4. ETTP Environmental Monitoring Programs

Setting

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 their emission points 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.

Update

In 2001, the emissions of radionuclides from ETTP operations were well within the allowable derived concentration guides published in DOE Order 5400.5, and were similar in most respects to 2000 emissions. Potential direct radiation to the public from uranium hexafluoride cylinder storage yards 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

In order 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., National Emission Standards for Hazardous Air Pollutants (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 Bechtel Jacobs Company LLC from operators subject to NESHAP regulations. For 2001, other prime contractors working directly for DOE at ETTP were also subject to NESHAP; data were obtained from the applicable sources and are reported here. 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 2001 varied from the previous year's total because of fluctuations in site operations. For this reporting period, a total of seven point sources and two grouped minor sources 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 radio-

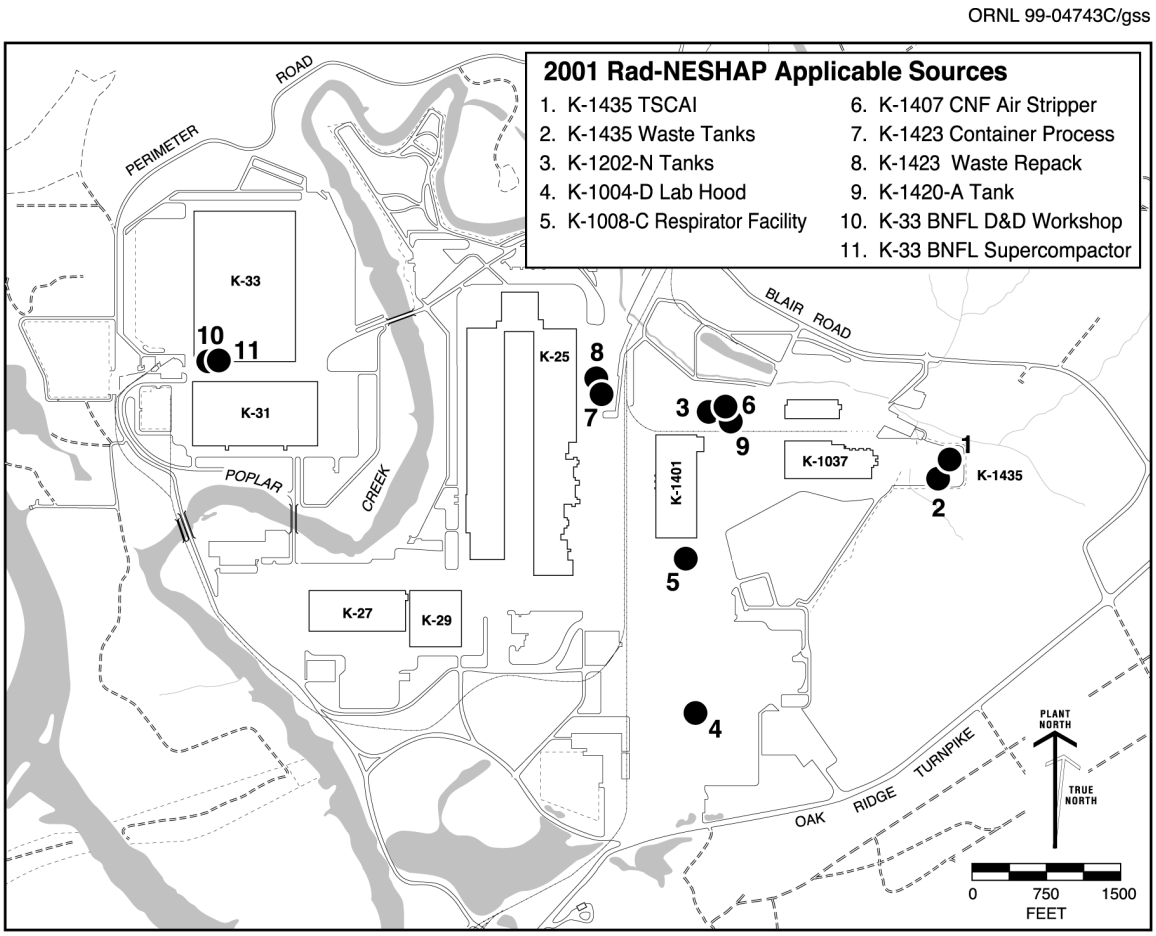


Fig. 4.1. Locations of airborne radionuclide point sources at the ETTP.

nuclide emissions that would cause a dose in excess of 0.1 mrem/year effective dose equivalent as defined under the rule. The two grouped minor sources are the laboratory hoods, grouped as 2 emission points, and the Toxic Substances Control Act (TSCA) Incinerator tank farm, a group of 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)—six point sources and one grouped source,
- health physics air measurements where room ventilation emissions exceeded 10% of derived air concentration worker protection guidelines—no sources,
- surrogate emission data from similar sources—one point source, 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

Three ETTP major sources operated during 2001. 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 radionuclides. Measurements of TSCA Incinerator emissions were based on monthly composites of weekly stack samples.

BNFL, Inc., operated two sources in the K-33 building requiring the continuous monitoring of radiological emissions. The decontamination and decommissioning workshop has two identical atmospheric release points, each equipped with a particulate filtration system and a continuous sampling device. The supercompactor vent continuous sampling system is the same design as the decontamination and decommissioning workshop units.

4.1.2 Results

The ETTP 2001 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. 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 Tennessee Department of Environment and Conservation (TDEC) Division of Air Pollution Control, the ETTP has eight major air emission sources listed as subject to Tennessee Title V Major Source Operating Permit program rules. 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. Beginning in 1999, the ETTP steam plant was transferred to the Community Reuse Organization of East Tennessee and is no longer included in the ASER. The ETTP paid an annual fee in 2001 amounting to $10,251.80. Table 4.3 shows the inventoried regulated emissions during 2001 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. Thus, actual emissions from the incinerator are inventoried with respect to determining the ETTP annual fee. 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 is reasonably achievable” process to minimize potential exposures to members of the public.

Table 4.1. East Tennessee Technology Park radionuclide air emission totals, 2001 (Ci)[a]

Radionuclide	Total major	TSCAI (major)[b]	Total minor	Total ETTP
^{228}Ac	–	–	9.26E–09	9.26E–09
^{241}Am	–	–	2.69E–07	2.69E–07
^{125}Sb	–	–	4.17E–10	4.17E–10
^{212}Bi	–	–	1.47E–09	1.47E–09
^{214}Bi	–	–	2.78E–09	2.78E–09
^{109}Cd	–	–	3.58E–09	3.58E–09
^{14}C	2.92E–04	2.92E–04	5.85E–05	3.51E–04
^{143}Ce	–	–	7.39E–11	7.39E–11
^{137}Cs	2.40E–04	2.40E–04	8.83E–06	2.48E–04
^{51}Cr	–	–	1.37E–12	1.37E–12
^{57}Co	–	–	2.85E–08	2.85E–08
^{58}Co	–	–	1.39E–09	1.39E–09
^{60}Co	–	–	2.37E–07	2.37E–07
^{152}Eu	–	–	3.71E–09	3.71E–09
^{154}Eu	–	–	8.82E–09	8.82E–09
^{155}Eu	–	–	1.32E–09	1.32E–09
^{129}I	–	–	2.78E–15	2.78E–15
^{131}I	–	–	2.38E–06	2.38E–06
^{55}Fe	–	–	1.39E–08	1.39E–08
^{59}Fe	–	–	1.52E–13	1.52E–13
^{85}Kr	2.83E–03	2.83E–03	9.61E–04	3.34E–03
^{210}Pb	–	–	1.69E–07	1.69E–07
^{212}Pb	–	–	3.95E–09	3.95E–09
^{214}Pb	–	–	2.35E–09	2.35E–09
^{54}Mn	–	–	6.95E–10	6.95E–10
^{237}Np	5.41E–06	5.41E–06	1.40E–06	6.81E–06
^{63}Ni	–	–	1.12E–09	1.12E–09
^{93m}Nb	–	–	5.01E–13	5.01E–13
^{95}Nb	–	–	3.74E–08	3.74E–08
^{238}Pu	3.04E–06	3.04E–06	1.92E–07	3.23E–06
^{239}Pu	3.46E–06	3.46E–06	2.15E–07	3.68E–06
^{210}Po	–	–	9.25E–09	9.25E–09
^{40}K	–	–	7.89E–07	7.89E–07
^{233}Pa	–	–	7.34E–09	7.34E–09
^{234}Pa	–	–	6.84E–08	6.84E–08
^{234m}Pa	5.32E–03	5.32E–03	2.58E–04	5.58E–03
^{226}Ra	–	–	3.14E–07	3.14E–07
^{106}Ru	–	–	1.21E–08	1.21E–08
^{22}Na	–	–	4.46E–10	4.46E–10
^{89}Sr	–	–	1.08E–07	1.08E–07
^{90}Sr	7.93E–06	7.93E–06	1.78E–06	9.72E–06

Table 4.1 (continued)

Radionuclide	Total major	TSCAI (major)[b]	Total minor	Total ETTP
^{99}Tc	3.96E–03	3.96E–03	4.85E–05	4.01E–03
^{125m}Te	–	–	2.07E–13	2.07E–13
^{208}Tl	–	–	4.14E–09	4.14E–09
^{228}Th	4.94E–05	4.94E–05	2.38E–07	4.96E–05
^{230}Th	1.88E–04	1.88E–04	1.62E–06	1.89E–04
^{231}Th	–	–	4.80E–07	4.80E–07
^{230}Th	1.88E–04	1.88E–04	1.62E–06	1.89E–04
^{231}Th	–	–	4.80E–07	4.80E–07
^{232}Th	1.27E–04	1.27E–04	2.16E–06	1.29E–04
^{234}Th	2.53E–03	2.53E–03	1.55E–04	2.68E–03
^{3}H	3.39E+02	3.39E+02	1.79E–02	3.39E+02
^{233}U	–	–	1.54E–05	1.54E–05
^{234}U	7.53E–04	4.96E–04	1.08E–04	8.61E–04
^{235}U	8.82E–04	8.68E–04	8.01E–06	8.90E–04
^{236}U	–	–	1.57E–06	1.57E–06
^{238}U	9.49E–04	8.44E–04	1.95E–04	1.14E–03
^{65}Zn	–	–	1.80E–09	1.80E–09
Totals	3.39E+02	3.39E+02	1.98E–02	3.39E+02

[a]1 Ci = 3.7E+10 Bq.
[b]Toxic Substances Control Act Incinerator.

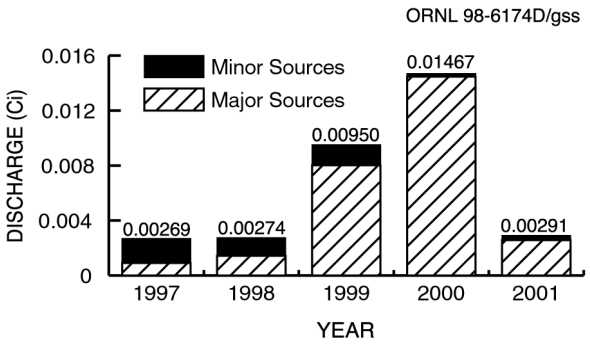


Fig. 4.2. Total curies of uranium discharged from the ETTP to the atmosphere, 1997–2001.

