3.5.3.1 Savannah River

Historically, the Augusta, North Augusta, and Aiken County areas have provided the major sources of pollution to the Savannah River in the area around the SRP. The City of Augusta did not have a secondary sewage treatment facility until 1975. Before 1975, most domestic and industrial wastes were discharged untreated or inadequately treated into the river or into Hawks Gully, Butler Creek, and Spirit Creek, which flow into the river. In the North Augusta and Aiken County areas, domestic and industrial effluents entered the Savannah River directly and via Horse Creek and Little Horse Creek (Matthews, 1982). Treatment facilities for the North Augusta and Aiken County areas did not begin operation until 1979. The SRP also discharges wastewater into the Savannah River under National Pollutant Discharge Elimination System (NPDES) Permit SC0000175. These discharges are primarily thermal effluents, but include domestic and industrial wastes (Lower, 1985).

Variability of water chemistry test results of Savannah River samples has diminished over the past 20 years, primarily because of improved waste treatment and flow stabilization provided by upstream dams. The pH of the river has remained slightly acidic. The river water is relatively soft and well oxygenated. Water temperature ranges from an average winter low of 8°C to more than 24°C during summer months. In the vicinity of the SRP, South Carolina Class B stream water classification standards are met in the Savannah River (Lower, 1985).

Based on samples collected as part of the Comprehensive Cooling Water Study from 1983 to 1985 at monitoring stations upriver of the confluence of the Savannah River with Upper Three Runs Creek and downriver of the confluence of the river with Steel Creek, mean water chemistry data indicated relatively no change in pH values, total suspended solids, alkalinity, chlorides, sulfates, phosphorus species, nitrate-nitrogen and nitrite-nitrogen, and trace metals. Mean dissolved oxygen, ammonia-nitrogen, and total kjeldahl nitrogen concentrations were slightly reduced at the downriver sampling station (Lower, 1985).

3.5.3.2 Onsite Streams

Data collected during recent studies indicate that the major factors affecting the water chemistry of onsite streams include a natural chemical gradient, thermal and current velocity conditions, addition of Savannah River water for reactor secondary cooling, natural transport and transformation processes, and point-source discharges related to SRP operations (Du Pont, 1985b). The following paragraphs describe results of recent water-chemistry samples associated with each onsite stream.

Upper Three Runs Creek

Upper Three Runs Creek tributaries are Tinker Creek and Tims Branch. Typical permitted surface discharges to Tims Branch from the A- and M-Areas include nonprocess cooling water, steam condensates, process effluents, and treated groundwater effluents (M-Area air stripper). In addition, three unnamed tributaries of Upper Three Runs Creek receive permitted ambient-temperature cooling water, steam condensate, powerhouse washdown waters, and ash basin effluents from the Separations Areas (Lower, 1985).

Upper Three Runs Creek is a slightly acid stream that is low in nutrients. The water of this stream is soft (low in calcium and magnesium). Suspended solids concentrations increase from the upper to lower reaches but are low in value at all monitoring stations. The stream has little, if any, buffering capacity to neutralize acids. The temperature of the stream ranges from approximately 8° to 24°C, with lows occurring from December through February. July and August normally constitute the period of highest temperature and lowest flows. The dissolved oxygen content is relatively constant at 8 milligrams per liter, varying slightly with the temperature of the stream; at all stations the water is saturated or nearly saturated with oxygen and exhibits a low chemical oxygen demand (less than 2 milligrams per liter) (Lower, 1984; Du Pont, 1985b). Temperature, pH, and dissolved oxygen meet South Carolina water-classification standards for Class B streams. Concentrations of metals throughout Upper Three Runs Creek reflect both the softness of the stream and the absence of any major industrial discharges (Lower, 1985). TC TC

Table 3-10 lists mean results of water chemistry samples of Upper Three Runs Creek from 1983 through 1985 at four sampling stations.

Four Mile Creek

From the Separations Areas, the upper reach of Four Mile Creek receives permitted powerhouse wastewater, cooling water, steam condensate, and sanitary-treatment-plant wastewater discharges. C-Reactor cooling water is discharged to Four Mile Creek. Small quantities of ambient-temperature cooling water and automotive shop effluents are also discharged to Four Mile Creek from the Central Shops (CS) Area.

Since 1973, the water quality of Four Mile Creek has been monitored at SRP Road A-7, a station downstream of F- and H-Area effluents, but upstream of thermal effluents from C-Reactor. Like Upper Three Runs Creek, waters along this reach of Four Mile Creek have low alkalinity, suspended solids, and chemical oxygen demand (Lower, 1984). However, concentrations of nutrients, particularly nitrates (as nitrogen), are higher in Four Mile Creek than in Upper Three Runs Creek. Nitrate-nitrogen concentrations at this station were generally an order of magnitude greater (mean 2.3 milligrams per liter of nitrate-nitrogen) than at all other onsite stream stations and were attributed to outcropping of nitrates from shallow groundwaters in the vicinity of the F- and H-Area seepage basins, which have received large volumes of nitrates. TC

Downstream of C-Reactor, mean temperatures of Four Mile Creek exceeded those of the Savannah River from 13°C at the creek mouth to 39°C at the cooling water discharge. The pH of thermally affected waters in the Creek, as well as concentrations of major ions and trace metals, reflected the higher pH and concentrations of Savannah River water used as cooling water for C-Reactor. Temperature and dissolved oxygen both did not meet Class B water-classifications standards during periods of C-Reactor operation (Lower, 1985). TE

Table 3-11 lists mean results of water chemistry samples at five stations along Four Mile Creek from 1983 through 1985.

Table 3-10. Mean Water Chemistry of Upper Three Runs Creek and Tims Branch, 1983-1985[a]

	Station location			
Parameter/units	Road F	Upstream of Road C	Tims Branch upstream of confluence with Upper Three Runs Creek	Mouth
Temperature (°C)	16.1	15.0	15.9	14.7
pH (-)	6.06	6.22	6.66	6.65
Dissolved oxygen (mg/L)	8.13	7.91	8.17	7.84
Suspended solids (mg/L)	8.70	19.0	6.70	28.8
Chlorides (mg/L)	1.60	1.70	1.80	2.10
Sulfates (mg/L)	0.35	0.53	0.26	1.24
Organic carbon (mg C/L)	6.0	8.30	7.10	7.9
Phosphorus (mg P/L)	0.03	0.05	0.04	0.05
Nitrites (mg N/L)	<0.05	<0.05	<0.05	<0.05
Nitrates (mg N/L)	0.18	0.12	0.16	0.11
Arsenic (μg As/L)	1.51	1.20	1.35	1.51
Cadmium (μg Cd/L)	0.26	0.32	0.28	0.49
Chromium (μg Cr/L)	13.5	17.9	9.97	13.5
Copper (μg Cu/L)	2.48	2.47	2.40	2.48
Lead (μg Pb/L)	2.69	2.85	2.08	2.69
Mercury (μg Hg/L)	0.05	0.06	0.07	0.05

[a]Source: Du Pont, 1985b.

Table 3-11. Mean Water Chemistry of Four Mile Creek, 1983-1985[a]

Parameter/units	Station location				
	Upstream of Road 4	Road 3	C-Reactor effluent canal	Road A-12.21	Mouth
Temperature (°C)	16.2	16.4	54.7	39.3	28.4
pH (-)	6.34	6.82	7.29	7.29	7.03
Dissolved oxygen (mg/L)	7.04	7.96	4.81	5.82	5.90
Suspended solids (mg/L)	7.50	8.30	11.9	9.50	9.30
Chlorides (mg/L)	2.60	2.90	5.30	5.00	5.70
Sulfates (mg/L)	0.61	7.70	5.10	4.90	5.70
Organic carbon (mg C/L)	9.70	6.10	9.10	7.80	7.10
Phosphorus (mg P/L)	0.02	0.02	0.10	0.09	0.11
Nitrites (mg N/L)	<0.05	<0.05	0.01	0.01	0.01
Nitrates (mg N/L)	0.02	2.27	0.28	0.44	0.39
Arsenic (μg As/L)	1.58	1.66	3.08	1.89	1.97
Cadmium (μg Cd/L)	0.46	0.35	0.25	0.26	0.21
Chromium (μg Cr/L)	11.7	15.1	17.4	11.9	12.4
Copper (μg Cu/L)	2.02	3.98	3.78	4.65	5.17
Lead (μg Pb/L)	3.09	2.03	2.78	2.13	2.05
Mercury (μg Hg/L)	0.06	0.05	0.05	0.05	0.06

[a]Source: Du Pont, 1985b.

Beaver Dam Creek

DOE placed the heavy-water production facility on standby in 1982. Since then, Beaver Dam Creek has received permitted condenser cooling water from the coal-fired powerhouse in D-Area, neutralization wastewater, sanitary wastewater, ash basin effluent waters, and various laboratory wastewaters.

In relation to onsite nonthermally or postthermally affected streams, water-quality data downstream of the D-Area near the onsite swamp exhibits chemical characteristics of a stream impacted by industrial point-source discharges. Historic water-quality data indicate Beaver Dam Creek near the swamp did not meet South Carolina Class B water-classification standards for temperature, although it met all other Class B requirements routinely. In relation to data collected at Upper Three Runs Creek, historic data also indicate that Beaver Dam Creek was higher in pH and concentrations of alkalinity, chemical oxygen demand, suspended solids, chlorides, sulfates, nutrients, and selected metals (Lower, 1984).

Table 3-12 lists mean results of water chemistry samples at three stations along Beaver Dam Creek from 1983 through 1985.

