# 3. East Tennessee Technology Park

The 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 to recycle spent fuel. (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, cleanup and/or demolition of the facilities, restoration of the land, and environmental monitoring. Beginning in the 1990s, reindustrialization (the conversion of underutilized government facilities for use by the private sector) also became a major mission at ETTP. These activities consist of cleaning or demolishing facilities and cleaning up outdoor storage and disposal areas. Proper disposal of the huge quantities of waste that were generated over the course of production operations is also a major task. Reindustrialization allows private industry to lease underutilized facilities, thus both providing jobs and a new use for facilities that otherwise would have to be demolished. Environmental monitoring consists of two main activities: effluent monitoring and environmental surveillance. 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 2007, there was better than 99% compliance with permit standards for emission from ETTP operations.

## 3.1 Introduction

Construction of the East Tennessee Technology Park (ETTP), originally known as the K-25 site, began in 1943 as part of the World War II Manhattan Project. It was built as the home of the Oak Ridge Gaseous Diffusion Plant (ORGDP) (Fig. 3.1). The plant's original mission was production of highly enriched uranium for nuclear weapons.

Enrichment was initially carried out in two process buildings, K-25 and K-27. 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. 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 production of only slightly enriched uranium to be fabricated into fuel elements for nuclear reactors and the recycling of fuel elements from 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, 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. In 1997, the K-25 Site was named the "East Tennessee Technology Park" to reflect its new mission.

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 the land as well as decontamination and decommissioning (D&D) of most 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

**Fig. 3.1. The East Tennessee Technology Park.**

facilities may then be subleased or sold, with the goal of stimulating private industry and recruiting business to the area.

The ETTP mission is to reindustrialize and reuse site assets through leasing of excess or underutilized land and facilities and incorporation of commercial industrial organizations as partners in the ongoing environmental restoration, D&D, and waste treatment and disposal. During 2007, one building (the K-1652 Fire Station) and two land parcels (ED-5 East and ED-7, totaling approximately 10 ha) were transferred to the city of Oak Ridge. Similar to its leasing process for federally owned facilities, CROET also subleases transferred facilities.

## 3.2 Environmental Compliance

Operations at ETTP are governed by state and federal laws and the attendant regulations, by DOE orders, and by agreements with regulatory bodies. Table 3.1 provides a synopsis of the major environmental protection laws and programs at ETTP and the compliance status during 2007. Table 3.2 lists the major environmental permits in place at ETTP in 2007. Compliance is verified by internal audits and assessments as well as routine assessments by state and federal regulators (Table 3.3)

## 3.3 Current Operations

### 3.3.1 Waste Management Activities

Waste disposal, environmental remediation, and D&D constitute the major operations at ETTP.

The ETTP is home to the Toxic Substances Control Act (TSCA) Incinerator, a unique thermal treatment facility. It is the only facility licensed to incinerate both polychlorinated biphenyl (PCB) waste and radioactive mixed waste. The TSCA Incinerator treats waste from all across the DOE complex and as such is a key component of DOE remediation efforts across the nation (Fig. 3.2).

The TSCA Incinerator treated approximately 1.3 million lb of waste in 2007 (1.1 million lb of liquid waste and more than 216,000 lb of solid waste). This amount represents the most waste treated in a fiscal year since 1999, double the annual average for the preceding five years. As of the end of 2007, the

**Table 3.1. Major regulatory programs at East Tennessee Technology Park**

| Regulatory program description | Compliance status |
|---|---|
| **The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)** provides the regulatory framework for remediation of releases of hazardous substances and of inactive hazardous waste disposal sites. Regulators include Environmental Protection Agency (EPA), DOE, and the Tennessee Department of Environment and Conservation (TDEC) | In 1989, the ORR was placed on EPA's National Priorities List, a list of facilities that pose a sufficient threat to human health and/or the environment and warrant cleanup under CERCLA. 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 |
| **The National Environmental Policy Act (NEPA)** requires federal agencies to follow a prescribed process to anticipate the impacts on the environment of proposed major federal actions and alternatives | Bechtel Jacobs Company activities on the ORR are in full compliance with NEPA requirements. Procedures for implementing the NEPA requirements have been fully developed and implemented. At ETTP, a checklist incorporating NEPA and Environmental Management System requirements has been developed as an aid for project planners. For routine operations, generic categorical exclusions (CXs) have been issued. During 2007, two CXs (for building demolition and planting of switch grass) were issued, and five review reports (for reindustrialization projects) were prepared |
| **The National Historic Preservation Act** identifies, evaluates, and protects historic properties eligible for listing in the *National Register of Historic Places*. Such properties can be archeological sites or historic structures, documents, records, or objects | On the 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 others are scheduled to be demolished as part of the site-wide remediation project. Any artifacts of historical and/or cultural significance identified during demolition were cataloged in the *National Register's* database to aid in historic interpretation of the ETTP |
| **The Clean Air Act (CAA)** and Tennessee environmental conservation laws regulate the release of air pollutants, including radionuclides, through permits and air quality limits. Tennessee has implementation authority through the state construction and operating permit program or Title V Major Source Permitting Program. Emission measurement methods for radionuclides are regulated by EPA, via the National Emission Standards for Hazardous Air Pollutants (NESHAP) authorizations. NESHAP source category emission standards for nonradionuclide hazardous air pollutants are regulated by EPA | EPA has delegated authority for implementing and enforcing the CAA to the state of Tennessee. ETTP facilities were in full compliance with the CAA during 2007 |
| **The Clean Water Act (CWA)** seeks to improve surface water quality by establishing standards and a system of permits. Wastewater discharges and pump and haul systems for collection of sewage are regulated by National Pollutant Discharge Elimination System (NPDES) permits issued by TDEC | ETTP-permitted discharges include treated industrial wastewater, treated sanitary wastewater, and storm water discharges. In 2007, there were five noncompliances of the NPDES permit and CWA requirements (see Appendix E) |

**Table 3.1** (continued)

| Regulatory program description | Compliance status |
|---|---|
| **The Safe Drinking Water Act** establishes minimum drinking water standards and monitoring requirements | The K-1515 sanitary water plant provided drinking water for ETTP and for an industrial park south of the site. In 2007, the ETTP sanitary water plant met all primary drinking water standards as well as operational and maintenance requirements |
| **The Emergency Planning and Community Right-to-Know Act,** also referred to as the Superfund Amendment Reauthorization Act (SARA) requires reporting emergency planning information, hazardous chemical inventories, and environmental releases of certain toxic chemicals to federal, state and local authorities | ETTP operates in full compliance with emergency planning and reporting requirements. In 2007, ETTP inventories contained 13 regulated chemicals |
| **The Resource Conservation and Recovery Act (RCRA)** governs the generation, storage, handling, and disposal of hazardous wastes. RCRA also regulates underground storage tanks containing petroleum and hazardous substances, universal waste, and recyclable used oil | ETTP is defined as a large-quantity generator of hazardous waste because it generates greater than 1,000 kg of hazardous waste per month. The ETTP is also regulated as a handler of universal waste. TDEC's 2007 inspection at ETTP found no items of concern. Two underground storage tanks are permitted at ETTP |
| **The Toxic Substances Control Act (TSCA)** regulates the manufacture, use, and distribution of all chemicals and mandates controls on toxic substances. It requires the administrator of the EPA to adopt rules requiring testing of chemical substances and mixtures that may present an unreasonable risk of injury to health or the environment. The administrator is authorized to regulate, limit, or prohibit the manufacture, processing, distribution, use, and disposal of these substances and mixtures | Facilities at ETTP manage TSCA-regulated materials, including PCBs, in compliance with all requirements. Almost all TSCA-related activities at ETTP involve the TSCA Incinerator |
| **The Federal Insecticide, Fungicide, and Rodenticide Act** governs the manufacture, use, storage, and disposal of pesticides and herbicides, as well as pesticide containers and residuals | There are no restricted-use pesticide products used at ETTP |
| **The ETTP Floodplains Management Program** incorporates floodplain management goals into planning, regulatory, and decision-making processes, to reduce the risk of flood loss, minimize the impact of floods, and restore and preserve natural and beneficial values served by floodplains | At ETTP, protection of floodplains is implemented through the NEPA program, and surveys for the presence of wetlands are conducted for projects or programs as needed |
| **The ETTP Protection of Wetlands Program** incorporates wetlands protection goals into planning, regulatory, and decision-making processes to reduce the risk of flood loss, minimize the impact of floods, and restore and preserve natural and beneficial values served by wetlands | At ETTP, wetlands protection is implemented through the NEPA program, and surveys for the presence of wetlands are conducted for projects or programs as needed |

**Table 3.1** (continued)

| Regulatory program description | Compliance status |
|---|---|
| **The Endangered Species Act** prohibits activities that would jeopardize the continued existence of an endangered or threatened species or cause adverse modification to a critical habitat | The ETTP is host to numerous species of flora and fauna that are categorized as threatened or of special concern. At present, no species classified as endangered are known to be present |
| **DOE Order 231.1A, *Environment, Safety, and Health Reporting***, ensures timely collection, reporting, analysis, and dissemination of information on environment, safety, and health issues | The *ORR Annual Site Environmental Report* (ASER) is prepared to summarize environmental activities on the ORR and to characterize environmental performance. The ETTP participates in the publication of the ASER |
| **The Pollution Prevention Act** requires DOE operations to evaluate and implement materials, processes, and practices that reduce or eliminate the generation and release of pollutants. Waste minimization also includes recycling and reuse | The ETTP Pollution Prevention Program is currently under development |
| **DOE Order 435.1, Change 1**, ***Radioactive Waste Management***, is implemented to ensure that all DOE radioactive waste is managed in a manner that protects workers, public health and safety, and the environment. | Some ETTP operations generate radioactive waste. ETTP has implemented a waste certification program |
| **DOE Order 450.1A, *Environmental Protection Program***, has the objective of implementing sound stewardship practices that protect the air, water, land, and other natural and cultural resources affected by DOE operations. DOE facilities meet this objective by implementing Environmental Management Systems | ETTP has implemented an Environmental Management System that is integrated with the site's Integrated Safety Management System. Details can be found in Sect. 3.4.2 |
| **DOE Order 5400.5, *Radiation Protection***, was established to protect members of the public and the environment against undue risk from radiation This order establishes standards and requirements for operations of DOE and DOE contractors | The guidance values provided in DOE Order 5400.5 are used at ETTP to ensure that effluents and emissions do not affect the environment or public and worker safety and health, and to ensure that all doses meet the "as low as reasonably achievable" policy |

**Table 3.2. Permit actions at East Tennessee Technology Project**

| Permit No. | Units covered | Issued | Expires | Comments |
|---|---|---|---|---|
| TNHW-015 | TSCA Incinerator | Sep. 28, 1987 | Sep. 28, 1997 | Continued while renewal application being reviewed |
| TNHW-133 | Container and tank storage and treatment units | Sep. 28, 2007 | Sep. 28, 2017 | Replaces TNHW-015A |
| TNHW-117 | Container storage and treatment | Sep. 30, 2004 | Sep. 30, 2014 | |
| TNHW-121 | Solid waste management units | Sep. 28, 2004 | Sep. 28, 2014 | Encompasses the entire Oak Ridge Reservation |
| TN0074225 | Central Neutralization Facility Wastewater Treatment System | | | National Pollutant Discharge Elimination System permit for treated liquid effluent |
| TN0002950 | Storm water outfalls | April 1, 2004 | | 121 permitted outfalls in 4 categories |

**Table 3.3. Oversight and assessment at East Tennessee Technology Park (ETTP) in 2007**

| Regulatory area | Reviewer | Dates | Subject | Findings |
|---|---|---|---|---|
| Resource Conservation and Recovery Act | Tennessee Department of Environment and Conservation (TDEC) | February | TSCA Incinerator | No notice of violations |
| Toxic Substances Control Act (TSCA) | U.S. Environmental Protection Agency TDEC | February | TSCA Incinerator | No findings |
| Clean Water Act/ National Pollutant Discharge Elimination System | TDEC | September | Central Neutralization Facility, TSCA Incinerator wastewater, ETTP storm water outfalls | No new issues identified |

**Fig. 3.2. The Toxic Substances Control Act Incinerator.**

incinerator had operated 629 days since the last recordable injury and 1,462 days since the last lost workday injury. DOE is planning to incinerate approximately 1.2 million lb of waste in the TSCA Incinerator in 2008.

The Central Neutralization Facility (CNF), ETTP's primary wastewater treatment facility, which processes both hazardous and nonhazardous waste streams, treated more than 15 million gal of wastewater in 2007. Although the largest single contributor by far is the TSCA Incinerator, wastes also arise from other 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. CNF was scheduled to be replaced by the K-1435 Waste Water Treatment System (WWTS), but because of technical issues related to the WWTS, the CNF will probably be retained to process wastewater in conjunction with WWTS for the foreseeable future.

### 3.3.2 Environmental Restoration Activities

The ETTP operated as an enrichment facility for four decades, during which time many of the buildings became contaminated to some degree with radionuclides, heavy metals, and toxic organic compounds. In addition, large quantities of wastes were generated, much of which was stored on the site. The Environmental Management Program is designed to demolish all unnecessary facilities and restore the site to a usable condition.

Safety and health of employees and the public is a constant focus. Cost effectiveness is also a major consideration in the cleanup operations. Building demolition is being performed through several projects: (1) K-25/K-27 Buildings; (2) Group 2, Phase 2 Buildings (K-1064 Peninsula); (3) Group 2, Phase 3 Remaining Facilities; and (4) K-29/K-31/K-33 Buildings Decontamination. Buildings that can be used by the private sector and for which suitable tenants are found will remain but will be transferred to CROET.

Because these are removal actions, CERCLA Zone 1 and 2 records of decision (RODs) will determine the final remedy for the contaminated slabs, soils, and below-grade structures. Zone 1 is the

567 ha area outside the security fence surrounding ETTP. Zone 2 includes the area within the main security fence at ETTP (approximately 324 ha). The Federal Facilities Agreement (FFA) among EPA, TDEC, and DOE provides the broad agreement of the cleanup goals and schedules.

One of the major operations at the ETTP site is dismantling and preparing the K-25 building for demolition. This is one of the largest D&D projects in the entire DOE complex. The three-story, U-shaped K-25 building, built during the Manhattan Project, covers 1.64 million $ft^2$ (approximately 18 ha) and contains 3,018 stages of gaseous diffusion process equipment and associated auxiliary systems, including approximately 400 miles of piping. Each stage consists of a converter, two compressors, two compressor motors, and associated piping. Removal of the high-risk equipment components is expected to be completed in the west wing in 2008 and the east wing in 2009, with the actual demolition of the west wing scheduled to begin in the fall of 2008. Activities under way to prepare the K-25 building for demolition include process system stabilization by foaming, removal and segmentation of high-risk components, removal of transite panels, and shipment of converters off-site for disposal.

Additional activities in 2007 included constructing segmentation and nondestructive assay shops to expand dismantling capabilities, installing nets and barriers to protect workers from falling debris, and initiating removal of approximately 2,700 light ballasts.

The K-27 building covers 374,000 $ft^2$ and contains 540 stages of gaseous diffusion equipment and associated auxiliary equipment.

An action memorandum (AM) for the demolition of the K-25 and K-27 buildings was signed in February 2002. The AM stipulates that the buildings be demolished to slab and that associated waste be disposed of. The first phase of the demolition, hazardous materials removal, started in December 2001 and was completed in June 2005. Hazardous materials removal primarily included the removal of asbestos-containing building material, such as transite panels and insulation, from inside the K-25 and K-27 buildings. During the three-and-a-half-year period, 944 waste shipments containing approximately 621,000 $ft^3$ of waste were transported to the on-site CERCLA Waste Facility, a waste disposal facility located near the Y-12 National Security Complex. A new plan for demolishing the K-25 and K-27 buildings was developed in 2006 that would better protect workers from deteriorated conditions in the buildings by reducing the number of workers and their hours in the buildings. The new plan involves removing high-risk components, unbolting and removing motors and compressors, and then demolishing the building from the outside using heavy equipment.

DOE signed an AM in July 2002 for the demolition of 18 facilities and the removal of scrap material located in the K-1064 peninsula area. In 2007, the work was completed, and the removal action report was prepared.

In September 2003, DOE signed an AM to demolish the approximately 500 remaining facilities. In 2007, 16 predominantly uncontaminated facilities, 20 low-risk/low-complexity facilities, and two high risk facilities—K-1401 and K-1420—were demolished.

K-1401 was built in the early 1940s as a maintenance facility to support the gaseous diffusion process. It was approximately 400 × 1,000 × 32 ft with a basement measuring approximately 200 ft by 340 ft (Figs. 3.3 and 3.4). The demolition of K-1401 was completed in September 2007.

K-1420 was built in 1953 and was placed into operation in 1954 for maintenance and reconditioning of uranium enrichment equipment. It had approximately 101,600 $ft^2$ of floor space. Huge excavators were used to rip through the concrete and steel walls and floors. Demolition of K-1420 was completed in December 2006, although remediation efforts continued at K-1420 into 2007 (Figs. 3.5 and 3.6).

In the Poplar Creek area, asbestos abatement was completed in K-633, K-131, K-631, K-1231, and K-413; chemical treatment was completed in K-633 and the K-27/K-633 tie line; and characterization was completed in K-1231, K-1233, K-633, and the K-633/K-27 tie line. Chemical treatment was completed for all facilities and tie lines associated with hydrofluoric acid distribution to the uranium-processing facilities, and the remaining $UF_6$ cylinders from Building K-33 were disposed of. The soil at ETTP is to

Fig. 3.3. K-1401 as it appeared in 2005.

Fig. 3.4. K-1401 footprint at the end of 2007.

Fig. 3.5. K-1420 as it appeared in 2005.

Fig. 3.6. K-1420 footprint after demolition.

be remediated to a level that protects a future industrial work force and the underlying groundwater (Fig 3.7). Two RODs have been signed that address soil, slabs, subsurface structures, and burial grounds.

**Fig. 3.7. Remediation of soil at East Tennessee Technology Park.**

The Zone 1 ROD was signed by DOE, TDEC, and the EPA in November 2002. The Zone 2 ROD was signed by DOE, TDEC, and EPA in April 2005.

In Zone 1, characterization of the Contractor's Spoils Area and K-901 North Area, removal of several underground storage tanks, and remediation of Duct Island soil and the K-895 piers were completed in 2007. Also, the K-770 Scrap Removal Project and its phased construction completion report (PCCR) were completed. In Zone 2, the characterization results of 11 of the 44 delineated exposure units were documented in a PCCR. This PCCR cleared approximately 58 ha and identified two areas requiring remedial actions. Also, the K-1407 E & F Ponds and the K-1420 and K-1501 basements were backfilled.

Remediation in the Zone 2 Balance of Site–Laboratories area continued, including removing the K-1004-A, B, C, D, and L concrete slabs and removing seven acid pits from the laboratory area. A remedial investigation/feasibility study was submitted to EPA and TDEC addressing the nature and extent of groundwater contamination and ecological concerns, evaluating alternatives for remediation, and providing the basis for the final remediation decision for ETTP. EPA and TDEC reviewed the document in 2007. A revision was prepared and reviewed by those agencies, and a second revision was prepared. This second revision is expected to be approved in 2008. A proposed plan was submitted to EPA and TDEC in 2007; however, it will be placed on hold until the remedial investigation/feasibility study is finalized.

An AM for the remediation of the K-1007 Holding Ponds, K-901-A Holding Pond, K-720 Slough, and K-770 Embayment was approved in 2007. The remedial action work plan was drafted, and the waste-handling plan was completed.