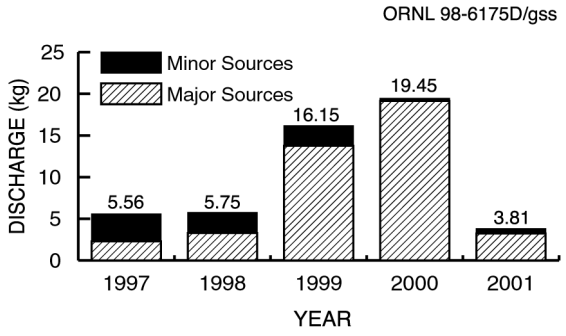


Fig. 4.3. Total kilograms of uranium discharged from the ETTP to the atmosphere, 1997–2001.

4.3.1 Sample Collection and Analytical Procedure

The ETTP monitored the treated effluent from the K-1407-J Central Neutralization Facility (Outfall 014) (Fig. 4.4). Weekly samples were collected from the Central Neutralization Facility and were composited into monthly samples. These samples were then analyzed for radionuclides. Results of these sampling efforts were compared with the derived concentration guides (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 radionuclide from ETTP via the storm water discharge system.

Table 4.2. Allowable emissions of criteria pollutants from the East Tennessee Technology Park, 1997–2001

Pollutant	Allowable emissions (tons/year)				
	1997	1998	1999	2000	2001
Particulate matter	194	192	13	13	13
Volatile organic compounds	120	122	14	14	14
Sulfur dioxide	428	427	39	39	39
Nitrogen oxides	224	185	20	20	20
Carbon monoxide	157	147	20	19	19
Hazardous air pollutants	24	24	21	20	21
Miscellaneous	0	0	0	0	0
Total	1147	1097	127	125	126

Table 4.3. Actual emissions of criteria pollutants from permitted East Tennessee Technology Park sources, 2001

Pollutant	Actual emissions	
	lb/year	tons/year
Particulate matter	11.5	0.006
Volatile organic compounds	371.5	0.19
Sulfur dioxide	7.7	0.004
Nitrogen oxides	11,837	5.92
Carbon monoxide	3,095	1.55

Table 4.4. Actual vs allowable air emissions from the Toxic Substances Control Act Incinerator at the East Tennessee Technology Park, 2001

Pollutant	Emissions (tons/year)		Percentage of allowable
	Actual	Allowable	
Lead	0.004	0.575	0.6
Beryllium	0.000002	0.00037	0.5
Mercury	0.001	0.088	1.4
Hydrogen fluoride	0.003	2.98	0.1
Hydrogen chloride	0.02	16.12	0.14
Sulfur dioxide	0.004	38.5	0.01
Particulate matter	0.006	13.1	0.04

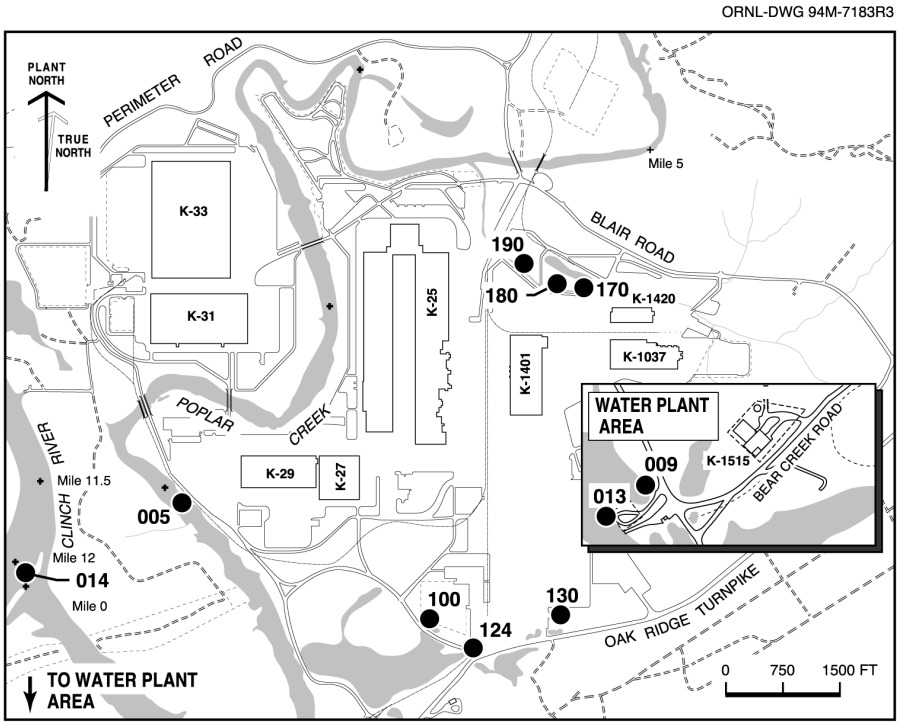


Fig. 4.4. ETTP National Pollutant Discharge Elimination System major outfalls and Category IV storm water outfalls.

4.3.2 Results

The sum of the fractions of the DCGs at the Central Neutralization Facility was calculated at 14.6% for 2001, up from 11.2% in 2000. Table 4.5 lists radionuclides discharged from the ETTP to off-site surface waters in 2001. Total uranium discharges from the Central Neutralization Facility were 0.0059 Ci in 2001. Total discharge of transuranics was 1.6×10^{-4} Ci, which is more than an order of magnitude less than the contribution from uranium.

Uranium discharges from the Central Neutralization Facility 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, although ^{3}H, with slightly smaller contributions from ^{14}C and ^{99}Tc, accounted for the largest portion of the total activity discharged. This is because the allowable DCGs for ^{3}H, ^{14}C, and ^{99}Tc are much higher than the DCG for uranium (Fig. 4.6). TSCA Incinerator wastewater, which is sent to the Central Neutralization Facility for treatment before discharging at Outfall 014, is a major contributor of uranium; other operations contribute smaller amounts.

The radionuclides discharged from the ETTP storm water system in 2001are listed in Table 4.6. Total uranium discharges from ETTP storm water outfalls were 0.003 Ci in 2001. Total technetium discharges from ETTP stormwater outfalls were 0.007 Ci in 2001.

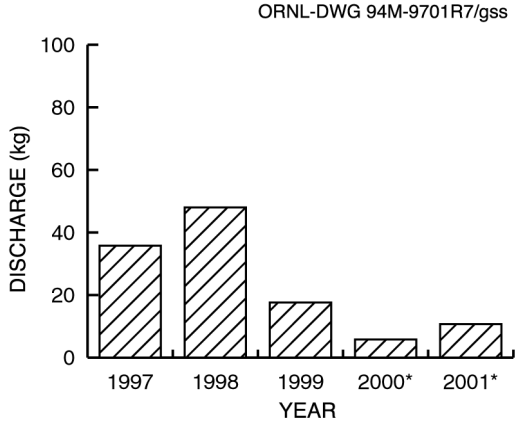
4.4 NONRADIOLOGICAL LIQUID DISCHARGES—ETTP SURFACE WATER EFFLUENTS

The current ETTP National Pollutant Discharge Elimination System (NPDES) permit (Permit Number TN0002950) went into effect on October 1, 1992, and a major modification was issued effective June 1, 1995. The modification included removal of inactive outfalls, addition of effluent limits for new treatment technologies at the Central Neutralization Facility, addition of new storm drains, and clarification of various requirements.

Table 4.5. Radionuclides released to off-site surface waters from the East Tennessee Technology Park, 2001
Effluent discharge locations, Central Neutralization Facility

Radionuclide	Amount (Ci)[a]	Radionuclide	Amount (Ci)[a]
^{241}Am	1.6E–5	^{238}U	3.8E–3
^{137}Cs	4.8E–3	^{14}C	1.3E–1
^{237}Np	1.3E–4	^{3}H	2.2E–1
^{238}Pu	1.6E–5	^{234}U	1.9E–3
^{239}Pu	1.0E–5	^{235}U	9.2E–5
^{99}Tc	5.4E–2	^{236}U	6.7E–5

[a]1 Ci = 3.7E+10 Bq.



**Outfall 014 only.*

Fig. 4.5. Five-year trend of uranium releases to surface waters from the ETTP (Outfalls 005 and 014).

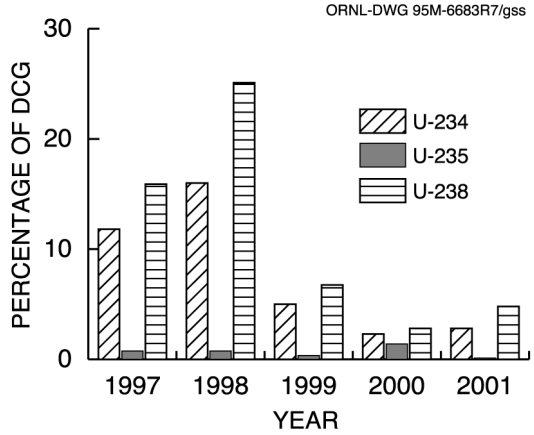


Fig. 4.6. Percentage of DOE derived concentration guides for uranium isotopes from K-1407-J (Outfall 014).

Table 4.6. Radionuclides released to off-site surface waters from the East Tennessee Technology Park storm water system, 2001

Radionuclide	Amount (Ci)[a]	Radionuclide	Amount (Ci)[a]
^{137}Cs[b]	2.1E–3	^{99}Tc	7.1E–3
^{40}K	3.1E–2	^{234}U	1.6E–3
^{237}Np	1.3E–5	^{235}U	9.8E–5
^{212}Pb	2.8E–4	^{236}U	9.3E–5
^{238}Pu[b]	–1.1E–4	^{238}U	9.6E–4
^{239}Pu	9.9E–5		

[a]1 Ci = 3.7E+10 Bq.
[b]All results less than or equal to laboratory error values.

In accordance with this NPDES permit, the ETTP is authorized to discharge process wastewater, cooling water, storm water, steam condensate, and groundwater to the Clinch River, Poplar Creek, and Mitchell Branch. The permit currently includes 2 process outfalls and 136 storm water outfalls. Compliance with the permit for the last 5 years is summarized in Fig. 4.7. Table 4.7 details the permit requirements and compliance records for all of the outfalls that discharged during 2001. The table provides a list of the discharge points, effluent analytes, permit limits, number of noncompliances, and the percentage of compliance for 2001. Samples from these outfalls are collected and analyzed as specified in the NPDES permit.

The two permitted outfalls on the ETTP are Outfall 005, the permitted outfall for discharge of treated effluent from the K-1203 Sewage Treatment Plant to Poplar Creek, and Outfall 014, the permitted outfall for the discharge of effluent from the Central Neutralization Facility to the Clinch River.

The current ETTP NPDES Permit expired on September 29, 1997. An application for renewal of this permit was submitted to TDEC in March 1997. To facilitate the transfer of ownership and operation of ETTP facilities to other parties, it was determined that separate NPDES permits would be required for each of the ETTP treatment facilities. In addition, it was determined that a separate NPDES permit for the storm water drainage system would be necessary. A general NPDES permit for former outfalls 009 (K-1515 Sanitary Water Plant) and 013 (K-1513 Sanitary Water Intake Backwash Filter) was issued on January 14, 2000, and became effective on March 1, 2000. The issuance of this permit (Permit Number TN0074233) allowed outfalls 009 and 013 to be removed from ETTP NPDES Permit Number TN0002950. The K-1203 Sewage Treatment Plant, the Central Neutralization Facility, and the ETTP storm water outfalls will continue to discharge under NPDES Permit Number TN0002950 until new NPDES permits for these outfalls are issued.