Pen Branch

The only significant tributary to Pen Branch is Indian Grave Branch, which flows into Pen Branch about 8 kilometers upstream from the onsite swamp. Indian Grave Branch receives K-Reactor cooling water discharge. Other permitted discharges to Pen Branch and Indian Grave Branch include nonprocess cooling water, ash-basin effluent waters, powerhouse wastewater, waste-treatment-plant overflow, reactor process wastewater, and sanitary wastewater, all of which are associated with K-Area operations. The only additional continuous surface discharge to Pen Branch is a small overflow from the sewage-treatment basin at the Central Shops Area near the Pen Branch headwaters (Lower, 1985).

Data from the nonthermal mainstream of Pen Branch indicate water chemistry conditions generally similar to those of Upper Three Runs Creek. Like Upper Three Runs Creek and nonthermal Four Mile Creek waters, nonthermal Pen Branch waters meet South Carolina Class B stream requirements for temperature, pH, and dissolved oxygen. Concentrations of chlorides, sulfates, phosphorous species, and organic carbon are similar in each of these streams (Lower, 1985). TE

The water chemistries of thermal Pen Branch and Four Mile Creek waters, particularly for trace-level metals, are similar due to the discharges of large volumes of cooling water withdrawn from the Savannah River. In relation to the Savannah River, thermal Pen Branch waters were slightly higher in pH and lower in dissolved oxygen content; the latter is attributable to elevated stream temperature. Nitrate-nitrogen concentrations closely resembled those of upriver Savannah River water. Conductivity, turbidity, suspended solids, and alkalinity analyses showed the same similar trend (Lower, 1985). TE TE

Table 3-13 lists mean results of water chemistry samples at five stations along Indian Grave Branch and Pen Branch from 1983 through 1985.

Table 3-12. Mean Water Chemistry of Beaver Dam Creek, 1983-1985[a]

Parameter/units	Station location		
	Downstream of coal-fired powerhouse	Downstream of ash basin effluent	Onsite swamp upstream of confluence with the Savannah River
Temperature (°C)	25.7	24.8	21.7
pH (-)	7.03	6.90	6.81
Dissolved oxygen (mg/L)	7.43	7.25	5.61
Suspended solids (mg/L)	10.7	13.6	15.1
Chlorides (mg/L)	6.20	6.30	5.70
Sulfates (mg/L)	6.82	11.2	7.10
Organic carbon (mg C/L)	11.1	9.80	9.20
Phosphorus (mg P/L)	0.13	0.13	0.09
Nitrites (mg N/L)	0.02	0.02	0.01
Nitrates (mg N/L)	0.31	0.33	0.29
Arsenic (μg As/L)	2.27	3.75	2.02
Cadmium (μg Cd/L)	0.35	0.44	0.23
Chromium (μg Cr/L)	15.9	12.6	19.0
Copper (μg Cu/L)	7.71	8.95	4.45
Lead (μg Pb/L)	4.18	2.34	2.24
Mercury (μg Hg/L)	0.07	0.07	0.06

[a]Source: Du Pont, 1985b.

Table 3-13. Mean Water Chemistry of Indian Grave Branch and Pen Branch, 1983-1985[a]

Parameter/units	Station location				
	Road B	Indian Grave Branch at Road B below K-Reactor effluents	Road A-13	Onsite swamp near Road A-17 and above Pen Branch Boardwalk	Onsite swamp above confluence with Steel Creek
Temperature (°C)	14.6	46.5	42.4	33.2	17.0
pH (-)	6.92	7.43	7.40	8.07	6.91
Dissolved oxygen (mg/L)	8.22	5.38	5.71	7.48	6.76
Suspended solids (mg/L)	10.0	10.4	14.4	4.90	3.20
Chlorides (mg/L)	2.50	5.90	5.60	6.00	5.80
Sulfates (mg/L)	2.60	5.10	4.80	5.00	5.10
Organic carbon (mg C/L)	7.20	7.60	7.60	7.70	8.50
Phosphorus (mg P/L)	0.04	0.11	0.08	0.10	0.06
Nitrites (mg N/L)	<0.05	0.02	0.02	0.01	<0.05
Nitrates (mg N/L)	0.05	0.27	0.30	0.23	0.09
Arsenic (µg As/L)	1.49	3.40	3.56	2.78	1.46
Cadmium (µg Cd/L)	0.22	0.30	0.25	0.21	0.24
Chromium (µg Cr/L)	9.74	15.7	16.5	11.1	11.1
Copper (µg Cu/L)	3.16	5.14	3.47	4.10	3.23
Lead (µg Pb/L)	2.31	3.15	2.07	3.55	1.99
Mercury (µg Hg/L)	0.06	0.06	0.06	0.05	0.05

[a]Source: Du Pont, 1985b.

Steel Creek

Discharges to Steel Creek, before the operation of L-Reactor, included those from the P- and L-Areas and the Railroad Yard. These effluents were discharged either to Steel Creek or to Meyers Branch, its principal tributary. The permitted discharges include ash basin effluent water, nonprocess cooling water, powerhouse wastewater, reactor process effluents, sanitary-treatment-plant effluents, water-treatment-plant wastewaters, and vehicle wash waters (Lower, 1985).

Temperature and dissolved oxygen data from 1960 to 1968 in Steel Creek at Road A, when the Creek received thermal discharges, indicated conditions similar to those in Four Mile Creek and Pen Branch (Jacobsen et al., 1972). Temperature values and dissolved oxygen concentrations for the latter half of 1968 show a return to nonthermal temperature and dissolved oxygen conditions following the placement of L-Reactor on standby in February 1968.

Recent sampling indicates that all major constituent groups - standard parameters, nutrients, major cations, and metals - fall in ranges associated with streams where natural drainage rather than point-source discharges is the dominant input. Calcium concentrations are slightly increased in relation to those in Upper Three Runs Creek, reflecting the natural chemical gradient existing from the northwest to the southeast borders of the SRP (Du Pont, 1985b). South Carolina Class B water-classification standards for temperature, pH, dissolved oxygen, and fecal coliform counts were met routinely (Lower, 1985).

Table 3-14 lists mean results of water chemistry samples at stations along Steel Creek from 1983 through 1985.

DOE identified the construction of L-Lake on Steel Creek as the preferred method for thermal mitigation of the cooling water from L-Reactor heat exchangers after restart (DOE, 1984b). Fifty percent of this 1000-acre lake is maintained below 32.2°C to support a balanced biological community. The lake is about 1200 meters wide at its widest point and extends about 7000 meters along the Steel Creek valley. The normal pool elevation of the lake is 58 meters above mean sea level (MSL). The storage volume at normal pool elevation is about 31 million cubic meters.

The lake is formed by an embankment approximately 800 meters upstream from the Seaboard Coast Line Railroad Bridge across Steel Creek or 1700 meters upstream from Road A. It is 1200 meters long at the crest, which includes approximately 600 meters of low embankment connecting the west end of the main embankment to the natural ground at elevation 61 meters above MSL. The main embankment is about 26 meters high, 12 meters wide at the top, and 200 meters wide at the base. An outlet structure with gates controls the discharge from the lake to a conduit running 220 meters under the embankment. This conduit discharges into a stilling basin to reduce the water velocity before its release into Steel Creek. TE

Lower Three Runs Creek

Lower Three Runs Creek is the second-largest watershed of the SRP streams. In 1958, its headwaters were impounded to form Par Pond for the recirculation of

Table 3-14. Mean Water Chemistry of Meyers Branch and Steel Creek, 1983-1985[a]

	Station location				
Parameter/units	Road B	Above confluence with Meyers Branch	Meyers Branch above confluence with Steel Creek	Road A-19.1	Below delta after confluence with Pen Branch
Temperature (°C)	17.7	17.2	15.3	15.6	17.2
pH (-)	7.08	7.01	6.93	7.01	6.91
Dissolved oxygen (mg/L)	8.44	8.05	8.03	7.54	6.82
Suspended solids (mg/L)	28.0	16.9	4.60	10.7	2.50
Chlorides (mg/L)	5.20	5.30	2.70	4.50	5.20
Sulfates (mg/L)	4.30	5.20	0.90	3.40	4.50
Organic carbon (mg C/L)	6.00	8.60	8.50	8.70	9.00
Phosphorus (mg P/L)	<0.05	0.06	0.02	0.05	0.05
Nitrites (mg N/L)	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrates (mg N/L)	0.19	0.20	0.09	0.14	0.07
Arsenic (µg As/L)	2.69	2.89	1.90	2.50	2.05
Cadmium (µg Cd/L)	0.20	0.26	0.22	0.21	0.24
Chromium (µg Cr/L)	7.15	9.23	10.8	12.1	6.48
Copper (µg Cu/L)	4.46	2.65	2.36	3.47	3.02
Lead (µg Pb/L)	2.13	4.88	1.74	4.62	1.72
Mercury (µg Hg/L)	0.05	0.07	0.05	0.07	0.05

[a]Source: Du Pont, 1985b.

cooling water from P- and R-Reactors. Cooling water from P-Reactor was discharged to Steel Creek until 1963, when it was diverted to Par Pond. Temperature data from just downstream of Par Pond indicate an average temperature about 2°C higher than other nonthermal streams. In addition, reduced dissolved oxygen concentrations, especially during summer months, are observed at this station. Calcium concentrations are higher in the waters of Lower Three Runs Creek than in other onsite streams. Higher concentrations of calcium and total iron indicate that Lower Three Runs Creek is less soft than the other onsite stream waters. Portions of Lower Three Runs Creek are underlain by calcareous deposits (Langley and Marter, 1973), which increase the hardness of the water. These historic water-chemistry trends have been confirmed by more recent water-quality studies (Du Pont, 1985b).

Table 3-15 lists mean results of water chemistry samples at stations along Lower Three Runs Creek from 1983 through 1985.

