3. East Tennessee Technology Park

The ETTP was originally built during World War II as part of the Manhattan Project. Known as the K-25 Site, its primary mission was to enrich uranium for use in atomic weapons. After the war the mission was changed to include the enrichment of uranium for nuclear reactor fuel elements and recycling of 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, the cleanup of outdoor storage and disposal areas, the demolition and/or cleaning up of the facilities, land restoration, and environmental monitoring. Proper disposal of the huge quantities of waste that were generated over the course of production operations is also a major task. Beginning in the 1990s, reindustrialization (the conversion of underutilized government facilities for use by the private sector) also became a major mission at ETTP. Reindustrialization allows private industry to lease underutilized facilities, thus providing both jobs and a new use for facilities that otherwise would have to be demolished. Bechtel Jacobs Company (BJC) is the prime environmental contractor for the ETTP environmental monitoring and surveillance program. 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 2008, there was better than 99% compliance with permit standards for emissions from ETTP operations.

3.1 Description of Site and Operations

Construction of the 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.

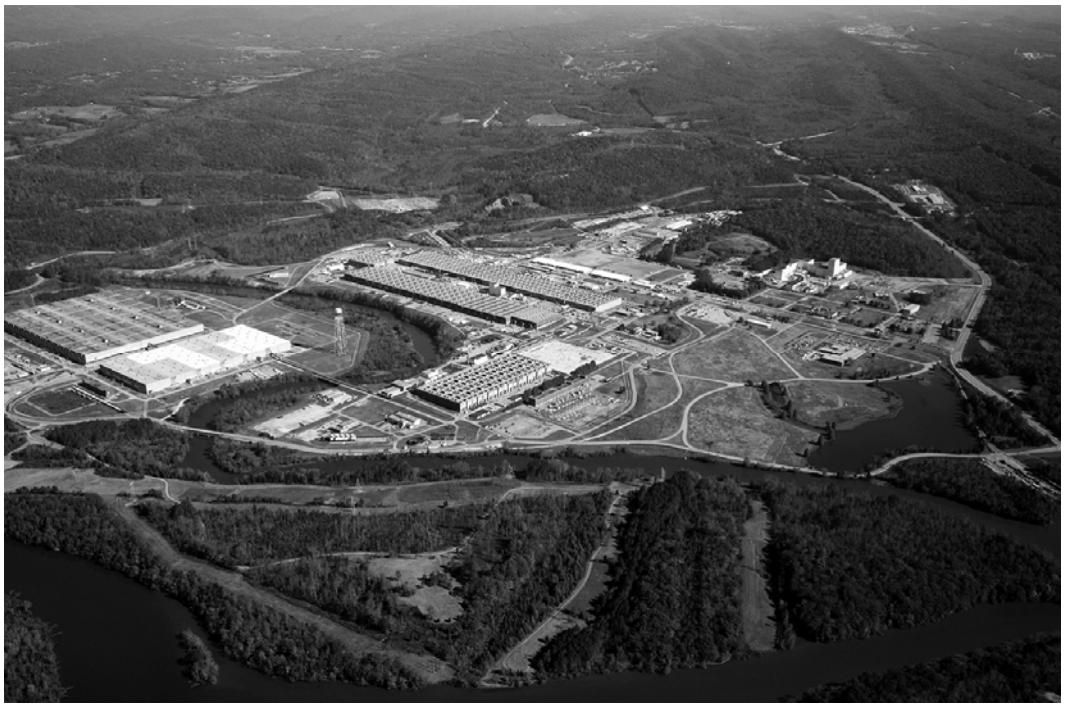


Fig. 3.1. East Tennessee Technology Park

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 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 through incorporation of commercial industrial organizations as partners in the ongoing environmental restoration, D&D, and waste treatment and disposal.

3.2 Environmental Management System

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

Environmental protection considerations, as part of the ETTP ISMS, have taken on a new focus with the issuance of a presidential executive order and a DOE directive. The Environmental Compliance and Protection (EC&P) Oversight Program is an integral part of the BJC Environmental Management System (EMS) mandated by Presidential Executive Order 13423, "Strengthening Federal, Environmental, Energy, and Transportation Management," and its implementing document, DOE Order 450.1A, *Environmental Protection Program*. The DOE order requires that each DOE operation have an EMS to be implemented as part of its ISMS, which was established at DOE sites pursuant to DOE P 450.4, *Safety Management System Policy*. BJC uses its ISMS to implement the EMS, including EC&P considerations, into the line ES&H Oversight Program at DOE sites managed by BJC. DOE Order 450.1A also requires

implementation and development of pollution prevention (P2) and sustainable environmental stewardship goals.

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

The EMS is part of the ISMS in that it relies on the existing ISMS five core functions, seven guiding principles, and worker participation to fully integrate EC&P considerations into all work processes. In addition, BJC's EMS is based on the elements and framework contained in International Organization for Standardization (ISO) 14001 (ISO 2004). Depending on the scope of work involved, there are EMS attributes or actions related to the environment that an individual could apply at each of the five core functions. Such actions are specifically relevant to environmental compliance, protection of natural resources, prevention of pollution, and minimization of waste. When EMS attributes or actions are applied through the ISMS process, the elements of the EMS Program become an integral part of a continuing cycle of planning, implementing, evaluating, and improving processes and actions. The EMS is supported at each of the five core functions of ISMS, and the ISMS provides the framework for implementing EMS policies, processes, and tools in all phases of work. BJC's definition of "safety" embodies protection of workers and the public health as well as the environment. BJC protects the safety and health of workers and the public by identifying, analyzing, and mitigating aspects, hazards, and impacts and by implementing sound work practices. All BJC employees and subcontractors are held responsible for complying with all ES&H requirements during all work activities and are expected to correct noncompliant conditions immediately. BJC internal management assessments also provide a measure of how well EMS attributes are integrated into work activities through the ISMS. BJC has embodied its program for environmental compliance and protection of natural resources in a company-wide environmental management and protection policy. The policy is BJC's fundamental commitment to incorporating sound environmental management practices into all work processes and activities.

3.3 Compliance Status

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 2008. Table 3.2 lists the major environmental permits in place at ETTP in 2008. Compliance is verified by internal audits and assessments as well as routine assessments by state and federal regulators (Table 3.3)

3.4 Air Quality Program

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 Toxic Substances Control Act (TSCA) Incinerator (Fig. 3.2), 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 is equipped with extensive exhaust gas pollution control equipment, enabling it to operate in regulatory compliance with both the federal Clean Air Act (CAA) and the Tennessee Air Code.

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 the 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	Activities of Bechtel Jacobs Company 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 2008, no CXs 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. To date, 60 have been demolished. Artifacts of historical and/or cultural significance are identified prior to demolition and are cataloged in a database to aid in historic interpretation of the ETTP
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 2008
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 2008, there were no noncompliances of the NPDES permits and CWA requirements (see Appendix E)
The Safe Drinking Water Act establishes minimum drinking water standards and monitoring requirements	The K-1515 sanitary water plant provides drinking water for ETTP and for an industrial park south of the site. In 2008, the ETTP sanitary water plant met all primary drinking water standards as well as operational and maintenance requirements, and was transferred to the City of Oak Ridge

Table 3.1. (Continued)

Regulatory program description	Compliance status
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 2008, 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 permitted for storage and treatment of hazardous waste and is also registered as a large-quantity generator (>1,000 kg of hazardous waste per month) of hazardous waste and a large quantity handler of universal waste. TDEC's 2008 inspection of the hazardous/universal waste areas at ETTP resulted in no violations. Two underground storage tanks are permitted at ETTP. One Notice of Violation was issued for the tanks at the garage complex, and all issues have been resolved
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 polychlorinated biphenyls (PCBs), in compliance with all requirements. Almost all PCB-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. Locations of new projects or programs are compared to the ETTP floodplain map as needed in order to determine if the activity will be located in a floodplain. If so, then the appropriate review process is initiated.
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 3.2. Permit actions at East Tennessee Technology Park

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	Replaces TNHW-056
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	Oct. 1, 2003	Sep. 30, 2008	NPDES permit for treated liquid effluent; continued while renewal application being reviewed.
TN0002950	Storm water outfalls	Mar. 1, 2004	Mar. 31, 2008	121 permitted outfalls in 4 groups; continued while renewal application being reviewed.
045253P	K-1407-U VOC Air Stripper	Jun. 20, 1996	Oct. 1, 2000*	Operating Permit Tennessee Air Quality Act
958435P	K-1423 TSCA Solid Waste Repack Facility	Oct. 10, 2005	Oct. 10, 2006*	Permit to Construct Tennessee Air Quality Act
029895P	K-1425 Waste Oil/Solvent Storage Tank Farm	Sep. 21, 1990	Oct. 1, 1995*	Operating Permit Tennessee Air Quality Act
957808I	K-1435 TSCA Incinerator	Jan. 25, 2005	Oct. 13, 2009*	Permit to Construct Tennessee Air Quality Act
037460P	K-1435-C Liquid Waste Tank Farm	Mar. 31, 1994	Oct. 18, 1998*	Operating Permit Tennessee Air Quality Act
SOP-05068	Waste Transportation Project	Feb. 28, 2006	Feb. 28, 2009	Blair Road and Portal 6
SOP-99033	K-1310-DF trailer	April 29, 2005	April 29, 2010	
SOP-01042	K-1065 facility	November 30, 2006	May 31, 2010	

Table 3.2. (Continued)

Permit No.	Units covered	Issued	Expires	Comments
N/A	Sewage discharges	May 27, 2008	Ongoing	City of Oak Ridge Sewage Discharge Approval

*Permit shield: A Title V Major Source Operating Permit application was originally submitted in 1996 and updated in 2004 for ETTP operations; therefore, existing permits shall serve as operating permits until TDEC issues the Title V permit.

Abbreviations

NPDES	National Pollutant Discharge Elimination System
TSCA	Toxic Substances Control Act
VOC	volatile organic compound

Table 3.3. Oversight and assessment at East Tennessee Technology Park, 2008

Date	Reviewer	Subject	Issues
February 4–6	TDEC	Annual RCRA Storage Area	0
April 24	EPA/TDEC	TSCA Incinerator PCB Inspection	0
	TDEC		2
May 7	TDEC	K-1414 UST Inspection	2
May 14	City of Oak Ridge	Sewage Pretreatment Assessments	0
June 17	City of Oak Ridge	Sewage Pretreatment Assessments	0
September 11	TDEC	TSCA Incinerator PCB Inspection	0
November 18	TDEC	Central Neutralization Facility, TSCA Solid Waste Repack Facility, TSCA Incinerator, TSCA Tank Farms Clean Air Act Inspection	0
November 21	City of Oak Ridge	Sewage Pretreatment Assessments	0

Abbreviations

EPA	Environmental Protection Agency
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
TDEC	Tennessee Department of Environment and Conservation
UST	underground storage tank

Fig. 3.2. TSCA Incinerator

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, which were developed under sponsorship of the U.S. Environmental Protection Agency (EPA) 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 2008 period of performance, the TSCA Incinerator contributed more than 75% of the total ETTP dose to the ETTP-specific most exposed member of the public. Figure 3.3 conservatively illustrates the estimated monthly and annual dose from TSCA Incinerator operations during 2008. During this reporting period, tritium was the major dose contributor, followed by isotopes of uranium. The total estimated airborne dose is far below 10 mrem/year effective dose equivalent (EDE), which is the rad NESHAP regulatory limit that is the applicable standard for combined radionuclide emissions from all ORR facilities.

The TSCA Incinerator presently is the largest operating nonradionuclide air emissions source and is 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. Total NO_x emissions for 2008 were 10.3 tons (20,547 lb). Total CO emissions were 2.6 tons (5,137 lb). Emissions of all nonradiological regulated air pollutants from TSCA Incinerator operations are noted in Figs. 3.4 through 3.6. In the three categories of data presented, emissions are compared with EPA ambient air quality standards and are identified as criteria pollutants, which are hazardous air pollutants as regulated under 40 CFR 63, Subpart EEE, "National Emission Standards for Hazardous Air Pollutants for Source Categories (Maximum Achievable Control Technology (MACT)" and other pollutants as regulated under Permit No.957808I, the current air permit issued by the Tennessee Department of Environment and Conservation (TDEC) for the TSCA Incinerator. Each data point on these figures represents the

accumulated pollutant emissions for a continuous 12-month period. Table 3.4 lists all TSCA Incinerator emission limits that include those pollutant parameters associated with Figs. 3.4 through 3.6. All graphical information is based on the allowable rates identified in the TSCA Incinerator air permit. 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.

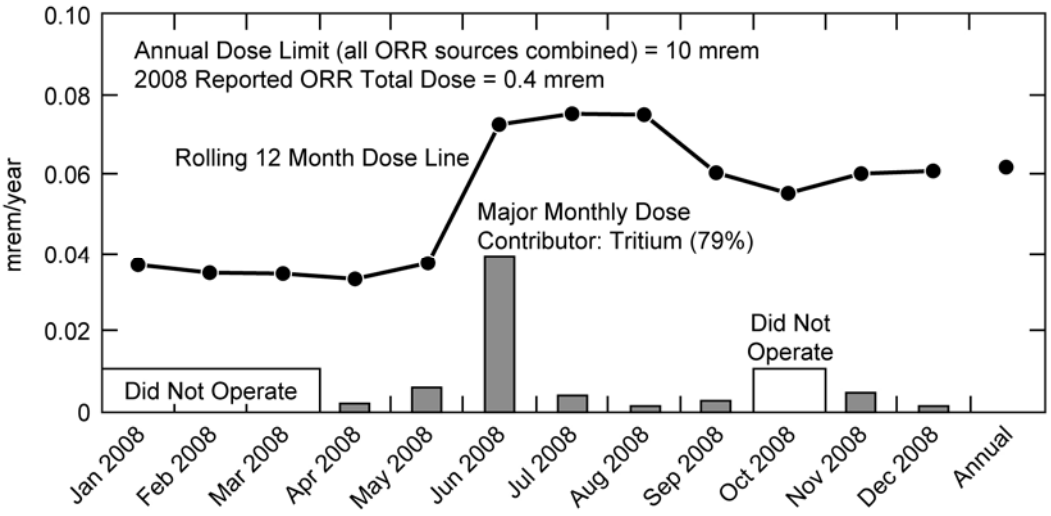
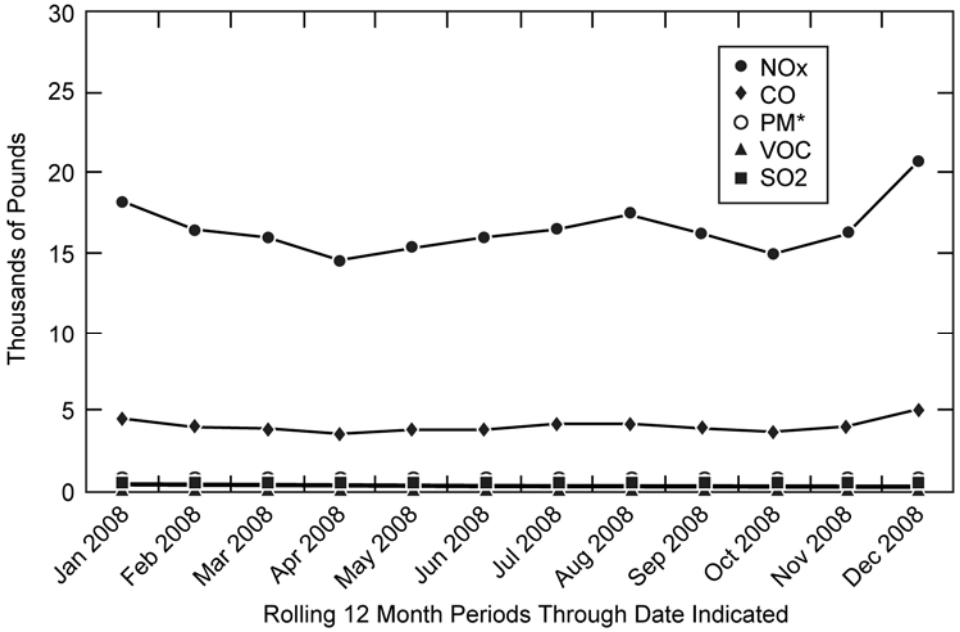


Fig. 3.3. Dose from TSCAI operations.