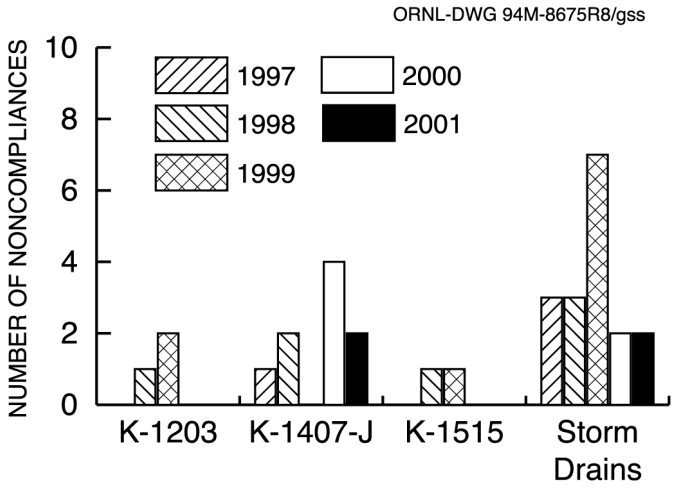


Fig. 4.7. ETTP National Pollutant Discharge Elimination System compliance history by source of noncompliance.

4.4.1 Results

The ETTP had four NPDES noncompliances in 2001, two at the Central Neutralization Facility and two at storm water outfalls. On September 28, 2001, an accidental discharge of wastewater occurred from the Central Neutralization Facility, NPDES Outfall 014, to the Clinch River. The discharge was discovered when an erratic discharge flow rate was observed. After the accuracy of the flow measurement was confirmed, a check of the air-operated flow-directional valve was performed. A mechanical failure of this valve was identified. The failure of the valve allowed a partial amount of the batch of treated wastewater to bypass the filtration, air-stripping, and carbon-adsorption units. Immediate actions were taken to close the valve. In order to prevent any future incidents of this type, the valve actuator and the air supply solenoid exhaust filter were replaced.

It is not expected that any NPDES permit parameter limits were exceeded because the entire batch of wastewater received chemical oxidation treatment. No threat to human health or the environment is believed to have occurred as a result of this event. A courtesy notification of the event was made to the TDEC/DOE Oversight staff.

On October 11, 2001, it was discovered that there were no results for a VC3 sample (acetone, acetonitrile, and methyl ethyl ketone) that was required for the third quarter of CY 2001 for the Central Neutralization Facility (NPDES Outfall 014). A review was conducted of the contaminants of concern, sampling schedules, and logbook

Table 4.7. National Pollutant Discharge Elimination System compliance at the ETTP, 2001

Discharge point	Effluent parameter	Effluent limits				No. of noncompliances	Percentage of compliance
		Monthly avg[a]	Daily max[a]	Monthly avg (lb/day)	Daily max (lb/day)		
Outfall 005 (K-1203 Sewage Treatment Facility)	Ammonia nitrogen	5	7	27	38		100
	Biochemical oxygen demand	15	20	81	109		100
	Chlorine, total residual	0.14	0.24				100
	Dissolved oxygen		5[b]				100
	Fecal coliform, col/100 mL	200[c]	1,000				100
	LC_{50}, *Ceriodaphnia*, %		14.6[d]				100
	LC_{50}, *Pimephales*, %		14.6[d]				100
	NOEL,[e] *Ceriodaphnia*, %		4.2[d]				100
	NOEL,[e] *Pimephales*, %		4.2[d]				100
	pH, standard units		6.0–9.0				100
	Settleable solids, mL/L		0.5				100
	Suspended solids	30	45	27	244		100
Outfall 014 (K-1407-J Central Neutralization Facility to Clinch River)	Benzene	*d*	0.005				100
	Cadmium	0.18	0.69				100
	Carbon tetrachloride	0.5	0.5				100
	Chloride, total	35,000	70,000				100
	Chlorine, total residual		1.0				100
	Chloroform	0.5	0.5				100
	Chromium	1.71	2.77				100
	Copper	1.34	2.15				100
	Ethylbenzene		0.01				100
	Lead	0.38	0.69				100
	Nickel	2.38	3.98				100
	Oil and grease		30				100
	PCB	0.00022	0.00045				100
	Petroleum hydrocarbons		0.1				100
	pH, standard units		6.0–9.0				100
	Silver	0.24	0.43				100
	Suspended solids		40				100
	Tetrachloroethylene		0.7				100
	Toluene		0.01				100
	Total toxic organics		2.13				100
	Trichloroethylene	0.5	0.5				*f*
	Vinyl chloride	0.2	0.2				*f*
	Zinc	1.48	2.61				
	Unpermitted discharge	*f*	*f*			1	
	Missed sample	*f*	*f*			1	
Category I storm drains	pH, standard units		4.0–9.0				100
Category II storm drains	pH, standard units		4.0–9.0				100
Category III storm drains	pH, standard units		4.0–9.0				100
Category IV storm drains (to Poplar Creek)	Chlorine, total residual		0.14				100
	pH, standard units		6.0–9.0				100
Category IV storm drains (to Mitchell Branch)	Chlorine, total residual		0.019			2	83
	pH, standard units		6.0–9.0				100

[a]Units are mg/L unless otherwise stated.
[b]Daily minimum.
[c]Geometric mean.
[d]Toxic if LC_{50} <14.6% effluent or NOEL < 4.2%.
[e]No observable effect level.
[f]Not applicable.

entries for July, August, and September 2001. Verification was made that a VC3 sample had not been collected for the third quarter of CY 2001.

Corrective actions were implemented to improve sample scheduling to ensure that no future samples are missed. In addition, an increased management review of sampling protocol has been implemented.

On January 2, 2001, the required quarterly sample for total residual chlorine was taken at storm water outfall 170. The total residual chlorine level at storm water outfall 170 was measured at 0.231 mg/L. This measurement exceeded the ETTP's NPDES permit limit for outfall 170, which is 0.019 mg/L.

It was determined that the source of the elevated total residual chlorine was a sanitary water line rupture in the area near Building K-1037. The broken sanitary water line was believed to have been caused by the alternating freezing and thawing of the soil during cold weather conditions, which puts a great amount of stress on underground utilities. Utility subcontractor personnel placed a mesh bag containing sodium sulfite tablets into the affected storm water catch basin to dechlorinate the water entering the storm drain system from the sanitary water line leak. Efforts to identify and repair the leaking sanitary water line were begun upon receiving all appropriate excavation permits and other required documentation. Utility subcontractor personnel isolated the leaking sanitary water line and removed it from service. No further elevated total residual chlorine readings have been noted at outfall 170 since this water line was repaired.

No threat to human health or the environment is believed to have occurred as a result of this event. A courtesy notification of the event was made to the TDEC/DOE Oversight staff.

On January 2, 2001, the required quarterly sample for total residual chlorine was taken at storm water outfall 180. The total residual chlorine level at storm water outfall 180 was measured at 0.233 mg/L. This measurement exceeded the ETTP's NPDES permit limit for outfall 180, which is 0.019 mg/L. It was determined that a sanitary water line had ruptured in the area near the southeast corner of Building K-1303. The broken sanitary water line was believed to have been caused by the alternating freezing and thawing of the soil during cold weather conditions, which puts a great amount of stress on underground utilities. Utility subcontractor personnel placed a mesh bag containing sodium sulfite tablets downstream of the area of the sanitary water leak to dechlorinate the water entering the storm drain system from the sanitary water line break. The portion of the sanitary water line that was leaking was immediately isolated and valved off. The leaking portion of the sanitary water line was repaired at a later date.

No threat to human health or the environment is believed to have occurred as a result of this event. A courtesy notification of the event was made to TDEC/DOE Oversight staff.

4.5 STORM WATER POLLUTION PREVENTION PROGRAM

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.

Based on knowledge of past processes and activities at the ETTP, only parameters of particular concern were monitored during 2001. These parameters include gross alpha radioactivity, gross beta radioactivity, polychlorinated biphenyls (PCBs), mercury, metals, and volatile organic compounds. Gross alpha and gross beta radioactivity were monitored at storm drain outfalls where they were detected at levels above screening criteria during more than one previous sampling effort. PCBs were monitored at storm

drain outfalls where they were detected above the detection limit of the analytical method. Metals were monitored at locations where they were detected in amounts exceeding the screening criteria during more than one previous sampling effort and that may have received runoff from cooling tower areas. Volatile organics were monitored at storm drain locations that are potentially affected by contaminated groundwater plumes and at locations where they were detected in amounts exceeding the screening criteria during more than one previous sampling effort.

Analytical results from the storm water sampling effort were compared to 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 this Storm Water Pollution Prevention Program 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. Exceedance of screening criteria does not necessarily indicate a potential area of concern. Screening levels are used only to identify areas that may require further investigation and to eliminate areas where no concerns are present from additional investigation.

All storm water samples were collected according to guidelines stated in Sect. 7.4 of the *ETTP Storm Water Pollution Prevention Program Baseline Document*, (BJC 2002d).

Gross alpha radiation was detected in the discharge from storm water outfall SD-350 at a level of 162 pCi/L. This level exceeds the screening criterion for gross alpha activity of 15 pCi/L, which is the maximum contaminant level established by the Safe Drinking Water Act. In addition, gross beta radiation was detected in the discharge from this storm water outfall at a level of 76.5 pCi/L. This level exceeds the screening criteria for gross beta activity of 50 pCi/L, which is the maximum contaminant level established by the Safe Drinking Water Act. Also, several radionuclides were detected in the discharge from SD-350 that were in excess of 4% of the DCGs for air and water. This represents the DOE criterion of 4-mrem effective dose equivalent from ingestion of drinking water. Uranium-233/234 was detected in the discharge from SD-350 at a level of 70.31 pCi/L, which exceeds the 4% of DCG standard of 20 pCi/L for this radionuclide. Potassium-40 was detected in the discharge from SD-350 at a level of 798 pCi/L, which exceeds the 4% of DCG standard of 280 pCi/L for this radionuclide.

Storm water outfall SD-350 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 (UF_6) cylinders. In addition, SD-350 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. A portion of the SD-350 drainage network consists of an open, grass-lined ditch that has been roped off as a radioactively contaminated area. The area that drains to SD-350 will be addressed as part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site-wide remedial action program.

Gross alpha radiation was detected in the discharge from storm water outfall SD-292 at a level of 63.3 pCi/L, which exceeds the maximum contaminant level of 15 pCi/L for this analyte. Gross beta radiation was detected in the discharge from SD-292 at a level of 87.6 pCi/L, which exceeds the maximum contaminant level of 50 pCi/L for this analyte. Also, several radionuclides were detected in the discharge from SD-292 at levels in excess of 4% of the DCG. Uranium-233/234 was detected at a level of 30.83 pCi/L, which exceeds the 4% of DCG level of 20 pCi/L for this radionuclide. Uranium-238 was detected at a level of 24 pCi/L, which equals 4% of the DCG for this analyte. Potassium-40 was detected at a level of 724.8 pCi/L, which exceeds the 4% of DCG level of 280 pCi/L for this radionuclide.

