampling locations along Mitchell Branch met the habitat goals for this region. In the 2009 study, MIK 0.4 failed to meet the habitat goals. In the 2010 study, MIK 0.8 met the habitat goals. MIKs 0.4, 0.7 and 1.4 were scored as being moderately impaired, although the scores for MIKs 0.7 and 1.4 (124 and 125, respectively) were only slightly less than the TDEC goal of 131. The results of the semiquantitative macroinvertebrate assessment indicated that Mitchell Branch overall is moderately impaired, which is broadly consistent with the results from the studies using UT-Battelle protocols. Although improvements in the water quality and health of the community may be due to improvement in the stream's quality, it may also be possible that the actual biotic indices (only slightly different) indicate that the changes were within the range of natural annual fluctuations.

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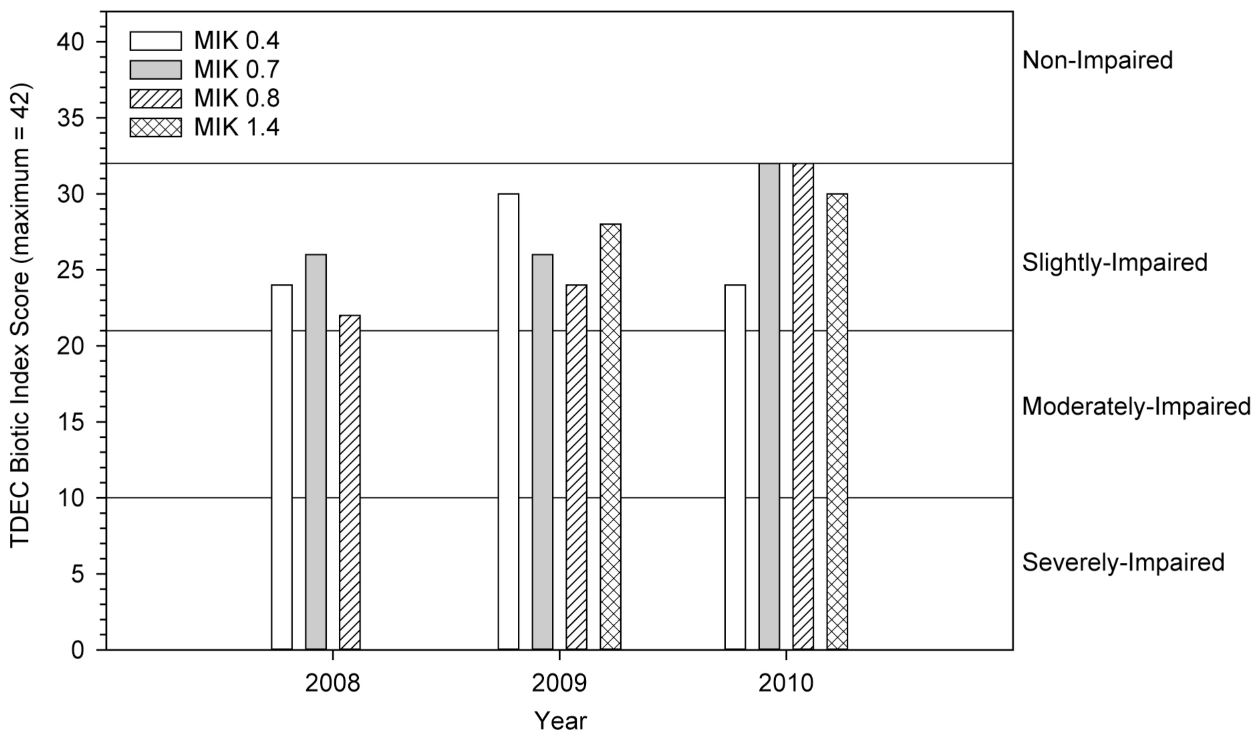

Fig. 3.64. Temporal trends in TDEC Biotic Index scores for Mitchell Branch, August 2008–2010. Horizontal lines show the lower thresholds for biotic condition ratings; respective narrative ratings for each threshold are shown on the right side of each graph.

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Fig. 3.65. Benthic macroinvertebrate sampling using Tennessee Department of Environment and Conservation protocols.

Fish communities in Mitchell Branch (MIKs 0.4 and 0.7) and at three reference sites were sampled in March and April of 2010 (Table 3.47). Species richness, density, and biomass were examined. Results for MIK 0.4 indicated a poorer fish community compared to the same location in 2009. Total density and biomass decreased dramatically from 2009. At MIK 0.7 biomass and density showed slight decreases from last year, while species richness remained unchanged. Wide swings in these three parameters are typical of streams that have been severely impacted and are still recovering. While the condition of the fish community has not yet reached a stable condition typical of less impacted streams in the area, the stream is still dominated by more tolerant fish species.

Table 3.47. Fish species richness, density (individuals/m^2), and biomass (g fish/m^2) at Mitchell Branch sites (MIK) and reference sites, Mill Branch (MBK), Scarboro Creek (SCK), and Ish Creek (ISK) for March and April, 2010