3.5.4 SURFACE-WATER USE

The Savannah River upstream from the SRP supplies municipal water for Augusta, Georgia, and North Augusta, South Carolina. Downstream, the Beaufort-Jasper Water Authority in South Carolina (River Mile 39.2) withdraws about 19,700 cubic meters per day (0.23 cubic meter per second) to supply domestic water for a population of about 51,000. The Cherokee Hill Water Treatment Plant at Port Wentworth, Georgia (River Mile 29.0) withdraws about 116,000 cubic meters per day (1.35 cubic meters per second) to supply a business-industrial complex near Savannah, Georgia, that has an estimated consumer population of about 20,000 (Du Pont, 1982b). Plant expansions for both systems are planned for the future (i.e., Beaufort-Jasper Water Authority to supply domestic water to 117,000 people and Cherokee Hill Water Treatment Plant to supply a domestic equivalent of 200,000 people in the year 2000).

With the restart of L-Reactor, the maximum SRP withdrawal rate from the river has increased to about 37 cubic meters per second, primarily for use as cooling water in production reactors and coal-fired steam plants. Almost all of this water returns to the river via SRP streams; consumptive water use is about 0.85 cubic meter per second at C- and K-Reactors, 1.25 cubic meters per second at L- and P-Reactors, and about 0.3 cubic meter per second at the D-Area powerhouse (DOE, 1984b).

A cooling water withdrawal of about 2.6 cubic meters per second and a discharge of 0.7 cubic meter per second for both units of the Alvin Vogtle Nuclear Power Plant is expected late in the 1980s (NRC, 1985). Unit 1 began full-power operation in May 1987. TC

The Urquhart Steam Generating Station at Beech Island, South Carolina, withdraws approximately 7.4 cubic meters per second of once-through cooling water. Upstream, recreational use of impoundments on the Savannah River, including water-contact recreation, is more extensive than it is near the SRP and downstream. No uses of the river for irrigation have been identified in either South Carolina or Georgia (Du Pont, 1982b).

Table 3-15. Mean Water Chemistry of Par Pond and Lower Three Runs Creek, 1983-1985[a]

Parameter/units	Station location				
	Near bubble-up	Pumphouse intakes	Road B	Pattersons Mill	Highway 125
Temperature (°C)	30.3	20.9	18.7	15.7	15.5
pH (-)	7.33	7.28	6.92	7.17	7.17
Dissolved oxygen (mg/L)	6.56	8.27	7.14	7.63	7.45
Suspended solids (mg/L)	2.18	3.65	4.30	5.60	4.50
Chlorides (mg/L)	6.25	6.02	6.10	3.70	3.60
Sulfates (mg/L)	5.02	4.97	3.40	1.60	0.70
Organic carbon (mg C/L)	6.46	7.47	10.2	7.90	9.00
Phosphorus (mg P/L)	0.04	0.02	0.04	0.03	0.05
Nitrites (mg N/L)	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrates (mg N/L)	0.05	0.03	0.04	0.09	0.13
Arsenic (µg As/L)	2.42	1.56	2.58	1.94	1.95
Cadmium (µg Cd/L)	0.20	0.31	0.22	0.12	0.26
Chromium (µg Cr/L)	13.6	8.94	10.9	10.8	6.88
Copper (µg Cu/L)	3.12	4.29	3.46	2.45	2.60
Lead (µg Pb/L)	1.58	3.17	1.74	1.25	2.24
Mercury (µg Hg/L)	0.09	0.07	0.06	0.05	0.06

[a]Source: Du Pont, 1985b.

3.6 ECOLOGY

The United States Government acquired the 780-square-kilometer Savannah River Plant in 1951. At that time the land was approximately two-thirds forested and one-third cropland and pasture. The U.S. Forest Service allowed the abandoned fields to pass through vegetational succession or planted them with various pine species. Today, more than 90 percent of the SRP is forested.

Table 3-16 lists recent SRP land utilization, other than the land used for chemical or nuclear processes and support facilities. The SRP, which was designated as a National Environmental Research Park in 1972, is one of the most extensively studied environments in this country (Dukes, 1984).

Table 3-16. Land Utilization, 1983[a]

	Area (acres)
Land	
Open fields	650
Slash pine	35,000
Longleaf pine	37,500
Loblolly pine	48,000
Pine-hardwood (60% pine)	4,000
Hardwood-pine (60% hardwood)	6,300
Scrub oak	2,000
Upland hardwoods	4,500
Bottomland hardwoods	29,000
Other pine	100
Subtotal	167,050
Wetlands	
Creeks/floodplains	24,500
Savannah River swamp	10,000
Par Pond	2,700
Carolina bays	1,000
Other	1,000
Subtotal	39,200
Total	206,250[b]

[a]Adapted from Dukes, 1984.
[b]Exceeds total SRP acreage due to overlap in wetlands and bottomland hardwood acres.

3.6.1 TERRESTRIAL ECOLOGY

3.6.1.1 Soils

A general soils map of the Savannah River Plant (Aydelott, 1977) groups the soil types into 23 mapping units. The dominant types are Fuquay/Wagram Soils (27.3 percent), Dothan/Norfolk soils (9.6 percent), Savannah River swamp and Lower Three Runs corridor (9.4 percent), Troop Loamy Sand, Terrace phase (8.4 percent), Gunter Sand (7.5 percent), and Vaucluse/Blaney Soils (6.5 percent). Together, these units account for approximately 70 percent of the soil types on the SRP.

3.6.1.2 Vegetation

The SRP is near the line that divides the oak-hickory-pine forest and the southern mixed forest. Consequently, it has species representative of each forest association. Prior to its acquisition by the Government, approximately one-third of the SRP was cropland. Except for the production areas and their support facilities, the U.S. Forest Service has reclaimed many previously disturbed areas through natural plant succession or by planting with pine trees. No virgin forest remains in the region (Braun, 1950).

A variety (150 families, 1097 species) of vascular plants exist on the Plant (Dukes, 1984). Typically, a scrub oak community covers the drier sandy areas; longleaf pine, turkey oak, bluejack oak, blackjack oak, and dwarf post oak with ground cover of three awn grass and huckleberry dominate such communities.

Oak-hickory hardwoods are prevalent on more fertile, dry uplands. The characteristic species are white oak, post oak, southern red oak, mockernut hickory, pignut hickory, and loblolly pine with an understory of sparkleberry, holly, TC greenbriar, and poison ivy. Table 3-17 lists the common and scientific names for selected biota (flora and fauna) on the Plant.

3.6.1.3 Wildlife

TE The diversity and abundance of wildlife that inhabit the SRP (Table 3-17) reflect the interspersion and heterogeneity of the habitats existing on the Plant. Because of its mild climate and the variety of aquatic and terrestrial habitats, the SRP contains a varied and abundant herpetofauna (DOE, 1984b; Gibbons and Patterson, 1978). The species on the Plant include 31 snakes, 26 frogs and toads, 17 salamanders, 10 turtles, 9 lizards, and 1 alligator (Dukes, 1984).

Species collected during intensive field studies on Steel Creek, particularly during 1981 and 1982, are representative of species existing in similar creeks and wetland areas (Dukes, 1984). Biologists have identified more than 213 species of birds on the SRP. Gamebird populations such as quail and dove were abundant initially but have declined since the 1960s because the conversion of agricultural fields to forests has resulted in a reduced carrying capacity. Waterfowl on the SRP are mainly winter migrants. Wood ducks are the only waterfowl species to breed consistently in the SRP region, although mallards and hooded mergansers occasionally breed on the SRP.

Table 3-17. Common and Scientific Names for Selected Biota on the SRP

Common Name	Scientific Name	
	VEGETATION	
White oak	*Quercus alba*	
Post oak	*Quercus stellata*	
Turkey oak	*Quercus laevis*	
Southern red oak	*Quercus falcata*	
Black-jack oak	*Quercus marilandica*	
Blue-jack oak	*Quercus incana*	
Scrub oak	*Quercus* sp.	
Dwarf post oak	*Quercus* sp.	
Mockernut hickory	*Carya tomentosa*	
Pignut hickory	*Carya glabra*	
Long-leaf pine	*Pinus palustris*	
Loblolly pine	*Pinus taeda*	
Squaw-huckleberry	*Vaccinium stamineum*	
Sparkleberry	*Vaccinium arboreum*	
Holly *Ilex* spp.		
Three-awn grass	*Aristida* spp.	
Greenbrier	*Smilax* spp.	
Poison ivy	*Rhus radicans*	
Poison oak	*Rhus toxicodendron*	TC
	AQUATIC FLORA	
Watermilfoil	*Myriophyllum* spp.	
Hornwort	*Ceratophyllum* spp.	
Alligatorweed	*Alternanthera philoxeroides*	
Water-weed	*Elodea* spp.	
Arrowhead	*Sagittaria* sp.	
	WILDLIFE	
Bobwhite quail	*Colinus virginianus*	
Mourning dove	*Zenaidura macroura*	
Wood duck	*Aix sponsa*	
Mallard duck	*Anas platyrhynchos*	
Hooded merganser	*Mergus cucullatus*	
	COMMERCIAL AND RECREATIONALLY VALUABLE SPECIES	
White-tailed deer	*Odocoileus virginianus*	
Feral hog (swine)	*Sus scrofa*	
Bullfrog	*Rana catesbeiana*	
Slider turtle	*Pseudemys* spp.	
Florida cooter	*Chrysemys f. floridana*	

Table 3-17. Common and Scientific Names for Selected Biota on the SRP (continued)