Storm water outfall SD-292 receives storm water runoff from the converter shell storage area on the K-1064 peninsula. The converter shells, which were once utilized in the uranium enrichment process, are surrounded by a gravel berm. Storm water runoff from the converter shell storage area is directed toward SD-292 by these berms. A project is currently scheduled for

FY 2003 to organize and remove materials that have been stored at K-1064.

Gross alpha radiation was detected in the discharge from storm water outfall SD-160 at a level of 114 pCi/L, which exceeds the maximum contaminant level of 15 pCi/L for this analyte. Gross beta radiation was detected in the discharge from SD-160 at a level of 49 pCi/L, which approaches but does not quite exceed the maximum contaminant level of 50 pCi/L for this analyte. Also, several radionuclides were detected in the discharge from SD-160 at levels in excess of 4% of the DCG. Uranium-233/234 was detected at a level of 66 pCi/L, which exceeds the 4% of DCG level of 20 pCi/L for this analyte. Uranium-238 was detected at a level of 38 pCi/L, which exceeds the 4% of DCG level of 24 pCi/L for this analyte.

Storm water outfall SD-160 carries drainage from the roof of building K-1420. This building has been used in the past for a variety of functions, including uranium recovery, classified parts disassembly and cleaning, and reclaiming of uranium-contaminated oil. Decontamination and decommissioning activities were initiated at K-1420, but are suspended at this time.

Gross alpha radiation was detected in the discharge from storm water outfall SD-724 at a level of 36 pCi/L, which exceeds the maximum contaminant level of 15 pCi/L for this analyte. None of the individual radionuclides were detected at this location in excess of 4% of the DCG.

Storm water outfall SD-724 carries runoff from the K-770 Scrap Metal Yard. Various types of metals generated during operation of the K-25 Site are stored at the K-770 area. Much of the material stored at this scrap yard is contaminated with radioactive material, especially uranium. The area that drains to SD-724 will be addressed as part of the CERCLA site-wide remedial action program.

Gross alpha radiation was detected in the discharge from storm water outfall SD-158 at a level of 17 pCi/L, which exceeds the maximum contaminant level for this analyte. None of the individual radionuclides were detected at this location in excess of 4% of the DCG.

Storm water outfall SD-158 was smoke tested in 1997 and was found to carry roof drainage from the south side of building K-1420. In addition, a catch basin was identified that collects storm water runoff from a grassy area located in a radiation protection area north of K-1420.

Metals concentrations above applicable screening criteria were detected at several of the locations sampled as part of the FY 2001 sampling effort. Metals that were commonly detected in storm water runoff included aluminum, iron, magnesium, manganese, potassium, calcium, and sodium. However, the presence of these metals in storm water runoff in concentrations above screening criteria is not believed to be problematic. All of these metals are commonly found in soils and sediments within the geographic region of the ETTP. The source of the metals detected in the samples collected as part of this sampling effort is most likely related to sediment and suspended solids being transported in storm water runoff. In addition, concentrations of these metals in storm water outfalls that flow on a constant basis may be attributable to the discharge of groundwater. This condition is known to occur at several storm water outfalls. Therefore, it is believed that the vast majority of detectable concentrations of metals detected in storm water effluent from ETTP is due to the contact of storm water with the soil and/or the discharge of groundwater containing detectable metals concentrations.

Metals other than those mentioned above that are commonly found in soils and sediments of this area were compared to a screening criterion of 100 µg/L, which is found in Part III, Section A of the ETTP NPDES Permit. This screening criterion was used to determine whether metals were being discharged in storm water in quantities that could impact the environment. Metals that are not commonly found in the soils and sediments of this area, and metals that were historically used or are currently being used in any of the following were compared to the 100-µg/L screening criterion:

- metals that may have been discharged to the environment as part of an industrial process at ETTP;
- metals that have been or are currently being used in wood preservatives, cooling tower treatments, or other industrial uses; and
- metals that could have been transported from burial grounds or disposal areas in ground-water flow.

A storm water sample collected at SD-190 contained nickel at a concentration of 235 µg/L, boron at a concentration of 102 µg/L, and a barium concentration of 103 µg/L. Another sample collected at SD-190 had a nickel concentration of 152 µg/L, a boron concentration of 122 µg/L, and a barium concentration of 116 µg/L. A storm water sample collected at SD-100 contained zinc at a concentration of 443 µg/L. Each of these results exceeds the screening criteria of 100 µg/L.

The exact source of these metals is not known. It is most likely that they are natural components of soils and sediments in the area, but in more limited quantities than other, more common metals. If the presence of these metals in discharges from the storm drain system is determined to be detrimental to the environment, additional efforts will be undertaken to identify potential sources of these metals. Remedial actions may be considered, if appropriate. Additional sampling for metals will be performed as part of the FY 2002 sampling program.

Volatile organics were not detected in concentrations greater than the established screening level of 100 µg/L in any of the storm water samples collected as part of the FY 2001 sampling program. However, volatile organics were detected in concentrations greater than State of Tennessee Water Quality Criteria at two storm drain locations.

At SD-180, trichloroethene was detected at a concentration of 57 µg/L in a storm water sample. The Tennessee Water Quality Criteria for Domestic Water Supply for this compound is 5 µg/L. Also, 1,1-Dichloroethene was detected at SD-180 at a concentration of 3 µg/L. The Tennessee Water Quality Criteria for Recreation and Water Supply for this compound is 0.57 µg/L.

At SD-190, vinyl chloride was detected at a concentration of 100 µg/L. The Tennessee Water Quality Criteria for Domestic Water Supply for this compound is 2 µg/L. In addition, trichloroethene was detected at SD-190 at a concentration of 38 µg/L. The Tennessee Water Quality Criteria for Domestic Water Supply for this compound is 5 µg/L. 1,1-Dichloroethane was detected at SD-190 at a concentration of 30 µg/L. The Tennessee Water Quality Criteria for Recreation and Water Supply for this compound is 10 µg/L. 1,1-Dichloroethene was detected at SD-190 at a concentration of 10 µg/L. The Tennessee Water Quality Criteria for Recreation and Water Supply for this compound is 0.57 µg/L.

The presence of these volatile organic compounds at SD-180 and SD-190 is believed to be due to the discharge of contaminated groundwater and not to the discharge of contaminated storm water runoff.

Aroclor-1248 was found at a concentration of 1.3 µg/L at SD-100. SD-100 received discharges from the K-1004 area laboratory drain system for many years. A RCRA facility investigation of the K-1004 laboratory drain system conducted in 1988 indicated that several types of contaminants, including PCBs, were believed to have been present in discharges from the laboratory drains. An investigation performed in 1995 by ORNL personnel using semipermeable membrane devices indicated the presence of PCBs in several tributary pipes in the SD-100 network, including several in the K-1004 laboratory complex. Remediation of PCBs in the SD-100 network will be conducted as part of the CERCLA site-wide remedial action program.

Aroclor-1254 was detected at SD-190 at a concentration of 0.41 µg/L. The exact source of the PCBs discharged at this outfall is unknown. Additional sampling in the SD-190 piping network may be conducted to pinpoint the location of the PCB contamination. Remediation of PCBs in the SD-190 network will be addressed as part of the CERCLA site-wide remedial action program.

Sump S-032A is located in Building K-808. The sump collects water that enters a venturi vault located southeast of the K-802 pumphouse for the recirculating cooling water system and pumps it to storm water outfall SD-320. Gross alpha radiation was detected at a level of 15 pCi/L, which is equal to the maximum contaminant level for this analyte. Gross beta radiation was detected at a level of 47 pCi/L, which is slightly less than the maximum contaminant level for this analyte, which is 50 pCi/L. The source of the radioactive contamination in this sump is unknown. Sump S-032A will be resampled as part of the FY 2002 sampling effort. Additional efforts will be undertaken to identify potential sources of radioactive contamination in this sump.

No gross alpha or gross beta contamination above the maximum contaminant level was found

at any of the other sumps that were sampled as part of the FY 2001 sampling effort.

Trichloroethene was detected at sump S-048 at a concentration of 140 µg/L. This exceeds the Storm Water Pollution Prevention Program screening criterion of 100 µg/L for trichloroethene.

Sump S-048 is located in building K-1210. The sump collects water from the cascade portion of the building and pumps it to storm water outfall SD-100. Building K-1210 was used for testing centrifuges that were used in the uranium enrichment process. The building also contained a pilot plant that was used for testing UF_6 feed, transfer, and withdrawal systems. Organic solvents may have been utilized for cleaning of metal parts during these activities. Sump S-048 will be sampled again as part of the FY 2002 sampling program. Alternatives for discharge of water from this sump may be recommended at that time.

Trichloroethene was detected at sump S-054 at a concentration of 5 µg/L. This does not exceed the Storm Water Pollution Prevention Program screening criterion of 100 µg/L, but it is equal to the criterion amount in the Tennessee Water Quality Criteria for Domestic Water Supply.

Sump S-054 is located in the basement of Building K-731. This building serves as the switch house for the K-732 switchyard, which is the primary power center for ETTP. Sump S-054 discharges to storm water outfall SD-440. The source of the trichloroethene in this sump is not known at this time. The sump will be resampled as part of the FY 2002 sampling effort. Alternatives for discharge of water from this sump may be recommended at that time.

Five out of six sumps that were sampled in 2001 in the K-731/K-732 area contained at least one PCB aroclor (see Table 4.8). All of these sumps are associated with various operations conducted in Building K-731 and the K-732 switchyard, which is the primary power center for ETTP.

Sump S-054 is located in the basement of building K-731, which is the switch house for the K-732 switchyard. Sump S-056 serves a valve vault in the K-731/K-732 area. Sump S-057 serves synchronous condenser No. 101 in the K-732 switchyard. Sump S-058 serves synchronous condenser No. 102 in the K-732 switchyard. Sump S-059 serves synchronous condenser No. 103 in the K-732 switchyard.

All of these sumps discharge to storm water outfall SD-440. Discharges from SD-440 pass through an oil-water separator before they enter the Clinch River. PCBs were commonly used in electrical equipment until a few years ago and have been found in several components of the ETTP electrical power distribution system. All of these sumps will be sampled again as part of the FY 2002 sampling effort.

Aroclor-1260 was detected in sump S-068 at a concentration of 1.8 µg/L. Sump S-068 is located in the basement of Building K-761, which is the switch house for the K-762 switchyard. This switchyard transferred electrical power from the TVA transmission lines to operations in the Building K-31. The switchyard is no longer in operation, and the electrical equipment has been removed. The K-762 switchyard area is currently under the control of BNFL, Inc.

Sump S-068 discharges to storm water outfall SD-510. Discharges from SD-510 pass through an oil-water separator before entering Poplar Creek. This sump will be resampled as part of the FY 2002 sampling effort.

Selected storm water outfalls were smoke tested as part of the FY 2001 program. The storm water outfalls that were smoke tested included SD-360, SD-362, SD-600, SD-610, and SD-696.

