4. ETTP Environmental Monitoring Programs

The East Tennessee Technology Park (ETTP), formerly known as the Oak Ridge Gaseous Diffusion Plant or K-25 Site, was originally built as part of the Manhattan Project. Uranium was enriched for weapons and nuclear reactor fuel elements and included recycling of reactor return fuel elements. Other activities included research and support operations. After the enrichment operations ceased in 1985, the primary focus of the plant shifted to environmental restoration, reindustrialization, and reuse of the facilities.

Environmental monitoring remains a major activity on the ETTP. Environmental monitoring encompasses two activities: effluent monitoring and environmental surveillance. Effluent monitoring consists of the collection and analysis of samples or measurements of liquid or gaseous effluents at the point of emission to determine and quantify contaminants released. Environmental surveillance consists of the collection and analysis of samples of air, water, soil, vegetation, biota, and other media from the ETTP and its surroundings. External direct radiation is also measured. Data from environmental monitoring activities are used to assess exposures to members of the public and the environment, to assess the effects of ETTP operations on the public and the environment, to help plan remediation projects, and to evaluate the efficacy of these projects.

In 2006, the emissions of radionuclides from ETTP operations were well within the allowable derived concentration guides (DCGs) published in DOE Order 5400.5 and were similar in most respects to 2005 emissions. Potential direct radiation to the public from uranium hexafluoride cylinder storage yards and the K-770 scrap metal yard at ETTP remained below the requirements in DOE orders. Nonradiological emissions were also within limits, and compliance with permit limits was better than 99%.

4.1 ETTP Radionuclide Airborne Effluent Monitoring

To demonstrate compliance with DOE Order 5400.5 and Tennessee Rule 1200-3-11-.08, "Emission Standards for Emission of Radionuclides Other than Radon from Department of Energy Facilities" (i.e., NESHAP), all airborne radionuclide emissions from DOE sources at ETTP must be determined for purposes of estimating dose to the most exposed member of the public.

Locations of airborne radionuclide point sources at the ETTP are shown in Fig. 4.1. Radionuclide emission information for these release points is compiled under the direction of BJC from operators subject to NESHAP regulations. Point sources shown in Fig. 4.1 include both individual point sources and grouped point sources, such as laboratory hoods. Radionuclide emissions data were determined from either EPA-approved sampling results or EPA-approved calculation methods.

4.1.1 Radionuclide Emissions Monitoring Approach

4.1.1.1 Minor Sources

The number of minor sources in 2006 varied from the previous year's total because of fluctuations in site operations. For this reporting period, a total of five point sources and one grouped minor source subject to NESHAP regulations operated. Minor sources are grouped if they have similar characteristics (e.g., general location, type of activity, or type of control) and provided that any one group does not have potential radionuclide emissions that would cause a dose in excess of 0.1-mrem/year EDE as defined under the rule. An example of a minor group source is the TSCA Incinerator tank farm with 15 emission points.

Emissions from the various minor sources located at the ETTP were estimated by means of one of the following EPA-approved methods:

- radionuclide inventory (i.e., material balance)—five point sources,
- health physics air measurements where room ventilation emissions exceeded 10% of derived air concentration worker protection

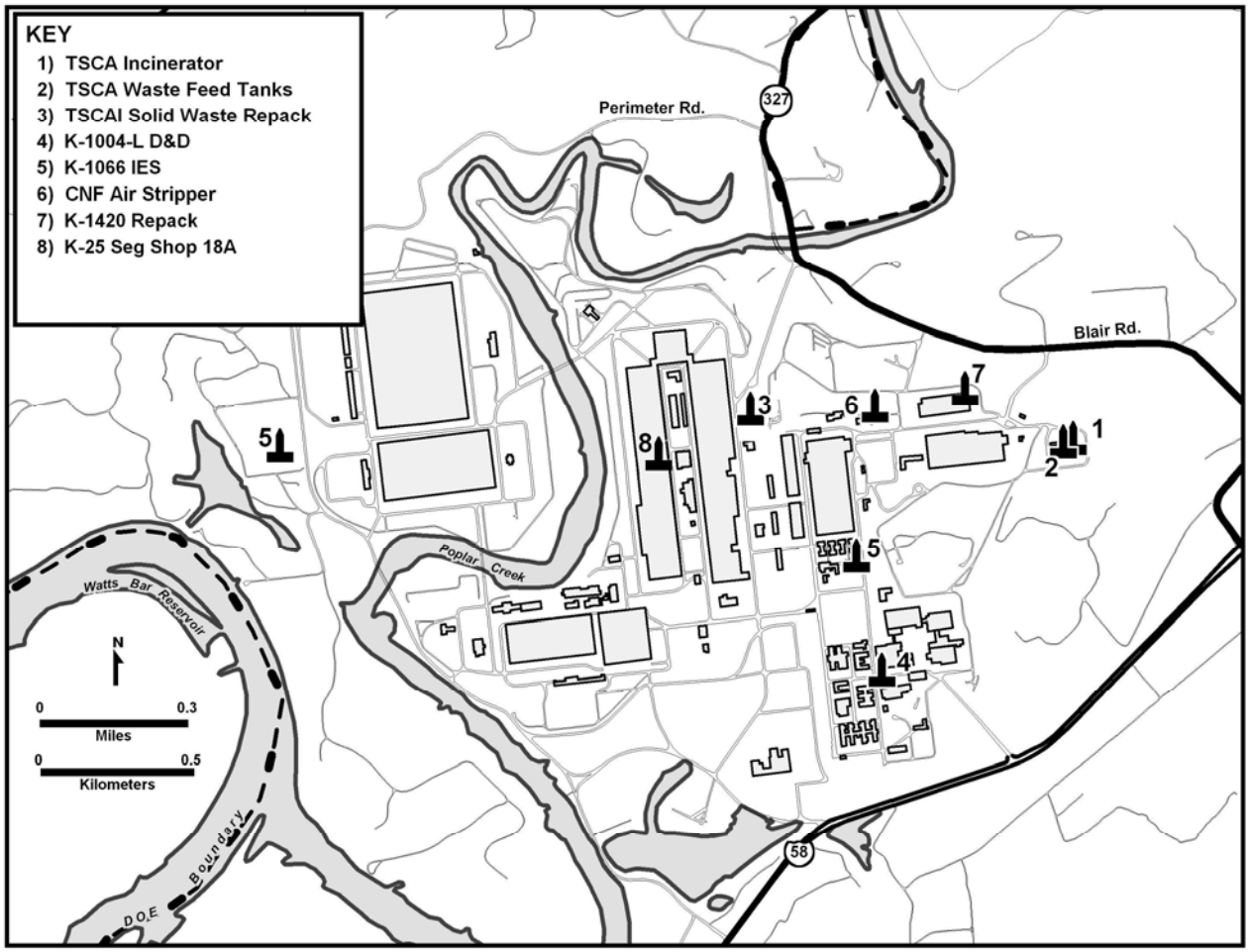

Fig. 4.1. Locations of airborne radionuclide point sources at the ETTP.

guidelines—no sources,
- surrogate emission data from similar sources—no sources, and
- evaporative emissions—one grouped source.

All techniques are conservative methods of estimating emissions based on the physical form of the radionuclides and the maximum operating temperature of the process or activity.

Any remaining emissions were classified as major sources or diffuse/fugitive sources that are spatially distributed in nature or that were not emitted with forced air from a stack, vent, or other confined conduit. Typical examples of diffuse/fugitive sources include
- emissions from shutdown buildings;
- resuspension of contaminated soils, debris, or other materials;
- unventilated tanks;
- wastewater treatment systems;
- outdoor storage and processing areas;
- emissions from piping, valves, or other piping equipment and pump components; and
- decontamination and demolition activities.

Fugitive emission sources are monitored by way of the ORR and ETTP ambient air surveillance programs.

4.1.1.2 Major Sources

Two ETTP major sources operated during 2006. Radionuclide emission measurements from the TSCA Incinerator were determined by means of a continuous stack-sampling system. The system is designed to automatically adjust sample flow rate to maintain near-isokinetic sampling conditions at the stack. The effluent is passed through filter media to collect particulate matter and through impingers with absorbing and adsorbing media to collect gaseous radionu-

clides. Measurements of TSCA Incinerator emissions were based on monthly composites of weekly stack samples. The K-1423 Solid Waste Repack facility was redesignated as a major source based on a change in the on-site member of the public location. Emissions were determined both by tracking the waste processing radiological characterization for assessing the dose to an off-site member of the public and by ambient air sampling at a location conservatively representative of the impact to the on-site location.

4.1.2 Results

The ETTP 2006 radionuclide emissions from the major and minor emission sources are shown in Table 4.1. Additionally, Figs. 4.2 and 4.3 show a comparison of the total discharges of uranium with those of previous years. The total curies and mass of uranium discharged to the air can vary from year to year. Emissions during 2006 showed a slight upturn, but the upturn was within historical variations. The variations are attributable to changes in project activities and source process rates. The resulting airborne dose from all ETTP radionuclide emissions was less than the reservation maximum limit of 10 mrem/year.

4.2 ETTP Nonradiological Airborne Emissions Monitoring

Under an application shield granted by the TDEC Division of Air Pollution Control, the ETTP has five major air emission sources listed as subject to Tennessee Title V Major Source Operating Permit program rules as of the end of this reporting period.

No direct monitoring of airborne emissions is required for nonradionuclide air contaminants from permitted sources. Instead, monitoring of key process and air pollution control device parameters is performed to ensure compliance with all permitted emission limits.

The ETTP is required to pay a major source emission fee each year for all regulated pollutants, excluding carbon monoxide and pollutants from exempt emission sources. To verify the air emission fee that is based on a combination of permitted allowable and actual emissions for air pollutants, an inventory of regulated emissions from the permitted sources at the ETTP is updated annually. Table 4.2 shows the results of the annual inventory of emissions of criteria pollutants from ETTP operations for the past 5 years. The ETTP paid an annual fee in 2006 amounting to $4,500 based on the fee rate of $21.50 per ton of emissions but not less than $4,500 during that period for a facility subject to Title V Major Source Operating Permit requirements. Table 4.3 shows the inventoried regulated emissions during the 2006 reporting period from the ETTP.