**PM is also regulated under 40 CFR 63, Subpart EEE (MACT).*

Fig. 3.4. TSCAI criteria pollutant emissions.

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	0.06 mrem/year
Particulate matter (PM)	30 mg/dscf	5.0 ton/year	0.21 ton/year
Sulfur dioxide (SO_2)	8.8 lb/h	38.5 ton/year	0.012 ton/year
Oxides of nitrogen (NO_x)	Not applicable	Not applicable	10.3 ton/year
Volatile organic compounds (VOCs)	1.15 lb/h	5.0 ton/year	0.23 ton/year
Carbon monoxide (CO)/total hydrocarbons (HC)	100 ppmv CO/10 ppmv HC	20.3 ton/year CO/ 2.03 ton/year HC	2.6 ton/year CO
Low-volatile metals:	92 µg/dscm combined As-Be-Cr	31.5 lb/year	2.6 lb/year
Beryllium (normal operations)	0.02 lb/d	7.3 lb/year	0.03 lb/year
Beryllium (compliance testing only)	0.075 lb/d	Not applicable	Not applicable
Semivolatile metals:	230 µg/dscm combined Cd-Pb	76.7 lb/year	12.8 lb/year
Manganese (Mn)	Not applicable	Not applicable	2.6 lb/year
Nickel (Ni)	Not applicable	Not applicable	0.32 lb/year
Mercury (Hg)	130 µg/dscm	43.1 lb/year	5.7 lb/year
Hydrogen chloride/chlorine	77 ppmv	6.5 ton/year	0.032 ton/year
Hydrogen fluoride	0.68 lb/h	5,957 lb/year	1.4 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)	0.00013 lb/year	Not applicable

Abbreviations

DOE	U. S. Department of Energy
ORR	Oak Ridge Reservation
TEQ	toxic equivalent for dioxin

Units of measure

dscf	dry standard cubic foot
dscm	dry standard cubic meter
ppmv	parts per million by volume

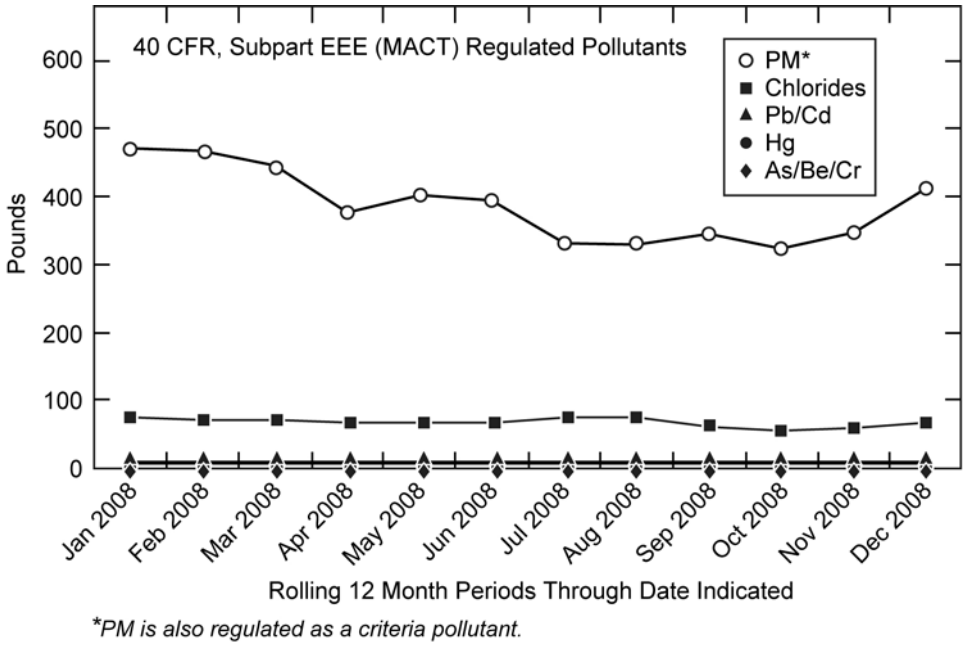


Fig. 3.5. TSCAI MACT regulated pollutant emissions.

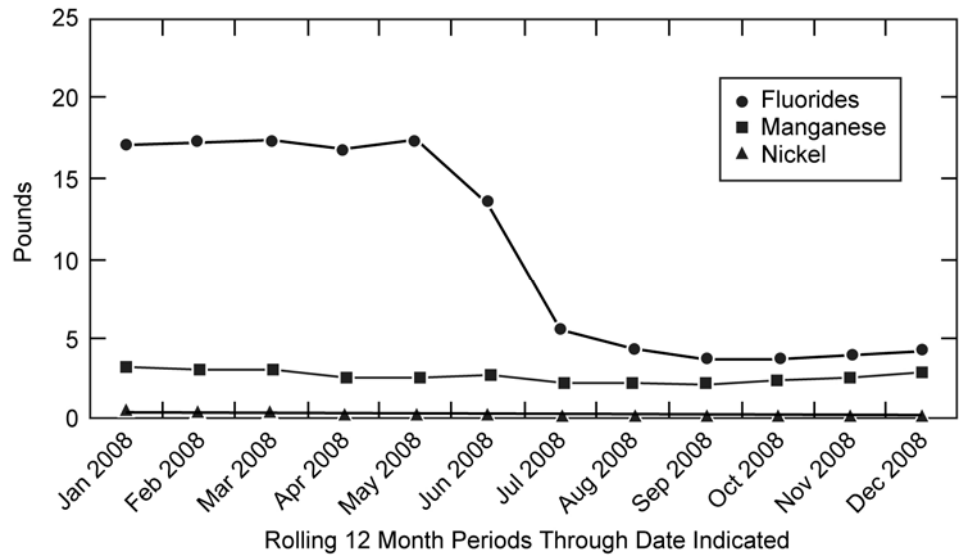


Fig. 3.6. TSCAI other regulated pollutant emissions.

All reported emission data for the TSCA Incinerator were within all permitted limits. For criteria pollutants, the highest emissions result against the permitted limit and based on an annualized comparison was CO at 12.6%. Emissions of the combination of Pb and Cd were only 2% of the permitted limit. The highest emissions result of any other regulated pollutant was for fluorides at less than 1%.

ETTP operations release airborne pollutants from a variety of sources, such as stacks, vents, and fugitive and diffuse activities. With the exception of the TSCA Incinerator, all other stack and vent emissions are calculated as allowed based on their low emissions. Compliance of fugitive and diffuse sources is demonstrated based on environmental measurements. The ETTP Ambient Air Quality Monitoring Program is designed to provide environmental measurements and 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 sampling stations in the ETTP area are designated as base, supplemental, TSCA, or ORR perimeter air monitoring (PAM) stations. The base program consists of two locations using high-volume ambient air samplers. Supplemental locations are typically temporary, project-specific stations that would have samplers specific to a type of potential emissions. Samplers typically include high-volume systems, depending on the source emission evaluation of the project. 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 are included in the ETTP network for comparative purposes. Figure 3.7 shows the location of all ambient air sampling stations during this reporting period.

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

Figures 3.8 through 3.12 illustrate the air concentrations of As, Be, Cd, Cr, and Pb for the past 5 years, based on quarterly composites of weekly continuous samples. The results are compared with any applicable standards for each pollutant. Also, the minimum detectable concentration is shown for all metals, including uranium. The annualized levels of As, Be, Cd, and Pb all show results well below the indicated annual standards. Results for 2008 are typically lower than results reported for 2007 and are more comparable with historical trends. (See Appendix A for a discussion of the 2007 data anomaly.) The chromium results are conservatively compared with the standard for hexavalent chromium. A modification to the National Ambient Air Quality Standard for lead in October 2008 lowered the quarterly limit from 1.5 µg/m3 to 0.15 µg/m3. Lead measurement results still indicate that all levels are well within the new standard.

Total uranium metal was measured as a quarterly composite of continuous weekly samples from stations K2, K6, and K11. The total uranium mass for each sample was determined by the inductively coupled plasma-mass spectrometer (ICP-MS) analytical technique. Figure 3.13 illustrates the air concentrations of uranium metal for the past 5 years based on quarterly composites of weekly continuous samples. The uranium averages and maximum individual concentration measurements for all sites are presented in Table 3.5. The averaged results ranged from a minimum of approximately 0.000001, up to 0.000034 µg/m^3. The highest 12-month average result (0.000034 µg/m^3) was measured at Station K2. The annual average value for all stations due to uranium was 0.000018 µg/m^3 The ICP-MS results are compared with the derived concentration guide (DCG) for natural uranium as listed in DOE Order 5400.5. The DCG is based on an annual air concentration exposure that would give a dose of 100 mrem.

The highest annual result (K2) only corresponds to 0.01% of the DCG. The single sampling location with the highest quarterly concentration (0.000092 µg/m^3) was at station K2. If this concentration were extrapolated to a 12 month exposure, it would only represent 0.06% of the DCG. Radiochemical analyses were initiated during 2000 on quarterly composite samples collected at all stations. The selected isotopes of interest were ^{237}Np, ^{238}Pu, ^{239}Pu, ^{99}Tc, and isotopic uranium (^{234}U, ^{235}U, ^{236}U, and ^{238}U). The concentration and dose results for each of the nuclides are presented in Table 3.6 for 2008.

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 reevaluation of the parameters being sampled and the monitoring site locations.

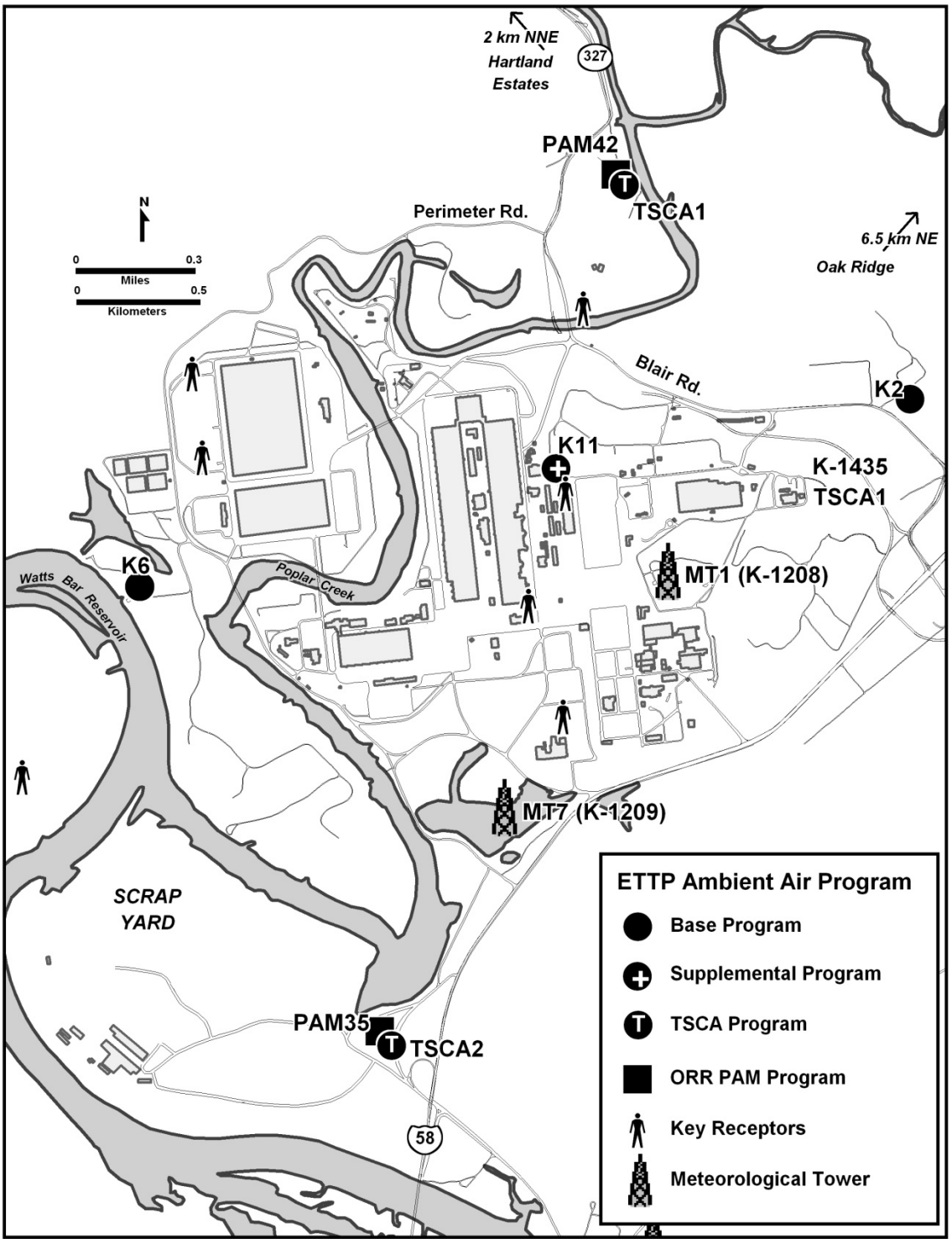
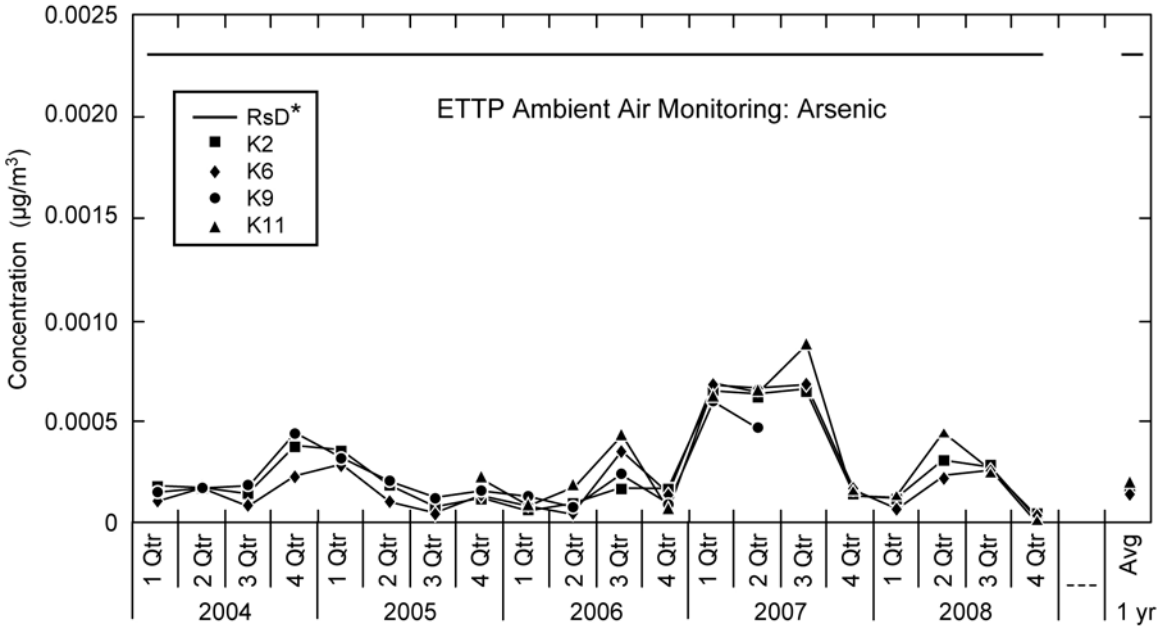
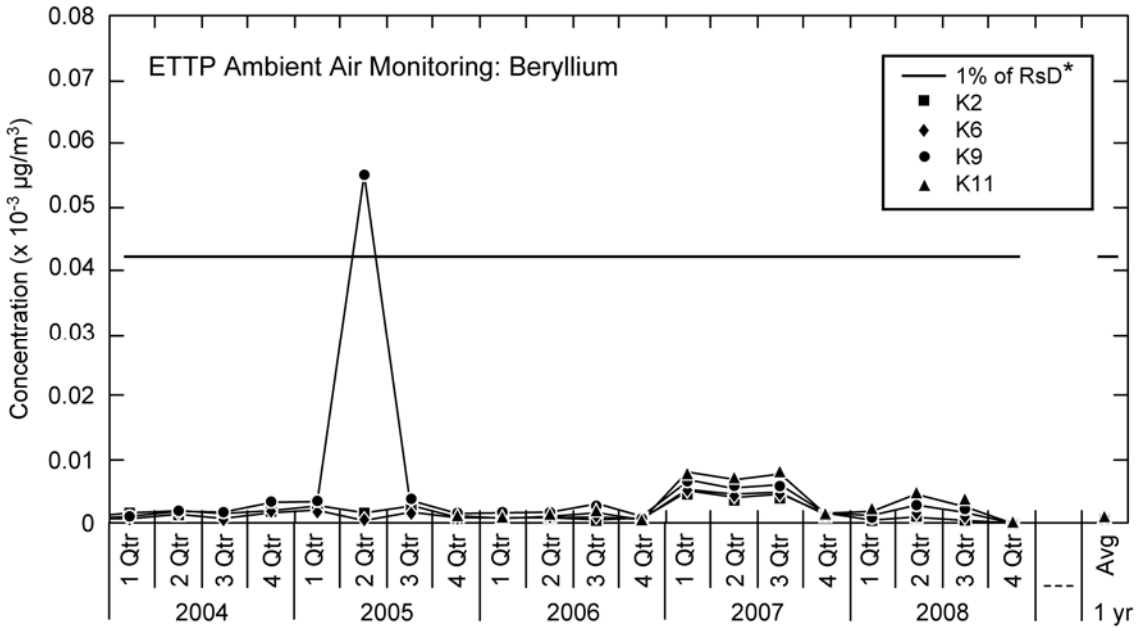