Species	MIK 0.7	MIK 0.4	MBK 1.6	SCK 2.2	ISK 1.0
Largescale stoneroller	1.57	0.06	-	0.11	0.44
Campostoma oligolepis	(5.96)	(0.13)		(0.23)	(1.20)
Striped shiner	1.19	0.09	0.03	-	0.85
Luxilus chrysocephalus	(4.15)	(0.38)	(0.31)		(1.54)
Tennessee dace	-	-	-	-	0.01
Phoxinus tennesseensis					(0.01)
Bluntnose minnow	-	-	-	-	0.04
Pimephales notatus					(0.10)
Western blacknose dace	1.65	0.13	0.19	0.56	0.18
Rhinichthys obtusus	(4.64)	(0.32)	(0.60)	(2.38)	(0.37)
Creek chub	0.36	0.06	0.17	-	0.08
Semotilus atromaculatus	(2.18)	(0.39)	(1.91)		(0.32)
White sucker	-	-	0.04	-	-
Catostomus commersoni			(0.91)		
Western mosquitofish	0.01	-	-	-	-
Gambusia affinis	(0.01)				
Banded sculpin	0.09	0.01	-	0.34	0.22
Cottus carolinae	(0.69)	(0.04)		(1.21)	(1.11)
Redbreast sunfish		0.01			0.01
Lepomis auritus	-	(0.28)	-	-	(0.03)
Hybrid sunfish	-	-	-	0.01	0.01
Lepomis sp. x				(0.03)	(0.06)
Green sunfish	0.03	-	-	0.10	0.41
Lepomis cyanellus	(0.29)			(0.92)	(1.64)
Warmouth	-	-	0.04	-	-
Lepomis gulosus			(0.21)		
Bluegill	-	-	0.07	-	0.01
Lepomis macrochirus			(0.36)		(0.02)
Spotted bass	-	-	-	-	0.01
Micropterus punctulatus					(0.01)
Largemouth bass	-	-	<0.01	-	-
Micropterus salmoides			(0.20)		
Blackside snubnose darter	-	-	<0.01	-	-
Etheostoma duryi			(<0.01)		
Stripetail darter			0.02		
Etheostoma kennicotti	-	-	(0.05)	-	-
Snubnose darter					0.16
Etheostoma simoterum					(0.25)
Species richness	7	6	9	4	12
Total density	4.90	0.36	0.56	1.12	2.43
Total biomass	17.92	1.54	4.55	4.77	6.66

3.7 Quality Assurance Program

BJC is committed to developing, implementing, and maintaining a formal QA program that ensures the highest standards of performance by empowering employees in their respective areas of responsibility through fostering a "no fault" attitude toward the identification and reporting of quality deficiencies. The quality program provides the framework for a results-oriented management system that focuses on performing work safely and meeting mission and customer expectations while allowing BJC and its subcontractors to become more efficient through process improvement.

The BJC QA Program is a management system that addresses three major elements: managing work, performing work (whether self-performed or subcontracted), and assessing the adequacy of work. The management element encompasses management programs, including organizational structure and responsibilities, and management processes, including planning, scheduling, and resource considerations. The management element also includes personnel training and qualifications, continuous improvement, and documents and records. The performance element includes work processes, design, procurement, and inspection and acceptance testing. The assessment element includes external assessments, independent assessments, and management assessments.

The BJC QA Program is based on the Title 10 *Code of Federal Regulations* (CFR) Part 830.120, "Quality Assurance Requirements" and is incorporated within the ISMS. The program identifies the consensus standards used in its development and implementation and describes how the contractor responsible for the facility will implement the requirements contained in those documents. Where equivalent elements do not already exist, additional requirements for radioactive waste packaging are included from 10 CFR 71 Subpart H. DOE reviews changes made to the program annually.

The QA Program requirements are reflected in implementing procedures. Subcontractors must meet the same elements when developing and following their own QA plan for each scope of work, or when following the BJC QA Program in executing work scope. Through its BJC Park Worker Annual Training Program, BJC introduces and emphasizes the importance of the QA Program so that it is understood by BJC and subcontract personnel.

New and revised DOE standards (e.g., orders, manuals, technical standards, guides) are screened by BJC QA organization staff for applicability to BJC work scope and to recommend an approach for developing BJC's position on incorporation into the contract. Applicable standards are routed to functional managers and subject matter experts (SMEs). Necessary actions to address new and/or revised federal, state, and local laws and regulations are considered by the BJC Standards Review Board, whose responsibilities include evaluating issues to determine the need for considering changes to BJC contractual standards due to the following:

- challenges that relate to the appropriateness of safety standards;
- changes to federal, state, and local laws and regulations;
- changes to voluntary consensus standards included as contractual standards;
- changes to approved DOE directives that address safety requirements; and
- new work scope or hazards.

Links to the current set of contractual standards and requirements are maintained on the BJC web site. Additional links are provided for reference to DOE's directives. The BJC organizational structure, functional responsibilities, levels of authority, and interfaces for those planning, managing, performing, and assessing the work are defined in company policies, program plans, program procedures, directives, and subcontracts, as appropriate.

The BJC QA organization has a key role in implementing continuous improvement and provides direct support to program and project teams throughout the company to facilitate integration of QA requirements into project activities. The BJC QA functional manager is responsible for providing central leadership, direction, and assessment of the BJC QA Program and for assisting BJC project managers and subcontract coordinators in verifying that, when required, subcontractors have an adequate QA plan in place before work is initiated.

BJC senior management is responsible for the leadership and commitment to quality achievement and improvement within a framework of public, worker, and environmental safety. BJC management also has the primary responsibility and accountability for the scope and implementation of the BJC QA Program. BJC personnel are held directly responsible for the quality of their work; line management has final responsibility for the achievement of quality. BJC personnel have the responsibility to immediately stop work if an operation or process seriously jeopardizes safety, health, or the environment or if it possesses imminent life-threatening implications as defined in BJC procedures. These responsibilities are passed down to subcontractors through language contained in each subcontract and through the *Worker Safety and Health Program* (BJC 2009e) and *Environmental Compliance and Protection Program* (BJC 2009f).

The BJC QA Program is implemented through management processes, which include training personnel and verifying their qualifications; identifying opportunities for improvement; controlling documents and records; and planning, scheduling, and identifying resources.