Common Name	Scientific Name
ENDANGERED AND THREATENED SPECIES	
American alligator[a]	*Alligator mississippiensis*
Southern bald eagle	*Haliaeetus l. leucocephalus*
Wood stork	*Mycteria americana*
Red-cockaded woodpecker	*Picoides borealis*
Smooth coneflower	*Echinacea laevigata*
Pelict trillium	*Trillium reliquum*
Sand-burrowing mayfly	*Dolania americana*
AQUATIC FAUNA	
Mayflies	Ephemeroptera
Dragonflies	Odonata
True flies	Diptera
Snails	Gastropoda
Clams	Pelecypoda
Asiatic clam	*Corbicula fluminea*
Sunfish	*Lepomis* spp.
TC Redbreast	*Lepomis auritus*
Flat bullheads	*Ictalurus platycephalus*
Bowfin	*Amia calva*
Spotted suckers	*Minytrema melanops*
Channel catfish	*Ictalurus punctatus*
Largemouth bass	*Micropterus salmoides*
American eel	*Anguilla rostrata*
White catfish	*Ictalurus catus*
Longnose gar	*Lepisosteus osseus*
Striped mullet	*Mugil cephalus*
Silver redhorse	*Myoxostoma anisurum*
Chain pickerel	*Esox niger*
Quillback carpsucker	*Carpiodes cyprinus*
Shiners	*Notropis* spp.
Brook silverside	*Labidesthes sicculus*
COMMERCIALLY AND RECREATIONALLY VALUABLE SPECIES	
American shad	*Alosa sapidissima*
Channel catfish	*Ictalurus punctatus*
Atlantic sturgeon	*Acipenser oxyrhynchos*
ENDANGERED SPECIES	
Shortnose sturgeon	*Acipenser brevirostrum*

[a]Threatened due to similarity of appearance.

3.6.1.4 Commercially and Recreationally Valuable Biota

The ecosystems on the SRP support many commercially and recreationally valuable game populations (Table 3-17); however, DOE restricts recreational use to controlled hunts for white-tailed deer and feral hogs. Many species are highly mobile and migrate offsite where activities such as hunting are allowed. Other resident species that are edible and that migrate offsite include the wood duck, bullfrog, and various species of turtles. The slider turtle is the most abundant turtle known to migrate offsite; other common species that move offsite include the Florida cooter and the snapping turtle (DOE, 1984b). Commercially valuable plant biota on the Savannah River Plant include approximately 175,000 acres of timber managed by the U.S. Forest Service. TE

3.6.1.5 Endangered and Threatened Species

Three species listed as endangered by the U.S. Fish and Wildlife Service - the bald eagle, the wood stork, and the red-cockaded woodpecker - have been identified on the SRP. In addition, one plant species - smooth coneflower (Echingcea laevigata) - found on the Plant is currently under status review by the U.S. Fish and Wildlife Service. The smooth coneflower occurs along Burma Road, which parallels Upper Three Runs Creek between F-Area and TNX-Area. To date, the U.S. Fish and Wildlife Service has not identified any "critical habitat" on the SRP. (See Table 3-17). The relict trillium (Trillium reliquum), a proposed endangered species, is not found on the Plant but in nearby counties (Aiken and Allendale). It is reported as locally abundant along Savannah River bluffs northwest of Beech Island. The sand-burrowing mayfly (Dolania americana), under status review, is found in Upper Three Runs Creek on the Plant. On June 4, 1987, the U.S. Fish and Wildlife Service reclassified the American alligator from endangered to threatened due to similarity of appearance, because the species is no longer biologically endangered or threatened in seven states, including Georgia and South Carolina (52 FR 21059-21064). The threatened due to similarity of appearance status was retained to ensure against excessive taking and to continue necessary protection to the American crocodile (Crocodylus acutus), a morphologically similar species. TC TC TC TE

3.6.2 AQUATIC ECOLOGY

3.6.2.1 Aquatic Flora

The Savannah River is the dominant water body on the SRP. Biologists have identified approximately 400 species of algae in the river, with diatoms predominant. Blue-green algae are sometimes common upstream from the site; their abundance is attributed to organic loading from municipal sources. Algal diversity has decreased since 1951, probably because of increased organic loading in the Savannah River upriver of the SRP (ANSP, 1961, 1974).

Aquatic macrophytes in the river, most of which are rooted, are limited to shallow areas of reduced current and to areas along the shallow margins of tributaries. Eight species of vascular plants have been identified in the river adjacent to the SRP, the most abundant being water milfoil, hornwort, alligatorweed, waterweed, and duck potato (DOE, 1984b).

3.6.2.2 Aquatic Fauna

Shallow areas and quiet backwaters and marshes of the Savannah River near the SRP support a diverse aquatic invertebrate fauna. However, the bottom substrate of most open portions of the river consists of shifting sand that does not provide the ideal habitat for bottom-dwelling organisms. During the 1950s, the total number of invertebrate species in the river decreased; this has been attributed primarily to the effects of dredging (Patrick, Cairns, and Roback, 1967). The groups most affected are those sensitive to the effects of siltation and substrate instability. Mayflies and dragonflies predominated
TE among insect fauna in earlier surveys. In more recent surveys, true flies have been dominant (DOE, 1984b). See Table 3-17.

Mollusks such as snails and clams are an important component of the Savannah River invertebrate community, but they do not occur in the drift communities, presumably because their relatively high density (weight) prevents them from floating. The Asiatic clam, Corbicula, is found in the Savannah River and larger tributary streams in the vicinity of the SRP (DOE, 1984b).

The Savannah River and its associated swamp and tributaries are typical of southeastern Coastal Plain rivers and streams; they support a diverse fish fauna. Sixty-six adult fish species were collected as part of the Comprehensive Cooling Water Study (Du Pont, 1985b). The dominant small fishes (excluding minnows) were sunfishes (especially redbreast) and flat bullheads. The dominant large fishes were bowfin, spotted suckers, and channel catfish. Other important species were largemouth bass, American eel, white catfish, longnose gar, striped mullet, silver redhorse, chain pickerel, and quillback carpsucker. The most abundant small forage species were shiners and brook silverside.

3.6.2.3 Commercially and Recreationally Valuable Biota

The Savannah River supports both commercial and sport fisheries. Most fishing is confined to the marine and brackish waters of the coastal regions of South Carolina and Georgia. The only commercial fish of significance near the SRP are the American shad, the channel catfish, and the Atlantic sturgeon
TE (Table 3-17). (The commercial catch of American shad from the Savannah River during 1979 was 57,600 kilograms.)

3.6.2.4 Endangered and Threatened Species

TE Recent fisheries surveys on the Savannah River revealed that the endangered shortnose sturgeon (Table 3-17) spawn in the vicinity of the Savannah River Plant (Du Pont, 1985b). A biological assessment of the potential effects of SRP operations on the shortnose sturgeon in the Savannah River (Muska and Matthews, 1983) was submitted to the National Marine Fisheries Service (NMFS). The NMFS and DOE have concurred that the population of the shortnose sturgeon in the Savannah River would not be jeopardized by SRP operations (Oravetz, 1983).

3.7 RADIATION AND HAZARDOUS CHEMICAL ENVIRONMENT

3.7.1 *RADIATION ENVIRONMENT*

Environmental radiation consists of (1) natural background radiation from cosmic and terrestrial sources and internally deposited natural radionuclides; and (2) man-made radiation from medical diagnosis and therapy, weapons test fallout, consumer and industrial products, and nuclear facilities. The following sections briefly describe the current radiation environment from natural and other offsite sources and radioactivity in the atmospheric, water, and soil environments as a result of SRP activities, as summarized in Table 3-18. TE

3.7.1.1 Radiation Levels from Natural and Other Offsite Sources

Natural radiation sources contribute about 288 millirem per year in the SRP vicinity, 75 percent of the annual dose of 384 millirem received by an average member of the public in this area from all sources. The contribution of cosmic radiation to this dose varies with both latitude and altitude, but averages about 40 millirem per year to an unshielded individual in Georgia and South Carolina (EPA, 1972); this is reduced to about 80 percent of that value (or 32 millirem per year) by buildings. J-38

Local gamma radiation exposure from naturally radioactive daughters of uranium and thorium, and naturally radioactive potassium-40 present in the ground within 80 kilometers of the SRP ranges between 6 and 385 millirem per year (Langley and Marter, 1973). The average unshielded external terrestrial background radiation in the vicinity of SRP averages about 55 millirem per year, and is reduced by buildings and the body to about 33 millirem per year.

Internal radiation from natural sources arises primarily from potassium-40, carbon-14, rubidium-87, and daughters of radium-226 deposited in various organs of the body. The estimated average radiation exposure in the United States from these natural radionuclides internal to the body is 28 millirem per year (BEIR, 1980). Radon emanations in houses, previously not reported, account for an average of 195 millirem (dose to the human lung) per year per individual (Zeigler et al., 1987). TC

Radiation received as a consequence of medical diagnosis and therapy represents the largest single contribution of man-made origin to the average individual dose. In the United States, this dose, averaged over the population, is about 93 millirem per year, or about one-third of that received from natural background in the vicinity of the SRP. All other man-made sources, including such sources as weapons test fallout, consumer and industrial products, nuclear facilities, and air travel, account collectively for less than 10 millirem per year, or about 5 percent of the total annual dose to an average individual (BEIR, 1980). J-38

Other nuclear facilities operating within 80 kilometers of the SRP are the low-level radioactive waste burial site operated by Chem-Nuclear Systems, Inc., near the eastern SRP boundary, and Unit 1 of the Alvin W. Vogtle Nuclear Power Plant. The Chem-Nuclear facility, which began operating in 1971, releases essentially no radioactivity to the environment, and the incremental radiation dose to the public from both normal operations and the transportation of waste to the burial site is negligible. F-9

TE Table 3-18. Major Sources of Radiation Exposure in the Vicinity of the SRP[a]

Source of exposure	Dose to average individual (mrem/yr)	Percent of exposure
Natural background radiation		
Cosmic radiation	32.0	
External terrestrial gamma	33.0	
Internal	28.0	
Radon in homes[b]	195.0	
Subtotal	288.0	75.0
Medical radiation		
Diagnostic X-rays	77.0	
Radiopharmaceuticals	14.0	
Subtotal	91.0	23.7
Weapons test fallout	4.6	1.2
Consumer and industrial products	4.5	1.2
Air travel	0.5	0.1
Nuclear facilities (other than SRP)	<0.1	<0.1
SRP environmental radioactivity - 1986	0.05	<0.1
Total	384.0	

J-38

[a]Source: Zeigler et al., 1987.
[b]Dose to human lung.