During 2008, design work for the cleanup efforts at the ORNL and Y-12 sites is scheduled to begin as defined within previously signed RODs. The on-site CERCLA Waste Facility, located in Bear Creek Valley, is used for disposal of waste resulting from CERCLA cleanup actions on the ORR. The CERCLA Waste Facility is an engineered landfill that accepts low-level radioactive and hazardous wastes in accordance with specific waste acceptance criteria under an agreement with state and federal regulators. The CERCLA Waste Facility received 9,186 truckloads of waste (Fig 3.8) accounting for 104,062 tons


**Fig. 3.8. Loading truck with waste for disposal.**

during 2007. ETTP projects that have disposed of waste at the CERCLA Waste Facility include the following:

- ETTP Scrap Removal Project;
- ETTP Main Plant Facilities including K-1085, Balance of Site—Laboratories, K-1070-B Burial Ground, and Duct Island Soil Mounds;
- ETTP D&D Project, including Buildings K-1420 and K-1401; and
- K-25/K-27 D&D Project.

Concurrent with the activities at the CERCLA Waste Facility, DOE also operates solid waste disposal facilities located near the Y-12 Complex, called the ORR Sanitary Landfills. In 2007, more than 109,000 $yd^3$ of industrial, construction/demolition, classified, and spoil material waste were disposed of. To keep landfill capacity ahead of the demand, Area IV at Construction Demolition Landfill VII became available for use in early 2007. This expansion provides an additional 336,000 $yd^3$ of capacity to support the accelerated cleanup program as well as the other sanitary waste generators on the ORR. The CERCLA Waste Facility and the ORR landfills are serving the disposal needs of the ORR cleanup program as well as the active missions of the Y-12 Complex and ORNL.

## 3.3.3 Reindustrialization

The Reindustrialization Program was developed to accelerate cleanup of the site and to allow for beneficial reuse of underutilized facilities and land. Facilities that have been determined to be appropriate for reuse are leased or transferred to non-DOE entities such as CROET, private industry, or the city of Oak Ridge. CROET is a not-for-profit corporation established to foster diversification of the regional economy by reutilizing DOE property for private sector investment and job creation. In 2007, the Reindustrialization Program obtained both regulatory and DOE secretarial approval for the transfer of the ETTP fire station and water treatment plant and two land parcels totaling 9 ha. At the time of publication of this report, the two land parcels have been transferred to CROET, while the fire station and water treatment plant have been transferred to the city of Oak Ridge.

One parcel, referred to as ED-5 East, is approximately 7 ha and is located near the front of ETTP, behind Building K-1007, a large office building previously transferred to CROET. This parcel of land has been identified for new construction. The second parcel, referred to as ED-7, is approximately 2 ha in size. ED-7 has been transferred to CROET and will be used for development of the Southern Appalachian Railway Museum. Both of the land parcels have received all necessary approvals, and the transfers took place in early 2008.

In 2008, the ETTP Water Treatment Plant complex (K-1515) was transferred to the city of Oak Ridge. The K-1515 water treatment plant complex was constructed between 1944 and 1945, and consists of the main water treatment plant and a raw water intake structure on the Clinch River. Two potable water tanks, one dating from the early 1970s and the other from 1982, are also part of the transfer. In addition, much of the water and sewer system at the site was transitioned to the city. Together, these transfers will allow the city to provide potable water service to ETTP as it transitions to a private-sector park.

The K-1652 Fire Station was also transferred to the city of Oak Ridge, and the city will provide fire and emergency response services at ETTP and to the west end of Oak Ridge. The K-1652 building was constructed in 1983 and offers approximately 23,000 $ft^2$ of space that consists of offices and an emergency vehicle bay on about 1 ha of land. These transfers are a significant achievement in the transition of the site.

In summary, transition of the entire site into a private sector business/industrial park is progressing. In all, eight buildings and two land parcels at ETTP have been transferred to CROET; additional properties are anticipated to be transferred in the near term.

## 3.4 Bechtel Jacobs Company Quality Assurance/Quality Control at the ETTP

### 3.4.1 Quality Assurance Program

Bechtel Jacobs Company LLC (BJC) is committed to developing, implementing, and maintaining a formal Quality Assurance (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, performing (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. This 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.” BJC’s QA Program, which is integrated with the Safety Management System (SMS), identifies the consensus standards used in the development and implementation of the QA Program, and describes how the contractor responsible for the nuclear facility will implement the requirements contained in those documents. Additional requirements for radioactive waste packaging are included from 10 CFR 71 Subpart H where equivalent elements do not already exist. 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 QA 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. Necessary actions to address new and/or revised federal, state, and local laws and regulations are considered by the 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 website. 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 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, with line management having 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 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 Description and Environmental Compliance and Protection Plan*.

The BJC QA Program is implemented through management processes, which include training and verifying qualifications of personnel; 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 these 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.

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.

### 3.4.2 Integrated Safety Management System

It is the intent of the BJC QA Program to be fully consistent with and supportive of the company's Integrated Safety Management System (ISMS) Program. The BJC QA Program implements methodologies employed to do work processes safely, free of environmental insult, and in accordance with established procedures. It also describes the mechanism in place to seek continuous improvements by identifying and correcting deficiencies and preventing their recurrence.

The effective implementation of QA requirements supports the principles and functions of ISMS. The BJC fundamental quality expectation is that work is conducted safely and meets established requirements. In that regard, the QA Program ensures compliance with approved standards and requirement so that the expectation for safe work within controls is met, and that workers, the environment, and the public are protected from harm. The BJC management systems ensure that quality and safety requirements are properly integrated to achieve their objectives.

The QA Organization has also established the BJC integrated assessment and oversight process as an integral part of the ISMS feedback and continuous improvement process. The QA Organization is responsible for the following:

- developing an integrated assessment process;
- planning and conducting closure project evaluations utilizing performance-based criteria with reports to senior management;
- screening assessment findings, observations, proficiencies, and resulting corrective actions for effectiveness and establishing company-wide priorities;
- evaluating feedback data to determine effectiveness of safety management program implementation; and
- identifying opportunities for improvement.

### 3.4.3 Integrated Assessment and Oversight Program

QA Program implementation and procedural and subcontract compliance are verified through the BJC Integrated Assessment and Oversight Program. This 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 integrated assessment and oversight 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 having 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 more formal self-assessments include management assessments and subcontractor oversight. Informal self-assessments include weekly inspections and routine walkthroughs conducted by subcontractor coordinators; environment, safety, and health 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. Data from these processes are evaluated by senior management to identify opportunities for improvement.

# 3.5 Environmental Monitoring

## 3.5.1 Effluent Monitoring

### 3.5.1.1 Air

ETTP airborne discharges are generated from residual contamination, waste storage and treatment operations, site remediation and demolition activities, and site maintenance support activities. The primary source of radiological emissions at ETTP is the K-1435 TSCA Incinerator, which is the major active airborne radionuclide emission source at ETTP regulated under National Emission Standards for Hazardous Air Pollutants for Radionuclides (rad NESHAP) for DOE facilities. The TSCA Incinerator operates in regulatory compliance with the federal CAA as well as the Tennessee Air Code using extensive exhaust gas pollution control equipment.

Characterization of the impact on public health of radionuclides released to the atmosphere from ETTP operations is accomplished by conservatively estimating the dose to the maximally exposed member of the public. The dose calculations are performed using the Clean Air Assessment Package (CAP-88) computer codes developed under EPA sponsorship for use in demonstrating compliance with the rad NESHAP emission standard.

The TSCA Incinerator is the only operating source at ETTP required by rad NESHAP regulation to directly monitor stack emissions continuously for radionuclide emissions due to the potential to emit. During the 2007 period of performance, the TSCA Incinerator contributed more than 80% of the total ETTP dose to the ETTP-specific most exposed member of the public. Figure 3.9 conservatively illustrates the estimated monthly and annual dose from TSCA Incinerator operations during 2007. Tritium was the major dose contributor followed by isotopes of uranium during this reporting period. The total estimated airborne dose is far below the 10 mrem/year effective dose equivalent rad NESHAP regulatory limit that is the applicable standard for combined radionuclide emissions from all ORR facilities.

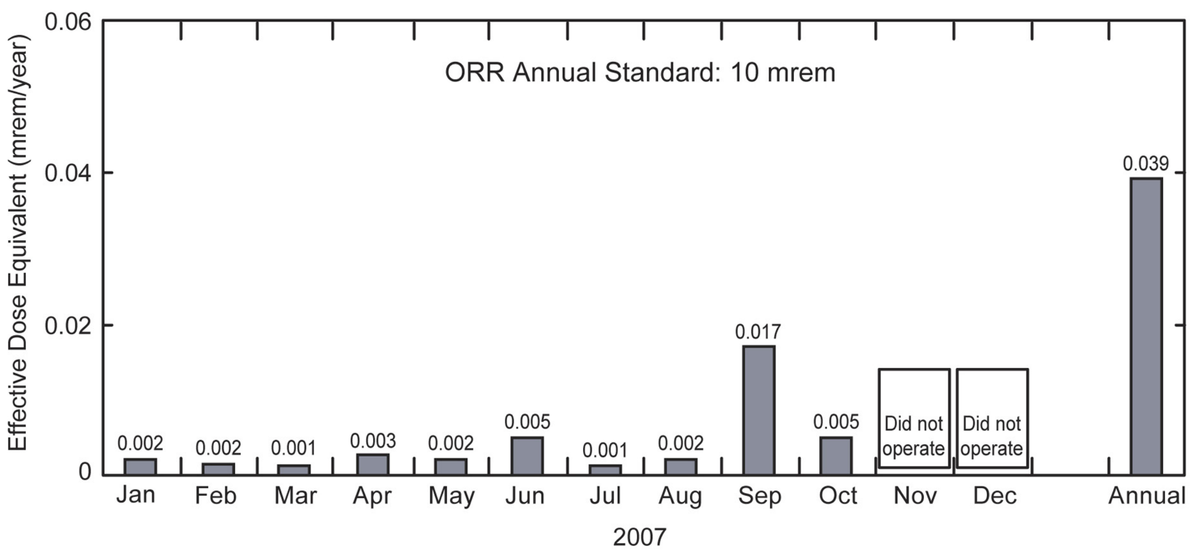



**Fig. 3.9. Dose from Toxic Substances Control Act Incinerator operations.**

The K-1435 TSCA Incinerator is currently the largest operating ETTP nonradionuclide air emissions source and the largest source of criteria pollutant emissions such as nitrogen oxides ($NO_x$) and carbon monoxide (CO) for all sources listed in the DOE ETTP Major Source Operating Permit application (Fig. 3.10). Total $NO_x$ emissions for 2007 reporting period were 10.2 tons. Total CO emissions were 2.5 tons. Emissions of hazardous air pollutants from TSCA Incinerator operations are noted in Figs. 3.10, 3.11, and 3.12. Table 3.4 lists all actual annual emissions from the TSCA Incinerator and emission limits.