The quality of items, services, and processes is ensured for subcontracts through the procurement process by requiring subcontractors to work under the BJC QA Program or to provide a QA plan that identifies the specific quality requirements applicable to the subcontractor's scope of work.

Environmental management operations include environmental cleanup, waste management, and reindustrialization activities. The ultimate success of BJC's environmental program and projects depends on the quality of the environmental data collected and used in the decision-making process. Environmental data operations include the collection, management, use, assessment, retention, and reporting of such data.

All activities involving the generation, acquisition, and use of environmental data are planned and documented. The type and quality of the data are determined with respect to their intended use. The data quality objective process establishes the objectives for data collection and quality. Determining the type and quality of environmental data needed involves data users as well as personnel responsible for activities affecting data quality.

Environmental monitoring programs at ETTP incorporate data quality objectives and other quality assurance protocols through the sampling and analysis plans and the associated laboratory statements of work. The monitoring program SME and the BJC Sample Management Office (SMO) collaborate in choosing the most appropriate analytic methodology for both radiological and nonradiological monitoring. Sample quantitation levels (the point at which it is possible to quantify the concentration within the appropriate level of confidence), screening levels for notification, analytical methods, and other information necessary to ensure that the data collected are of the appropriate quality and are included in the plans. The SMO and the SME review these criteria with the contracting laboratories to ensure that they are capable of meeting the criteria. If for any reason the laboratory is unable to meet any of the requested criteria, the SME must determine if the laboratory's capabilities are adequate. The appropriate action is then taken to either amend the statement of work or to send the analytical work to a laboratory capable of meeting the monitoring program needs.

Laboratories conducting radiological and nonradiological analyses for ETTP environmental monitoring programs are reviewed periodically by the SMO to ensure that the quality of the analytical work continues to meet the appropriate standards. In 2009, all laboratories used by ETTP environmental monitoring programs performed satisfactorily. Laboratories used by ETTP must be approved by DOE's Analytical Services Program (DOECAP Audit Team), which conducts routine audits (at least once a year, and more frequently if a problem is noted) to ensure that the analyses are of the highest quality.

When data are received from the laboratory, the SMO reviews the data package from the laboratory. Data completeness, quantitation levels, screening levels, holding times, and methodology are examined to ensure that all quality aspects of the analyses meet the criteria set forth in the Sampling and Analysis Plan and the Statement of Work (SOW). Any deficiencies are noted, and the laboratory is contacted for clarification. When the SMO is satisfied that the data are complete and meet all criteria, the data are forwarded to the SME. The SME conducts further reviews and uses the data in the appropriate calculations and reports.

Selected programs or projects impose unique QA requirements on their activities. Such special QA Program requirements are added to and, where possible, integrated with the basic BJC QA Program requirements for the affected facilities and activities. For subcontracted work, the necessary QA requirements are included in subcontract language, or the subcontractor is required to develop a QA plan to be submitted to BJC for review and approval. These special QA requirements are applicable to a specific work scope and are monitored by BJC and/or subcontractor personnel, as appropriate.

3.7.1 Integrated Assessment and Oversight Program

QA Program implementation and procedural and subcontract compliance are verified through the BJC Integrated Assessment and Oversight Program. The program identifies the processes for planning, conducting, and coordinating assessment and oversight of BJC 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 BJC, (2) independent assessments conducted by teams independently of the project/function being assessed, and (3) management assessments conducted as self-assessments 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 subcontractor oversight. Informal self-assessments include weekly inspections and routine walkthroughs conducted by subcontractor coordinators, ES&H representatives, quality engineers, and line managers.

QA issues 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 evaluate data from those processes to identify opportunities for improvement.

3.8 Environmental Management and Waste Management Activities

3.8.1 Waste Management Activities

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

The Toxic Substances Control Act (TSCA) Incinerator, located at ETTP, was shut down permanently on December 2, 2009, after treating 35.6 million pounds of liquid and solid waste over a 19-year period. The TSCA Incinerator was a one-of-a-kind thermal treatment unit. It played a key role in treating radioactive PCB and hazardous wastes (mixed wastes) from the Oak Ridge Reservation, as well as other facilities across the DOE complex, thus facilitating compliance with regulatory and site closure milestones. Closure activities at the incinerator will continue through FY 2011 to remove residual waste such as sludge, ash, and scrubber packing material. Much of the waste generated during 2010 cleanup activities was disposed at facilities on the Oak Ridge Reservation.

EMWMF, located in Bear Creek Valley west of the Y-12 Complex, is an engineered landfill that accepts waste generated from cleanup activities on the Oak Ridge Reservation. It currently consists of four active disposal cells, with a fifth cell awaiting final regulatory approval for use and a sixth cell under construction at the end of FY 2010. 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 2010, EMWMF operations collected, analyzed, and dispositioned approximately 4.8 million gallons of leachate and 1.3 million gallons of contact water at the ORNL Liquid/Gaseous Waste Operations Facility. An additional 10 million gallons of contact water was collected, analyzed, and released to the storm water retention basin after determining that it met the release criteria. EMWMF received approximately 22,700 truckloads of waste accounting for approximately 262,000 tons during FY 2010. Projects that have disposed of waste at EMWMF during the year include the following:

- K-25 Building Demolition Project, including waste generated from the west wing demolition;

- ETTP Decontamination and Decommissioning Project, including K-770 Scrapyard, K-1070-B Burial Ground, and K-1036/K-1058 demolition debris;
- Y-12 Old Salvage Yard Project, Alpha 5 Project, and Biology Project; and
- ORNL Building 3026 and 2000 Complex.

