CHAPTER 3

3.0 NUCLEAR GENERATION ALTERNATIVES ON THE BELLEFONTE SITE – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The BLN site has been the subject of several environmental reviews. The environmental consequences of constructing and operating BLN 1&2 (B&W units) were addressed comprehensively in TVA's 1974 FES and AEC's 1974 FES. Subsequent environmental reviews updated these analyses (see Section 1.7). By 1988, when TVA deferred construction activities, most of the land-disturbing construction effects had already occurred. The environmental consequences of constructing and operating BLN 3&4 (AP1000 units) were addressed in the COLA ER, Revision 1 (TVA 2008a). This chapter updates the information contained in those earlier reviews; identifies any new or additional direct, indirect, and cumulative effects that could result from the completion or construction and operation of a single nuclear unit at the BLN site; and assesses the potential environmental impacts.

The investigations and analyses described in this chapter were conducted within the Bellefonte project area illustrated in Figures 2-1 and 2-12, unless otherwise specified. As noted in Section 2.0 and shown in updated Figure 2-1, the south security checkpoint has been added to the B&W project area. Additional fieldwork was conducted in February 2010 to assess the potential for effects to this small additional area to be disturbed. The effects were found to be insignificant.

The potential for additional construction and operational cumulative effects are considered in the following assessments. Cumulative effects of constructing and operating BLN Units 1&2 were considered in both TVA's and NRC's 1974 FESs. Cumulative effects are also considered in many of the documents incorporated by reference and/or tiered from for this supplement. Most notably, cumulative effects of spent fuel storage and transportation were addressed in CLWR FEIS (DOE 1999); cumulative effects of transportation of radioactive materials were addressed in NUREG-75/038 (NRC 1975), and cumulative hydrothermal and water supply effects of TVA operations were addressed in the ROS FEIS (TVA 2004). With the exception of Section 3.13, Socioeconomics, cumulative effects are discussed in the environmental consequences section along with direct and indirect effects. The cumulative effects on socioeconomics are discussed at the end of Subsection 3.13.11.

In response to public and agency comments on the DSEIS, several of the following sections, particularly plant water use, global climate change, aquatic communities, socioeconomic effects, and radioactive emissions, have been revised.

3.1. Surface Water Resources

3.1.1. Surface Water Hydrology and Water Quality

3.1.1.1. Affected Environment

Guntersville Reservoir extends 76 river miles from Guntersville Dam in northeast Alabama (TRM 349.0), across the Alabama-Tennessee state line (TRM 416.5), to Nickajack Dam in southeast Tennessee (TRM 424.7). The Sequatchie River enters Guntersville Reservoir at TRM 422.7, just downstream of Nickajack Dam. Guntersville Reservoir has a drainage

area of 24,450 square miles, of which 2,589 square miles are not regulated by upstream dams. The reservoir has a shoreline length of 890 miles, a volume of 1,018,000 acre-feet, and a water surface area of 67,900 acres at a normal maximum pool elevation of 595 feet mean sea level (msl). The width of the reservoir ranges from 900 feet to 2.5 miles. Average flow (1976-2008) at Guntersville Dam is 40,000 cubic feet per second (cfs).

Consistent with the *TVA Act,* Guntersville Dam and Reservoir are operated for the purposes of flood protection, navigation, and power production, as well as to protect aquatic resources and provide water supply and recreation. During normal operations, the surface elevation of Guntersville Reservoir varies between 593 feet msl in winter and 595 feet msl in summer. During high-flow periods, the top of the normal operating elevation range may be exceeded to regulate flood flows. From mid-May to mid-September, TVA varies the elevation of Guntersville Reservoir by 1 foot to aid in mosquito population control. Because of the need to maintain a minimum depth for navigation, Guntersville is one of the most stable TVA reservoirs, fluctuating only 2 feet between its normal minimum pool in the winter and its maximum pool in the summer.

The BLN site at TRM 391.5 is located on a peninsula formed by the Town Creek embayment on the right (western) bank of Guntersville Reservoir (Figure 1-1). The Town Creek embayment borders the northern and western property boundaries of the BLN site. Town Creek originates approximately 3 miles southwest of the BLN site and flows northwestward into Guntersville Reservoir at TRM 393.4. The drainage area of Town Creek at the BLN site is approximately 6 square miles.

The State of Alabama has designated the reach of the Tennessee River in the vicinity of BLN for public water supply, swimming and other whole-body water-contact sports, and fish and wildlife use classifications. The state also assesses the water quality of streams in the state. Those not meeting water quality standards are listed in a federally mandated report, referred to as a 305(b) report (from the section of the CWA). This report is published in alternate years. The 2008 version of the report (ADEM 2008) lists two impaired tributary streams to Guntersville Reservoir, neither of which are in the immediate area of BLN: Town Creek (a different stream from the one at the BLN site), which enters the reservoir at TRM 361.5; and Scarham Creek, a tributary to Short Creek, the mouth of which is at TRM 360.5.

TVA has conducted the Vital Signs (VS) Monitoring Program on Guntersville Reservoir in alternate years since 1994. The VS program uses five metrics to evaluate the ecological health of TVA reservoirs: chlorophyll concentration, fish community health, bottom life, sediment contamination, and dissolved oxygen. Values of good, fair, or poor are assigned to each metric. Scores from monitoring sites in the deep area near the dam (forebay, TRM 350), midreservoir (TRM 375.2), and at the upstream end of the reservoir (inflow, TRM 420 and 424) are combined for a summary score. The data from these sites characterize the surface biological and water quality of the reservoir and the BLN site.

The ecological health condition of Guntersville Reservoir rated at the upper end of the fair range in 2008 (see Figure 3-1). Guntersville's ecological health scores had fluctuated within the good range in prior years. The lower score in 2008 was largely because several ecological indicators at the forebay (dissolved oxygen, chlorophyll, and bottom life) received their lowest scores to date. The lower scores may have been influenced by drought conditions that occurred in 2007 and 2008. Ecological health scores tend to be lower in most Tennessee River reservoirs during years with low flows, because chlorophyll concentrations are typically higher and dissolved oxygen levels are lower. As in past years,

scores for the ecological health indicators at the midreservoir and inflow locations were among the highest observed for all TVA reservoirs.

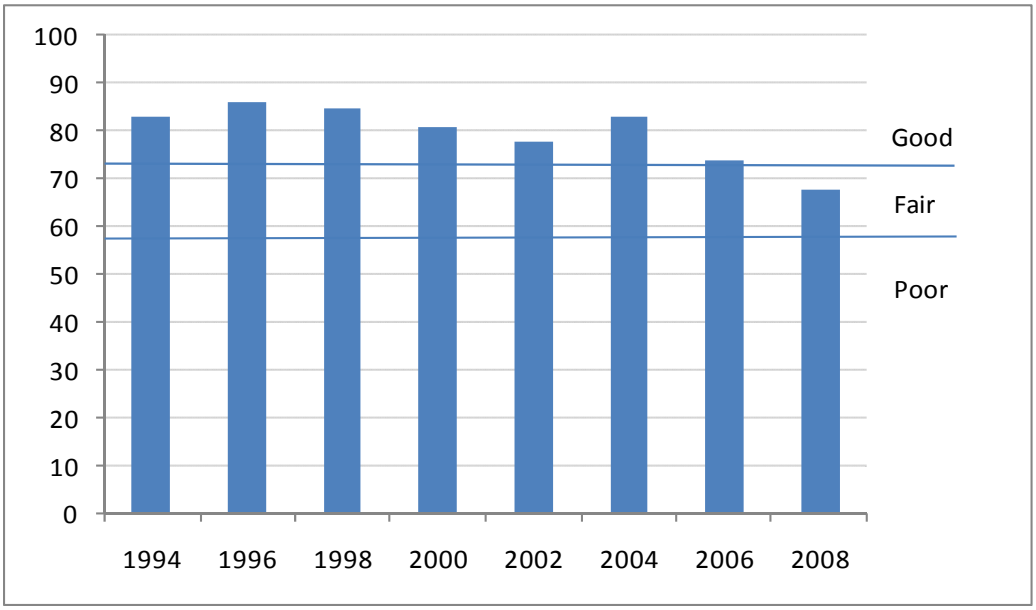


Figure 3-1. Guntersville Reservoir Ecological Health Ratings, 1994-2008

In 2008, the five individual metrics scored good or fair at all sites except for chlorophyll in the forebay station, which rated poor (Table 3-1). These metrics are briefly explained in the paragraphs that follow.

Table 3-1. Ecological Health Indicators for Guntersville Reservoir, 2008

Monitoring Locations	Dissolved Oxygen	Chlorophyll	Fish	Bottom Life	Sediment
Forebay	Fair	Poor	Fair	Fair	Fair
Midreservoir	Good	Good	Fair	Fair	Good
Inflow	*	*	Fair	Good	*

* Not measured at inflow station

Dissolved Oxygen. Dissolved oxygen (DO) levels typically rate good at both monitoring locations, and the midreservoir continued to do so in 2008 (Table 3-1). However, the forebay received its first fair rating for DO, rating at the upper end of the fair range. This was because concentrations were low in a small area along the bottom of the reservoir in early summer.

Chlorophyll. Chlorophyll rated poor at the forebay and good at the midreservoir monitoring location. Chlorophyll concentrations were elevated at the forebay during several sample periods, likely a result of the low flow conditions in the reservoir. Chlorophyll ratings have fluctuated between good, fair, and poor at the forebay, generally in response to reservoir flows. Chlorophyll concentrations at the midreservoir monitoring location have consistently rated good.

Fish. As in previous years, low catch rates contributed to fair ratings for the fish community at all locations. While the fish assemblage generally rates fair at the forebay and midreservoir, ratings at the inflow have fluctuated between good and fair and even poor in 2000 (one point from fair), the lowest score to date for the reservoir. This fish rating rebounded to good in 2002 and to a "high fair" in 2004, possibly indicating that the poor rating was an anomaly.

Bottom Life. Bottom life rated fair at the forebay and midreservoir and good at the inflow. Bottom life typically rates fair or good at all monitoring locations. However, bottom life rated at the low end of the fair range at the forebay in 2008—lower than in previous years. The lower rating was due to the reduced density and diversity of organisms in the samples collected from the reservoir bottom.

Sediment. Sediment quality rated good at the midreservoir monitoring location because no polychlorinated biphenyls (PCBs) or pesticides were detected, and no metals had elevated concentrations. The forebay rated fair because PCBs were detected. Sediment quality typically rates fair at the forebay due to the presence of one or more contaminants: PCBs, chlordane, or zinc. The sediment rating at the midreservoir has fluctuated between good and fair due primarily to chlordane, which was detected in 1996, 2002, and 2004; PCBs were detected at this location in 2002.

Fish Consumption Advisories. There are no fish consumption advisories on Guntersville Reservoir. TVA collected channel catfish and largemouth bass from the reservoir for tissue analysis in autumn 2004. All contaminant levels were either below detectable levels or below the levels used by the State of Alabama to issue fish consumption advisories.

3.1.1.2. Environmental Consequences

Alternative A
No changes in the plant facilities or operations would occur under this alternative, and the NPDES permit would be maintained. Consequently, there would be no impacts or changes in current surface water conditions.

Alternatives B and C
While both the B&W and AP1000 involve some land-disturbing construction activities, land disturbances would be greater for the AP1000. As development of either alternative occurs, soil disturbances associated with access roads and other construction activities could potentially result in adverse water quality impacts. Improper water management or storage and handling of potential contaminants could result in polluting discharges or surface runoff to receiving streams. Erosion and sediment could clog small streams and threaten aquatic life. Improper use of herbicides to control vegetation could result in runoff to streams and subsequent aquatic impacts.

Precautions would be included in the project design, construction, operation, and maintenance to minimize the potential impacts. Construction, operation, and maintenance activities would comply with state construction and runoff permit requirements. BMPs sufficient to avoid adverse impacts would be followed for all construction activities. Site grading and soil removal would be minimized to preserve and protect the environment and receiving waters. Clearing operations would be staged so that only land that would be developed promptly is stripped of protective vegetation. Mulch or temporary cover would be applied whenever possible to reduce sheet erosion. Permanent vegetation, ground

cover, and sod would be installed as soon as possible after site preparation. All natural features, such as streams, topsoil, trees, and shrubs would be preserved to the extent possible and incorporated into the final design layout. Sediment basins or other control options would be used to control sediment runoff. Surface runoff would be managed to avoid adverse impacts. Landscape maintenance would employ only EPA-registered herbicides used in accordance with label directions. These and other similar precautions would minimize potential construction impacts such that no mitigation measures would be necessary.

Under Alternatives B (B&W) and C (AP1000), construction activities would incorporate existing facilities and structures and use previously disturbed ground where possible. Both a B&W and an AP1000 unit would use the existing intake channel and pumping station, cooling towers, blowdown discharge diffuser, barge unloading dock, switchyard, and transmission system.

Under Alternative B dredging in the intake channel from the intake pumping station to the shoreline (a distance of approximately 1,200 feet) would result in removal of approximately 10,000 cubic yards of dredged material (Figure 3-2). Additionally, from the shoreline boom to the main river channel (a distance of approximately 760 feet), approximately 1,100 cubic yards of dredged material would be removed. Periodic maintenance dredging of the intake channel would be conducted in the future. No dredging in the area of the barge unloading dock would be required. Dredged material would be disposed of in an on-site spoils area above the 500-year flood elevation. During the dredging operation, temporary increases in turbidity are expected in the immediate vicinity. All appropriate permits would be obtained prior to dredging. No significant or long-term water quality impacts are expected. The steam generator replacement process could entail hydrodemolition using a high-pressure water jet to remove concrete. The process would use approximately 450,000 gallons of water, likely from the local municipal source, and would produce a water and concrete slurry. This one-time generation of wastewater would be captured, sampled, treated, and released through an approved NPDES discharge point.

Under Alternative C, there would be slightly less dredging (Figure 3-2). Dredging of the area between the intake pumping station and the shoreline would be the same as under Alternative B and there would be no dredging between the shoreline and the main river channel. Periodic maintenance dredging of the intake channel would be conducted in the future. Additionally, dredging in the area of the barge unloading dock would involve removal of approximately 240 cubic yards of dredged material. Impacts to water quality would be similar to Alternative B. Dredged material would be disposed of in an on-site spoils area above the 500-year flood elevation. During dredging, temporary increases in turbidity are expected in the immediate vicinity. As with Alternative B, all appropriate permits would be obtained prior to dredging. No significant or long-term water quality impacts are expected.

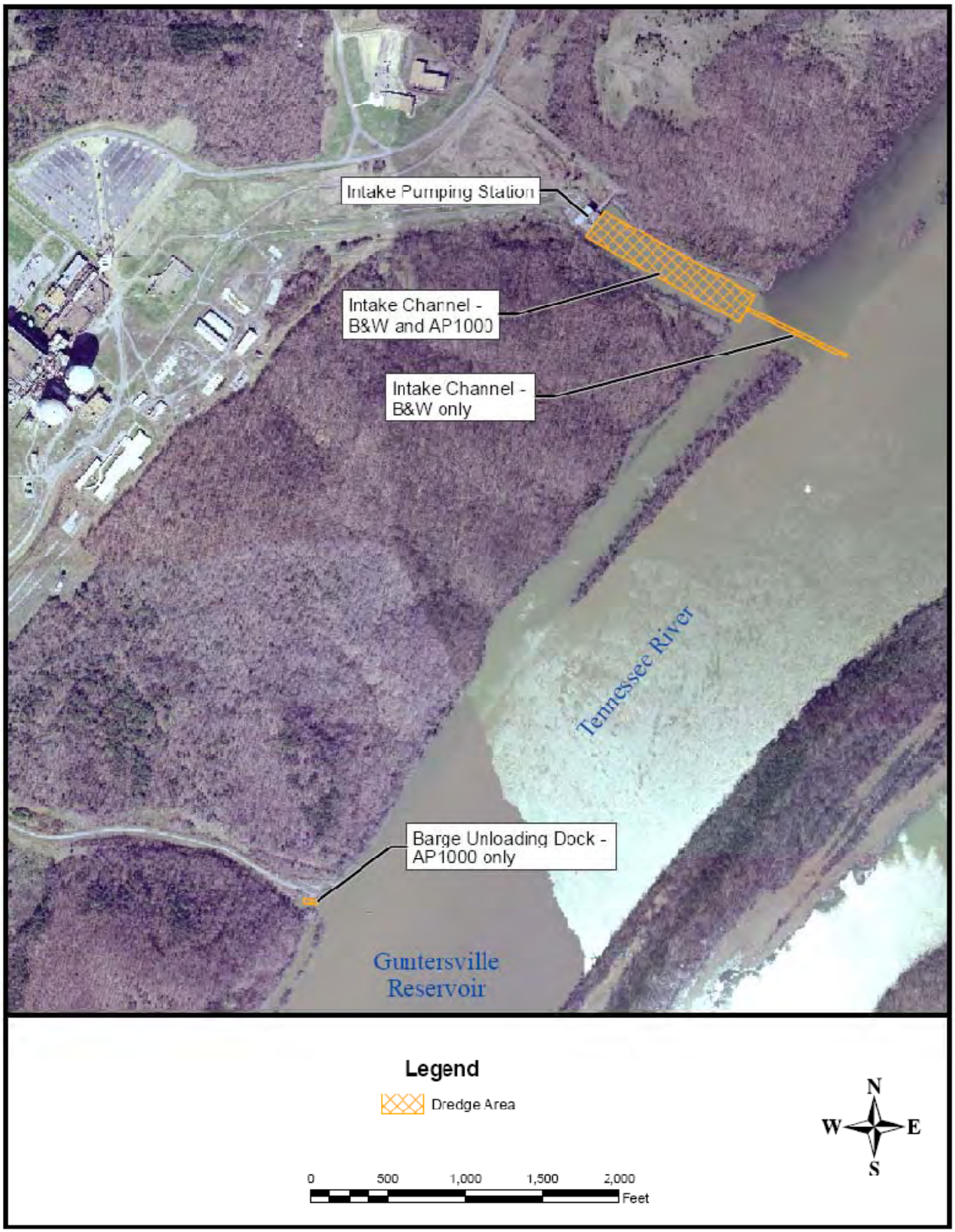


Figure 3-2. Areas to be Dredged Under Alternative B (B&W) or Alternative C (AP1000)

In summary, under Alternatives B and C, initial dredging and periodic maintenance dredging of the intake channel would be necessary. The areas requiring dredging vary between the two alternatives. Alternative B would require the removal of about 10 percent more material from the intake channel than would Alternative C; it would also require dredging out to the main river channel that would not occur under Alternative C. However, Alternative C would require a one-time dredge at the barge unloading area.

Construction of either a B&W or an AP1000 unit is expected to result in temporary and minor impacts to surface waters. The proximity of the Tennessee River and the magnitude of the river flow provide a ready source of raw water of sufficient quantity to meet foreseeable needs, including the operation of a natural draft cooling tower. No cumulative construction impacts are anticipated.

3.1.2. Surface Water Use and Trends

3.1.2.1. Affected Environment

Surface water supply withdrawals within the Guntersville Reservoir catchment area in 2005 totaled approximately 1,523 millions of gallons per day (MGD), or less than 6 percent of the average flow through Guntersville Reservoir (Bohac and McCall 2008). Table 3-2 identifies the water users, the supply source, and water demands in 2005 and projections for 2030. The total return flow in 2005 was 1,501 MGD; thus, the net consumptive use was approximately 22 MGD.

Table 3-2. Surface Water Withdrawals in Guntersville Watershed

Facility Name	Source	County, State	2005 Rate (MGD[1])	2030 Rate (MGD)
Public Systems				
Dunlap Water System	Sequatchie River	Sequatchie, Tenn.	0.75	1.01
Monteagle Public Utility	Laurel Lake	Grundy, Tenn.	0.43	0.55
Jasper Water Dept.	Sequatchie River	Marion, Tenn.	0.47	0.59
South Pittsburg Water System	Guntersville Reservoir	Marion, Tenn.	1.02	1.27
Taft Youth Center	Bee Creek	Bledsoe, Tenn.	0.06	0.08
Tracy City Water System	Big Fiery Gizzard	Grundy, Tenn.	0.47	0.60
Whitwell Water Dept.	Sequatchie River	Marion, Tenn.	0.80	1.00
Albertville Municipal Utilities	Short Creek	Marshall, Ala.	11.64	14.46
Arab Water Works Board	Guntersville Reservoir	Marshall, Ala.	4.31	5.35
Bridgeport Utility Board	Guntersville Reservoir	Jackson, Ala.	2.36	3.12
North Marshall Utilities	Guntersville Reservoir	Marshall, Ala.	1.20	1.49
Northeast Alabama Water	Guntersville Reservoir	Marshall, Ala.	1.36	1.69
Scottsboro Water Board	Guntersville Reservoir	Marshall, Ala.	4.66	6.15
Section & Dutton Water	Guntersville Reservoir	Jackson, Ala.	3.06	4.03
Guntersville Water Works	Guntersville Reservoir	Marshall, Ala.	2.66	3.03
Fort Payne Water Works	Guntersville Reservoir	DeKalb, Ala.	0.47	0.60
Industrial				
Bellefonte Nuclear Plant	Guntersville Reservoir	Jackson, Ala.	0	48.00 / 36.00[2]
Widows Creek Fossil	Guntersville Reservoir	Jackson, Ala.	1,476.30	1,476.30

Facility Name	Source	County, State	2005 Rate (MGD[1])	2030 Rate (MGD)
Plant				
Avondale Mills	Guntersville Reservoir	Jackson, Ala.	0.05	0.07
Shaw Industries	Guntersville Reservoir	Jackson, Ala.	0.20	0.28
Smurfit-Stone Container	Guntersville Reservoir	Jackson, Ala.	8.53	12.26
Irrigation			1.77	2.21
Total			**1,522.57**	**1,584.13 / 1,571.31**

Source: Bohac and McCall 2008
[1] MGD = Millions of gallons per day
[2] Estimated water withdrawal is 48.00 MGD for the B&W and 36.00 MGD for the AP1000.

3.1.2.2. Environmental Consequences

Alternative A
No changes in the plant facilities or operations would occur under this alternative. Consequently, there would be no impacts or changes in current surface water use at the BLN site.

Alternatives B and C
As indicated in Table 3-2, the BLN water intake is one of 21 surface water withdrawals within the Guntersville Reservoir catchment area. All plant water, except for potable water, would be withdrawn from Guntersville Reservoir via the existing intake. Potable water would be supplied by the Jackson County Water Authority. Sanitary waste would be pumped through existing sewer pipes to the Jackson County Water Authority's County Road 33 wastewater treatment facility for treatment.

A 1,200-foot intake channel connects Guntersville Reservoir with the BLN intake pumping station (Figure 2-1). The station has four intake openings slightly more than 10 feet wide and approximately 36 feet high. The top of the openings is at elevation 592.75 feet and the bottom at elevation 557 feet. An intrusion barrier would be installed across the intake channel to provide security for the intake channel and pumping station. The pumping station would be protected by a trash rake and a traveling screen on each of the intake openings.

The approximate alignments of the intake conduit that would carry cooling water to the plant and the discharge conduit that would carry cooling tower blowdown back to the reservoir are shown for operation of the B&W units in Figures 3-3 and 3-4. The approximate alignments of the same conduits for an AP1000 unit are shown in Figure 3-5. Both Action Alternatives use the same intake pumping station and the same blowdown conduit and diffuser.