Storm water outfall SD-360 is an 18-in. reinforced concrete pipe that carries water from a ditch located north of Building K-1410 to Poplar Creek. This ditch, which is located within a radiologically contaminated area, collects surface runoff from a grassy area located north of K-1410 and west of K-1031. Smoke testing indicated that drains on the north side of Building K-1410 had

Table 4.8. Polychlorinated biphenyls (PCBs) in K-731 Switch House sumps, 2001

Sump	PCB Aroclor	Amount (µg/L)
S-054	1260	0.9
S-056	1260	13.8
S-057	1254	3.4
S-058	1254	18.6
S-059	1254	14.2

once discharged to the ditch through a 12-in. pipe. It is believed that this pipe was plugged or blanked off and removed from service as part of the demolition activities conducted at K-1410 in CY 2000.

Storm water outfall SD-362 is monitored at the discharge point of a small ponded area. Three separate pipes currently discharge or formerly discharged into this ponded area. The discharge that remains active consists of a large open ditch that receives storm water runoff from a grassy area located southeast of the former location of Building K-1410. This open ditch drains into an 18-in. concrete pipe, which then discharges to another open ditch. This section of open ditch once received discharges from Building K-1410, in addition to receiving storm water runoff. Smoke testing indicated that all of the pipes that once carried discharges from Building K-1410 were plugged, most likely as part of the demolition of the building. The discharge from this section of open ditch drains into a 36-in. corrugated metal pipe. The pipe carries the discharge to the ponded area. An 8-in. clay pipe that discharges to the ponded area was also smoke tested. The smoke testing indicated that the pipe was plugged and no longer carries flow. A 6-in. clay pipe, which also discharges to the ponded area, was also smoke tested. Smoke testing indicated that this pipe carried drainage from a storm drain catch basin located north of Building K-413. The basin had been filled with gravel. This section of pipe no longer carries flow.

It is recommended that this storm drain be allowed to remain active because this drainage system continues to carry storm water runoff from a fairly large grassy area. Because all of the pipes have been plugged that discharge to the ponded area where SD-362 is sampled, it is recommended that the monitoring location for SD-362 be moved to the terminus of the 36-in. corrugated metal pipe if possible. The ponded area should probably be breached and drained, which would allow for a more direct discharge of storm water from the 36-in. pipe.

Storm water outfall SD-600 is a 12 -in. steel pipe that carries storm water runoff from an area located north of Building K-31. Drainage passes through an oil-water separator (K-897-D) before it is discharged to Poplar Creek. This outfall discharges storm water on a very infrequent basis. Smoke testing of this network indicated that all of the piping in the network appears to be open and clear of blockages. However, many of the manholes that carry drainage from the area are plugged with debris or have been covered with waste storage boxes.

Because it drains such a large area, this pipe will remain active and will not be plugged. If drainage problems occur in any area drained by this piping network, a recommendation will be made to BNFL, Inc., to remove the debris from the manhole gratings and/or to move the storage boxes so they no longer block the storm drain inlet. In addition, the oil-water separator was mislabeled. The sign on the oil-water separator was exchanged with the sign on the oil-water separator that serves SD-610. Both oil-water separators are now correctly labeled.

Storm water outfall SD-610 is a 30-in. pipe that is routed through an oil-water separator (K-897-C) and discharges into a concrete flume. The flume carries discharge from the pipe toward Poplar Creek. The piping network carries storm water drainage from a large paved area near the southeast corner of Building K-33 and from a section of Avenue Q North. Smoke testing indicated that the pipe network also received roof drainage from the south end of Building K-33 and the north end of Building K-31. Several steam condensate lines were also found to be discharging to this storm drain network.

Because of the size of the area from which this storm drain receives runoff, and because of the steam condensate that discharges into the network, it is recommended that this storm drain remain active. However, because flow is rarely seen from this storm drain, the integrity of the K-897-C oil-water separator may need to be tested to ensure that it is not allowing flow to leak out before it enters the downstream piping and the concrete flume. In addition, at the time the storm drain was smoke tested, the sign on the oil-water separator that serves this storm drain identified it as K-897-D. The sign was exchanged with the sign from the SD-600 oil-water separator, which was also mislabeled. Both oil-water separators are now correctly labeled.

Storm water outfall SD-696 is a 15-in. corrugated steel pipe that carries storm water from the K-892-J cooling tower basin area. The cooling tower basin is atop a small, relatively steep hill.

This cooling tower was demolished several years ago, and the cooling tower basin was filled with construction debris. Smoke testing of this drainage system indicates that surface flow from the area around the cooling tower basin drains into two concrete flumes, which join at a junction box. Storm water discharge then exits through SD-696 into an open field, where it migrates over land toward Poplar Creek. Smoke testing verified that storm water that enters the cooling tower basin and percolates through the construction debris does not discharge via SD-696. A section of pipe that once connected the cooling tower basin to the concrete flumes has been plugged.

It is recommended that this storm drain be allowed to remain active. It should not be removed from the new NPDES permit when it is received from TDEC. Because of the steepness of the hill drained by this storm drain, drainage patterns could develop in the area that could lead to localized soil erosion if the drain were plugged.

Storm water outfalls SD-750, SD-760, and SD-770 are steel pipes located in the Powerhouse area that discharge to the Clinch River. The diameters of outfalls SD-750, 760, and 770 measure 8, 16, and 24 in., respectively. All three of the pipes carry storm water runoff underneath River Road from a riprap-lined ditch located on the southwest side of the K-770 scrap yard. The influent end of SD-760 and SD-770 could not be seen beneath the riprap; the influent end of SD-750 was visible. The area drained by these storm drains is a radiological contamination area.

When the new NPDES permit is received from TDEC, these storm drains will be evaluated to determine whether they should be permanently plugged. The storm drain carries flow from a ditch that receives very little surface runoff, so no drainage problems would be created with the elimination of this storm drain. In addition, the plugging of these pipes eliminates three potential conduits for the discharge of radiological contamination from the K-770 Scrap Yard into the Clinch River.

Several storm water outfall sampling locations were identified by sampling technicians as being potentially unsafe to access for sampling or monitoring purposes. Access to these storm water outfall sampling locations was improved as part of a project that was funded and conducted during FY 2001.

The storm water outfalls that were identified as having unsafe access, and the actions undertaken to correct the safety concerns are as follows:

- at SD-142, a hand rail was constructed to end of pipe and the tread surfaces on steps were improved;
- at SD-146, a hand rail was constructed to end of pipe and the tread surfaces on steps were improved;
- at SD-170, a hand rail was constructed along the top and down the east side of the headwall;
- at SD-430, a sampling platform and steps were constructed; and
- at SD-710, steps and a platform were constructed at the top of concrete channel, and additional steps were constructed to the bottom of the concrete channel.

4.6 ETTP TOXICITY CONTROL AND MONITORING PROGRAM

The NPDES permit requires that biannual toxicity testing be performed at Outfall 005 (K-1203, the Sewage Treatment Plant). The results of the toxicity tests of wastewaters conducted during 2001are given in Table 4.9, which also provides the wastewater's no-observable-effect level and lethal concentration for 50% of the test organisms (LC_{50}) for fathead minnows (*pimephales promelas*) and *Ceriodaphnia dubia* for each test. Average water quality measurements obtained during each toxicity test are shown in Table 4.10.

Effluent from K-1203 was tested three times during 2001with fathead minnows and *Ceriodaphnia*. The first test was conducted by ORNL's Environmental Sciences Division, as have been all previous tests. However, a new subcontractor, Environmental Science Corporation, was chosen by Operations Management International, Inc., for the subsequent tests. (Operations Management International currently manages the water treatment plant and the sewage treatment plant as well as some aspects of the storm drain network.) In all tests, samples did not reduce survival, growth, or reproduction. Thus the no-observed-effect levels and the LC_{50}s were within the permit limits.

Table 4.9. East Tennessee Technology Park (ETTP) National Pollutant Discharge Elimination System Permit Number TN 0002950 toxicity tests results, 2001

ETTP Outfall	Test date	Species	NOEC[a] (%)	LC_{50}[b] (%)	IWC[c] (%)
K-1203 (Outfall 005)	January	Fathead minnow	100	>100	2.2
		Ceriodaphnia	100	>100	2.2
	July	Fathead minnow	4.2	>14.6	3.0
		Ceriodaphnia	4.2	>14.6	3.0
	November	Fathead minnow	4.2	>14.6	2.3
		Ceriodaphnia	4.2	>14.6	2.3

[a]No-observable-effect concentration.
[b]96-h lethal concentration for 50% of the test organisms.
[c]Instream waste concentration (based on critical low flow of Poplar Creek).

Table 4.10. East Tennessee Technology Park (ETTP) average water quality parameters measured during toxicity tests of ETTP wastewaters, 2001
Values are averages of full-strength wastewater for each test (N = 6 or 7)

ETTP Outfall	Test date	pH (standard units)	Conductivity (µS/cm)	Alkalinity (mg/L $CaCO_3$)	Hardness (mg/L $CaCO_3$)
K-1203 (005)	January	8.1	370	94	150
	July	7.6	240	93	120
	November	8.0	310	83	160

4.7 ETTP BIOLOGICAL MONITORING AND ABATEMENT PROGRAM

The 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. The BMAP consists of four tasks: (1) toxicity monitoring, (2) bioaccumulation monitoring, (3) ecological surveys of instream communities (both fish and benthic macroinvertebrates), and (4) waterfowl monitoring.

4.7.1 Toxicity Monitoring

The toxicity monitoring task for the BMAP includes tests of effluent from treatment facilities (see Sect. 4.6) and effluent from storm drains SD-170, SD-180, and SD-190 concurrently with surface water from six ambient sites in Mitchell Branch [Mitchell Branch kilometer (MIK) 0.12, MIK 0.45, MIK 0.54, MIK 0.71, MIK 0.78, and MIK 1.43]. (The number following "MIK" indicates the distance in kilometers from the mouth of Mitchell Branch on Poplar Creek.) *Ceriodaphnia dubia* were used to evaluate effluent from SD-170 and SD-190 for toxicity five times during 2001. Full-strength effluent from SD-170 reduced *Ceriodaphnia* survival or reproduction in four of five tests. Full-strength effluent from SD-190 reduced *Ceriodaphnia* survival or reproduction in all five tests. Effluent from SD-180 was evaluated for toxicity two times in 2001; the effluent did not reduce *Ceriodaphnia* survival or reproduction in either test. In selected tests, water samples from storm water outfall 190 have been treated to remove metals. This treatment has decreased toxic effects, indicating that the primary source of toxicity is from metals. An analysis of water from the storm drain 190 network has indicated that both nickel and zinc are present at levels that have been shown to be toxic to *Ceriodaphnia*. Toxicity tests of surface water from Mitchell Branch downstream of each storm drain were conducted five times in 2001. Reduction in *Ceriodaphnia* reproduction occurred

only once in these tests, and survival was not affected in any of the five tests.

4.7.2 Bioaccumulation Studies

In 2001, resident fish and caged clams in Mitchell Branch, the K1007-P1 pond, and the K901-A pond were monitored for PCB contamination. In Mitchell Branch, the mean PCB concentration in redbreast sunfish was 4.09 µg/g wet weight in 2001; this is the highest concentration recorded in redbreast sunfish to date at this location. Clam-monitoring results suggest that the major PCB input to Mitchell Branch was associated with SD-190; a smaller contribution came from SD-170. The mean PCB concentration in composited clams at MIK 0.2 (6.6 µg/g) was the highest concentration reported in Mitchell Branch clams to date and is consistent with the increase in PCBs observed in fish in 2001. PCBs in the clams upstream from SD-190 were lower but are still higher than levels found in clams from reference streams.