The Central Neutralization Facility, located at ETTP, treated 9.5 million gallons of wastewater in FY 2010. The facility is ETTP's primary wastewater treatment facility and processes both hazardous and nonhazardous waste streams arising from multiple waste treatment facilities and remediation projects. The facility removes heavy metals and suspended solids from the wastewater, adjusts pH, and discharges the treated effluent into the Clinch River. Sludge from the treatment facility is treated, packaged, and disposed of off-site. With the shutdown of the TSCA Incinerator, the Central Neutralization Facility operated at a reduced capacity on day shift only instead of the previous 24/7 operation. The main waste stream is the hexavalent chromium-contaminated groundwater collected from Mitchell Branch. The facility also continued to treat wastewaters generated at the TSCA Incinerator and remediation and investigation projects to support the closure activities. It will be shut down in FY 2011 for decommissioning after establishing a smaller chromated water treatment unit that will sit within the existing Central Neutralization Facility footprint.

At ORNL, approximately 120 million gallons of wastewater were treated and released at the Process Waste Treatment Complex. In addition, the liquid low-level waste evaporator at ORNL treated 120,800 gallons of such waste. A total of 2.2 billion m^3 of gaseous waste was treated at the ORNL 3039 Stack Facility.

These waste treatment activities supported both EM and Office of Science mission activities in a safe and compliant manner during FY 2010. The National Nuclear Security Administration (NNSA) at the Y-12 Complex treated 116.5 million gallons of contaminated ground/sump water at the Groundwater Treatment Facility, the Central Mercury Treatment System, Big Springs Water Treatment System, and the East End Volatile Organic Compounds Treatment System.

The Big Springs Water Treatment System treated 104 million gallons of mercury-contaminated groundwater. The East End Volatile Organic Compound Treatment System treated 11 million gallons of VOC-contaminated groundwater. The West End Treatment Facility and the Central Pollution Control Facility at the Y-12 Complex processed 1.2 million gallons of wastewater primarily in support of NNSA operational activities. The Central Pollution Control Facility also down-blended more than 37,000 gallons of enriched wastewaters using legacy and newly generated uranium oxides from on-site storage and was completed ahead of schedule and under budget in May. EMWMF began operations in 2002 to provide on-site waste disposal capacity from remediation of the Oak Ridge Reservation. Although it is being expanded to its maximum capacity, EMWMF will not be able to handle all of the waste expected to be generated from reservation cleanup activities.

Further expansion at EMWMF is constrained by physical limitations of the site. Therefore, DOE is considering other locations to build a new disposal facility. DOE began evaluating disposal alternatives in FY 2010 for future reservation cleanup waste.

Similar to the CERCLA process that was completed for the existing EMWMF, DOE will evaluate the following alternatives detailed in a Focused Feasibility Study:

- No action
- On-site disposal (constructing and operating a new disposal facility on the reservation)
- Off-site disposal (shipping to an off-site facility)

The on-site disposal alternative includes consideration of options for siting a new facility in the East Bear Creek Valley area or in two other candidate areas (White Wing Scrap Yard and West Bear Creek Valley).

The use of RFIDs was implemented for waste shipments to EMWMF. This innovation allows for faster and more accurate tracking of waste shipments and reduces paperwork, decreases the shipment cycle time, and improves security of the materials being transported along the haul road.

The Oak Ridge Reservation landfills are located near the Y-12 complex and are designed for the disposal of sanitary, industrial, construction, and demolition wastes that meet the waste acceptance criteria for each landfill. In FY 2010, more than 139,000 cubic yards of waste was disposed of at these facilities, and more than 1.4 million gallons of leachate was collected, monitored, and discharged to the Oak Ridge sewer system. In 2009, planning was initiated to expand Landfill V of the Oak Ridge Reservation landfills.

3.8.2 Environmental Restoration Activities

The ETTP operated as an enrichment facility for 4 decades, during which time many of the buildings became contaminated to some degree with radionuclides, heavy metals, and toxic organic compounds. In addition, large quantities of wastes were generated, much of which was stored on the site.

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

DOE has signed two of three key CERCLA records of decision with the state of Tennessee and EPA authorizing environmental restoration of about 890 ha of land at ETTP. The area encompasses approximately about 567 ha outside the main plant security fence (Zone 1) and about 324 ha inside the fence within the former plant production area (Zone 2). The main objectives of the two decisions are to protect future industrial workers and the underlying groundwater from contamination in soil, slabs, and subsurface structures. The Zone 1 Interim Record of Decision (ROD) was signed in November 2002 and covers the 566-ha area surrounding ETTP outside the main plant perimeter. The Zone 2 ROD was signed in April 2005 and covers the 324-ha in the main plant area. The final site-wide record of decision for groundwater, surface water, sediment, and ecological soil risk is in development.

Final data were collected in FY 2010 to characterize five parcels surrounding ETTP in order to determine if these parcels can be removed from the National Priorities List site boundary, which encompasses the contaminated sites on the reservation. The entire reservation was originally placed on the National Priorities List, but EPA has since clarified that listed sites are based on contaminated areas, not property boundaries.

3.8.2.1 K-25 Building Demolition

The K-25 Building, built during the Manhattan Project, occupied approximately 40 acres and contained more than 3,000 stages of gaseous diffusion and associated auxiliary equipment. Each stage consists of a converter, two compressors, two compressor motors, and associated piping. The west wing of the K-25 Building has been demolished, and debris from the demolition has been removed from the site (Fig. 3.66).

ORNL 2011-G00821/chj

Fig. 3.66. The K-25 Building after demolition of the west wing.