The TSCA Incinerator is permitted as a major source of air emissions from the ETTP. Emissions from the incinerator are controlled by extensive exhaust-gas treatment. For fee-reporting purposes, permitted allowable limits are used to determine the total potential emissions from the incinerator. A comparison of actual and allowable TSCA Incinerator emissions is presented in Table 4.4. All other permitted sources have emissions inventoried based on permit allowable limits.

4.3 Liquid Discharges—ETTP Radiological Monitoring Summary

The ETTP conducts radiological monitoring of liquid effluent and 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 members of the public.

4.3.1 Sample Collection and Analytical Procedure

The ETTP monitored the treated effluent from the K-1407-J CNF (outfall 001). Weekly samples were collected from the CNF and were composited into monthly samples. The samples were then analyzed for radionuclides. Results of these sampling efforts were compared with the DCGs listed in DOE Order 5400.5.

The Storm Water Pollution Prevention Program, which is described in more detail in Sect. 4.5, included sampling for gross alpha and beta radioactivity as well as specific radionuclides at selected storm water outfalls. Results were used to estimate the total discharge of each

Table 4.1. ETTP radionuclide air emission totals, 2006 (Ci)[a]

Radionuclide	Total major	TSCAI (major)[b]	Total minor	Total ETTP
^{228}Ac	–	–	2.21E–08	2.21E–08
^{241}Am	5.42E-09	–	1.12E-07	1.17E-07
^{243}Am	1.36E-09	–	–	1.36E-09
^{14}C	4.84E–05	4.84E–05	7.41E–04	7.90E–04
^{137}Cs	7.13E-05	7.13E-05	–	7.13E-05
^{60}Co	–	–	1.32E-11	1.32E-11
^{244}Cm	–	–	3.76E–08	3.76E–08
^{245}Cm	1.10E-09	–	–	1.10E-09
^{247}Cm	1.62E-09	–	–	1.62E-09
^{248}Cm	7.28E-10	–	–	7.28E–10
^{85}Kr	4.99E–03	4.99E–03	–	4.99E–03
^{210}Pb	–	–	2.00E–07	2.00E–07
^{237}Np	2.52E-06	2.52E-06	1.44E–07	2.67E-06
^{238}Pu	1.23E-06	1.23E-06	5.52E-08	1.29E-06
^{239}Pu	4.61E–06	4.61E–06	3.70E–07	4.98E–06
^{242}Pu	2.58E-09	–	–	2.58E-09
^{231}Pa	5.97E-10	–	6.19E–08	6.25E–08
^{234m}Pa	5.52E–03	5.52E–03	–	5.52E–03
^{226}Ra	4.46E-08	–	4.56E-06	4.61E–06
$^{89/90}$Sr	7.32E–06	7.32E–06	–	7.32E–06
^{99}Tc	9.86E–03	9.85E–03	1.34E-03	1.12E-02
^{228}Th	1.35E–05	1.35E–05	1.20E–07	3.36E–05
^{230}Th	1.66E–04	1.66E–04	2.37E–07	1.66E–04
^{232}Th	2.88E–05	2.88E–05	4.64E–08	2.88E–05
^{234}Th	1.76E–03	1.76E–03	8.38E–05	1.84E–03
^{3}H	2.97E+02	2.97E+02	–	2.97E+02
^{232}U	7.97E-09	–	–	7.97E-09
^{233}U	1.34E-08	–	2.55E-06	2.57E-06
^{234}U	3.17E-03	3.17E-03	3.75E–05	3.21E-03
^{235}U	4.45E–04	4.44E–04	2.60E–06	4.47E–04
^{236}U	–	–	5.50E–07	5.50E–07
^{238}U	3.60E-03	3.60E-03	1.04E–04	3.70E-03
Totals	2.97E+02	2.97E+02	2.32E-03	2.97E+02

[a]1 Ci = 3.7×10^{10} Bq.

[b]Toxic Substances Control Act Incinerator.

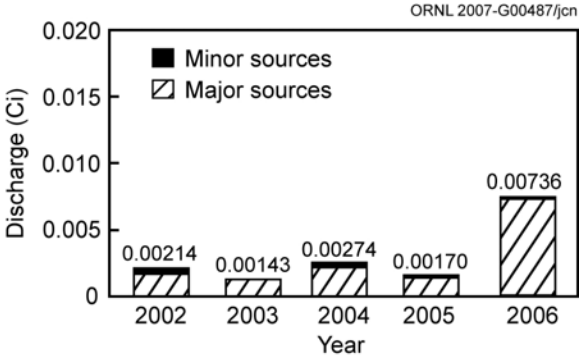

Fig. 4.2. Total curies of uranium discharged from the ETTP to the atmosphere, 2002–2006.

radionuclide from ETTP via the storm water discharge system. Figure 4.4 shows the location of the major NPDES outfalls.

4.3.2 Results

The sum of the fractions of the DCGs at the CNF was calculated at 37% for 2006, up from 14.8% in 2005. Table 4.5 lists radionuclides discharged from the ETTP CNF to off-site surface waters in 2006. Total uranium discharges from the CNF were 0.0074 Ci in 2006. Total discharge of transuranics was 0.0000025 Ci, which is more than three orders of magnitude less than the contribution from uranium.

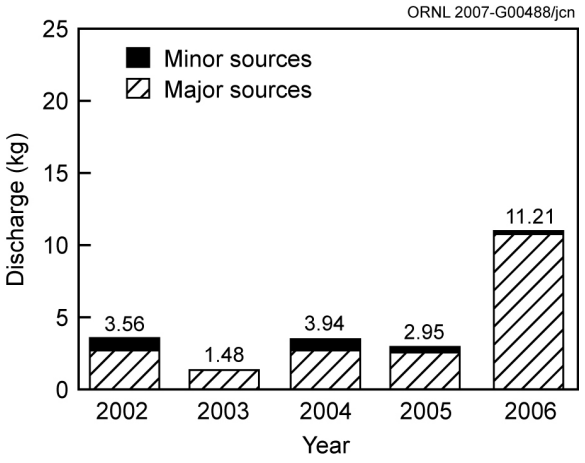

Fig. 4.3. Total kilograms of uranium discharged from the ETTP to the atmosphere, 2002–2006.

In terms of total activity of the discharges, ^{3}H, ^{14}C, and ^{99}Tc were the greatest contributors. However, their allowable DCGs are greater than those for the uranium isotopes, so their contribution to the sum of the fractions of the DCGs is relatively small. Technetium-99 accounted for 5.8% of the sum of the fractions, ^{14}C for 5.6%, while ^{3}H accounted for 0.081%. Uranium discharges from the CNF during a 5-year period were investigated to observe their trend (Fig. 4.5). Uranium isotopes were the major contributors to the fraction of the DCG, contributing 24% of the sum of the fraction of the DCG (Fig. 4.6). All of the remaining isotopes cumulatively accounted for just over 12% of the allowable DCG. TSCA Incinerator wastewater, which is sent to the CNF for treatment before being discharged to the Clinch River, is a major contributor of uranium; other operations contribute smaller amounts.

4.4 Nonradiological Liquid Discharges—ETTP Surface Water Effluents

The current ETTP NPDES permit (Permit Number TN0002950) for storm water discharges went into effect on April 1, 2004. This permit authorizes the ETTP to discharge storm water runoff, groundwater infiltration, groundwater from sumps, noncontact cooling water, and steam condensate to the Clinch River, Poplar Creek, and Mitchell Branch through 121 storm water outfalls. The 121 outfalls were divided into four groups based on the volume and nature of the monitored discharge. Of the 121 total outfalls, 39 are monitored as being representative of the 4 outfall groups. Samples from these outfalls are collected and analyzed as specified in NPDES permit TN0002950.

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 on historical sampling data, outfall flow characteristics, and outfall locations, the storm water outfalls that provide the most accurate representation of the water quality of the outfall group were selected as the representative outfalls to be sampled for the group. The representative outfalls for each group are designated in the NPDES permit tables. All storm water monitoring and characterization sampling for the storm water outfall groupings are performed at the designated representative outfalls. Sheet flow and runoff from

Table 4.2. Allowable emissions of criteria pollutants from the ETTP, 2002–2006

Pollutant	Allowable emissions (tons/year)[a]				
	2002	2003	2004	2005	2006
Particulate matter	13	13	13	14	14
Volatile organic compounds	14	14	14	11	11
Sulfur dioxide	39	39	39	39	39
Nitrogen oxides	20	20	20	20	20
Carbon monoxide	19	19	19	19	19
Hazardous air pollutants	21	21	21	21	21
Miscellaneous	0	0	0	0	0
Total	126	126	126	124	124

[a]1 ton = 907.2 kg.

Table 4.3. Actual emissions of criteria pollutants from permitted ETTP sources, 2006

Pollutant	Actual emissions	
	lb/year[a]	tons/year[b]
Particulate matter	530.5	0.265
Volatile organic compounds	711.8	0.356
Sulfur dioxide	18.9	0.009
Nitrogen oxides	23,505	11.75
Carbon monoxide	5,876	2.94

[a]1 lb = 0.435359237 kg.
[b]1 ton = 907.2 kg.

small drainage swales in the drainage area of the groupings are considered to be part of the total flow of the grouping. Unless otherwise stated, all storm water outfall groups also receive general site runoff, which may include storm water runoff from grassy areas, roads, and paved areas within ETTP.

The current NPDES permit (Permit Number TN0074255) for the CNF went into effect on November 1, 2003. The permit authorizes treated industrial effluent from outfall 001 to be discharged to the Clinch River. Table 4.6 details the requirements and compliance records for the two NPDES permits for 2006. The table provides a list of the discharge points, effluent parameters, effluent limits, number of noncompliances, and the percentage of compliance for 2006. Samples from outfall 001 are collected and analyzed as specified in NPDES permit TN0074255.

4.4.1 Results

The ETTP had one NPDES noncompliance in 2006 under NPDES Permit No. TN0002950. On November 27, 2006, during routine weekly sampling required by ETTP NPDES Permit No. TN0002950, a noncompliance with the NPDES Permit limit for TRC concentration was identified at storm water outfall 100. The sample result, 0.20 mg/L, exceeded the NPDES Permit limit for TRC for outfall 100, which is a daily maximum concentration of 0.140 mg/L.

On November 27, 2006, field investigations were initiated to identify the source of the TRC in the discharge from outfall 100. Dechlorination tablets were placed in the outfall 100 drainage network immediately after the discovery of the noncompliance. Field investigations indicated that the source of the TRC was an underground sanitary water line break. On December 15, 2006, repairs to the broken sanitary water line were completed.