In the K1007-P1 pond (Fig. 4.8), PCB concentrations in largemouth bass increased slightly from last year (an average of 25.1 µg/g and a maximum of 67.0 µg/g in 2001), up from an average of 21.8 µg/g in 2000). Although there has been some variation, the overall levels of PCBs in the fish in the pond remain above the human health risk guidelines. Monitoring of caged clams at inflows and outflows to the pond indicated continuing inputs of PCBs. Levels in clams from SD-120, SD-124, SD-480, and the P1 pond exit ranged from 0.5 to 3.5 µg/g. The SD-100 outfall continued to be the greatest PCB source to the pond, having an average PCB concentration of 14.6 µg/g in the caged clams.

PCB concentrations in largemouth bass and caged clams from the K901-A pond were comparatively low (means of 0.67 µg/g, wet weight for largemouth bass fillet samples and 0.23 µg/g for clams). The levels for PCBs in the largemouth bass were near the historical concentrations in bass collected from this location. Clam studies indicate that the PCB flux from K-901-A is modest compared with that from Mitchell Branch and K-1007-P1 pond.

4.7.3 Ecological Surveys of Instream Communities

The benthic macroinvertebrate community downstream of the main storm drains in Mitchell Branch continued to show impacts compared with the upstream reference site, although the differences in the 2001 studies are not as great in the earlier studies. In general, taxonomic richness, including the richness of the pollution-sensitive

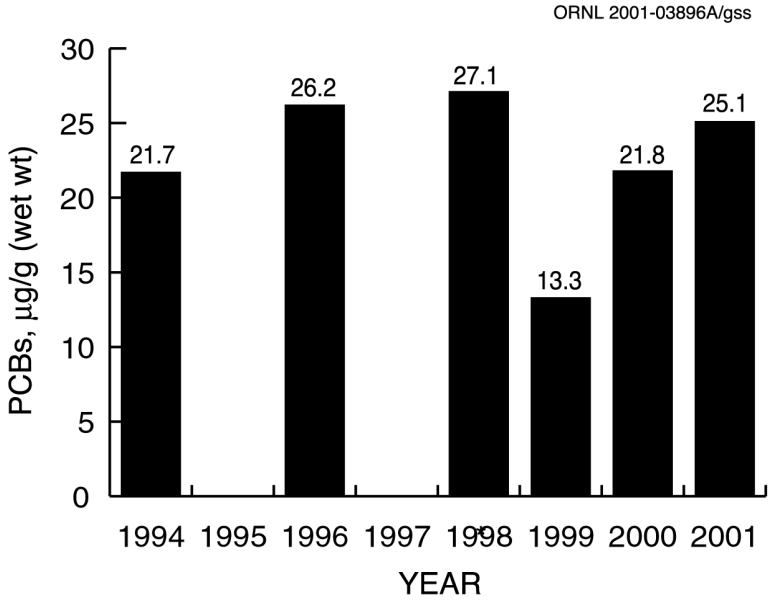


Fig. 4.8. Mean PCB concentrations in largemouth bass from the K-1007-P1 pond at the ETTP. Samples are fillets; N = 2–8 fish/year. No fish were collected in 1995 or 1997.

taxa (Ephemeroptera, Plecoptera, and Trichoptera), has increased at all sites, with the most dramatic increases at MIK 0.71and MIK 0.45. The magnitude of the increases has been greater in those sites within the industrial portion of the ETTP, although the richness at these sites continues to lag behind that of the reference site (MIK 1.43). Thus, the evidence indicates that past industrial operations have adversely affected the stream but that pollution abatement and remediation measures in the last decade have improved the overall quality of the stream.

Fish community data gathered at both MIK 0.45 and MIK 0.71 show that Mitchell Branch has been adversely affected but that some recovery is taking place. Species richness at MIK 0.71 increased slightly in 2001 compared with that observed in 2000, after dropping slightly from 1999 to 2000, a reflection of the general instability of the fish community at that location. Both locations contained five species of fish in the 2001 study. However, the additional two species present at MIK 0.71 in the 2001 study indicate that the conditions in Mitchell Branch continue to improve. Measures of population density and biomass are greater at MIK 0.45 than at MIK 0.71, a continuation of the trend since the spring of 1998, when the construction of the Mitchell Branch Interceptor Trench disrupted the aquatic communities at MIK 0.71.

4.7.4 Waterfowl Surveys

Eighteen waterfowl surveys were conducted on the ORR during 2001. The number of species recorded (32) was slightly lower than the number observed in recent years, in part because of a slight decline in the number of duck and sandpiper species observed. The number of Canada geese (*Branta canadensis*) observed this year increased, indicating that the decade-long decline in the ORR goose population may have leveled off. No radioactively contaminated geese were found during the June 2001 roundup at ETTP. Ninety-three geese were captured at ETTP, of which 87 received new legbands, 60 were fitted with new neck collars, and 39 received whole-body gamma scans. All 39 scanned geese had whole body gamma counts of less than 0.4 pCi/g.

No endangered species of birds were observed, although several state-listed bird species in addition to waterfowl were observed, including the northern harrier (*Circus cyaneus*), sharp shinned hawk (*Accipiter striatus*), great egret (*Ardea alba*), and olive-sided flycatcher (*Contopus cooperi*). Other interesting species observed include the red-headed woodpecker (*Melanerpes erythocephalus*) and brown-headed nuthatch (*Sitta pusilla*), both of which were rarely seen on the ORR until lately. It is likely that landscape changes resulting from beaver (*Castor canadensis*) and southern pine beetle (*Dendroctonus frontalis*) activity have increased the amount of habitat favorable to red-headed woodpeckers. The recent appearance of brown-headed nuthatches on the ORR is likely related to the maturity of the cultivated loblolly pine (*Pinus taede*) stands on the ORR.

4.8 ETTP AMBIENT AIR MONITORING

DOE Order 5400.1 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 contaminants 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.

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.

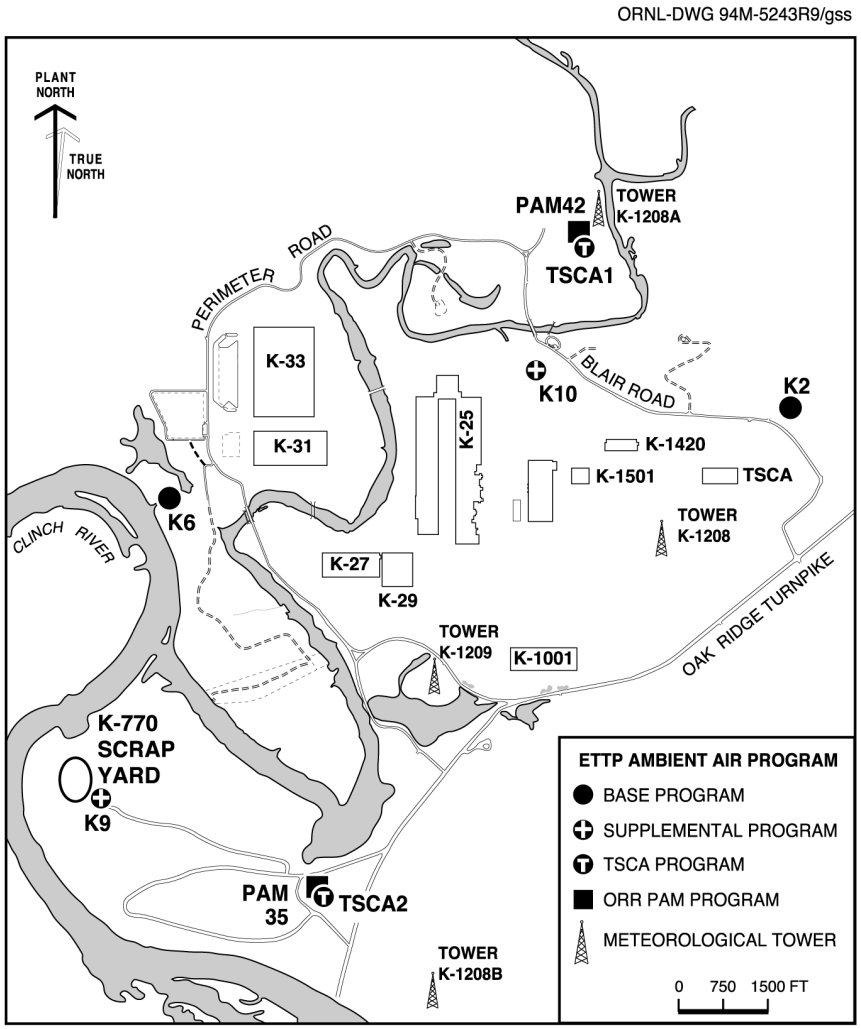


Fig. 4.9. Locations of ambient air monitoring stations at the ETTP, 2001.

The ambient air sampling schedule and monitored parameters are listed in Table 4.11. 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 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 2001were arsenic, beryllium, cadmium, chromium, lead, and uranium. Uranium was analyzed by both inorganic and radiochemical methods. Radiochemical analyses included isotopes of uranium (^{234}U, ^{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 was modified with respect to ETTP operations. A review of ambient air sampling for particulate matter smaller than 10 microns (PM10) for a ten-year period (1991–2000) was conducted. The review indicated that all results were below the 24-hour and annual ambient air quality standards over the entire history of PM10 sampling. Additionally, there has been no indication that ETTP operations have contributed levels of PM10 in the ambient air that could be distinguished from typical background levels for this area of the state. Therefore, with DOE and TDEC concurrence, all PM10 sampling was discontinued at the end of CY 2000 until regulations, DOE orders, or a management decision would require reactivating. No other sampling procedures or locations were changed from the previous year.

Samples were collected weekly from the following stations: K2, K6, K9, K10, and perimeter air monitors 35 and 42.

4.8.1 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. Table 4.11 lists selected parameters measured during 2001.

4.8.2 Criteria Pollutant Levels

Quarterly lead results were determined from analyses of monthly composites of continuous weekly samples from stations K2, K6, K9, and K10. 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

Table 4.11. Summary of types and frequencies of samples collected at East Tennessee Technology Park perimeter ambient air monitoring stations, 2001

Parameter	Sampling locations	Sampling period	Collection frequency	Analysis frequency[a]
Criteria pollutants				
Lead	K2, K6, K9,[b] K10[b]	Continuous	Weekly	Monthly
Hazardous air pollutants carcinogen metals				
Arsenic	K2, K6, K9	Continuous	Weekly	Monthly
Beryllium	K2, K6, K9	Continuous	Weekly	Monthly
Cadmium	K2, K6, K9, K10	Continuous	Weekly	Monthly
Chromium	K2, K6, K9	Continuous	Weekly	Monthly
Organic compounds				
Polychlorinated biphenyls	TSCAI[c] 1, 2	*d*	*d*	*d*
Furan	TSCAI 1, 2	*d*	*d*	*d*
Dioxin	TSCAI 1, 2	*d*	*d*	*d*
Hexachlorobenzene	TSCAI 1, 2	*d*	*d*	*d*
Radionuclides (by inorganic analysis)				
Uranium (total)	K2, K6, K9, K10	Continuous	Weekly	Monthly
	PAM 35, 42	Continuous	Weekly	Quarterly
	TSCAI 1, 2	*d*	*d*	*d*
Radionuclides (by radiochemical analysis)				
^{99}Tc, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{234}U, ^{235}U, ^{236}U, ^{238}U	K2, K6, K9	Continuous	Weekly	Monthly
^{234}U, ^{235}U, ^{236}U, ^{238}U	K10	Continuous	Weekly	Monthly

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

[b]Temporary sampling station.