Debris from the demolition activities is shipped to the EMWMF. Pre-demolition activities continued in the East Wing, including the removal of high-risk equipment. Workers also continued performing vent, purge, drain, and inspection activities; asbestos removal; and draining of lubrication oil and coolant from the process system in both the east and north wings. Measures were previously taken to improve the safety of workers inside the facility, including the installation of nets and barriers to add protection from falling debris.

3.8.2.2 K-27 and K-33 Buildings Demolition

The K-27 Building is similar to the K-25 Building in terms of process and is approximately 900 ft long, 400 ft wide, and 58 ft in height. Pre-demolition work that has been initiated includes removal of asbestos, hazardous material, loose material, and draining of lubrication oil and coolant. DOE has awarded a contract for the demolition of the K-33 Building. One of the last steps necessary before demolition begins—that is, isolation of the tie line connecting that building to the K-31 Building—was completed.

3.8.2.3 Groundwater Treatability Study

Remediation activities to reduce ETTP groundwater and surface water contamination continued in FY 2010. Work was initiated in FY 2010 to prepare a Zone 1 Final ROD that will address groundwater and ecological protection. Field work on that project will be initiated in FY 2011. A two-phase groundwater treatability study at ETTP began in FY 2009 to support selection of a site-wide groundwater remedy.

The purpose of the study was to determine the feasibility of in situ treatment technologies to restore the groundwater. Two in situ technologies have been identified as possibilities, and one or both may be suitable: thermal conductive heating and biological treatment. The purpose of the first phase of the study was to characterize and delineate suspected areas of solvent contamination. Seven boreholes were installed to depths of 110 to 160 ft below ground surface in FY 2009 (Fig. 3.67).

In FY 2010, Dense Non-Aqueous Phase Liquid (DNAPL) was detected in one of the boreholes in the vicinity of the former K-1401 Vapor Degreasing Tank. DNAPLs are a group of organic substances that are relatively insoluble in water and more dense than water. Seven additional boreholes were installed to further delineate the lateral extent of DNAPL contamination.

A workshop was held in September 2010 to review the data and select a technology for a Phase II Pilot Field Study. The workshop concluded that in situ thermal treatment may be appropriate for DNAPL treatment in the weathered bedrock zone, that in situ thermal or biological treatment may be appropriate for treatment of the unconsolidated zone, and that a waiver may be appropriate for the deep bedrock zone. The objective of the study is to determine if these technologies would be effective in reducing the mass of contamination in the groundwater and reducing the risk of exposure to human health and the environment.

ORNL 2011-G00822/chj

Fig. 3.67. Drilling exploratory boreholes near the K-1401 area.

3.8.2.4 Soil, Burial Ground, and Exposure Unit Remediation Activities

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

Remediation of contaminated soil continued at the K-770 Scrapyard, and approximately 97,000 yd^3 of soil has been shipped to EMWMF for disposal. Remediation of the K-770 Scrapyard was 99% complete at the end of FY 2010.

In Zone 2, work in Exposure Units (EUs) 31 and 32 was completed, and remediation of the K-1070-B Burial Ground continued. EU 31 is in the center of ETTP and spans approximately 8.5 ha. A Phased Construction Completion Report (PCCR) was completed that documented the characterization of the EU, the remediation of the K-1035 slab and underlying soil, the removal of the K-1401 slab, and the backfilling of the K-1401 basement.

EU 32 also is in the center of ETTP and spans approximately 7.4 ha. A PCCR was prepared that documented the characterization of the EU and the remediation of the K-1066-G Yard, which consisted of the removal of equipment and material that was stored there.

Through the end of FY 2010, approximately 93,000 yd^3 were excavated from the K-1070-B Burial Ground. Excavation of the trenches was initiated, and the groundwater collection, filtering, and transfer system to the Central Neutralization Facility was installed.

3.8.2.5 Mitchell Branch Chromium Collection System

In 2007, surveillance data indicated that the chromium levels in Mitchell Branch had markedly increased. Subsequent analyses showed that the chromium was almost entirely in the hexavalent state.

Since hexavalent chromium has not been used at ETTP for many years, it is believed that the source is groundwater contaminated with legacy material, and not a result of current operational issues. The chromium collection system consists of a grout layer to impede the flow of the groundwater and two extraction wells and pumps to pump the groundwater from the vicinity of storm water outfall 170 for treatment at the CNF and discharge through the CNF NPDES outfall. Since the installation of this system and subsequent modifications to increase pumping rates, chromium levels in Mitchell Branch have been reduced to well below the WQC of 11 µg/L, and near or below the detection levels of 1 to 3 µg/L. In FY 2010, DOE approved a non-time-critical Removal Action for a long-term solution to the release of hexavalent chromium into Mitchell Branch. The Removal Action Work Plan and conceptual design were completed in FY 2010. DOE had previously approved a time-critical Action Memorandum to address releases of hexavalent chromium from an unknown source to Mitchell Branch in FY 2007.

3.8.2.6 K-1007 Ponds Remediation

Largemouth bass from the K-1007-P1 Pond were known to accumulate high concentrations of PCBs in their muscle tissue. As a result of multiple studies of the pond, the major source of PCB contamination was thought to be in the sediments, which are easily suspended by bottom-feeding fish like carp and shad, especially in this system where grass carp totally decimated pond plants that historically served to stabilize the sediments. High nutrient loads in the pond from a large goose population were thought to contribute high suspended algal biomass. Lipid-rich gizzard shad, which forage on sediment and suspended algae and therefore accumulate very high PCBs, served as a major vector of PCB transfer to largemouth bass and wildlife. In 2009, a non-time-critical removal action was implemented that used fish, wildlife, and plant management principles to minimize the risks associated with PCBs in the pond. The problem fish were removed from the pond, geese were discouraged from the area, and extensive pond recontouring and planting was conducted. The goal was to create in the pond a population of relatively low bioaccumulator fish (i.e., primarily small sunfish), plus dense areas of rooted aquatic vegetation to stabilize the sediment to prevent resuspension. This innovative approach was deemed more cost-effective than traditional dredging operations and served to preserve the pond as an ecological and aesthetic asset for the area.