On December 11, 2006, during routine NPDES Permit compliance sampling activities, several dead fish were observed in the riprap-lined channel that transports discharges from the outfall 100 storm drain network to the K-1007-P1 Pond. It was estimated that the total mortality was in excess of 1000 fish. The vast majority of the dead fish were determined to be shad. The cause of the fish kill is believed to be related to the sanitary water line break that discharged chlorinated water into the outfall 100 piping network.

4.5 Storm Water Pollution Prevention Program

4.5.1 Storm Water Monitoring Strategy

Development and implementation of the ETTP Storm Water Pollution Prevention Program is required by Part IV of ETTP NPDES Permit No. TN0002950. The objective of the program is to minimize the discharge of pollutants in storm water runoff from the ETTP.

The purpose of the ETTP Storm Water Pollution Prevention Program is to assess the quality of storm water discharges from ETTP, determine potential sources of pollutants affecting storm water, and provide effective controls to reduce or eliminate these pollutant sources. It provides a means whereby sources of pollutants that are likely to affect the quality of storm water discharges are identified, best management practices to control the entry of pollutants into storm water discharges are developed, and methods for implementing pollution prevention practices are devised. The sampling effort incorporates an increased emphasis on the identification of specific sources of pollutants that may be transported by storm water. This information is used to support the site cleanup program that is being conducted in accordance with CERCLA requirements.

During 2006, the ETTP Storm Water Pollution Prevention Program sampling was conducted in support of two primary goals.

- Sampling for the ETTP Water Quality Program (EWQP)—Surface water samples were collected at locations that are exit pathways

Table 4.4. Actual vs allowable air emissions from the Toxic Substances Control Act Incinerator at the ETTP, 2006

Pollutant	Emissions (tons/year)[a]		Percentage of allowable
	Actual[b]	Allowable	
Semivolatile metals (As, Be, and Cr)	0.0018	0.116	1.5
Beryllium	0.00002	0.00021	9.6
Low-volatile metals (Cd and Pb)	0.0064	0.286	2.2
Mercury	0.00037	0.155	0.2
Hydrogen fluoride	0.011	2.98	0.4
Hydrogen chloride	0.014	0.092	15.1
Sulfur dioxide	0.009	38.5	<0.1
Volatile organic compounds	0.356	5.0	7.1
Dioxin/furan	*c*	*c*	n/a
Particulate matter	0.265	5.64	4.7

[a]1 ton = 907.2 kg.

[b]Actual emissions based on removal efficiencies measured during permit required air emission tests conducted during 2005.

[c]The criterion for dioxin and furan is the "destruction/removal efficiency." Actual: 99.999%; allowable: 99.99%.

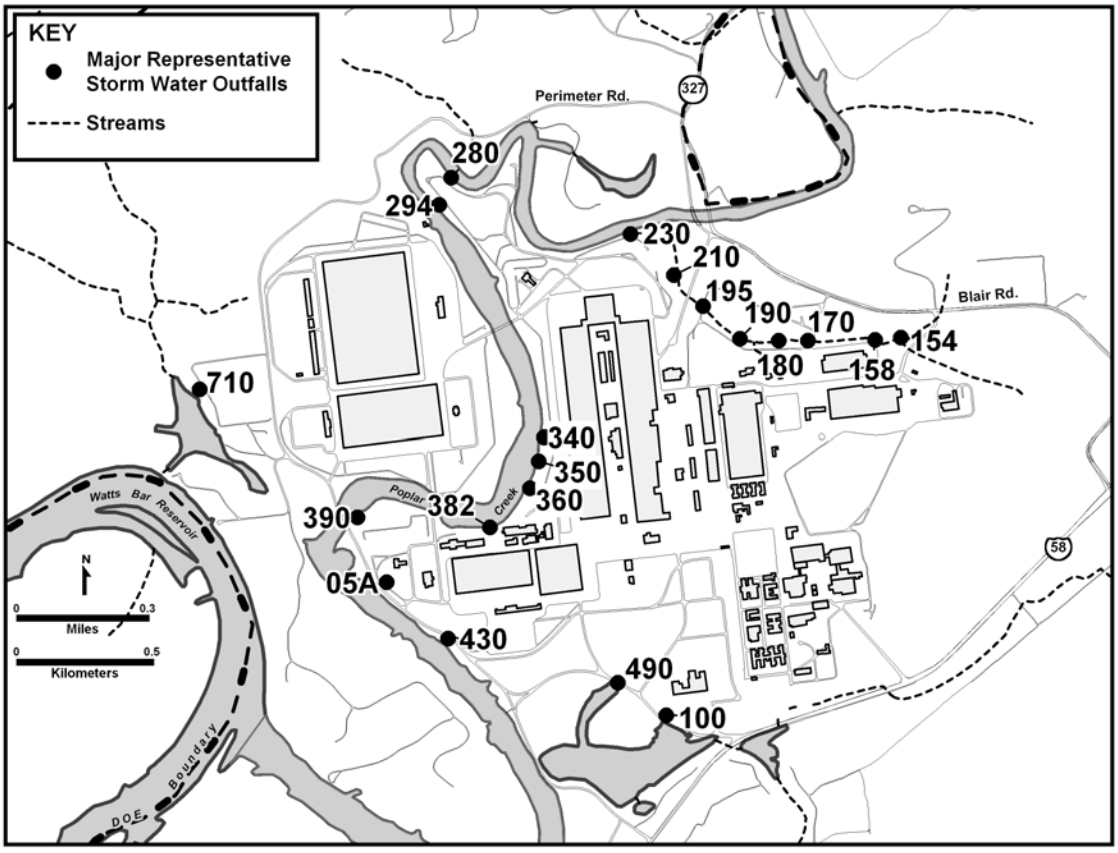

Fig. 4.4. ETTP National Pollutant Discharge Elimination System major representative storm water outfalls.

Table 4.5. Radionuclides released to off-site surface waters from the ETTP, 2006

Effluent discharge location: Central Neutralization Facility

Radionuclide	Amount (Ci)[a]	Radionuclide	Amount (Ci)[a]
^{14}C	2.5 E–1	^{230}Th	1.5E–4
^{137}Cs	8.1 E-5	^{234}U	1.9 E-3
^{3}H	1.4 E-1	^{235}U	1.3 E–4
^{237}Np	6.5 E–7	^{236}U	4.4 E–5
^{239}Pu	1.9 E–6	^{238}U	5.3 E–3
^{99}Tc	3.8 E–1		

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

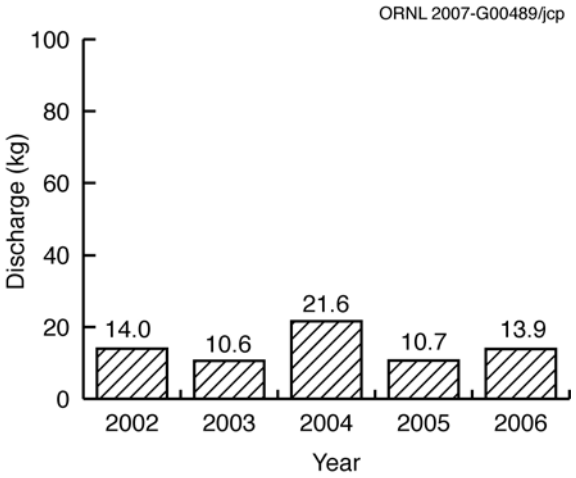

Fig. 4.5. Five-year trend of uranium releases to surface waters from the K-1407-J Central Neutralization Facility.

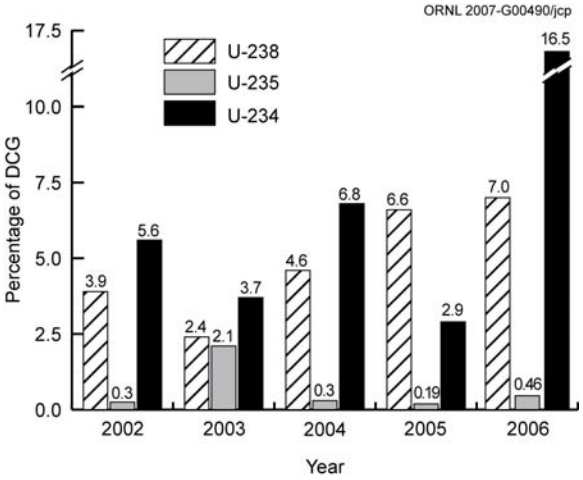

Fig. 4.6. Percentage of DOE derived concentration guides for uranium isotopes from the K1407-J Central Neutralization Facility.

for contaminants from ETTP. The locations have a direct discharge or potential for direct discharge to Poplar Creek or the Clinch River.

- Sampling in preparation for the application for ETTP NPDES permit renewal—Selected outfalls that were designated as group representatives in the reissued ETTP NPDES Permit Number TN0002950 were sampled, and the results will be incorporated in the ETTP NPDES permit renewal application. The current ETTP NPDES permit expires on March 31, 2008; the permit renewal application must be submitted to TDEC 180 days prior to permit expiration.

4.5.2 ETTP Water Quality Program Monitoring Program Results

In 2006 surface water samples were collected from selected locations around the ETTP as part of the Storm Water Pollution Prevention Program and in association with the EWQP monitoring program. These samples were analyzed for selected analytes which have the potential to be present at these particular locations. Data from this monitoring will be used to identify contaminants that may be discharging to surface waters within ETTP boundaries, and also that may have the potential to migrate off-site, as well as to evaluate changes in contaminant concentrations near potential contaminant sources.