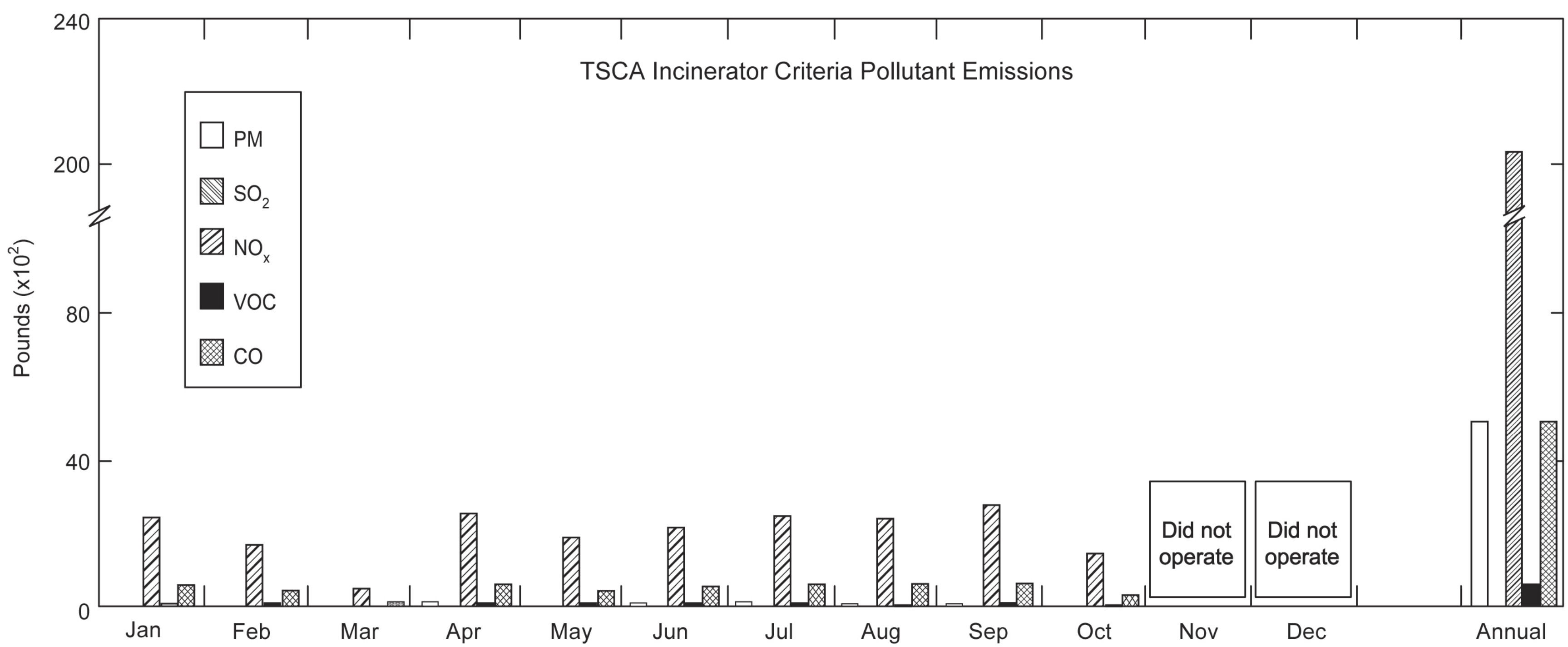



**Fig. 3.10. Toxic Substances Control Act (TSCA) Incinerator criteria pollutant emissions.**

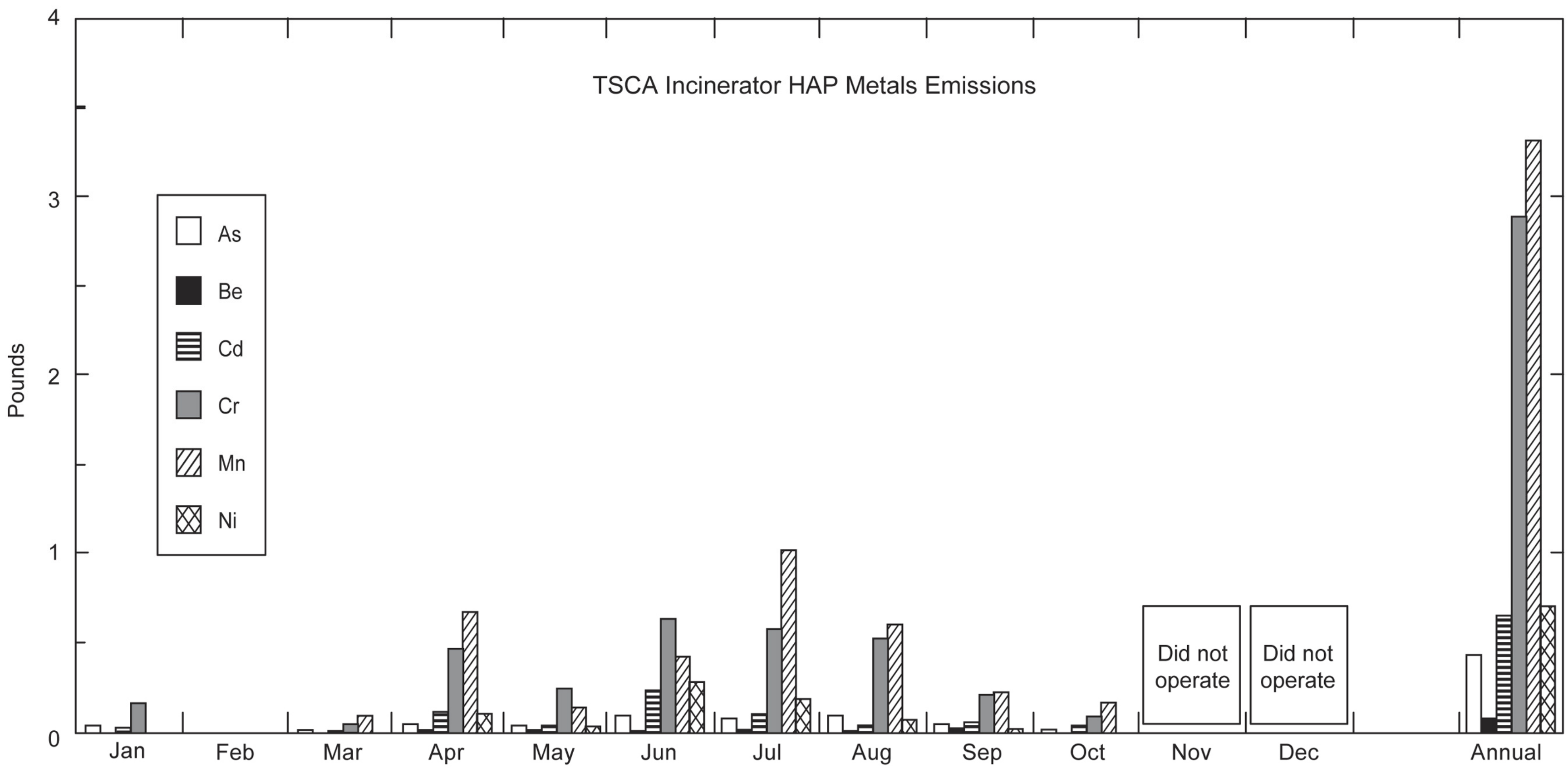



**Fig. 3.11. Toxic Substances Control Act (TSCA) Incinerator hazardous air pollutant (HAP) emissions: metals.**

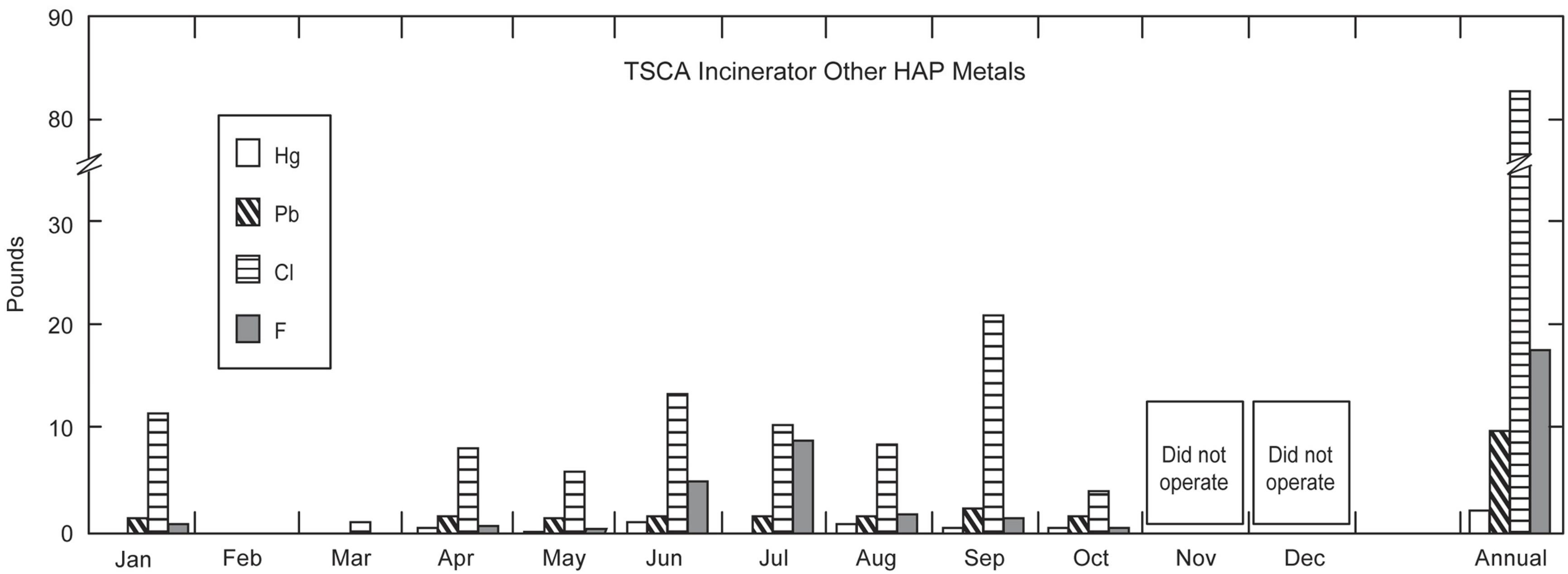



**Fig. 3.12. Toxic Substances Control Act (TSCA) Incinerator hazardous air pollutant emissions: others.**

**Table 3.4. Toxic Substances Control Act**
**Incinerator allowable and actual emissions**

| Pollutant | Limitation | Annual equivalent | Actual emissions |
|---|---|---|---|
| Radionuclides | 10 mrem/year—all combined DOE ORR emission sources | 10 mrem/year—all combined DOE ORR emission sources | 0.04 mrem/year |
| Particulate matter (PM) | 0.015 g/dscf | 11,280 lb/year | 469.1 lb/year |
| Sulfur dioxide ($SO_2$) | 8.8 lb/h | 77,000 lb/year | 23.0 lb/year |
| Oxides of nitrogen ($NO_x$) | 22.1 ton/year | 22.1 ton/year | 10.2 ton/year |
| Volatile organic compounds (VOCs) | 1.15 lb/h | 10,000 ton/year | 0.3 ton/year |
| Carbon monoxide (CO)/total hydrocarbons (HC) | 100 ppmv CO/10 ppmv HC | 20.3 ton/year CO/ 2.03 ton/year HC | 2.5 ton/year CO |
| Low-volatile metals: | 97 µg/dscm combined As-Be-Cr | 230 lb/year | 10.5 lb/year |
| Arsenic (As) | | | |
| Beryllium (Be) | | | |
| Beryllium (normal operations) | 0.02 lb/d | 0.15 lb/year | 0.08 lb/year |
| Beryllium (compliance testing only) | 0.079 lb/d | 28.8 lb/year | Not applicable |
| Chromium (Cr) | | | |
| Semivolatile metals: | 240 µg/dscm combined Cd-Pb | 570 lb/year | 3.4 lb/year |
| Cadmium (Cd) | | | |
| Lead (Pb) | | | |
| Manganese (Mn) | Not applicable | Not applicable | Not applicable |
| Nickel (Ni) | Not applicable | Not applicable | Not applicable |
| Mercury (Hg) | 130 µg/dscm | 310 lb/year | 2.1 lb/year |
| Hydrogen chloride (HCL)/chlorine | 77 ppmv | 184 lb/year | 82.4 lb/year |
| Hydrogen fluoride (HF) | 0.68 lb/h | 5,960 lb/year | 5.9 lb/year |
| Destruction and removal efficiency | 99.99% for each principal organic pollutant/99.9999% for each principal organic hazardous pollutant | Not applicable | Not applicable |
| Dioxin/furan | 0.4 ng/dscm (TEQ) | 0.0005 lb/year | Not applicable |

Abbreviations:
DOE = U. S. Department of Energy
ORR = Oak Ridge Reservation
TEQ = toxic equivalent for dioxins

Units of measure:
dscf = dry standard cubic foot
dscm = dry standard cubic meter
ppmv = parts per million by volume

The limits include those associated with Figs. 3.10 through 3.12 and are based on the allowable rates identified in the TSCA Incinerator construction permit (957808I). Actual emissions are conservatively calculated using removal efficiencies as determined from the most recent permit-required air test or other previously approved compliance demonstration test.

### 3.5.1.2 Water

### 3.5.1.2.1 Clean Water Act Monitoring

The Clean Water Act (CWA)/National Pollutant Discharge Elimination System (NPDES) Program 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. The ETTP CWA/NPDES Program provides management, oversight, and guidance to ETTP organizations to ensure compliance with applicable regulations and requirements.

ETTP discharges storm water into waters of the state of Tennessee under NPDES permit No. TN0002950, which became effective April 1, 2004. The ETTP NPDES permit regulates the discharge of storm water runoff, groundwater infiltration, and groundwater from sumps from ETTP to Mitchell Branch, Poplar Creek, and the Clinch River.

Currently available storm drain system configuration information made it possible to effectively group storm water outfalls based on the types of discharges they are most likely to receive. As part of the ETTP NPDES permit, storm water outfall grouping was performed in order to reduce the amount of required sampling that must be performed under the NPDES permit guidelines while providing sufficient monitoring and characterization data to meet TDEC and EPA requirements. The grouping of storm wateroutfalls in the ETTP NPDES Permit was based on information obtained through sampling conducted under the previous NPDES Permit, storm drain piping configuration studies, and smoke and dye testing results.

The storm drain groupings in the ETTP NPDES Permit allow storm water discharges from outfalls that are similar to be monitored at representative outfalls. Based upon a variety of criteria, including historical data, each storm water outfall was placed within a group of outfalls with shared characteristics. In each group, the most typical outfalls were selected to be representative of the group for monitoring purposes. All storm water monitoring and characterization sampling for the storm water outfall groupings are performed at the designated representative outfalls (Fig. 3.13). Sheet flow and runoff from small drainage swales in the drainage area of the groupings are considered part of the total flow of the grouping. Unless otherwise stated, all storm water outfall groups also receive general site runoff, which may include storm water runoff from grassy areas, roads, and paved areas within ETTP.

There are 121 permitted storm water outfalls at ETTP that are regulated under NPDES permit No. TN0002950. The storm water outfalls are listed in four groups (categories) based on the types of flows being discharged through the outfalls. A total of 38 storm water outfalls are required to be sampled as being representative of the groups. The four groups are described below.

- **Group IV storm water outfalls—**These outfalls 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 outfall in this group must be monitored weekly for flow, pH, and total residual chlorine (TRC) and quarterly for oil and grease and total suspended solids (TSS) (Table 3.5).
- **Group III storm water outfalls—**These outfalls flow continuously or intermittently. They may discharge storm water runoff, groundwater infiltration, groundwater from sumps. These outfalls receive storm water runoff from site industrial operations where there is a 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 (Table 3.6).

**Fig. 3.13. Storm water sampling at East Tennessee Technology Park.**

- **Group II storm water outfalls—**These outfalls 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 (Table 3.7).
- **Group I storm water outfalls—**These outfalls 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 (Table 3.8).

### 3.5.1.2.2 Storm Water Pollution Prevention Program Requirements

The development of the ETTP Storm Water Pollution Prevention Program (SWP3) is required by Part IV of the ETTP NPDES permit No. TN0002950. The program is in place to minimize the discharge of pollutants in storm water runoff from ETTP and to assess the quality of storm water discharges from ETTP, determine potential sources of pollutants affecting storm water, and provide effective controls to reduce or eliminate these pollutant sources. SWP3 provides a means whereby sources of pollutants that are likely to affect the quality of storm water discharges are identified, best management practices that can be used to control the entry of pollutants into storm water discharges are developed, and methods for

**Table 3.5. Group IV storm water outfalls[a,b]**

| Parameter | Method | Frequency | Sample type | Minimum | Maximum | Screening level |
|---|---|---|---|---|---|---|
| Flow (mgd) | Estimated[c] | Weekly | NA | NA | NA | NA |
| pH (standard units)[d] | EPA-150.1 | Weekly | Grab | 6.0 | 9.0 | <6.4 or >8.4 |
| Total suspended solids (TSS) (mg/L) | SM-2540 D | Quarterly | Grab | NA | NA | 70 |
| Oil and grease (mg/L) | EPA-1664A | Quarterly | Grab | NA | NA | 8.0 |
| Total residual chlorine (TRC) (mg/L)[d,e] | SM-4500-Cl D | Weekly | Grab | NA | 0.140 | Detectable |

[a]Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2007 Results*, DOE/ORO/2263, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2008.

[b]Storm water outfall 100 shall be sampled as being representative of Group IV. The following Group IV storm water outfalls will not be sampled: 128 and 130.

[c]Technical Report 55 method with rainfall data will be used by the Environmental Compliance and Protection Organization to estimate flows. Flow will be reported in million gal per day (mgd) as estimated daily maximum values. No flow field measurements are required.

[d]The pH and TRC analyses shall be performed within 15 min of sample collection.

[e]TRC monitoring will only be required at those outfalls that discharge from an active once-through cooling water system (chlorinated effluent). TRC monitoring is not required if waters being discharged are not chlorinated. The acceptable methods for detection of TRC are any methods specified in 40 CFR 136 that reach a detection level allowing accurate evaluation of compliance with the permit limits. The required analytical quantitation level for TRC is the permit limit or 0.05 mg/L, whichever is lower. In cases where there appear to be matrix interferences and the permit limit is less than 0.05 mg/L, the permittee may request approval for using 0.05 mg/L as the analytical quantitation level that shall be used for compliance evaluations. A quantitation level other than 0.05 mg/L may be appropriate, but the permittee will not be approved to use it without supporting data for the wastewater in question. A request to use >0.05 mg/L or an alternate compliance evaluation detection level must be submitted to the regional Tennessee Environmental Assistance Center and to the Enforcement and Compliance Section. Use of any detection level higher than the permit limits for evaluating compliance is not permitted without prior approval from TDEC.

implementing pollution prevention practices are devised. Analytical parameters to be monitored at each storm drain as part of the ETTP SWP3 are chosen based upon a review of available analytical data from previous storm water sampling efforts and knowledge of past processes and practices at ETTP.

The storm water discharges into Mitchell Branch are fully characterized during each NPDES permitting period and in accordance with storm water pollution prevention plans. The NPDES permit can be issued for as long as 5 years, although the current ETTP site storm water permit was issued for a 4 year period so that the ETTP permit expiration date would be consistent with the state of Tennessee watershed schedule for this area of the state.

#### 3.5.1.2.3 Comparison of Storm Water Pollution Prevention Program Sampling Results to Screening Criteria

Analytical results from SWP3 sampling effort conducted in 2007 were compared to applicable screening criteria to identify locations where storm water runoff could be contributing pollutants to

**Table 3.6. Group III storm water outfalls[a,b]**

| Parameter | Method | Frequency | Sample type | Minimum | Maximum | Screening level |
|---|---|---|---|---|---|---|
| Flow (mgd) | Estimated[c] | Monthly | NA | NA | NA | NA |
| pH (standard units)[d] | EPA-150.1 | Monthly | Grab | 4.0 | 9.0 | < 6.0 or > 8.4 |
| Total suspended solids (mg/L) | SM-2540 D | Quarterly | Grab | NA | NA | 70 |
| Oil and grease (mg/L) | EPA-1664A | Quarterly | Grab | NA | NA | 8.0 |

[a]Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2007 Results*, DOE/ORO/2263, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2008.

[b]The following storm water outfalls shall be sampled as being representative of Group III: 05A, 154, 158, 170, 180, 190, 195, 210, 230, 280, 294, 340, 350, 360, 382, 390, 430, 490, 710, 724/760, and 992.The following Group III storm water outfalls will not be sampled: 156, 160, 162, 168, 200, 240, 270, 292, 330, 362, 387, 440, 700, 720, 730, 740, 750, 770, and 970. 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 instead.

[c]Technical Report 55 method with rainfall data will be used by the Environmental Compliance and Protection Organization to estimate flows. Flow will be reported in mgd as estimated daily maximum values. No flow field measurements are required.

[d]The pH analyses shall be performed within 15 min of sample collection.

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

| Parameter | Method | Frequency | Sample type | Minimum | Maximum | Screening level |
|---|---|---|---|---|---|---|
| Flow (mgd) | Estimated[c] | Quarterly | NA | NA | NA | NA |
| pH (standard units)[d] | EPA-150.1 | Quarterly | Grab | 4.0 | 9.0 | < 6.0 or > 8.4 |
| Total suspended solids (mg/L) | SM-2540 D | Yearly | Grab | NA | NA | 70 |

[a]Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2007 Results*, DOE/ORO/2263, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2008.

[b]The following storm water outfalls shall be sampled as being representative of Group II: 124, 142, 150, 250, 380, 510, 570, 690 and 890. The following Group II storm water outfalls will not be 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.

[c]Technical Report 55 method with rainfall data will be used by the Environmental Compliance and Protection Organization to estimate flows. Flow will be reported in mgd as estimated daily maximum values. No flow field measurements are required.

[d]The pH analyses shall be performed within 15 min of sample collection.

receiving waters. These criteria were applied to all data collected as part of this SWP3 storm water 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 criterion for that parameter. Applicable screening criteria for data collected as part of SWP3 sampling program are listed in Table 3.9.

The screening criteria 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 criteria 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).

**Table 3.8. Group I storm water outfalls[a,b]**

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

[a]Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2007 Results*, DOE/ORO/2263, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2008.

[b]The following storm water outfalls shall be sampled as being representative of Group I: 198, 334, 410, 532, 660, 900 and 996. The following Group I storm water outfalls will not be 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.

[c]Technical Report 55 method with rainfall data will be used by the Environmental Compliance and Protection Organization to estimate flows. Flow will be reported in mgd as estimated daily maximum values. No flow field measurements are required.

[d]The pH analyses shall be performed within 15 min of sample collection.

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

Exceedances of screening criteria indicate potential areas of concern. Screening levels are used to identify discharges that may require further investigation.

#### 3.5.1.2.4 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 that remain following building demolition and waiting for remediation. A review of the Balance of Site—Laboratories PCCR by TDEC personnel raised issues about monitoring of the building slabs. TDEC personnel expressed concern about the potential release of contaminants from the slabs and did not believe that the PCCRs sufficiently describe the monitoring effort. 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 slab in question.

In response to the concerns raised by TDEC personnel, it was agreed that the following actions would be taken.

- In general, loose contamination will not be left on slabs, removable contamination will be removed or fixed, and removable contamination will not be left above the criteria contained in 10 CFR 835.
- The pads would be characterized following demolition to identify the proper level of radiological posting. If contamination on the pad was fixed, annual monitoring would be adequate to determine if it is migrating. For removable contamination, the monitoring would be focused on the perimeter of the pad and the direction of storm water flow off the pad. The frequency of monitoring would be varied based on the location and the level of the contamination.
- Storm water monitoring occurs at various outfall locations throughout the plant and at watershed exit pathway locations. More extensive analytical analysis would be indicated if elevated levels of contamination were identified in gross alpha and gross beta results.
- The PCCRs would be expanded to explain the radiation protection program survey schedules planned for the pads, the storm water monitoring applicable to the pads, and ambient watershed exit pathway sampling. Additional sampling would not be expected if the routine program was determined adequate.

**Table 3.9. Project quantitation levels, screening levels, and reference standards for storm water monitoring at East Tennessee Technology Park**

| 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 |
| $^{226}Ra$ | 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 |

**Table 3.9** (continued)

| Parameter | Project quantitation level | Screening level | Reference standard | Units |
|---|---|---|---|---|
| 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 |
| **Polychlorinated biphenyls (PCBs)** | | | | |
| PCBs | 0.5 | detectable | 0.00064 | µg/L |
| **Metals** | | | | |
| Aluminum | 100 | NA | NA | µg/L |
| Antimony | 100 | 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 | °C |

- The PCCRs were revised to indicate that this radiological monitoring would be done on an interim basis until the pads are remediated. The remedial action PCCR would then replace the D&D PCCR in terms of monitoring.

In order to obtain additional analytical information to address some of TDEC's stated concerns with the PCCRs, sampling of storm water runoff was conducted at various locations where radiological contamination may be present on the concrete pads or footprints of buildings that have recently been demolished. Samples of storm water runoff from the concrete pads/building footprints in each of these areas were collected at nearby storm water catch basins or directly from the building pads. The samples were collected to obtain data that will be considered as the worst-case rad discharge from those areas. Runoff samples collected directly from the building pads were collected from areas where the flow is most prevalent or most concentrated into a distinct discharge. Samples collected at storm drain catch basins surrounded by straw bales were taken from areas behind the straw bales, when possible, where the flow of water into the catch basin has been slowed. Samples collected from catch basins that are not surrounded by straw bales were collected as the flow enters the basin.

Samples were collected at each of the following building pads or at catch basins that receive runoff from the building pads, as indicated:

- K-1420 building—building pad runoff from area near calciner room,
- K-1401 building—catch basin 13004 (east side) and catch basin 13039 (west side),
- K-1070-B burial ground area—inside catch basin 8017,
- K-1015 area—catch basins 18031 and 18058,
- K-1004-L—catch basin 23066 or catch basin 23069 (depending on runoff patterns), and
- K-29 building—building pad runoff from the south side of the building pad.

These sampling locations were chosen based on the observed runoff characteristics for each pad. The exact number of sampling locations was also changed in some instances based on runoff flow patterns. Because some of the sampling of the building pads and catch basins required a fairly heavy and intense downpour, the rainfall criteria in the *Storm Water Pollution Prevention Program (SWP3) Sampling and Analysis Plan* was not used to determine when the runoff samples would be collected. 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. Samples collected from each of the listed building pads and catch basins were analyzed for gross alpha/gross beta radiation, isotopic uranium, total uranium, and $^{99}$Tc.

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. As in the sampling of the building pads and catch basins, the specific rainfall criteria that are in the *SWP3 Sampling and Analysis Plan* were not used in the collection of storm water outfall samples conducted as part of this sampling effort. Sampling of storm water outfalls is summarized in Table 3.10.

**Table 3.10. Storm water outfall samples, East Tennessee Technology Park**

| Building | Outfalls sampled |
|---|---|
| K-1004 lab area | 100 |
| K-1420 building | 158, 160, 170 |
| K-1401 building/K-1070-B area | 180, 190 |
| K-29 building | 490 |

Except as noted, samples collected from each of the storm water outfalls were analyzed for the following parameters:

- gross alpha/gross beta,
- isotopic uranium,
- total uranium,
- technetium-99, and
- inductively coupled plasma (ICP) metals (outfall 190 only).

All of the runoff samples and outfall samples collected as part of this effort were taken 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 the ETTP *SWP3 Sampling and Analysis Plan* concerning sample documentation, analytical procedures, QA, and quality control (QC) were followed as part of this sampling effort (Table 3.11).