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

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

summarized in Table 4.12 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 0.0043 µg/m^3. This value was only 0.3% of the quarterly standard for lead. No lead concentrations of environmental concern were measured (see Fig. 4.10 for 5-year lead trend).

4.8.3 Hazardous Air Pollutant Carcinogenic Metal Levels

Analyses of hazardous air pollutant carcinogenic metals (arsenic, beryllium, cadmium, and chromium) were performed on one monthly composite per quarter of continuous weekly samples from stations K2, K6, and K9. All monthly composite samples from K10 were only analyzed for cadmium. Total mass of each selected metal was determined by the ICP-MS analytical technique.

Table 4.12. Lead concentrations in ambient air at the East Tennessee Technology Park (ETTP), 2001

Station	Quarterly averages of monthly composites (µg/m^3)				Max quarterly result (µg/m^3)	Max monthly result (µg/m^3)	Max percent of quarterly standard[a,b]
	1	2	3	4			
K2	0.003237	*b*	0.003760	0.002891	0.003760	0.003760	0.25
K6	0.003023	*b*	0.002527	0.002343	0.003023	0.003023	0.20
K9[c]	0.002908	0.003386	0.002440	0.002512	0.003386	0.003386	0.23
K10[d]	0.000831	0.000587	0.000702	0.001481	0.001481	0.002483	0.10
Quarterly avg	0.002500	0.001986	0.002357	0.002307	0.002500	N/A	0.17
Quarterly max	0.003237	0.003386	0.003760	0.002891	0.003760	N/A	0.25
Annual average for all stations = 0.002425 µg/m^3							

[a]Tennessee and national air quality standard for lead is 1.5 µg/m^3 quarterly arithmetic average.
[b]No lead analysis performed.
[c]Conservative comparison of the maximum individual monthly result with the quarterly standard.
[d]ETTP temporary stations activated during 2000.

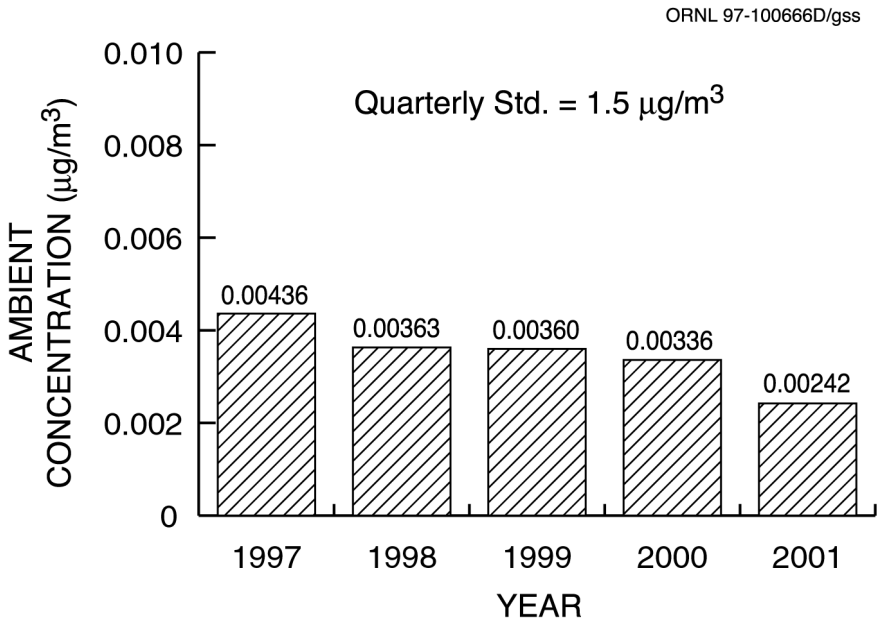


Fig. 4.10. Ambient air monitoring 5-year trend results for lead at the ETTP.

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 0.00075 µg/m^3, well below the risk-specific dose of 0.0023 µg/m^3. Individual results ranged from approximately 0.00053 to 0.00109 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 0.000007 µg/m^3 with individual results ranging from approximately <0.000006 to 0.000018 µg/m^3. Cadmium concentration results ranged from approximately 0.00012 to 0.00042 µg/m^3. The cadmium annual average was 0.00021 µg/m^3, well below the risk-specific dose of 0.0056 µg/m^3. Individual chromium measurements ranged from approximately 0.00014 to 0.00065 µg/m^3. The annual average result for chromium was 0.00003 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 4.13.

4.8.4 Radionuclide Levels

Total uranium metal was measured as a monthly composite of continuous weekly samples from stations K2, K6, K9, and K10 and as quarterly composites of weekly continuous samples from stations perimeter air monitoring stations 35 and 42. The total uranium mass for each sample was determined by the ICP-MS analytical technique. The uranium annual averages and maximum individual concentration measurements for all sites are presented in Table 4.14. Results ranged from a minimum of approximately 0.00002 to 0.01267 µg/m^3. The highest monthly result was measured at Station K2, which is in the prevailing downwind direction of the ETTP. The annual average value for all stations due to uranium was 0.00043 µg/m^3. The ICP-MS results are compared with a dose based on the DCG for natural 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 station K2. The annual result was 0.00137 µg/m^3, which corresponds to 0.92% of the DCG (see Fig. 4.11 for 5-year uranium trend).

The highest recorded monthly uranium concentration for this CY 2001 was measured at station K2, located on Blair Road. The K2 November sample result of 0.01267 µg/m^3, if assumed to be the annual average concentration, would equate to 8.4% of the DCG for an individual located at that station for the entire year. Due to the elevated monthly result, an investigation was initiated to determine the validity of the corresponding data. The investigation included data validity and management checks with both internal calculations and with the analytical support laboratory. No data irregularities were

Table 4.13. Hazardous air pollutant concentrations in ambient air at the East Tennessee Technology Park, 2001

Parameter	Ambient air concentration (µg/m^3)			Percentage of standard[a]	
	Annual avg	Monthly max	Max location		
Arsenic	0.000750	0.001094	K9	32.6	
Beryllium	<0.000007	<0.000018	K9	<0.2	
Cadmium	0.000205	0.000422	K10	3.7	
				Cr-III	Cr-VI
Chromium	0.000299	0.000651	K9	<0.1	34.0

[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.

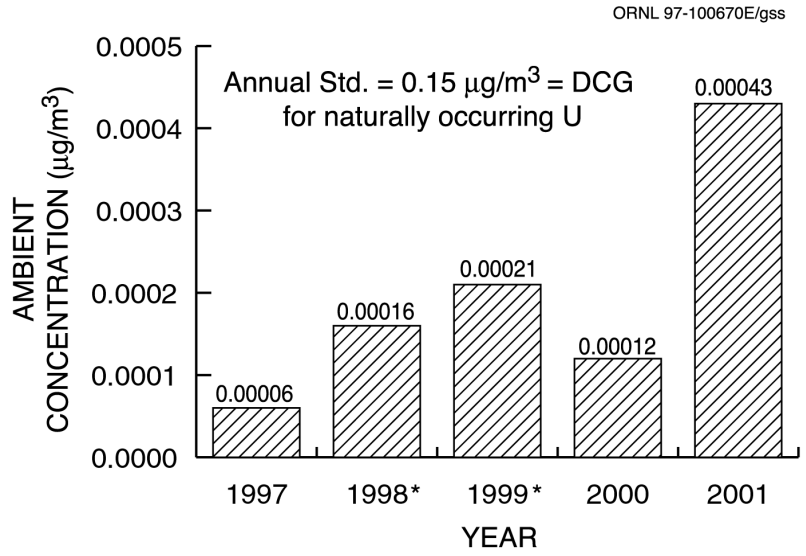
Table 4.14. Total uranium in ambient air by inductively coupled plasma mass spectrometry analysis at the East Tennessee Technology Park, 2001

Station	No. of samples	Concentration[a]				Percentage of DCG[b] (%)	
		(μg/m³)		(μCi/mL)			
		Avg	Max[c]	Avg	Max[c]	Avg	Max[c]
K2	12	0.001373	0.012666	9.15E–16	8.44E–15	0.92	8.44
K6	12	0.000314	0.000720	2.09E–16	4.80E–16	0.21	0.48
K9	12	0.000117	0.000351	7.79E–17	2.34E–16	0.08	0.23
K10	12	0.000557	0.001961	3.71E–16	1.31E–15	0.37	1.31
PAM35	4	0.000094	0.000160	6.28E–17	1.07E–16	0.06	0.11
PAM42	4	0.000108	0.000163	7.22E–17	1.09E–16	0.07	0.11
ETTP total	56	0.000427	0.012666	2.85E–16	8.44E–15	0.28	8.44

[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.



**Site annual average modified from 1999 report to include all temporary station data.*

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

found. The laboratory was requested to reanalyze the remaining sample solution; however, there was insufficient sample available; therefore, a new duplicate composite sample was submitted for analysis. The new composite sample was prepared from the same filters used for the original sample. Material deposition on the filters has been shown to be uniform and therefore analyses performed on different areas of the original filter will yield equivalent results. There was sufficient filter material to perform both ICP/MS and isotopic analyses. Concurrently with the data check, the investigation also identified that measurement results from station K10 also showed an increase from October to November, approximately proportional to K2 results during

the same period. Coincidentally, uranium emissions from the TSCA Incinerator significantly increased during the same period. Figure 4.12 shows comparative monthly trends of total uranium data from K2 and TSCA Incinerator stack emission data. The intent of this figure is only to show the relative trend of the two measurement results. The similar trends of the two independent data sets would seem to indicate that a significant increase in the ambient air total uranium concentration is to be expected. The results of the investigation show that both the original and duplicate ICP-MS analysis data are comparable. This review showed that the ambient air system and analytical procedures were sensitive to activities at the ETTP that produce airborne releases of radionuclides and that all emission sources were operating within permitted limits and within all emission standards.