Both the B&W and AP1000 would use closed-cycle cooling systems, discharging cooling tower blowdown via a diffuser in Guntersville Reservoir, requiring only a small amount of water compared both to the average flow and the minimum expected drought flow in the Guntersville Reservoir. The two plant designs differ in volumes of operating water flows (see Table 3-3). For a single B&W unit, a total of 35,000 gpm (0.20 percent of the average flow) would be withdrawn from Guntersville Reservoir. About 12,000 gpm would be consumed by evaporation, and the remaining 23,000 gpm would be discharged to the reservoir as blowdown. For a single AP1000 unit, a total of 24,000 gpm (0.14 percent of the average flow) would be withdrawn, 16,000 gpm consumed by evaporation, and 8,000

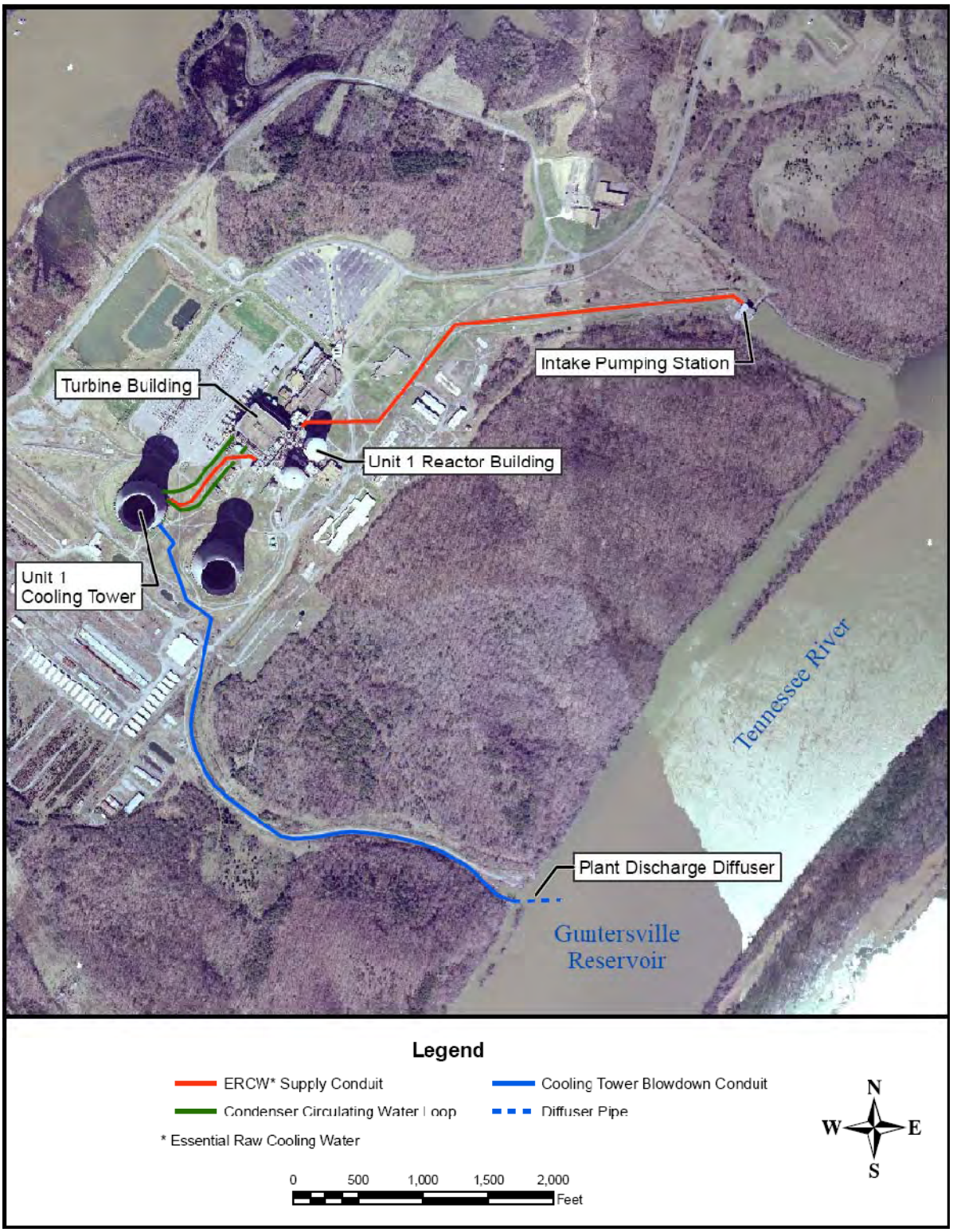


Figure 3-3. B&W Unit 1 Water Intake and Discharge Facilities

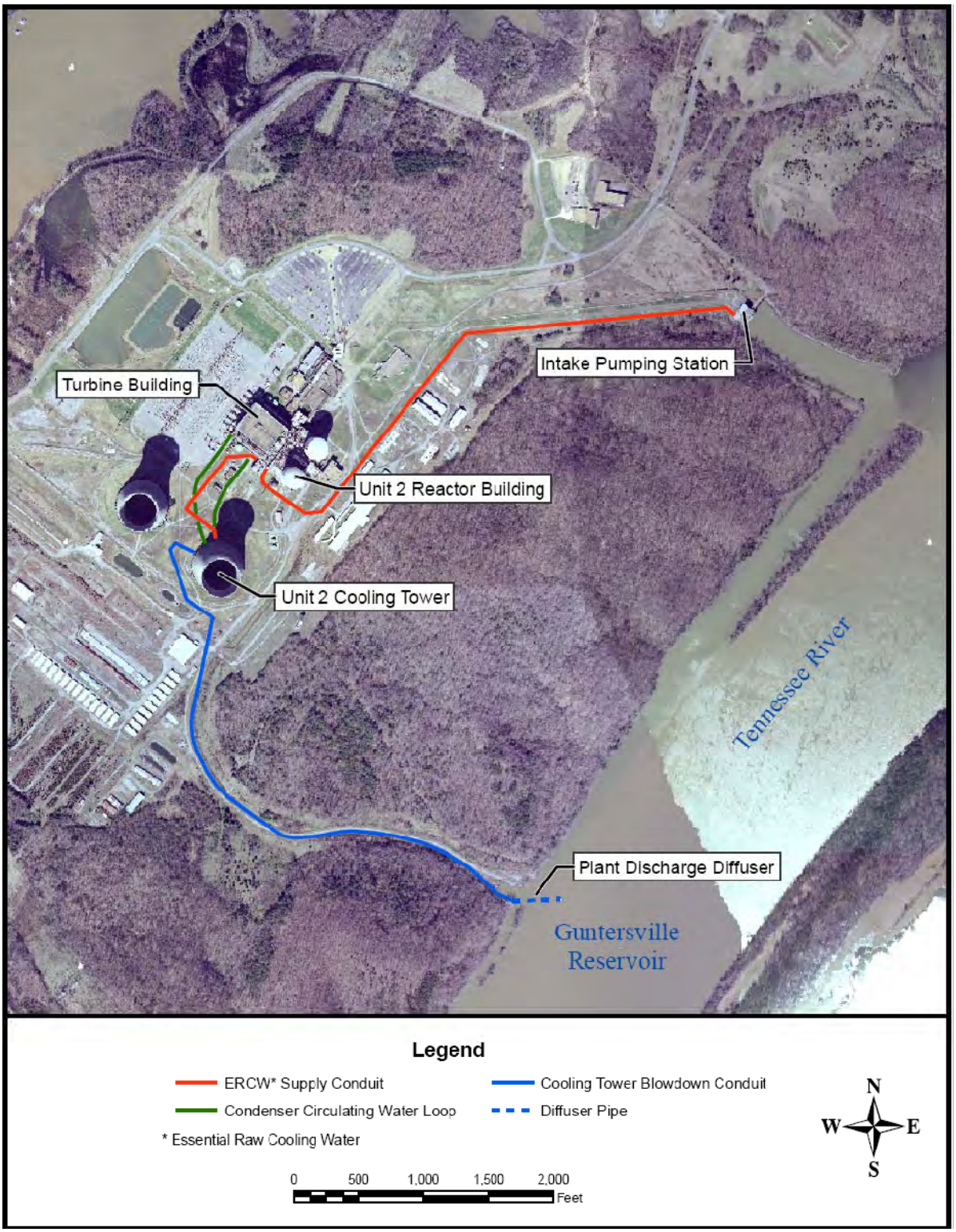


Figure 3-4. B&W Unit 2 Water Intake and Discharge Facilities

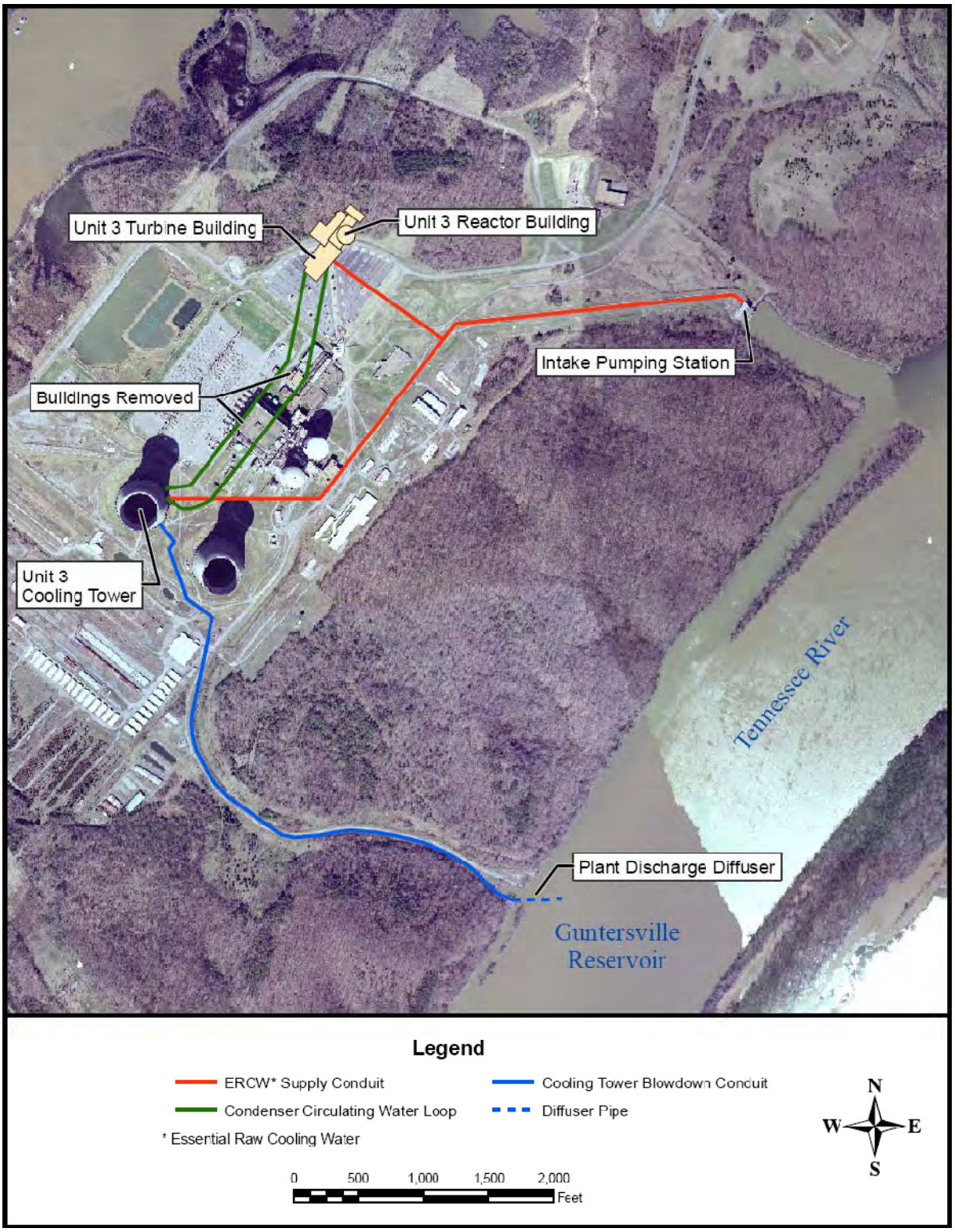


Figure 3-5. AP1000 Unit 3 Water Intake and Discharge Facilities

gpm discharged to the reservoir. Both plants would meet the same specifications for temperature of discharged water. Consequently, no water supply impacts or cumulative effects are expected from the construction or operation of either a B&W or an AP1000 unit. The impacts of the proposed action on local water supply are further discussed in Subsection 3.13.5.

Table 3-3. B&W and AP1000 Water Use

	B&W[1]	Percent Average River Flow[2]	AP1000[3]	Percent Average River Flow[2]
Condenser Circulating Water Flow Rate (Closed Cycle)	420,000 gpm	N/A	500,000 gpm	N/A
Evaporation (Consumption)	12,000 gpm	0.07%	16,000 gpm	0.1%
Blowdown (Discharge)	23,000 gpm	0.13%	8,000 gpm	0.05%
Makeup (Withdrawal)	35,000 gpm	0.21%	24,000 gpm	0.14%

[1]B&W operating water flow rates source: TVA 1976 and T. Spink, TVA, personal communication, March 2010.
[2]Average River Flow at Bellefonte is 37,300 cfs (approximately 16,700,000 gpm). Source: P. Hopping, TVA, personal communication, February 2010.
[3]AP1000 operating water flow rates source: TVA 2008a.

3.1.3. Hydrothermal Effects of Plant Operation

3.1.3.1. Affected Environment

Closed-Cycle Cooling Water System

Under both Alternative B and Alternative C, BLN would withdraw water from and discharge wastewater to Guntersville Reservoir to provide cooling water for the operation of one unit. For a B&W or an AP1000 unit, the proposed operation would follow the design strategy for BLN 1&2, which sought to minimize thermal impacts to Guntersville Reservoir by using a closed-cycle cooling system. Closed-cycle cooling systems are considered the “best technology available” to minimize hydrothermal, entrainment, and impingement impacts (see Section 3.5). The cooling system for the B&W unit is described in the 1974 FES (TVA 1974a), and the cooling system for the AP1000 is described in the COLA ER. Two natural draft hyperbolic cooling towers, one for each of the two units, were built for BLN 1&2. In a closed-cycle cooling system, waste heat removed from the steam cycle by the plant condensers is rejected to the atmosphere by evaporation in a cooling tower. The cool water exiting the cooling tower is then cycled back through the condensers for reuse.

In a closed-cycle cooling system, a small fraction of the condenser circulating water is continuously lost by evaporation and drift in the cooling tower. In this process, to control the concentrations of additives and natural minerals in the water, a small portion of the condenser circulating water must be continuously removed and replaced with fresh water supplied by the plant intake pumping station. The temperature of the water removed from the system, or blowdown, is the same as that of the cooling tower effluent, and would vary with wet bulb temperature and other meteorological conditions. For the proposed operation of either a B&W or an AP1000 unit, cooling tower blowdown would be discharged to Guntersville Reservoir via the NPDES-permitted outfall Discharge Serial Number 003, shown in Figure 3-6.

The outfall includes an existing two-pipe multiport diffuser on the bottom of the river, as shown in Figure 3-7. The upstream pipe extends about 475 feet into the reservoir in an upstream direction at an angle of about 65 degrees from the shoreline. The diffuser section includes the last 45 feet of the pipe and is 36 inches in diameter. The downstream pipe is parallel to and 45 feet shorter than the upstream pipe. The diffuser section of the downstream pipe includes the last 75 feet of the pipe and is 42 inches in diameter. For both pipes, the outlets for the diffuser section are centered 22 degrees above the horizontal and point downstream.

Current NPDES Permit

The NPDES permit, AL0024635, for the BLN site was renewed in November 2009, and the permit is next subject to renewal in November 2014. This permit is amended as new wastewater streams are identified. The NPDES permit establishes criteria that are protective of water quality for the receiving stream. For BLN, ADEM has established criteria to protect Guntersville Reservoir water quality for its designated uses as a drinking water source, recreation, and industrial use such as cooling.

Within the permit, point-source discharge outfalls are assigned a discharge serial number (DSN). For each discharge point shown in Figure 3-6, the NPDES permit establishes limitations as to the types and quantities of effluents, monitoring and reporting requirements, and required sampling locations. BLN is currently authorized to discharge as follows:

DSN002: Impoundment pond discharge consisting of main plant area storm water runoff and fire and supply test water associated with electric power generation.

DSN003: Diffuser discharge consisting of cooling tower blowdown and other wastewater resulting from electric power generation.

DSN004: East culvert impoundment discharge consisting of storm water runoff.

DSN005: Plant intake trash sluicing consisting of intake screen and strainer backwash and intake pumping station sumps/drains.

DSN007: Simulator Training Facility treated sanitary, equipment room floor drains, and laboratory wastewaters.

DSN008: Simulator Training Facility once-through cooling water, HVAC and atomic adsorption unit condensate, and fire protection system flush water.

DSN009-015: Uncontaminated storm water runoff.

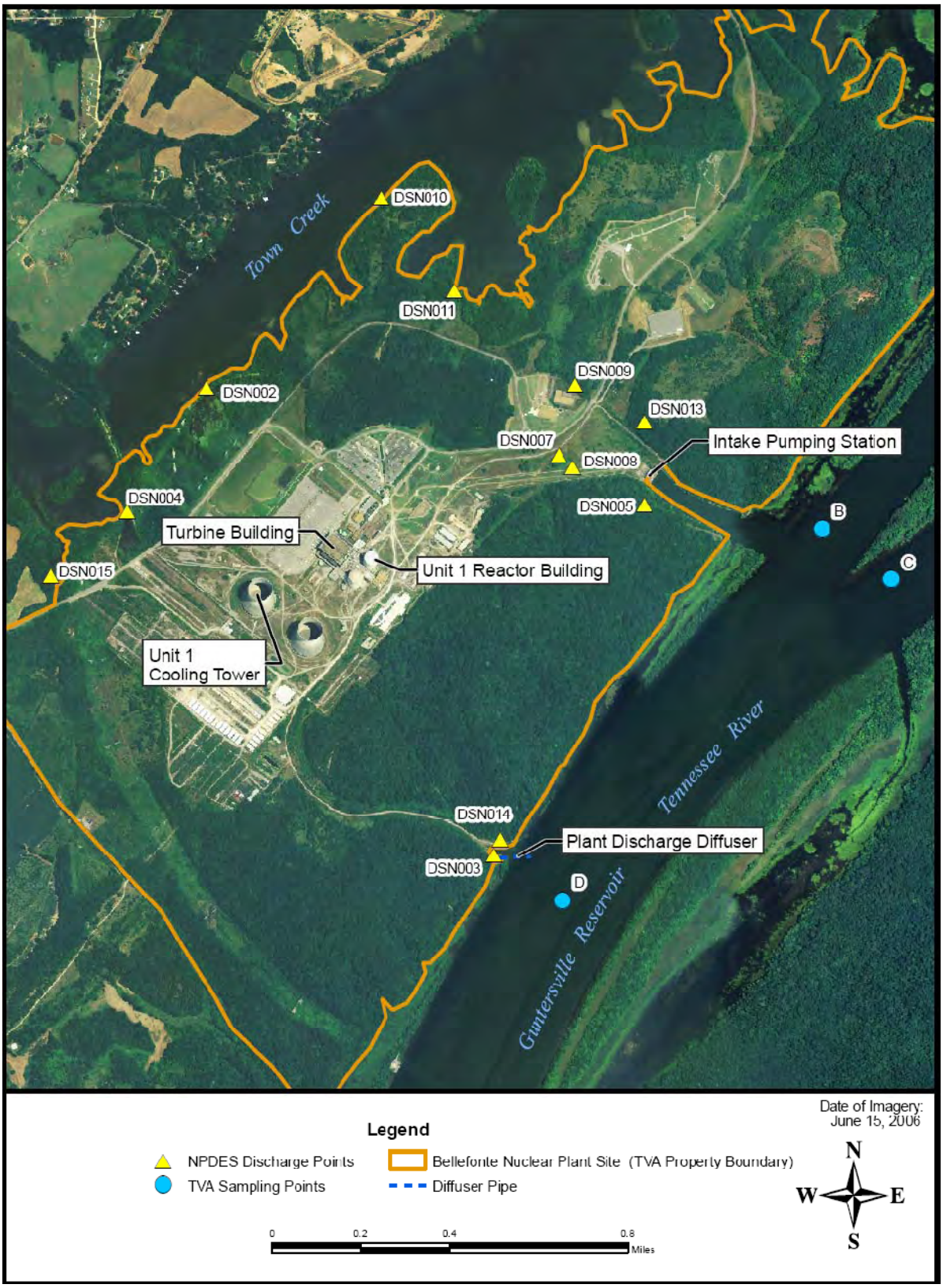


Figure 3-6. Outfalls for NPDES Permit AL0024635 of November 2009

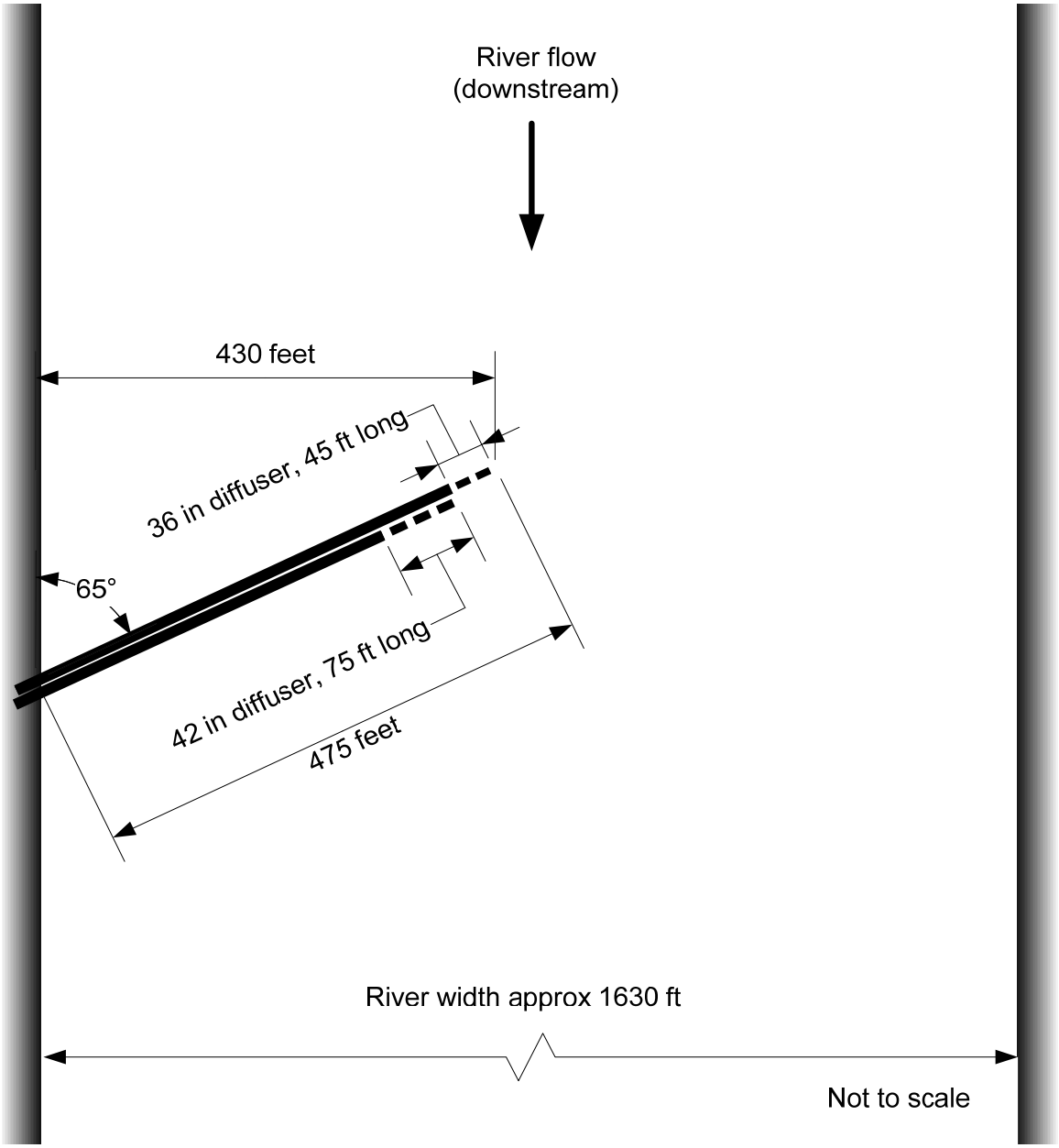


Figure 3-7. Diffuser for Blowdown Discharge, Outfall DSN003

NPDES Permit Temperature Limits and Mixing Zone for Cooling Tower Blowdown
Under the current NPDES permit, the discharge water temperature for the cooling tower blowdown is limited to a monthly average of 92°F and a daily maximum of 95°F (Table 3-4). The mixing zone for this discharge is defined by the locus of points 250 feet from the diffuser and extending over the entire depth of the reservoir (TVA 1977c). Consistent with Section 316(a) of the CWA, the discharge temperature limitations (92°F/95°F) would ensure that the temperature at the edge of the mixing zone would not exceed 90°F, the temperature considered as protective of maintaining a balanced indigenous population of fish, shellfish, and aquatic life (ADEM 1998; TVA 1982a). TVA would request a

continuation of these temperature limits in the operational stages of the plant under Section 316(a). In addition to these limits, Alabama water quality standards prohibit the addition of artificial heat by a discharger that would cause the maximum instream temperature rise above ambient water temperature to exceed 5°F (ADEM 2008).

Table 3-4. NPDES Discharge Limits for BLN Outfall DSN003 to the Tennessee River

Effluent Characteristic	Units	Discharge Limitations			Monitoring Requirements	
		Daily Minimum	Daily Maximum	Monthly Average	Measurement Frequency	Sample Type
Flow	MGD	N/A	Monitor	Monitor	Continuous	Totalized or Recorder
Temperature	°F	N/A	95	92	Continuous	Recorder or Multiple Grabs

Hydrothermal Modeling of Potential Heat Effects

Potential near-field and far-field hydrothermal effects associated with the blowdown discharge were examined using two models: (1) CORMIX to examine near-field effects of the thermal plume near the diffuser and (2) CE-QUAL-W2 to examine far-field, reservoirwide effects within Guntersville Reservoir. CORMIX is an EPA-supported mixing zone model for assessment of regulatory mixing zones resulting from steady, continuous point source discharges (Jirka et al. 2007). CE-QUAL-W2 is a two-dimensional, laterally averaged, hydrodynamic and water quality model for reservoirs (CE-QUAL-W2 1995). It models basic eutrophication processes to estimate the distribution and fate of constituents such as heat (water temperature), DO, nutrients, algae, organic matter, and sediment.

CORMIX was used to evaluate the near-field performance of the cooling system and diffusers (DSN003) relative to thermal limits contained in the current NPDES permit as well as the state water quality standards for temperature rise (i.e., 95°F daily maximum and 92°F monthly average blowdown discharge temperatures from the NPDES permit, and 5°F instream rise at the end of the mixing zone above the ambient river temperature for the state water quality standards). The analyses encompassed worst-case conditions based on potential ranges for river flow, river temperature, meteorology, and plant operations. The range of river flow was based on historical hydrology and the expected future operating policy for the TVA river system. The range of river temperature was based on historical measurements at various stations in Guntersville Reservoir, and the range of meteorology was based on local airport data. More than 30 years of data were examined for each factor (i.e., river flow, river temperature, and meteorology). With this information, the CORMIX model was used to predict the river temperature and plume dimensions at the edge of the 250-foot diffuser mixing zone. The following cases were identified as producing worst-case conditions in the receiving water (Loyd 2009).

Case 1. Maximum River Temperature Rise (March) — This condition would arise for a day with warm, humid weather occurring concurrently during a period when the river temperature is cold. Historical data indicate that this would likely occur in March. The expected minimum ambient river temperature for March is about 41°F. The expected highest wet bulb temperature for the same month is about 71.3°F. Based on the performance of the plant cooling system, this would produce blowdown with a discharge temperature of about 86.4°F, which is 45.4°F above the minimum river temperature for March. This case was modeled using the expected minimum 24-hour average river flow for March, about 3,130 cfs.

Case 2. Minimum 24-hour River Flow (April) — This condition would likely arise in a dry year, again for a day with warm, humid weather occurring concurrently during a period when the river temperature is cold The expected minimum 24-hour average river flow past the BLN site is about 190 cfs, occurring during reservoir filling in April. For the month of April, the expected minimum ambient river temperature is about 52°F, and the expected highest wet bulb temperature is about 76.2°F. Based on the performance of the plant cooling system, this would produce blowdown with a discharge temperature of about 90.4°F, which is 38.4°F above the minimum river temperature.

Case 3. Maximum Discharge Temperature (July) — This condition would likely arise in a hot, dry year, when humid "heat waves" produce both high ambient river temperature and reduced cooling tower performance. Historical data indicate that this would likely occur in July. The expected maximum ambient river temperature for July is about 89.5°F and the expected minimum 24-hour average river flow is about 3,760 cfs. The expected maximum wet bulb temperature is about 85.2°F. Based on the performance of the plant cooling system, this would produce blowdown with a discharge temperature of about 97.7°F, which is 8.2°F above the maximum river temperature. It should be noted that this discharge temperature is the maximum calculated value, and it lasted for only one hour out of a record of 33 years.

Case 4. Reverse River Flow — Periodically, reverse river flow occurs in the vicinity of the BLN site. These events are caused by variations in reservoir releases at Nickajack Dam and Guntersville Dam and are highly unsteady. The primary concern for reverse river flow is decreased diffuser performance and the possibility that the discharge may become entrained in the withdrawal zone for the plant intake. For this case, the analyses focused on conditions producing a maximum temperature rise in the river. Thus, the ambient river temperature and blowdown discharge temperature were the same as those for Case 1, 41°F and 86.4°F, respectively, and occurred in March. To be consistent with the steady flow aspects of CORMIX, the average flow over the largest reverse flow event for March was examined. Based on the operating policy for the TVA river system, such an event is expected to last between five and six hours and contain an average river flow in the upstream direction of about 9,160 cfs.