F-9 Unit 1 of the Vogtle Nuclear Power Plant began full-power operation in May 1987; Unit 2 is currently under construction. Based on radionuclide releases reported from 71 commercial power reactors operating at 48 sites in 1981, the average per capita dose to residents within 80 kilometers was about 0.0016 millirem (NRC, 1985). Assuming average performance by the Vogtle plant, the total environmental radiation dose from natural and other offsite sources would not change significantly.

3.7.1.2 SRP Radiation Environment

TC As noted in Table 3-18, SRP releases in 1986 contributed about 0.05 millirem to the average individual within 80 kilometers of the Plant, less than
TC 0.1 percent of the total individual radiation dose from all sources. The major contributor to this dose and to that calculated at the SRP perimeter (see Table 3-19) is tritium released to the atmosphere.

Table 3-19. Atmospheric Releases and Concentrations at SRP Perimeter, 1986[a]

Nuclide	Curies released at emission source	Calculated average concentration at Plant perimeter, (μCi/cm³)	DOE derived concentration guide, (μCi/cm³)[b]	Percent of DOE derived concentration guide
		Gases and Vapors		
H-3 (oxide)	2.85×10^{5}	8.8×10^{-11}	2.0×10^{-7}	4.4×10^{-2}
H-3 (elemental)	1.40×10^{5}	4.3×10^{-11}	b	b
H-3 Total	4.25×10^{5}	1.3×10^{-10}	b	b
C-14	5.60×10^{1}	1.8×10^{-14}	5.0×10^{-7}	3.5×10^{-6}
Ar-41	8.32×10^{4}	1.3×10^{-11}	b	b
Kr-85m	1.99×10^{3}	4.7×10^{-13}	b	b
Kr-85	7.10×10^{5}	2.2×10^{-10}	b	b
Kr-87	1.38×10^{3}	1.7×10^{-13}	b	b
Kr-88	2.43×10^{3}	4.9×10^{-13}	b	b
Xe-131m	3.00×10^{-1}	9.3×10^{-17}	b	b
Xe-133	1.06×10^{4}	3.3×10^{-12}	b	b
Xe-135	2.60×10^{3}	7.1×10^{-13}	b	b
I-129	8.70×10^{-2}	2.5×10^{-17}	7.0×10^{-11}	3.5×10^{-5}
I-131	2.64×10^{-2}	7.4×10^{-18}	4.0×10^{-10}	1.9×10^{-6}
		Particulates		
Co-60	8.00×10^{-6}	2.3×10^{-21}		
Se-75	2.10×10^{-5}	6.0×10^{-21}	1.0×10^{-9}	6.0×10^{-10}
Sr-89,90	1.97×10^{-3}	5.6×10^{-19}	9.0×10^{-12}	6.2×10^{-6}
Zr-95	4.38×10^{-3}	1.2×10^{-18}	6.0×10^{-9}	2.1×10^{-7}
Nb-95	9.18×10^{-3}	2.6×10^{-18}	3.0×10^{-9}	8.7×10^{-8}
Ru-103	3.50×10^{-3}	9.9×10^{-19}	2.0×10^{-9}	5.0×10^{-8}
Ru-106	5.90×10^{-2}	1.7×10^{-17}	3.0×10^{-11}	5.6×10^{-5}
Cs-134	6.94×10^{-4}	2.0×10^{-19}	2.0×10^{-10}	9.9×10^{-8}
Cs-137	2.95×10^{-3}	8.4×10^{-19}	4.0×10^{-10}	2.1×10^{-7}
Ce-141	1.90×10^{-5}	5.4×10^{-21}	1.0×10^{-9}	5.4×10^{-10}
Ce-144	1.10×10^{-2}	3.1×10^{-18}	3.0×10^{-11}	1.0×10^{-5}
Os-185	1.40×10^{-4}	4.0×10^{-20}	1.0×11^{-9}	4.0×10^{-9}
U-235,238	1.57×10^{-3}	4.5×10^{-19}	1.0×10^{-13}	4.5×10^{-4}
Pu-238	2.02×10^{-3}	5.7×10^{-19}	3.0×10^{-14}	1.9×10^{-3}
Pu-239	3.36×10^{-4}	9.5×10^{-20}	2.0×10^{-14}	4.8×10^{-4}
Cm-242,244	2.80×10^{-5}	7.9×10^{-21}	4.0×10^{-14}	2.0×10^{-5}
Am-241,243	1.54×10^{-4}	4.4×10^{-20}	2.0×10^{-14}	2.2×10^{-4}

Source: Zeigler et al., 1987.

[a]Derived air concentration guide is that concentration breathed continuously at a rate of 8400 cubic meters per year that will result in an annual dose rate of 100 mrem/year.

[b]*Not applicable to elemental tritium and inert noble gases.*

J-38

Atmospheric Environment

J-38 Table 3-19 lists the releases of radioactive materials to the atmosphere from SRP operations in 1986. This table also compares the average concentrations of these materials in the air at the SRP perimeter to DOE concentration guides. These guides are recommended concentration limits for continuous inhalation exposure for persons in uncontrolled areas beyond the SRP boundary, based on a prolonged exposure (expected to last 5 years) of 100 millirem per year. The concentrations at the SRP boundary of all radionuclides released to the atmosphere from the Plant in 1986 were less than 1 percent of the DOE concentration guides (Zeigler et al., 1987).

Tritium from the SRP was detectable at offsite stations. The maximum tritium oxide concentration observed at an SRP perimeter station was 520 picocuries
J-38 per cubic meter, which is 0.26 percent of the DOE concentration guides. The concentration in air at all SRP perimeter stations averaged 79 picocuries per cubic meter - 0.04 percent of the concentration guide - compared to 10 picocuries per cubic meter at 160-kilometer-radius stations (Zeigler et al., 1987).

The small amount of particulate alpha and beta radioactivity released to the atmosphere, primarily from the fuel separations areas, generally is obscured in the area surrounding SRP by worldwide fallout. The four sampling location
J-38 groups (onsite, SRP perimeter, 40-, and 160-kilometer radius) had essentially the same monthly average particulate alpha and beta concentrations in 1986. The 1986 average alpha activity range at these four location groups was 0.00086 to 0.0013 picocurie per cubic meter, which was similar to the 1985 range of 0.00098 to 0.0012 picocurie per cubic meter (Zeigler et al., 1987).

In 1986, the particulate beta-gamma concentrations for all sample groups averaged 0.021 to 0.028 picocurie per cubic meter. This is slightly above the average beta-gamma activity reported in 1985. Since 1981, however, there has
J-38 been a fourfold decline in the average beta activity in air. This decreased activity is attributed to a decline in worldwide fallout from atmospheric nuclear weapons testing. The last announced atmospheric weapons test occurred in China in 1980 (Zeigler, Lawrimore, and Heath, 1986; and Zeigler et al., 1987).

In 1986, environmental gamma radiation measurements at the air-monitoring stations were within the ranges observed at these stations during the past several years. Variations in background radiation levels are caused by
J-38 differences in cosmic radiation in the natural radium and thorium content of the soil and the presence of rocks on or near the earth's surface (rocks contain more radium and thorium than soil). The variations in background radiation are reflected in the data listed in Table 3-20 (Zeigler et al., 1987).

Groundwater Environment

TC Solid and liquid low-level radioactive waste is treated and disposed of on the SRP. Radioactive releases from disposal operations enter the shallow groundwater at specific operating areas on the Plant. The migration of radionuclides to groundwater occurs via seepage basins that have received low-level radioactive liquid waste streams and via leachates from buried solid low-level
TC radioactive wastes. The shallow groundwater that contains radioactivity eventually discharges to onsite streams (Stone and Christensen, 1983).

Table 3-20. Air Monitoring Station Radiation Measurements, 1986[a] TE

Locations	Radioactivity measurements (millirem per year) Maximum	Minimum	Average
Plant perimeter	84	47	73
40-km radius	84	47	58
160-km radius	204	40	88

[a]Source: Zeigler et al., 1987.

J-38

Tritium is the most abundant and mobile radionuclide that enters the shallow groundwater. Others include strontium-90, cesium-137, and plutonium-238 and -239. However, because the latter radionuclides tend to adsorb on soil beneath the seepage basins and burial grounds, they migrate very slowly. The soil column acts as a mechanism which removes many radionuclides from groundwater. However, technetium-99 and iodine-129 are long-lived and mobile in the groundwater environment. These radionuclides have been detected in groundwater by special techniques. They cccur at very low levels that cannot be measured by accepted standard routine monitoring procedures (Stone and Christensen, 1983). TE

Waste sites that are the principal contributors of tritium to shallow groundwater include the K-Area containment basin, the F- and H-Area seepage basins, and the radioactive waste Burial Grounds (Stone and Christensen, 1983).