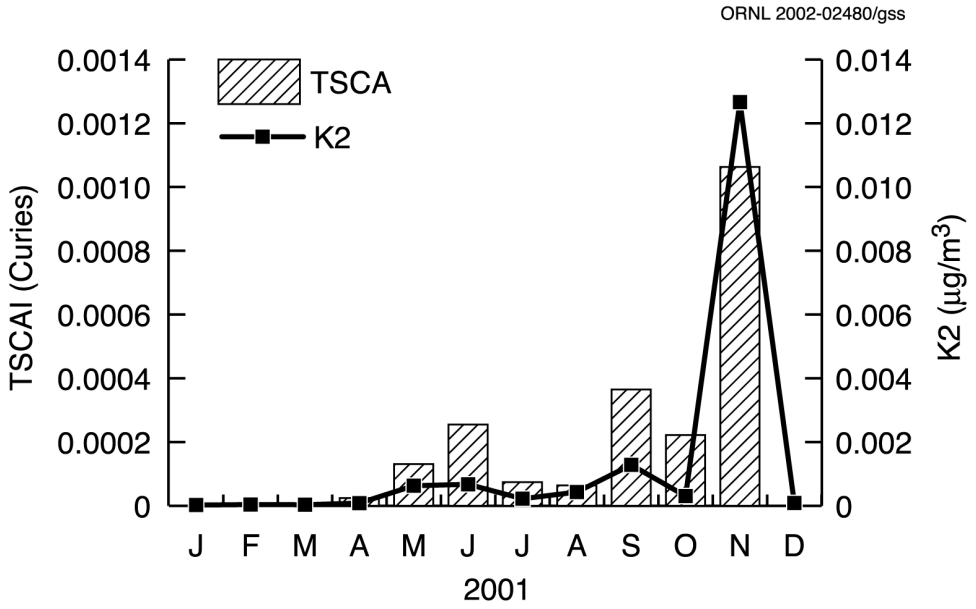
Periodic radiochemical analyses were initiated during 2000 on selected monthly composite samples collected at Stations K2, K6, K9 and K10. The selected isotopes of interest were ^{237}Np, ^{238}Pu, ^{239}Pu, ^{99}Tc, and isotopic uranium (^{234}U, ^{235}U, ^{236}U, and ^{238}U). The concentration for each and all nuclides measured are presented in Table 4.15. For comparison, the total uranium results associated with ICP-MS analyses of composite samples are compared with the uranium results determined by radiochemical techniques.

4.8.5 Organic Compound Levels

Currently, measurements of selected semivolatile organics are performed only during an operational upset of the TSCA Incinerator. There were no events that required the activation of sampling systems for organic pollutants in the ambient air during this reporting period. In the event that an unplanned release occurred, ambient air sampling stations would be activated automatically or manually.

4.8.6 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.



NOTE: In 2001, TSCAI did not operate during January, February, March, or December.

Fig. 4.12. Ambient air monitoring at ETTP Station K2 by ICP/MS vs TSCA Incinerator stack sampling results by radiochemistry.

Table 4.15. Radionuclides in ambient air by radiochemistry at the East Tennessee Technology Park, 2001

Station	Concentration (μCi/mL)									
	Total U[a] (ICP)	Total U[b] (alpha sp.)	^{237}Np	^{238}Pu	^{239}Pu	^{99}Tc	^{234}U	^{235}U	^{236}U	^{238}U
K2	3.49E–16	5.05E–16	2.08E–17	8.96E–19	1.79E–17	6.61E–15	1.56E–16	2.10E–17	7.40E–18	3.20E–16
K6	2.67E–16	3.74E–16	2.46E–17	1.53E–18	1.26E–17	1.13E–15	1.77E–16	3.21E–17	4.59E–18	1.60E–16
K9	9.71E–17	2.75E–16	3.05E–17	1.75E–17	1.63E–17	5.81E–16	1.50E–16	2.26E–17	1.49E–17	8.80E–17
K10	3.59E–16	2.17E–16	*c*	*c*	*c*	*c*	9.81E–17	6.51E–18	3.77E–18	1.08E–16

[a]The ICP results from Stations K2, K6, K9, and K10 correspond to the periodic alpha spec. analyses. Mass to curie concentration conversions assume a natural uranium assay of 0.717% ^{235}U.

[b]All results by alpha spec. ($^{234/235/236/238}$U, ^{237}Np, $^{238/239}$Pu, and ^{99}Tc) are the average of March, June, September, and December monthly composite analyses. Total U (alpha spec.) is the sum of the concentrations of each isotope of U.

[c]Data not available or sample not taken.

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.

4.9 ETTP SURFACE WATER MONITORING

Surface water surveillance is currently conducted at seven locations at the ETTP (Fig. 4.13). Stations K-1710 and MIK 1.4 provide information on conditions upstream of the ETTP. Stations K-716 and Clinch River kilometer (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 and field readings (dissolved oxygen, temperature, and pH) are conducted. At CRK 16, samples for radionuclides, volatile organic compounds, and selected metals are collected and analyzed on a monthly basis. Quarterly sampling for volatile organics, in addition to radionuclides and field readings, is conducted at the K-1700 and MIK 1.4 locations. 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, 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 CRK16, and certain volatile organics (primarily trichloroethane 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 occasionally fall below the minimum water quality standard during the summer months because of increased temperature (and therefore lower solubility of the gas) and increased biological activity. Water bodies in the vicinity of the ETTP are regularly inspected for signs of stress on aquatic organisms during these periods. For most of the remaining analyses, results are within the reference standards or below detection limits for the instrument and method. Moreover, analytical results for samples collected upstream of the ETTP are chemically similar in most respects to those collected below the ETTP.

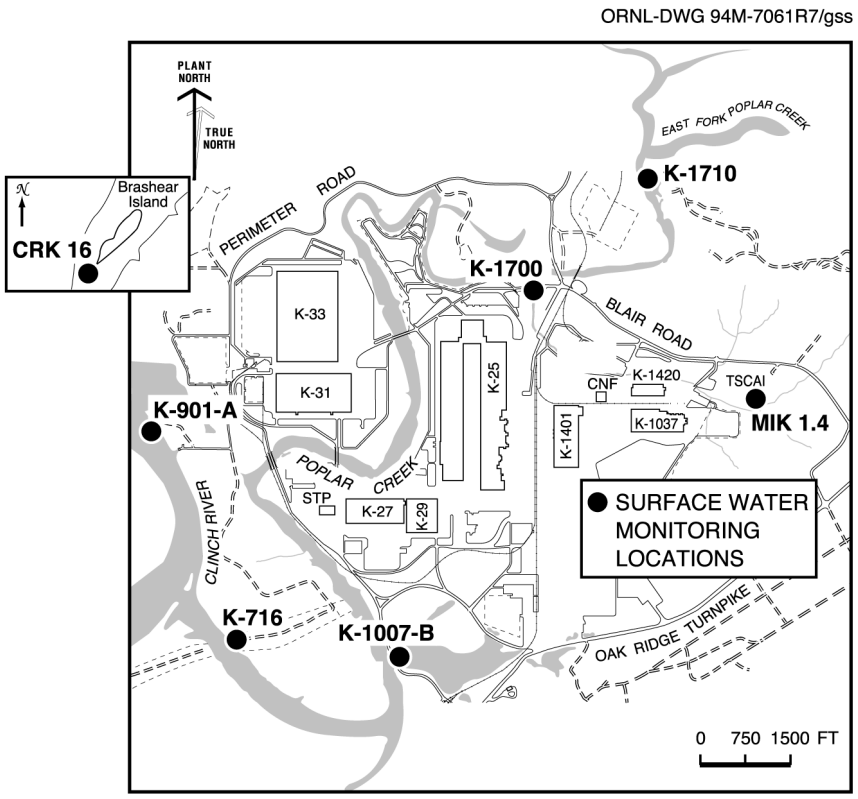


Fig. 4.13. Monitoring locations for surface water at the ETTP.

The sum of the fractions of the DCGs for all stations remained below 4% of the DCG values for ingestion, which are the equivalent to the DOE drinking water systems criterion of 4 mrem/year (Fig. 4.14). The highest sum of the fractions,1.5% 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 results found throughout the 1990s. 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.

4.10 ETTP SOIL AND SEDIMENT MONITORING

In 2001, soil monitoring was reinstated at ETTP. Due to the possibility of aerial deposition of contaminants, the soil monitoring locations are co-located with ambient air monitoring stations (K2, K6, K9, K10, and perimeter air monitors 35 and 42). Samples are collected and analyzed annually for selected radionuclides and metals. Results from the 2001 sampling indicate that ETTP operations have made some impacts on the environment, and comparison with ambient air monitoring results show that these impacts are ongoing. However, the results to date do not indicate that environmentally significant impacts are occurring at this time (for example, radionuclides other than ^{99}Tc and uranium were undetectable in the 2001 soil samples).

Currently, most sediment monitoring is conducted by the Water Resources Restoration Program in association with CERCLA remedial actions. Sediment monitoring is conducted both to provide a baseline for current conditions and to help gauge the effectiveness of the remedial actions. Results from the sediment monitoring conducted in association with CERCLA activity are described in the *2001 Remediation Effectiveness Report* (DOE 2002b).

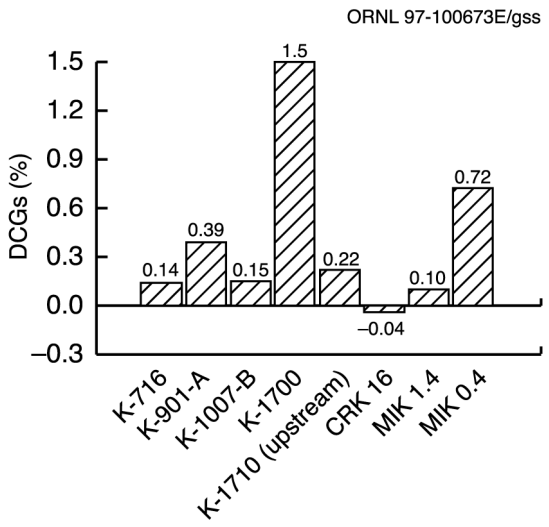


Fig. 4.14. Percentage of DOE derived concentration guides for ETTP surface monitoring locations.

4.11 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, Oak Ridge Operations, Office* (DOE 1999) has been developed to accelerate the transition of areas of concern 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 area of concern or multiple areas of concern to be investigated and/or remediated. This approach allows for the systematic monitoring and evaluation of contaminant sources and migration through the use of integrated surface-water and groundwater monitoring.

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 monitored by the ETTP Environmental Monitoring Plan surface water surveillance program. Because off-site releases need to be monitored more effectively, a report required by the Federal Facility Agreement, *Remediation Effectiveness Report* (DOE 2002b), includes a summary of NPDES compliance. The current edition of this report 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.

4.12 ETTP DIRECT RADIATION

The UF_6 cylinder storage yards at ETTP may be sources of potential exposure to the public from gamma radiation from radionuclides in the cylinders. Measured exposure rates and a hypothetical model of a maximally exposed individual were used to calculate theoretical doses. The calculated effective dose equivalents were based on gamma 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 noted in the discussion that follows are less than the 100 mrem/year required by DOE Order 5400.5.

Gamma dose rates from each area were measured in January 2002 with a tissue-equivalent dose rate meter. Background readings were established at the ambient air monitoring stations north and northeast of ETTP off Blair Road and near the intersection of Power House Road and Bear Creek Road. The average gamma background was 0.003 mrem/h, and all neutron background measurements were 0 mrem/h. Neutron dose rates for a count time of 1 min were 0 mrem/h at each of the monitoring locations.

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 effective dose equivalent above background of about 0.50 mrem along the bank of Poplar Creek near the K-1066-J Cylinder Yard, or 1.75 mrem along the bank of Poplar Creek near the K-1066-E Cylinder Yard during 2001. This 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.

General area dose rates were recorded in the vicinity of the K-770 Scrap Yard, along the near bank of the Clinch River. The average gamma dose rate was equivalent to the background level of 0.003 mrem/h; therefore, a hypothetical Clinch River fisherman would not be expected to have received any effective dose equivalent attributable to the K-770 Scrap Yard during 2001.

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. 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 effective dose equivalent above background of about 1.13 mrem during 2001.