It should be emphasized that for the geometry of the BLN diffuser summarized above, the CORMIX model is unable to predict the behavior of the thermal effluent for a river flow in the reverse (upstream) direction. As such, for Case 4, the simulations were made with the diffuser ports pointing upward in a vertical direction. This will bound the impact of the thermal effluent because the mixing for this geometry will be reduced compared to that with the ports pointing downstream in opposition to the reverse river flow. Reduced mixing would result in higher (bounding) temperature than would actually occur.

Model results for all four cases are summarized in Appendix E, Table E-1. Included are simulations for a B&W unit and an AP1000 unit, both for operation of the 36-inch diffuser pipe and 42-inch diffuser pipe. It is emphasized that for a single BLN unit, the operation of the diffuser would be limited to one or the other, but not both, of the diffuser pipes.

For both a B&W and an AP1000, and for both diffuser pipes, Cases 1, 2, and 4 all meet the thermal criteria by not exceeding the 92°F monthly average and 95°F daily maximum blowdown temperatures and not exceeding the 5°F limit for instream temperature rise.

Case 3 produced a 97.7°F blowdown discharge temperature lasting one hour for both alternatives and both diffuser pipes. This exceeds the daily maximum blowdown discharge temperature limit of 95°F. However, the conditions producing this worst-case scenario included a combination of three factors that are unlikely to occur simultaneously: (1) the most extreme one-hour period of meteorology, (2) the highest 24-hour average ambient river temperature, and (3) the lowest monthly average river flow, each from periods of record exceeding 30 years of data. In fact, in these records, all three factors never occur simultaneously. Hence, based on historical data, the probability of the blowdown temperature approaching 97.7°F is considered very low. For example, a frequency analysis of the plant cooling tower operation based on these data indicates that the duration of the blowdown discharge temperature approaching the 95°F thermal limit is of magnitude 0.04 percent of the time, an average of about four hours per year. During such occurrences, plant derates would be required to prevent a violation of the NPDES permit.

Given that derates would be used in the rare events that the blowdown discharge temperature approaches 95°F, the results in Table E-1 (Appendix E) also indicate that the temperature at the edge of the mixing zone is not expected to exceed 90°F, the temperature that has been determined to be protective of aquatic life (ADEM 1998; TVA 1982a). In this manner, the CORMIX computations confirm that enforcement of a 95°F limit at the blowdown discharge preserves the veracity of a 90°F limit at the edge of the mixing zone. The maximum width (758 feet vs. a full channel width of about 1,600 feet) and thickness (10 feet vs. a channel depth of about 25 feet) of the thermal plume at the edge of the mixing zone allows an adequate zone for passage of aquatic life and protection of bottom-dwelling species.

An analysis of the data for expected river operating conditions suggests that reverse flows at BLN would typically last less than six hours. As summarized in Appendix E, Table E-1 (Case 4), the diffuser performance with reverse flows produced good dilution of the blowdown for both diffuser pipes and for both the B&W and AP1000 alternatives. The maximum computed temperature rise for the edge of the mixing zone was 3.4°F for the B&W and the 36-inch diffuser pipe. It is emphasized that these results are consistent with the results from the physical model study of the diffuser pipes that was conducted as part of the design of the original plant (TVA 1977b). In the model, the diffuser was tested with a reverse flow of about 24,000 cfs and a blowdown temperature equivalent to a wintertime increase of 36°F above the ambient river conditions. The resulting temperature rise at the edge of the mixing zone measured in the model was about 3°F.

For extreme reverse flow events, effluent from the diffuser pipes could potentially travel upstream and reach the intake channel. In terms of the impact on the diffuser performance, such conditions are not expected to be significant due to two factors. First, the diffuser is designed and constructed to mix the thermal effluent across the river where it would tend to move upstream along the opposite side (TVA 1977c). Second, the duration of extreme reverse flow events are brief (i.e., of magnitude six hours) compared to the time required for the volume of diffuser effluent to significantly impact the temperature of ambient water in the river. CORMIX simulations suggest that any thermal effluent reaching the region of the plant intake channel would reside primarily in the surface layer of the river (e.g., upper 3 feet), making it unlikely to have a significant impact on the temperature of the water at the pump intakes, which are constructed to withdraw water from the bottom layer of the river. However, given the fact that some of the diluted diffuser effluent could possibly reach the plant intake withdrawal zone, future administrative controls may be necessary for the operation of the plant and/or the operation of the river system should other nonthermal

constituents of the blowdown occur in high enough concentrations to create an unacceptable impact on the plant and/or environment (TVA 2008a).

CE-QUAL-W2 was used to assess potential far-field impacts to water quality in Guntersville Reservoir. The two-dimensional model segments the reservoir longitudinally and vertically into computational elements. The water in each element is assumed to be fully mixed with uniform water quality. Input for the model includes meteorology, hydrology, and inflow water quality. The model assumes a seasonal pattern of flows, temperatures, and water quality parameters throughout the reservoir.

The reservoir model was calibrated for 1999 (a typical flow year) and 2007 (the driest year of record and containing above normal temperatures). Four cases were simulated: (1) a reference case without the WCF and without a BLN plant; (2) a base case with only WCF; (3) a case with WCF and a B&W unit at BLN; and (4) a case with WCF and an AP1000 unit at BLN.

The model results, shown in Appendix E, Tables E-2 and E-3, provide an estimate of thermal effects on reservoir water temperatures (i.e., beyond the diffuser mixing zone), DO concentrations, and algae biomass. Results are shown for four reservoir segments:

1. Upstream of WCF intake (TRMs 409.5-410.7).
2. Upstream of BLN intake (TRMs 393.0-393.9).
3. Downstream of BLN discharge (TRMs 389.0-390.0).
4. Guntersville Reservoir forebay (TRMs 349.8-350.5).

Comparing the reference case (no plant at WCF or BLN) with the base case (a plant at WCF but no plant at BLN) indicates a thermal effect from the WCF plant. The mean temperature increase in the 2007 April-September time period ranges from 1.6°F upstream of the BLN intake to 0.1°F at the Guntersville forebay. In comparing the two proposed alternatives for operating a single unit at the BLN site with having no unit at BLN (base case), there is essentially no change in the 1999 or 2007 downstream temperatures, DO concentrations, or algae biomass. This is primarily because the volume of blowdown from a BLN unit for the two alternatives is small compared to the natural volume of water flowing down the river. The only observed differences are (1) a 1999 maximum day temperature increase of 0.1°F for each alternative upstream of the BLN intake and in the reservoir forebay for 1999 and 2007, and (2) a DO decrease of 0.1 milligrams per liter for an AP1000 on the maximum day in 1999 at the reservoir forebay. There were no changes in seasonal mean values for temperature, DO, or algae biomass.

As discussed in Subsection 3.16.3, TVA has studied the sensitivity of the river and power systems to extreme meteorology and climate variations (Miller et al. 1993). In terms of water temperature, the studies evaluated the response to changes in meteorology for a typical mainstream reservoir like Guntersville Reservoir. The results found that based solely on changes in air temperature, the average (April through October) natural water temperature in a mainstream reservoir could increase between 0.3°F and 0.5°F for every 1°F increase in air temperature. An assessment of potential climate change in the Tennessee Valley suggests that air temperatures could increase 0.8°C/1.4°F by 2020 and up to 4°C/7.2°F by 2100 (EPRI 2009b). For an increase in air temperatures of 2°C/3.6°F during the first 30 years of operation of a BLN unit, the potential increase in water temperatures in Guntersville Reservoir could be from 0.5°C/1.0°F to 1.1°C/2.0°F. Such a temperature rise would impact the operation of a BLN generating unit. For example, the frequency of events where the blowdown discharge temperature approaches the NPDES

limit of 95°F would increase, and the number of unit derates necessary to maintain compliance would increase.

3.1.3.2. Environmental Consequences

Alternative A
No changes in the plant facilities or operations would occur under this alternative. Consequently, there would be no impacts or changes in current surface water conditions.

Alternative B
Under this alternative, one B&W unit would be completed and operated. The following conclusions are based on the near-field and far-field model assessments of thermal discharges from the BLN outfall DSN003 diffusers. The CORMIX near-field model assessed compliance with the current Alabama NPDES and water quality criteria (i.e., discharge temperatures not to exceed limits of 92°F monthly average, 95°F daily maximum, or 5°F increase over ambient conditions). The CE-QUAL-W2 far-field model assessed potential cumulative effects on Guntersville Reservoir.

- The CORMIX near-field results indicate that thermal effluent requirements would be met at full load, except during infrequent hydrological and meteorological conditions. A frequency analysis of available data and cooling tower operation suggests that a daily maximum blowdown discharge temperature approaching the 95°F thermal limit would be expected about 0.04 percent of the time (an average of about four hours per year). Potential increases in river water temperatures of 0.5°C/1.0°F to 1.1°C/2.0°F, due to future climate changes, could increase this occurrence from about 0.04 percent of the time to about 0.56 percent of the time (an average of about 50 hours per year). During such events, measures up to and including plant derates would be taken to prevent a violation of the NPDES permit.

- The CORMIX results confirm that enforcement of the 95°F thermal limit for the blowdown discharge would ensure the temperature at the edge of the 250-foot mixing zone would not exceed 90°F, the temperature considered protective of aquatic life (ADEM 1998; TVA 1982a). The maximum width (758 feet) and thickness (10 feet) of the thermal plume at the edge of the mixing zone is less than half of the river width and depth, thus, allowing an adequate zone for passage of aquatic life and protection of bottom-dwelling species.

- The CORMIX results suggest sufficient dilution of the blowdown for reverse river flow. Based on the expected operation of Nickajack Dam and Guntersville Dam, it is considered possible for the diffuser effluent to reach the region of the plant intake withdrawal zone, especially for extreme reverse river flow events. The impact of this on water temperature is not expected to be significant; however, future administrative controls on the operation of the plant and/or the river may be necessary if other nonthermal constituents of the blowdown (see Subsection 3.1.4) occur in unacceptable amounts in the plant withdrawal zone.

- The CE-QUAL-W2 far-field model assessment of potential impacts to water quality indicates that the effects on reservoir temperatures, DO concentrations, and algae biomass would not be significant. This analysis included cumulative effects from solar activity and WCF, the latter being the only other significant source of waste heat in Guntersville Reservoir.

In summary, the near-field and far-field (e.g., cumulative) hydrothermal effects on Guntersville Reservoir are not expected to be significant. By virtue of the fact that the plant would be operated to comply with thermal limits (even with potential climate changes), the heated effluent is not expected to have a significant impact on near-field conditions. Far-field modeling indicates that the impacts to temperatures, DO concentrations, and algal biomass in Guntersville Reservoir would not be significant.

Alternative C
Under this alternative, one AP1000 unit would be constructed and operated. Direct and cumulative hydrothermal impacts associated with this alternative are expected to be similar to Alternative B, but slightly reduced because less water is required for blowdown and less water would be discharged to the river (i.e., the Alternative C withdrawal and discharge would be 72 percent and 36 percent, respectively, of that associated with Alternative B).

3.1.4. Chemical Additives for Plant Operation

3.1.4.1. Affected Environment

A primary area of concern for surface water quality relates to the chemicals added to treat water used for condenser circulating water, equipment cooling, fire protection, and potable water in nuclear plant operations, which result in chemical discharges.

The sources of chemical discharges from a B&W plant would include cooling tower blowdown, cooling tower makeup and essential raw cooling water systems, wastes from various makeup water and condensate demineralizers, component-cooling system, reactor coolant system, and yard drainage systems and various sumps (TVA 1974a). Sources of chemical discharge from an AP1000 plant would include the circulating water system, service water system, demineralized water treatment system, steam generator blowdown system, and yard drainage systems and various sumps (TVA 2008a).

The source of fire protection water for a B&W plant would be the raw cooling water system. For an AP1000 plant, the makeup water for the fire protection system would be provided by the Jackson County Water Authority. Treatment of the B&W raw cooling water system is described below under Proposed Schemes for Cooling Water Treatment for B&W and AP1000 Units. The water supplied by the Jackson County Water Authority is treated off site in accordance with applicable drinking water standards, and no further treatment would be performed on site. The source of potable water for either a B&W plant or an AP1000 plant would be the Jackson County Water Authority. The water supplied by this water system is treated off site in accordance with applicable drinking water standards, and no further treatment would be performed on site. Sanitary waste would be routed to the sanitary drainage system, which would be discharged off site to the Jackson County Water Authority's County Road 33 wastewater treatment plant.

Chemical additives are used in plant cooling water systems for two primary purposes:

1. To inhibit the chemical process of corrosion (rust formation) on metal piping and other plant equipment surfaces.

2. To maintain efficient heat transfer through all plant heat exchangers for heat removal from the reactor. Optimal heat transfer cannot be achieved unless heat transfer surfaces are clean. Surfaces that have deposits of metal oxides (rust), scale (such as lime deposits), biological fouling (zebra mussel and Asiatic clam), or

bacterial coatings experience lower heat transfer efficiency. In addition, certain types of bacteria can accelerate the chemical oxidation or corrosion of surfaces through various waste products such as sulfate, which certain bacteria produce. This phenomenon is referred to as microbiologically influenced corrosion.

A discussion of heat transfer-related (cooling) systems for a PWR nuclear plant is provided below. As explained in Section 2.2 and 2.3 of this SEIS both the B&W and the AP1000 are PWRs. The discussion is followed by a description of the types of chemicals that are added to the plant cooling water systems.

Overview of PWR Plant Cooling Systems for Reactor Heat Removal

Two major systems are used to convert the heat generated in the reactor's nuclear fuel assemblies into electrical power. The primary system, also called the reactor coolant system, is composed of the reactor vessel, steam generators, reactor coolant pumps, pressurizer, and connecting pipes. The main function of the primary system is to carry heat away from the reactor's nuclear fuel assemblies to the steam generators.

The major secondary systems of the PWR are the main feedwater system, the condensate system, and main steam system, which are physically separated from the primary system. These secondary systems are designed to heat and pressurize cooler water to produce feedwater for the steam generators. The main steam system then routes steam from the steam generators to the plant turbines for power generation. The condensate system receives exhausted steam from the turbine discharge to repeat the cycle.

The PWR has three layers of plant water systems, referred to as cooling water systems, which provide cooling water to the primary and secondary systems described above.

The first layer of cooling, the primary water system, or "primary loop" is in contact with the nuclear fuel assemblies inside of the reactor pressure vessel, or core, and carries the heat away from the fuel assemblies. The primary coolant carries with it not only significant heat, but also significant quantities of radioactive isotopes of various atoms, or radioisotopes.

The second layer of cooling water is referred to as the "secondary loop." For the PWR, the interface of the first and second layers of cooling is at the steam generators, which are very large, vertical heat exchangers. The steam generators contain hundreds of metal tubes, which are attached to a circular, horizontally mounted metal plate. The reactor coolant flows through the inside of the tubes, while the clean, normally nonradioactive secondary coolant flows past the outside of the tubes. The heat is transferred through the metal tubes to the cooler secondary-side cooling water. This arrangement keeps the steam dryer and other components within the upper portion of the steam generator relatively free of radioactive contamination. Secondary-side contamination only occurs in minor amounts in the event of a small leak in one or more of the tubes.

From the upper head of the steam generator, the steam is directed to the plant turbine, where the massive internal blades spin on a shaft that is connected to a motor to produce electricity. At the outlet end of the turbine, steam is directed to the main plant condenser.

The third layer of cooling and heat transfer occurs at the main plant condenser, where the steam is directed over hundreds of horizontal tubes through which cooling water flows. The source of cooling water for the main plant condenser is the large water retention basin of the plant and is referred to as the heat rejection system (B&W) or circulating water system (AP1000).

Additional "secondary systems" include the service water system (AP1000), and component cooling water system (B&W and AP1000), which are used to provide cooling for plant auxiliary systems during normal operation and during shutdown conditions. Note that the service water and component cooling water systems operate continuously and not only during periods of cooling associated with reactor shutdown.

The secondary-side cooling water includes water treatment systems necessary to maintain water purity. These include the steam generator blowdown system, which continuously treats a portion of the total flow running through the steam generators. In addition, PWRs feature partial and sometimes full-flow condensate treatment systems to treat either a portion or the entire flow of water coming from the main condenser en route to the feedwater system.

Other B&W and AP1000 plant systems to which chemicals are added include the chilled water systems, turbine building heating system, auxiliary boilers, and diesel jacket cooling systems (B&W only).

Chemicals Added To Plant Water Cooling Systems
The types of chemicals currently used in operating plant cooling water systems are described as follows:

Scale Inhibitors – Also called anti-scalants, these chemicals inhibit the formation of lime (calcium oxide) deposits, which would otherwise tend to form on the high temperature surfaces of the heat exchanger tubes, and limit the deposition of other chemical forms of oxide scale upon the heat exchanger tubes. Anti-scalants are organic (carbon-based) polymers containing phosphate attachments on the molecule.

Corrosion Inhibitors – These are also organic polymers, which contain phosphonate rather than phosphate. The chemical (molecular) structure of the phosphonate-based corrosion inhibitors are similar, but not identical to the scale inhibitors, in that they both include phosphorus, but they behave differently because of the oxidation state of the phosphorus in the two compounds. Corrosion inhibitors behave as "oxygen scavengers," and tend to draw up and chemically bind available oxygen, which makes less oxygen locally available to form rust compounds, which are metal oxides.

Oxidizing Biocide – Sodium hypochlorite (at a 12 percent by weight concentration) is conventionally used to control microbiological activity, including slime formation and microbiologically influenced corrosion. Dependent upon microbiological activity, additional sodium hypochlorite may be applied to the circulating water system at the suction side of the circulating water pumps. A maximum limit for total residual chlorine is typically stated in the site NPDES permit.

Molluscicide – Ammonium chloride or a quaternary amine can be used for zebra mussel and Asiatic clam control.

Algaecide – Chemical that can be either basic ammonium chloride, NH_4Cl, or a quarternary amine compound similar to the molluscicide chemical described above. The algaecides are used to inhibit the formation of algae inside of the plant cooling water towers.

Dehalogenation Agent – Sodium bisulfite may be utilized to ensure that the oxidizing biocide (total residual oxidant) discharge limit as it pertains to the total residual halogen, usually chloride, is not exceeded.

Detoxification Agent – Bentonite clay may be required to detoxify the molluscicide chemical from the water through absorption at a ratio of 5:1 to the quaternary amine.

Biopenetrant – Non-ionic surfactant (a simple soap) may be applied to increase the efficacy of the oxidizing biocide, by cleaning off the surfaces of the biota in order to make the chlorine-based (or other halogen such as bromine-based) biocide or molluscicide chemical penetrate more effectively into the biological material, or biota.

Brief descriptions of plant cooling treatments discussed in earlier environmental reviews for the BLN site are provided in the following paragraphs.

Prior Environmental Reviews of Plant Cooling Water Chemical Treatments
Previous environmental reviews for proposed projects at the BLN site (TVA 1974a; AEC 1974; DOE 1999; TVA 2008a) analyzed potential impacts to surface water and water quality, including the addition of chemicals to treat plant cooling water systems. An examination of the prior environmental reviews as they described proposed plant cooling water chemical applications found that chemical treatments for plant cooling water systems have improved and discharge limits for chemicals have become more restrictive than how they were described in the earlier reviews. These earlier analyses adequately bound the potential for effects but require update to reflect changes in environmental regulations, improvements in chemical additives, and proposed raw water treatment.

For example, in 1974, the principal organism that created macrofouling in the Tennessee Valley was the Asiatic clam (*Corbicula manilensis*). Since 1991, another invasive species, the zebra mussel (*Dreissena polymorpha*), has also caused fouling problems at the TVA plants. TVA's 1974 FES (TVA 1974a), Section 2.5, recommended using the product *acrolein* to address macrofouling. However, the product is no longer used in the industry, because in the past decade, more effective chemicals that control both species have become available. The chemical presently in use at TVA plants is generically known as a quaternary amine.

In its 1974 FES (TVA 1974a), Section 2.5, TVA determined that a biocide would likely be used in the condenser cooling water system or the essential raw cooling water system, if faunal or floral populations developed in either of the systems. It has been TVA's experience that microbiological activity has been the cause of microbiologically influenced corrosion, and oxidizing biocides have been routinely used in raw service water systems to control this mechanism.

The 1980 BLN FSAR (TVA 1980a), Subsection 10.4.5.2, discussed the periodic injection of sodium hypochlorite into the heat rejection system to prevent organic fouling, noting that the injection points would be at the suction side of the circulating water pumps and immediately upstream of the cooling towers. TVA concluded, however, that no corrosion inhibitor or other chemical additives would be needed in the heat rejection system, based on Guntersville Reservoir water quality and TVA's operating experience at other power plants. This earlier statement is still generally true. However, under the currently proposed treatment scheme for a B&W unit discussed below, chemicals would be applied to the essential raw cooling water (source of makeup for the B&W heat rejection system).

The CLWR FEIS (DOE 1999), Subsection 5.2.3.4, described the sources of chemical discharges from a B&W plant and summarized chemical discharges from operation of BLN Unit 1 and BLN Units 1&2 in Tables 5-28 and 5-29 of that document. Expected inorganic chemicals and observed and expected trace metal concentrations are listed. The CLWR

FEIS concluded that even under adverse conditions, chemical discharges from BLN 1&2 would be small, and the change in average concentrations in the reservoir after mixing would represent a small increase over the observed background concentrations. The CLWR FEIS also concluded that actual discharges and concentrations should meet the limitations of the NPDES permit and ADEM drinking water standards.

The COLA ER described anticipated nonradioactive, liquid-waste chemical and biocide discharge concentrations for the AP1000 in ER Section 3.6. The impact of chemical additives on surface water is summarized in the following paragraph.

Biocides are added in very low concentrations (in the low parts per million) and consumed, leaving very small concentrations by the time they are discharged. The NPDES permit issued by ADEM imposes monitoring and concentration limits on releases. The current NPDES permit takes biocide and chlorine concentrations into account, and the associated discharge limits are established to protect receiving waters. Because biocides and chemicals used for water treatment are added in low parts per million (ppm) concentrations and are largely consumed serving their purposes, and the NPDES permit takes into consideration the potential for these substances being in the discharge by establishing requirements for appropriate chemical parameter monitoring and acceptable limits, the impact from these discharges is considered minor.

Proposed Schemes for Cooling Water Treatment for B&W and AP1000 Units
As discussed in Section 2.7, the B&W and AP1000 reactor coolant systems and power conversion systems are functionally similar and would use similar chemicals and processes for water treatment. Chemical treatments for either the B&W or the AP1000 design would follow the EPRI guidelines that are in effect at the time of the treatment.

TVA currently treats cooling water systems in a manner different from the treatment applications discussed in the earlier environmental reviews. The treatment scheme that has evolved at TVA's operating nuclear plants, and would be used for either a B&W unit or an AP1000 unit, is injection of specific chemicals to control corrosion and micro- and macrofouling.

For the B&W, the treatment chemicals used would be injected into the raw water system that serves as makeup to the heat rejection system and as a source for fire protection water, consisting of the circulating water pumps, conduits, main condenser, and cooling towers. As a result, the chemicals applied to the essential raw cooling water for a B&W unit would be carried over and slightly concentrated in the heat rejection system. Sodium hypochlorite would also be periodically injected into the heat rejection system to prevent organic fouling. Based on the water quality in the Guntersville Reservoir and TVA's operating experience at its other power plants, there would be no need for a corrosion inhibitor or other chemical additives in the heat rejection system. No adverse environmental effect is anticipated from the blowdown water or the tower evaporation. Because the water discharged into the heat rejection system, including initial filling and makeup, comes from the Tennessee River via the essential raw cooling water system, provisions are made in the essential raw cooling water system to restrict the introduction of Asiatic clams or their larvae into the heat rejection system (TVA 1980a).

As discussed in COLA ER Chapter 3, the AP1000, circulating water system chemistry is maintained by a local chemical feed skid at the circulating water system cooling tower. Biocide and water treatment chemicals are injected to maintain a noncorrosive, nonscale-forming condition and limit the biological film formation and are adjusted as required.

Biocide application may vary with seasons, and algaecide is applied, as necessary, to control algae formation on the natural draft cooling tower. Chemical concentrations are measured through analysis of grab samples from the circulating water system. Residual chlorine is measured to monitor the effectiveness of the biocide treatment (TVA 2008a).

The AP1000 service water system chemistry is maintained by the turbine island chemical feed system as discussed in the COLA FSAR (TVA 2009a). Biocide and water treatment chemicals are injected to maintain a noncorrosive, nonscale-forming condition and limit the biological film formation and are adjusted as required. Specific chemicals used within the system, other than the biocide, are determined by the site water conditions. Biocide application may vary with seasons, and algaecide is applied, as necessary, to control algae formation on the natural draft cooling tower. Chemical concentrations are measured through analysis of grab samples from the circulating water system. Residual chlorine is measured to monitor the effectiveness of the biocide treatment (TVA 2008a).

The AP1000 demineralized water treatment system receives water from the raw water system and filters and processes this water to remove ionic impurities. A pH adjustment chemical is added upstream of the filtration units to adjust the pH of the reverse osmosis influent, which is maintained within the operating range of the reverse osmosis membranes. A dilute antiscalant, chemically compatible with the pH adjustment chemical, is used to increase the solubility of salts and decrease scale formation on the membranes. Both the pH adjustment chemical and the antiscalant are injected into the demineralized system from the turbine island chemical feed system (TVA 2008a).

The AP1000 steam generator blowdown system assists in maintaining acceptable secondary coolant water chemistry during normal operation and during anticipated operational occurrences of main condenser inleakage. It does this by removing impurities that are concentrated in the steam generator. The system extracts blowdown water from each steam generator and processes the water as required. Chemicals needed to maintain proper operation of the system are injected by the turbine island chemical feed system on an as-needed basis, and are not dependent on the modes of operation of the plant (TVA 2008a).

As discussed earlier, TVA presently uses a chemical generically known as a quaternary amine to control macrofouling, which is effectively applied at a minimum of 1.5 ppm of active product (3.0 ppm total product). Typically, the quaternary amine is applied to the systems three to five times per season for 24 or 72 hours. During the application process, bioboxes of healthy specimens are typically utilized to monitor for mortality of both species. Quaternary amines lose their effectiveness by dilution or may be detoxified by adding bentonite clay.

While oxidizing biocides have been routinely used in raw service water systems to control faunal and floral populations, chemical biocides have not been routinely used in TVA nuclear plant condenser cooling water systems. Instead, cleanliness of condensers has generally been maintained mechanically by a continuous tube-cleaning system, such as the Amertap system, which would be applicable to a B&W unit or an AP1000 unit. However, some chemical biocides may be used, if needed for biological control.