In CY 2006, gross alpha radiation was detected above the screening level of 15 pCi/L at storm water outfalls 180 and 190. No gross alpha or gross beta contamination above the screening levels was found at any of the other storm water outfalls that were sampled in CY 2006 as part of the EWQP sampling effort. In

Table 4.6. National Pollutant Discharge Elimination System compliance at the ETTP, 2006

Effluent parameter	Effluent limits[a]		Number of noncompliances	Compliance (%)
	Monthly average	Daily maximum		
Outfall 001 (K-1407-J Central Neutralization Facility to the Clinch River)				
Benzene		0.005		100
Cadmium	0.18	0.69		100
Carbon tetrachloride	0.5	0.5		100
Chloride, total	35,000	70,000		100
Chloroform	0.5	0.5		100
Chromium	1.71	2.77		100
Copper	1.34	2.15		100
Cyanide, total	0.650	1.200		100
Ethylbenzene		0.01		100
Lead	0.38	0.69		100
Nickel	2.38	3.98		100
Oil and grease	26	30		100
PCB	0.00022	0.00045		100
pH, standard units		6.0–9.0		100
Silver	0.24	0.43		100
Suspended solids	31	40		100
Tetrachloroethylene		0.7		100
Toluene		0.01		100
Total toxic organics		2.13		100
Trichloroethylene	0.5	0.5		100
Vinyl chloride	0.2	0.2		100
Zinc	1.48	2.61		100
Group I storm water outfalls				
pH, standard units		4.0–9.0		100
Group II storm water outfalls				
pH, standard units		4.0–9.0		100
Group III storm water outfalls				
pH, standard units		4.0–9.0		100
Group IV storm water outfalls				
Chlorine, total residual		0.14	1	98
pH, standard units		6.0–9.0		100

[a]Units are mg/L unless otherwise stated.

addition, no levels of transuranics or isotopic uranium exceeding 4% of the DCG level were detected in samples from any of the other storm water outfalls sampled in CY 2006 as part of the EWQP sampling effort. Volatile organic compounds (including 1,2-dichloroethene, cis-1,2-dichloroethene, trichloroethene, and vinyl chloride) were found at levels above screening criteria at storm water outfall 190 in samples collected as part of the EWQP sampling effort during CY 2006. Field measurements for dissolved oxygen were below the screening level of 6.0 mg/L at outfalls 170 and 190 during EWQP monitoring performed during CY 2006. No PCBs were detected at levels above detection limits at any of the locations sampled as part of the EWQP monitoring effort during CY 2006. Analytical results for the EWQP sampling effort are presented in Tables 4.7 and 4.8.

4.5.3 Radiological Monitoring of Storm Water Discharges

In 2006, radiological monitoring of storm water discharges was performed as part of the Storm Water Pollution Prevention Program

Table 4.7 EWQP storm water monitoring—radiological monitoring results that exceeded screening criteria, 2006[a]

Storm water outfall	Gross alpha radiation (pCi/L)
180[b]	16.6
190[b]	36.7/42.7
190[c]	16.5

[a]Screening level is 15 pCi/L alpha radiation. 1 pCi = 3.7×10^{-2} Bq.

[b]Sample collected during first quarter of CY 2006.

[c]Sample collected during third quarter of CY 2006.

NPDES permit renewal sampling effort. Gross alpha radiation above screening criteria was found in storm water collected from outfall 760. Uranium-233/234 and uranium-238 levels above screening criteria were also found in samples collected from outfall 760. Analytical results above screening criteria for the radiological monitoring are presented in Table 4.9. A synopsis of the results from radiological monitoring at all the storm water outfalls is given in Table 4.10.

4.5.4 Nonradiological Monitoring of Storm Water Discharges

Storm water from several outfalls that were sampled in 2006 contained metals and organic compounds in concentrations above the screening criteria levels. The exact sources of the materials are unknown. It is likely that some are the results of natural components of the soils and sediments in the area. Analytical results above the screening criteria for the nonradiological parameters are presented in Table 4.11.

4.6 ETTP Biological Monitoring and Abatement Program

BMAP is a requirement of the NPDES permit. Its purpose is to assess the ecological health of the ETTP's receiving streams and ponds. In 2006, the BMAP consists of three tasks:

- toxicity monitoring,
- bioaccumulation monitoring, and
- ecological surveys of instream communities (both fish and benthic macroinvertebrates).

The BMAP is conducted by the ORNL Environmental Sciences Division under the direction of the ETTP Environmental Compliance and Protection Organization.

Table 4.8. EWQP storm water monitoring—nonradiological monitoring results that exceeded screening criteria, 2006

Storm water outfall	Dissolved oxygen (mg/L)[a]	1,2 Dichloroethene (μg/L)[b]	*cis*-1,2 Dichloroethene (μg/L)[b]	Trichloroethene (μg/L)[b]	Vinyl chloride (μg/L)[b]
170[c]	5.7				
190[d]		390	390	140	120
190[c]	5.4	940	930	260	180

[a]Screening criteria for dissolved oxygen is < 6.0 mg/L.

[b]Screening criteria for 1,2 dichloroethene, cis-1,2-dichloroethene, trichloroethene, and vinyl chloride is 100 ug/L.

[c]Sample collected during third quarter of 2006.

[d]Sample collected during first quarter of 2006.

4.6.1 BMAP Toxicity Monitoring

The toxicity monitoring task for BMAP includes annual tests of effluent from storm water outfalls 170 and 190 concurrently with surface water from ambient sites in Mitchell Branch. The sites are Mitchell Branch kilometer (MIK) 0.12, 0.45, 0.71, and 0.78. The number following "MIK" indicates the distance in kilometers

Table 4.9. NPDES permit renewal sampling, 2006—Maximum exceedances of radiological screening criteria for storm water outfalls, (pCi/L)[a]

Storm water outfall	Alpha	Beta	U-233/234	U-238
760	64.4		38.7	24.3

[a]Screening levels are 15 pCi/L alpha radiation, 20 pCi/L ^{234}U, and 24 pCi/L ^{238}U. 1 pCi = 3.7×10^{-2} Bq.

Table 4.10. Radionuclides released to off-site surface waters from the ETTP storm water system, 2006

Radionuclide	Amount[a] (Ci)	Radionuclide	Amount[a] (Ci)
^{137}Cs	3.0E–6	^{235}U	3.1E–4
^{99}Tc	3.9E–2	^{236}U	2.8E–6
^{234}U	6.8E–3	^{238}U	3.7E–3

[a] 1 Ci = 3.7×10^{10} Bq.

from the mouth of Mitchell Branch on Poplar Creek. *Ceriodaphnia dubia* were used to evaluate effluent from storm water outfalls 170 and 190, and the ambient monitoring locations, for toxicity.

In April, survival and reproduction toxicity tests using *Ceriodaphnia dubia* on water from storm water outfall 170 and all ambient locations revealed no toxicity (Table 4.12). However, effluent from storm water outfall 190 reduced both reproduction and survival. Effluent from storm water outfall 190 reduced reproduction at all tested concentrations and survival in all but the lowest two tested concentrations (12% and 6%). Thus, the overall trend is one of some level of toxicity to *Ceriodaphnia* from storm water outfall 190, with no or very infrequent toxicity from the ambient locations and occasional toxicity at storm water outfall 170. Although the source of the problem at storm water outfall 190 was not positively identified, the data gathered in previous studies indicated that groundwater was percolating through waste in the K-1070-B Burial Ground and leaching out small quantities of metals. Some of this groundwater was then flowing into the storm drain system and could contribute to the toxicity. Nickel and zinc are present in water collected from the storm drain system near K-1070-B, at levels that have been shown to be toxic to *Ceriodaphnia.*

4.6.2 BMAP Bioaccumulation Studies

In June and July 2006, caged clams *(Corbicula fluminea)* were placed at several locations around ETTP. After 4 weeks, they were removed and analyzed for PCBs. Results from the 2006 monitoring were generally lower than the results of earlier monitoring, but the overall distribution pattern was similar. The highest concentrations (3.4 μg/g) were found in the clams from storm water outfall 100, with lesser concentrations found in clams from other locations in the P1 pond and Mitchell Branch. Although the concentrations of PCBs in the clams from storm water outfall 100 have consistently been the highest on the ETTP, the analytical results have shown some decrease in concentrations in recent years. Mitchell Branch clams from areas upstream of storm water outfall 190 had relatively low concentrations of PCBs, while clams from MIK 0.45 (immediately downstream of storm water outfall 190) averaged 1.0 ppm PCBs, and clams from further downstream at MIK 0.2 averaged concentrations of 2.75 ppm PCBs. The concentrations in clams from MIK 0.2 are surpassed at ETTP only by the concentrations in clams from storm water outfall 100. In the K-901-A Pond, clams from near the two major storm water outfalls that discharge into the pond (storm water outfalls 700 and 710) contain higher concentrations than in the clams from the K-901-A Pond outfall, indicating that these two storm water outfalls may be the proximate source of PCB contamination in the pond. Clams from the K-1007-P3 Pond exhibit levels (0.015 ppm) that are roughly consistent with those in clams from the Sewee Creek reference stream (0.01 ppm).

Fish were collected from Mitchell Branch, K-1007-P1 Pond, and K-901-A Pond in May 2006. Largemouth bass were collected from the pond sites, and redbreast sunfish were collected

Table 4.11. Maximum exceedances of nonradiological screening criteria for each storm water outfall, 2006 (µg/L)

Outfall	Parameter	Monitoring result	Criteria
390	Zinc	151	65
410	Aluminum	2920	750
410	Iron	4520	1000
410	Zinc	131	65
532	Aluminum	886	750
532	Iron	1820	1000
710	Zinc	161	65

Table 4.12. Mitchell Branch and associated storm water outfall toxicity test results, April 2006[a]

Test	MIK 0.78	SD 170	MIK 0.71	SD 190	MIK 0.45	MIK 0.12
Ceriodaphnia survival	NR	NR	NR	R	NR	NR
Ceriodaphnia reproduction	NR	NR	NR	R	NR	NR

[a]NR: No significant reduction compared with the control population. R: Significant reduction compared with the control population.

from Mitchell Branch. Game fish of a size large enough to be taken by sportsfishermen were selected both to provide more accurate data of potential human health concerns and to reduce the amount of variation in contamination levels in the individual fish due to age and size differences. Fillets taken from each game fish were analyzed for PCBs. Table 4.13 gives a synopsis of the results. Results from the K-901-A Pond monitoring (an average concentration of 0.5 ppm PCBs) are similar to historical results. Results from the fish taken from Mitchell Branch were the lowest since 1996. However, even at 1.6 ppm PCBs, these were still the highest concentrations found in any sunfish from the ORR. In the bass from K-1007-P1 pond, the 2004 results showed a significant decrease in PCB concentrations when compared with previous year's monitoring results. Results from the 2005 monitoring (an average of 16.1 ppm) returned to the range of historical levels, while results from the 2006 monitoring again showed a significant decrease (an average of 7.1 ppm). Fluctuations in the bass from K-1007-P1 may reflect variations in the availability of gizzard shad as prey. Gizzard shad, due to their physiology and ecology, are more likely to accumulate large amounts of PCBs than are most other species of forage fish. The state of Tennessee posting limit for PCBs in fish is 1 ppm. Levels in sunfish from the Hinds Creek reference location averaged less than 0.01 ppm PCBs.