**Table 3.11. Results of radiological monitoring performed in conjunction with remedial action and decontamination and decommissioning activities (pCi/L)[a,b,c]**

| Sampling location | Gross alpha radiation | Gross beta radiation | $^{233/234}U$ | $^{238}U$ |
|---|---|---|---|---|
| 158 | 33.2 | | | |
| 160 | 98.2 | 56.3 | 85.9 | |
| K-1004-L Pad—NW Corner | 97.6 | 179 | | |
| K-1015 Pad—NE Corner | 59.3 | 63 | | |
| K-1015 Pad—SW Corner | 60.7 | 105 | | |
| K-1420 Pad—N side | 243 | 117 | 194 | 24.8 |
| K-1420 Pit—E Side | 41.9 | 232 | | |
| K-1420 Pit—N Side | 253/218 | 182/64.9 | 134/-617 | 23.3/90.7 |
| K-1420 Pits Composite—W Side | 127 | 69.5 | | |
| K-29 Pad—SW Corner | | 51.1 | | |

[a]Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2007 Results*, DOE/ORO/2263, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2008.

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

[c]1 pCi = 0.037 Bq.

### 3.5.1.2.5 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" process to minimize potential exposures to the public.

Sampling for gross alpha and gross beta radioactivity, as well as specific radionuclides, is conducted as part of the SWP3 sampling efforts (Table 3.12). Analytical results are used to estimate the total discharge of each radionuclide from ETTP via the storm water discharge system (Table 3.13). Results were calculated using activities as reported by the analytical laboratories. The activities may be below background levels, below the method detection limit, and/or less than zero.

**Table 3.12. Storm water sampling for radiological discharges, 2007[a]**

| Storm water outfall | Date sampled | Gross alpha/ gross beta | Transuranics[b] | U isotopic | $^{99}Tc$ |
|---|---|---|---|---|---|
| 230 | 8/23/07 | X | X | X | X |
| 292 | 2/22/07 | X | X | X | X |
| 430 | 2/14/07 | X | X | X | X |
| 724 | 3/1/07 | X | X | X | X |
| 730 | 4/16/07 | X | X | X | X |
| 750 | 4/12/07 | X | X | X | X |
| 760 | 4/12/07 | X | X | X | X |

[a]Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2007 Results*, DOE/ORO/2263, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2008.

[b]Includes $^{237}Np$, $^{238}Pu$, and $^{239/240}Pu$.

**Table 3.13. Radionuclides released to off-site surface waters from the East Tennessee Technology Park storm water system, 2007 (Ci)[a,b]**

| Radionuclide | Amount | Radionuclide | Amount |
|---|---|---|---|
| $^{137}Cs$ | 1.7E–6 | $^{235}U$ | 2.5E–4 |
| $^{99}Tc$ | 2.8E–2 | $^{238}U$ | 2.5E–3 |
| $^{234}U$ | 5.4E–3 | | |

[a]Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2007 Results*, DOE/ORO/2263, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2008.

[b]1 Ci = $3.7 \times 10^{10}$ Bq.

Additional radiological monitoring of storm water discharges was performed as part of the SWP3 sampling effort conducted in 2007 to obtain up-to-date radiological results for calculating total radiological discharge. These samples were collected either manually or with Isco composite sampling equipment, depending on which method was best suited for a particular outfall. These storm water samples were collected from discharges resulting from a storm event of equal to or greater than 0.1 in. that occurs within a time period of 24 h or less and which occurs at least 72 h after any previous rainfall equal to or greater than 0.1 in. in 24 h. The samples were collected as manual grab samples or grab samples collected using an Isco sampler, and were collected within the first 30 min of a storm water discharge.

The results of the radiological monitoring of storm water discharges conducted in 2007 as part of the SWP3 monitoring effort that were over screening levels are given in Table 3.14.

#### 3.5.1.2.6 Storm Water Pollution Prevention Program Sampling in Support of the ETTP NPDES Permit Renewal

A portion of the SWP3 sampling effort conducted in 2007 focused on selected outfalls that were designated as group representatives in the reissued ETTP NPDES permit No. TN0002950. The storm water monitoring results were incorporated in the ETTP NPDES permit renewal application. The current ETTP NPDES permit expired on March 31, 2008; the permit renewal application was submitted to TDEC 180 days prior to permit expiration. The permit renewal application was submitted in September 2007, as required.

All samples collected as part of this portion of the SWP3 sampling effort were grab samples that were collected manually or by the use of Isco samplers. A grab sample is defined as a discrete, individual

**Table 3.14. Storm water sampling results exceeding screening levels for radiological discharges, 2007 (pCi/L)[a,b]**

| Storm water outfall | Gross alpha | Gross beta | $^{233/234}U$ | $^{238}U$ |
|---|---|---|---|---|
| 292 | 136 | 88 | 84.1 | 51.4 |
| 724 | 134 | 64.5 | 65 | 50.8 |
| 730 | 27.4 | — | — | — |
| 750 | 96.2 | 116 | 59.6 | 35.5 |
| 760 | 32.1 | — | — | — |

[a]Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2007 Results*, DOE/ORO/2263, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2008.

[b]1 pCi = 0.037 Bq.

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 min or less. Both manual grab samples and grab samples collected using an Isco sampler were collected within the first 30 min of a discharge.

The sample collection method for each parameter (i.e., whether the sample for a specific parameter is collected as a manual grab or as a grab collected by Isco sampler) was specified by the analytical method for that parameter. The method of sample collection for each parameter is listed in Tables 3.15 and 3.16. Parameters designated to be collected by Isco sampler were collected by manual grab if they could not be collected by Isco sampler due to location, volume, or time constraints.

Manual grab samples were collected according to the guidelines specified in Sect. 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. Isco samplers were used to collect grab samples according to guidelines specified in Sect. 3.1.3 and 3.3.2 of the EPA's *NPDES Storm Water Sampling Guidance Document* (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor and the BJC Maintenance Department's Instrument Shop.

Table 3.15 provides the list of storm water outfalls that were sampled in 2007, the analytical parameters, and whether a manual grab or an Isco sampler grab was required for each parameter.

Table 3.16 contains a list of storm water outfall locations where sampling for additional analytical parameters was required. These parameters were identified as being necessary for the NPDES storm water permit renewal application after the initial manual grab or grab-by-compositor samples had already been collected. The samples for these additional parameters were collected either by manual grab or with an automatic sampler.

No analytical results for any of the analytes were above screening criteria at any of the locations sampled for the SWP3 NPDES permit renewal sampling effort.

### 3.5.1.2.7 Dry Weather Sampling of Non-Storm Water Discharges

As part of the SWP3 sampling effort that was conducted in 2007, samples were collected from the ETTP storm drain system during dry weather conditions to check for volatile organic compound (VOC) contaminants in non-storm water discharges (Table 3.17). Groundwater infiltration is the primary source of non-storm water discharges from the permitted storm drain system at ETTP. Groundwater plumes contaminated with VOCs have been identified and mapped for ETTP using data from groundwater wells. This dry weather sampling effort was performed to help verify where VOC-contaminated groundwater is present in the storm drain system and which VOCs are present.

**Table 3.15. Manual grab samples and grab-by-compositor samples collected in 2007 in support of the NPDES permit renewal application[a,b]**

| Storm water outfall | BOD, COD (Isco sampler) | TSS, TDS (Isco sampler) | Rad,[c] ICP metals, total chloride (Isco sampler) | PCBs pesticides, surfactants (Isco sampler) | Nitrate/ nitrite, sulfate/ sulfide, phosphorus, Hg (Isco sampler) | VOCs, TOC, BNA, total phenols, total cyanide (manual grab) | Ammonia as nitrogen, Kjeldahl nitrogen (manual grab) | Oil and grease (manual grab) | Temperature TRC, pH (manual grab) |
|---|---|---|---|---|---|---|---|---|---|
| 390 | | | | | | X | X | X | X |
| 410 | | | | | | X | X | X | X |
| 532 | | | | | | X | X | X | X |
| 660 | X | X | X | X | X | X | X | X | X |
| 900 | | | | | | X | X | X | X |

[a]Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2007 Results*, DOE/ORO/2263, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2008.

[b]Abbreviations:
BNA = base neutral acid extractable
BOD = biochemical oxygen demand
COD = chemical oxygen demand
ICP = inductively coupled plasma
NPDES = National Pollutant Discharge Elimination System
PCB = polychlorinated biphenyl
TDS = total dissolved solids
TOC = total organic carbon
TRC = total residual chlorine
TSS = total suspended solids
VOC = volatile organic compound

[c]Radioactive analyses consisted of the following: gross alpha/beta, isotopic U, $^{99}$Tc, $^{238}$Pu, $^{239/240}$Pu, $^{237}$Np.

**Table 3.16. Individual grab samples collected in 2007 in support of the NPDES permit renewal application[a,b]**

| Storm water outfall | TPH | TSS | Settleable solids | Dissolved oxygen | pH | $^{137}$Cs | Total chloride | Acetonitrile | Fecal coliform | Oil and grease | Total cyanide | VOCs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05A | | | X | X | | | | | X | | | |
| 100 | | | | | X | | | | | X | | |
| 142 | X | X | | | X | X | X | | | X | X | |
| 150 | X | X | | | | X | X | X | | | X | |
| 154 | | X | | | | | | | | | | |
| 158 | | X | | | | | | | | | | |
| 170 | X | | | | | X | | X | | | | |
| 334 | | | | | | | | | | | | X |
| 570 | | | | | | | | | | | | X |

[a]Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2007 Results*, DOE/ORO/2263, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2008.

[b]Abbreviations:
NPDES = National Pollutant Discharge Elimination System
TPH = total petroleum hydrocarbons
TSS = total suspended solids
VOCs = volatile organic compounds

**Table 3.17. Dry weather sampling of non-storm water discharges[a,b]**

| Storm water outfall | VOCs |
|---|---|
| 05A | X |
| 100 | X |
| 130 | X |
| 142 | X |
| 170 | X |
| 180 | X |
| 190 | X |
| 195 | X |
| 230 | X |
| 340 | X |
| 380 | X |
| 382 | X |
| 430 | X |
| 490 | X |
| 660 | X |
| 710 | X |
| 724 | X |
| 992 | X |

[a]Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2007 Results*, DOE/ORO/2263, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2008.

[b]Samples were collected during dry weather conditions, which are defined as a period of at least 72 h after a storm event of 0.5 in. or greater.

All samples were collected by the manual grab sampling technique during dry weather conditions, which was defined as a period of at least 72 h after a storm event of 0.5 in. or greater. All appropriate procedures for the collection of water samples were followed.

VOCs were found at levels above screening criteria at storm water outfall 190 as part of the dry weather sampling effort. The presence of VOCs is believed to be due to the discharge of contaminated groundwater and not contaminated storm water runoff. No VOC results that exceeded the screening criteria were found in analytical data from any of the other locations sampled as part of the dry weather sampling effort.

The storm water outfalls are divided up into groups of dozens of outfalls and are monitored in both dry weather and wet weather conditions. Usually, the results for several outfalls would be included; however, in the 2007 sampling effort, only outfall 190 had results that exceeded the criteria, so only its results are given. The results of dry-weather storm water monitoring that exceeded the screening criteria at outfall 190 are as follows: 323/345 µg/L for cis-1,2 Dichloroethene; 104 µg/L for trichloroethene; and 95.4/110 µg/L for vinyl chloride.

### 3.5.1.3 NPDES Monitoring

#### 3.5.1.3.1 NPDES Monitoring at the Central Neutralization Facility TSCA Waste Water Treatment System

Non-radiological monitoring of Central Neutralization Facility (CNF) effluent is conducted according to the requirements of NPDES permit No. TN0074225. Monitoring requirements, frequencies, and sample types required under NPDES permit No. TN0074225 are listed in Table 3.18. Wastewater from CNF is discharged through outfall 001 into the Clinch River.

Radiological sampling of effluent from CNF and/or the K-1435 Waste Water Treatment System (WWTS) is conducted weekly. These weekly samples are then composited into a single monthly sample. Table 3.19 lists the total discharges in 2007 by isotope. These results are then compared to the derived concentration guides (DCGs) published in DOE Order 5400.5. The sum of the fractions must be kept below 100% of the DCGs, but in practice the effluent results from this outfall have historically been well below this amount until this year. Figure 3.14 shows a rolling 12-month average for the past year. Beginning in September 2006 and continuing at irregular intervals until October 2007, there were some anomalously high results for uranium isotopes which caused spikes in comparisons of the sums of the fractions of the DCGs. In October 2007, the sum of the fractions of the DCGs exceeded 1.0 for the first time. In November, there were no discharges from CNF, and the December 2007 discharges were only the volume necessary to drain the basins at the TSCA Incinerator for maintenance.

Work continues on evaluating the most effective way to treat the waste. Operational changes that have taken place include more frequent change out of the carbon filters, more frequent removal of built up clarifier sludge, double treatment of the water when necessary, and the substitution of ferrous sulfate for ferric sulfate to cause the uranium to precipitate more readily. This substitution was made as a result of bench-scale jar tests to determine the most effective materials to use. Results in December 2007 and January 2008 monitoring have been very encouraging.

Although uranium isotopes constitute the greatest mass (approximately 54 kg) of radionuclides discharged from CNF, $^{99}$Tc and tritium account for the greatest activity, due to the much higher specific activity of these two isotopes. Transuranic isotopes constitute a small fraction of the total.

In 2007, there was one NPDES noncompliance for pH at CNF.

#### 3.5.1.3.2 NPDES Permit Noncompliances

In 2007 there were five CWA or NPDES permit noncompliances (Table 3.20). Each is described in detail below.

On February 15, 2007, a dye test was conducted on the TSCA Incinerator purge basin discharge line. The purge basins are used to contain untreated incinerator wastewater. Approximately 10 min into the dye test, it was determined that the flow increased in storm water outfall 140, located immediately down slope of the purge basins. Dye was also observed in storm water outfall 140, which discharges into Mitchell Branch.

The release of TSCA Incinerator wastewater to outfall 140 is believed to have begun on or about January 23, 2007. Wet ground near the purge tank discharge line was observed on or about January 24, 2007. The dye test indicated that contaminated water leakage to storm water outfall 140 occurred during transfer operations that occurred between January 23, 2007, and January 26, 2007. Transfer operations were suspended on January 26, 2007, because of the discovery of the leak. The incinerator had been in a low-temperature, non-waste-treatment operational mode since the time the leak was thought to have started.

ETTP EC&P staff identified the area affected by the leak as a solid waste management unit (SWMU). Therefore, a nonroutine report was submitted under the Hazardous and Solid Waste Amendment (HSWA) permit TNHW-121. This report was due to regulatory agencies within 30 d of the discovery of any condition in an SWMU that was not already being addressed under conditions of the HSWA permit.

**Table 3.18. NPDES permit No. TN0074225 outfall 001 monitoring requirements**

| Parameter | Collection frequency | Sample type |
|---|---|---|
| Flow | Continuous | Recorder |
| pH | Continuous | Recorder |
| Total suspended solids (TSS) | Weekly | 24-h composite |
| Chemical oxygen demand (COD) | Weekly | 24-h composite |
| Benzene | Twice per month | Grab |
| Ethylbenzene | Twice per month | Grab |
| Toluene | Twice per month | Grab |
| Methylene chloride | Twice per month | 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-h composite |
| Polychlorinated biphenyls (PCB) | Monthly | 24-h 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-h composite |
| Chromium, total | Quarterly | 24-h composite |
| Copper, total | Quarterly | 24-h composite |
| Lead, total | Quarterly | 24-h composite |
| Nickel, total | Quarterly | 24-h composite |
| Silver, total | Quarterly | 24-h composite |
| Zinc, total | Quarterly | 24-h composite |
| Mercury, total | Quarterly | 24-h 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] | Twice per year | Grab |
| Cyanide, total | Yearly | 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 National Pollutant Discharge Elimination System (NPDES) permit parameter, and the result is not reported with the discharge monitoring report.

**Table 3.19. Isotopic discharges from the Central Neutralization Facility/Waste Water Treatment System, 2007**

| Isotope | Curies | Isotope | Curies |
|---|---|---|---|
| $^{241}$Am | 2.8E–6 | $^{239}$Pu | 2.3E–6 |
| $^{14}$C | 3.6E–4 | $^{99}$Tc | 1.6E–1 |
| $^{137}$Cs | 9.2E–4 | $^{230}$Th | 1.3E–5 |
| $^{60}$Co | 3.2E–5 | $^{234}$Th | 1.3E–2 |
| $^{3}$H | 5.6E–1 | $^{234}$U | 5.9E–3 |
| $^{131}$I | 5.6E–5 | $^{235}$U | 5.2E–4 |
| $^{237}$Np | 7.6E–6 | $^{236}$U | 1.6E–4 |
| $^{238}$Pu | 1.1E–6 | $^{238}$U | 1.8E–2 |

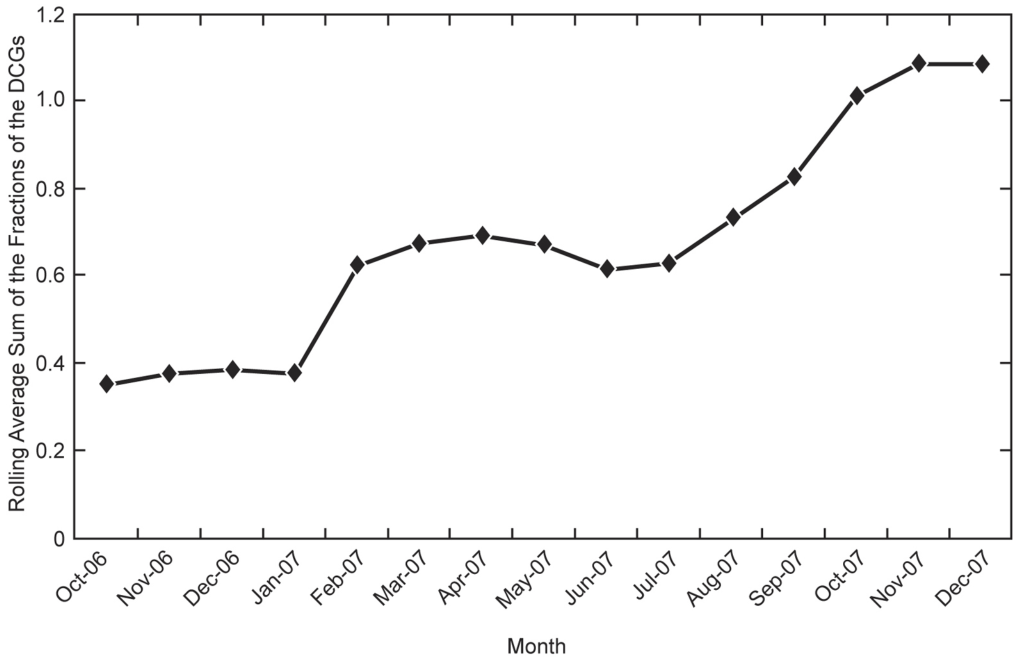



**Fig. 3.14. Trend of the isotopic sum of fractions of derived concentration guides (DCGs) at K-1407-J/K-1435 Waste Water Treatment System.**

A preliminary reportable quantity (RQ) evaluation was performed for the TSCA Incinerator wastewater release to outfall 140. The evaluation was based on the latest characterization data available for influent water from the TSCA Incinerator that was received at CNF. This evaluation indicated that no CERCLA RQs for radioactive constituents were exceeded in wastewater that leaked from the incinerator's purge basin discharge line and discharged through outfall 140.

RCRA hazardous waste quantities released were evaluated and determined to be below any occurrence reporting or environmental reporting limits. The blow down water is considered a RCRA-listed waste because of contact with incinerated listed wastes and/or equipment surfaces that have contacted incinerated listed wastes.