Fish removal, recontouring, and revegetation were completed at the ETTP P1 Pond located next to Building K-1007 (Fig. 3.68). Fish removal was also conducted in two additional ETTP ponds located adjacent to Highway 58, with approximately 8.5 tons of fish recovered from all three. Removal of the fish was necessary because the species that were in the ponds would stir the contaminated sediment at the bottom of the ponds. The pond was restocked with fish species that are less likely to disturb the pond sediment. Barriers were placed to prevent fish from migrating into the pond from Poplar Creek. The fish barrier was damaged during FY 2010 after a severe weather event. Undesirable fish that reentered the pond were removed, and the fish barrier was repaired.

Miscellaneous Remediation Efforts

ETTP has designated certain facilities with a low risk for radiological and chemical contamination as “Low-Risk/Low-Complexity” D&D facilities. All waste from these facilities is expected to contain a low level of expectation risk and contamination. In FY 2010, six low-risk/low-complexity facilities were demolished.

ORNL 2011-G00823/chj

Fig. 3.68. Revegetating the K-1007-P1 Pond.

3.8.3 Reindustrialization

The Reindustrialization Program was developed to accelerate cleanup of the site and to allow for beneficial reuse of underutilized facilities and land. Facilities determined appropriate for reuse are leased or transferred to non-DOE entities such as the Community Reuse Organization of East Tennessee (CROET) or the city of Oak Ridge. CROET is a not-for-profit corporation established to foster diversification of the regional economy by reutilizing excess DOE property for private-sector investment and job creation.

With the property and infrastructure transfers and upgrades in FY 2010, the DOE Oak Ridge Office Reindustrialization Program marked a turning point in realizing DOE's vision to transform ETTP into a private sector business/industrial park. In FY 2010, the Reindustrialization Program transferred Land Parcel ED-8 and the K-792 Switchyard Complex (including Buildings K-796-A and K-791-B) to CROET. Approximately 145 contiguous acres, with supporting infrastructure located along Highway 58 at the front portion of ETTP, are now available for economic development. Additional land areas at ETTP are in various stages of the transfer process, and utility infrastructure improvements continue to support expansion of ETTP. In addition to land, DOE transferred the Phase I Electrical Distribution System in February 2010 and several site roadways to the city of Oak Ridge in May and June 2010. The Phase I portion of the electrical system included all direct off-site main plant power lines. The roadway transition included 1.3 miles of roads at the main site entry and arterial roadways to provide public access to privately owned buildings at ETTP.

In FY 2010, CROET completed construction of two speculative buildings and upgraded the fire protection systems in the privately owned buildings at ETTP, while the city constructed a new power line from their substation to serve the speculative buildings and the Land Parcels ED-5 East and West.

DOE has now transferred ownership of approximately 176 acres of land (Fig. 3.69) and 332,000 ft^2 in building space at ETTP. These transfers have been made via a provision in CERCLA that allows for the transfer of property for economic development purposes. These activities are all part of DOE's plan to transform ETTP into a private-sector business and industrial park.