In 2006, an engineering evaluation/cost analysis was completed for the K-1007-P1 Pond. The analysis evaluated various options for addressing the human health concerns associated with the high concentrations of PCBs in K-1007-P1 Pond fish. It was determined from the analysis that ecological enhancement was the preferred alternative for the pond. That alternative will be implemented as a non-time-critical removal action under CERCLA. Ecological management provides an alternative approach to more conventional pond remediation options, such as sediment removal, draining and capping, and point source/discharge actions. The basic premise of that option is that ecological manipulations can interrupt the contaminant exposure pathways that lead to ecological or human receptors. The focus of the contaminant pathway interdiction is at the higher food chain level, in contrast to conventional options, where interdiction is at the soil or sediment source level. At the K-1007-P1 Pond, the greatest food chain risk to humans and ecological receptors, largemouth bass and gizzard shad, will be removed from the

Table 4.13. PCB concentrations in biota at ETTP, 2006

Location	Species	Mean concentration (ppm)[a]	Range	Number >1 ppm/N
MIK 0.2	Redbreast sunfish (*Lepomis auritus*)	1.6	0.76–2.9	5/6
K-1007-P1	Largemouth bass (*Micropterus salmoides*)	7.1	2.6–10.8	6/6
K-901-A	Largemouth bass (*Micropterus salmoides*)	0.5	0.1–0.96	0/6
Hinds Creek (reference)	Redbreast sunfish (*Lepomis auritus*)	<0.01	<0.001–0.01	0/6
MIK 0.78	Asiatic clams (*Corbicula fluminea*)	0.06	N/A	N/A
MIK 0.71 (SD170)	Asiatic clams (*Corbicula fluminea*)	0.1	N/A	N/A
MIK 0.45 (SD190)	Asiatic clams (*Corbicula fluminea*)	0.96	N/A	N/A
MIK 0.2	Asiatic clams (*Corbicula fluminea*)	2.8	N/A	N/A
SD100 (inside drain)	Asiatic clams (*Corbicula fluminea*)	0.8	N/A	N/A
SD100 (discharge to P1 Pond)	Asiatic clams (*Corbicula fluminea*)	2.7	N/A	N/A
SD120	Asiatic clams (*Corbicula fluminea*)	0.8	N/A	N/A
K-1007P3	Asiatic clams (*Corbicula fluminea*)	0.02	N/A	N/A
SD490	Asiatic clams (*Corbicula fluminea*)	0.9	N/A	N/A
K-1007P1	Asiatic clams (*Corbicula fluminea*)	0.5	N/A	N/A
K-901-A	Asiatic clams (*Corbicula fluminea*)	0.2	N/A	N/A
SD700	Asiatic clams (*Corbicula fluminea*)	0.2	N/A	N/A
SD710	Asiatic clams (*Corbicula fluminea*)	0.2	N/A	N/A
Little Sewee Creek (reference)	Asiatic clams (*Corbicula fluminea*)	0.01	N/A	N/A

[a]1 ppm = 1 mg/L.

system and will pose no risks to humans or wildlife after removal. Pond bioaccumulation processes will be further minimized by ecological management actions that prevent future bioaccumulation to unacceptable levels. Ecological actions include fish management, vegetation management, wildlife management, water quality manipulations, and preventive actions. Once the system has been changed to a steady-state, highly vegetated pond, contaminated sediments will be stabilized, and cleaner sediments will overlay and further isolate contaminated sediments over time. Preventive actions such as fish barriers and the isolating effects of dams will also ensure that undesirable fish cannot reenter the pond. The strategy should enhance the pond environment, providing substantial natural resource benefits over the long-term.

4.6.3 BMAP Ecological Surveys of Instream Communities

Although past ETTP operations had adversely affected the communities of Mitchell Branch, and although there continue to be some impacts, the results to date overall indicate that the institution of best management practices and remediation efforts have resulted in gradual, but more or less continuous, improvement of conditions in the stream.

In April 2006, the benthic macroinvertebrate communities at four Mitchell Branch locations (MIKs 0.45, 0.71, 0.78, and 1.43) were sampled. MIK 1.43 serves as the reference location. In the last ten years, the benthic macroinvertebrate community at all locations in Mitchell Branch has generally shown increases in diversity and numbers of individuals. Results from this year's sampling showed similar species richness and richness of pollution-intolerant species at the two most upstream sites, with lower values at the downstream locations (Figs. 4.7 and 4.8). Results from the 2006 monitoring show a decline from 2005 in most metrics at both MIK 0.45 and MIK 0.71. Mitchell Branch has historically shown the effects of impacts from past operations, and results indicate that conditions at these two monitoring locations continue to be suboptimal. However, the patterns of stonefly density merit comment. Stonefly species typically are sensitive to a range of environmental

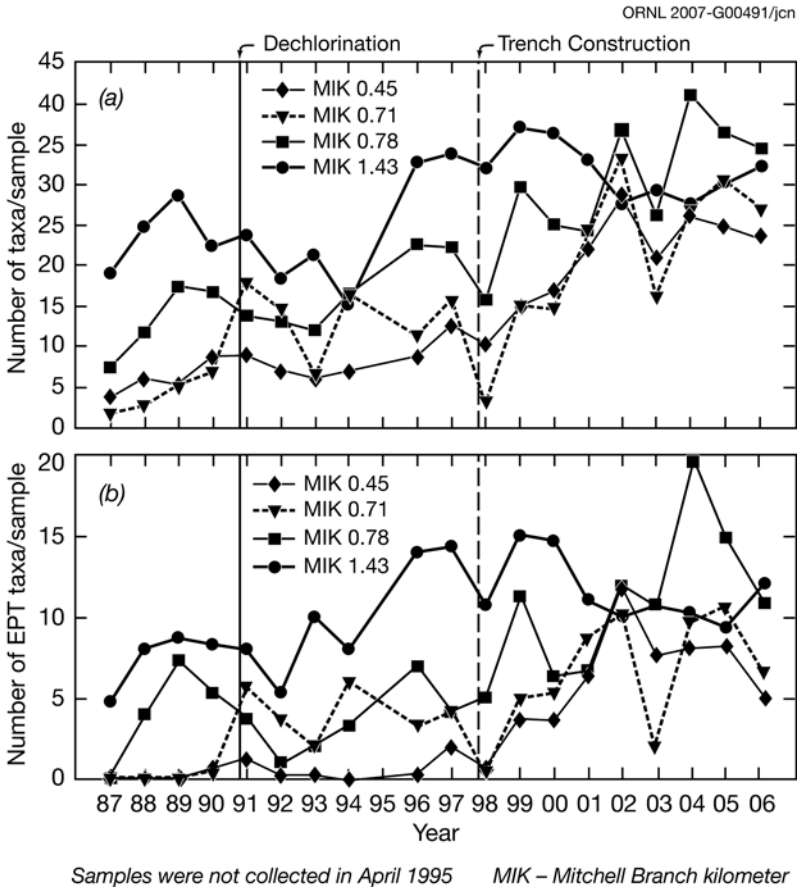

Fig. 4.7. Total taxonomic richness (a) and richness of pollution-sensitive taxa (b) in Mitchell Branch.

parameters, including nutrient enrichment, pollutants, pH, dissolved oxygen levels, and physical characteristics (including fluctuations in stream flow, sedimentation, and substrate instability). Stonefly densities at both MIK 0.45 and 0.71 were markedly lower than at the reference location at MIK 1.43, but levels at MIK 0.78 were actually higher than at the reference location.

Fish communities in Mitchell Branch (MIK 0.45 and 0.71) were sampled in April 2006. Species richness, density, and biomass were examined. The communities at both MIK 0.45 and MIK 0.71 showed a decrease in both density and biomass when compared with last years' results. In the 2005 monitoring, density at MIK 0.71 was the highest recorded for that location, and the density at MIK 0.45 was the second highest. In 2006, the density and biomass at both locations showed a decrease to values more consistent with the trends of recent years, and were similar to values seen in un-impacted streams. These wide swings are typical of streams that have been severely impacted, are in the process of recovery, but have not yet reached the long-term stable state. Species richness appears to have more or less stabilized, with results from the 2005 and 2006 sampling similar at both locations. The stream is still dominated by more tolerant fish species, so although the conditions and fish community structure are improving, they have not yet reached a stable community structure typical of less impacted streams in the area.

4.7 ETTP Ambient Air Monitoring

DOE Order 450.1 requires surveillance of ambient air to assess the impact of DOE operations on air quality. In addition, airborne radionuclide monitoring is required for compliance with radionuclide NESHAP regulatory agreements. DOE Order 5400.5 also specifies requirements for airborne radionuclide surveillance. The ETTP ambient air monitoring program is designed to monitor selected air con-

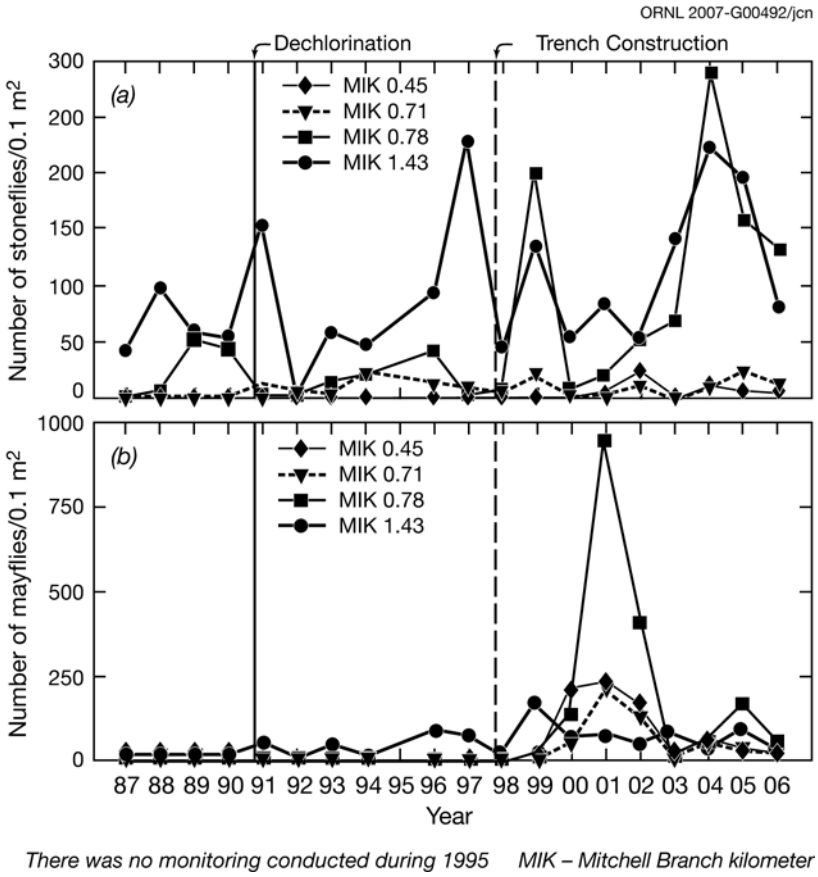

Fig. 4.8. Density of pollution-intolerant stoneflies (a) and pollution-tolerant mayflies (b) in Mitchell Branch.