Because the analytical results for RCRA-listed waste constituents in the water released through outfall 140 were low and due to the fact that no RQ was exceeded, the final decision regarding cleanup of the affected area was coordinated with the TDEC Division of Solid Waste/Knoxville Office. Since the affected area is also designated an SWMU, the area where the transfer line break occurred was also evaluated for any required CERCLA remediation activities under the Zone 2 ROD.

**Table 3.20. National Pollutant Discharge Elimination System noncompliances at East Tennessee Technology Park, 2007[a]**

| Outfall | Date | Permit requirement | Permit noncompliance | State action | Apparent cause | Environ. impact | Corrective actions | Probability of recurrence |
|---|---|---|---|---|---|---|---|---|
| 140 storm water | 2/15/07 | Permitted discharges only | Discharge of TSCAI water from line leak | None | Equipment failure | None | Pipeline with leak bypassed | Medium |
| 170 storm water | 3/5/07 | pH 4.0–9.0 | pH 10.8 | None | K-1501 water in contact with D&D concrete | None | Discharge relocated to avoid storm drain system | Low at K-1501 Medium site-wide |
| 170[b] storm water | 7/20/07 | No pollutant in hazardous detrimental quantity | Chromium discharge at detrimental concentration | NOV | Source still unknown and being investigated | WQC exceeded instream toxicity | Collecting and treating water in CNF | Medium |
| 992 storm water | 8/30/07 | pH 4.0–9.0 | pH 3.3 | None | Coal fly ash pile seep in drought conditions | None | Channel lined with limestone riprap | Low |
| 001 CNF | 12/11/07 | pH 6.0–9.0 | pH >9.0 for >60 min. allowable excursion | None | Equipment and operational issues | None | Alarm point lowered, procedures changed | Low |

[a]Abbreviations:
CNF = Central Neutralization Facility
D&D = decontamination and decommissioning
NOV = notice of violation
TSCAI = Toxic Substances Control Act Incinerator
WQC = water quality criteria

[b]See Sect. 3.7.2 for details.

Based on the levels of contamination in the TSCA Incinerator purge basin discharge line, no significant impact on the environment was caused by this event. No dead fish or other aquatic organisms were observed during surveys of Mitchell Branch conducted subsequent to the leak.

On March 5, 2007, sampling personnel were performing routine monthly pH monitoring at storm water outfalls, as required by NPDES permit TN0002950. At the time the pH readings were being taken at storm water outfall 170, sampling personnel noticed that the flow in the outfall was elevated above normal levels, despite the absence of a recent rainfall event. A field reading for pH was taken at the outfall, and a reading of 10.8 standard units was obtained. This exceeds the upper limit for pH at this outfall, which is 9.0 standard units. The instrument was rechecked and was found to be properly calibrated, thus verifying the elevated pH reading.

Upon verification of the elevated pH, an investigation into the source of the elevated pH was conducted. It was determined that the elevated pH was caused by water that was being pumped from the basement of the K-1501 building into a nearby grassy ditch, which eventually discharged into the outfall 170 piping network. Straw bales and other protective measures had been installed in the ditch to slow the discharge of the water and allow infiltration of the water into the soil to the greatest extent possible. These measures were recommended in best management practices that were issued by ETTP EC&P personnel. It is believed that concrete rubble and other debris fell into the water that had accumulated in the K-1501 basement and that the contact between the water and the building debris caused the pH of the water to become elevated. The elevated rate at which the water was being discharged on March 5, 2007, did not allow sufficient time for the water to adequately infiltrate into the soil in the grassy ditch. The excess discharge entered the storm drain system and was eventually discharged into Mitchell Branch at storm water outfall 170.

EC&P personnel inspected Mitchell Branch to determine if any environmental impact had occurred as a result of this discharge. No dead fish were noted and no impact to other biota in the pond was observable. No threat to human health or the environment is believed to have occurred as a result of this discharge.

Storm water outfall 992 is routinely monitored as part of the ETTP NPDES permit compliance program. This outfall is located in the Powerhouse area adjacent to the K-702 slough. Storm water outfall 992 is monitored at a location downstream of a point where discharges from the following several sources come together.

- Discharge of surface runoff from a remediated coal fly ash pile enters this outfall by means of a below-ground concrete pipe. This pipe has several openings to the ground surface, and collects surface runoff and groundwater infiltration from a remediated coal fly ash pile. The remediation effort for the coal fly ash pile was completed in the 1990s and included adding significant volumes of lime to the disposal area, covering the fly ash with soil and vegetation, and installing this piping system to minimize the amount of contact between storm water flows and residual fly ash.
- During both wet and dry weather conditions, a groundwater seep discharges to the outfall at a location immediately below a beaver dam. It is believed that groundwater migrates through the former coal ash pile before it seeps into the outfall drainage channel.
- During wet weather conditions, leakage occurs through, and sometimes over, a beaver dam that has created a large beaver pond upstream of the outfall. This discharge into the outfall drainage channel usually occurs only after a heavy rainfall event that causes the level of the beaver pond to rise to a point that the pond overtops the beaver dam or water pressure forces water through the dam.
- During wet weather conditions, surface runoff that has collected in a small pond formerly used as a coal ash sluice pond also discharges through an open channel to the outfall discharge channel.

On August 30, 2007, sampling subcontractor personnel were collecting routine NPDES permit compliance data at storm water outfall 992. They obtained a pH reading of 3.3 standard units at the designated NPDES monitoring location for that outfall. Sampling subcontract personnel then verified the calibration of the pH meter according to procedure. The pH meter calibration proved to be accurate. The pH reading of 3.3 standard units is outside the NPDES permitted range of 4.0 to 9.0 standard units for this outfall. This constitutes a noncompliance with the ETTP NPDES storm water permit.

During most years, the compliance sampling point for outfall 992 is underwater for at least 6 months during the spring and summer due to the seasonal rise in the Clinch River water levels caused by TVA power generation and flood control operations. However, during this sampling event, the water levels in the Clinch River and Poplar Creek were uncharacteristically low due to continuing drought conditions. The storm drain flows in the ditch were also extremely low and were completely attributable to groundwater seeps into the discharge ditch with no surface water runoff contributions. This combination of abnormal seasonal conditions resulted in an unusual sampling event at the compliance point for outfall 992.

Investigations into the sources of the low pH reading were begun on August 30, 2007, and are still ongoing. Additional pH readings have been collected at various locations upstream of the compliance sampling point in an attempt to identify any potential discharge sources that might be contributing to the low pH. Also, additional monitoring has been conducted during wet and dry weather conditions to determine the effects of storm water runoff on the pH at this outfall. In addition, bench-scale testing has been performed in an attempt to determine the effects of the sediments, soil, and gravel in the outfall 992 area on the pH of the discharge from the outfall.

Readings for pH that were collected during dry weather conditions indicate that a low pH flow is present in the area below the beaver dam even when no storm event has occurred for an extended period of time. This flow is most likely the result of a groundwater seep that discharges into the outfall 992 drainage channel at a location immediately below the beaver dam. Readings for pH that were collected during wet weather conditions (including later on the same day of the noncompliance) showed that the pH levels were elevated substantially with an increase in flow. This indicates that surface runoff over the outfall 992 area was most likely not the source of the low pH readings, and that storm water runoff raised the pH levels through dilution of the low pH discharge. The results of the bench-scale testing were inconclusive, but they did seem to indicate that the pH of water from outfall 992 decreased in proportion to the length of time the water was in contact with sediments from the outfall 992 drainage channel. Therefore, it appears that the cause of the low pH at outfall 992 is related to the discharge of water from a groundwater seep that has saturated the remediated coal fly ash pile in the area, the contact between water and sediments that are present in the outfall 992 drainage channel, or a combination of both of these factors.

Several corrective actions were considered in an attempt to control or eliminate the low pH discharge from outfall 992. The discharge channel was lined with riprap in an effort to prevent contact between sediments in the outfall 992 drainage channel and the water flowing through the channel. It is also believed that lining the discharge channel helps maintain the pH of the discharge at a level within the NPDES-permitted limits.

No threat to human health or the environment occurred as a result of this event. No fish kills or other adverse impacts to the biota in the area of outfall 992 were observed.

On December 11, 2007, the CNF discharged 36,000 gal of treated effluent to outfall 001 in the Clinch River between 1400 and 1600 h. During this discharge, CNF operators monitored pH and flow from the CNF control room. According to the pH strip chart located in the CNF control room, the pH of the effluent did not exceed 8.8 standard units. On the morning of December 12, 2007, sampling subcontractor personnel observed the pH strip chart in the K-1407-Q sampling station. They discovered that the pH of the discharged water did not meet the discharge criteria for pH that is stated in the CNF NPDES Permit (permit TN0074225). As stated in the NPDES Permit, the pH of the CNF effluent is not to exceed 9.0 standard units for more than 60 min in a single excursion. The duration of the excursion that occurred on December 11 was up to 75 min, and the highest pH recorded was 9.2 standard units.

It has been determined that the CNF control room pH strip chart recorded a lower pH level than the K-1407-Q monitoring station compliance point. The CNF control room strip chart did not indicate a pH level that would trigger CNF operator actions during the discharge conducted on December 11.

Sampling subcontractor personnel immediately notified the CNF facility manager and EC&P personnel of the pH excursion. Waste operations personnel suspended the planned release of the remainder of the contents of the east basin until further investigation of the pH excursion was conducted. Calibration of the pH probe was conducted by sampling subcontract personnel in accordance with specified procedures. The calibration conducted on December 12 indicated a high variance of 0.1 standard units.

In response to this incident, the level at which the high pH alarm in the CNF control room has been lowered. CNF operators have been instructed to check the pH reading in the K-1407-Q sampling station if a control room alarm occurs. Appropriate actions (e.g., stopping the discharge pumps) are to be taken based on the pH reading in the K-1407-Q station.

The water released on December 11 had been in the east basin since October 2007. It is believed that pH stratification of the water occurred during this time. The pH of the water remaining in the east basin will be lowered prior to discharge through outfall 001.

The K-1407-Q sampling station and CNF control room pH strip charts have been compared and corrective actions taken to ensure proper correlation between them. An interlock is in place to shut off discharge pumps when pH readings approach NPDES permit limits; this interlock has been checked to ensure that it is operating properly.

Notification of the pH excursion was made to DOE and TDEC on December 12.

## 3.6 Biological Monitoring

The ETTP *Biological Monitoring and Abatement Plan* (BMAP) consists of three tasks designed to evaluate the effects of ETTP operations on the local environment, identify areas where abatement measures would be most effective, and test the efficacy of these measures. Figure 3.15 shows the major water bodies at ETTP. These tasks are (1) toxicity monitoring of effluent and ambient waters from several locations within Mitchell Branch, (2) bioaccumulation studies, and (3) instream monitoring of biological communities.

In April and October 2007, survival and reproduction toxicity tests using *Ceriodaphnia dubia* were conducted at four ambient locations in Mitchell Branch (Figs. 3.16 and 3.17). At the same time, survival and reproduction toxicity tests using *Ceriodaphnia dubia* were conducted on effluent from storm water outfalls 170 and 190 (Tables 3.21 and 3.22).

In the April tests on the ambient locations and on the effluent from storm water outfall 170 and 190, water from MIK 0.4, MIK 0.7 and both storm water outfalls 170 and 190 exhibited some degree of toxicity. Reproduction was reduced in the tests using samples from MIK 0.4 and MIK 0.7, but survival was not reduced. Both survival and reproduction were reduced in the tests using samples from both storm water outfalls 170 and 190. Effluent from storm water outfall 170 reduced both survival and reproduction at the 100% concentrations, but had no effect at lower concentrations. Effluent from storm water outfall 190 reduced reproduction at all tested concentrations down to and including 6%, and survival at the 100% concentration.

In the October tests on the ambient locations and on the effluent from storm water outfall 170 and 190, water from MIK 0.4, MIK 0.7, MIK 0.8 and both storm water outfalls 170 and 190 exhibited some degree of toxicity. Water from the MIK 0.4 ambient location reduced reproduction but did not affect survival. Water from the MIK 0.7 and MIK 0.8 ambient locations reduced both reproduction and survival. Effluent from both storm water outfalls 170 and 190 reduced reproduction at tested concentrations down to and including 50%, and survival at the 100% concentration. Thus, the overall trend is one of consistent toxicity to *Ceriodaphnia* from storm water outfall 190, with infrequent toxicity from the ambient locations and occasional toxicity at storm water outfall 170. The sources of these problems have not been definitively identified. The data gathered in previous studies indicates at least two possible sources. One possible source is groundwater percolating through waste in the K-1070-B Classified Burial Ground and leaching out small quantities of metals. Some of this groundwater flows into the storm drain system, and likely contributes to the toxicity at storm water outfall 190. Nickel and zinc are present in water collected from the storm drain system near K-1070-B at levels that have been shown to be toxic to *Ceriodaphnia.* Another possible source is the presence of elevated levels of chromium in discharges from storm water outfall 170 and from nearby seeps. Water samples collected from the ambient locations in Mitchell

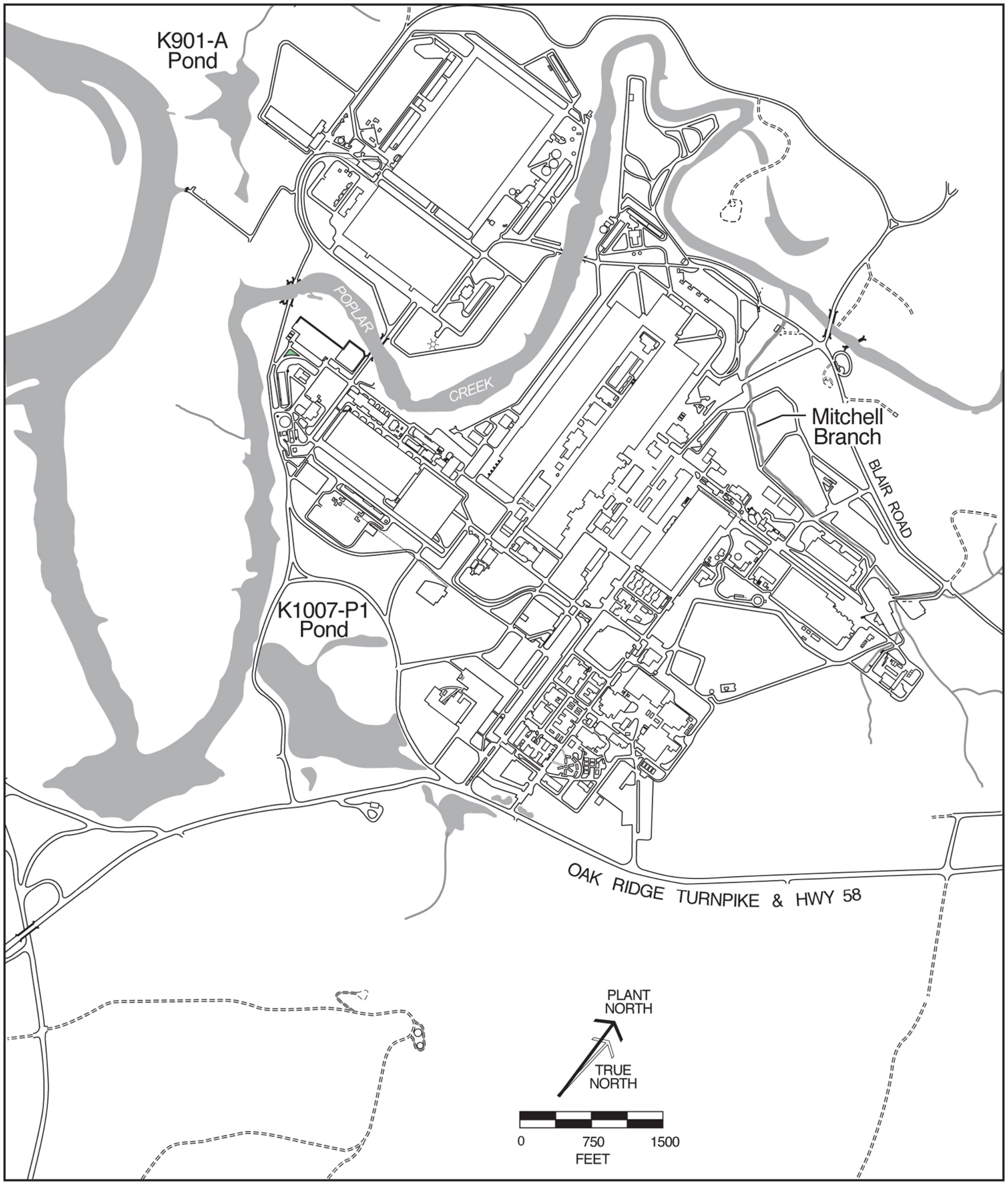



**Fig. 3.15. Waterways at East Tennessee Technology Park.**

Branch at the same time as the October–November toxicity samples were analyzed for metals and organic compounds. Water from the locations exhibiting toxicity also showed levels of chromium that were elevated compared to background levels. The chromium issue is discussed in more detail in Sect. 3.7.2.

In June and July 2007, caged clams *(Corbicula fluminea)* were placed at several locations around ETTP. The clams were allowed to remain in place for 4 weeks and were then analyzed for uptake of PCBs. The clams in the cage deployed at storm water outfall 710 suffered 50% mortality, and the clams in one of the two cages deployed at storm water outfall 700 suffered 100% mortality. Otherwise, results were consistent with those of previous years' trends. The highest concentrations were in the clams from the K-1007-P1 Pond (especially for the clams at storm water outfall 100) and Mitchell Branch (where

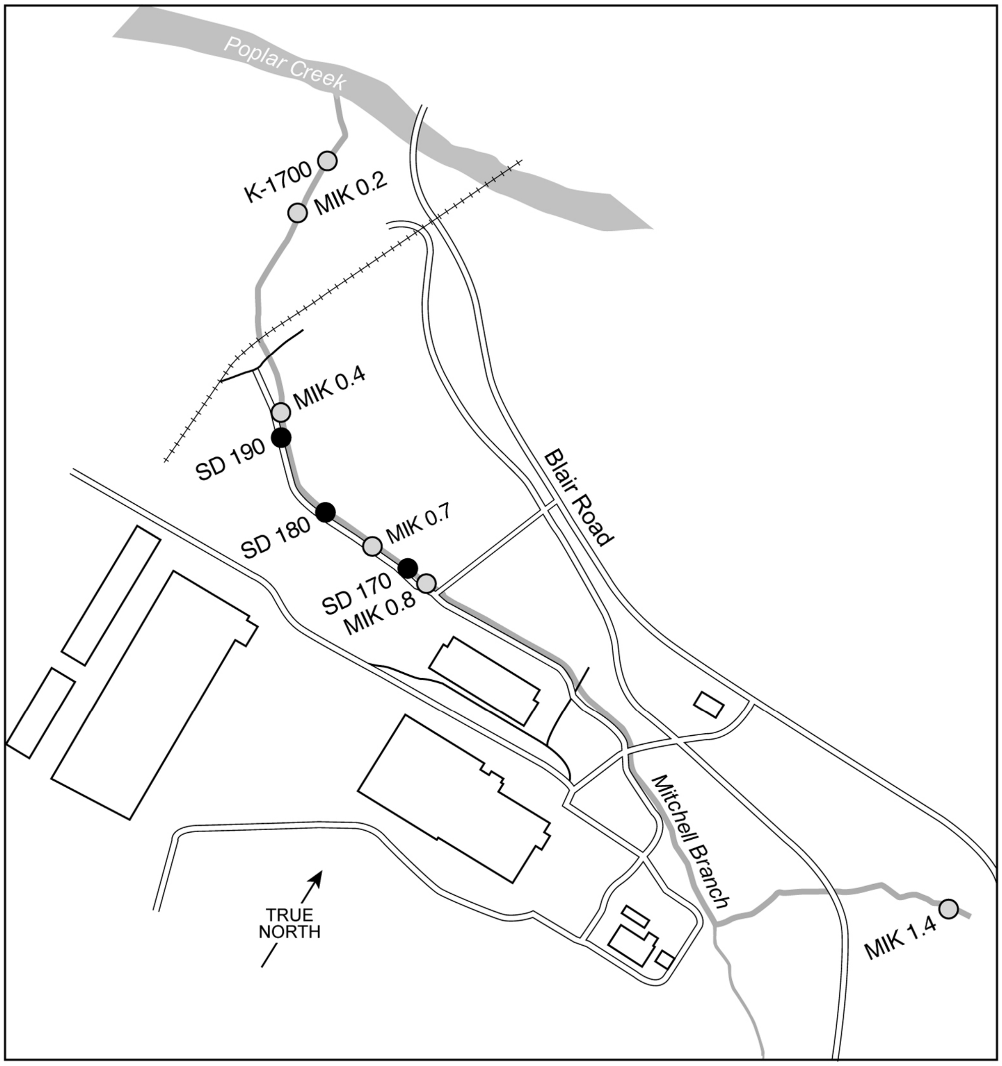



**Fig. 3.16. Major storm water outfalls and *Biological Monitoring and Abatement Plan* locations on Mitchell Branch.**

concentrations increased dramatically in the clams from downstream of storm water outfall 190). The increase in the PCB levels in Mitchell Branch clams contrasts with the decrease in the levels in the fish from the same location. Since the fish were collected before the clams, it is possible that some disturbance in the Mitchell Branch watershed caused an increase in the amount of PCBs in the stream during summer 2007. Clams from the K-901-A Pond contained detectable concentrations of PCBs, but the levels were considerably lower. In the K-1007 Pond network, clams from the K-1007-P3 pond showed no evidence of PCB contamination. In the clams from Mitchell Branch, the PCBs detected were primarily Arochlor-1254. In the K-1007-P1 Pond, on the other hand, elevated levels of Arochlors-1248, -1254, and -1260 were detected. In the K-901-A Pond, low levels of both Arochlors-1254 and -1260 were detected. In general, the concentrations at Mitchell Branch locations from the 2007 monitoring were lower than those from the 2006 effort.