Fig. 3.7. ETTP ambient air monitoring station locations.



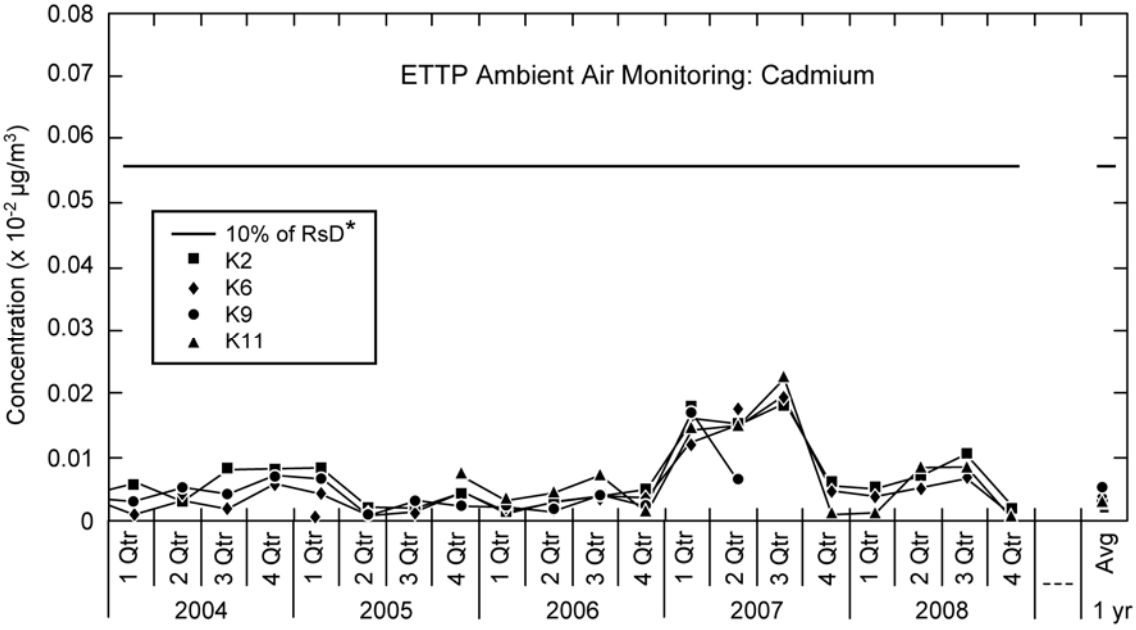
* *RsD - Risk-specific dose. EPA acceptable RsD for arsenic = 0.0023 µg/m^3.*

Fig. 3.8. Arsenic monitoring results: 5-year history through 2008.



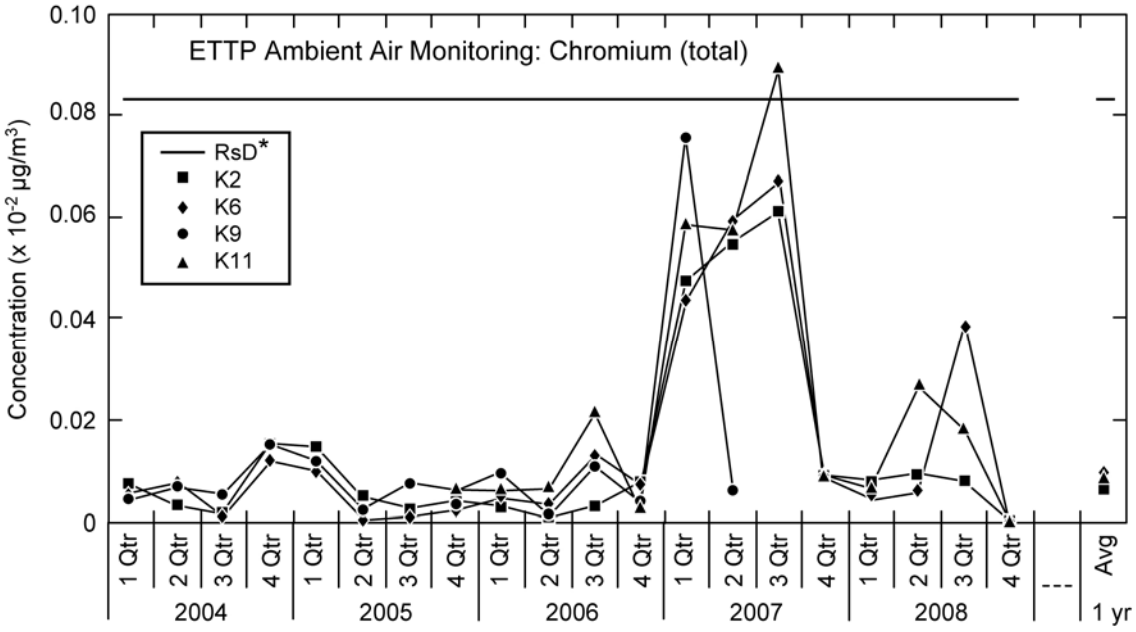
* *RsD - Risk-specific dose. EPA regulatory annual RsD for beryllium = 0.0042 µg/m^3 (40 CFR 266, App. V).*

Fig. 3.9. Beryllium monitoring results: 5-year history through 2008.



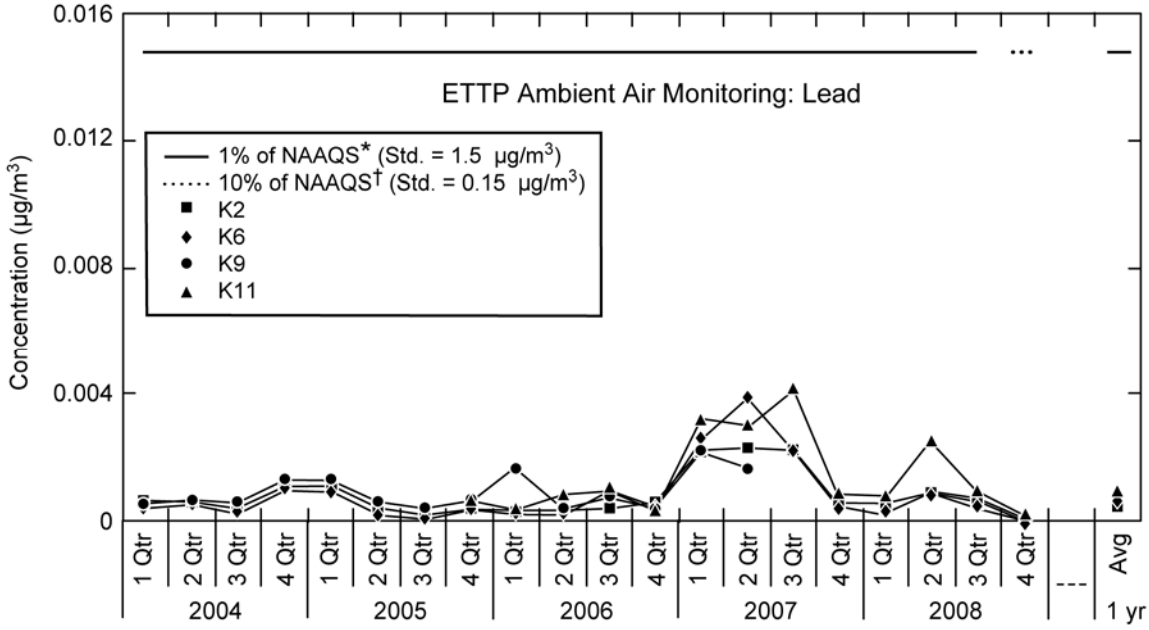
* *RsD - Risk-specific dose. EPA acceptable RsD for cadmium = 0.0056 µg/m^3.*

Fig. 3.10. Cadmium monitoring results: 5-year history through 2008.



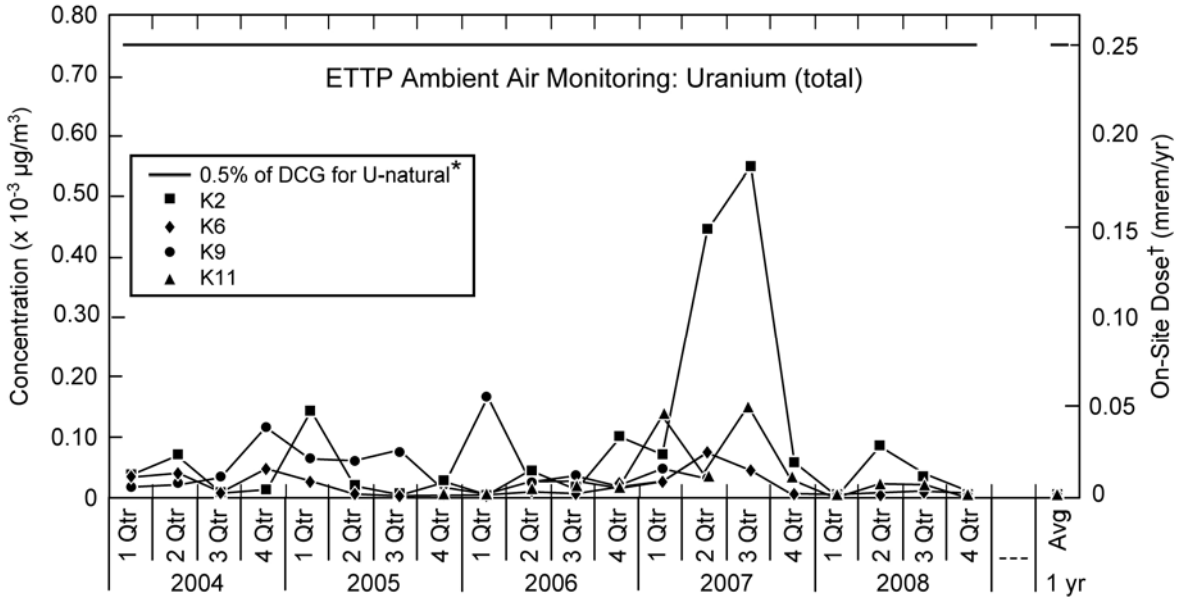
* *RsD - Risk-specific dose. EPA acceptable RsD for chromium-VI = 0.00088 µg/m^3.*

Fig. 3.11. Chromium monitoring results: 5-year history through 2008.



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

Fig. 3.12. Lead monitoring results: 5-year history through 2008.



*DCG for natural U resulting in 100 mrem/year dose is 1.03E-13 µci/m^3 = 0.15 µg/m^3.
†EPA approved ORR on-site business receptor dose assumes a 50% annual occupancy.

Fig. 3.13. Uranium metal monitoring results: 5-year history through 2008.

Table 3.5. Total uranium in ambient air by inductively coupled plasma analysis at East Tennessee Technology Park, 2008

Station	No. of Samples	Concentration[a]				Percentage of DCG[b] (%)	
		μg/m^3		μCi/mL			
		Avg	Max[c]	Avg	Max	Avg	Max
K2	4	0.000034	0.000092	2.28E–17	6.14E–17	0.02	0.06
K6	4	0.000007	0.000018	4.62E–18	1.19E–17	<0.01	0.01
K11	4	0.000013	0.000027	8.85E–18	1.80E–17	<0.01	0.02
ETTP total	12	0.000018		1.21E–17		0.01	

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

[b]DOE Order 5400.5 derived concentration guide (DCG) for naturally occurring uranium is an annual concentration of 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.

Table 3.6. Radionuclides in ambient air at East Tennessee Technology Park, 2008

Station	Concentration (μCi/mL)								
	Total U	^{237}Np	^{238}Pu	^{239}Pu	^{99}Tc	^{234}U	^{235}U	^{236}U	^{238}U
K2	3.35E–17	ND[a]	3.63E-18	ND	1.53E–16	9.95E–18	1.95E–18	1.95E-18	3.34E–17
K6	5.30E–18	1.70E-18	ND	ND	8.91E–18	3.93E–18	ND	ND	4.72E–18
K11	2.4E–17	ND	3.05E-18	ND	1.62E–15	1.32E–17	ND	ND	1.11E–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	0.023	ND	0.008	ND	0.001	0.005	0.001	0.001	0.016
K6	0.004	0.004	ND	ND	<0.001	0.002	ND	ND	0.002
K11	0.012	ND	0.006	ND	0.007	0.007	ND	ND	0.005

[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.

Figure 3.14 is a 5 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.