taminants for the ongoing monitoring of the impact of plant operations on the immediate environment. Specific locations were selected to determine air contaminant concentrations in the prevailing directions, upwind and downwind of the site, and to obtain airborne radiological measurements in the direction of both the nearest and most exposed member of the public. The current locations of these monitoring stations are shown in Fig. 4.9. The ETTP ambient air monitoring program complies with all requirements of DOE orders. One station activated in November of 2005 is representative of DOE facility access changes that require on-site monitoring of radiological emissions. This station ensures compliance with NESHAP regulations and is consistent with previously approved sampling methodologies defined in the *ORR NESHAP Compliance Plan* (DOE 1994).

National ambient air quality standards are referenced by DOE orders as guidance with respect to ambient air concentrations of certain air contaminants. These regulations specify 24-h, quarterly, and annual standards for specific or criteria pollutants. Additionally, results are compared with any applicable risk-specific dose and reference air concentration listed in 40 CFR 266, Subpart H.

The ambient air sampling schedule and monitored parameters are listed in Table 4.14. All parameters were chosen with consideration of existing and proposed regulations and the nature of operations in and around the ETTP. Changes in emissions, wind profile, site activities, or any other parameter that may alter the potential impact of ETTP activities within the facility and on nearby communities, or the environment may warrant periodic changes of air contaminants measured, number of stations, or relocation of existing stations. The principal parameters monitored during 2006 were arsenic, beryllium, cadmium, chromium, lead, and uranium. Uranium was analyzed by both inorganic and radiochemical methods. Radiochemical analyses included isotopes of uranium (^{234}U,

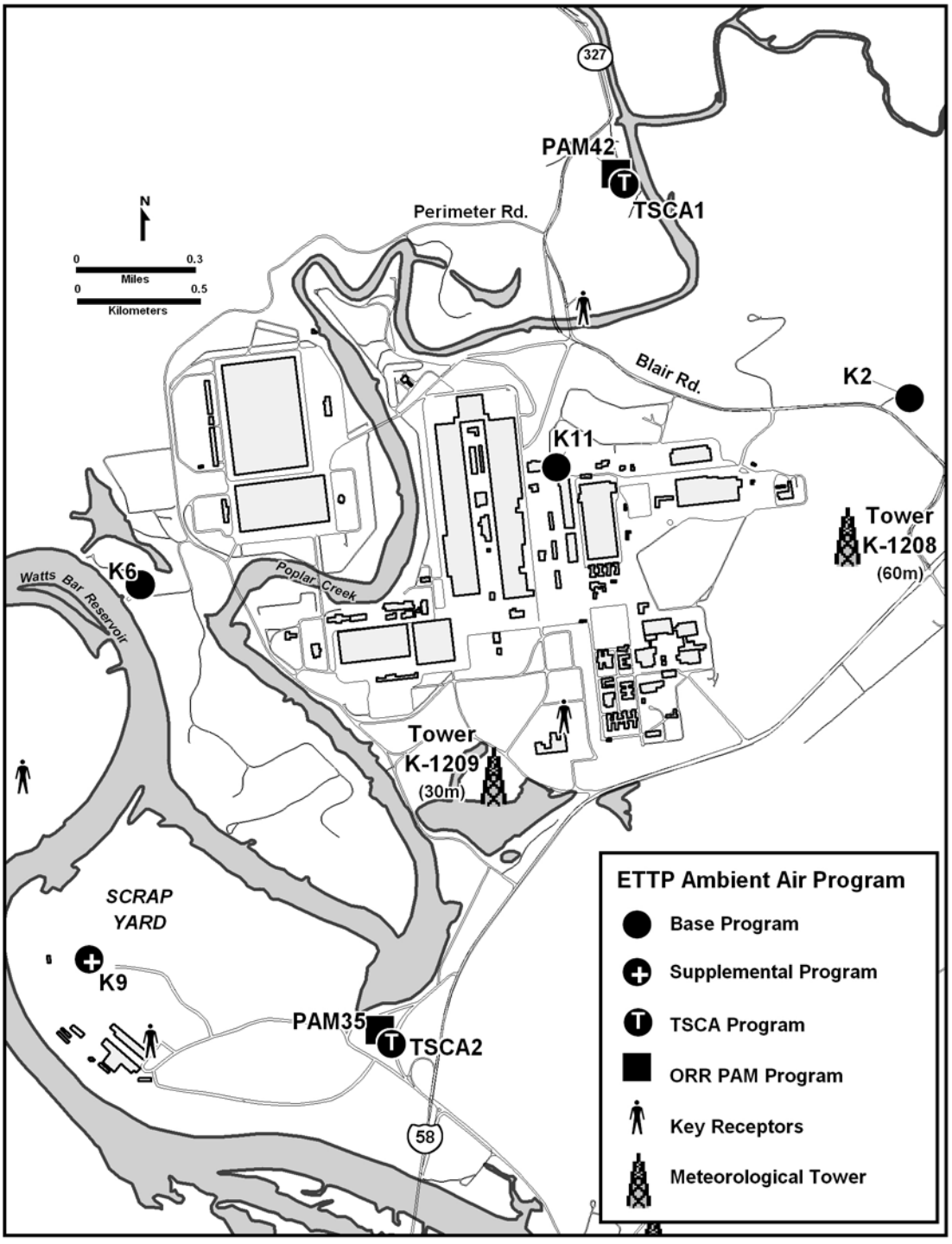

Fig. 4.9. Locations of ambient air monitoring stations at the ETTP.

Table 4.14. Summary of types and frequencies of samples collected at ETTP perimeter ambient air monitoring stations, 2006

Parameter	Sampling locations	Sampling period	Collection frequency	Analysis frequency[a]
Criteria pollutants				
Lead	K2, K6, K9, K11	Continuous	Weekly	Quarterly
Hazardous air pollutants carcinogen metals				
Arsenic	K2, K6, K9, K11	Continuous	Weekly	Quarterly
Beryllium	K2, K6, K9, K11	Continuous	Weekly	Quarterly
Cadmium	K2, K6, K9, K11	Continuous	Weekly	Quarterly
Chromium	K2, K6, K9, K11	Continuous	Weekly	Quarterly
Organic compounds				
Polychlorinated biphenyls	TSCAI[b] 1, 2	*c*	*c*	*c*
Furan	TSCAI 1, 2	*c*	*c*	*c*
Dioxin	TSCAI 1, 2	*c*	*c*	*c*
Hexachlorobenzene	TSCAI 1, 2	*c*	*c*	*c*
Radionuclides (by inorganic analysis)				
Uranium (total)	TSCAI 1, 2	*c*	*c*	*c*
Radionuclides (by radiochemical analysis)				
^{99}Tc, ^{237}Np, ^{238,239}Pu, ^{234,235,236,238}U	K2, K6, K9, K11	Continuous	Weekly	Quarterly

[a] Quarterly frequencies are composite sample analyses of all weekly samples collected over the identified period.

[b] Toxic Substances Control Act (TSCA) Incinerator.

[c] Stations are activated automatically only if a TSCA Incinerator operational upset occurs. Identified samples are then immediately submitted for analysis.

^{235}U, ^{236}U, and ^{238}U), ^{99}Tc, ^{237}Np, ^{238}Pu, and ^{239}Pu.

During this reporting period, the ambient air monitoring network consisted of four ETTP sampling stations and utilized information obtained from two ORR perimeter air monitoring (PAM) stations. Samples were collected weekly from the following stations: K2, K6, K9, K11, and PAM 35 and 42. During 2006, sample compositing was performed quarterly (every 3 months) prior to analysis for all pollutant analyses.

4.7.1 Results

No standards were exceeded, and, with the exception of uranium levels, there were no significant variations of annual pollutant concentrations associated with site operations when compared with data from the previous year. Sampling results assessing the impact of specific site activities on air quality show that the ETTP, including project-specific measurements, did not have any impact of concern on local air quality. Also, radiochemical analyses of ambient air samples confirm low radiological emissions from the ETTP.

4.7.2 Criteria Pollutant Levels

Lead results were determined from analyses of quarterly composites of continuous weekly samples from stations K2, K6, K9, and K11. The total mass quantities of lead for each sample were determined by the inductively coupled plasma mass spectrometry (ICP-MS) analytical technique. Lead analytical results are summarized in Table 4.15 and are compared with the Tennessee and national quarterly ambient air quality standard of 1.5 μg/m^3. There are no 24-h, monthly, or annual ambient air quality standards for lead. The maximum individual lead result was 0.0016 μg/m^3. This value was only 0.11% of the quarterly standard for lead. No lead concentrations of environmental concern were measured (see Fig. 4.10 for a 5-year lead trend).

Table 4.15. Lead concentrations in ambient air at the ETTP, 2006

Annual average for all stations = 0.00055 μg/m^3

Station	Quarterly averages of monthly composites (μg/m^3)				Maximum quarterly result (μg/m^3)	Maximum percent of quarterly standard[a]
	1	2	3	4		
K2	0.00024	0.00032	0.00038	0.00051	0.00051	0.03
K6	0.00033	0.00023	0.00086	0.00048	0.00086	0.06
K9	0.00164	0.00034	0.00071	0.00031	0.00164	0.11
K11	0.00035	0.00083	0.00096	0.00035	0.00096	0.06
Quarterly average	0.00064	0.00043	0.00073	0.00041	0.00073	0.05
Quarterly maximum	0.00164	0.00083	0.00096	0.00051	0.00164	0.11

[a]Tennessee and national air quality standard for lead is 1.5 μg/m^3 quarterly arithmetic average.