Another difference between the proposed scheme for the B&W and the treatment process described in the 1980 FSAR (TVA 1980a), Subsection 10.4.5.2, relates to additional makeup water for the B&W condenser cooling water system. In the 1980 FSAR discussion, a small amount of additional makeup for the condenser circulating water system was to be

supplied by BLN sewage treatment plant effluent. Under the proposed scheme, it is expected that the essential raw cooling water system would provide all makeup water for a B&W unit. No on-site sewage treatment plant is planned for either a B&W unit or an AP1000 unit. BLN sanitary waste would be discharged to the Jackson County Water Authority's wastewater treatment facility, as discussed earlier in this section.

TVA's operational philosophy regarding chemical additives for plant operation reflects minimization of chemical use through an optimization program. The optimization program includes (1) monitoring operating plant parameters, (2) continually evaluating water chemistry, and (3) inspecting equipment to minimize the total amount of chemicals added. Under both Alternatives B and C, the treatment plan would include treatment of intake or process waters with biocides, dispersants, corrosion-inhibiting chemicals, and detoxification chemicals. Prior to use in TVA plants, chemicals undergo an extensive toxicological review and comparison with maximum instream wastewater concentrations to ensure water quality standards are met.

Under either Alterative B or C, water treatment processes would be controlled to comply with state water quality criteria and applicable NPDES permit conditions to ensure protection of the receiving water body. The standards and criteria applied by the state in establishing NPDES permit limits and requirements are to protect public health and water resources, as well as to maintain the designated uses for the receiving water body.

The amounts of the various chemicals injected for the B&W reactor versus an AP1000 reactor are very comparable, but somewhat lower in the AP1000. The differences are based on plant thermal cycle efficiency. Additional heat "recovery and reuse" features of the AP1000 reactor translate into lower overall rates of cooling water flow. With lower daily volumes of cooling water flowing through the plant systems, less chemicals are needed to treat cooling water.

Secondary system chemistry specifications would be based on the recommendations in the version of the EPRI PWR Secondary Water Chemistry Guidelines that are current at that time. For component cooling water, both a B&W and an AP1000 unit would use chemistry-control specifications consistent with the version of the EPRI Closed Cooling Water Chemistry Guideline that is current at that time. For the emergency diesel jacket water cooling system (B&W only), an industry-standard-approved corrosion inhibitor to control corrosion in the emergency diesel jacket water cooling system would be used.

Acceptance criteria for each monitored parameter would be established and described in approved plant procedures. In the event the acceptance criteria are not met, specific corrective actions would be implemented in accordance with TVA's corrective action program. Any releases to the environment would be governed by the NPDES permit.

3.1.4.2. Environmental Consequences

Alternative A
Under this alternative, no construction or nuclear plant operation would occur at BLN. Therefore, selection of this alternative would not result in direct, indirect, or cumulative effects from chemical additives to surface water.

Alternatives B and C
Based on average estimated daily streamflow of 37,300 cfs, blowdown for the B&W and AP1000 alternatives as a percentage of average flow is approximately 0.130 percent (B&W)

and 0.046 percent (AP1000) of the average flow of the Tennessee River. Of the estimated more conservative 7Q10 flow of 5,130 cfs calculated for the BLN site (one unit only), the percent of Tennessee River flow would be 0.970 percent (B&W) and 0.350 percent (AP1000). Concentrations of solids and residual water treatment chemicals in the cooling tower blowdown would quickly dissipate in the river, because the blowdown volume is insignificant relative to the river flow. The impact of chemical additives would be further reduced through the use of bisulfite chemicals and chemical-absorbing media.

Although the volume of the cooling tower blowdown is anticipated to be small when compared to the river flow and the treatment chemicals added are largely consumed leaving very small concentrations by the time they are discharged, the discharge is regulated by an Alabama state NPDES permit and would comply with applicable water quality standards and criteria. Therefore, for either Alternative B or C, the direct, indirect and cumulative effects of chemical discharges would be minor.

3.2. Groundwater Resources

3.2.1. Affected Environment

Groundwater conditions at the BLN site have been documented in several reports over time, beginning with TVA's 1974 FES through the COLA ER (TVA 2008a) and COLA FSAR (TVA 2009a). A summary of that groundwater information is provided below.

Groundwater Hydrology

In and near the plant area, the principal water-bearing formations are the Knox Dolomite of Cambrian and Ordovician age and the Fort Payne Chert of Mississippian age. The Knox crops out approximately 3,200 feet northwest of the plant site and dips to the southeast, so it is about 1,000 feet below the land surface in the site area. The Fort Payne crops out about 3,000 feet southeast of the plant site and dips southeastward away from the plant (TVA 1986). The Chickamauga Formation, the (uppermost) bedrock at the main plant site, is a poor water-bearing formation in this region (TVA 1986). More recently, with the reclassification of the regional stratigraphy (Osborne et al. 1988), the main site is said to be underlain instead by the Stones River Group Limestone (TVA 2008a). The physical properties of the formation remain unchanged by the reclassification.

Groundwater at the BLN site occurs under unconfined conditions, as reflected by the water table. The water table conforms closely to topography and ranges in depth below ground surface from zero along Town Creek embayment to a maximum of about 22 feet (TVA 1986) or more (Julian 1996; TVA 2008a; 2009a) at the plant site. The water table occurs primarily in soil composed of residual silts and clays derived from in-place weathering of the underlying rock and also in the upper fractured, weathered zones of the bedrock. Recharge is provided by precipitation, mostly as rain, which averages about 50 inches annually, of which about 8 inches goes into groundwater storage (TVA 1986).

Historic potentiometric plots of groundwater levels (TVA 1986) and later data in the 1980s and 1990s all show the direction of groundwater flow from the plant site toward Town Creek on the northwest for the most part. For some shorter periods of the year, some flow goes to the Tennessee River (Guntersville Reservoir) (TVA 2008a; 2009a). Subsurface testing at BLN using a network of test observation wells installed in 2006 was conducted in support of the COLA (TVA 2008a; 2009a).

Groundwater Use and Trends

There are no groundwater supply wells on site at BLN. Previous TVA reports have documented the use of groundwater supply wells by the town of Hollywood and city of Scottsboro, both of which are within 3 and 7 miles (respectively) of BLN, and by the city of Stevenson, which is about 12 miles from BLN (Julian 1996). A recent communication with ADEM (M. Browman, TVA, personal communication, August 2009) verified that Hollywood and Scottsboro no longer use groundwater supply wells to meet their water needs. Stevenson and Pisgah (located on the east side of Guntersville Reservoir) are the only two municipal or industrial entities in Jackson County, Alabama, that have groundwater supply wells. Groundwater is not used as a municipal or industrial water source within a 2-mile radius of BLN (TVA 2008a; 2009a).

Private groundwater sources were identified early on (1961) within a 2-mile radius (see Figure 3-8 and Table 3-5) (TVA 1986) and more recently within a 1-mile radius (Figure 3-9) (TVA 1997) of the BLN site. A coarse visual comparison indicated that within the zone of overlap, there was a doubling of wells from the first to the second survey. The overwhelming predominance of these wells is northwest of the BLN site and separated from the site by Town Creek embayment, which provides a hydraulic barrier between the wells and the plant. A survey conducted by TVA in 2009 for private wells within an arc 2 miles from the plant, southwest along the peninsula to the plant, revealed two private wells. One has been capped off and unused for 20 years, and the other is used for nonpotable purposes.

Groundwater Quality

Groundwater quality at BLN has been monitored over the years to obtain background concentrations, to examine the effect of on-site disposal practices, and in response to specific incidents. Monitored parameters included radionuclides, organics, and inorganics (TVA 1978c; 1979; 1980b; 1981b; 1982b; 1983a; 1984).

The locations of the TVA monitoring wells installed on site between 1973 and 1996 (Julian 1999), and in 2006 (TVA 2008a) in support of the COLA are shown in Figure 3-10.

Background levels of selected radionuclides (gamma-emitting and tritium) were monitored from 1977 through 1983 in six bedrock wells (TVA 1978c; 1979; 1980b; 1981b; 1982b; 1983a; 1984). Results were spatially and temporally variable.

Monitoring through 1990 of the effects of trisodium phosphate waste/wastewater disposal on site in the early to mid-1980s indicated that the associated metals and phosphorus concentrations had returned to background or near-background levels. The same was true for sodium, except at one well, which continued to show elevated concentrations (Lindquist 1990).

Background sampling by TVA across the site from 1981 to 1991 for total concentrations of inorganics, except for nickel, showed very few constituents in excess of the Drinking Water Standards. Exceedances for iron, manganese, and aluminum were attributed to colloidal mineral material (TVA 1997). Sampling conducted in support of the COLA ER for a similar array of parameters yielded generally similar results. Monitoring in response to diesel spills on site in the 1980s and early 1990s, indicated that, by 2004, the levels of critical contaminants had decreased to regulatory acceptable values (C. Spiegel, ADEM, personal communication, February 2006; A. Nix, TVA, personal communication, July 2006).

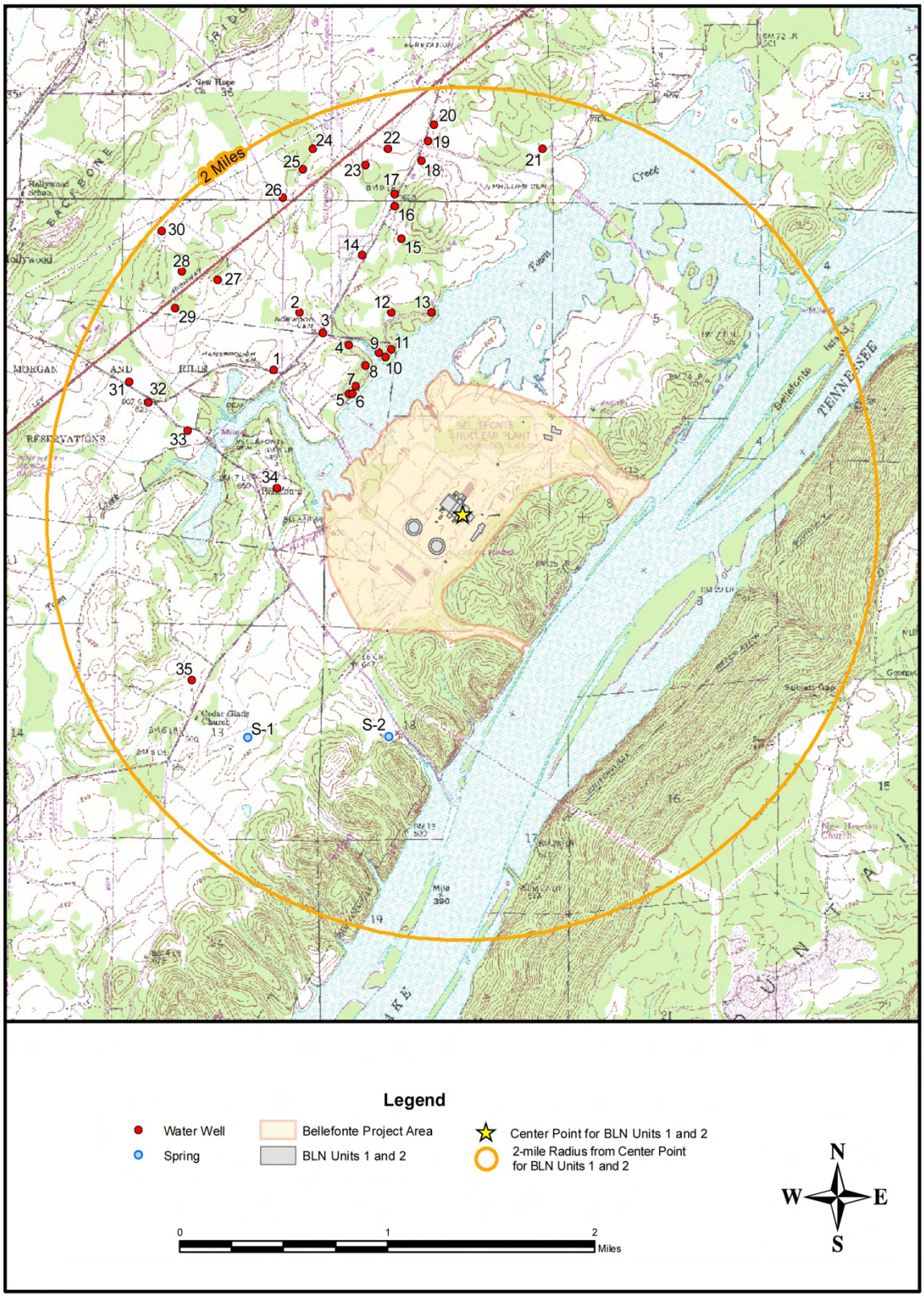


Figure 3-8. Water Wells and Springs Within 2-Mile Radius of BLN

Table 3-5. Inventory of Private Wells and Springs Located Within 2-Mile Radius of BLN, 1961 Data[a]

Well Number[b]	Year Installed	Elevation[c] (feet msl)	Well Depth (feet)	Completion Zone	Comments
1	U	611	20	U	Private residential well
2	U	621	U	U	Private residential well
3	U	609	72	U	Private residential well
4	U	602	U	U	Private residential well
5	U	610	U	U	Private residential well
6	U	600	U	U	Private residential well
7	U	605	U	U	Private residential well
8	U	608	U	U	Private residential well
9	U	605	U	U	Private residential well
10	U	605	U	U	Private residential well
11	U	605	U	U	Private residential well
12	U	629	172	U	Private residential well
13	U	610	39	U	Private residential well
14	U	623	33	U	Private residential well
15	U	670	72	U	Private residential well
16	U	629	102	U	Private residential well
17	U	619	34	U	Private residential well
18	U	621	97	U	Private residential well
19	U	637	70	U	Private residential well
20	U	630	77	U	Private residential well
21	U	620	70	U	Private residential well
22	U	635	U	U	Private residential well
23	U	617	55	U	Private residential well
24	U	640	135	U	Private residential well
25	U	630	131	U	Private residential well
26	U	640	48	U	Private residential well
27	U	640	200	U	Private residential well
28	U	634	68	U	Private residential well
29	U	630	72	U	Private residential well
30	U	638	52	U	Private residential well
31	U	615	U	U	Private residential well
32	U	620	125	U	Private residential well
33	U	604	72	U	Private residential well
34	U	639	116	U	Private residential well
35	U	645	U	U	Private residential well
S-1	N/A	637	Spring	N/A	Intermittent spring[d]
S-2	N/A	600	Spring	N/A	Intermittent spring[d]

(a) This table may include wells that have been abandoned or installed since the original survey from 1961.
(b) See Figure 3-8 for locations.
(c) Elevation at the ground surface (wells 1-35, springs S-1, and S-2) or top of well casing. Elevations were either obtained by reference or estimated from topographic maps.
(d) Flow was observed from the two intermittent springs in January 2009.

msl = Above mean sea level
U = Unknown
N/A = Not applicable

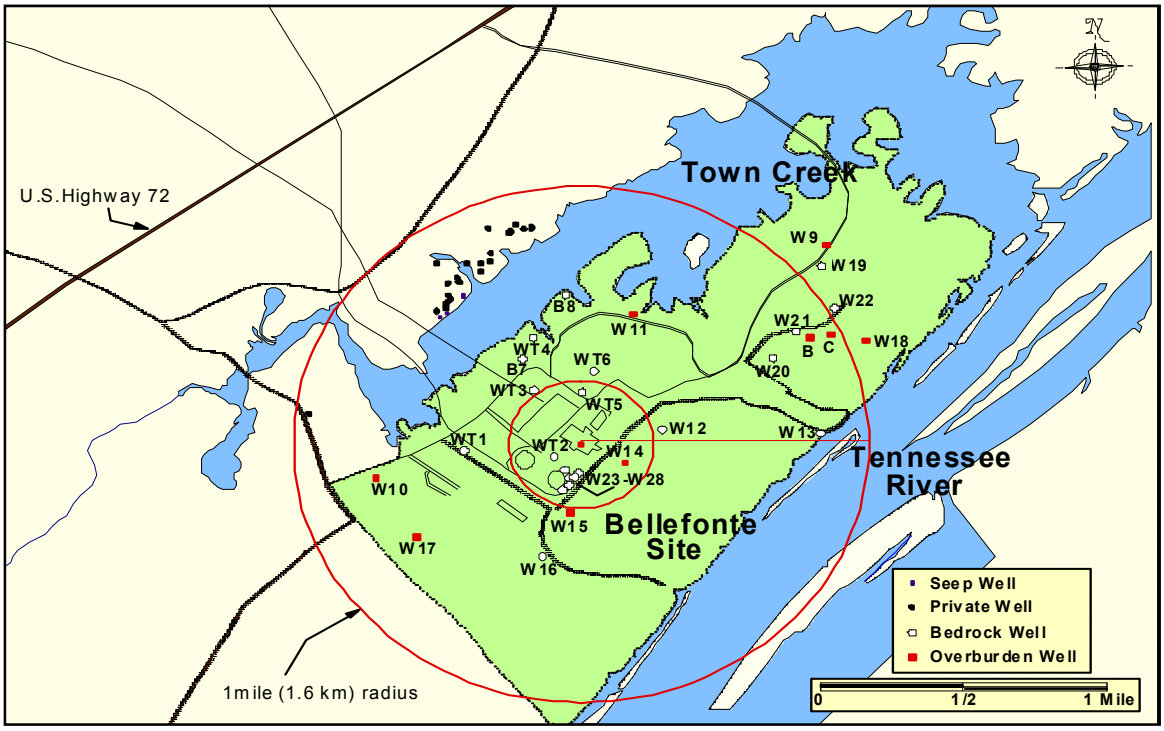


Figure 3-9. Groundwater Wells Within 1-Mile Radius of the BLN Site - 1990

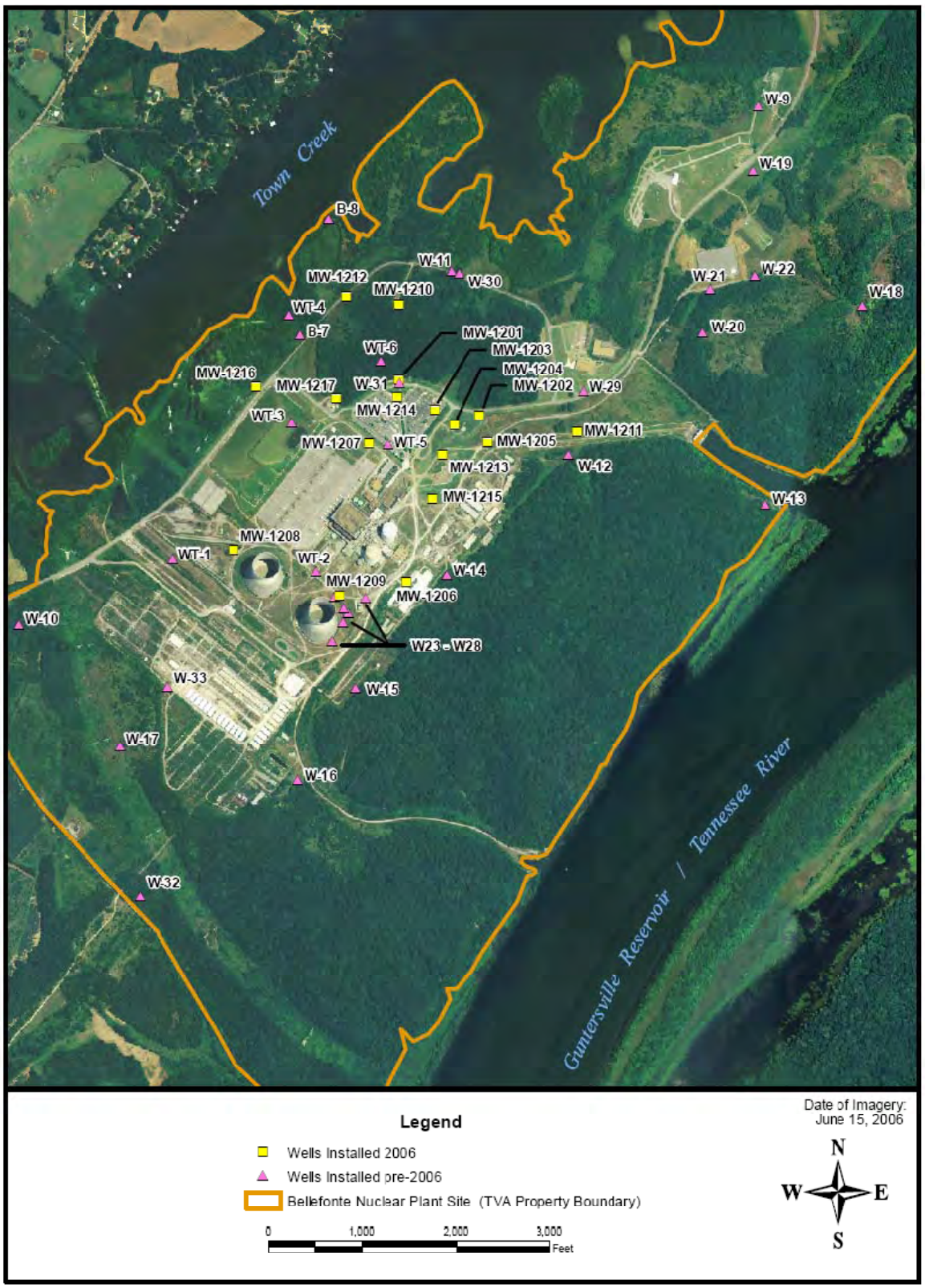


Figure 3-10. BLN B&W Groundwater Wells

3.2.2. Environmental Consequences

Alternative A
Under the No Action Alternative, there would be no effects to the groundwater hydrology, groundwater use, or groundwater quality. The current much-reduced activity and equipment inventory at the site favor the lack of effect on most aspects of groundwater and on groundwater quality in particular. The current use of BMPs for the handling of chemicals, together with the adherence to the site SPCC plan for the management and cleanup of oils, limit likelihood that oil or chemicals would reach groundwater. There is currently no groundwater use on site. Under the No Action Alternative, the quality of groundwater may actually improve. Residual chemicals from past spills and from industrial practices that have been discontinued would decrease over time, leading to the improvement in water quality.

Alternatives B and C
Nonradiological. The completion of one B&W unit or the construction of one AP1000 unit would have no impact on the groundwater hydrology or groundwater use, either on site or locally. Potable water would be supplied by the Jackson County Water Authority. The source of fire protection water for a B&W unit would be the raw water cooling system. For an AP1000, the makeup water for the fire protection system would be provided by the Jackson County Water Authority. Water for concrete batching (if necessary) and other construction uses would be withdrawn from the Tennessee River/Guntersville Reservoir. TVA does not anticipate the use of groundwater as either a safety-related source of water for a BLN unit or its source of water supply for any purpose during operation.

With the adoption of either alternative, nonradiological impacts on groundwater quality are expected to be minor and insignificant. Under both alternatives, chemicals used during construction would be managed using BMPs, thereby limiting the likelihood of chemical contamination of surface water as well as groundwater. In addition, BLN and similar sites that store oil in volumes above a certain threshold and in containers meeting certain size specifications are required to have an SPCC plan (EPA 2008a) applicable to gasoline, diesel fuel, lubricating oil, insulating oil, and other oils. An SPCC plan reduces the likelihood that oil spills will occur on site and provides measures for the expeditious control and cleanup of such spills if they do occur. Implementation of the SPCC plan and the BMPs would help keep oils and chemicals out of surface waters as well as groundwater. With these controls in place, and with the gradual decrease in concentration of existing residual chemicals from historic on-site spills and practices, it is expected there would be an improvement in groundwater quality over time as stated for Alternative A.

Over the past 12 years, several instances of nuclear plants inadvertently releasing tritium contamination to the soil and/or groundwater have been documented. A recent NRC (2010) fact sheet concluded that although the leaks do not present a risk to the public, enhanced efforts are being focused on proper monitoring and repair of pipes by plant operators. Because no radioactive waste has been produced at the BLN site, either of the proposed nuclear units can benefit from the experience gained at operating plants and from the recent industry guidance from the NRC and Nuclear Energy Institute (NEI).

Radiological. With the adoption of either alternative, impacts on groundwater quality from radiological sources are expected to be minor and insignificant. Under both alternatives, TVA would comply with the NEI's groundwater protection initiative, NEI 07-07 (NEI 2007). This initiative identifies actions to improve utilities management and response to instances

where the inadvertent release of radioactive substances may result in low, but detectible, levels of plant-related radioactive materials in subsurface soils and water. Aspects addressed by the initiative include site hydrology and geology, site risk assessment, on-site groundwater monitoring, and remediation. The placement and distribution of monitoring wells would be determined by a qualified hydrogeologist. Further discussion of the groundwater monitoring program is provided in COLA FSAR Subsection 12AA.5.4.14, Groundwater Monitoring Program.

An AP1000 unit at BLN would be compliant with NEI 08-08 (NEI 2008), which offers guidance for new plant design and operation, in terms of engineering and administrative controls that would minimize the occurrence of and provide for the management of inadvertent releases of licensed materials, including tritium, to groundwater. Aspects addressed include design of systems, structures, and components, leak detection, and review of operational practices. The B&W unit would comply with specific requirements of NEI 08-08 (NEI 2008) regarding protection of newly installed buried piping.

A detailed technical evaluation (TVA 2010a) was performed on the existing B&W unit to identify possible sources of radioactive substances that could potentially leak into the groundwater, and specific actions are provided to prevent and monitor leaks, including replacement of the existing plant discharge line, installation of additional monitoring wells, and development of a monitoring program. Specific engineering features that preclude the leakage of radioactive discharge to the environment for an AP1000 unit are discussed in the COLA FSAR Subsection 11.2.1.2.4. These include visual inspection points, piping designs that preclude inadvertent or unidentified releases to the environment, and location of all valves and fittings inside of buildings. Further discussion of the groundwater monitoring program for the AP1000 is provided in COLA FSAR Subsection 12AA.5.4.14. For both Alternatives B and C, the exterior radwaste discharge piping would be enclosed within a guard pipe (secondary containment) and monitored for leakage (see COLA FSAR Subsection 11.2.1.2.4)

Because the direct and indirect effects of the proposed Action Alternatives are expected to be insignificant and TVA is not aware of other activities planned or underway in the vicinity of the plant that contribute to groundwater impacts, construction and operation of a BLN nuclear unit would not result in significant cumulative effects to groundwater.