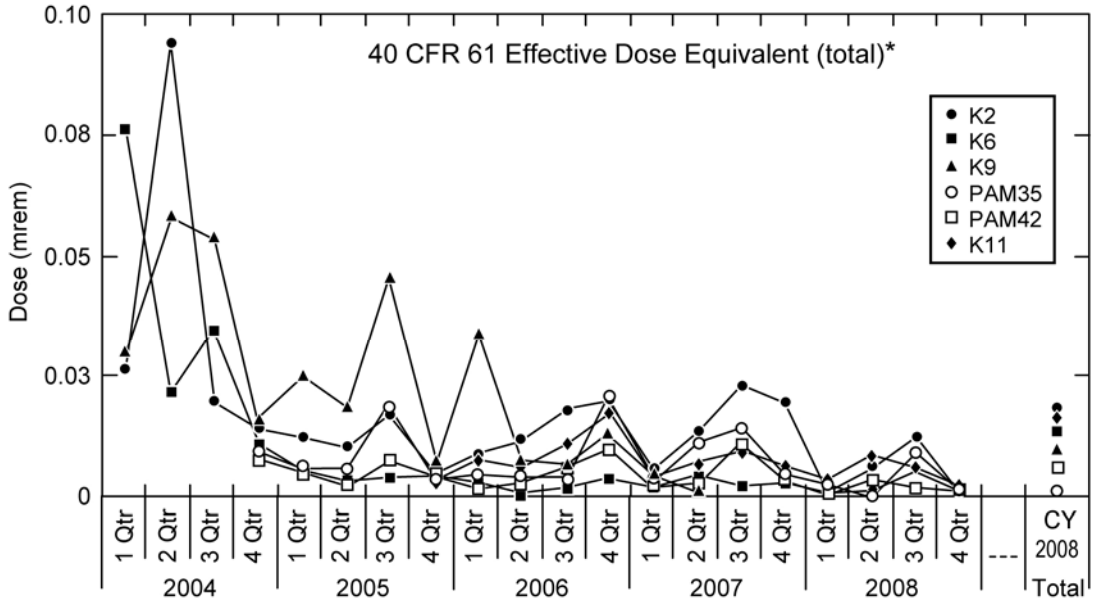


Fig. 3.14. Radionuclide monitoring results: 5-year history through 2008.

3.5 Water Quality Program

3.5.1 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 from ETTP of storm water runoff, groundwater infiltration, and groundwater from sumps 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 water outfalls 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. 3.15). 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.

Fig. 3.15. Storm water sampling at ETTP.

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 regulated under NPDES permit No. TN0002950. Of the 121 total outfalls, 38 representative outfalls are required to be sampled. The outfalls are grouped into four categories based on the types of flows being discharged through the outfalls.

- **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 outfalls in this group must be monitored weekly for flow and pH and quarterly for oil and grease and total suspended solids (TSS) (Table 3.7).
- **Group III storm water outfalls**—These outfalls flow continuously or intermittently. They may discharge storm water runoff, groundwater infiltration, and groundwater from sumps. These outfalls receive storm water runoff from site industrial operations 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 3.8).

- **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 3.9).

Table 3.7. 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-CI 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: 2008 Results*, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2009. The DOE document reference is to be determined.

[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 millions of gallons 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 be required only 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. TRC monitoring was performed through January 2008 but is no longer required.

- **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 3.10).

Table 3.8. 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: 2008 Results*, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2009. The DOE document reference is to be determined.

[b]The following storm water outfalls will 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 millions of gallons per day (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 3.9. 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: 2008 Results*, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2009. The DOE document reference is to be determined.

[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 millions of gallons per day (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 3.10. 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: 2008 Results*, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2009. The DOE document reference is to be determined.

[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 millions of gallons per day (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.

3.5.1.1 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 the 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 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 the area of the state in which ETTP is located.

3.5.1.2 Comparison of SWP3 Sampling Results to Screening Criteria

Analytical results from the SWP3 sampling effort conducted in 2008 were compared with applicable screening criteria to identify locations where storm water runoff could be contributing pollutants to receiving waters. These criteria were applied to all data collected as part of the 2008 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 the SWP3 sampling program are listed in Table 3.11.

Table 3.11. 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

Table 3.11. (Continued)

Parameter	Project quantitation level	Screening level	Reference standard	Units
Volatile organic compounds (VOCs) (Continued)				
Cis-1,3-Dichloropropene	2	75	100	µg/L
Dibromochloromethane	2	75	100	µg/L
Ethylbenzene	2	75	100	µg/L
Methylene chloride	2	75	100	µg/L
Styrene	2	75	100	µg/L
Tetrachloroethene	2	25	33	µg/L
Toluene	2	75	100	µg/L
trans-1,2-Dichloroethene	2	75	100	µg/L
trans-1,3-Dichloropropene	2	75	100	µg/L
Trichloroethene	2	75	100	µg/L
Vinyl chloride	2	18	24	µg/L
Xylenes (dimethyl benzene)	2	75	100	µg/L
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

Table 3.11. (Continued)

Parameter	Project quantitation level	Screening level	Reference standard	Units
Field readings				
Dissolved oxygen (minimum)	4.0–8.0	<6.0	5.0	mg/L
pH (maximum)	14.0	>8.4	9.0	Standard units
pH (minimum)	1.0	<6.4	6.0	Standard units
Temperature	0-100	>27	NA	^{o}C

The screening criterion for a specific radionuclide is equal to 4% of the 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 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).

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.

3.5.1.3 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 that await remediation. A review of the *Balance of Site – Laboratory Phased Construction Completion Reports* (PCCRs) (DOE 2007, 2007a, 2007b) 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 currently describe the monitoring effort in sufficient detail. 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 whether or not 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 to be adequate.

- 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 (RA) 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 the areas were collected at nearby storm water catch basins or directly from the building pads. The samples were collected in order to obtain data that will be considered as the worst-case rad discharge from these 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.

Because some of the sampling of the building pads and catch basins required a fairly heavy and intense downpour, samples were collected when runoff from the pads was sufficient to allow all of the samples for the given analytical parameters to be collected, regardless of the amount or intensity of the rainfall event. Storm water outfalls were sampled as close as possible to the time that the building pads, or catch basins that drain to them, were sampled. This was done to allow some correlation of the contaminant levels in the runoff samples from the building pads with the levels of contaminants in the storm water outfall samples. Samples collected from each of the locations listed in Table 3.12 were analyzed for gross alpha/gross beta radiation, isotopic uranium, total uranium, and ^{99}Tc.

Table 3.12. Storm water sampling for the PCCR

Sampling location	Gross alpha/ gross beta	Transuranics	U isotopic	Tc-99
K-1420 Pad runoff	X	X	X	X
Outfall 158	X	X	X	X
Outfall 160	X	X	X	X
Outfall 170			X	

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 Sections 3.1.2 and 3.3.1 of the EPA's *NPDES Storm Water Sampling Guidance Document* (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor. All guidelines stated in the ETTP *SWPP Program (SWP3) Sampling and Analysis Plan* (SAP) (BJC 2007, 2008) concerning sample documentation, analytical procedures, quality assurance (QA), and quality control (QC) were followed as part of this sampling effort.

As part of the 2008 SWP3 sampling effort, samples were collected at the north side of the K-1420 building footprint in an area near the former calciner room. Samples were also collected from storm water outfalls 158, 160, and 170 in concurrence with the K-1420 pad samples. Samples of building pad runoff from the area were scheduled to be collected on a monthly basis during wet weather conditions. However, due to the lack of qualifying storm events, the samples were not collected between April and August 2008.

Screening criteria for a specific radionuclide are equal to 4% of the DCG for that radionuclide in water, as listed in DOE Order 5400.5, Chapter 3; the reference standard is the DCG for each radionuclide. Four percent of DCG represents the DOE criterion of 4 millirem 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 Part 141). Table 3.13 presents the results of the radiological monitoring done for the PCCR.

Table 3.13. Results exceeding screening levels for radiological monitoring performed in conjunction with PCCR RA and D&D activities[a]

Sampling Location	Date sampled	Gross alpha radiation (pCi/L)	Gross beta radiation (pCi/L)	U-233/234 (pCi/L)	U-235/236 (pCi/L)	U-238 (pCi/L)	Total uranium (µg/L)
Outfall 158	Jan	121	–[b]	48.3	–	32.4	98
Outfall 158	Feb	23.8	–	–	–	–	–
Outfall 158	Mar	15.8	–	–	–	–	–
Outfall 158	Aug	245	66.0	121	–	68.2	206
Outfall 160	Jan	592	239	405	–	73.8	228
Outfall 160	Feb	188	–	130	–	–	65.7
Outfall 160	Mar	191	90.8	150	–	–	70.8
Outfall 160	Aug	296	135	216	–	59.7	182
Outfall 170	Mar	–	–	–	–	–	73.8
Outfall 170	Jun	–	–	–	–	–	53.4
K-1420 Pad runoff	Jan	26.7	–	–	–	–	–
K-1420 Pad runoff	Feb	16.1	–	–	–	–	–

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

[b]Dashes indicate that the value detected in the sample did not exceed the screening criteria.

Gross alpha radiation was detected in the discharge from storm water outfall 158 at levels greater than15 pCi/L, which is the maximum contaminant level (MCL) established by the Safe Drinking Water Act. The range of the gross alpha radiation data collected as part of the SWP3 sampling effort is fairly consistent with historical levels. Levels of gross beta radiation were detected in the discharge from storm water outfall 158 at levels that exceed the MCL of 50 pCi/L. The range of the gross beta radiation data collected as part of the 2008 SWP3 sampling effort is fairly consistent with historical levels. Uranium-233/234 was detected in the discharge from outfall 158 at levels that exceed the 4% of DCG level of 20 pCi/L for this radionuclide. The range of the U-233/234 data collected as part of the 2008 SWP3 sampling effort is fairly consistent with historical levels. Uranium-235 was not detected in the discharge from outfall 158 at levels that exceed the 4% of DCG level of 20 pCi/L for this radionuclide as part of 2008 SWP3 sampling. Uranium-238 was detected in discharges from outfall 158 at levels that exceed the 4% of DCG level of 24 pCi/L for this radionuclide. The range of ^{238}U levels in data collected as part of the 2008 SWP3 are below levels found in historical data and well below DCG levels of 600 pCi/L. Total uranium was detected in the discharge from storm water outfall 158 at levels that exceed the screening level of 31 µg/L for this analyte. Total uranium levels in data collected as part of the 2008 SWP3 are below DCG levels of 600 pCi/L. There are no historical results available for total uranium at outfall 158. No ^{99}Tc was detected at levels above the screening level of 4000 pCi/L in any of the more recent analytical results collected at outfall 158. No historical results are available for ^{99}Tc for outfall 158.

Gross alpha radiation was detected in the discharge from storm water outfall 160 at levels greater than the MCL of 15 pCi/L. The range of the gross alpha radiation data collected as part of the 2008 SWP3 sampling effort is fairly consistent with historical levels. Levels of gross beta radiation were detected in the discharge from storm water outfall 160 at levels that exceed the MCL of 50 pCi/L. The range of the

gross beta radiation data collected as part of the 2008 SWP3 sampling effort is fairly consistent with historical levels. Uranium-233/234 was detected in the discharge from outfall 160 at levels that exceed the 4% of DCG level of 20 pCi/L. The range of the U-233/234 data collected as part of the SWP3 sampling effort is fairly consistent with historical levels and well below the DCG standard of 500 pCi/L. Uranium-235 was not detected in the discharge from outfall 160 at levels that exceed the 4% of DCG level of 20 pCi/L for this radionuclide as part of SWP3 sampling conducted in 2008. Uranium-238 was detected in discharges from outfall 160 at levels that exceed the 4% of DCG level of 24 pCi/L. The range of ^{238}U levels in data collected as part of the 2008 SWP3 are below levels found in historical data and well below DCG levels of 600 pCi/L. Total uranium was detected in the discharge from storm water outfall 160 at levels that exceed the screening level of 31 µg/L. Total uranium levels in data collected as part of the 2008 SWP3 are below DCG levels of 600 pCi/L. There are no historical results available for total uranium at outfall 160. No ^{99}Tc was detected at levels above the screening level of 4000 pCi/L in any of the more recent analytical results collected at outfall 160. No ^{99}TC was detected at levels above the screening criteria of 4,000 pCi/L in any of the more recent analytical data from samples collected at outfall 160.

It is believed that contaminated sediments in the outfall 158 and outfall 160 drainage systems are contributing to the elevated levels of gross alpha and gross beta radiation as well as the elevated isotopic uranium results. Some of the samples collected as part of the 2008 SWP3 were taken during storm events where considerable amounts of rainfall occurred. The heavy rainfall could have caused sediments in the outfall 158 and 160 drainage systems to become suspended, resulting in elevated radiological results.

Total uranium was detected in the discharge from storm water outfall 170 at a level of 73.8 ug/L in March 2008. This level exceeds the screening criteria of 31 ug/L for this analyte. Total uranium was also detected in the discharge from storm water outfall 170 at a level of 53.4 ug/L in June 2008, which is well below the DCG value of 600 pCi/L. No isotopic uranium data or ^{99}Tc data were collected for outfall 170 as part of the 2008 SWP3 sampling.

Gross alpha radiation was detected in the runoff from the K-1420 pad at levels greater than the MCL of 15 pCi/L in samples collected as part of the 2008 SWP3 sampling effort. However, the levels of gross alpha radiation from the samples collected in 2008 were, in all cases, much lower than levels observed in the storm water outfalls associated with the K-1420 pad. Also, levels of gross alpha radiation have decreased dramatically from levels detected in historical samples. Levels of gross beta radiation were detected in runoff from the K-1420 pad at levels that exceed the MCL of 50 pCi/L. However, the levels of gross beta radiation from the samples collected in 2008 were, in most cases, much lower than levels observed in the storm water outfalls associated with the K-1420 pad. Uranium-233/234 was detected in the runoff from the K-1420 pad at levels that exceed the 4% of DCG level of 20 pCi/L. However, subsequent samples indicate that the levels of U-233/234 were much lower than levels observed in the storm water outfalls associated with the K-1420 pad. Uranium-235 was not detected in the runoff from the K-1420 pad at levels that exceed the 4% of DCG level of 20 pCi/L for this radionuclide as part of SWP3 sampling conducted in 2008. Uranium-238 was detected in discharges from the K-1420 pad at levels that exceed the 4% of DCG level of 24 pCi/L. The range of U-238 levels in data collected as part of the 2008 SWP3 are below levels found in historical data and well below DCG levels of 600 pCi/L. Total uranium was detected in the discharge from storm water outfall 160 at levels that exceed the screening level of 31 µg/L. However, this screening level was not exceeded in data from subsequent sampling performed at the K-1420 pad. No ^{99}Tc was detected at levels above the screening level of 4000 pCi/L in any of the runoff samples collected from the K-1420 pad.

The acceptable dose rate in surface water for piscivorous wildlife is 100 mrad per day. The total uranium activity on the slab that will result in a 100 mrad per day dose in Mitchell Branch is 2600 pCi/L. Recent analytical data indicate that total uranium concentrations are several orders of magnitude below the 2600 pCi/L level. The levels of radioactive contaminants were below screening criteria in samples collected during the last two sampling events. Therefore, it is recommended that additional monitoring of the K-1420 pad be reduced to once per year rather than once per month. If the concentration of total uranium in the pad runoff exceeds 2600 pCi/L as part of future sampling activities, action will be taken to determine the cause and correct it. However, because of the elevated levels of radioactive contaminants in

the outfalls 158, 160, and 170 drainage systems from legacy soil and sediment contamination, it is recommended that routine monitoring of these outfalls continue.

3.5.1.4 Radiological Monitoring of Storm Water Discharges

The ETTP conducts radiological monitoring of storm water discharges to determine compliance with applicable dose standards. It also applies the as low as reasonably achievable (ALARA) process to minimize potential exposures to the public. Sampling for gross alpha and gross beta radioactivity, as well as specific radionuclides, (namely transuranics including Np-237, Pu-238, and Pu-239/240), isotopic uranium, and Tc-99, is conducted as part of the SWP3sampling efforts (Table 3.14). Analytical results are used to estimate the total discharge of each radionuclide from ETTP via the storm water discharge system (Table 3.15). 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 3.14. Storm water sampling for radiological discharges,[a] 2008

Storm water outfall	Date sampled
124	8/26/08
158	7/10/08
160	10/9/08
180	3/20/08
190	7/10/08
195	3/4/08
360	3/5/08
380	8/7/08
382	9/9/08
490	10/9/08
740	2/4/08

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

Additional radiological monitoring of storm water discharges was performed as part of the 2008 SWP3 sampling effort in order to obtain up-to-date radiological results for calculating total radiological discharge. Storm water samples were collected from discharges resulting from a storm event greater than 0.1 in. that occurred within a time period of 24 h or less and that occurred at least 72 h after any previous rainfall greater than 0.1 in. in 24 h. Composite samples were collected at each outfall using automated sampling equipment. The composite samples consisted of at least three aliquots taken during the first 60 minutes of a storm event discharge. Samples composited by time (equal volume aliquots collected at a constant interval) were used. In situations where the use of an automated sampler was not feasible or practical, a series of at least three manual grab samples of equal volume were collected during the first 60 minutes of a storm event discharge and combined into a composite sample.