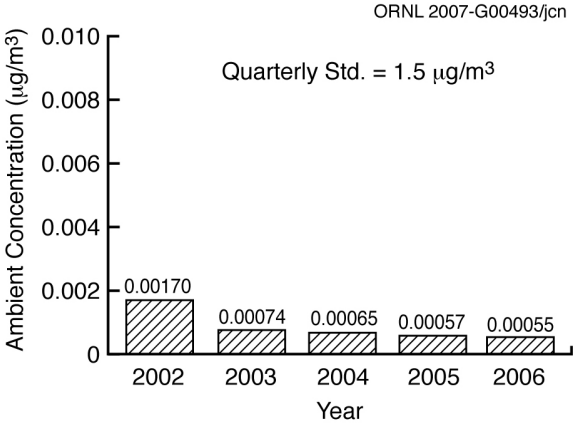

Fig. 4.10. Ambient air monitoring 5-year trend results for lead at the ETTP.

4.7.3 Hazardous Air Pollutant Carcinogenic Metal Levels

Analyses of hazardous air pollutant carcinogenic metals (arsenic, beryllium, cadmium, and chromium) were performed on quarterly composite samples of continuous weekly samples from stations K2, K6, K9, and K11. Total mass of each selected metal was determined by the ICP-MS analytical technique.

There are no Tennessee or national ambient air quality standards for these hazardous air pollutant carcinogenic metals. However, comparisons have been made against risk-specific doses and reference air concentrations.

The annual average arsenic concentration for all measurement sites was 0.00016 μg/m^3, well below the risk-specific dose of 0.0023 μg/m^3. The individual maximum measured result was 0.00044 μg/m^3. Annual beryllium measurements were at or near the minimum detectable concentrations of the analytical method, orders of magnitude below the risk-specific dose of 0.0042 μg/m^3. The combined beryllium average for all sites was < 0.000001 μg/m^3 with the individual maximum result of 0.000003 μg/m^3. The maximum cadmium concentration result was 0.00007 μg/m^3. The cadmium annual average was 0.00003 μg/m^3. Both results are well below the risk-specific dose of 0.0056 μg/m^3. Individual chromium measurements ranged from approximately 0.00001 to 0.00022 μg/m^3. The annual average result for chromium was 0.00007 μg/m^3, well below the risk-specific dose of 0.00088 μg/m^3 for chromium VI. The form of chromium was not determined, and therefore the most conservative risk-specific dose (chromium VI) was used. A summary of the hazardous air pollutant carcinogenic metals measurements is presented in Table 4.16.

4.7.4 Radionuclide Levels

Total uranium metal was measured as quarterly composites from stations K2, K6, K9, and K11. The total uranium mass for each sample was determined by the ICP-MS analytical technique. The annual uranium averages and maximum individual concentration measurements for all sites are presented in Table 4.17. The average annual results for each station ranged from a minimum of approximately 0.000007 to 0.000059 μg/m^3. The highest single quarterly result, 0.000167 μg/m^3, was measured at Station K9, which is in one of the prevailing wind directions from the TSCA Incinerator. The annual average value for all stations due to uranium was 0.000030 μg/m^3. The ICP-MS results are compared with a dose based on the DCG for natural

Table 4.16. Hazardous air pollutant concentrations in ambient air at the ETTP, 2006

Parameter	Ambient air concentration (μg/m^3)			Percentage of standard[a]
	Annual average (all stations)	Quarterly maximum	Maximum station	
Arsenic	0.00016	0.00044	K11	6.8
Beryllium	0.000001	0.000003	K9	<0.1
Cadmium	0.000028	0.000070	K11	0.5
Chromium	0.000067	0.000217	K11	
Cr-111				<0.1
Cr-VI				7.7

[a]There are no Tennessee or national ambient air quality standards; however, annual averages are compared to risk-specific doses for As, Be, Cd, and Cr-VI and the reference air concentration for Cr-III as listed in 40 CFR 266.

Table 4.17. Total uranium in ambient air by inductively coupled plasma mass spectrometry analysis at the ETTP, 2006

Station	Samples	Concentration[a] (μg/m^3)		Concentration[a] (μCi/mL)		Percent of DCG[b] (%)	
		Average	Maximum[c]	Average	Maximum[c]	Average	Maximum[c]
K2	4	0.000038	0.000102	2.54E-17	6.78E-17	0.03	0.07
K6	4	0.000007	0.000015	4.63E-18	9.68E-18	<0.01	0.01
K9	4	0.000059	0.000167	3.95E-17	1.11E-16	0.04	0.11
K11	4	0.000016	0.000024	1.07E-17	1.58E-17	0.01	0.02
ETTP total	16	0.000030	0.000167	2.01E-17	1.11E-16	0.02	0.11

[a]Mass-to-curie concentration conversions assume a natural uranium assay of 0.717% ^{235}U. 1 μCi = 3.7 × 10^{4}Bq.

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

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

uranium. (The DCG is based on an annual air concentration exposure that would give a dose of 100 mrem.) The sampling location with the highest annual average concentration of uranium was at K9. The annual result was only 0.000030 μg/m^3, which corresponds to 0.02% of the DCG (see Fig. 4.11 for 5-year uranium trend).

Periodic radiochemical analyses were initiated during 2000 on selected monthly composite samples collected at Stations K2, K6, K9, and K11. For 2006, analyses were based on quarterly composite samples from these 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 resulting annual concentrations for all nuclides measured are presented in Table 4.18. Results from stations K2, K6, K9,

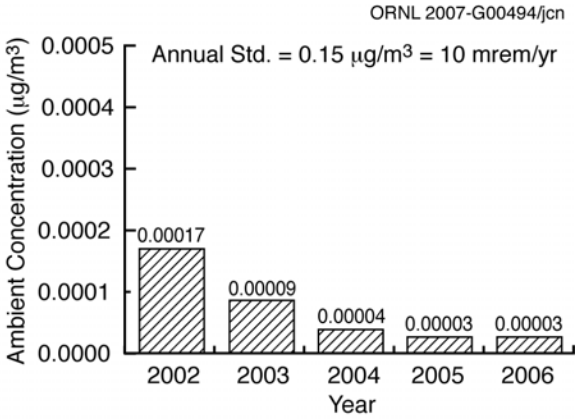

Fig. 4.11. Ambient air monitoring 5-year trend results for uranium at the ETTP.

Table 4.18. Radionuclides in ambient air by radiochemistry at the ETTP, 2006

Station[a]	Concentration (μCi/mL)[b]								
	^{237}Np	^{238}Pu	^{239}Pu	^{99}Tc	^{234}U	^{235}U	^{236}U	^{238}U	Total U
K2	*c*	6.58E-19	1.06E-18	3.28E-16	3.46E-17	3.91E-18	5.67E-19	6.87E-17	1.08E-16
K6	*c*	*c*	6.35E-19	1.71E-16	6.57E-18	3.47E-19	5.21E-19	6.58E-18	1.40E-17
K9	*c*	6.35E-19	2.49E-18	5.09E-16	5.28E-17	4.01E-18	1.83E-18	4.60E-17	1.05E-16
K11	*c*	*c*	1.05E-18	7.08E-16	3.51E-17	3.81E-18	*c*	3.41E-17	7.30E-17

[a]K2, K6, K9, and K11 annual results are the average of four quarterly composite analyses.
[b]1 μCi = 3.7×10^4 Bq.
[c]Not detected.

and K11 are averages of four quarterly composite sample analyses and represent an annual average for this report. For comparison, the total uranium results associated with ICP-MS analyses of composite samples are comparable with the uranium results determined by radiochemical techniques.

4.7.5 Organic Compound Levels

Currently, measurements of selected semivolatile organics are performed only during an operational upset of the TSCA Incinerator. The incinerator experienced one automatic thermal relief vent opening during 2006 due to a power loss in the ETTP distribution grid. This event occurred during the incineration of liquid wastes. If an unplanned release occurred, organic compound ambient air sampling stations TSCA1 and TSCA2 (see Fig. 4.9) would be activated automatically or manually. However, the potential release of organic compounds from this event was established to be below levels that would be detectable by ambient air monitoring. This decision was based on the characterizations of the wastes being processed at that time of the event and on the current inventory in the incinerator. The calculated waste inventory could not produce a detectable off-site impact. Additionally, meteorological conditions would not carry any potential release from the vent in the direction of either sampling station. Therefore, the samplers were not activated for this event.

4.7.6 Five-Year Trends

Five-year summaries of ETTP ambient air monitoring data are shown in Figs. 4.10 and 4.11 for lead and uranium, respectively. Variations of lead measurements were insignificant and most likely reflect background concentration variations of air quality. Uranium levels reflect typical levels that can be associated with normal ETTP operations.

Arsenic, beryllium, and cadmium measurements were initiated in 1993, and chromium measurements were initiated in 1986. Over the last 5 years, arsenic, cadmium, and chromium have been typically indistinguishable from background levels except during specific projects that have included major demolition activities. All beryllium measurements, historical and current, have been at or near analytical minimum detectable concentrations. During the 5-year period, no ambient air measurements have indicated any level of concern based on comparisons with any applicable standards.

4.8 ETTP Surface Water Monitoring

Surface water surveillance was conducted at eight locations at the ETTP (Fig. 4.12). Stations K-1710, MIK 1.4, and Clinch River kilometer (CRK) 23 provide information on conditions upstream of the ETTP. Stations K-716 and CRK 16 are located downstream from most ETTP operations and provide information on the cumulative effects of the ETTP activities as well as those upstream. The remaining sampling locations are at points where drainage in the major surface water basins converges before discharging to Poplar Creek (Stations K-1007-B, and K-1700) or to the Clinch River (Station K-901-A).