3.3. Floodplain and Flood Risk

3.3.1. Affected Environment

In AEC's 1974 FES, Subsection 12.1.2 states "Plant safety aspects are considered separately as part of the Preliminary Safety Analysis Report (PSAR) prepared by TVA and the staff's evaluation contained in the Safety Evaluation Report. The AEC's criteria of design against plant site flooding are provided in 10 CFR Part 50, Appendix A (Criterion 2)." The BLN COLA FSAR Section 2.4 (TVA 2010b) contains information related to potential flooding of the BLN site from the Tennessee River and local Probable Maximum Precipitation[5] (PMP) site drainage. Floodplain and flood risk information for the BLN site was updated in the COLA FSAR. The Bellefonte Conversion FEIS (TVA 1997) described the floodplain and flood risk conditions at the BLN site.

[5] The Probable Maximum Precipitation is defined as the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year (American Meteorological Society 1959). In consideration of the limited knowledge of the complicated processes and interrelationships in storms, PMP values are identified as estimates.

The BLN site is located on a peninsula formed by Town Creek embayment and the Tennessee River on Guntersville Reservoir in Jackson County, Alabama (Figure 1-1). The proposed project area could be flooded from both the Tennessee River and Town Creek, as well as local PMP site drainage. The area impacted by the proposed project extends from about TRM 390.4 to TRM 392.3, and from about Town Creek Mile 2.1 to 3.3.
The 100-year floodplain for the Tennessee River varies from elevation 600.5 feet msl at TRM 390.4 to elevation 601.1 feet msl at TRM 392.3. The TVA Flood Risk Profile (FRP) elevations on the Tennessee River vary from elevation 601.8 feet msl at TRM 390.4 to elevation 602.6 feet msl at TRM 392.3. For Town Creek, the 100-year floodplain is the area lying below elevation 601.4 feet msl. The FRP elevation is 603.1 feet msl. The FRP is used to control flood-damageable development for TVA projects and residential and commercial development on TVA lands. At this location, the FRP elevations are equal to the 500-year flood elevations.

Jackson County, Alabama, has adopted the 100-year flood as the basis for its floodplain regulations, and all development would be consistent with these regulations. There are no floodways published for this area (TVA 1997).

The BLN drainage system was evaluated for a storm producing the PMP on the local area. The site is graded such that runoff would drain away from safety-related structures to drainage channels and subsequently to the Tennessee River. The PMP flood analysis assumes that all discharge structures are nonfunctioning. The highest PMP water surface elevation in the vicinity of safety-related structures would be 627.53 feet msl (TVA 2009a).

Based on the 2009 reverification of the Probable Maximum Flood[6] (PMF), the controlling PMF elevation at the BLN site would be 625.7 feet msl with dam safety modifications that were made to Watts Bar and Nickajack dams. The effects of coincident wind wave activity are estimated to be 1.3 feet high. Therefore, the PMF and coincident wind wave activity results in a flood elevation of 627.0 feet msl (TVA 2010b).

The floodplains and flood risk assessment involves ensuring that facilities would be sited to provide a reasonable level of protection from flooding. In doing so, the requirements of EO 11988 (Floodplain Management) would be fulfilled. For nonrepetitive actions, EO 11988 states that all proposed facilities must be located outside the limits of the 100-year floodplain unless alternatives are evaluated, which either would identify a better option or support and document a determination of “no practicable alternative” to siting within the floodplain. If this determination can be made, adverse floodplain impacts would be minimized during design of the project (TVA 1997).

For a “critical action,” facilities must be protected to the 500-year flood elevation where there is no practicable alternative. A “critical action” is defined in the Water Resource Council Floodplain Management Guidelines as any activity for which even a slight chance of flooding would be too great. One of the criteria used in determining if an activity is a critical action is whether essential and irreplaceable records, utilities, and/or emergency services would be lost or become inoperable if flooded. Based on this criterion, construction activities associated with this project would be considered as “critical actions”

[6] The Probable Maximum Flood is defined as the most severe flood that can reasonably be predicted to occur at a site as a result of hydrometeorological conditions. It assumes an occurrence of PMP critically centered on the watershed and a sequence of related meteorologic and hydrologic factors typical of extreme storms.

because flooding of these facilities would render them inoperable. All facilities that would force the shutdown or curtailment of power generation if flooded, would either be located above or flood-proofed to the 500-year flood elevation at that location. Many of the support facilities that would not impact power generation if flooded would only be subject to evaluation using the 100-year flood (TVA 1997). Because the proposed project involves a nuclear generating facility, the NRC also requires a flood risk evaluation of possible impacts from the Tennessee River PMF and local PMP site drainage for all alternatives.

Because the activities evaluated in 1997 are different from those proposed for this project, the description of environmental consequences has been newly developed to address completion or construction and operation of a single-unit nuclear plant.

3.3.2. Environmental Consequences

Alternative A
Under the No Action Alternative, no new construction or dredging would occur at the BLN site; therefore, no actions inconsistent with EO 11988 would occur.

Alternative B
Because the existing nuclear-related structures would be utilized, only minor additional physical disturbance of the site from new construction would occur. The majority of work would take place within the existing structures. Minor upgrades to the existing switchyard and transmission line system would be needed. When the final site plans are developed, these activities would be further reviewed to confirm that the work is consistent with EO 11988.

Dredging would occur in the intake channel. However, consistent with EO 11988, dredging is a repetitive action that would result in minor impacts because the dredged material would be disposed of in an on-site spoils area above the 500-year flood elevation.

Section 2.4 of the BLN FSAR (TVA 1986) describes the plant grade of safety-related structures, other than the intake pumping station, as varying between elevations 628 and 646 msl and lists key plant structures and their elevations. The existing safety-related structures where work would take place are either located above the 100-year and FRP elevations or are flood-proofed to that flood level, so the project would be consistent with EO 11988. In addition, all safety-related structures are either located above or flood-proofed to the Tennessee River PMF and coincident wind wave elevation of 627.0 feet msl and above the local PMP site drainage elevation of 627.53 feet msl.

Construction and operation of the B&W unit would not increase the flood risk in the Guntersville Reservoir watershed because the plant would not impact upstream flood elevations. Therefore, there would be no cumulative effects to flood risk associated with the implementation of Alternative B.

Alternative C
Based on the site plan (Figure 2-12), all of the proposed construction activities would occur outside of the 100-year floodplain, which would be consistent with EO 11988. The only activity planned below the FRP elevation would be the construction of site parking. Every effort would be made to reduce the quantity of fill associated with this activity to ensure compliance with the TVA Flood Control Storage Loss Guideline.

Dredging would occur in the intake channel and barge unloading dock. However, consistent with EO 11988, dredging is a repetitive action that should result in minor impacts, because the dredged material would be disposed of in an on-site spoils area above the 500-year flood elevation.

An AP1000 would be constructed at a grade elevation of 628.6 feet msl, which would be above the Tennessee River PMF and coincident wind wave elevation of 627.0 feet msl and above the PMP site drainage elevation of 627.53 feet msl. All safety-related structures would either be located above or floodproofed to the resulting flood levels. The new administration building would be located well above the 100-year and FRP elevations.

As with Alternative B, there would be no cumulative effects to flood risk associated with implementation of Alternative C.

3.4. Wetlands

3.4.1. Affected Environment

Wetlands are areas inundated or saturated with surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (Environmental Laboratory 1987).

Wetlands are regulated under Sections 404 and 401 of the CWA and addressed under EO 11990. To conduct certain activities in the “waters of the U.S.” that may affect wetlands, authorization under a Section 404 permit from the USACE is required. Section 401 gives states the authority to certify whether activities permitted under Section 404 are in accordance with state water quality standards. ADEM is responsible for Section 401 water quality certifications in Alabama. EO 11990 requires all federal agencies to minimize to the extent practicable the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency’s responsibilities.

Vegetation communities, including bottomland areas, were assessed during the initial environmental review for the construction of BLN 1&2 (TVA 1974a). Wetland habitat was specifically addressed during subsequent proposals for associated on-site operations (TVA 1997; 2008a; DOE 1999). Wetlands are located along the 12.5-mile shoreline of Guntersville Reservoir and Town Creek embayment fronting the BLN site, but are outside the BLN project area or on the opposite side of Perimeter Road from the BLN plant facilities (Figure 3-11). These wetland areas consist of bottomland/riparian forest, shoreline emergent habitat, and floating aquatic beds. Throughout and following the construction of the existing BLN 1&2 structures, these shoreline wetland areas experienced very little impact (TVA 2008a).

A wetland assessment completed by TVA in 2006 indicated six forested wetlands were located between the perimeter road and the existing parking area. An interagency field review with USACE in 2009 resulted in the inclusion of one additional small forested wetland and wetland connectivity channels between the previously delineated areas. These seven forested wetlands ranged in size from 0.02 to 4.52 acres and totaled approximately 12.2 acres. In 2009, TVA wetland biologists also mapped two created scrub-shrub wetland areas upstream of the intake channel connecting to Guntersville Reservoir

via ephemeral conveyance. These wetlands totaled approximately 1 acre and met the USFWS wetland definition but did not exhibit all criteria required for wetland determination and USACE jurisdiction. One linear wetland feature was also mapped during the 2009 field reconnaissance along the west side of the road leading to the barge terminal. This wide, linear, forested wetland is located in a natural ravine and receives water via precipitation and runoff that empties into a culvert connecting to Guntersville Reservoir. On a 3-level functionality scale, the wetlands rank in Category 2 (moderate condition and provision of wetland function) and Category 3 (superior condition and provision of wetland function).

Wetland determinations were performed according to USACE standards (Environmental Laboratory 1987), which require documentation of hydrophytic vegetation (USFWS 1996), hydric soil, and wetland hydrology. Broader definitions of wetlands, such as the definition provided in EO 11990 (Protection of Wetlands), Alabama state regulatory definitions, and the USFWS definition (Cowardin et al. 1979) were also considered in making their delineations. Field delineation and habitat assessment forms are included in Appendix F.

3.4.2. Environmental Consequences

Alternative A
Under the No Action alternative, no alterations or improvements would be made to the existing facilities for the purpose of nuclear power generation. Therefore, selection of this alternative would not result in direct, indirect, or cumulative effects to wetlands.

Alternative B
Under Alternative B, completion of and improvements to existing facilities and continued operation of the plant would take place. Construction proposed under Alternative B would not directly affect wetlands (Figure 3-11). Proposed parking areas would be sited greater than 50 feet from any delineated wetland boundary to provide a buffer and avoid or minimize indirect impacts to wetlands. During operation, the impact of the thermal plume on emergent, floating-leaved, and submerged vegetation that composes much of the shoreline wetlands would be minimal due to the small temperature change predicted.

Some localized enhancement of macrophyte growth could occur along portions of the mainstream east bank and the adjacent shallow area (DOE 1999). No indirect effects to wetlands are anticipated from runoff or sedimentation during construction or initial or long-term operation of a B&W reactor at the BLN site. Therefore, because there are no wetlands within the construction footprint and the wetlands on or adjacent to the site would not experience significant ecological changes resulting from construction or power generation at the BLN site, no direct, indirect, or cumulative wetland impacts would occur under this alternative.

Figure 3-11. Wetlands Shown in Relation to the B&W Site Plan (Alternative B)

Alternative C

Under Alternative C, the new reactor facility would be constructed on and between the Perimeter Road and the existing parking area. The construction footprint for this alternative would result in direct and/or indirect impacts to the 12.2 acres of forested wetland located in that area (Figure 3-12). In compliance with the CWA, TVA would obtain a Section 404 permit and Section 401 certification for the wetland fill associated with the construction footprint for the new facility. Compensation for wetland impacts would be provided through purchasing wetland mitigation credits at the USACE approved wetland mitigation ratio from Robinson Spring Wetland Mitigation Bank, located within the same watershed as the proposed impacts. The impact of the thermal plume on wetland vegetation along the shoreline due to operation of an AP1000 unit on site would be minimal due to the small temperature change predicted.

Some enhancement of macrophyte growth could occur along portions of the mainstream east bank and the adjacent shallow area (DOE 1999). BMPs would be used to avoid or minimize indirect wetland impacts. Therefore, no significant wetland impacts are anticipated from runoff or sedimentation during the construction or operation of one AP1000 unit at BLN. Because TVA would mitigate in-kind within the watershed for wetland fill resulting from construction, no net loss of wetland functions within the watershed would be anticipated, resulting in no cumulative wetland impacts under Alternative C.

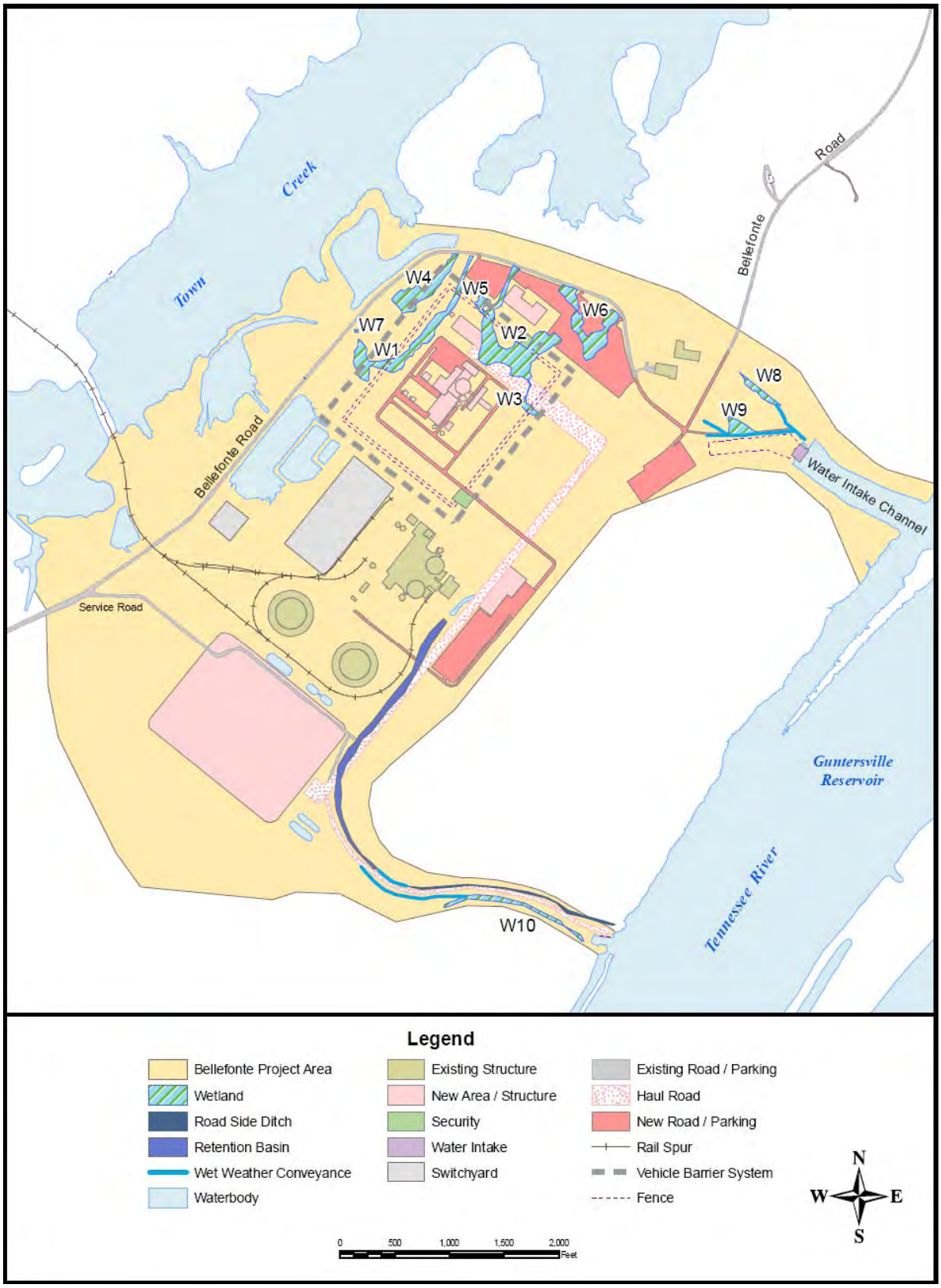


Figure 3-12. Wetlands Shown in Relation to the AP1000 Site Plan (Alternative C)

3.5. Aquatic Ecology

3.5.1. Affected Environment

To support the evaluation of the viability of licensing an additional nuclear reactor at the BLN site, TVA conducted one year of preoperational monitoring in Guntersville Reservoir. During 2009, sampling was conducted upstream and downstream of BLN to characterize site-specific conditions. Sampling at these sites was in addition to TVA's routine VS monitoring program. The VS program, supplemented with additional fish and benthic macroinvertebrate community monitoring upstream and downstream of fossil and nuclear power plants, is used to evaluate effects of thermal discharges to aquatic communities in the receiving water body.

The VS monitoring program in the Tennessee River system began in 1990. This program was implemented to evaluate ecological health conditions in major reservoirs as part of TVA's stewardship role. One of five indicators used in the VS program is the Reservoir Fish Assemblage Index (RFAI). RFAI has been thoroughly tested on TVA and other reservoirs and published in peer-reviewed literature (Jennings et al. 1995; Hickman and McDonough 1996; McDonough and Hickman 1999). The measures used in this methodology are indexed metrics, and not absolute measures of community diversity (number of species) or abundance (number of individuals of each species).

Fish communities are used to evaluate ecological conditions because of their importance in the aquatic food web and because fish life cycles are long enough to adapt to conditions over time. Benthic macroinvertebrate populations are assessed using the Reservoir Benthic Index (RBI) methodology. The RBI is an indexed measure that is used to compare reservoir sites within the Tennessee River system. Because benthic macroinvertebrates are relatively immobile, negative impacts to aquatic ecosystems can be detected earlier in benthic macroinvertebrate communities than in fish communities. RBI data are used to supplement RFAI results to provide a more thorough examination of differences in aquatic communities upstream and downstream of thermal discharges. Results of the 2009 preoperational monitoring near BLN are summarized below.

Fish Community

Data collected in 2009 indicate RFAI scores from sites sampled downstream from BLN were similar to those sampled upstream (Table 3-6; Appendix G, Tables 1-3).

Table 3-6. RFAI Scores Upstream and Downstream of BLN During 2009[1]

Season (2009)	Upstream From BLN			Downstream From BLN		
	Score	Rating	Percent[2]	Score	Rating	Percent[2]
Spring	34	Fair	56	35	Fair	58
Summer	35	Fair	58	30	Poor	50
Autumn	40	Fair	67	34	Fair	57

[1] Summarized from Simmons and Walton 2009
[2] Percent of highest attainable score

Although the scores reached only between 50 and 67 percent of the highest attainable score between spring and autumn, the variation between upstream and downstream scores during any season were within the acceptable six-point range of variation, which indicates no difference in the RFAI between upstream and downstream sites.

Average RFAI scores from established VS monitoring sites on Guntersville Reservoir, farther upstream and 15 river miles downstream of BLN range from 33 (Fair) to 39 (Fair),

which is similar to the average scores for the preoperational monitoring sites upstream and downstream of BLN during spring, summer, and autumn 2009 (Appendix G , Table 4).

TVA has conducted extensive fish sampling in Guntersville Reservoir between 1949 and 2009 using a variety of sampling methodologies. Surveys were conducted prior to 1949, but those data are not consolidated or easily accessible (e.g., specimens cataloged at various museums throughout the United States). A summary of the collection efforts and methods employed from 1949 to 2009 is presented below.

- Rotenone sampling. Between 1949 and 1993, selected coves in Guntersville Reservoir were blocked off and treated with rotenone, killing the fish in the cove so that species occurrence and abundance could be assessed. Rotenone sampling declined sharply in the mid-1980s due to changes in pesticide regulations, and TVA stopped using rotenone as a sampling method in 1993.

- Impingement mortality (number of fish impinged on trash screen at power plant cooling water intakes) sampling. These studies were conducted during 1974 -1975 and during 2005-2007 at WCF upstream of BLN on Guntersville Reservoir (TVA 1975b; 2007b).

- Electrofishing, gill nets, and hoop nets. These sampling methods were used in addition to the cove rotenone sampling during special studies conducted by TVA in Guntersville Reservoir from 1974 to 1984 (TVA 1974b; 1983c; 1985b).

- TVA did not conduct intensive reservoir monitoring from 1984 to 1993. During this time, the RFAI methodology was under development. Sampling was primarily aimed at developing these metrics, and the river system was not systematically sampled as it is under the current VS program.

- RFAI sampling. RFAI sampling is a standardized sampling protocol that uses electrofishing and gill nets only. This sampling program was initiated by TVA in 1993 and has continued until present as part of its VS monitoring program. The RFAI program replaced the cove rotenone sampling program.

- During summer 2009, TVA biologists conducted sampling in addition to the standardized preoperational RFAI monitoring in various sections of the Tennessee River, coves, and embayments of Guntersville Reservoir using boat electrofishing and small-mesh seines in shallow areas to evaluate species occurrences in areas that were not typically surveyed during RFAI sampling and to document the occurrence of species not collected by standard RFAI methodology (e.g., some small-bodied minnows and darters).

Because a variety of sampling methods was used, results must be interpreted and compared with caution. Variation in the effectiveness of the collection techniques used now (electrofishing and gill nets) as compared to the historic period (rotenone) must be considered. These collection techniques target different areas of the reservoir and tend to collect different species. Rotenone, used in coves, is effective in collecting species of all sizes. Electrofishing and gill netting, which occur in the main channel or shoreline areas, are effective in collection of larger-bodied fish species (e.g., black bass, sunfish, and suckers), but smaller-bodied species (minnows and darters) tend to be under-represented by these collection methods. Documenting the species inhabiting Guntersville Reservoir is

also complicated by the apparent misidentification of some specimens in historical collection records.

When comparing the older (1949–1984) data to more recent (1993–2009) data, some differences are apparent. Seventy-nine species are reported from historical rotenone, impingement, electrofishing, and gill net and hoop net surveys (1949 to 1989) (Appendix G, Table 13). Six species (blacktail shiner, bluntnose darter, fantail darter, redline darter, shortnose gar, and suckermouth minnow) are questionable records and likely represent historic misidentifications of other common species. Three of these species are mainly found in smaller streams and are infrequently found in reservoirs (bigeye chub, stripetail darter, creek chub) and should not be considered part of the resident fish community in the reservoir. Elimination of the erroneous identifications, and those species that are not residents, leaves a total of 70 native fish species historically present in Guntersville Reservoir.

Nineteen fish species reported from the 1949–1984 data were not collected in 1993–2009 RFAI samples. Three of these species are mainly found in smaller streams and infrequently found in reservoirs (bigeye chub, stripetail darter, and creek chub). Six species (blacktail shiner, bluntnose darter, fantail darter, redline darter, shortnose gar, and suckermouth minnow) are questionable records and likely represent historic misidentifications of other common species. Four species were collected as recent as the early 1990s in rotenone samples (ghost shiner, silver chub, pugnose minnow, and stripetail darter) but were not present in RFAI samples. Two species were collected from 2005 to 2009 WCF impingement samples (orangespotted sunfish) or in recent seining in the reservoir (whitetail shiner) but were not observed in RFAI samples. Of the 19 species "missing," only four have not been collected from the reservoir or the nearby watershed in recent times (highfin carpsucker, quillback, river carpsucker, and smallmouth redhorse) (Appendix G, Table 5). All four of these species are uncommon in the reservoir and are only collected sporadically.

Conversely, nine species were collected in TVA electrofishing and gill net samples during 1993 to 2009 that were not encountered in historical TVA fish surveys (TVA rotenone/electrofishing/gill net/hoop net) in Guntersville Reservoir (Appendix G, Table 5). Of these, two are recent nonnative invaders to the Tennessee River system (Atlantic needlefish and inland silverside). The remaining seven species (bluntnose minnow, channel shiner, dusky darter, river redhorse, silver redhorse, rainbow darter, and snubnose darter) are native species that prefer stream habitats and are infrequently encountered in the reservoir. An additional species, river darter, was collected in impingement samples at WCF during 2005 to 2007 (Appendix G, Table 5).

Based upon results of numerous studies, 71 species (69 native species) have been collected in Guntersville Reservoir during the past approximate 20 years (Simmons and Walton 2009). This number is based upon the following:

- 64 species collected in RFAI samples while electrofishing and gill netting from 1993 to 2009
- Three species collected during rotenone surveys from 1990 to 1993 (ghost shiner, pugnose minnow, silver chub)

- Two species collected from impingement samples at WCF during 2005 to 2007 (orangespotted sunfish and river darter)
- Two species collected while boat electrofishing (rainbow darter) and seining (whitetail shiner) in Guntersville Reservoir during summer 2009

The stripetail darter is not included in this total because it primarily inhabits streams, and two species that invaded the Tennessee River system during the past 15 years (Atlantic needlefish and inland silverside) are excluded from the comparison.

Comparing recent data to historical data, 69 native species of fish have been collected in Guntersville Reservoir between 1990 and 2009, and 70 native fish species were collected during historical surveys (1949 to 1984) (Appendix G, Table 13). Therefore, the differences between the historical reported fish community and the current reported fish community in Guntersville Reservoir are likely a consequence of sampling methods and species natural history and in errors in the historically reported data, rather than a substantial decline in the number of species inhabiting Guntersville Reservoir.

Some changes in fish community composition and abundance have occurred over the period from 1949 to the present, but these are well within the natural variation seen in fish communities throughout the Tennessee River drainage. These changes do not represent a declining trend in the fish community of Guntersville Reservoir. Population densities of individual species likely vary greatly from year to year due to climate and water quality conditions, but the number of species present in Guntersville Reservoir and the relative health of this community are fairly stable.

Benthic Macroinvertebrate Community

Benthic macroinvertebrate (bottom-dwelling organisms) data collected during spring 2009 from TRM 393.7 (upstream of BLN) and from TRM 389 (downstream of BLN) resulted in an RBI score of 25 (good) (Appendix G, Table 6). Appendix G, Table 7, provides estimated mean density per square meter by taxon at these sites. Results from samples taken downstream from BLN were very similar to those taken upstream. Both upstream and downstream sites received similar overall scores.

All VS sites on Guntersville Reservoir have averaged a “good” to “excellent” RBI score from 1993 to the present (Appendix G, Table 8). Results of preoperational RBI monitoring conducted near BLN during spring 2009 were similar to results of VS monitoring calculated in 2008, indicating conditions near BLN are similar to other sites on Guntersville Reservoir.

Although the RBI is a good index of overall reservoir health, it is not a measure of the freshwater mussel community composition or health. Conversion from a free-flowing river to an impoundment has affected the freshwater mussel community in the Guntersville Reservoir. Since closure of Guntersville Dam, the mussel community in this portion of the river has undergone a conversion from a diverse community typical of a large, free-flowing river to a community composed of relatively few species that are tolerant of reservoir conditions. RBI is used to compare sites within and among TVA’s reservoir system.