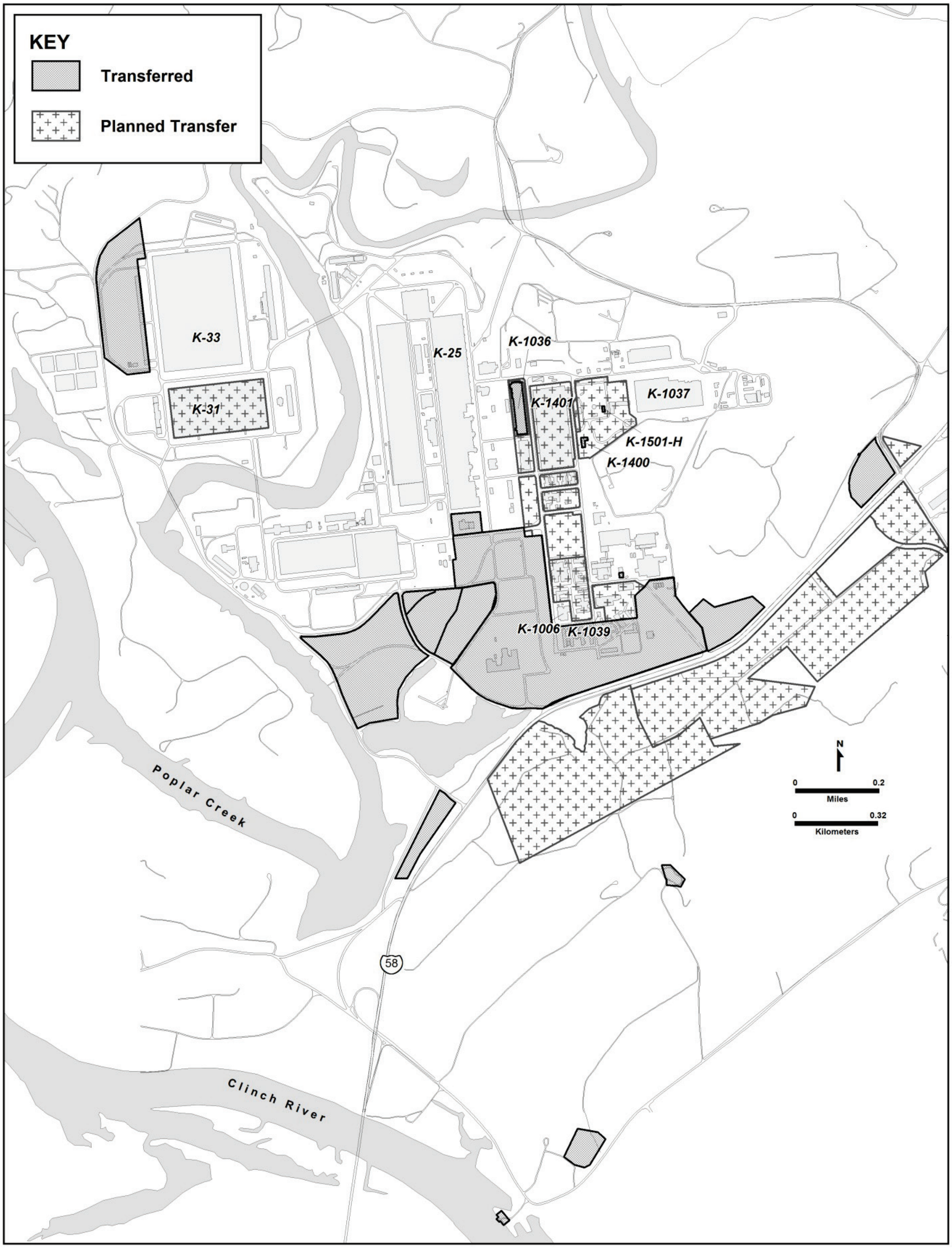

Fig. 3.69. ETTP Reindustrialization status, 2010.

3.8.4 Biosolids Program

Under the Biosolids Program, treated municipal sludge (biosolids) from the city of Oak Ridge publicly owned treatment works (POTW), is applied to six approved sites (Fig 3.70) on the Oak Ridge Reservation (ORR) as a soil conditioner and fertilizer. BJC provides oversight for the program (*Application of Sanitary Biosolids on the Oak Ridge Reservation, Program Oversight Plan,* BJC/OR-1217), which operates under a land license agreement between the DOE and the city. The city has applied biosolids on the ORR since 1983.

Land application is included in the EPA policy on municipal biosolids, which was formally articulated in June 1984 (49 CFR 24358), as an example of beneficial use. Municipal biosolids are regulated by the EPA under the provisions of Title 40, *Code of Federal Regulations* (CFR), Part 503 of the Clean Water Act (CWA). These regulations establish standards for biosolids use and disposal, including risk-based, metal-loading criteria and agronomic (nitrogen) loading limits for the receiving soil. Additional requirements are imposed by the Environmental Assessments (DOE/EA-1042, DOE/EA-1356, and draft DOE/EA-1779) written for the program and by the Tennessee Department of Environment and Conservation (TDEC) through the land application approval process.

In addition to metals, POTW biosolids typically contain both natural and anthropogenic radionuclides. In particular, the Oak Ridge POTW biosolids contain trace quantities (parts per million) of slightly enriched uranium from the Y-12 Plant. Radionuclides in biosolids are not currently regulated by the EPA. With the consent of TDEC, the city, and DOE, the Biosolids Program has established specific radionuclide limits for the biosolids and receiving soil using radiation dose limit calculations. Currently, the biosolids and soil limits are calculated using the Residual Radioactivity (RESRAD) model assuming conservative pathway scenarios (DOE/EA-1042, DOE/EA-1356).

The Nuclear Regulatory Commission (NRC) regulations prohibit an unlicensed entity from receiving, possessing, or handling special nuclear material (SNM). The state of Tennessee, however, is authorized by the NRC to exempt certain classes or quantities of SNM from the requirements of a potential license when it makes a finding that the exemption of such quantities of SNM would not constitute an unreasonable risk to the health and safety of the public. On April 29, 1993, the city requested a waiver from the SNM licensing requirement from TDEC Division of Radiological Health (DRH). This waiver was granted by DRH on September 27, 1993. Accordingly, the SNM aspects of the biosolids application program are in compliance with requirements of NRC and TDEC.

3.8.4.1 Biosolids Fields at the ORR

The biosolids land application sites are located on the ORR in Oak Ridge, Tennessee (Fig 3.70). Five of the active sites are in the vicinity of Bethel Valley Road, while the remaining active site, Watson Road, is located on Highway 95, near the Horizon Center. Table 3.48 presents the six application sites and their gross acreage values.