Table 3.15. Radionuclides released to off-site surface waters from the East Tennessee Technology Park storm water system, 2008 (Ci)[a]

Radionuclide	Amount
^{137}Cs	2.4E–6
^{99}Tc	1.2E–2
^{234}U	5.1E–3
^{235}U	4.1E–4
^{238}U	3.1E–3

[a]1 Ci = 3.7×10^{10} Bq.

The results of the radiological monitoring of storm water discharges conducted as part of the 2008 SWP3 monitoring effort that exceeded screening levels are shown in Table 3.16.

Gross alpha radiation was detected in the discharge from storm water outfall 158 at a level of 89.6 pCi/L. This level exceeds the screening level for gross alpha activity of 15 pCi/L, which is the MCL established by the Safe Drinking Water Act. Gross beta radiation was detected in the discharge from storm water outfall 158 at a level of 60.7 pCi/L, which exceeds the MCL of 50 pCi/L for this analyte. These gross alpha and gross beta radiation results are comparable to historical results for gross alpha and gross beta radiation. Uranium-233/234 was detected in the discharge from storm water outfall 158 at a level of 40.9 pCi/L, which exceeds the 4% of DCG level of 20 pCi/L for this radionuclide. Uranium-238 was detected at a level of 30.9 pCi/L, which exceeds the 4% of DCG level of 24 pCi/L for this radionuclide. Total uranium was detected in the discharge at a level of 93.7 µg/L, which exceeds the screening level of 31 µg/L for this analyte. The uranium results are considerably elevated over analytical results from samples that were collected from this outfall prior to the demolition of Building K-1420. It is possible that contaminated sediments in the outfall 158 drainage system that could have resulted from the demolition of Building K-1420 are contributing to the elevated levels of gross alpha and gross beta radiation as well as the elevated isotopic uranium results.

Table 3.16. Storm water radiological results exceeding screening levels for radiological discharges, 2008 (pCi/L) [a, b]

Storm water outfall	Gross alpha radiation (pCi/L)	Gross beta radiation (pCi/L)	U-233/234 (pCi/L)	U-238 (pCi/L)	Total Uranium (µg/L)
158	89.6	60.7	40.9	30.9	93.7
180	61.5	–	28.4	–	45.7
360	21.6	–	–	–	–
380	15.2	–	–	–	–
740	47.9	–	21.2	–	44.7

[a] 1 pCi = 0.037 Bq.

[b] Screening levels are 15 pCi/L gross alpha radiation, 50 pCi/L gross beta radiation, 20 pCi/L U-233/234,

24 pCi/L U-235 and U-238, and 31 µ/L total uranium.

[c] Dashed line indicates no exceedances.

Gross alpha radiation was detected in the discharge from storm water outfall 180 at a level of 61.5 pCi/L, which exceeds the MCL of 15 pCi/L. Uranium 233/234 was detected at a level of 28.4 pCi/L, which exceeds the 4% of DCG level of 20 pCi/L. Total uranium was detected in the discharge from storm water outfall 180 at a level of 45.7 µg/L, which exceeds the screening level of 31 µg/L. Each of these results exceeds historical levels from samples collected in 2005, 2006, and 2007 by a factor of 4 or more. The outfall 180 receives flow from a large area of ETTP where radiation contamination may be present, including the K-1401 area and the K-1070-C/D burial grounds. These elevated results may be due to activities related to the demolition of Building K-1401.

Gross alpha radiation was detected in the discharge from storm water outfall 360 at a level of 21.6 pCi/L, which exceeds the MCL of 15 pCi/L. This result is approximately one-half of the level recorded for samples collected in 2005. Storm water outfall 360 receives storm water primarily from surface drainages, including the former location of the K-1066-D Cylinder Yard area. This area was once used for the storage and handling of uranium hexafluoride (UF6) cylinders. In addition, outfall 360 receives drainage from the K-1031 and K-1031-A buildings, which were once used to store wastes from uranium decontamination and recovery operations, including organic degreasers, uranium compounds, and trace quantities of transuranics.

Gross alpha radiation was detected in the discharge from storm water outfall 380 at a level of 15.2 pCi/L, which exceeds the MCL of 15 pCi/L. This result is approximately twice the level recorded for samples collected in 2005. Storm water outfall 380 receives storm water primarily from surface drainages, including runoff from the K-27 building and the K-1131 building.. The K-27 building was one of the primary locations where uranium enrichment took place. Building K-1131 served as a UF6 production facility and as a depleted UF6 tails withdrawal facility. All storm water runoff from Buildings K-27 and K-1131 that enter this drainage system pass through oil skimmer K-897-H before discharging through outfall 380.

Gross alpha radiation was detected in the discharge from storm water outfall 740 at a level of 47.9 pCi/L, which exceeds the MCL of 15 pCi/L. Uranium-233/234 was detected at a level of 21.2 pCi/L, which exceeds the 4% of DCG level of 20 pCi/L. Total uranium was detected in the discharge from storm water outfall 740 at a level of 44.7 µg/L, which exceeds the screening level of 31 µg/L. Each of these results is considerably lower than results from samples collected at this outfall in 2003. Storm water

outfall 740 carries runoff from the K-770 Scrap Metal Yard. Various types of metals generated during operation of the K-25 Site were stored at the K-770 area. Much of the material stored at this scrap yard was contaminated with radioactive material, especially uranium. All of the scrap metal has been removed from the K-770 Scrap Metal Yard. Contaminated soils will be removed from the area beginning in CY 2009.

3.5.1.5 Dry Weather Sampling of Non-Storm Water Discharges

As part of the 2008 SWP3 sampling effort, samples were collected from the ETTP storm drain system during dry weather conditions to check for metal contaminants in non-storm water discharges. Groundwater infiltration is the primary source of non-storm water discharges from the permitted storm drain system at ETTP. Groundwater plumes contaminated with metals have been identified for ETTP using data from groundwater wells. This dry weather sampling will help verify where metals-contaminated groundwater may be present in the storm drain system and which metals are present.

All samples were collected by the manual grab sampling technique during dry weather conditions, which is defined as a period of at least 72 hours after a storm event of 0.5 inch or greater. All appropriate procedures for the collection of manual grab samples were followed. All samples were analyzed as per EPA-200.7. Table 3.17 provides additional information on this sampling effort.

The quarterly sampling at outfalls 170, 180, and 190 was coordinated to coincide with the quarterly monitoring of Mitchell Branch that is conducted as part of the ETTP Environmental Monitoring Program (EMP). EC&P personnel provided information concerning the scheduling of EMP monitoring activities. All other designated outfalls were sampled only one time. Where possible, samples were collected in the first quarter of FY 2008. Because of flow conditions, sampling of some of the outfalls was delayed until the second quarter of FY2008.

Table 3.18 contains the results exceeding screening levels for the dry weather sampling effort.

Mercury was detected in the discharge from storm water outfall 05A at a level of 0.108 µg/L. This result is comparable to historical results for mercury from this outfall. Any detectable mercury is an exceedance of the screening level. In addition to serving as a discharge point for storm water runoff, Outfall 05A once served as an auxiliary discharge point for sewage that was treated at the K-1203 sewage treatment plant. Normal discharges from K-1203 were performed using gravity flow. However, if the water level in Poplar Creek was too high to permit gravity discharges, or if flow into the K-1203 system exceeded the facility's treatment capacity, effluent was diverted to outfall 05A. This outfall, which consists of a sump, sump pump, and discharge piping to Poplar Creek, provided a forced discharge to Poplar Creek. It is possible that mercury may have entered the sump at outfall 05A during its historical operation as part of the sanitary sewer system. The K-1203 facility is no longer in service and outfall 05A is no longer used in discharging effluent from the facility. Outfall 05A now receives and discharges only storm water runoff.

Mercury was detected in the discharge from storm water outfall 710 at a level of 0.0402 µg/L. Mercury was not detected in samples collected from this outfall in 2006. Outfall 710 receives storm water discharges from building K-33, a portion of building K-31, and the K-1065 waste storage facilities. All storm water runoff from buildings K-31 and K-33 that enter this drainage system pass through oil skimmer K-897-N before discharging through outfall 710. Buildings K-31 and K-33 are currently inactive. A decision on the final disposition of the buildings will be made in the future. The K-1065 facility remains active, but no discharges from the facility to the environment have been reported.

Total uranium was detected in the discharge from storm water outfall 170 at a level of 73.8 µg/L in the second quarter of FY 2008. This result exceeds the screening level of 31 µg/L. In subsequent sampling in 2008, total uranium was also detected in the discharge from storm water outfall 170 at a level of 53.4 µg/L. This result also exceeds the screening level of 31 µg/L for this analyte. These levels are considerably higher than the levels of total uranium detected in historical samples from this outfall. Outfall 170 receives flow from a large area of ETTP where radiation contamination may be present, including the K-1420 area and Building K-1037.

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

Storm water outfall	Sampling frequency
05A	1/year
100	1/year
124	1/year
130	1/year
142	1/year
170	1/quarter[c]
180	1/quarter[c]
190	1/quarter[c]
195	1/year
230	1/year
340	1/year
382	1/year
430	1/year
490	1/year
710	1/year
724	1/year
992	1/year

[a]Samples were collected during dry weather conditions, which is defined as a period of at least 72 hours after a storm event of 0.5 inch or greater.

[b]Metals analyses included Al, Ag, As, Ba, Be, B, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, V, Zn, and Tl. All samples were analyzed as per EPA-200.7.

[c]Quarterly sampling of outfalls 170, 180, and 190 was scheduled, to the extent possible, to coincide with ETTP EMP quarterly surface water monitoring in Mitchell Branch.

In sampling conducted in 2008, total uranium was detected in the discharge from storm water outfall 180 at a level of 45.7 µg/L, which exceeds the screening level of 31 µg/L. This result is considerably higher than the total uranium results obtained from sampling conducted in 2007. Outfall 180 receives flow from a large area of ETTP where radiation contamination may be present, including the K-1401 area and the K-1070-C/D burial grounds. These elevated results may be due to activities related to the demolition of Building K-1401.

Table 3.18. Non-storm water results exceeding screening levels at ETTP storm water outfalls

Storm water outfall	Arsenic (µg/L)	Cadmium (µg/L)	Thallium (µg/L)	Mercury (µg/L)	Lead (µg/L)	Copper (µg/L)	Zinc (µg/L)	Selenium (µg/L)	Nickel (µg/L)	Uranium (µg/L)	Chromium (µg/L)
05A	22.1	1.26	21.8	0.108	–	–	–	–	–	–	–
100	16.4	1.04	13.6	–	–	–	–	–	–	–	–
124	10.9	1.09	–	–	–	–	–	32.4	–	–	–
130	19.9	1.49	23.3	–	–	–	–	–	–	–	–
142	20.3	1.78	25.9	–	–	–	164	9.62	–	–	–
170	17.1	1.41	24.5	–	–	–	–	5.32	–	–	–
170	13.8	1.35	14.8	–	–	–	–	11.7	–	73.8	123
170	–	–	5.19	–	–	–	–	–	–	53.4	147
180	18.5	1.37	18.4	–	2.66	–	–	–	–	–	–
180	14.9	1.11	12.7	–	–	–	–	–	–	45.7	–
180	–	–	–	–	9.4	10.3	–	–	–	–	–
190	20.6	1.12	19.6	–	–	–	–	–	76.6	–	–
190	14.1	1.18	10.5	–	–	–	--	6.19	–	54.7	–
190	–	–	–	–	–	–	--	5.8	–	–	–
195	15	–	–	–	–	–	125	–	–	–	–
230	18.3	1.24	20.8	–	–	29.3	–	–	–	–	–
340	9.7	1.09	6.71	–	3.37	–	–	–	–	–	–
382	8.38	1.05	7.13	–	–	–	–	12.8	–	48.4	–
430	19.4	1.22	14.8	–	–	–	–	–	–	–	–
490	18.4	1.2	18.9	–	–	–	–	–	–	–	–
710	15.2	–	10.1	0.0402	–	–	–	–	–	–	–
724	–	–	–	–	5.99	8.13	–	–	–	185	–
992	16	2.74	7.41	–	–	8	91	72.9	–	–	–

Screening levels: arsenic (7 µg/L), cadmium (detectable), thallium (detectable), mercury (detectable), lead (2 µg/L), copper (6.8 µg/L), zinc (90 µg/L), selenium (3.8 µg/L), nickel (39 µg/L), total uranium (31 µg/L), total chromium (75 µg/L).

Total uranium was detected in the discharge from storm water outfall 190 at a level of 54.7 µg/L, which exceeds the screening level of 31 µg/L. This result is considerably higher than the total uranium results obtained from sampling conducted in 2007. Uranium-233/234 was detected at a level of 29.18 pCi/L, which exceeds the 4% of DCG level of 20 pCi/L. This result is also considerably higher than the U-233/234 results obtained from sampling conducted in 2007. Storm water outfall 190 receives flow from a large area of ETTP where radiation contamination may be present, including the K-1401 area and the K-1070-B burial ground. These elevated results may be due to activities related to the demolition of Building K-1401.

Total uranium was detected in the discharge from storm water outfall 382 at a level of 48.4 µg/L, which exceeds the screening level of 31 µg/L. This result is considerably greater than the U-233/234 results obtained as part of historical sampling events. This outfall carries storm water runoff from buildings K-131 and K-631. Both of these buildings were historically used in uranium processing activities.

Total uranium was detected at storm water outfall 724 at a level of 185 µg/L, which exceeds the screening level of 31 µg/L. This result is comparable to total uranium results obtained from historical sampling. Outfall 724 carries runoff from the K-770 Scrap Metal Yard. Various types of metals generated during operation of the K-25 Site were stored at the K-770 area. Much of the material stored at this scrap yard was contaminated with radioactive material, especially uranium. All of the scrap metal has been removed from the K-770 Scrap Metal Yard. Contaminated soils will be removed from the area beginning in CY 2009.

Chromium was detected at outfall 170 during second quarter sampling at a level of 123 µg/L. Chromium was also detected at outfall 170 during third quarter sampling at a level of 147 µg/L. Both of the chromium levels exceed the screening level of 75 µg/L. A chromium collection system consisting of an aquitard with two extraction wells and pumps was installed to pump water from the vicinity of outfall 170 for treatment at the CNF and discharge through the CNF NPDES outfall. Since the installation of this system and subsequent modifications to increase pumping rates, the levels of chromium in Mitchell Branch have been reduced to levels below the detection levels of 1 to 3 ug/L. The levels of chromium in the third and fourth quarters of 2008 were routinely measured at levels of less than 3 ug/L. It is believed that the primary source of the chromium is from contaminated groundwater from the K-1420 area.

Exceedances of screening criteria for several metals were noted in the dry weather sampling results collected in 2008 as shown in Table 3.18. Investigation of these screening criteria exceedances will be conducted as part of future SWP3 sampling efforts.

3.5.1.6 Storm Water Outfall Sampling for VOCs and Mercury

Analytical results for volatile organic compounds (VOCs) from several SWP3 samples collected at storm water outfalls had several data qualifiers assigned by laboratory personnel. Therefore, the data were deemed to not be as reliable or accurate as data that did not have these data qualifiers. To confirm the levels of VOCs at the outfalls where the data variances occurred, additional sampling for VOCs was conducted. Outfalls that were sampled included outfalls 05A, 170, 180, 190, 195, 382, and 710. These outfalls were sampled during both wet weather and dry weather conditions. The analytical laboratories were requested to use the lowest practicable detection limits to avoid additional data concerns. No VOCs above screening levels were identified in the effluent from any of these outfalls during wet weather or dry weather sampling.