Ichthyoplankton

Data on fish communities, including density of fish eggs and larvae adjacent to BLN, were collected. The ichthyoplankton (fish eggs and larvae suspended in the water column) assessment results during 2009 in the vicinity of BLN are similar to historical assessments

during 1977 through 1983 (TVA 2009c). Taxonomic composition and abundance of ichthyoplankton during the 2009 study validated the historical ichthyoplankton data collected several years earlier. Mandated minimum flows generated from Chickamauga and Nickajack dams provide favorable spawning habitat and water quality conditions in Guntersville Reservoir to support spawning success of fish. Additionally, there has not been any significant change in the reservoir fish assemblage in upper Guntersville Reservoir since the TVA VS program was initiated in 1993, which suggests no major changes to spawning success.

3.5.2. Environmental Consequences

Alternative A
Because no construction or nuclear plant operation would occur at BLN, there would be no impacts to aquatic habitat or species under the No Action Alternative.

Alternative B
Under Alternative B, work would be conducted to complete a single B&W unit and bring it to full operational capacity. Because intake and discharge structures are already in place, new construction is not expected to occur near the banks of the reservoir, and accidental discharge and storm water runoff is limited under the construction storm water pollution prevention plan (SWPPP) and a site-specific SPCC plan, which are implemented prior to construction initiation. Refurbishment of the barge unloading dock would take place and would be performed in compliance with ADEM and applicable Alabama Department of Conservation and Natural Resources (ADCNR) and USACE permits.

Dredging 1,960 feet of the intake channel between the intake structure and the main river channel would be performed in compliance with applicable ADEM and USACE requirements. The intake channel was surveyed for native mussels and snails in 2009. Only common species were encountered within the intake channel. Densities of these species were very low compared to areas in the main channel of the Tennessee River. Predredge conditions should return as benthic communities recolonize the area and suspended solids settle out of the water column. Dredging would have only minor direct and indirect effects on aquatic communities. No cumulative effects to the benthic macroinvertebrate community are anticipated.

Operational impacts on aquatic communities could occur through the release of thermal, chemical, or radioactive discharges to the atmosphere or river. Operation of a BLN unit would be in compliance with the NPDES discharge limits, as outlined in the 2009 permit (#AL0024635). Thermal effects on the aquatic communities in the vicinity are anticipated to be minimal due to the relatively small amount of heat involved. Modeling indicates that the area of the river bottom directly contacted by the discharge plume is extremely small. Only minor effects on benthic organisms are anticipated. Because the plume does not affect the entire cross section of the river, there would be adequate room for fish passage around the affected area.

Potential chemical or radioactive releases could affect aquatic species near the site and in the reservoir downstream of the site, either directly or indirectly through the food chain. However, any potential uptake of excessive toxins would be incidental and localized, resulting in minimal impacts to aquatic life (AEC 1974; TVA 1991; DOE 1999). No adverse direct, indirect, or cumulative effects on aquatic communities are expected to result from plant releases (i.e., thermal, chemical, and radiological releases). Impacts on aquatic life

from chemical or radiological releases would be minor (Subsections 3.1.4 and 3.17.3, respectively).

Impingement and entrainment associated with operating plant intake structures have potential to affect aquatic organisms. Impingement occurs when aquatic organisms too large to pass through the screens of a water intake structure become pinned against screens and are unable to escape. Entrainment is the involuntary capture and inclusion of organisms in streams of flowing water, such as plant cooling water systems. Impingement and entrainment are regulated under Section 316(b) of the CWA. The effects of plant operation are unique to the aquatic community conditions and the physical characteristics of the withdrawal at each facility. However, impingement and entrainment monitoring can only occur when a plant becomes operational. For this SEIS analysis, TVA used two reference plants (WCF and WBN) and preoperational monitoring results to estimate the magnitude of these effects.

The known impingement and entrainment at WCF is used to estimate the maximum potential impingement and entrainment effects at BLN. Located approximately 16 river miles upstream of BLN on Guntersville Reservoir, WCF uses “once-through” cooling and withdraws significantly more water (approximately 1,476 MGD at WCF compared to a projected 48 MGD for the B&W and 36 MGD for the AP1000) from the river than would be used at BLN. TVA has monitored impingement at the WCF site and has determined that the WCF intake does not have a significant effect on fish communities in Guntersville Reservoir due to impingement (TVA 2008a). Both impingement and entrainment rates at WCF are small. Because BLN is equipped with a closed-cycle cooling system that minimizes the intake flow, the impingement and entrainment effects at BLN would be even smaller than the effects at WCF.

The impingement and entrainment rates at WBN are much lower than those documented at WCF primarily due to the use of closed-cycle cooling at WBN. WBN’s maximum intake pumping flow rate is 103.4 MGD. Entrainment estimates from Watts Bar, a similar one-unit nuclear plant with closed-cycle cooling, located upstream on Chickamauga Reservoir at TRM 528, were low, and it is expected that BLN entrainment estimate would also be low and would not adversely impact the fish community of Guntersville Reservoir. TVA's evaluation of the historical entrainment data supports the conclusion that the impact of entrainment of ichthyoplankton from the intake system at BLN when the plant becomes operational would be small, and no adverse environmental impact is expected.

Operation of BLN would result in some impingement and entrainment of fish. However, these effects would be minor, and would not result in direct or indirect adverse effects on fish communities in Guntersville Reservoir. These effects, even when considered as part of the cumulative effects of operation of the BLN and WCF facilities on Guntersville Reservoir, would not have a cumulative adverse effect on fish communities in Guntersville Reservoir.

Should one of the Action Alternatives be selected, TVA would perform impingement and entrainment monitoring necessary to comply with Section 316(b) of the CWA once the BLN facility is in operation to validate the projected low impingement and entrainment rates.

Alternative C

Under Alternative C, construction and operational activities, and measures implemented to minimize effects on aquatic organisms would be similar to those described under Alternative B with two exceptions.

Under both Action Alternatives, the intake channel would be dredged prior to initiating nuclear plant operations. However, under Alternative C, only the area between the intake structure and the shoreline (1,200 feet) would be dredged, reducing the volume of dredged material by approximately 1,100 cubic yards as compared to Alternative B.

Secondly, approximately 240 cubic yards of dredged material at the barge unloading dock would be removed if TVA were to implement Alternative C. During dredging, loss of the benthic community adjacent to the barge terminal and temporary increases in turbidity are expected. Predredge conditions should return as benthic communities recolonize the area and suspended solids settle out of the water column. Dredging of the barge unloading dock would add to effects from dredging the intake channel, but still would have only minor direct and indirect effects on aquatic communities. No cumulative effects are anticipated.

3.6. Terrestrial Ecology

The BLN site, located on the west bank of the Tennessee River in Jackson County, Alabama, lies within the Sequatchie Valley, a subregion of the Southwestern Appalachian ecoregion. The Sequatchie Valley extends nearly 100 miles from the Tennessee border to the southwest into Alabama. In the north, the open, rolling, valley floor, 600 feet in elevation, is nearly 1,000 feet below the top of the Cumberland Plateau and Sand Mountain. South of Blountsville, Alabama, the topography becomes more hilly and irregular with higher elevations. The Tennessee River flows through the Sequatchie Valley until it turns west near Guntersville, where it leaves the valley. Similar to parts of the Ridge and Valley subregion, the Sequatchie Valley is an agriculturally productive region, with areas of pasture, hay, soybeans, small grain, corn, and tobacco (Griffith et al. 2001).

Vegetation on the BLN site and adjacent lands has been continuously disturbed by decades of timber harvest and agricultural activities. Initial construction of BLN 1&2 in the 1970s disturbed approximately 400 acres of the 1,600-acre BLN site. The section summarizes previous site assessments, relays any changes since those assessments occurred, characterizes existing on-site terrestrial habitat, and states all potential impacts resulting from implementation of the three alternatives described in Chapter 2. Because extensive information previously was collected and analyzed (TVA 1974a; AEC 1974; TVA 1997; 2008a; DOE 1999), no new quantitative field data were collected for this supplemental review.

3.6.1. Plants

3.6.1.1. Affected Environment

Terrestrial plant communities were assessed during the initial environmental review for the construction of BLN 1&2 (TVA 1974a), during the Bellefonte Conversion FEIS (TVA 1997), and in support of the COLA ER (TVA 2008a). For the 1974 FES, vegetation analyses were based on statistical values for data obtained from systematic vegetation plot samples. Vegetation community boundaries were determined subjectively and plot data from those communities were analyzed for species importance values using frequency, density, and basal area (for trees). Five major plant community types were described: cultivated fields; elm-ash-soft maple forests; oak-hickory forests; mixed conifer and hardwood forests; and broomsedge-lespedeza fields. The majority of BLN construction occurred on previously disturbed young forest and agricultural fields (TVA 1974a) within the BLN site. A 1997 ecological assessment was completed for the remaining natural habitat of the BLN site. Five terrestrial vegetative communities were described: lawns and grassy fields;

bottomland/riparian hardwood forests; mixed hardwood forests; pine-hardwood forests; and scrub-shrub thickets.

During field reconnaissance in 2007 and 2008, vegetation sampling confirmed that previous habitat data are consistent with current conditions. Vegetative cover on the BLN site is primarily mixed hardwood forest and mixed improved and native grass fields (Table 3-7). Approximately 5 percent of the ground cover on the BLN site consists of roads and structures (Figure 3-13) (TVA 2008a). These vegetation communities are common and representative within the Sequatchie Valley. No globally rare or uncommon terrestrial plant communities are known to occur on site, nor are there any USFWS-designated critical habitats for plant species' protection within, on, or adjacent to the BLN site.

Table 3-7. Percent Cover of Major Habitat Types on the BLN Site

Habitat Type	Description	Percent Cover
Mixed improved and native grass fields	Introduced species including broomsedge, oat grass, orchard grass, sericea lespedeza, and tall fescue	24
Bottomland/riparian forests	Green ash, red maple, sweet gum, and various oak species such as cherrybark oak, overcup oak, water oak and willow oak; invasive species include Chinese privet, Japanese honeysuckle, and multiflora rose	11
Mixed hardwood forests	Mixed-mesophytic and oak-hickory forest vegetation typically dominated by American beech, mockernut hickory, red oak, sugar maple, and white oak	43
Pine-hardwood forests	Oak-pine or oak-hickory-pine communities commonly found in evergreen-deciduous forests; dominant species are loblolly pine and shortleaf pine, with black oak, southern red oak, and sweetgum also present	3
Scrub-shrub thickets	Early succession to forests; comprised of saplings of ash species (green and white), black locust, pine, sweetgum, and sumacs; these areas also contain various varieties of blackberries and catbriars	12

Most lands in and around the TVA power service area have been affected by introduced nonnative plant species. Nonnative plants occur across Southern Appalachian forests, accounting for 15 to 20 percent of the documented flora (U.S. Forest Service [USFS] 2008). According to NatureServe (2009), invasive nonnative species are the second-leading threat to imperiled native species. Not all nonnative species pose threats to our native ecosystems. Many species introduced by European settlers are naturalized additions to our flora and considered to be nonnative noninvasive species. These "weeds" have very little negative impacts to native vegetation. Examples of these are Queen Anne's lace and dandelion. However, other nonnative species are considered to be exotic invasive species and do pose threats to the natural environment. EO 13112 defines an invasive species as any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem, and whose introduction does or is likely to cause economic or environmental harm or harm to human health (USDA 2007).

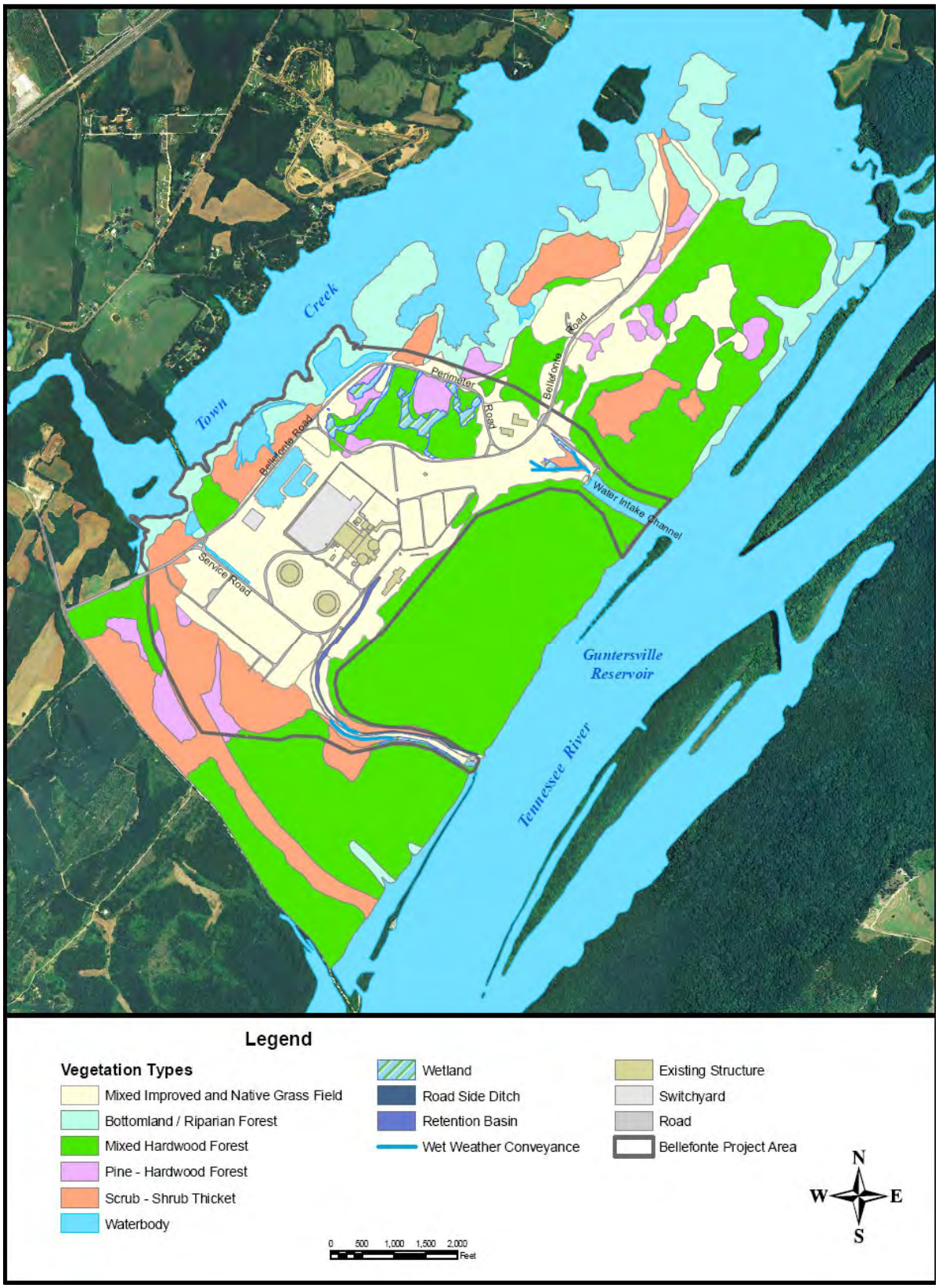


Figure 3-13. Vegetation Cover Types on the Bellefonte TVA Property

The Alabama Invasive Plant Council (2006) reports six of the top 10 Alabama worst weeds as occurring in Jackson County, and two additional species are found in DeKalb County. These exotic weeds, which pose a severe threat to native ecosystems, are alligator weed, Eurasian water milfoil, cogongrass, Chinese privet, hydrilla, kudzu, multiflora rose, and tropical soda apple. Cogongrass, hydrilla, and tropical soda apple are also on the Federal Noxious Weed List (USDA 2007). Field observations within the BLN site noted an abundance of Chinese privet and Japanese honeysuckle along with dandelion, multiflora rose, sericea lespedeza, and tall fescue.

The most effective, economical, and ecologically sound approach to managing invasive plants is to prevent them from invading (Center for Invasive Plant Management 2009). Land managers often concentrate on fighting well-established infestations, at which point management is expensive, and eradication is unlikely. Infestations must be managed to limit the spread of invasive plants, but weed management that controls existing infestations while focusing on prevention and early detection of new invasions can be far more cost-effective.

Weed prevention depends on the following:

- Limiting the introduction of weed seeds
- Early detection and eradication of small patches of weeds
- Minimizing the disturbance of desirable plants along trails, roads, and waterways
- Maintaining desired plant communities through good management
- Monitoring high-risk areas such as transportation corridors and bare ground
- Revegetating disturbed sites with desired plants
- Evaluating the effectiveness of prevention efforts and adapting plans for the following year

3.6.1.2. Environmental Consequences

Alternative A
Under the No Action Alternative, upgrades to existing units or construction of new units would not be undertaken. Because the terrestrial communities present on and around the BLN site are common and representative of the region, no impacts to the terrestrial plant ecology of the area are expected under this alternative. In addition, invasive plant species present on site will not be disturbed; therefore, this alternative would not contribute to the spread or introduction of exotic invasive plant species on or near the BLN site.

Alternative B
Under Alternative B, construction activities would occur within previously disturbed areas, resulting in very minor clearing of some terrestrial vegetation. Any clearing would take place in accordance with an SPCC plan and BMPs designed to minimize impacts to the adjacent land (TVA 1992). Disturbed areas would be revegetated with native or nonnative noninvasive plant species to reduce the introduction and spread of exotic invasive plant species associated with ground disturbance and other construction activities. Therefore, no indirect effects to terrestrial vegetation are expected. Criteria gaseous or particulate air pollutants emitted from the facility during construction or operation would meet the ambient air quality standards and would have no adverse direct, indirect, or cumulative effect on terrestrial vegetation. Because the terrestrial communities present on and around the BLN

site are common and representative of the region, no cumulative impacts to the terrestrial plant ecology of the area would be expected under this alternative.

Alternative C
Adoption of Alternative C would result in similar impacts associated with construction and operation. Under this alternative, about 50 acres of terrestrial vegetation (hardwood forest, pine-hardwood forest, mixed hardwood forested wetland, and native grass field) would be cleared, resulting in minor direct impacts to terrestrial vegetation. As with Alternative B, clearing would take place in accordance with an SPCC plan, BMPs, and revegetation plans as described under Alternative B. Therefore, no indirect effects to native terrestrial vegetation would occur under Alternative C. Because the terrestrial communities present on and around the BLN site are common and representative of the region, no cumulative impacts to the terrestrial plant ecology of the area are expected under Alternative C.

3.6.2. Wildlife

3.6.2.1. Affected Environment

The terrestrial ecology at the BLN site has changed little from that described in earlier environmental reviews (TVA 1974a; 1997; 2008a; DOE 1999). The project site, which is highly developed, includes parking areas, buildings, cooling towers, and roads. Habitat surrounding the existing facilities consists of improved and native grass fields that provide poor to moderate quality wildlife habitat. Mixed hardwood forest or scrub-shrub communities adjacent to the vegetated fields are of adequate extent for wildlife to use as movement corridors (TVA 2008a).

Wildlife using areas adjacent to the proposed B&W and AP1000 footprints include locally abundant species that are tolerant of human activity and highly modified habitats. Species associated with upland grassy areas and scrub-shrub communities surrounding existing BLN facilities include cottontail rabbit, woodchuck, hispid cotton rat, least shrew, eastern meadowlark, field sparrow, gray rat snake, eastern garter snake, and American toad. Other common species associated with the forested and emergent wetland communities include upland chorus frog, marbled salamander, and red-winged blackbird. Forested upland communities surrounding the site provide habitat for common wildlife including white-tailed deer, gray squirrel, raccoon, red-bellied woodpecker, blue jay, wood thrush, wild turkey, ring-necked snake, ground skink, and slimy salamander. Nearby embayments of Guntersville Reservoir are used by a wide variety of wildlife that favor riparian habitats. These areas are used extensively by waterfowl including gadwall, American coot, blue-winged teal, mallard, American wigeon, ruddy duck, and Canada geese. Pied-billed grebe, great blue heron, belted kingfisher, mink, muskrat, beaver, red-eared slider, false map turtles, and common musk turtles are also common in these embayments (Keiser et al. 1995).

3.6.2.2. Environmental Consequences

Alternative A
There would be no impacts from construction or operation to wildlife under the No Action Alternative. Wildlife and their habitat occurring on BLN properties would change very little in the foreseeable future as no substantive changes are expected to occur under this alternative.

Alternative B
Under Alternative B, new construction would occur in areas that previously were cleared. Criteria gaseous or particulate air pollutants emitted from the facility during construction or operation would meet the ambient air quality standards and would have no adverse direct, indirect, or cumulative effect on wildlife. In addition, previous studies conclude that small radioactive exposure relative to acceptable benchmarks, as would be the case under normal operating circumstances, are not expected to cause observable changes in terrestrial animal populations (International Atomic Energy Agency [IAEA] 1992; DOE 1999).

Potential for collisions between birds and structures, vehicles, and transmission lines exists. Many authors on the subject of avian collisions with utility structures agree that collisions are not a significant source of mortality for thriving populations of birds with good reproductive potential. NRC reviewed monitoring data concerning avian collisions with cooling towers at nuclear power plants and determined that overall avian mortality is low (NRC 1996).

Wildlife and their habitat occurring on BLN properties would change very little in the foreseeable future as no substantive changes are expected to occur to terrestrial wildlife under this alternative. No adverse direct or cumulative impacts to wildlife are expected under Alternative B.

Alternative C
Construction of an AP1000 unit would result in upgrading existing infrastructure on site and construction of new buildings and parking areas inside the perimeter road. Construction within the perimeter road would clear about 50 acres of a mixed hardwood forest, forested wetlands, native grass fields, and mixed pine-hardwood forest. Review of aerial photographs and results of field reconnaissance indicate that the existing habitat contains only a small amount of interior forest habitat favored by woodland species. Therefore, clearing approximately 50 acres would result in minor impacts to common species of wildlife inhabiting the Bellefonte project area. Potential effects on wildlife from operation of the plant would be similar to those described under Alternative B. No impacts on wildlife associated with operation are anticipated under Alternative C.

Because wildlife on the BLN property is locally abundant and no uncommon terrestrial habitats are currently known to exist within the Bellefonte project area, no cumulative impacts to terrestrial animal resources are anticipated from selection of Alternative C.

3.7. Endangered and Threatened Species

The ESA prohibits any person from taking a federally listed species. Significant habitat modification or degradation that results in death or injury of federally protected species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering is also prohibited. Most of the disturbance to aquatic and terrestrial habitats associated with completion of BLN has already occurred. The following sections provide updated information on the presence of federally listed and state-listed species found on and near (as defined in each subsection) the Bellefonte project area and the potential for impacts from proposed alternatives for nuclear generation.

To evaluate effects to federally listed species from completion (or construction) and operation of a single BLN nuclear unit, TVA prepared a biological assessment (BA) pursuant to the requirements of Section 7 of the ESA (TVA 2009d). The BA examined

potential impacts of completing and operating a single B&W unit, as well as constructing and operating a single AP1000 unit and associated transmission system improvements.

Fifty-two plants and animals federally listed as endangered, threatened, candidate for listing, or protected under the *Bald and Golden Eagle Protection Act* were addressed in the BA. Only two of the 52 of these species, the pink mucket pearlymussel (*Lampsilis abrupta* - federally listed as endangered and hereafter referred to as pink mucket) and sheepnose mussel (*Plethobasus cyphyus* - federal candidate) were identified in the TVA BA as occurring in areas potentially affected by construction activities at the BLN site or by subsequent operation of the facility. Potential impacts to the pink mucket and sheepnose mussel and measures to minimize those impacts are described in Subsection 3.7.1 below. The analysis and conclusions of the BA regarding plant construction and operation are discussed in Subsections 3.7.2 and 3.7.3. BA conclusions regarding the potential to impact species in the affected transmission line ROWs are discussed in Section 4.6.

In accordance with Section 7 of the ESA, TVA has conducted formal consultation with the USFWS to determine reasonable and prudent measures designed to avoid or minimize take of the two mussel species that would occur under either Action Alternative. TVA transmitted a BA to USFWS on November 14, 2009. USFWS (Daphne, Alabama, field office) acknowledged receipt of the BA in a December 7, 2009, letter. A follow-up letter from the USFWS (Daphne, Alabama, field office) dated January 21, 2010, stated the USFWS conclusion that only the pink mucket could be affected by the project and that there would be no effect on the candidate species sheepnose mussel.

USFWS issued a biological opinion (BO) for this project by letter dated April 15, 2010. The BO contains a “take” permit that allows for impacts to the federally listed pink mucket under either Action Alternative. Due to the poor habitat quality and low densities of mussels present in the project area, and the minimal effects on pink mucket identified in the BA, TVA has committed to providing a total of $30,000 to be used for research and recovery of pink mucket. Copies of these letters, including the BO, are included in Appendix H.

3.7.1. Aquatic Animals

3.7.1.1. Affected Environment

Seven federally listed aquatic species are known to occur recently in Jackson County, Alabama. These include one fish, one snail, and five mussels. Two federal candidate mussels are also reported from Jackson County (Table 3-8). There are historic records of six other federally listed mussels in Jackson County, but those species are presumed extirpated from Guntersville Reservoir. Only one species recently occurring in Jackson County, the pink mucket, has been documented in Guntersville Reservoir in the vicinity of the BLN site. Mussel and snail surveys in Guntersville Reservoir immediately adjacent to the site in 1995, 2007, and 2009 discovered one live pink mucket and one empty pink mucket valve. No other federally listed mussel or snail species were encountered. Habitat that could support the federal candidate sheepnose mussel was identified during this survey. On this basis, it is assumed that the sheepnose mussel, as well as pink mucket, is present within areas affected by BLN site development.