Fish were collected from Mitchell Branch, K-1007-P1 Pond, and K-901-A Pond in May 2007 (Fig. 3.18). Largemouth bass were collected from the pond sites, and redbreast sunfish were collected from Mitchell Branch. Game fish of a size large enough to be taken by sports fishermen were selected to provide more accurate data of potential human health concerns and to reduce the amount of variation in contamination levels in the individual fish as a result of age and size differences. Fillets were taken from

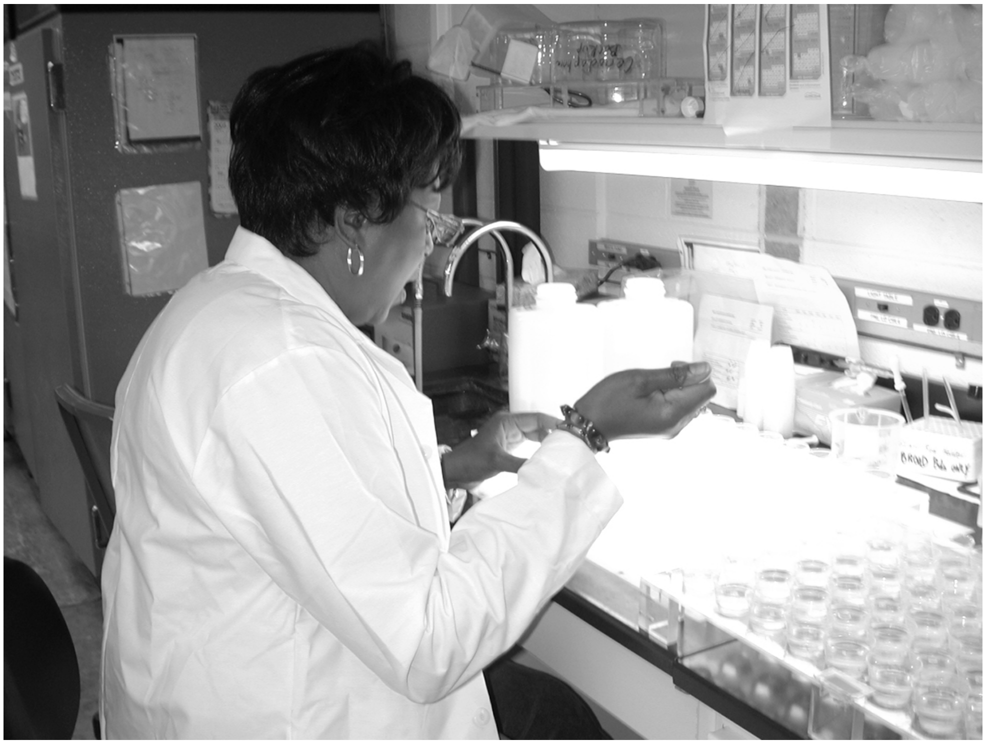


**Fig. 3.17. ORNL scientist conducting toxicity tests.**

**Table 3.21. Mitchell Branch and associated storm water outfall toxicity test results, April 2007[a]**

| Test | MIK 0.8 | SD 170 | MIK 0.7 | SD 190 | MIK 0.4 | MIK 0.2 |
|---|---|---|---|---|---|---|
| *Ceriodaphnia* survival | NR | R | NR | R | NR | NR |
| *Ceriodaphnia* reproduction | NR | R | R | R | R | NR |

[a]Abbreviations:
MIK = Mitchell Branch kilometer
NR = No significant reduction compared to the control population.
R = Significant reduction compared to the control population.
SD = Storm drain (storm water outfall)

**Table 3.22. Mitchell Branch and associated storm water outfall toxicity test results, October–November 2007[a]**

| Test | MIK 0.8 | SD 170 | MIK 0.7 | SD 190 | MIK 0.4 | MIK 0.2 |
|---|---|---|---|---|---|---|
| *Ceriodaphnia* survival | R | R | R | R | NR | NR |
| *Ceriodaphnia* reproduction | R | R | R | R | R | NR |

[a]Abbreviations:
MIK = Mitchell Branch kilometer.
NR = No significant reduction compared to the control population.
R = Significant reduction compared to the control population.
SD = Storm drain (storm water outfall)

**Fig. 3.18. Collecting fish for bioaccumulation monitoring.**

each game fish and analyzed for PCBs. Results from the Mitchell Branch and K-901-A Pond monitoring are similar to historical results (although the results from the Mitchell Branch fish were on the low end of the range for this location), with fish from both locations containing concentrations (an average of 0.88 and 0.65 ppm, respectively) near the state of Tennessee posting limit of 1 ppm. In the bass from K-1007-P1 pond, the 2007 results (an average of 14.2 ppm) showed an increase in PCB concentrations when compared to the 2006 monitoring results of 7.1 ppm. Table 3.23 shows the concentrations of PCBs found in biota at ETTP in 2007.

The increase in the PCBs levels in Mitchell Branch clams contrasts with the decrease in the levels in the fish from the same location. Since the fish were collected before the clams, it is possible that some disturbance in the Mitchell Branch watershed has resulted in an increase in the amount of PCBs in the stream during summer 2007. In the case of K-1007-P1 and K-901-A, the difference between levels in the clams from the locations is significant (0.82 versus 0.3 mg/kg), which reflects the difference in the concentrations in the ponds' sediments. However, the differences in the levels in the fish is even greater (14.2 vs 0.65 mg/kg). It is believed that this reflects the difference in the trophic structures at the two locations. In the K-901-A pond, there are relatively small populations of the fatty fish (such as shad) that readily accumulate PCBs in their tissues. Instead, terrestrial insects (which are low in PCBs) are a primary food source. In contrast, at K-1007-P1 pond fatty fish such as shad are abundant, and serve as a primary food source for the bass.

In April 2007, the benthic macroinvertebrate communities at four Mitchell Branch locations (MIKs 0.4, 0.7, 0.8, and 1.4) were sampled. (MIK 1.4 serves as the reference location.) In the last 10 years, the total taxonomic richness and richness of pollution-intolerant taxa at MIK 1.4 has remained relatively stable. However, the make-up of the downstream Mitchell Branch benthic macroinvertebrate communities has fluctuated considerably, although they have generally increased in diversity and numbers of individuals overall. Results from this year's sampling showed similar species richness and richness of pollution intolerant species at the most upstream sites, with lower values at the downstream

**Table 3.23. Average polychlorinated biophenyl (PCB) concentrations in biota, 2007[a]**

| Location | Species | Average PCB concentration, ppm | Range, ppm | Number above 1 ppm/total |
|---|---|---|---|---|
| K-1007-P1 Pond | Largemouth bass | 14.2 | 6.3-30.2 | 6/6 |
| K-901-A Pond | Largemouth bass | 0.65 | 0.51-0.86 | 0/6 |
| Mitchell Branch | Redbreast sunfish | 0.88 | 0.16-2.1 | 2/6 |
| Hinds Creek (ref) | Redbreast sunfish | 0.01 | <0.01-0.01 | 0/6 |
| MIK 0.78 | *Corbicula fluminea* | 0.24 | NA | NA |
| MIK 0.7 | *Corbicula fluminea* | 0.15 | NA | NA |
| MIK 0.45 | *Corbicula fluminea* | 2.6 | NA | NA |
| MIK 0.2 | *Corbicula fluminea* | 2.5 | NA | NA |
| SD100 (upper) | *Corbicula fluminea* | 1.6 | NA | NA |
| SD100 (lower) | *Corbicula fluminea* | 16.6 | NA | NA |
| SD120 | *Corbicula fluminea* | 0.76 | NA | NA |
| SD490 | *Corbicula fluminea* | 0.77 | NA | NA |
| K-1007-P1 outfall | *Corbicula fluminea* | 0.82 | NA | NA |
| K-1007-P3 outfall | *Corbicula fluminea* | 0.01 | NA | NA |
| SD710 | *Corbicula fluminea* | 0.04 | NA | NA |
| SD700 | *Corbicula fluminea* | 0.77 | NA | NA |
| K-901-A outfall | *Corbicula fluminea* | 0.3 | NA | NA |
| Sewee Creek (ref) | *Corbicula fluminea* | 0.02 | NA | NA |

[a]Abbreviations:
MIK = Mitchell Branch kilometer
NA = not applicable
PCB = polychlorinated biphenyl
ppm = parts per million
ref = reference location
SD = storm drain (storm water outfall)

locations. However, total density of all species at the lower locations were all greater than at MIK 1.4. Possible explanations for this may be that the hydrologic conditions at MIK 1.4 may be less hospitable (it is smaller and shallower than at the downstream locations), there may be responses to episodic disturbances (waterline breaks, impacts from construction or D&D activities, or some other source), or there may be some mild nutrient enrichment at the downstream locations that fuel the greater densities. Sometimes there are no readily apparent causes for fluctuations. For example, the community at MIK 0.7 (which received higher chromium concentrations in early 2007) was poorer in diversity and richness in the 2006 study than in the 2007 study.

Fish communities in Mitchell Branch (MIK 0.4 and MIK 0.7) (Fig. 3.19) were sampled in April 2007. Species richness, density, and biomass were examined. The community at MIK 0.4 was very similar to last years' results. Although one new species (bluntnose minnow *Pimephales notatus*) appeared, another (yellow bullhead *Ameiurus natalis*) was absent, leaving the richness unchanged. Total density was twice that of the 2006 study, but biomass has declined slightly. At MIK 0.7, both species richness and density showed slight decreases from last year, while biomass was roughly half that seen in the 2006 study. In the 2005 monitoring, density at MIK 0.7 was the highest recorded for that location, and the density at MIK 0.4 was the second highest. In 2006, the density and biomass showed significant decrease, but only to values more consistent with the trends of recent years. These wide swings are typical of streams that have been severely impacted, are in the process of recovery, but have not yet reached the long-term stable

**Fig. 3.19. Sunfish collected as part of the fish community study.**

state. Species richness appears to have more or less stabilized, with results from the last three years sampling similar at both locations. The stream is still dominated by more tolerant fish species, so although the conditions and fish community structure are improving, they have not yet reached a stable community structure typical of less impacted streams in the area.

## 3.7 Surveillance Monitoring

### 3.7.1 Air

The ETTP Ambient Air Quality Monitoring Program is designed to accomplish the following:

- measure background 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 ETTP area array of sampling stations are designated as base, supplemental, TSCA, and ORR perimeter air monitor (PAM). The base program consists of two locations using high-volume ambient air samplers (Fig. 3.20). Supplemental locations are typically project-specific temporary stations that would have a sampler specific to the type of potential emissions. This typically includes high-volume systems depending on the source emission evaluation of the project. Supplemental station K9 was discontinued at the end of April 2007 following the completion of remediation activities adjacent to this location. The TSCA stations will only be triggered during designated operational upsets at the TSCA Incinerator. The radiological monitoring results of samples collected at the two ETTP area PAM stations were provided by ORNL and included for ETTP network comparative purposes. Figure 3.21 shows the location of all ambient air sampling stations during this reporting period.


**Fig. 3.20. High-volume ambient air sampler.**

All base and supplemental stations collect continuous samples for radiological and selected metals analyses. The nonradiological pollutants measured are As, Be, Cd, Cr, Pb, and total uranium analyses using inorganic analytical techniques. Radiological analyses include the isotopes $^{237}$Np, $^{238}$Pu, $^{239}$Pu, $^{99}$Tc, $^{234}$U, $^{235}$U, $^{236}$U, and $^{238}$U for ETTP stations, and ORR stations include $^{234}$U, $^{235}$U, and $^{238}$U.

Figures 3.22 through 3.27 illustrate the air concentrations of As, Be, Cd, Cr, Pb, and total uranium for the past five years based on quarterly composites of weekly continuous samples. The results are compared against any applicable standards for each pollutant. Also, the minimum detectable concentration is shown for all metals, including uranium. The measured levels of As, Be, Cd, Pb, and U all show results well below the indicated standards. The chromium results are conservatively compared with the standard for hexavalent chromium.

Total uranium metal 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 the inductively coupled plasma-mass spectrometer (ICP-MS) analytical technique. The uranium averages and maximum individual concentration measurements for all sites are presented in Table 3.24. The averaged results ranged from a minimum of approximately 0.000008, up to 0.000040 μg/m$^3$. The highest 12-month average result (0.000040 μg/m$^3$) was measured at Station K2. The annual average value for all stations due to uranium was 0.000023 μg/m$^3$. The ICP-MS results are compared with the DCG for natural uranium. (DCG is based on an annual air concentration exposure that would give a dose of 100 mrem.) The highest annual result (K2) only corresponds to 0.03 % of the DCG. The single sampling location with the highest quarterly concentration (0.000140 μg/m$^3$) was at station K2. If this concentration were extrapolated to a 12 month exposure it would only represent 0.09% of the DCG.

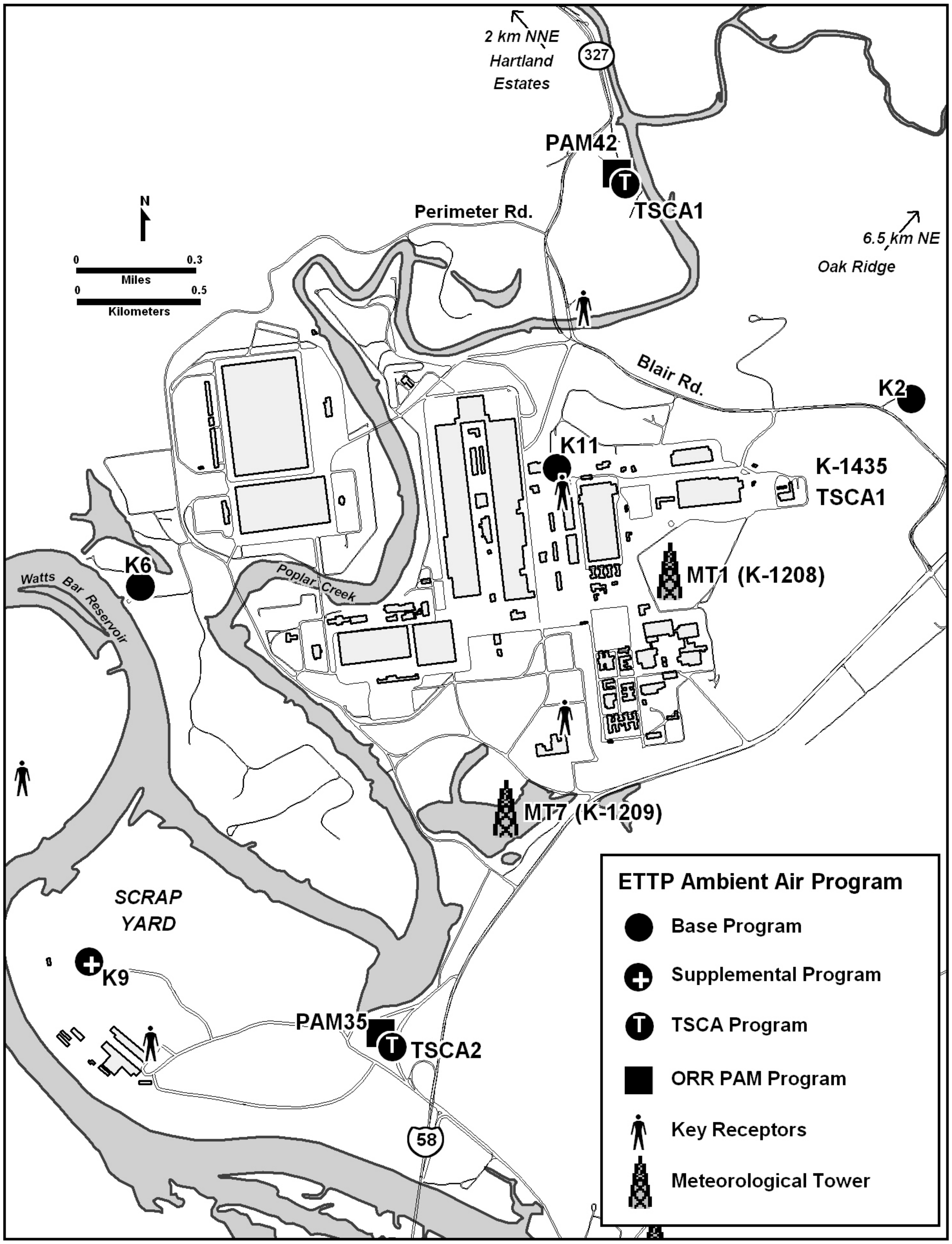
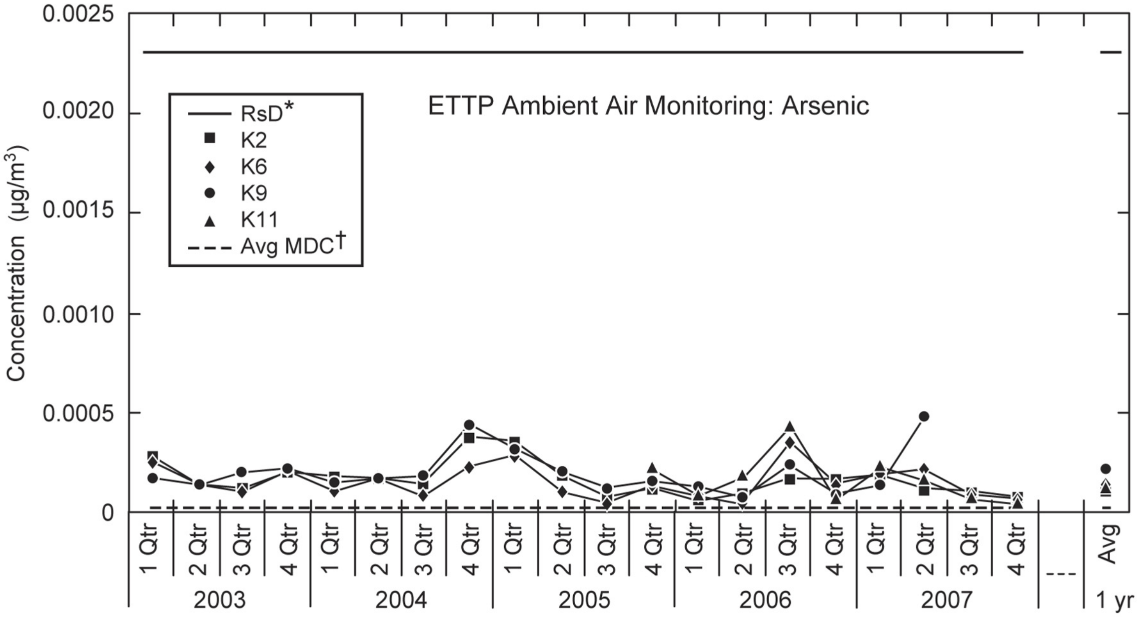
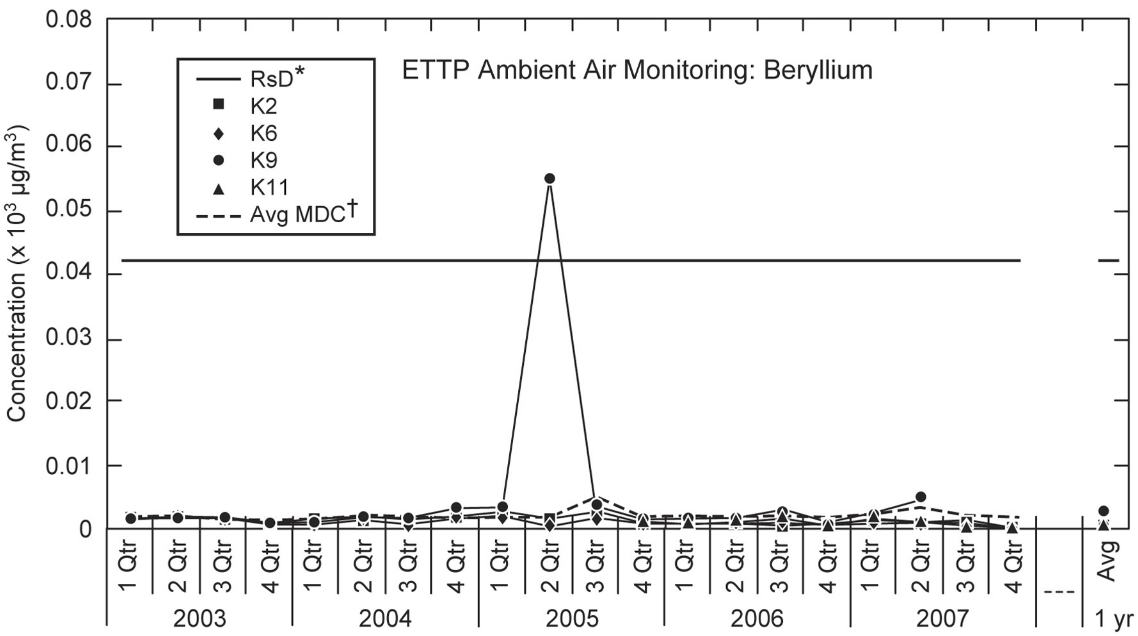