A review of previous storm water monitoring results indicated the presence of detectable quantities of mercury at several storm water outfalls. Outfalls that were sampled included outfalls 05A, 170, 180, 190, 195, 382, and 710. The outfalls were sampled during both wet weather and dry weather conditions.

Table 3.19 indicates the results of this sampling effort.

Mercury was detected in the discharge from storm water outfall 180 at a level of 0.925µg/L. This result is somewhat higher than historical mercury results from this outfall. The mercury that was detected at outfall 180 is possibly due to the historical release of small amounts of the material from operations in Buildings K-1303 and K-1401, both of which were located in the outfall 180 watershed. These elevated results may be due to activities related to the Building K-1401 demolition.

Table 3.19. Storm water outfall locations where mercury exceeded screening level

Storm water outfall	Sampling period	Mercury[a] (µg/L)
05A	Dry weather	0.205
05A	Wet weather	0.135
L180	Dry weather	0.925

[a]Mercury in any detectable quantity is an exceedance of the screening level.

Mercury was detected in the discharge from storm water outfall 05A at a level of 0.205 ug/L as part of dry weather sampling and 0.135 ug/L as part of wet weather sampling events conducted in 2008. These results are comparable to historical results for mercury from this outfall. It is possible that mercury may have entered the sump at outfall 05A during its historical operation as part of the sanitary sewer system. Outfall 05A now receives and discharges only storm water runoff.

Additional investigation into the potential source(s) of the mercury in the discharge from outfalls 05A and 180 will be conducted as part of future SWP3 sampling efforts.

3.5.1.7 NPDES Monitoring at the CNF TSCA Waste Water Treatment System

Nonradiological monitoring of CNF effluent is conducted according to the requirements of NPDES Permit No. TN0074225. Monitoring requirements, frequencies, and sample types required under the permit are listed in Table 3.20. Wastewater from CNF is discharged through outfall 001 into the Clinch River.

Radiological sampling of effluent from the CNF and/or the K-1435 Waste Water Treatment System (WWTS) is conducted weekly. The weekly samples are then composited into a single monthly sample. Table 3.21 lists the total discharges in 2008 by isotope. These results are then compared with the DCGs. The sum of the fractions must be kept below 100% of the DCGs; in practice the effluent results from the WWTS were well below 100% of the DCG until 2007. Figure 3.16 shows a rolling 12 month average for 2008. 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. Work continues on evaluating the most effective way to treat the waste. Operational changes that have taken place include more frequent changeout 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. The substitution was made as a result of bench-scale jar tests to determine the most effective materials to use. Monitoring results for 2008 showed a marked decrease in the rolling 12 month average of the sum of the fractions of the DCGs from a high of 1.1 in January 2008 to 0.42 in December 2008.

Although uranium isotopes constitute the greatest mass (approximately 28 kg) of radionuclides discharged from CNF, ^{99}Tc and tritium account for the greatest activity, due to their much higher specific activities. Transuranic isotopes constitute a small fraction of the total.

Table 3.20. 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 (PCBs)	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

Table 3.20. (Continued)

Parameter	Collection frequency	Sample type
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 NPDES permit parameter, and the result is not reported with the discharge monitoring report.

Table 3.21. Isotopic discharges from the Central Neutralization Facility/Waste Water Treatment System, 2008

Isotope	Curies	Isotope	Curies
^{241}Am	3.3E–6	^{239}Pu	1.2E–6
^{14}C	5.2E–4	^{99}Tc	8.3E–2
^{137}Cs	5.9E–4	^{230}Th	2.6E–5
^{60}Co	6.3E–5	^{234}Th	3.1E–3
^{3}H	9.0E–1	^{234}U	3.9E–3
^{131}I	7.0E–6	^{235}U	3.3E–4
^{237}Np	1.0E–5	^{236}U	1.1E–4
^{238}Pu	5.0E–6	^{238}U	9.3E–3

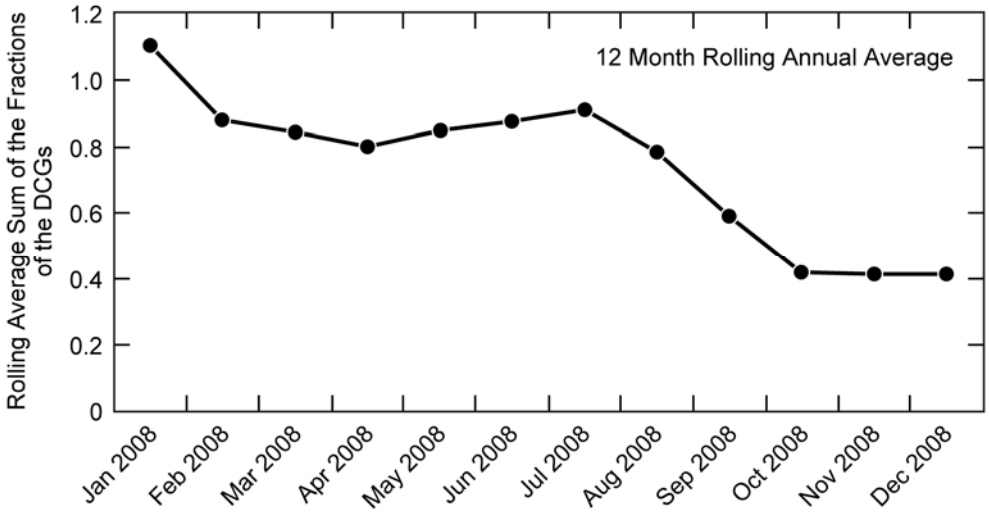


Fig. 3.16. Rolling sum of the fractions of the derived concentration guides at CNF.

3.5.1.8 NPDES Permit Noncompliances

There were no CWA or NPDES permit noncompliances at ETTP in 2008.

3.5.2 Surface Water Monitoring

The ETTP environmental monitoring program personnel conduct environmental surveillance activities at eleven surface water locations (Fig. 3.17). 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 MIK 0.5, 0.6, 0.7, and 1.4). Depending on the location, samples may be collected and analyzed for radionuclides quarterly (K-1700 and MIK 0.5, 0.6, 0.7, and 1.4) or semiannually (remainder of locations). Results of radiological monitoring are compared with the DCGs. Radiological data are reported as fractions of DCGs for reported radionuclides. If the sum of DCG fractions for a location exceeds 100% for the year, 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 with 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. 3.18). The exceptions are K-1700 and three of the most downstream locations on Mitchell Branch as indicated by the sums of the fractions of the DCGs for these locations as follows:

- K-1700: 3.4%,
- MIK 0.5: 2.3%,
- MIK 0.6: 2.6% , and
- MIK 0.7: 4.0 %.

The percentage of the DCGs at K-1700 (3.4%) was well below the percentage of the 2007 monitoring results (12%).

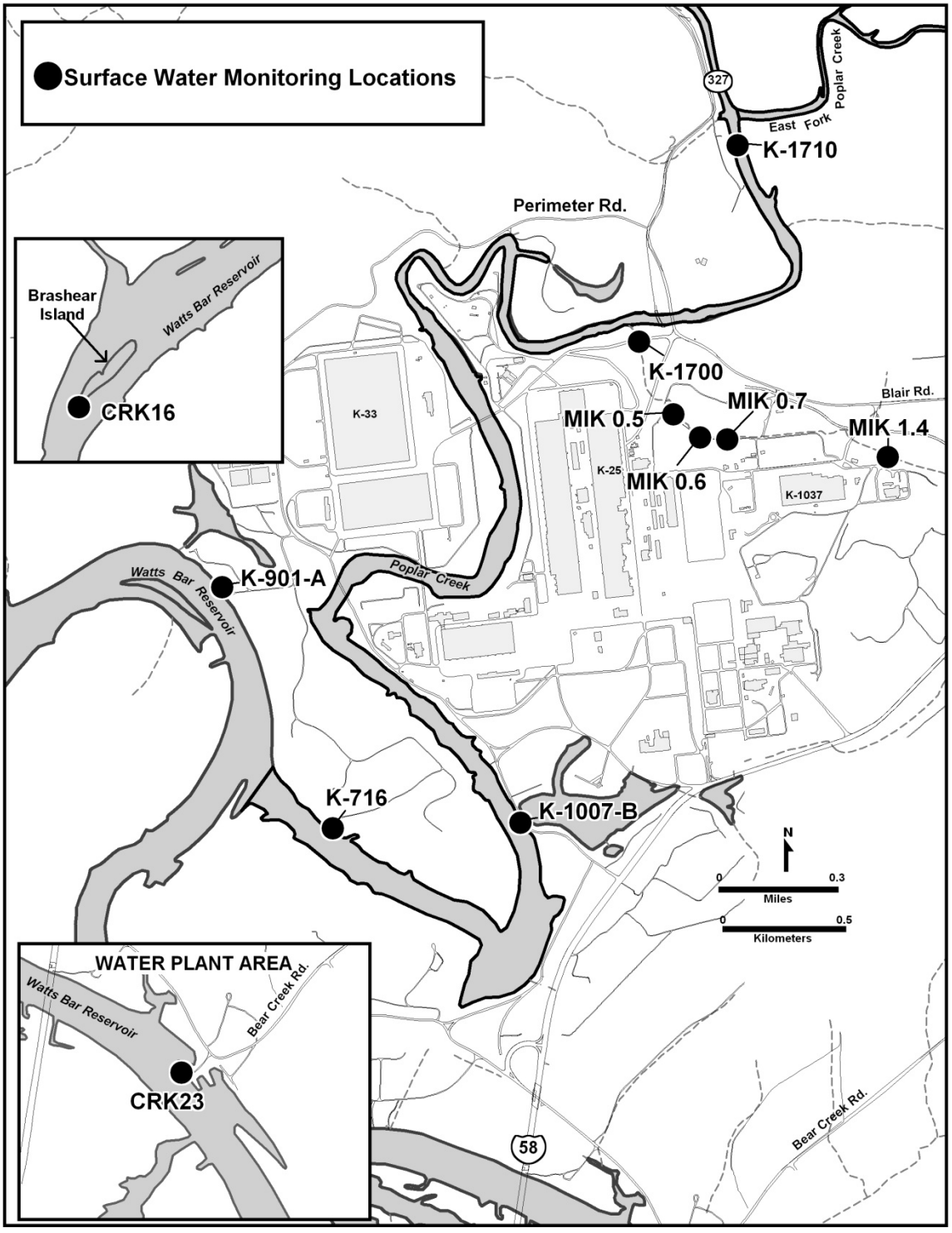


Fig. 3.17. Environmental monitoring program surface water monitoring locations.

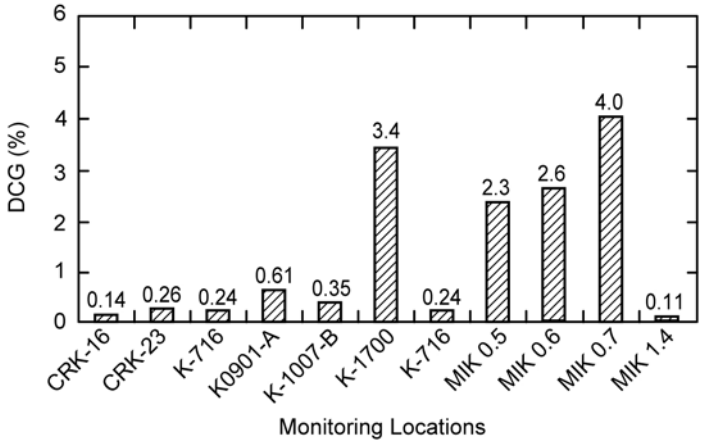


Fig. 3.18. Percentage of derived concentration guides (DCGs) at surface water surveillance locations, 2008.

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 the dissolved oxygen concentration was below the minimum standard can be traced to the natural stream conditions. The low dissolved oxygen result (4.3 mg/L) at K-901-A was during a period of very high temperatures and low stream flow. Similarly, the single instance of a pH exceedance was at K-1007-B during a period of low flow, high temperature, and high biological activity, which raised the pH to 9.3 standard units.

Figures 3.19 and 3.20 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. Concentrations of TCE and total 1,2-DCE are below the Tennessee General Water Quality Criteria (WQC) for Recreation, Organisms Only (300 μg/L for TCE and 10,000 μg/L for trans 1,2-DCE), which are appropriate standards for Mitchell Branch. Moreover, the standards for 1,2-DCE apply only to the trans form of 1,2-DCE; almost all of the 1,2-DCE is in the cis-isomer. However, the concentrations of TCE often exceed the 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 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. 3.21). In October 2007 a new, lower standard of 24 μg/L went into effect. The concentrations detected in Mitchell Branch did not exceed the WQC. However, there have been historical instances where the concentration levels in Mitchell Branch have come near but not exceeded the WQC. VOCs have been detected in groundwater in the vicinity of Mitchell Branch and in building sumps discharging into storm water outfalls that discharge into the stream; however, storm drain network monitoring generally has not detected these compounds in the storm water discharges. When detected, the concentrations are lower than in the stream. Therefore, it appears that the primary source of these compounds is contaminated groundwater.

Surface water has been routinely sampled by DOE contractors and TDEC for several years as part of environmental monitoring programs. The DOE contractor surface water sampling program is conducted in accordance with DOE order surveillance program guidance. In data collected as part of the DOE contractor's sampling effort, dry weather levels of total chromium over the past 10 years (Fig. 3.22) have been shown to be generally less than 0.01 mg/L, or in some instances, at nondetectable levels. Results from routine surface water monitoring conducted in fall 2006 showed a significant increase in the total chromium level in Mitchell Branch but still below the WQC for total chromium. Sampling performed in the spring of 2007 by DOE contractors and TDEC indicated that chromium levels had increased above the levels found in the fall 2006 sampling. 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

among DOE contractor, TDEC surface water, and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program personnel was initiated in June 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. A chromium collection system employing two extraction wells and pumps was installed to pump water from the vicinity of storm water outfall 170 for treatment at the CNF. Since this system was installed, chromium levels in Mitchell Branch have dropped dramatically, with levels in the third and fourth quarters of 2008 being routinely measured at less than 3 µg/L.

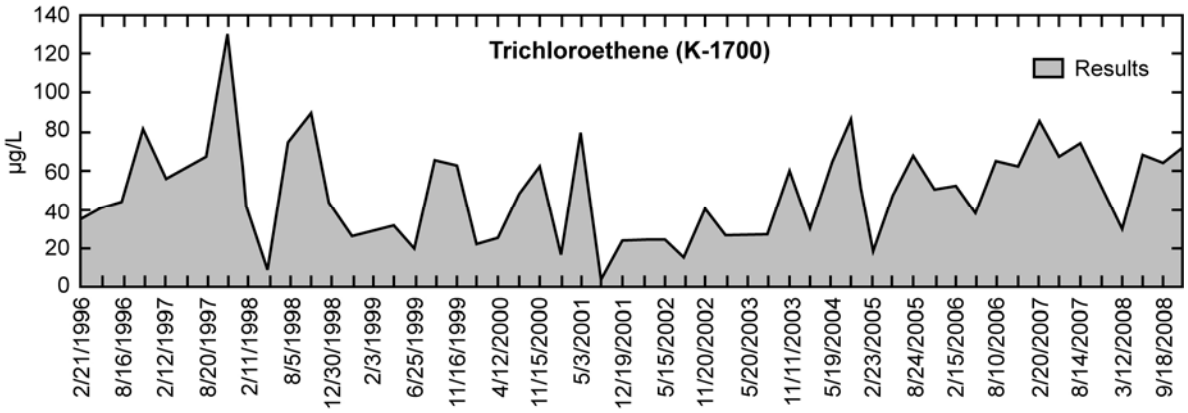


Fig. 3.19. TCE concentrations at K-1700.