Table 3-8. Federally Listed and State-Listed Aquatic Species Present in Jackson County, Alabama

Common Name	Scientific Name	Federal Status	Alabama (Status, Rank)
Insects			
A caddisfly	*Rhyacophila alabama*	-	(POTL, S1)
A glossosomatid caddisfly	*Agapetus hessi*	-	(TRKD, S1)
Hine's emerald dragonfly	*Somatochlora hineana*	LE	(PROT, SH)
Snails			
Anthony's riversnail	*Athearnia anthonyi*	LE	(PROT, S1)
Corpulent hornsnail	*Pleurocera corpulenta*	-	(TRKD, S1)
Varicose rocksnail	*Lithasia verrucosa*	-	(TRKD, S3)
Mussels			
Alabama lampmussel	*Lampsilis virescens*	LE	(PROT, S1)
Butterfly*	*Ellipsaria lineolata*	-	(TRKD, S3)
Cumberland moccasinshell	*Medionidus conradicus*	-	(PROT, S1)
Deertoe	*Truncilla truncata*	-	(TRKD, S1)
Fine-rayed pigtoe	*Fusconaia cuneolus*	LE	(PROT, S1)
Kidneyshell	*Ptychobranchus fasciolaris*	-	(TRKD, S1)
Monkeyface*	*Quadrula metanevra*	-	(TRKD, S3)
Ohio pigtoe*	*Pleurobema cordatum*	-	(TRKD, S2)
Painted creekshell	*Villosa taeniata*	-	(TRKD, S3)
Pale lilliput	*Toxolasma cylindrellus*	LE	(PROT, S1)
Pheasantshell	*Actinonaias pectorosa*	-	(TRKD, S1)
Pink mucket*	*Lampsilis abrupta*	LE	(PROT, S1)
Purple lilliput	*Toxolasma lividus*	-	(TRKD, S2)
Rabbitsfoot	*Quadrula cylindrica cylindrica*	-	(PROT, S1)
Rainbow	*Villosa iris*	-	(TRKD, S3)
Round hickorynut	*Obovaria subrotunda*	-	(TRKD, S2)
Sheepnose*	*Plethobasus cyphyus*	C	(PROT, S1)
Shiny pigtoe pearlymussel	*Fusconaia cor*	LE	(PROT, S1)
Slabside pearlymussel	*Lexingtonia dolabelloides*	C	(PROT, S1)
Slippershell mussel	*Alasmidonta viridis*	-	(PROT, S1)
Snuffbox	*Epioblasma triquetra*	-	(TRKD, S1)
Spike	*Elliptio dilatata*	-	(TRKD, S1)
Tennessee clubshell	*Pleurobema oviforme*	-	(TRKD, S1)
Tennessee heelsplitter	*Lasmigona holstonia*	-	(TRKD, S1S2)
Tennessee pigtoe	*Fusconaia barnesiana*	-	(TRKD, S1)
Wavy-rayed lampmussel	*Lampsilis fasciola*	-	(TRKD, S1S2)
Fish			
Blotched chub	*Erimystax insignis*	-	(TRKD, S2)
Blotchside logperch	*Percina burtoni*	-	(TRKD, S1)
Palezone shiner	*Notropis albizonatus*	LE	(PROT, S1)
Southern cavefish	*Typhlichthys subterraneus*	-	(PROT, S3)

*Denotes species that are known or likely to occur in Guntersville Reservoir and could be directly or indirectly affected by BLN site construction activities.
Federal status abbreviations: C = Candidate for federal listing; LE = Listed endangered
State status abbreviations: POTL = Potential candidate for state listing; PROT = Protected; TRKD = Tracked by the state natural heritage program
State rank abbreviations: S1 = Critically imperiled, often with five or fewer occurrences; S2 = Imperiled, often with <20 occurrences; S3 = Rare or uncommon, often with <80 occurrences; SH = Historical record; S#S# = Occurrence numbers are uncertain

The 1995, 2007, and 2009 surveys indicated Anthony's riversnail does not occur adjacent to the BLN site. No suitable habitat for other federally listed aquatic species known from Jackson County, Alabama, is present in streams near the BLN site or in Guntersville Reservoir adjacent to the BLN site. Three Alabama state-listed mussel species, Ohio pigtoe, butterfly, and monkeyface, were identified during the 2007 survey adjacent to the BLN site. These species are currently tracked by the state, but are not formally protected.

3.7.1.2. Environmental Consequences

Alternative A
There would be no construction or operation of a nuclear plant at BLN under Alternative A. Existing discharge to Guntersville Reservoir is in accordance with NPDES permits, which are designed to maintain water quality and aquatic habitat conditions that are suitable for aquatic life, including federally listed and state-listed species. Therefore, there would be no impacts to federally listed or state-listed aquatic species under the No Action Alternative.

Alternative B
Under Alternative B, a B&W unit would be completed and operated. The effects to listed aquatic species from site construction, dredging, towing barges, and operating the plant were evaluated.

Intake and discharge structures for the nuclear unit are already in place and new construction is not expected to occur near the banks of the reservoir. Accidental discharge and storm water runoff is limited under the construction SWPPP and a site-specific SPCC plan, which would be implemented prior to initiating construction. Refurbishment of the barge unloading dock would be performed in accordance with ADCNR and applicable ADEM and USACE permits. All site construction work would be conducted using appropriate BMPs, and no discharge-related impacts would occur. Therefore, on-site construction activities would not result in direct, indirect, or cumulative effects on the federally listed or state-listed aquatic animals in Guntersville Reservoir and its tributaries near BLN.

Dredging the intake channel may adversely affect the pink mucket and the three state-listed species present in the potentially affected areas. Due to the poor habitat quality and low densities of mussels present in the project area, few individuals would likely be directly harmed. The greatest number of mussels affected would be individuals inhabiting areas surrounding, and particularly downstream of, dredged areas in the main channel of the Tennessee River. Mussels in those areas would be indirectly affected by turbulence and the suspension and deposition of fine sediments. Although brief and temporary, turbulence and suspended silt could interfere with respiration, feeding, and reproductive activity of federally listed mussels. The use of BMPs such as silt curtains should limit the area affected by suspended sediments and sedimentation.

Mussels also may be indirectly affected by tows delivering less than 50 total barges prior to operation of BLN. Effects from tow propeller wash include brief periods of extreme turbulence, increased suspended sediments, scouring of substrate (and mussels) from the riverbed, and accumulation of fine sediments in surrounding areas. Subsequent effects could interfere with mussel respiration, feeding, and reproductive activity, including interactions with potential fish hosts; such effects may last months to years.

Discharge of chemicals needed to operate the plant is not expected to harm aquatic species. Concentrations of chemicals added to cooling tower blowdown are very small by the time they are discharged to the Tennessee River. The discharge is regulated and monitored under an NPDES permit. Results of studies at TVA's WBN show mussels and fish are not affected even if exposed to undiluted effluent.

Exposure to heated effluent may cause minor indirect effects to federally listed mussels by stressing the fish that carry larval mussels in their gills. Thermal effluent is not expected to harm mussels inhabiting the bottom of the river directly. As stated above in Section 3.5, modeling indicates that the river bottom area in Guntersville Reservoir that would be directly contacted by the thermal plume is small. Bottom contact would only occur within the mixing zone defined in Subsection 3.1.3.1. Therefore, exposure to heated discharge is minimal, and any potential thermal effects would be minor.

In addition to thermal and chemical discharges, operational effects may include impingement and entrainment of aquatic organisms (see Section 3.5 above). Impingement and entrainment could affect fish species that may serve as hosts for the pink mucket (e.g., largemouth bass, smallmouth bass, spotted bass, freshwater drum, sauger, white crappie, and walleye) and sheepnose (e.g., sauger and central stoneroller) and other state-listed species. Effects on these species are anticipated to be minor, and would not have a measurable adverse indirect or cumulative effect on the pink mucket, sheepnose, or other listed aquatic species.

In conclusion, TVA has determined that proposed dredging and barge towing proposed under Alternative B would result in adverse direct, indirect, and cumulative effects to the pink mucket and minor adverse affects to the state-listed mussels. Operation of the proposed B&W unit may have minor indirect impacts on those species. In accordance with Section 7 of the ESA, USFWS has issued a "take permit" that allows for these impacts to the federally listed as endangered pink mucket. Measures designed to minimize and/or mitigate for impacts to pink mucket identified in the USFWS BO are identified in Subsection 2.8 of this FSEIS and would become commitments in TVA's ROD. Due to the low densities of mussels present in the project area, and the minimal effects on pink mucket identified in the BA, rather than conduct an extensive mussel relocation effort for relatively few mussels, TVA has committed to providing a total of $30,000 to be used for research and recovery of the pink mucket.

Alternative C

Similar to Alternative B, proposed activities under Alternative C would use existing intake and discharge, all site construction work would be conducted using appropriate BMPs, and no discharge-related impacts would occur. On-site construction activities would not result in direct, indirect, or cumulative effects to the federally listed or state-listed aquatic species in Guntersville Reservoir or its tributaries near BLN.

As described under Alternative B, dredging may affect the pink mucket and the three state-listed species present in the potentially affected areas. As with Alternative B, due to the poor habitat quality and low densities of mussels present in the project area, few individuals would likely be directly harmed. Under Alternative C, dredging would occur in part of the intake channel and at the barge unloading dock. Because the portion of intake channel nearest the river would not be dredged, indirect impacts to the pink mucket and sheepnose mussel are about 70 percent less under Alternative C than Alternative B.

Transportation of materials by barge would occur more frequently during the site construction activities proposed under Alternative C than Alternative B. The greater number of barges would result in greater indirect effects to federally listed mussels near the barge unloading dock from turbulence, suspended sediments, and scouring, as compared to Alternative B.

Impacts from thermal and chemical discharge, as well as impingement and entrainment of potential fish hosts would be the same under Alternative C as described for Alternative B. Therefore, proposed dredging and barge towing proposed under Alternative C would result in adverse direct, indirect, and cumulative effects to the pink mucket and minor adverse effects to the state-listed mussels. Operation of the proposed AP1000 unit could have minor indirect impacts on those species. As with Alternative B, the USFWS has issued a take permit that allows for these impacts to the federally listed as endangered pink mucket, and TVA has committed to providing a total of $30,000 to be used for research and recovery of the pink mucket. Measures designed to minimize and/or mitigate for impacts to the pink mucket identified in the USFWS BO are identified in Subsection 2.8 of this FSEIS and would become commitments in TVA's ROD.

3.7.2. Plants

3.7.2.1. Affected Environment

A review of the TVA Natural Heritage database indicated no federally listed plants and 25 state-listed plant species occur within 5 miles of BLN (Table 3-9). No critical habitat has been designated for plant species within or near the BLN site. Four federally listed plant species and one candidate for federal listing are reported from greater than 5 miles from BLN but within Jackson County, Alabama. These include: American hart's-tongue fern, green pitcher plant, Morefield's leather-flower, Price's potato bean, and monkey-face orchid. The USFWS recommended that surveys be conducted to investigate presence of the green pitcher plant, monkey-face orchid, Morefield's leather flower, and Price's potato bean (TVA 2008a). Subsequent surveys conducted during winter 2007 and summer 2008 indicated no habitat suitable for any of the five federally listed or candidate plant species exists within the TVA property boundary at BLN. In addition, no state-listed species were identified during several field surveys within the TVA property boundary.

3.7.2.2. Environmental Consequences

Alternatives A, B, and C

Because no federally listed, candidate for federal listing, or state-listed threatened or endangered species are known to occur within the TVA property boundary at BLN, and no habitat suitable to support those species is present, no adverse impacts to federally listed or state-listed plant species would occur under any of the alternatives.

Table 3-9. State-Listed Plants Found Within 5 Miles of the BLN Site and Federally Listed Species Documented in Jackson County, Alabama

Common Name	Scientific Name	Federal Status	State Rank/Status
Alabama snow-wreath	*Neviusia alabamensis*	--	S2/SLNS
American hart's-tongue fern*	*Asplenium scolopendrium var. americanum*	LT	S1/SLNS
American smoke-tree	*Cotinus obovatus*	--	S2/SLNS
Appalachian quillwort	*Isoetes engelmannii*	--	S3/SLNS
Butler's quillwort	*Isoetes butleri*	--	S2/SLNS
Canada violet	*Viola canadensis*	--	S2/SLNS
Carolina silverbell	*Halesia carolina*	--	S2/SLNS
Creeping aster	*Eurybia surculosa*	--	S1/SLNS
Cumberland rosinweed	*Silphium brachiatum*	--	S2/SLNS
Goldenseal	*Hydrastis canadensis*	--	S2/SLNS
Green pitcher plant*	*Sarracenia oreophila*	LE	S2/SLNS
Harper's dodder	*Cuscuta harperi*	--	S2/SLNS
Horse-gentian	*Triosteum angustifolium*	--	S1/SLNS
Michaux leavenworthia	*Leavenworthia uniflora*	--	S2/SLNS
Monkey-face orchid (white fringeless orchid)*	*Platanthera integrilabia*	C	S2/SLNS
Morefield's leather-flower*	*Clematis morefieldii*	LE	S1S2/SLNS
Nuttall's rayless golden-rod	*Bigelowia nuttallii*	--	S3/SLNS
One-flowered broomrape	*Orobanche uniflora*	--	S2/SLNS
Price's potato bean*	*Apios priceana*	LT	S2/SLNS
Sedge	*Carex purpurifera*	--	S2/SLNS
Spotted mandarin	*Disporum maculatum*	--	S1/SLNS
Sunnybell	*Schoenolirion croceum*	--	S2/SLNS
Tennessee bladderfern	*Cystopteris tennesseensis*	--	S2/SLNS
Tennessee leafcup	*Polymnia laevigata*	--	S2S3/SLNS
Twinleaf	*Jeffersonia diphylla*	--	S2/SLNS
Wahoo	*Euonymus atropurpureus*	--	S3/SLNS
White-leaved sunflower	*Helianthus glaucophyllus*	--	SH/SLNS
Wister coral-root	*Corallorhiza wisteriana*	--	S2/SLNS
Woodland tickseed	*Coreopsis pulchra*	--	S2/SLNS
Yellowwood	*Cladrastis kentukea*	--	S3/SLNS

* Denotes known from the county but not from within 5 miles of the project area
Federal status abbreviations: C = Candidate; LE = Listed endangered; LT = Listed threatened
State rank abbreviations: S1 = Critically imperiled, often with five or fewer occurrences; S2 = Imperiled, often with <20 occurrences; S3 = Rare or uncommon, often with <80 occurrences; S4 = Apparently secure in the state with many occurrences; SH = Historical record; S#S# = Occurrence numbers are uncertain
State status: Alabama does not give status to state-listed species; SLNS = No state status

3.7.3. Wildlife

3.7.3.1. Affected Environment

No populations of terrestrial animal species federally listed as threatened or endangered (or species that are proposed or candidates for federal listing) are reported within 3 miles of BLN. Populations of two federally listed as endangered species, the gray bat (*Myotis grisescens*) and the Indiana bat (*Myotis sodalis*), are reported from the region but have not been documented on or within 3 miles of the Bellefonte project area. Gray bats roost in several caves in the county and routinely forage over Guntersville Reservoir near the BLN

facility (Thomas and Best 2000; Best et al. 1995). No suitable roosting habitat for this species (caves) exists on the BLN property.

Small colonies of Indiana bats hibernate in caves in Jackson County. No caves occur within the project boundary; however, suitable summer roosting habitat exists in forested portions of the property within the Bellefonte project area. Suitable habitat in the project area was examined in 2008 to assess the quality of this potential habitat for Indiana bats (TVA 2008a). Although a few moderate-quality roost trees were present, the overall habitat quality for Indiana bats was low because the subcanopy is relatively dense, and the site lacks multiple trees suitable for Indiana bat roosts. Indiana bat habitats typically roost in multiple trees having varying exposure to sunlight (Miller et al. 2002).

Additionally, bald eagles (*Haliaeetus leucocephalus*), which are federally protected under the *Bald and Golden Eagle Protection Act*, occur near BLN. Prior to 2009, the species was reported nesting approximately 1.4 miles east of the Bellefonte project area.

Several Alabama state-listed species are reported from Jackson County (TVA 2008a). Of these, ospreys (*Pandion haliaetus*) are the only state-listed terrestrial animal species known from the BLN project area. Osprey nests are present on transmission line structures within the proposed Bellefonte project area.

Eastern big-eared bats (*Corynorhinus rafinesquii*) are reported from Jackson County. The species has rarely been observed in recent years despite numerous cave and bat surveys performed by TVA and the ADCNR. Forested habitat within the Bellefonte project area was examined in 2008 (TVA 2008a). No potential roost trees suitable for big-eared bats (large hollow trees) were found on the site. Because big-eared bats often roost in man-made structures, an old water storage and pump facility on the property was examined for signs of bat use; no evidence of bats was identified. The closest suitable habitat for this species exists at wetlands on Bellefonte Island (mature hollow trees) in the Tennessee River and along the extensive sandstone escarpment of Sand Mountain located south and across the river from BLN.

3.7.3.2. Environmental Consequences

Alternative A
There would be no impacts to federally listed or state-listed wildlife under the No Action Alternative. Habitat suitable for these species, including foraging areas used by gray bats and low- to moderate-quality roosting habitat for Indiana bats would not be affected under this alternative.

Alternative B
Construction and operation activities proposed under Alternative B are not expected to negatively affect federally listed or state-listed wildlife. No suitable roosting habitat for gray bats exists on the BLN property. The proposed actions would not result in adverse impacts to roosting or foraging gray bats. Because construction would occur in nonforested areas, habitat potentially suitable for roosting Indiana bats would not be affected.

Given the overall lack of suitable roost trees, caves, or sandstone outcrops and no evidence of bat use at the water pump facility, eastern big-eared bats are unlikely to be present, and no impacts to that species are expected.

The distance between the Bellefonte project area and the single known bald eagle nest is greater than the recommended nesting buffer zone (660 feet) established by National Bald Eagle Management Guidelines to protect bald eagles. Therefore, construction activities at BLN are not expected to result in adverse impacts to bald eagles.

Operational impacts on threatened and endangered terrestrial animals could occur through the release of thermal, chemical, or radioactive discharges to the atmosphere or river. These releases could affect listed species near the site and in the reservoir downstream of the site, either directly or indirectly through the food chain. However, any potential uptake of excessive toxins would be incidental and localized, resulting in minimal impacts to protected species' populations. Noise associated with regular on-site operations is not expected to carry to nearby forested tracts that contain potential foraging habitat for some species. Infrequent activities occurring near these forested areas may cause species to leave the area temporarily, but no long-term effects on individuals or populations nearby are anticipated.

The use of habitats at BLN by federally listed and state-listed terrestrial animals is limited. Construction and operation activities proposed under Alternative B are not expected to result in adverse direct, indirect, or cumulative impacts to federally listed or state-listed species or their habitats.

Alternative C
Under Alternative C, potential effects from construction and operation of the AP1000 unit are the same as described for the B&W unit with one exception. Construction proposed under Alternative C involves removal of approximately 50 acres of forest within the perimeter road. Some potential roost trees of moderate quality exist in this area. Prior to clearing forest within the BLN site, TVA would conduct a survey for Indiana bats using methods approved by the USFWS. If Indiana bats are not detected, trees may be removed. If Indiana bats are detected, TVA would coordinate with the USFWS to establish methods to avoid or minimize effects to Indiana bats. In either instance, impacts to Indiana bats under Alternative C would be minor.

All other construction and operation activities proposed at BLN are not expected to result in adverse direct, indirect, or cumulative impacts to federally listed or state-listed species or their habitats.

3.8. Natural Areas

3.8.1.1. Affected Environment

Natural areas include managed areas, ecologically significant sites, and Nationwide Rivers Inventory (NRI) streams. This section addresses natural areas that are on, immediately adjacent to, or within 3 miles of BLN. No ecologically significant sites or NRI streams occur within that area.

Changes since the 1974 FES (TVA 1974a) concerning natural areas and the environmental impact on natural areas within 3 miles of BLN are assessed below for the purpose of updating previous documentation to current conditions.

Mud Creek State Wildlife Management Area (WMA), Bellefonte Island TVA Small Wild Area (SWA), Coon Gulf TVA SWA, and Section Bluff TVA SWA are the four natural areas currently listed in the TVA Natural Heritage database within 3 miles of BLN property

boundaries. Mud Creek State WMA and Bellefonte Island TVA SWA are within 1 mile of the BLN site. The remaining two areas are between 1 and 3 miles of BLN.

Mud Creek State WMA is located in Jackson County, Alabama, approximately 0.2 mile northeast of BLN property boundaries. Mud Creek WMA comprises approximately 8,273 acres owned by TVA and managed by ADCNR for waterfowl and small and big game hunting.

Bellefonte Island TVA SWA is located in Jackson County, Alabama, approximately 0.2 mile east of BLN property boundaries, within the midchannel of the Tennessee River between TRM 392.5 and TRM 394. Bellefonte Island TVA SWA comprises approximately 100 acres of property managed by TVA and features a naturally occurring stand of tupelo gum swamp that is suitable habitat for numerous species of waterfowl.

Coon Gulf TVA SWA is located in Jackson County, Alabama, approximately 1 mile northeast of BLN property boundaries. Coon Gulf TVA SWA comprises approximately 2,366 acres managed by TVA, features a forested cove on Guntersville Reservoir, and provides habitat for federally listed and state-listed species.

Section Bluff TVA SWA is located in Jackson County, Alabama, approximately 2.6 miles south of and across the river from BLN property boundaries. Section Bluff comprises approximately 600 acres managed by TVA and features extensive sandstone outcrops and mature hardwoods that provide habitat for federally listed and state-listed species.

3.8.1.2. Environmental Consequences

Alternative A
Under the No Action Alternative, no alterations or improvements would be made to existing facilities for the purpose of nuclear power generation. Therefore, no natural areas would be directly or indirectly affected, and no cumulative effects would result from adoption of this alternative.

Alternatives B and C
Under the Action Alternatives, improvements to existing facilities and continued operation of the plant would take place. Construction associated with completion of existing facilities would not directly or indirectly affect natural areas in the vicinity, because construction-related activities would be confined to land already previously altered due to the initial BLN construction. The distance between these areas and the BLN site provides ample buffer from any construction noise originating from the BLN site. Emissions of gaseous and particulate air pollutants from operation of combustion sources on site would result in small increases in air pollutant concentrations. However, the resulting concentrations of the pollutants in the vicinity would meet the ambient standards and would have no adverse effect on people or wildlife using these areas. In addition, previous studies conclude that small radioactive exposure relative to acceptable benchmarks, as would be the case under normal operating circumstances, are not expected to cause changes in terrestrial animal populations (IAEA 1992; DOE 1999). Therefore, potential for cumulative impacts to these areas resulting from the initial construction and long-term operation of either a single B&W unit or a single AP1000 unit are anticipated to be minor.

3.9. Recreation

3.9.1.1. Affected Environment

As documented in previous environmental assessments of the BLN site, the area within a 50-mile radius of BLN is well suited to a variety of outdoor recreation pursuits. There are several major parks and recreation resources within this region including Chattahoochee National Forest, Wheeler National Wildlife Refuge, Little River Canyon National Preserve, and several state parks. Guntersville Reservoir, which has 69,000 surface acres and approximately 80 developed public, commercial, or quasi-public recreation areas around its shoreline, is also one of the region's major recreation resources. The waters of this reservoir provide opportunities for a variety of recreation activities including power and nonpower boating, swimming, fishing, and waterfowl hunting. The surrounding shorelines offer accommodations for camping, hiking, hunting and wildlife observation, golfing, and vacationing.

While most of the recreation areas on Guntersville Reservoir, including major areas such as Lake Guntersville State Park, Buck's Pocket State Park, Goose Pond Colony, and most commercial recreation facilities, are more than 10 miles away from the BLN site, there are six areas within the 6-mile radius of the BLN. Figure 3-14 shows the location of these areas, as well as three additional reservoir recreation areas situated within 10 miles of the BLN site.

3.9.1.2. Environmental Consequences

Alternative A
Under this alternative, because no nuclear plant would be built or operated, no impact on recreational facilities or activities is anticipated.

Alternatives B and C
As indicated in earlier NEPA assessments (TVA 1974a; 2008a), plant construction and operation under either alternative would generate some noise and would also result in the removal and use of a small amount of water from Guntersville Reservoir.

As discussed in Section 3.12, some activities conducted during the construction of either of the alternatives would generate noise that could be an annoyance to recreationists and others in the vicinity of the plant site. Because such noise levels would occur over a short period of time, impacts on recreation would be negligible. Under either alternative, plant operation noise is expected to be attenuated to near ambient levels beyond the site boundary. Consequently, noise from plant operation would have a minor impact, and no mitigation would be required. No cumulative effects would be expected.

Plant water use would represent a minimal amount relative to total water flow in the waterways around BLN (Subsection 3.1.2). River level associated with consumptive water losses resulting from plant operations would not affect recreational boating in summer, when river use is at its highest, even during extreme low-flow conditions (TVA 2008a). Therefore, impacts on water-based recreation would be minor, and no mitigation would be required. No cumulative effects would be expected.

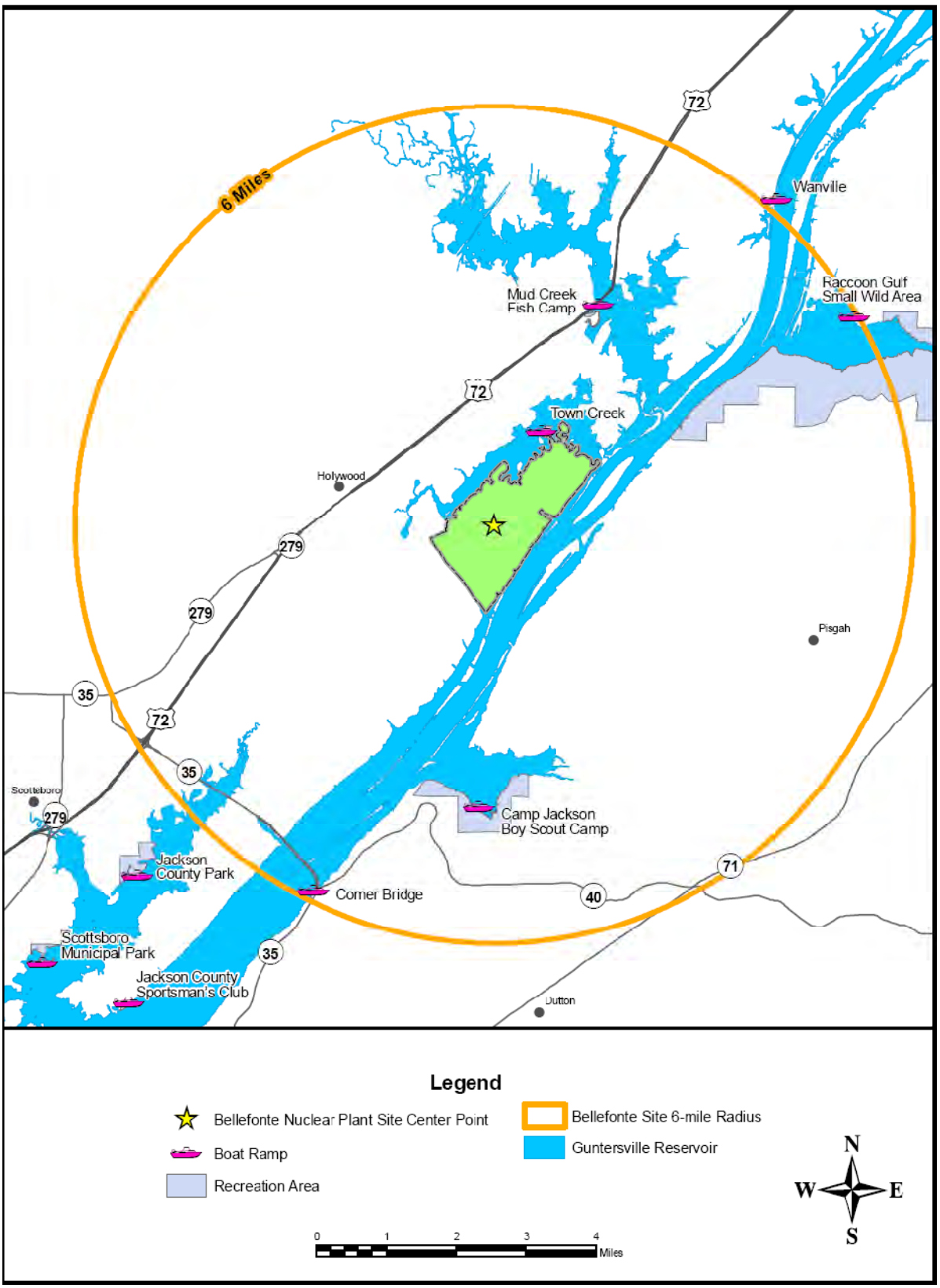


Figure 3-14. BLN Recreation Instream Use

3.10. Archaeological Resources and Historic Structures

3.10.1. Affected Environment

As noted in previous environmental reviews, the area surrounding the BLN property has been occupied by humans for more than 15,000 years. The archaeological record of the Tennessee River Valley has documented four major prehistoric occupational periods that began with the Paleo-Indian (14,000-8000 B.C.), the Archaic Period (8000-900 B.C.), the Woodland Period (900 B.C-A.D. 1100), and the Mississippian Culture (A.D. 1100-1630). Although the earliest European contact in the region severely impacted the Native American cultures, occupation by Cherokees continued through the early 19th century, when they were removed along the Trail of Tears. European settlers soon began to occupy the region, and Jackson County was established in 1819.