Tritium is the only radionuclide detected migrating via shallow groundwater from the K-Area containment basin to Pen Branch. Weekly flow measurements combined with tritium concentrations indicated the migration of 6130 curies in 1986 (Zeigler et al., 1987). Tritium concentrations in groundwater exceed the EPA drinking-water standard of 20,000 picocuries per liter (Stone and Christensen, 1983). In 1986, the total measured migration of tritium was 1770 curies from the F-Area seepage basins and 12,570 curies from the H-Area seepage basins and the low-level radioactive waste burial grounds. The tritium from these sources mix and cannot be distinguished from each other. The amounts of strontium-90 migration from F- and H-Area seepage basins are 0.16 and 0.08 curie, respectively (Zeigler et al., 1987). TE J-38

A tritium plume in shallow groundwater is present at all active reactor seepage basins. The basin in L-Area and the backfilled basins in R-Area have been inactive for many years. Tritium plumes already have reached surface streams in these areas (Pekkala et al., 1987). Tritium concentrations in groundwater around the P- and C-Area seepage basins exceed the EPA drinking-water standard of 20,000 picocuries per liter. Groundwater in R-Area contains strontium-90 in excess of the EPA drinking-water standard (8 picocuries per liter). Elevated levels of nonvolatile beta activity in monitoring wells near the P- and C-Area seepage basins suggest that groundwater near these basins contains strontium-90 above 8 picocuries per liter. Radionuclides have also been detected in shallow groundwater at the L-Area oil and chemical basin and TC TC the Savannah River Laboratory seepage basins (Stone and Christensen, 1983). Additional waste site groundwater monitoring and groundwater transport modeling data and information are given in the 26 Environmental Information Documents (EIDs) prepared in support of this EIS. These documents are referenced in Appendixes B and F.

Wells in the deep Middendorf/Black Creek (Tuscaloosa) aquifer provide drinking water for many areas of the SRP and for surrounding towns. Drinking water supplies from onsite and offsite wells in the Middendorf/Black Creek are routinely sampled and analyzed by the SRP for alpha, nonvolatile beta, and tritium. The analytical results for 1984, 1985, and 1986 are summarized in TC Tables 3-21 through 3-23. Alpha and nonvolatile beta values greater than the lower level of detection are attributed to the naturally occurring radium and thorium that exist in groundwater in the SRP area (Zeigler et al., 1987). Tritium levels are occasionally greater than the lower level of detection, but are well below the drinking-water standard of 20,000 picocuries per liter. Elevated levels of tritium in onsite deep wells are under study by DOE.

Surface-Water Environment

TE Table 3-24 lists liquid releases from the SRP and resulting concentrations in surface water for 1986, together with their Derived Concentration Guides (DCGs). The release of tritium accounts for more than 99 percent of the total J-38 radioactivity introduced into streams and rivers from SRP activities; 28,000 curies were transported in the Savannah River in 1985. After dilution by SRP streams and the Savannah River, tritium concentrations averaged 3900 picocuries per liter in the river below the Plant at Highway 301.

TC Radionuclides in onsite streams include both releases directly to the streams and migration in shallow groundwater from seepage basins and waste burial J-38 sites. Table 3-25 lists mean concentration values reported for 1986 with their DCGs. Even before dilution in the Savannah River, these concentrations in onsite streams are very small percentages of their respective DCGs.

Soil Environment

Radioactive materials are found in surface soils on and in the vicinity of the SRP as a result of deposition processes from the atmosphere. A major portion of the area-wide deposit has resulted from atmospheric nuclear weapons testing. The cumulative deposit of strontium-90 and cesium-137 in the 30°-40° north latitude band (where the SRP is located) has been estimated to be about 63 and 101 millicuries per square kilometer, respectively (United Nations, 1982). Corresponding cumulative deposition values for plutonium-238 and -239 are 0.03 and 1.15 millicuries per square kilometer, respectively.

Releases from the SRP have contributed to soil radionuclide concentrations. Appendix B describes such contributions from waste management activities in subsurface soils. Airborne materials have been deposited primarily in proximity to the F- and H-Area stacks. Sampling onsite and in the SRP vicinity TE have produced the deposition values for 1986, listed in Table 3-26. These J-38 values are similar to or less than those estimated from nuclear weapons testing. The measured strontium-90 outside the SRP represents only a small fraction of the estimated worldwide deposition rate; cesium-137 is measured at about 30 percent of the estimated deposition rate, and the values for

Table 3-21. Tritium Concentrations in Drinking Water from Onsite and Offsite Deep Wells, 1984-1986[a]

Location[b,c]	Tritium concentration (pCi/liter) 1984[d] Maximum	1984[d] Minimum	1985[d] Maximum	1985[d] Minimum	1986[e] Maximum	1986[e] Minimum
ONSITE						
C-Area	LLD[f]	LLD	1700	LLD	570	LLD
Central Shops	LLD	LLD	1500	LLD	LLD	LLD
D-Area	390	360	530	500	950	460
F-Area	LLD	LLD	270	LLD	LLD	LLD
Firing range	1600	1500	1800	1400	1800	610
Forestry Building	1400	1000	1200	710	1400	1100
H-Area	1400	LLD	580	LLD	690	LLD
K-Area	280	LLD	1500	LLD	1800	LLD
L-Area	LLD	LLD	470	LLD	LLD	LLD
P-Area	LLD	LLD	1700	LLD	5600	LLD
TC	480	220	260	LLD	LLD	LLD
105-K Building	NR[g]	NR	NR	NR	410	LLD
105-P Building	NR	NR	NR	NR	5500	LLD
221-H Building	NR	NR	NR	NR	1200	1200
701-8G Barricade 8	NR	NR	NR	NR	3600	3600
701-12G Barricade 7	NR	NR	NR	NR	8000	8000
701-13G Barricade 6	NR	NR	NR	NR	2300	2300
OFFSITE						
Allendale	LLD	LLD	260	LLD	LLD	LLD
Bath	260	LLD	230	LLD	LLD	LLD
Jackson	360	LLD	570	570	630	460
Langley	LLD	LLD	240	LLD	LLD	LLD
New Ellenton	LLD	LLD	280	LLD	450	400

[a]Sources: Du Pont 1985a; Zeigler, Lawrimore, and Heath, 1986; Zeigler et al., 1987.
[b]Data are not reported for locations at which tritium concentrations of all samples were less than the lower level of detection.
[c]Wells are assumed to be screened in the Middendorf/Black Creek only.
[d]Lower level of detection = 210 pCi/liter.
[e]Lower level of detection = 380 pCi/liter.
[f]LLD = Concentration is less than the lower level of detection.
[g]NR = Not reported or not sampled.

TC

Table 3-22. Alpha Concentrations in Drinking Water from Onsite and Offsite Deep Wells, 1984-1986[a]

	Alpha concentration (pCi/liter)					
	1984[d]		1985[d]		1986[e]	
Location[b,c]	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
ONSITE						
A-Area	LLD[f]	LLD	0.27	LLD	LLD	LLD
C-Area	0.62	0.57	0.59	LLD	1.10	LLD
Central Shops	0.39	LLD	0.25	LLD	LLD	LLD
Classification yard	0.62	0.33	0.25	LLD	LLD	LLD
Emergency Operations Ctr.	0.31	0.31	0.25	0.25	LLD	LLD
F-Area	LLD	LLD	0.76	0.55	3.4	LLD
Firing range	2.6	2.5	2.1	1.4	2.2	LLD
Forestry Building	1.6	0.47	1.2	0.83	1.3	LLD
H-Area	1.9	1.8	2.6	1.7	1.1	LLD
K-Area	0.94	LLD	0.58	LLD	LLD	LLD
L-Area	0.39	0.31	0.34	LLD	LLD	LLD
P-Area	0.49	0.23	0.50	0.33	LLD	LLD
Par Pond Lab, 905-89G	0.39	LLD	LLD	LLD	LLD	LLD
TC	2.6	1.3	0.59	0.50	1.6	0.70
TNX	0.62	0.23	0.42	0.42	0.70	LLD
105-C Building	NR[g]	NR	NR	NR	0.87	LLD
105-K Building	NR	NR	NR	NR	1.3	LLD
105-L Building	NR	NR	NR	NR	0.61	LLD
221-F Building	NR	NR	NR	NR	3.5	3.5
221-H Building	NR	NR	NR	NR	3.3	3.3
681-1G	0.41	0.31	LLD	LLD	LLD	LLD
OFFSITE						
Allendale	0.23	LLD	LLD	LLD	LLD	LLD
Bath	0.32	LLD	0.31	LLD	0.58	LLD
Blackville	0.24	LLD	LLD	LLD	LLD	LLD
Jackson	0.86	0.39	0.61	0.25	2.3	LLD
Langley	0.55	0.47	0.27	LLD	1.4	1.3
New Ellenton	0.24	LLD	LLD	LLD	2.1	LLD

[a]Sources: Du Pont 1985a; Zeigler, Lawrimore, and Heath, 1986; Zeigler et al., 1987.
[b]Data are not reported for locations at which alpha concentrations of all samples were less than the lower level of detection.
[c]Wells are assumed to be screened in the Middendorf/Black Creek only.
[d]Lower level of detection = 0.22 pCi/liter.
[e]Lower level of detection = 0.57 pCi/liter.
[f]LLD = Concentration is less than the lower level of detection.
[g]NR = Not reported or not sampled.