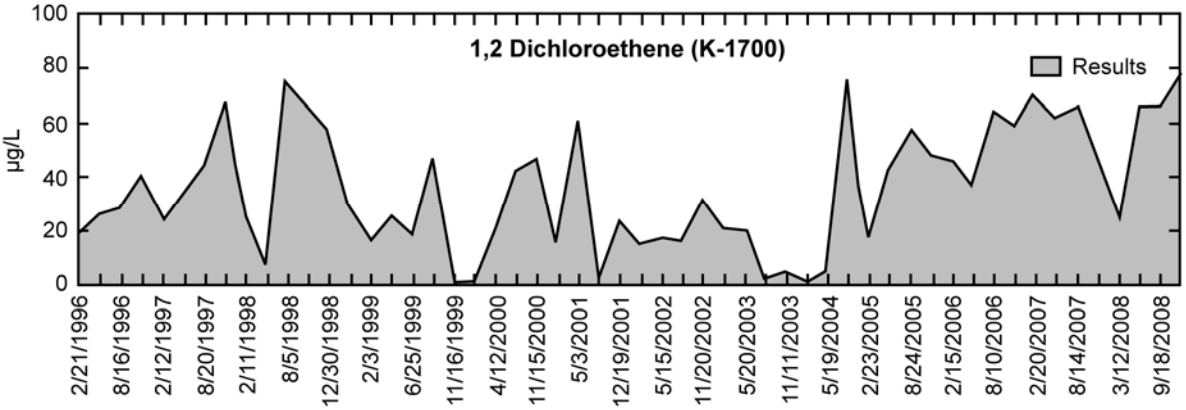


Fig. 3.20. 1,2-DCE concentrations at K-1700.

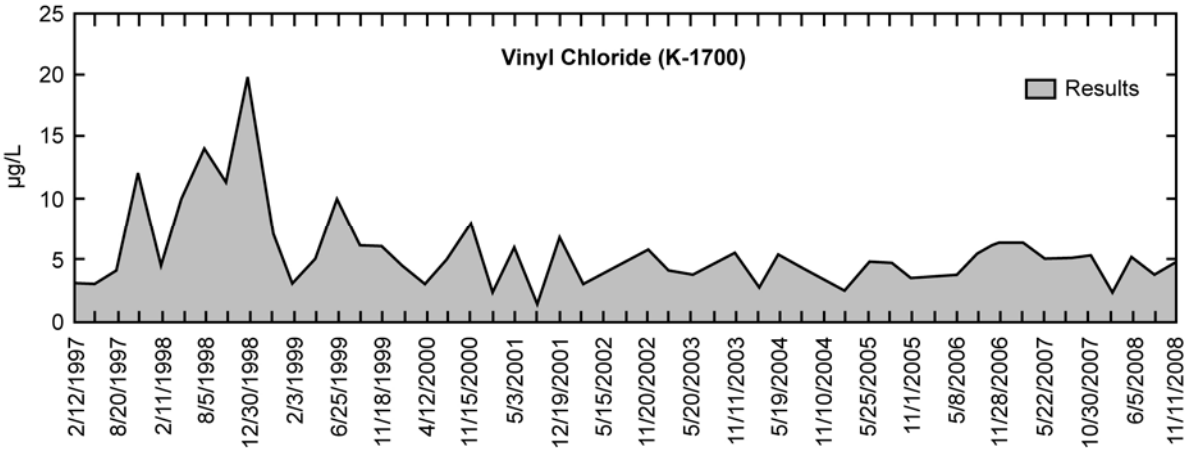


Fig. 3.21. Vinyl chloride concentrations at K-1700.

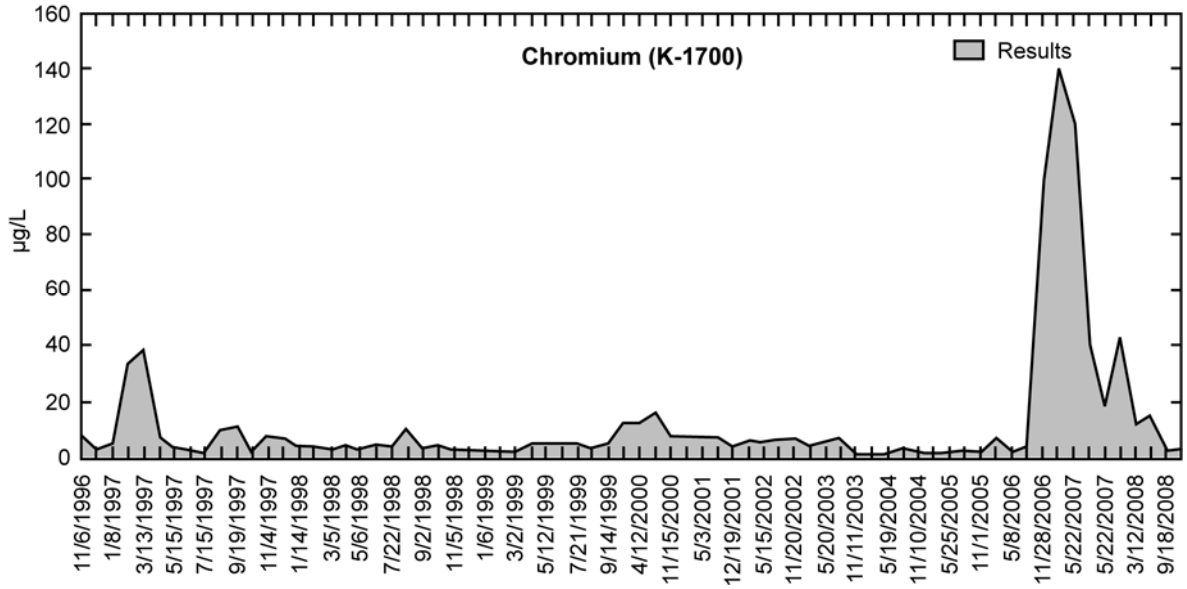


Fig. 3.22. Total chromium concentrations at K-1700.

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 the measures. Figure 3.23 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. Figure 3.24 shows the monitoring locations along Mitchell Branch.

In March 2008, survival and reproduction toxicity tests were conducted on *Ceriodaphnia dubia* at four ambient locations in Mitchell Branch. At the same time, survival and reproduction toxicity tests were conducted on *Ceriodaphnia dubia* with effluent from storm water outfalls 170 and 190 (Table 3.22). In the tests, none of the water exhibited toxicity. Previously, the overall trend was 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 were not definitively identified. The data gathered in previous studies indicate at least two possible sources. One possible source is groundwater percolating through waste in the K-1070-B Burial Ground and leaching out small quantities of metals. Some of that groundwater flows into the storm drain system and likely contributes to the toxicity at storm water outfall 190. Nickel and zinc were present in water collected from the storm drain system near K-1070-B, at levels that have been shown to be toxic to *Ceriodaphnia.*

The data from the study were used to calculate presumptive water effects ratios for each test location. At both storm water outfall 170 and MIK 0.8, the presumptive water effects ratio was greater than one (indicating that the test water would be expected to be less toxic than the control water). Using that ratio, the presumptive site-specific hexavalent chromium WQC would be 20 µg/L at Mitchell Branch downstream from the chromium seep (MIK 0.8).

Special toxicity studies conducted in November 2008 included collecting water samples from storm water outfall 170, MIK 1.4, and immediately downstream of the chromium seep at MIK 0.8. The samples were analyzed, and it was confirmed that hexavalent chromium concentrations at all three locations were at or below the detection limit. Hexavalent chromium was added to each sample in a dilution series (concentrations of 0, 12.8, 32, 80, 200, and 500 µg/L hexavalent Cr), and 6-day, three-brood *Ceriodaphnia* toxicity tests were conducted on each sample. As expected, increasing concentrations of

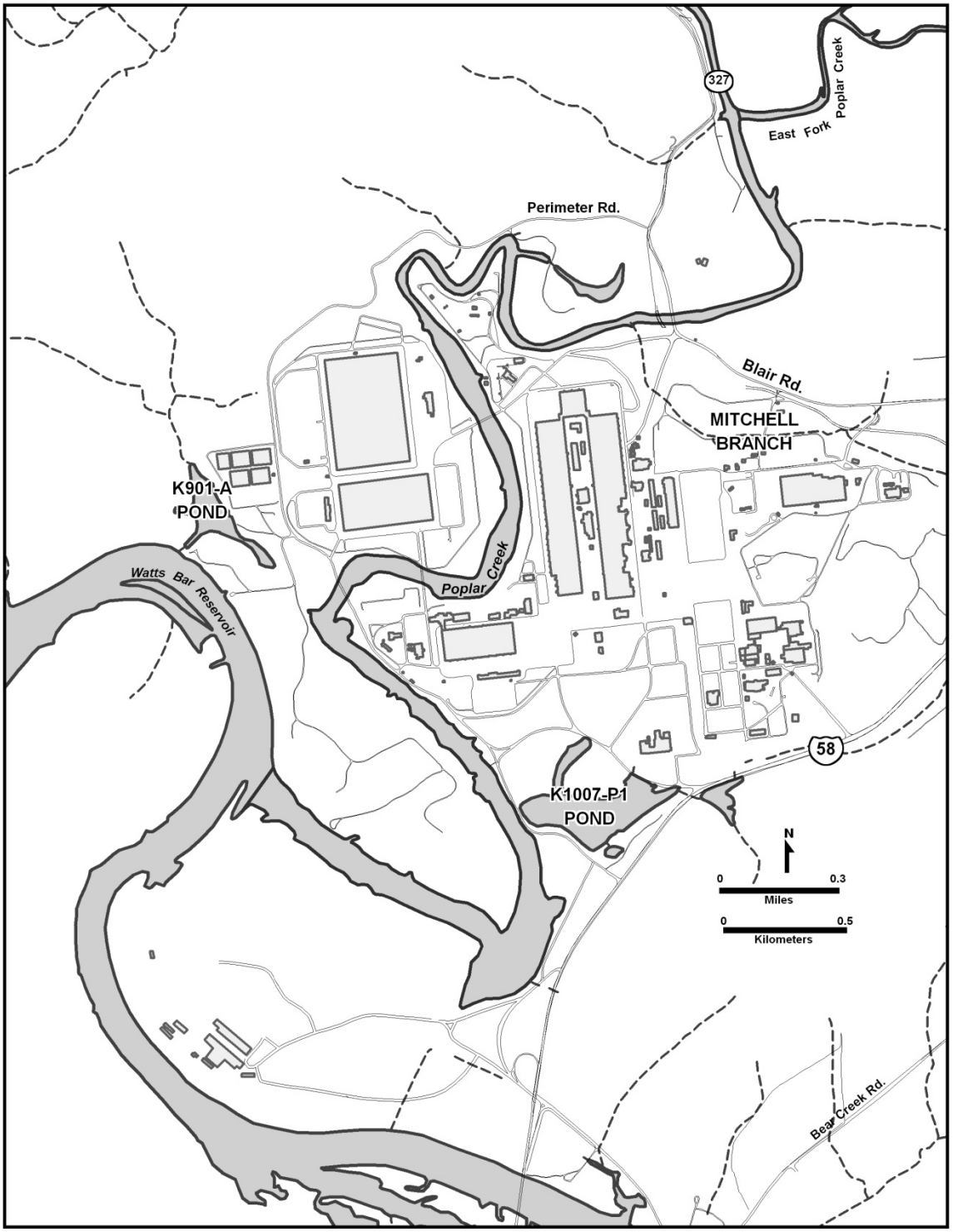


Fig. 3.23. Waterways at ETTP.

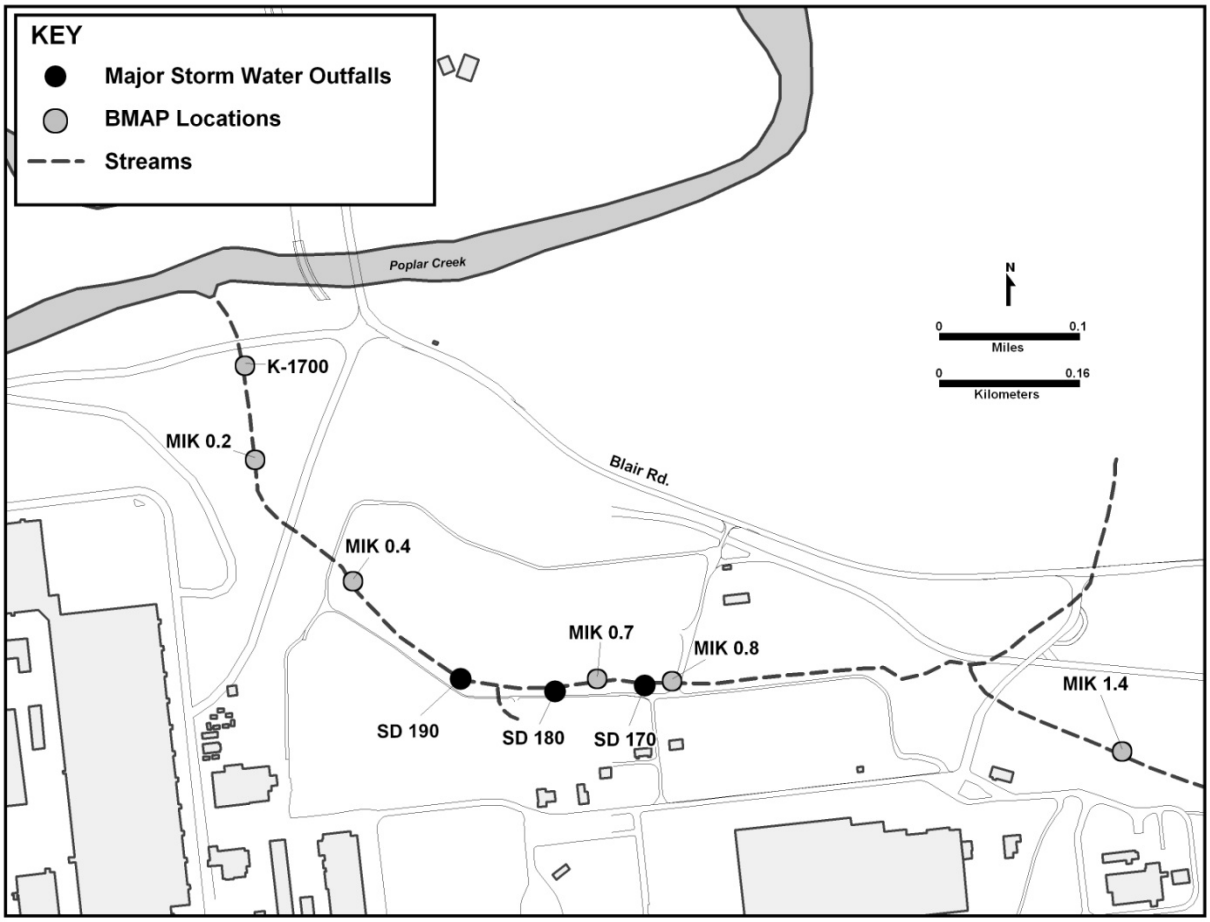


Fig. 3.24. Major storm water outfalls and biological monitoring locations on Mitchell Branch.