At most surveillance stations, semiannual sampling and analyses for radionuclides, metals, and field readings (dissolved oxygen, temperature, and pH) were conducted. At the Clinch River sites (CRK 16 and 23) volatile organic compounds were also monitored semiannually. Quarterly monitoring for volatile organics, metals, radionuclides, and field readings is con-

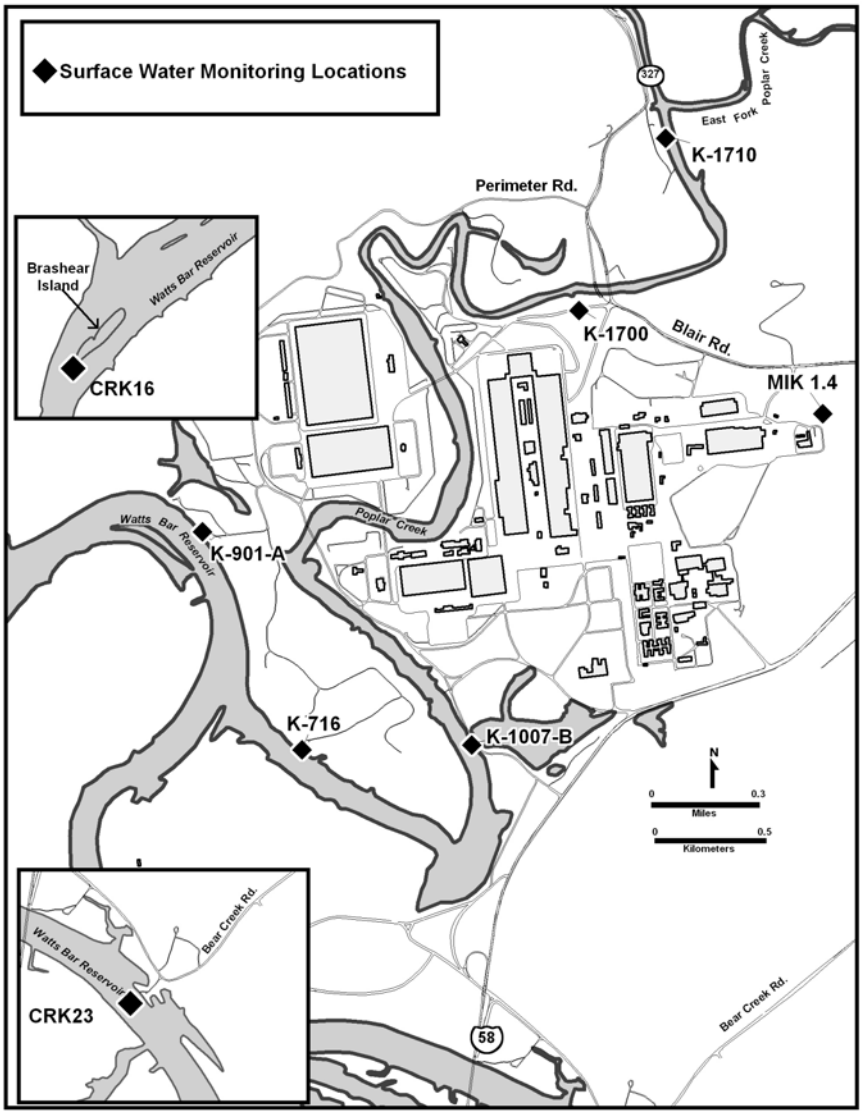

Fig. 4.12. Monitoring locations for surface water at the ETTP.

ducted at the K-1700 and MIK 1.4 locations. In November 2006, analytical results for chromium at K-1700 were 0.095 mg/L. The appropriate water quality standard at this location is 0.1 mg/L. Results from 2007 monitoring will be closely evaluated to determine whether chromium levels return to historic background levels. Further investigations will be initiated as appropriate based upon those results. Radionuclide results are compared with the DCGs. Nonradiological results are compared with Tennessee water quality standards for fish and aquatic life. The water quality standards use the numeric values given in the Tennessee general water quality criteria (TDEC 2004), which are a subset of the water quality standards.

In most instances, results of the monitoring for nonradiological parameters are well within the applicable standards. Heavy metals were often detected at CRK 16, K-901-A, and K-1700 (barium was the most common heavy metal detected), and certain volatile organics (primarily trichloroethane, vinyl chloride, and 1,2-dichloroethane) were regularly detected at K-1700, but in all instances the results were below the applicable water quality standard. Dissolved oxygen measurements at K-1700 fell below the minimum water quality standard of 5.0 mg/L during one summer sampling event due to a combination of elevated temperatures and the stagnation due to very low flows at that location. Water bodies in the vicinity of the

ETTP are regularly inspected for signs of stress on aquatic organisms during low-flow periods. For the remaining analyses, results were within the reference standards or below detection limits for the instrument and method. Moreover, analytical results for samples collected upstream of the ETTP were chemically similar in most respects to those collected below the ETTP.

The sum of the fractions of the DCGs for most stations remained below 1% of the DCG values for ingestion (Fig. 4.13). The highest sum of the fractions, 6.4% of the DCGs, was reported for sampling location K-1700. The results at the other surface water surveillance locations are all below 1% of the DCGs. These data are consistent with the historical results, except for the increase at K-1700. Due to this stasis, monitoring at the surveillance locations will continue to be maintained at the reduced frequency until significant changes are detected or until ETTP operations change to include activities with the potential to affect discharges.

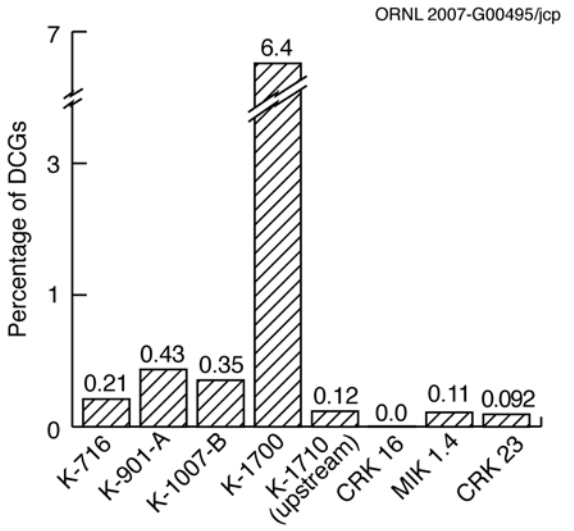

Fig. 4.13. Percentage of DOE derived concentration guides for ETTP surface water monitoring locations.

4.9 ETTP 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 *2007 Remedial Effectiveness Report for the U.S. Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee* (DOE 2007a).

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 (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 *2005 Remediation Effectiveness Report* (DOE 2007a) includes summaries of groundwater monitoring actions required for individual cleanup actions at the ETTP, along with recommendations to modify any requirements that would further ensure protection of human health and the environment.

4.10 ETTP Direct Radiation

The UF_6 cylinder storage yards and K-770 Scrap Yard at ETTP are potential sources of direct gamma and neutron radiation exposure to the public. Measured exposure rates and a hypothetical model of a maximally exposed individual were used to calculate theoretical doses. The calculated EDEs were based on gamma and neutron dose rates measured at the K-1066-J and K-1066-E Cylinder Yards along the near bank of Poplar Creek, the parking lot adjacent to the K-1066-K Cylinder Yard, and the near bank of

the Clinch River in the vicinity of the K-770 Scrap Yard. The dose levels to the public calculated from the measured exposure rates are less than the 100 mrem/year limit established by DOE Order 5400.5.

Gamma and neutron dose rates from each area were measured in January 2006 with tissue-equivalent dose rate meters. Background readings were established at the ambient air monitoring stations north and northeast of ETTP off Blair Road, south and southwest of ETTP in the Powerhouse Area, and west of ETTP at the K-901 pumping station. The average gamma background was 0.004 mrem/h. The average neutron background was 0.001 mrem/h.

The potential maximally exposed individual model used for exposure from the K-1066-J or K-1066-E Cylinder Yard is a hypothetical fisherman who was assumed to have spent 250 h/year near the point of average exposure. This hypothetical individual could have received an EDE above background of about 0.25 mrem from gamma radiation and 0.50 mrem from neutron radiation along the bank of Poplar Creek near the K-1066-E Cylinder Yard during 2006. That section of the creek runs through the ETTP plant and is used at times by fishermen; however, it is very unlikely that anyone would fish this stretch of Poplar Creek for 250 h/year. At the time of the January surveys, no cylinders were being stored in the K-1066-J Cylinder Yard, and consequently there was no potential dose above background levels at that location.

General area dose rates were recorded in the vicinity of the K-770 Scrap Yard, along the near bank of the Clinch River. A hypothetical fisherman who was assumed to have spent 250 h/year near the point of average exposure along the bank of the Clinch River near the K-770 Scrap Yard could have received an EDE above background of about 0.50 mrem from gamma radiation and no dose from neutron radiation during 2006.

The parking lot adjacent to the K-1066-K Cylinder Yard is used by workers and the public; therefore, it was included in the survey. This parking lot is intended for employees and has no public facilities. A potential maximally exposed individual is someone assumed to have spent 30 min per work day (125 h/year) waiting in the parking lot at the point of average exposure along the edge closest to the K-1066-K Cylinder Yard. This hypothetical individual could have received an EDE above background of no dose above background levels from gamma radiation and 0.13 mrem from neutron radiation during 2006. At the time of the survey, no cylinders were being stored in the K-1066-K Cylinder Yard.

4.11 Modernization and Reindustrialization

DOE-ORO established the Reindustrialization Program in 1996 as an innovative way to address some of the environmental and financial challenges left at the end of the Cold War. Under the program, transfers of excess or underutilized land and facilities are made available. The goal is to accelerate cleanup by reducing costs, while allowing for the productive use of the assets by the private sector. The process helps to offset negative impacts on the community caused by DOE downsizing, facility closeouts, and workforce restructuring. DOE-ORO worked with local officials and business leaders to establish CROET. Through CROET, the Reindustrialization Program has successfully leased land and facilities at the ETTP. DOE-ORO has transitioned to a cleanup of ETTP in preparation for its closure as a DOE site. ETTP will then be available for use as a private-sector industrial park. As part of this accelerated process, the emphasis is on facility transfer of ownership (title transfer).

In 2003, DOE-ORO completed a FONSI to allow the transfer of property to Horizon Center LLC. The property, in the past known as Parcel ED-1, only consists of the portions suitable for development. The remainder of the property, known as the Natural Area, will continue to be leased by Horizon Center LLC and owned by DOE.

DOE has been working with the state of Tennessee to grant the state an indefinite-term conservation easement of approximately 1214 hectares to be located on the west end of the ORR. This action, the result of an agreement-in-principle related to the Natural Resources Damage Act affecting the ORR, was granted in early 2005.