**Fig. 3.21. Locations of ambient air monitoring stations at East Tennessee Technology Park.**



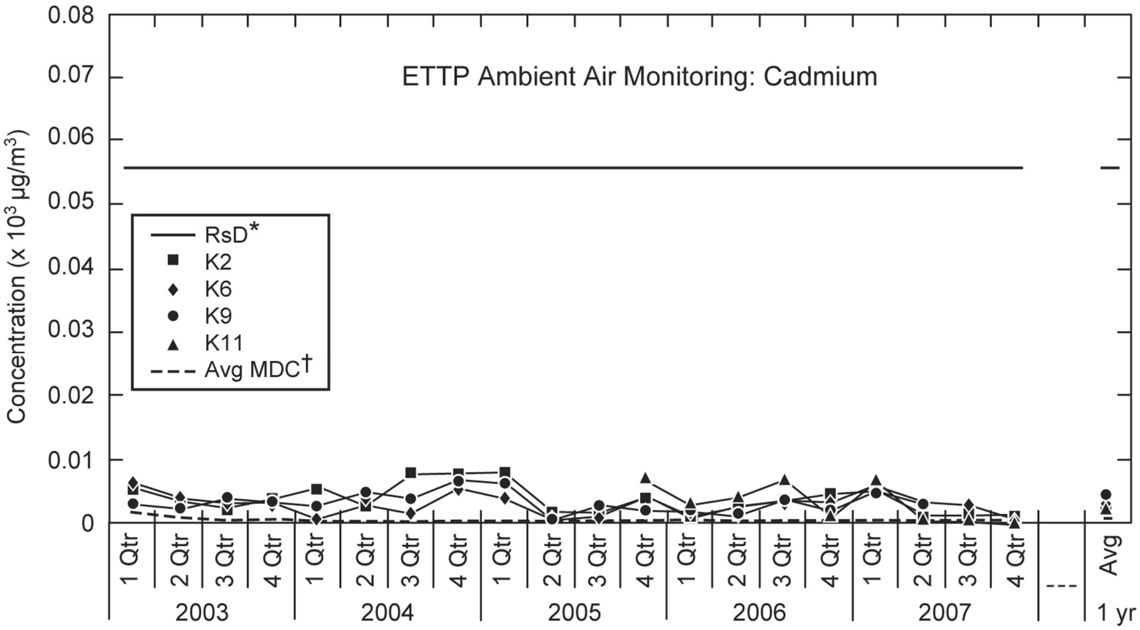

** RsD - Risk-specific dose. EPA acceptable RsD for arsenic = 0.0023 μg/m$^3$.*
*† MDC - Minimum detectable concentration.*

**Fig. 3.22. East Tennessee Technology Park ambient air monitoring, 2007: Arsenic.**



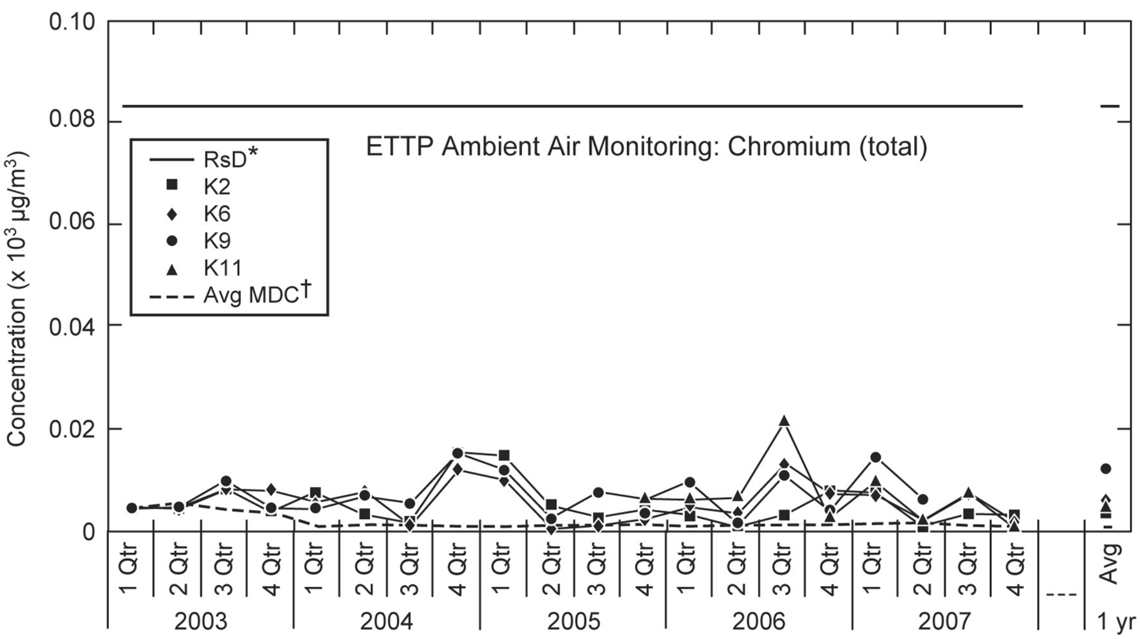

** RsD - Risk-specific dose. EPA regulatory annual RsD for beryllium = 0.0042 μg/m$^3$ (40 CFR 266, App. V).*
*† MDC - Minimum detectable concentration.*

**Fig. 3.23. East Tennessee Technology Park ambient air monitoring, 2007: Beryllium.**



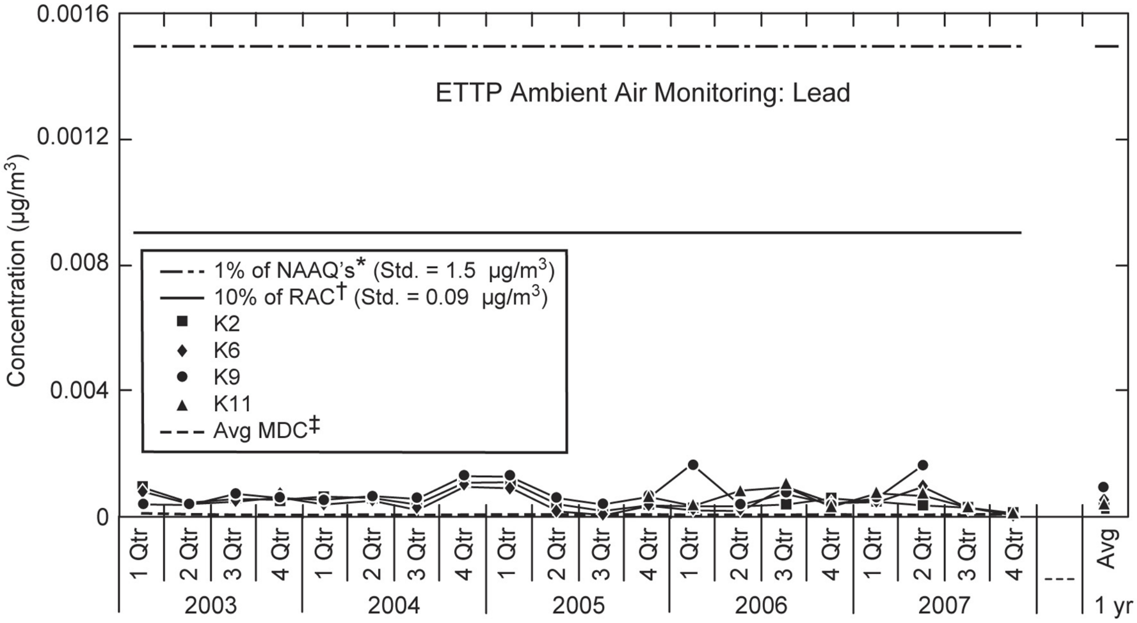

* *RsD - Risk-specific dose. EPA acceptable RsD for cadmium = 0.0056 µg/m³.*
† *MDC - Minimum detectable concentration.*

**Fig. 3.24. East Tennessee Technology Park ambient air monitoring, 2007: Cadmium.**



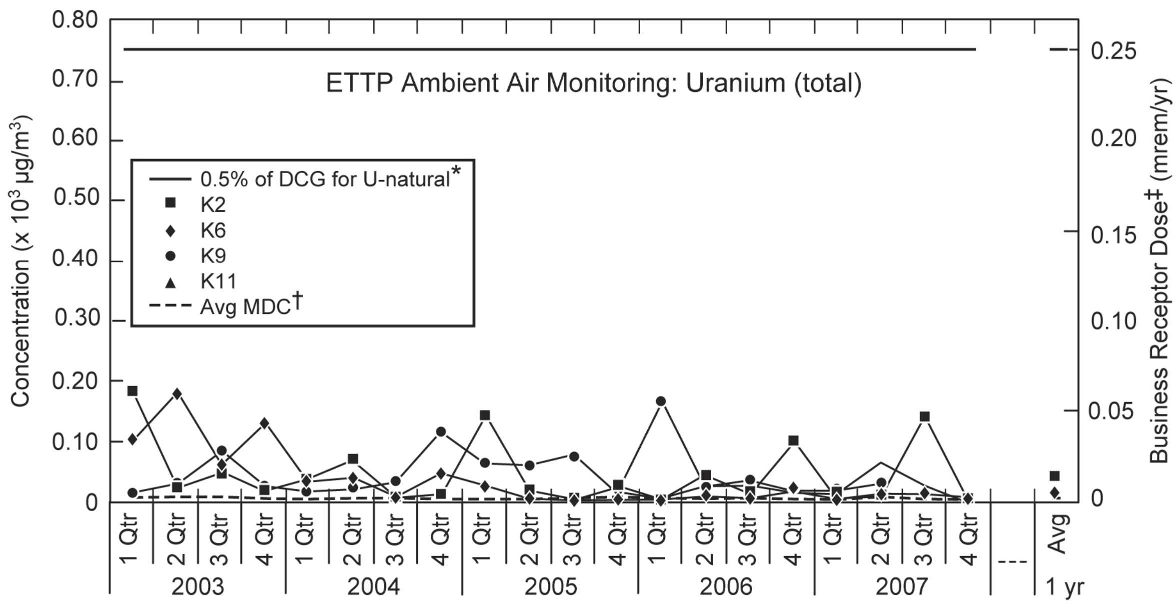

* *RsD - Risk-specific dose. EPA acceptable RsD for chromium-VI = 0.0083 µg/m³.*
† *MDC - Minimum detectable concentration.*

**Fig. 3.25. East Tennessee Technology Park ambient air monitoring, 2007: Total chromium.**




*1% of National Ambient Air Quality Standard for lead in 1.5 µg/m³ per quarter.*
† *Reference air concentration (RAC) for lead = 0.09 µg/m³.*
‡ *MDC - Minimum detectable concentration.*

**Fig. 3.26. East Tennessee Technology Park ambient air monitoring, 2007: Lead.**




* *MEI - Maximally exposed individual. The DCG for natural U resulting in 100 mrem dose to the MEI per year = 1.03E-13 µci/mL = >0.015 µg/m³.*
*40 CFR 61, Subpart H limit 10 mrem per year equates to maximum concentration at the MEI of 0.015 µg/m³ per year.*
† *MDC - Minimum detectable concentration.*
‡ *EPA approved ORR business receptor dose assumes a 50% annual occupancy.*

**Fig. 3.27. East Tennessee Technology Park ambient air monitoring, 2007: Total uranium.**

**Table 3.24. 2007 Total uranium in ambient air by inductively coupled plasma analysis at East Tennessee Technology Park**

| Station | No. of Samples | Concentration[a] | | | | Percentage of DCG[b] (%) | |
|---|---|---|---|---|---|---|---|
| | | μg/m³ | | μCi/mL | | | |
| | | Avg | Max[c] | Avg | Max | Avg | Max |
| K2 | 4 | 0.000032 | 0.000102 | 2.12E–17 | 6.78E–17 | 0.02 | 0.07 |
| K6 | 4 | 0.000010 | 0.000015 | 6.50E–18 | 9.68E–18 | <0.01 | 0.01 |
| K9 | 4 | 0.000021 | 0.000032 | 1.40E–17 | 2.10E–17 | 0.01 | 0.02 |
| K11 | 4 | 0.000028 | 0.000063 | 1.85E–17 | 4.19E–17 | 0.02 | 0.04 |
| ETTP total | 16 | 0.000023 | | 1.50E–17 | | 0.02 | |

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

[b]U.S. Department of Energy (DOE) Order 5400.5 derived concentration guide (DCG) for naturally occurring uranium is an annual concentration of 1E–13 μCi/mL, which is equivalent to a 100 mrem annual dose.

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

Periodic radiochemical analyses were initiated during 2000 on 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). The concentration and dose results for each of the nuclides are presented in Table 3.25 for calendar year 2007.

**Table 3.25. 2007 Radionuclides in ambient air at East Tennessee Technology Park**

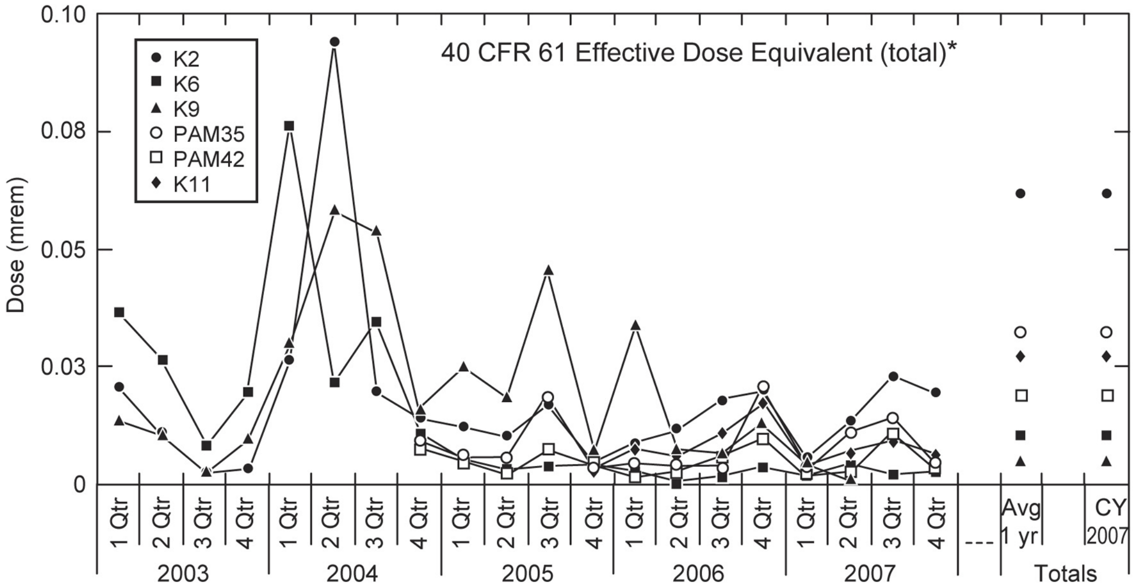
| Station | Concentration (μCi/mL) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total U | $^{237}$Np | $^{238}$Pu | $^{239}$Pu | $^{99}$Tc | $^{234}$U | $^{235}$U | $^{236}$U | $^{238}$U |
| K2 | 1.08E–16 | ND[a] | ND | 2.65E–18 | 2.51E–16 | 3.64E–17 | 4.17E–18 | ND | 6.82E–17 |
| K6 | 1.16E–16 | ND | ND | 1.15E–18 | 2.73E–16 | 4.71E–17 | 3.95E–18 | 2.08E–18 | 6.41E–17 |
| K9 | 4.25E–17 | ND | 2.54E–18 | 6.35E–18 | 4.97E–16 | 2.10E–17 | 1.36E–18 | 1.68E–18 | 2.07E–17 |
| K11 | 6.93E–17 | ND | ND | 1.64E–18 | 6.20E–15 | 3.42E–17 | 6.15E–18 | ND | 3.20E–17 |
| Station | 40 CFR 61, Effective dose equivalent (mrem/year)[b] | | | | | | | | |
| | Total U | $^{237}$Np | $^{238}$Pu | $^{239}$Pu | $^{99}$Tc | $^{234}$U | $^{235}$U | $^{236}$U | $^{238}$U |
| K2 | 0.053 | ND | ND | 0.006 | 0.001 | 0.019 | 0.002 | ND | 0.032 |
| K6 | 0.058 | ND | ND | 0.002 | 0.001 | 0.025 | 0.002 | 0.001 | 0.030 |
| K9 | 0.022 | ND | 0.005 | 0.013 | 0.002 | 0.011 | 0.001 | 0.001 | 0.010 |
| K11 | 0.036 | ND | ND | 0.003 | 0.003 | 0.018 | 0.003 | ND | 0.015 |

[a]ND = not detected.