TC

Table 3-23. Nonvolatile Beta Concentrations in Drinking Water from Onsite and Offsite Deep Wells, 1984-1986[a]

Location [b,c]	1984[d] Maximum	1984[d] Minimum	1985[d] Maximum	1985[d] Minimum	1986[e] Maximum	1986[e] Minimum
	Nonvolatile beta concentration (pCi/liter)					
ONSITE						
A-Area	1.6	1.6	LLD	LLD	LLD	LLD
C-Area	1.6	LLD[f]	0.81	LLD	LLD	LLD
Central Shops	1.7	LLD	1.4	LLD	LLD	LLD
Classification yard	2.0	0.97	1.2	0.81	2.4	LLD
D-Area	1.7	1.2	1.6	LLD	2.4	LLD
Emergency Operations Ctr.	1.2	1.2	0.92	0.92	LLD	LLD
F-Area	2.2	1.8	4.1	4.1	6.8	2.0
Firing range	3.6	3.6	3.2	2.7	3.7	LLD
Forestry Building	2.0	LLD	1.3	1.1	2.0	LLD
H-Area	4.7	4.6	5.1	2.8	6.2	1.8
K-Area	1.6	1.0	1.4	1.1	2.9	2.0
L-Area	1.1	0.87	1.8	1.7	LLD	LLD
P-Area	1.5	1.3	1.4	1.0	1.6	LLD
Par Pond Lab, 905-89G	1.1	LLD	LLD	LLD	LLD	LLD
Par Pond pumphouse	NR[g]	NR	2.7	2.7	4.3	LLD
TC	2.7	1.9	1.6	1.5	2.5	LLD
TNX	3.1	2.8	3.1	3.1	4.9	1.8
105-C Building	NR	NR	NR	NR	2.0	LLD
105-K Building	NR	NR	NR	NR	4.0	LLD
105-L Building	NR	NR	NR	NR	1.8	LLD
105-P Building	NR	NR	NR	NR	3.7	LLD
221-F Building	NR	NR	NR	NR	9.6	9.6
221-H Building	NR	NR	NR	NR	6.5	6.5
681-3G	3.8	3.2	3.5	2.8	3.9	2.0
704-S DWPF	NR	NR	NR	NR	1.6	LLD
OFFSITE						
Blackville	1.7	1.5	1.0	LLD	2.3	LLD
Jackson	1.1	LLD	1.5	LLD	4.6	LLD
Langley	1.3	1.2	1.8	1.2	3.1	LLD
New Ellenton	LLD	LLD	LLD	LLD	3.4	LLD

[a]Sources: Du Pont 1985a; Zeigler, Lawrimore, and Heath, 1986; Zeigler et al., 1987.
[b]Data are not reported for locations at which nonvolatile beta concentrations of all samples were less than the lower level of detection.
[c]Wells are assumed to be screened in the Middendorf/Black Creek only.
[d]Lower level of detection = 0.80 pCi/liter.
[e]Lower level of detection = 1.60 pCi/liter.
[f]LLD = Concentration is less than the lower level of detection.
[g]NR = Not reported or not sampled.

TC

Table 3-24. Liquid Releases and Concentrations for 1986[a] TE

Nuclide	Curies released at emission source	Derived conc. guide (pCi/L)[b]	Below SRP[c] Conc. (pCi/L)	Beaufort-Jasper[d] Conc. (pCi/L)	Port Wentworth[e] Conc. (pCi/L)
H-3	2.8×10^{4} (f)	3,000,000	3,900 (g)	3,100 (g)	3,400 (g)
Sr-89,-90	3.6×10^{-1} (f)	300	1.7×10^{-1}	4.0×10^{-2}	4.4×10^{-2}
I-129	2.2×10^{-2}	60	3.5×10^{-3}	2.5×10^{-3}	2.7×10^{-3}
Cs-137	1.1×10^{-1}	20,000	1.1×10^{-1}	1.2×10^{-2}	1.3×10^{-2}
Uranium	4.4×10^{-2}	4,000	7.0×10^{-3}	4.9×10^{-3}	5.4×10^{-3}
Pu-239	8.5×10^{-3}	5,000	1.3×10^{-3}	9.4×10^{-4}	1.0×10^{-3}

J-38

[a]Source: Zeigler et al., 1987.
[b]Derived water concentration guide is the concentration that when consumed at a rate of 730 liters per year will result in an annual dose rate of 100 mrem. TE
[c]Savannah River just downriver from the SRP.
[d]Beaufort-Jasper drinking water.
[e]Port Wentworth drinking water.
[f]Includes releases to streams and groundwater migration from seepage basins.
[g]Measured concentrations. All other concentrations were calculated from nuclide releases measured on the Plant using models verified by tritium measurements. TC

Table 3-25. Radioactivity in Onsite Streams[a]

TE

Radionuclide	Derived concentration guide[b] (pCi/L)	Savannah River, upstream of plant	Concentration, Mean (pCi/L)					
			Upper Three Runs Creek[c]	Four Mile Creek[c]	Beaver Dam Creek[d]	Pen Branch[c]	Steel Creek[c]	Lower Three Runs Creek[e]
H-3	2,000,000	360	2200	130,000	54,000	52,000	2500	3700[c]
Cr-51		j	f	j	f	j	j	j
Co-60	5,000	j	f	j	f	j	j	j
Zn-65		j	f	j	f	j	j	j
Sr-89, 90	1,000[g]	0.31	f	7.1	f	0.05	0.79	0.40[c]
Zr-95, Nb-95	40,000[l]	j	f	j	f	j	j	j
Ru-103, 106	6,000[h]	j	f	j	f	j	j	j
I-131	3,000	j	m	j	f	j	j	j
Cs-134	2,000	j	0.09	2.0[m]	f	0.02[m]	0.87[m]	2.8[m]
Cs-137	3,000	j	f	f	f	f	f	f
Ce-141, 144	7,000[i]	j	f	j	f	j	j	j
U/Pu	300[k]	j	0.16	0.20	f	0.17	f	0.18

J-38

TE

[a]Source: Zeigler et al., 1987.
[b]DOE Interim Order DOE 5480.1A.
[c]Measured at Road A.
[d]400-D Effluent.
[e]Measured at Patterson Mill.
[f]Not reported.
[g]DCG for Sr-90.
[h]DCG for Ru-106.
[i]DCG for Ce-144.
[j]Less than the Lower Limits of Detection.
[k]DCG for Pu-239.
[l]DCG for Zr-95.
[m]Chem. Cs (Zeigler, Heath, Taus, and Todd, 1987, Table 2-22).

J-38

TE

Table 3-26. Radioactivity Deposited in Soil, 1986[a]

	Deposition[b] (mCi/km^2, 5-cm depth)			
Location	Sr-90	Cs-137	Pu-238	Pu-239[c]
F-Area[c] average[d]	4.0 ± 2.5	60 ± 5.9	0.74 ± 0.11	5.5 ± 0.33
H-Area[c] average[d]	4.9 ± 2.5	84 ± 5.5	2.0 ± 0.18	5.1 ± 0.31
J-38 SRP perimeter average[d]	3.6 ± 2.3	38 ± 3.2	0.047 ± 0.04	0.87 ± 0.14
160-km radius average[d]	12 ± 22	32 ± 3.8	0.049 ± 0.050	0.53 ± 0.11

TE [a]Source: Zeigler et al., 1987.
[b]The ± value = 2-sigma counting error.
[c]F- and H-Area samples collected 2000 feet from 200-foot stack in each cardinal direction.
TC [d]The ± value = 2 standard deviations from the mean.

plutonium-238 and -239 are very close to those estimated on a worldwide basis. This confirms the observation that deposited cesium-137 is retained on soils more strongly than strontium-90, but less so than plutonium-238 and -239.

3.7.2 HAZARDOUS CHEMICAL ENVIRONMENT

Hazardous chemicals are used and produced as byproducts of certain SRP operations. Also, hazardous or potentially hazardous chemicals have been disposed of at known sites on the Plant. The following sections describe the existing hazardous chemical environment on the SRP for the atmosphere, groundwater, surface water, and soils.

3.7.2.1 Atmospheric Environment

Emissions from the seven SRP coal-fired powerplants include sulfur dioxide, nitrous oxides, and smoke. All were within applicable emission standards in
J-38 1986 (Zeigler et al., 1987; see Section 3.2.4.2).

3.7.2.2 Groundwater Environment

At the Plant, 168 waste sites have been identified that have been or are being used for the disposal or storage of wastes. The majority of these sites contain nonradioactive wastes. Criteria waste sites are described in detail in Appendix B. Thirty-seven sites might have received or potentially contain hazardous wastes; 19 are low-level radioactive sites; and 21 potentially are mixed waste sites. Appendix B includes a history of waste disposal; evidence of past and existing contamination; waste characteristics (i.e., the types, forms, quantities, and concentrations of waste); the chemical and physical properties of the waste; and the potential for transport (volatility, mobility in soil, and solubility in water).

The nonradioactive wastes disposed of at the Plant include the following categories (Christensen and Gordon, 1983):

Nonhazardous solids	- Wood, lumber, concrete blocks and slabs, bricks, glass, fenceposts, tires, rubber, and trash
Nonvolatile organics	- Fuel, motor oil and grease, waste oil, and paint
Anions	- Coal pile runoff, acids, caustics, ash sluice, liquid chemicals, and hydrofluoric acid
Pesticides	- Biocidal compounds used either in plant operation or plant maintenance
Metals	- Heavy and reactive metals, metal shavings, and mercury
Volatile organics	- Chlorinated hydrocarbons, chlorinated biphenyls, solvents, and other organics

Groundwater at 55 of the waste disposal sites was monitored for hazardous constituents in 1986. Types of potential groundwater contaminants include chlorinated organics, heavy metals, and nitrates. Levels of contamination range from detectable limits to greater than drinking-water standards. About half of the radioactive, nonradioactive, and mixed waste sites for which groundwater monitoring data exist have some contaminants that exceed drinking-water standards.