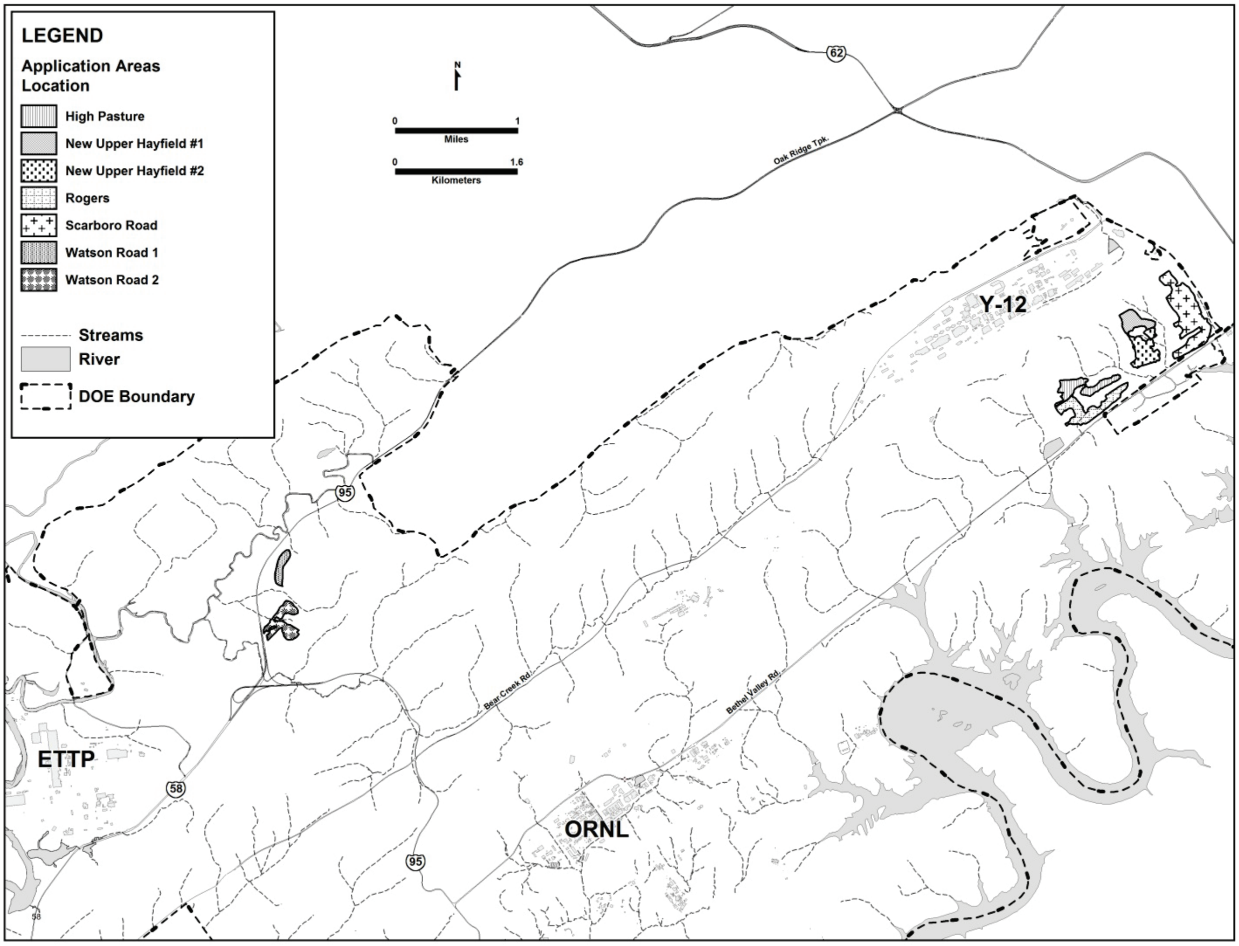

Fig. 3.70. Location of the biosolids application sites with respect to the ETTP, Y-12, and ORNL facilities within the region.

Table 3.48. ORR biosolids active land application sites gross acreage

Site	Acres (Ac)	Hectares (ha)
Upper Hayfield #1	30	12.15
Upper Hayfield #2	27	10.93
High Pasture	46	18.62
Watson Road	117	47.37
Scarboro	77	31.17
Rogers	32	12.96

3.8.4.2 Current Program

The city POTW near Turtle Park in Oak Ridge, Tennessee, processes approximately 30 million gallons per day (gpd) of wastewater. The plant receives wastewater from a variety of industrial, commercial, and residential generators in the Anderson/Roane County area. The DOE contributes approximately 20% of the influent to the POTW directly from the Y-12 site, with lesser amounts from the ETTP through the Rarity Ridge treatment plant, and from ORNL through tanker delivery of sludge. All industrial generators are required by Oak Ridge Ordinance Number 9-91 to obtain an industrial discharge permit (IDP) from the city, which prescribes discharge limits and monitoring/reporting requirements. The POTW uses a standard activated-sludge process in which biosolids from both the primary and secondary sedimentation basins are fed into two aerobic holding tanks. From there, the liquid biosolids are pumped to a belt press system for drying.

The city is working toward production of Class B biosolids with 20% to 25% solids content, which will then be transported to one of the six active application sites using a standard-size discharge manure spreader. All of the tanks formerly used for anaerobic treatment have now been converted to aerobic digesters. It is estimated that up to 2600 lb of dry solids could be land applied on an average day.

3.8.4.3 Current Status

The city has accumulated approximately 750,000 gal of liquid (approximately 97–98% liquid) biosolids in digesters that resulted from attempts to produce a class B product. Under a land application approval from TDEC, the city began application of the liquid biosolids in November 2010 at the ORR using a sprayer truck. Currently, the environmental assessment DOE/EA-1356 governs restrictions for biosolids application at the ORR. These restrictions include protective boundaries, setbacks for surface water features, and areas with potential channels to groundwater of 500 ft, and 50 ft around waters of the state. In accordance with industry best-management practices, application is not permitted under conditions of saturated site soil, precipitation, or excessive wind. Additionally, in accordance with TDEC land application guidance, application is only permitted on slopes of 8% or less.

From November 10, 2010, through December 31, 2010, the city made nine trips to the High Pasture site and applied 3.61 dry tons of product. Current loading calculations indicate that a maximum of 16.5 tons of dry material may be applied to the High Pasture southern tabletop without exceeding nitrogen requirements for vegetation present on the fields. Table 3.49 presents data on biosolids applied during 2010 at the ORR.

Table 3.49. Biosolids applied during 2010 at the ORR

Date	Dry amount applied (lb)	lb	tons	% used	Loads
11/10/2010	528	528	0.26	1.60	1
11/11/2010	2,358	2,886	1.44	8.75	2
11/12/2010	1,560	4,446	2.22	13.47	2
11/22/2010	1,284	5,730	2.87	17.36	2
11/29/2010	757	6,487	3.24	19.66	1
12/10/2010	729	7,216	3.61	21.87	1

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