Table 3.22. Mitchell Branch and associated storm water outfall toxicity test results, March 2008 (sample concentrations of 100%)

Test	MIK 0.8	SD 170	MIK 0.7	SD 190	MIK 0.4	MIK 0.2
Ceriodaphnia survival (%)	100	100	100	100	100	100
Ceriodaphnia reproduction (%)	27.2	22.8	27.9	23.3	28.0	27.3

hexavalent chromium generally increased toxicity in water samples from any given location. However, toxicity in the samples from MIK 1.4, above most ETTP operational influences, proved to be greater than in water from the control. Conversely, toxicity in the water from storm water outfall 170 and MIK 0.8 was less than in the control. It is hypothesized that some factor in the water from storm water outfall 170 and MIK 0.8, perhaps related to elevated hardness or conductivity, mitigates the toxicity of the hexavalent chromium. However, at storm water outfall 170, the test results indicated that chronic toxicity was not observed until hexavalent Cr concentrations were as high as 163µg/L.

In June and July, 2008, caged clams *(Corbicula fluminea)* were placed at several locations around ETTP (Table 3.23). The clams were allowed to remain in place for 4 weeks, and then were analyzed for

uptake of polychlorinated biphenyls (PCBs). 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 concentrations increased dramatically in the clams from downstream of storm water outfall 190). Clams from the K-901-A Pond contained detectable concentrations of PCBs, but the levels were considerably lower. 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 Arochlor-1248, Arochlor-1254, and Arochlor-1260 were detected. In the K-901-A Pond, low levels of Arochlor-1248, Arochlor-1254 and Arochlor-1260 were detected. In general, the concentrations at Mitchell Branch locations from the 2008 monitoring were similar to those from the 2007 effort, although there was considerable variation at individual locations. For example, levels at MIK 0.7 averaged 0.15 µg/g in the 2007 samples but averaged 0.41 µg/g in 2008, while at MIK 0.4, the average dropped from 2.6 µ/g in 2007 to 1.6 µg/g in 2008. Levels at MIK 0.2 were very similar in both years (2.5 µg/g in 2007 and 2.76 µg/g in 2008).

Fish were collected from Mitchell Branch, K-1007-P1 Pond and K-901-A Pond in May 2008 (Fig. 3.25). 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 sportfishermen were selected both to provide more accurate data of potential human health concerns and to reduce the amount of n contamination levels in the individual fish due to age and size differences. Fillets were taken from each game fish and were analyzed for PCBs. Results from the Mitchell Branch and K-901-A Pond monitoring were higher than last year's results, but are within the range of historical results; fish from both locations contained concentrations (an average of 1.6 and 0.97 ppm, respectively) near the state of Tennessee posting limit of 1 ppm. In the bass from the K-1007-P1 pond, the 2008 results (an average of 20.2 ppm) showed an increase in PCB concentrations when compared with the 2007 monitoring results (14.2 ppm).

In April 2008, the benthic macroinvertebrate communities at four Mitchell Branch locations (MIK 0.4, 0.7, 0.8, and 1.4) were sampled using the traditional techniques developed by the ORNL Environmental Sciences Division (Fig. 3.26). MIK 1.4 serves as the reference location. In the last 10 years, the benthic macroinvertebrate communities at all locations in Mitchell Branch have generally increased in diversity and numbers of individuals. In the 2008 study, both the total taxa richness and the richness of the ephemeroptera, plecoptera, and trichoptera (EPT) species was greatest at MIK 1.4 and decreased with lower values at the downstream locations. EPT species are generally pollution intolerant, and lower values generally correlate to some degree of impact to the stream. Total density of all species at locations MIK 0.8 and MIK 0.7 were greater than at MIK 1.4, but the density of pollution-intolerant species was lower at all of the locations downstream of MIK 1.4. One possible explanation for the lower number of individuals at MIK 1.4 than at MIK 0.7 and MIK 0.8 may be that Mitchell Branch is shallower at MIK 1.4, and the lower flows may inhibit the population size.

In 2008, TDEC requested that the protocols developed by TDEC for benthic macroinvertebrate community studies be used at ETTP. Consequently, in August TDEC protocols were used at three locations on Mitchell Branch (MIK 0.4, 0.7, and 0.8). TDEC protocols differ from the ORNL protocols in several key respects. TDEC has established habitat goals for all streams in the eco-region. The habitat assessment (which primarily considers the physical aspects of the stream to determine the suitability of the stream to support invertebrate communities) indicated that Mitchell Branch does not meet the habitat goals for this region. The results of the semiquantitative assessment indicated that Mitchell Branch is slightly impaired, which is consistent with the results from the studies using the ORNL protocols.

Fish communities in Mitchell Branch (MIK 0.4 and 0.7) were sampled in March and April 2008. Species richness, density, and biomass were examined. The results for the community at MIK 0.4 were very similar to the 2007 results. Although new sunfish species appeared, some previously observed minnow species were absent, leaving the richness unchanged. Total density and biomass increased slightly. At MIK 0.7, species richness, biomass, and density showed increases from last year. Wide swings in those three parameters are typical of streams that have been severely impacted and that are in the process of recovery but have not yet reached the long-term stable state. The stream is still dominated by more-tolerant fish species. This pattern is often found in impacted streams, where less tolerant species are excluded by one or more conditions in water quality or other factors in the environment. 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.

Table 3.23. Average PCB concentrations in biota, 2008

Location	Species	Average PCB concentration (ppm)	Range (ppm)	Number above 1 ppm[a]/total
K-1007-P1 Pond	Largemouth bass	20.2	7.4–42	6/6
K-901-A Pond	Largemouth bass	0.97	0.35–1.74	3/6
Mitchell Branch	Redbreast sunfish	1.60	1.02–2.2	6/6
Hinds Creek (ref)	Redbreast sunfish	0.01	<0.01–0.01	0/6
MIK 0.99	Asiatic clam	0.16	NA	NA
MIK 0.8	Asiatic clam	0.33	NA	NA
MIK 0.7	Asiatic clam	0.41	NA	NA
MIK 0.5	Asiatic clam	0.68	NA	NA
MIK 0.4	Asiatic clam	1.61	NA	NA
MIK 0.2	Asiatic clam	2.76	NA	NA
SD100 (upper)	Asiatic clam	1.08	NA	NA
SD100 (lower)	Asiatic clam	4.11	NA	NA
SD 120	Asiatic clam	1.06	NA	NA
SD 490	Asiatic clam	1.17	NA	NA
K-1007-P1 outfall	Asiatic clam	0.65	NA	NA
K-901-A outfall	Asiatic clam	0.21	NA	NA
Sewee Creek (ref)	Asiatic clam	0.01	NA	NA

3.7. Quality Assurance Program

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

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

Fig. 3.25. Collecting fish for bioaccumulation monitoring.

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

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

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

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

Fig. 3.26. Benthic Macroinvertebrate sampling.

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

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

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

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

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

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

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

3.7.1 BJC ISMS Program

It is the intent of the BJC QA Program to be fully consistent with and supportive of the company's 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 expectations are that work be conducted safely and that it meet established requirements. In that regard, the QA Program ensures compliance with approved standards and requirements 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 the effectiveness of safety management program implementation; and
- identifying opportunities for improvement.

3.7.2 Integrated Assessment and Oversight Program

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

Self-assessments are performed by the organization/function 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 formal self-assessments include management assessments and subcontractor oversight. Informal self-assessments include weekly inspections and routine walkthroughs conducted by subcontractor coordinators, ES&H representatives, quality engineers, and line managers.

QA issues identified from internal and external assessments are documented, causal analyses are performed, and corrective actions are developed and tracked to closure. Analyses are conducted periodically to identify trends for management action. Data from those processes are evaluated by senior management to identify opportunities for improvement.

3.8 Environmental Management Activities

3.8.1 Waste Management Activities

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

The ETTP is home to the TSCA Incinerator, a thermal treatment facility. It is one of the few facilities licensed to incinerate both 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. The incinerator treated approximately 1.31 million lb of waste in 2008 (1.1 million lb of liquid waste and more than 142,000 lb of solid waste). DOE is planning to incinerate approximately 2.1 million lb of waste in TSCA Incinerator in 2009. The treatment quantities include fuel oil rinses of the tank farm as the incinerator is readied for closure in the final year of operation. Closure activities will begin in 2009 and continue into FY 2010.

The CNF, ETTP's primary wastewater treatment facility, which processes both hazardous and nonhazardous waste streams, treated more than 18.5 million gal of wastewater in 2008. 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. TDEC is in the process of developing and issuing a new NPDES permit that will reflect the changing conditions at the ETTP.

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 approximately 6,500 truckloads of waste (Fig 3.27) accounting for 89,000 tons during FY 2008. In addition, approximately 1.8 million gal of leachate were collected and disposed of at the ORNL Liquids and Gases Treatment Facility. An additional 6.1 million gal of contact water were collected, analyzed, and released to the sediment basin after analyses confirmed that the water met the release criteria. ETTP projects that have disposed of waste at the CERCLA Waste Facility include the following:

Fig. 3.27. Loading truck with waste for disposal.

- ETTP removal actions, including the Scrap Removal Project, K-1070-B Burial Ground, K-1085, and Duct Island (soil removals);
- the K-25/K-27 D&D Project, including Building K-1030 and K-1024; and
- other ETTP D&D projects, including Building K-1004 Laboratories, K-1420, K-1401, and K-413.

3.8.2 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 EMP 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.

DOE has signed two of three key CERCLA records of decision (RODs) with the state of Tennessee and EPA authorizing environmental restoration of about 890 ha (2200 acres) of land at ETTP. The area encompasses approximately about 567 ha (1400 acres) outside the main plant security fence (Zone 1), and about 324 ha (800 acres) inside the fence within the former plant production area (Zone 2). The main objectives of the two decisions are to protect future industrial workers and the underlying groundwater from contamination in soil, slabs, and subsurface structures. Development of the final Site-Wide ROD for groundwater, surface water, sediment, and ecological soil risk is in progress.

One of the major ongoing operations at the ETTP site is dismantling the west wing of the K-25 building and preparing the east wing of the K-25 building for demolition. It 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 was completed in the west wing in 2008 and is expected to be completed in the east wing in 2010. Activities under way to prepare the east wing for demolition include radiological and chemical characterization; process system stabilization by foaming, removal and segmentation of high-risk components; removal of transite panels and excess materials, shipment of converters off site for disposal; and installing nets and barriers to protect workers from falling debris.

The first demolition activity on the K-25 building was successfully completed in 2008. The northwest bridge that connected the west wing to the base of the U-shaped structure has been removed. The bridge housed pipes that transferred uranium as it was undergoing enrichment between building wings. Workers used excavators and other heavy equipment to demolish the two-story, 143,000 ft^3 structure. The bridge removal paved the way for demolition of the west wing, which began in December 2008. Demolition of both wings of the building is scheduled to be completed by the end of 2011.

In 2008, three predominantly uncontaminated facilities and 13 low-risk/low-complexity facilities were demolished. Asbestos abatement and universal waste removal from K-1035 was completed. 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;
- characterization was completed in K-413, K-1231, K-1233, K-633, and K-633/K-27 tie line;
- chemical treatment was completed on all facilities and 80% of the tie lines associated with hydrofluoric acid distribution to the uranium-processing facilities; and
- the remaining uranium hexafluoride cylinders from Building K-33 were disposed of.

Demolition of the K-413 Building structure was initiated and is 50% completed, with 50% of the building rubble having been disposed of at Environmental Monitoring and Waste Management Facility (EMWMF). The remaining rubble will be disposed of at the Nevada Test Site in 2009. The D&D of Building K-1401, a 500,000 ft^2 structure in the center of ETTP, was completed in 2007, and activities in the area in 2008 included backfilling the basement area and removing the concrete slabs of K-1401, the K-1008 change houses, and K-1020.

Remediation in the Zone 2 Balance of Site–Laboratories area was completed, 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 (RI/FS) submitted to EPA and TDEC addressed the nature and extent of groundwater contamination, contamination of Mitchell Branch, and ecological concerns. The document addressed evaluating alternatives for remediation and provided 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. Also in 2008, plans were initiated to conduct a groundwater treatability study, which will be conducted in FY 2009. A proposed plan was submitted to EPA and TDEC in 2007; however, it will be placed on hold until the RI/FS study is finalized.

3.8.3 Reindustrialization

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

On May 29, 2008, DOE Oak Ridge Office's Reindustrialization Program transferred the K-1515 Water Treatment Plant Complex to the city of Oak Ridge. The K-1515 Water Treatment Plant transfer includes the intake structure, day tanks, and select portions of the potable water distribution system as well as select portions of the sanitary sewer collection system. Transfer of the K-1515 Water Treatment Plant complex is part of a comprehensive plan for the city of Oak Ridge to provide potable water service to ETTP as well as other development on the extreme western end of the city.

On January 4, 2008, DOE transitioned the 25,000-ft^2 ETTP K-1652 Fire Station (re-named Station No. 4) to the city of Oak Ridge, making it an official part of the Oak Ridge Fire Department. Station No. 4 was previously operated by BJC for DOE as an ETTP-site-only fire department. As part of the transfer, the city received fire engines, a rescue truck, a hazardous materials response truck, ambulances, and several trailers equipped with special rescue equipment. The City of Oak Ridge Fire Department also assumed operation of the DOE ambulances, which can respond to off-site emergencies as well as to those which may occur on DOE sites. With the addition of this new fire station, west end residents and businesses have closer access to firefighting and emergency medical services.

One land parcel, referred to as ED-5 West, has been identified for new construction. It was transferred to CROET on December 22, 2008. ED-5 West consists of approximately 10.5 ha located near the front of ETTP, behind Pond K-1007-P1 and adjacent to Poplar Creek and Parcel ED-5 East.

In addition to transfers, several facilities were leased to CROET during 2008. On February 12, 2008, K-1251, the barge area adjacent to the Clinch River west of ETTP, was leased to CROET. K-1251 was subsequently leased by CROET to Energy Solutions, Inc. Buildings K-796-A and K-791-B, along with the K-792 Switchyard area located in the northwest corner of ETTP, were leased to CROET on April 1, 2008.

These transfers and leases are part of DOE's plan to transform ETTP into a private-sector business and industrial park. Additional buildings at ETTP and several land areas are in various stages of the transfer process.

3.9 Groundwater Monitoring

Groundwater monitoring at the ETTP is focused primarily on investigating and characterizing sites for remediation under CERCLA. As a result of the Federal Facility Agreement and certification of closure of the K-1407-B and K-1407-C Ponds, the principal driver at the ETTP is CERCLA.

The cleanup strategy described in *Accelerating Cleanup: Paths to Closure* (DOE 1999) has been developed to accelerate the transition of areas of concern (AOCs) from characterization to remediation by making decisions at the watershed scale based on recommended land use. The watershed is a surface-drainage basin that includes an AOC or multiple AOCs to be investigated and/or remediated. ETTP groundwater monitoring is conducted by the Water Resources Restoration Program to assess the performance of completed CERCLA actions. Groundwater data can be found discussed in the *2009 Remediation Effectiveness Report* (DOE 2009).

ETTP Groundwater Protection Program requirements are incorporated into the Water Resources Restoration Program. The Water Resources Restoration Program, which was established to provide a consistent approach to watershed monitoring across the ORR, is responsible for conducting groundwater surveillance monitoring at the ETTP, including exit pathway monitoring wells. Groundwater discharges into Poplar Creek, the Clinch River, and the three main surface water bodies at ETTP (i.e. the K-901 Pond, K-1007 Pond, and Mitchell Branch). Many of the contaminants at ETTP migrate toward one of these surface water bodies, which are monitored by the ETTP Environmental Monitoring Plan surface water surveillance program. The *2009 Remediation Effectiveness Report* (DOE 2009) includes summaries of groundwater monitoring actions required for individual cleanup actions at the ETTP, along with recommendations to modify any requirement that would further ensure protection of human health and the environment.

3.10 Direct Radiation Monitoring

Direct radiation monitoring is no longer necessary for locations that were formerly the UF_6 cylinder storage yards and the K-770 Scrap Yard at ETTP because direct dose measurements that have been taken have confirmed that they are no longer a source of potential dose to the public above the background levels.

3.11 References

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