Groundwater contaminants have been identified in the F-, H-, and M-Area seepage basins. These basins have been used to dispose of a variety of industrial chemicals. Suspected or confirmed contaminants include the following (Zeigler et al., 1987):

F-Area seepage basins	- Acid, cadmium, chromium, lead, sodium, and nitrate
H-Area seepage basins	- Acid, lead, chromium, mercury, nitrate, and sodium
M-Area seepage basin	- Organics, lead, nitrate, and sodium

J-38

Extensive monitoring of the M-Area settling basin site has defined a plume of organic compounds in groundwater (Zeigler et al., 1987). Maximum J-38 concentrations of 269,000 parts per billion of trichloroethylene, 161,000 parts per billion of tetrachloroethylene, and 260 parts per billion of 1,1,1-trichloroethane were detected in monitoring wells in 1983 (Du Pont, 1984). A groundwater treatment (air stripping) program has been initiated in J-38

J-38 this area, and none of the organic compounds has been detected in offsite groundwater (Zeigler et al., 1987).

Since organic compounds were detected in the M-Area groundwater, all SRP drinking-water supplies are analyzed for these constituents. No significant concentrations were detected in 1984. However, trichloroethylene at 1 to 7 parts per billion (slightly above the minimum detectable concentration) was detected on a few occasions in 1984 in the 3/700-Area (Du Pont, 1985a).

J-38 At several of the remaining waste disposal sites monitored in 1986, preliminary data indicate that concentrations of some chemicals and metals might be higher than ambient levels. Groundwater monitoring has indicated the presence or possible presence of groundwater contaminants at the following sites:

TC	Silverton Road waste site	- Volatile organics (trichloroethylene, tetrachloroethylene, and 1,1,1-trichloroethane), barium, cadmium, chromium, and mercury (which were found infrequently in excess of EPA drinking-water standards) (Scott, Killian, Kolb, Corbo, and Bledsoe, 1987)
TC	Chemicals, metals, and pesticides (CMP) pits	- Volatile organics (methylene chloride, tetrachloroethylene, toluene, and benzene) and bis(2-ethylhexyl)phthalate (Scott, Kolb, Price, and Bledsoe, 1985)
TC	Savannah River Laboratory seepage basins	- Chromium and lead (occasionally detected in excess of EPA drinking-water standards), and volatile organics (trichloroethylene, tetrachloroethylene) (Fowler et al., 1987)
TC	Old TNX basin	- Acid, mercury, manganese, nickel, and nitrate (Dunaway et al., 1987)
TC	Radioactive waste burial grounds	- Mercury (Jaegge et al., 1987)
TC	Metals burning pit/ miscellaneous chemical basin site	- Trichloroethylene (Pickett, Muska, and Marine, 1987)

Additional waste site groundwater monitoring and groundwater transport modeling data and information in chemical contaminants are available in the EIDs
J-38 prepared in support of this EIS in 1987. They are referenced fully in Appendixes B and F.

3.7.2.3 Surface-Water Environment

Water-quality monitoring for nonradioactive parameters was initiated for SRP onsite streams as early as 1959. Routine water-quality monitoring of the streams began in 1971. An extensive sampling program was conducted in 1985 (see Chapter 5). The results of this monitoring indicate that concentrations of pesticides, herbicides, and polychlorinated biphenyls (PCBs) in Savannah

River and onsite stream water were below the limits of detection in 1984, 1985, and 1986. In 1984, aldrin, 2,4-dichlorophenoxyacetic acid, and malathion were detected in river sediment; however, with the exception of 2,4-dichlorophenoxyacetic acid, concentrations were near the detection limit (Du Pont, 1985a; Zeigler, Lawrimore, and Heath, 1986). Of these three compounds, only malathion exceeded detection limits during 1986 (Zeigler, Heath, Taus, and Todd, 1987). Also, sediment from Lower Three Runs Creek and Par Pond contained higher than normal concentrations of silvex, 2,4-dichlorophenoxyacetic acid, heptachlor, and endrin aldehyde. The presence of these compounds is attributed to forestry and agricultural applications. Other compounds detected in sediment from SRP streams include aldrin, endosulfan, and gamma-benzene hexachloride = 1,2,3,4,5,6-hexachlorocychlohexane (Zeigler et al., 1987). In 1985, detectable quantities of beta-benzene hexachloride and alpha-benzene hexachloride were reported in river sediment. Detectable quantities of beta-benzene hexachloride were also present in river sediment in 1986. Concentrations of alpha-benzene hexachloride were near the minimum detectable concentration, while those for beta-benzene hexachloride were somewhat higher (Zeigler et al., 1987). J-38 TE J-38 J-38

Sediments from the Par Pond pumphouse and most locations in the onsite streams contained detectable levels of beta-benzene hexachloride. Other chemicals reported in measurable quantities in sediments from SRP streams were the pesticides 4,4-DDD, 4,4-DDE, 4,4-DDT, and heptachlor (Zeigler et al., 1987). There is no significant difference between upriver and downriver concentrations. These data indicate that the occasional positive pesticides, herbicides, and PCB concentrations detected in SRP water and sediments originate off the site (Zeigler, Lawrimore, and Heath, 1986). J-38

3.7.2.4 <u>Soils Environment</u>

At the existing waste sites, information on soil contaminated with hazardous material is limited primarily to the soil underlying nonradioactive or mixed waste sites. Potential soil contaminants are those associated with the wastes disposed at nonradioactive or mixed waste sites; these include nonvolatile organics, anions, pesticides, heavy metals, and volatile organics (Stone and Christensen, 1983). Suspected soil contaminants or contaminants identified from borings or sediment sampling and analyses at waste sites include the following:

- M-Area settling basin and vicinity (above reference background levels) (mixed waste site) – Barium, chromium, copper, lead, manganese, magnesium, nickel, bis(2-ethyl hexyl)phthalate, tetrachloroethylene, 1,1,1-trichloroethylene, methylene chloride, toluene, di-n-octyl phthalate, tetrachlorobiphenyl, pentachlorobiphenyl, and hexachlorophenyl (Pickett, Muska, and Colven, 1987) TC
- Old TNX seepage basin – Silver, chromium, copper, mercury, nickel, and cyanide (Dunaway et al., 1987)
- F-Area seepage basins – Mercury (Killian et al., 1987a) TC
- H-Area seepage basins – Chromium and mercury (Killian et al., 1987b)

TC CMP Pits (following soil excavation) - Volatile organics (mostly less than 1 part per million) and pesticides (less than 10 parts per million) (Scott, Kolb, Price, and Bledsoe, 1987)

3.8 CONTROL AND SECURITY

Access to the SRP is controlled at primary roads by permanently manned barricades. Other roads are closed to traffic by gates or fixed barricades. The entire perimeter of the SRP, with the exception of its Savannah River boundary, is fenced. Additionally, the site is posted against trespass under State of South Carolina and Federal statutes. Operating areas are separately fenced and patrolled continuously by armed security personnel.

The following sections present site-specific information on site location and accessibility. Table 3-27 lists the existing waste sites and indicates if
TE they are enclosed by perimeter fence lines.

3.8.1 NEW FACILITIES

Although specific sites have not been approved for the new facilities described below, all proposed sites are inside the SRP perimeter fence. The proposed security measures for each facility would be the same, regardless of the exact site selected.

One or two security fences would be constructed surrounding the facilities, depending on the security regulations in effect at the expected time of operation of the facilities. Normal access to the area would be through a main gate that would be controlled by operating personnel. Other gates, including any railroad gates, would remain locked during normal operation.

A perimeter road would be constructed adjacent to the outer fence suitable for all-weather travel by security patrols and maintenance personnel. Additional roads would be installed as required so patrol personnel would be able to observe clearly all operating areas of the storage/disposal facility. Tall lighting poles would be constructed to make the entire area visible at night. The lights should be connected to an emergency power supply.

3.8.2 INSTITUTIONAL CONTROLS

Institutional control of low-level radioactive waste sites, although not specified in DOE Order 5820.2, is required under 10 CFR 61.7(b)(4) for a period as long as 100 years to permit "The disposal of Class A and Class B waste without special provision for intrusion protection...." This document assumes that stable governmental control would exist for 100 years. The minimum period of monitoring required by the EPA regulations for hazardous waste is 30 years after the closure of the site.

The facility would be designed with a goal of "zero maintenance." During the period of institutional control, any repairs that might be necessary are expected to be minor. After the institutional control period, the system should continue to perform well for many years.

Table 3-27. Fenced/Unfenced SRP Waste Sites

TE

Area	Fenced	Unfenced
A- and M-Areas		
Silverton Road waste site		X
Waste oil basins		X
Metals burning pit/miscellaneous chemical basin		X
Metallurgical laboratory basin		X
Burning/rubble pits[a]		X
M-Area settling basin	X	
SRL seepage basins	X	
F- and H-Areas		
Acid/caustic basins[b]		X
F-Area seepage basins	X	
Old F-Area seepage basin		X
H-Area seepage basins	X	
Mixed waste management facility	X	
Separations area retention basins[c]	X	
Radioactive waste burial grounds	X	
R-Area		
Reactor seepage basins	X	
Bingham pump outage pits		X
C- and CS-Areas		
Hydrofluoric acid spill area		X
Ford Building seepage basin	X	
Ford Building waste site		X
TNX Area		
Old TNX seepage basin	X	
New TNX seepage basin		X
TNX burying ground	X	
Road A Area		
Road A chemical basin		X
L-Area		
CMP pits		X
L-Area oil and chemical basin	X	
Miscellaneous areas		
SRL oil test site		X
Gun site 720 rubble pit		X

TC

[a]Only the F-Area burning/rubble pit is fenced.
[b]Only the H-Area basin is fenced.
[c]Only the H-Area retention basin is fenced.

3.8.3 POSTINSTITUTIONAL CONTROL

Postinstitutional control is the period after about 100 years during which control of access to the disposal site is assumed to be lost. For calculational purposes, the general population is assumed to occupy the site and build houses, farm the land, drill wells, and raise livestock during the postinstitutional control period.