[b]40 CFR 61, Subpart H limit = 10 mrem per year for U.S. Department of Energy Oak Ridge Reservation combined radionuclide airborne emissions to the most exposed member of the public.

All parameters were chosen with regard to existing and proposed regulations and with respect to activities at ETTP. Changes of emissions from ETTP may warrant periodic re-evaluation of the parameters being sampled and the monitoring site locations.

Figure 3.28 is a five-year historical summary chart of dose-calculation results. 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 exposures well below the 10 mrem annual dose limit.




*40 CFR 61, Subpart H limit = mrem per year DOE ORR combined radionuclide airborne emssions to the most exposed member of the public.

**Fig. 3.28. East Tennessee Technology Park ambient air sampling program radiochemistry analysis historical results.**

### 3.7.2 Surface Water Monitoring

The ETTP environmental monitoring program personnel conduct environmental surveillance activities at nine surface water locations (Figs. 3.29 and 3.30). These stations monitor groundwater and storm water runoff (K-1700, K-1007-B, and K-901-A) or ambient stream conditions (CRK-16, CRK-23, K-1710, K-716, and MIKs 0.7 and 1.4). Depending on the location, samples may be collected and analyzed for radionuclides quarterly (K-1700 and MIKs 0.7 and 1.4) or semiannually (remainder of locations). Results of radiological monitoring are compared to the DCGs published in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. 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, 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% would be required. Comparisons to DCGs are updated regularly to maintain an annual average. The monitoring results at all of the surveillance locations generally have remained less than 1% of the allowable DCG (Fig. 3.31). The exceptions are at K-1700 and MIK 0.7. The sum of the fractions at K-1700 was just under 12% of the DCGs, while the sum of the fractions at MIK 0.7 was 19% of the DCGs (it should be noted that the result at MIK 0.7 was based upon a single sample, as radiological monitoring has just been instituted at this location). Although percentage of the DCGs at K-1700 was still well within the allowable limits, it was roughly twice the percentage of the 2006 monitoring results. Increases in radionuclides at K-1700 during late 2006 and early 2007 coincide with increases in chromium results. The cause of this increase is the subject of an extensive investigative effort, but as of this writing the source has not been definitively found.

Depending on the monitoring location, water samples may be analyzed for pH, selected metals, and VOCs. Analytical results were, in most cases, well within the appropriate water quality standards. The single instance where the result for dissolved oxygen concentration was below the minimum standard can be traced to the natural stream conditions. The low dissolved oxygen result at K-1700 was during a period of very high temperatures and low stream flow.

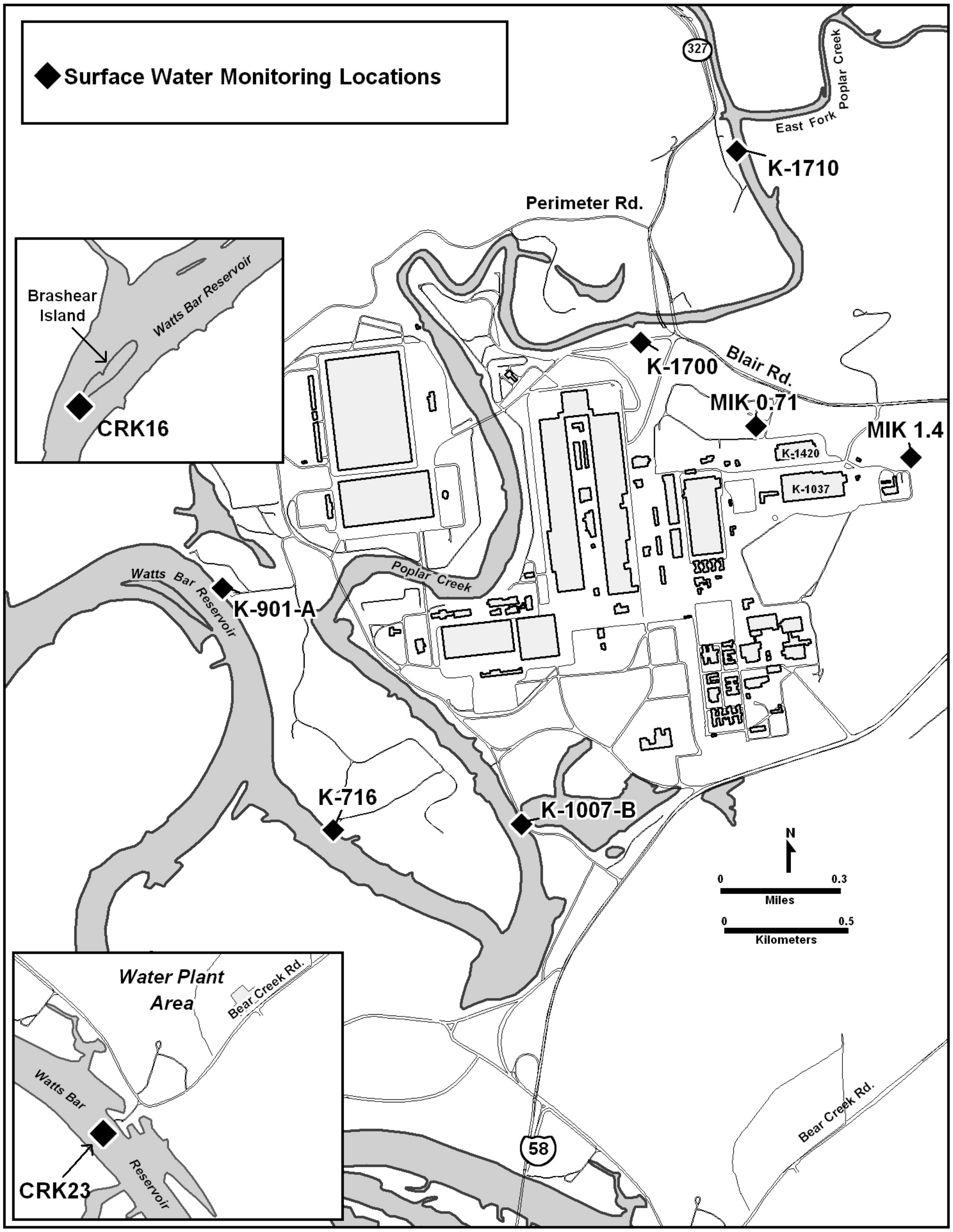



**Fig. 3.29. East Tennessee Technology Park Environmental Monitoring Program sampling locations for surface water.**

**Fig. 3.30. Surface water sampling at East Tennessee Technology Park.**

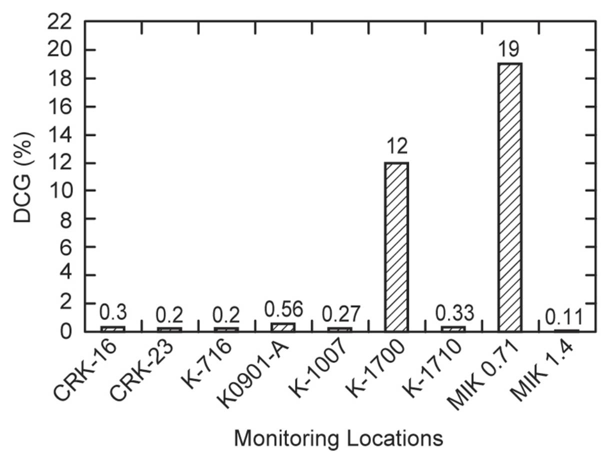



**Fig. 3.31. Percentage of derived concentration guides (DCGs) at surface water surveillance locations, 2007.**

Figures 3.32 and 3.33 illustrate the concentrations of trichloroethene (TCE) and total 1,2-dichloroethene (1,2-DCE) from K-1700 (which monitors Mitchell Branch), the only surface water monitoring location where VOCs are regularly detected. In October 2007, the Tennessee General Water Quality Criteria (WQC) were revised. Concentrations of TCE and total 1,2-DCE are below the Tennessee General WQC (300 μg/L for TCE and 10,000 μg/L for *trans* 1,2-DCE) for Recreation, Organisms Only, 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. However, the concentrations of TCE often exceed the new (October 2007) standards for recreation, water and organisms of 25 μg/L (since the recreation, water and organisms standards apply only to waterways that serve as a drinking

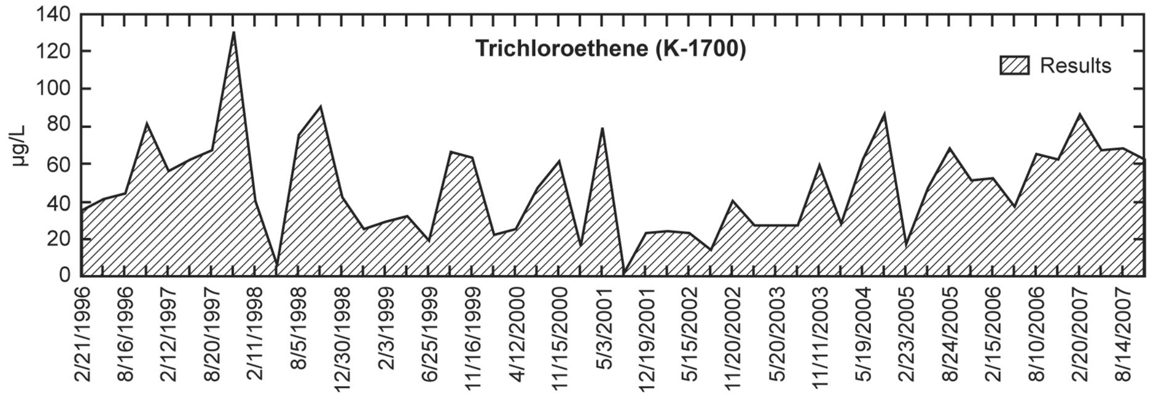



**Fig. 3.32. K-1700 surface water trichloroethene results for 1996–2007.**

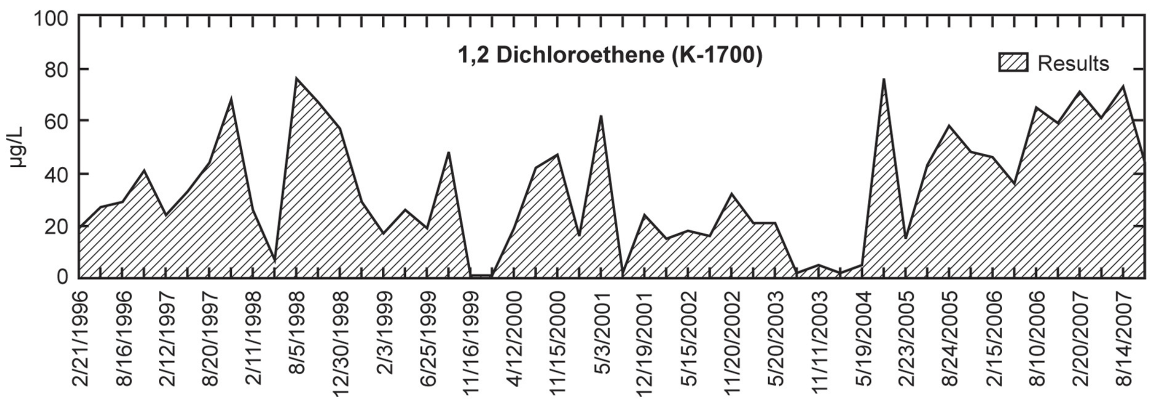



**Fig. 3.33. K-1700 surface water 1,2-dichloroethene results for 1996–2007.**

water source, they do not apply to Mitchell Branch and are included solely for comparison purposes). In addition, vinyl chloride has sometimes been detected in Mitchell Branch water (Fig. 3.34). In October 2007 a new, lower standard of 24 µg/L went into effect. Although the concentrations detected in Mitchell Branch in 2007 meet this WQC, there have been historical instances where the levels approached the WQC. All of these 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.

Surface water has been routinely sampled by DOE contractors and TDEC as part of environmental monitoring programs for several years. 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 chromium over the past 10 years (Fig. 3.35) have been shown to be generally less than 0.01 mg/L, or in some instances, at non-detectable levels. Results from routine surface water monitoring conducted in fall 2006 showed a significant increase in the total chromium level in Mitchell Branch, but this level was still below the WQC for total chromium. Sampling performed in the spring of 2007 by DOE contractors and TDEC indicated that chromium levels had increased above the levels found in the fall 2006 sampling. The highest total chromium result was a value of 0.14 mg/L, which exceeded the then applicable WQC of 0.10 mg/L. Based on these sampling results, a joint effort between DOE contractors and TDEC surface water and CERCLA program personnel was initiated in June 2007.

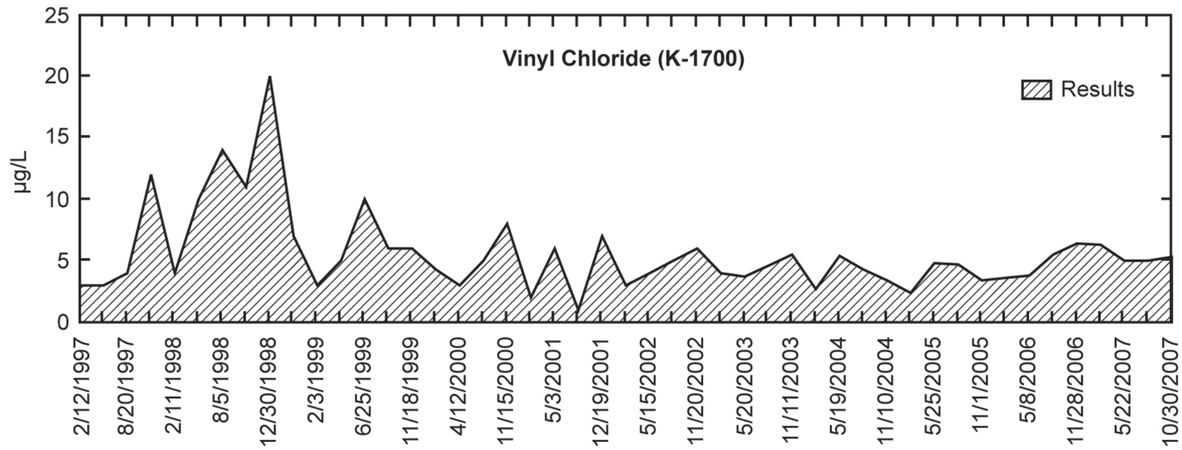



**Fig. 3.34. K-1700 surface water vinyl chloride results for 1997–2007.**

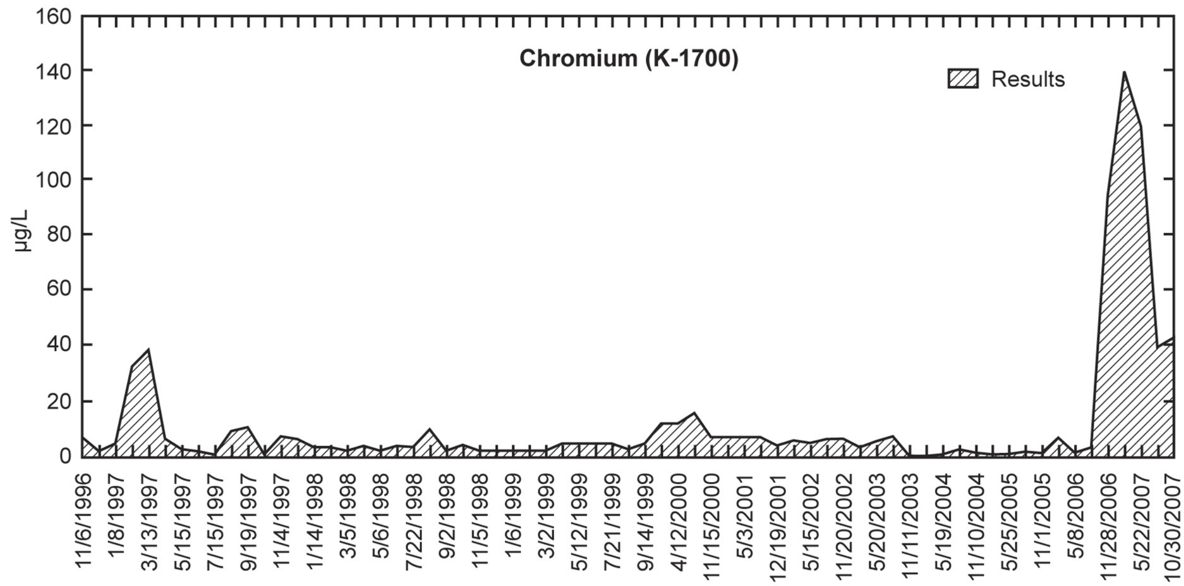



**Fig. 3.35. K-1700 surface water chromium results for 1996–2007.**

Historical maps and photographs, utility and waste process pipeline drawings, monitoring records for building sumps, and other sources of information were reviewed to search for possible uses and sources of chromium in the Mitchell Branch watershed.

During a meeting held on June 7, 2007, personnel from the TDEC DOE Oversight Division office informed ETTP EC&P personnel that they had observed an increase in the levels of chromium in the analytical data from samples that they had collected from Mitchell Branch at MIK 0.7 and MIK 0.45 in the fourth quarter of 2006 and the first quarter of 2007. Chromium levels at these two locations had increased from 2 ug/L in spring 2006 (which had been within the historical norm of 1–7 µg/L) to levels over the water quality criteria in spring 2007. An immediate cause for this increase in chromium levels could not be identified, so ETTP EC&P personnel began an extensive investigation of surface water and groundwater flow into Mitchell Branch in an attempt to gain information on the source(s) of the chromium. This extensive investigation did not succeed in identifying the ultimate source of the chromium, but did identify a seep in the vicinity of storm water outfall 170 as being the location where the chromium-laden water enters Mitchell Branch. A system was installed as a time-critical removal action to capture this water and transfer it to the CNF for treatment. Approval from TDEC was obtained and the system began operation in December 2007.

### 3.7.3 Direct Radiation Monitoring

In previous years, the $UF_6$ cylinder storage yards and K-770 Scrap Yard at ETTP were potential sources of direct gamma and neutron radiation exposure to the public. All remaining $UF_6$ cylinders stored at ETTP were shipped in December 2006 to the Portsmouth site for disposition; direct dose measurements in the vicinity of each empty storage yard confirmed that the cylinder yards are no longer sources of potential dose to the public above background levels.

All remaining contaminated scrap was shipped from the K-770 Scrap Yard to the Environmental Management Waste Management Facility (EMWMF) in early 2007. General area dose rates were recorded in the vicinity of the K-770 Scrap Yard, along the near bank of the Clinch River on February 26, 2007. These measurements confirmed that the K-770 Scrap Yard is no longer a source of potential dose to the public above background levels.