Previous undertakings associated with this area have documented the archaeology within the BLN site. A summary of these earlier investigations is included in the COLA ER. TVA determined the area of potential effects (APE), shown on Figure 2-1, for both Action Alternatives to be the approximate 606 acres surrounding the proposed construction and its associated infrastructure for archaeological resources and the 1-mile viewshed for historic structures, due to similarity of areas needed for construction and operation. This 606-acre APE is the same APE determined with concurrence of the Alabama SHPO for evaluating BLN 3&4. The archaeological APE is identified on Figure 2-1 (B&W site plan) and Figure 2-12 (AP1000 site plan) as “Bellefonte Project Area.”

Previous archaeological surveys conducted within the archaeological APE identified four sites (1JA111, 1JA113, 1JA300, and 1JA301). Only two of these sites were recommended for additional archaeological investigations (1JA300 and 1JA301) (Oakley 1972). Excavations were conducted at site 1JA300 prior to construction of the original plant.

When TVA began developing a demonstration COLA for new nuclear generation at BLN, it was determined that a more systematic survey would be necessary to ensure that no historic properties (which includes prehistoric and historic sites, buildings, structures, and objects) would be affected. Two new surveys were subsequently conducted within the APE to identify archaeological sites or historic structures that may be impacted by this undertaking (Deter-Wolf 2007; Jenkins 2008).

Results of the new archaeological survey concluded that sites 1JA300 and 1JA301 were completely destroyed during construction of the intake. Site 1JA111 was determined to be potentially eligible for listing in the National Register of Historic Places (NRHP). One new site (1JA1103) was identified that was considered, along with 1JA113, to be ineligible for listing in the NRHP.

Five historic structures had been previously recorded within the visual APE for this project (Jenkins 2008). The new survey for historic structures conducted in 2008 revisited these sites and identified 10 new properties, for a total of 15 historic properties (Jenkins 2008). Only two of these properties (Bellefonte Cemetery and the African-American Bellefonte Cemetery) were determined to meet the criteria of eligibility for the NRHP. Both cemeteries are nearly 1 mile from the BLN cooling towers.

3.10.2. Environmental Consequences

Alternative A
The No Action Alternative would result in no new construction and therefore would have no effect on historic properties.

Alternative B
Site 1JA111 was identified within the archaeological APE and was recommended as potentially eligible for listing in the NRHP. TVA has determined that 1JA111 would be fenced off, marked on the BLN site drawings, and avoided by any future planned construction should Alternative B be selected. Any future modification to current project plans that have a potential to affect this site would require TVA to conduct further testing of 1JA111 to determine its NRHP-eligibility status.

Two historic resources eligible for listing in the NRHP were identified within the historic viewshed (visual APE) of the proposed construction site. The Bellefonte Cemetery and the African-American Bellefonte Cemetery are both protected by dense vegetative buffers and would not be affected by Alternative B.

With the avoidance of archaeological site 1JA111 and the presence of vegetative buffers surrounding the cemeteries, TVA has determined that Alternative B would have no direct or indirect effect on historic properties. In a letter dated September 9, 2009, the Alabama SHPO concurred with TVA's findings that proposed completion of the BLN site would have no effect on historic properties (see Appendix H). Because no effects are anticipated, there are no cumulative effects to historic properties from B&W completion and operation.

Alternative C
Effects to historic properties under Alternative C would be the same as those anticipated under Alternative B. Although the construction of a new reactor would result in slightly more ground disturbance than under Alternative B, the construction area was surveyed and no historic properties were identified within this area. As with Alternative B, 1JA111 would be fenced off, marked on the BLN site drawings, and avoided by any future planned construction. Any future modification to current project plans for a single AP1000 that would have a potential to affect this site would require TVA to conduct further testing of 1JA111 to determine its NRHP-eligibility status.

With the avoidance of archaeological site 1JA111 and the vegetative buffers surrounding the cemeteries, TVA has determined that the implementation of Alternative C would have no direct or indirect effect on historic properties. Because no effects are anticipated, there would be no cumulative effects to historic properties from AP1000 construction and operation. As with Alternative B, TVA consulted with the Alabama SHPO, who concurred with TVA's no effects finding in the September 9, 2009, letter (see Appendix H).

3.11. Visual Resources

3.11.1. Affected Environment

The BLN site is buffered from the main river channel by a wooded ridgeline that rises approximately 200 feet above the lake surface. Only distant views of the existing cooling towers are experienced by passing river traffic as a result of the close proximity of the ridgeline to the lake shoreline. The plant site is situated on level to gently rolling bottomland formerly used for agricultural purposes. Pasture and crop land still extend southwesterly

from the plant site toward Scottsboro, Alabama. Scattered residential development can be seen along county roads ranging from abandoned farmhouses to new subdivisions. The terrain is generally open with occasional stands of bottomland hardwoods dotted with patches of pine and cedar.

The existing plant site is most visible to more than 50 cabins, second homes, and primary residences located along the north shore of Town Creek embayment, an area known as Creeks Edge development (see Figure 3-15). The embayment, which bounds the west side of the BLN site, is only accessible to small boat traffic as passage is limited by a box culvert under the BLN site's secondary entrance road. Fishermen and pleasure boaters using other portions of Town Creek and Mud Creek to the northeast of BLN have direct views into the plant site.

The town of Hollywood is located approximately 3 miles to the northwest of BLN. Its location to the north of U.S. Highway 72 is screened somewhat from a view of the plant by Backbone Ridge.

The BLN site is seen most frequently by passing motorists from various points along U.S. Highway 72. The plant facilities such as roads, parking, and administration-type buildings are screened for the most part by low rolling terrain in the foreground. Distant views of the 474-foot cooling towers and the reactor domes can be seen in excess of 5 miles away. The cooling towers along with the multiple high-voltage transmission lines associated with the BLN site are the dominant man-made visual features in the surrounding landscape.

Sand Mountain stretches in either direction from the plant site as it forms the eastern shoreline of Guntersville Reservoir. While it is the most dominant natural feature in the landscape, it provides background to easterly views of BLN. Views of the existing plant facilities appear as focal points when one looks west off the rim of the mountain. No public viewing areas appear along the mountain's edge, but a few residences have spectacular views of the valley below. A different visual/aesthetic character of landscape can be experienced in the coves and hollows along the Sand Mountain rim. Laurel and rhododendron line the creeks that cascade over limestone creek beds on their descent to the Tennessee River. Distant glimpses of the plant site can be seen from these mountainside vantage points. Additional views can be seen by highway travelers traversing the mountain on Alabama State Routes 35 and 40, as well as by those crossing the lake on the Comer Bridge.

As described in Section 3.8, Natural Areas, Bellefonte Island and the Mud Creek State WMAs, adjacent to and just upstream of the BLN site also provide a visual quality protector to the scenic environment. A heron rookery can be seen by boaters at the tip of the peninsula between the Town and Mud creek's confluence with the Guntersville Reservoir. Coon Gulf TVA SWA, approximately 1.0 mile upstream on the opposite bank, also contributes to the visual quality. Section Bluff TVA SWA is approximately 2.5 miles downstream on the opposite bank.

In summary, the BLN site is located in a valley setting partially screened from the passing Tennessee River and overlooked by Sand Mountain. The existing plant facilities, in particular the cooling towers, and the associated transmission lines currently present the most noticeable visual/aesthetic change in character to an area generally within a 5- to 7-mile radius.

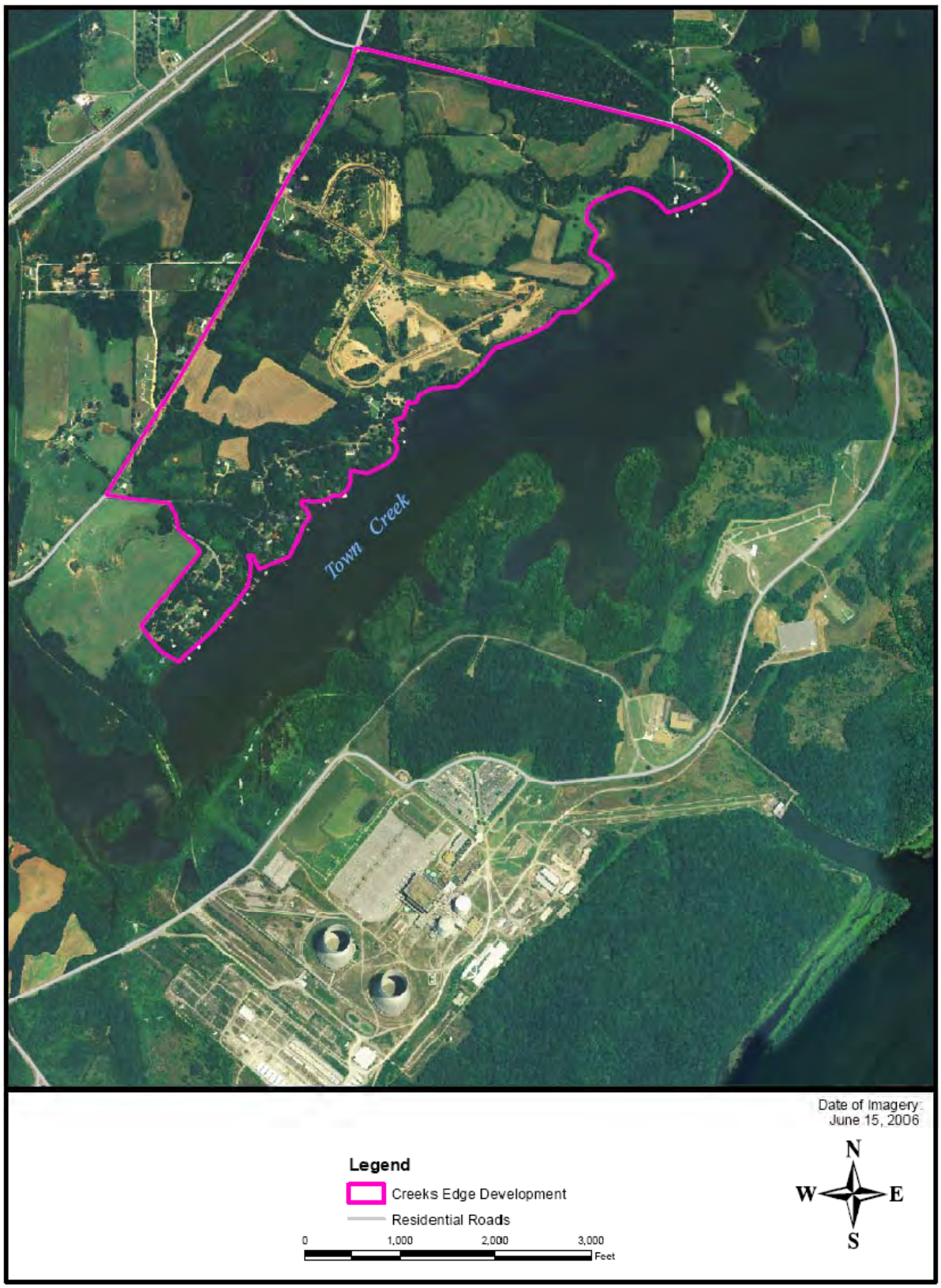


Figure 3-15. Creeks Edge Development Near BLN

3.11.2. Environmental Consequences

Alternative A
Under this alternative, TVA would not complete or operate one partially completed B&W unit or construct and operate an AP1000 unit. Visual resources would not be affected.

Alternative B
Under this alternative, TVA would refurbish the existing 161-kV and 500-kV switchyards, construct a new laydown area southwest of the existing BLN 1&2 cooling towers and reconfigure the northern parking areas. The new laydown area would be visually similar to the industrial buildings and storage yards in the area now. There would likely be associated support structures constructed throughout the plant site area. These support structures would add to the number of discordantly contrasting elements seen at the plant site, but would be visually insignificant in the industrial environment.

Visual impacts during construction would be minor and insignificant. Motorists along U.S. Highway 72 to the west would likely not have views of construction activities at the plant site. Residents along County Road 33 entering the plant site would notice a small increase in traffic for plant site deliveries and an increase in the number of employees and contractors entering and leaving the site. This would be temporary until construction activities are complete.

During operation of the B&W, residents along Town Creek and motorists along U.S. Highway 72 would notice a water vapor plume from one of the existing 474-foot cooling towers on the plant site. The visibility of the plume would vary with atmospheric conditions. The plume would be most discernible during the winter months following leaf drop and the differences between the temperature and humidity of the plume and ambient conditions are the greatest; under these conditions it can be visible for many miles in all directions. Plumes would be less visible during the summer months when temperature and humidity are higher, hazy conditions persist, and morning fog is more common. Visual presence of these fog/plume conditions would be similar to those currently associated with the operation of the Smurfit Stone Plant and WCF located upstream.

The new plume seen in the landscape would have a potential minor cumulative impact on visual resources. Increasing the number of adversely contrasting elements would contribute to reducing visual harmony and coherence of the rural landscape. The visual impact of incremental changes may not be individually significant, but when additions are seen in combination with similar existing features, the impact continues to grow. This would cause a cumulative minor change in the visible landscape and the aesthetic sense of place.

Alternative C
Under this alternative, visual impacts would be similar to those described for Alternative B. However, the AP1000 would require construction of a new turbine and reactor building on the north side of the existing employee and visitor parking lot. This structure would likely be visible to residents along Town Creek, and while it would add a new broadly horizontal element to the industrial landscape, the new structure would be visually similar to other structures seen on the plant site now. In addition, the overall plant arrangement for an AP1000 unit is designed to minimize the building volumes and quantities of bulk materials consistent with safety, operational, maintenance, and structural needs to provide an aesthetically pleasing effect. Natural features of the site would be preserved as much as possible and utilized to reduce the plant's impact on the environment, and landscaping for

the site, areas adjacent to the structures, and the parking areas would blend with the natural surroundings to reduce visual impacts. Visual impacts would be minor.

3.12. Noise

3.12.1. Affected Environment

At high levels, noise can cause hearing loss and at moderate levels noise can interfere with communication, disrupt sleep, and cause stress. Even at relatively low levels, noise can cause annoyance. Noise is measured in decibels (dB), a logarithmic unit, so an increase of 3 dB is just noticeable and an increase of 10 dB is perceived as a doubling of sound level. Because not all noise frequencies are perceptible to the human ear, A-weighted decibels (dBA), which filters out sound in frequencies above and below human hearing, were used for this assessment. Ambient environmental noise is usually assessed using the day-night noise level (Ldn). The day-night noise level is a weighted logarithmic 24-hour average with a 10 dB penalty added to noise between 10 p.m. and 7 a.m. to account for the potential for sleep disruption.

Community noise impacts are typically judged based on the magnitude of the increase above existing background sound levels. There are no federal, state, or local industrial noise statutes for the communities surrounding the BLN site. EPA recommends an Ldn less than 55 dBA to protect the health and well-being of the public with an adequate margin of safety. The U.S. Department of Housing and Urban Development (HUD) considers areas with an upper limit Ldn of 65 dBA to be acceptable for residential development. In addition, the Federal Interagency Committee on Noise (1992) recommends that a 3 dB increase indicates a possible impact requiring further analysis when the existing Ldn is 65 dBA or less.

BLN is located in a rural area along the Tennessee River in northeast Alabama. The nearest residence, situated across Town Creek, is located 0.75 mile from the Unit 1 steam generators and 0.66 mile from the Unit 1 cooling tower. There are approximately 50 cabins, second homes, and primary residences located along the north shore of Town Creek embayment in the Creeks Edge development. The homes most likely to be impacted by noise are clustered in the southwestern portion of the development (see Figure 3-15).

Background ambient sound levels were measured in 2006 at BLN fenceline locations with values ranging from 47 to 55 dBA, which is typical of a rural community (TVA 2008a). Noise sources in the vicinity of the BLN site include barge traffic, road traffic, dogs barking, insects, power boats, plant equipment at BLN (fans, transformers, compressors), and power line hum.

3.12.2. Environmental Consequences

Alternative A

Because there would be no construction/completion and operation of a nuclear plant, implementation of this alternative would have no impact on noise levels near BLN.

Alternative B

During completion of a B&W unit, the largest source of noise would be the hydrodemolition to access the steam generators. Hydrodemolition can be very loud, with noise levels often exceeding 110 dBA. However, all hydrodemolition work would be done inside the containment walls, which would greatly decrease the potential for off-site impacts.

Hydrodemolition would take place 24 hours a day, seven days a week, for up to 12 days. While limiting most of the construction activities to daytime hours can reduce potential noise impacts, hydrodemolition would not be limited to daylight hours. Any noise impacts of hydrodemolition at nearby residences would be temporary and would last for no more than 12 days.

Other phases of construction would require the use of cranes, forklifts, man lifts, compressors, backhoes, dump trucks, and pier driller and portable welding machines. This type of equipment would generate noise levels up to 91 dB at 50 feet (EPA 1971). Construction noise of 91 dBA at 50 feet would be about 56 dBA at the nearest residence approximately 0.75 mile away. Most construction activites would be limited to daylight hours and would not exceed either EPA's recommendation or HUD's guideline for residential areas. Noise from construction equipment is expected to be audible over background noise levels, but it is not expected to cause a significant adverse impact**.** Based on the projected noise levels and the duration of construction activities, noise impacts from construction activities associated with Alternative B are expected to be minor for the surrounding communities, and minor to moderate for the nearest residents of Creeks Edge development (Figure 3-15).

The major noise source in the operation of a B&W unit is the cooling tower. Noise from the cooling tower is expected to be 85 dBA near the tower and approximately 55 dBA 1,000 feet from the tower. At the nearest residence, noise from the cooling tower is expected to be approximately 48 dBA, which is similar to background noise levels in the area. Considering that the cooling towers would operate 24 hours per day when the plant is in operation, the Ldn at the nearest residence would be 54.6 dBA, which is an increase of 1.8 dBA over background levels. If the cooling tower were operated less frequently, the increase in noise levels would be even less. These levels would not exceed EPA's recommendation or HUD's guideline for residential areas. Based on the projected noise levels, noise impacts associated with operation of a B&W unit are expected to be minor, for both the surrounding communities and for the nearest residents of Creeks Edge development.

Alternative C

As shown in Figure 2-12, construction of an AP1000 would be slightly closer to the nearest residences across Town Creek. Most activities necessary to construct an AP1000 unit would be similar to those implemented under Alternative B and would have similar impacts on noise levels in the vicinity of BLN. Although no hydrodemolition work on the steam generator would be necessary under this alternative, site preparation for the construction of an AP1000 unit would require blasting, which would cause temporary noise impacts. Peak instantaneous A-weighted noise levels from blasting are predicted to be 75 dBA at the source and approximately 40 dBA at the nearest residence. Blasting is expected to occur intermittently over the course of one year, though there would likely be several weeks when blasting would occur daily. When blasting does occur, there would likely be two or three detonations per day, each lasting less than one second. Potential mitigation measures include, but are not limited to, the use of blasting blankets, notification of the surrounding receptors prior to blasting, and limiting blasting activities to daylight hours. Based on the projected noise levels and the duration of construction activities, noise impacts from construction activities associated with Alternative C are expected to be minor for the surrounding communities and minor to moderate for the nearest residents of Creeks Edge development.

The major noise source in the operation of an AP1000 is the cooling tower and the impacts of operation of an AP1000 unit on noise levels in the vicinity of BLN are identical to the impacts anticipated under Alternative B. Based on the projected noise levels, noise impacts from the operation of Alternative C are expected to be minor for both the surrounding communities and for the nearest residents of Creeks Edge development.

3.13. Socioeconomics

The direct and indirect effects of 10 aspects of the socioeconomic environment are described in the following subsections. Environmental consequences are described for both construction and operation. The cumulative effects on socioeconomics of TVA's proposed action in concert with other past, present, and future projects known from a 50-mile radius around the BLN site are included in Subsection 3.13.11

3.13.1. Population

3.13.1.1. Affected Environment

The BLN site is located in Jackson County, Alabama, in the northeast corner of the state (Figure 1-1). Population of the area was described in TVA's 1974 FES, Section 1.2; the 1999 CLWR FEIS, Subsection 4.2.3.8; and the 1997 BLN Fossil Conversion FEIS, Subsection 3.1.12.1. Since that time, the population of the county has increased.

The 2000 Census of Population count for Jackson County was 53,926 (Census 2000a). Population and demographic characteristics were discussed in the COLA ER, Subsection 2.5.1. Population was estimated from the proposed reactor location. The basic geographic unit was block groups; as necessary, individual blocks were used to divide block groups that crossed the 5-mile boundary. As cited, the U.S. Census of Population, 2000, SF1 was used. Estimated population by direction and distance from the site are provided in COLA ER, Figures 2.5-2 and 2.5-3. These include 16 compass directions with concentric circles at 2, 4, 6, 8, 10, 16, 40, 60, and 80 kilometers.

The U.S. Census Bureau estimate for 2009 shows a small decline in population to 52,838 (Census 2009). The estimated population living within 10 miles of the site is approximately 25,500; of these, about 4,600 live within 5 miles. Except for a small area in DeKalb County, southeast of the site, all of the area within 10 miles of the BLN site is in Jackson County.

Scottsboro, Alabama, is the principal economic center closest to the site. The closest incorporated place is Hollywood, a small town of slightly fewer than 1,000 residents.

In addition to the residential population surrounding the site, there are substantial transient populations within 50 miles of the site due to the following major nearby attractions: Lake Guntersville Park; a campground that can host as many as about 650 campers daily; the Unclaimed Baggage Center in Scottsboro, with over a million visitors per year; and the Goose Pond Colony Golf Course, the second-largest attractor of transient population in the area with more than 100,000 visitors per year. Transient populations are discussed in detail in the COLA ER, Subsection 2.5.1.3.

3.13.1.2. Environmental Consequences

Alternative A
Under Alternative A, the No Action Alternative, no completion or construction and operation of a plant would occur, and therefore there would be no impacts from construction or operation.

Alternatives B and C
Completion of Alternative B is expected to take about 4.7 years (56 months), with a peak on-site workforce of approximately 3,000. About 1,900 of these would be construction employees, and the remainder (approximately 1,100) would be engineering operations, testing, and security workforce. If Alternative C were selected, construction is expected to take about 6.5 years (two years site preparation and 54 months construction), with a peak on-site workforce of approximately 3,000. About 2,200 of these would be construction workers, and the remainder (approximately 800) would be engineering operations, testing, and security workforce. Impacts from a temporary increase in population due to construction are discussed in TVA's 1974 FES, Section 2.8; the CLWR FEIS, Subsection 5.2.3.8; and the BLN Conversion FEIS, Subsection 4.2.12.1. Under either Alternative B or Alternative C, according to Subsection 4.4.2.1 of the COLA ER, construction-phase workers and their families would represent a small percentage of the existing county population, and the impact of in-migration is anticipated to be small. The impacts to the communities within the 6-mile vicinity (Scottsboro, and the area along its major transportation routes) are expected to be moderate.

During operation, under Alternative B, the BLN site is expected to employ approximately 800 operations workers at the new unit. Under Alternative C, operations employment is expected to be approximately 650. However, some of those would already be working at the site during construction. Therefore, not all operations workers would be additions to the local population after completion of the construction phase. The impacts of plant operation would be similar to those discussed in the CLWR FEIS (Subsection 5.2.3.8) and probably somewhat greater than those anticipated in the Bellefonte Conversion FEIS (Subsection 4.2.12.2) or the 1974 FES (Section 2.8). Under either Alternative B or Alternative C, the impacts are expected to be minor, similar to those discussed in the COLA ER, Subsection 5.8.2.1., where the percent of increase in population is below 1 percent for Jackson County. Because a number of operations workers (including security personnel) would have moved into the area during the construction phase, the remaining operations workers would represent a very small long-term increase in the existing population. Within the communities in the 6-mile vicinity, the influx of operations workers during scheduled outages helps reduce the effect of population decline caused by the departure of construction workers. Impacts under Alternative C would be slightly less than under Alternative B, because operations employment would be lower for the AP1000.

3.13.2. Employment and Income

3.13.2.1. Affected Environment

Employment and income in the area were not discussed in TVA's 1974 FES. They were discussed in the 1997 BLN Conversion FEIS, Subsection 3.1.12.2, and in the 1999 CLWR FEIS, Subsection 4.2.3.8. Employment and income in Jackson County have increased since these earlier studies were prepared (U.S. Department of Commerce, Bureau of Economic Analysis [BEA] 2010a). In 2008, total employment in Jackson County averaged 25,841, compared to 25,999 in 2007 (BEA 2010b). However in 2009, the county

unemployment rate rose to 11.7 percent, more than double the 5.7 percent rate in 2008 (Alabama Department of Industrial Relations 2010), and more than the Alabama rate of 10.1 and the U.S. rate of 9.3 percent (U.S. Department of Labor, Bureau of Labor Statistics 2010). Per capita personal income in Jackson County in 2008 averaged $28,842, about 86 percent of the state average and 72 percent of the national average (BEA 2010c) (see Table 3-10).

In Jackson County, the largest employer is the manufacturing sector with 22.8 percent of total jobs (Table 3-10), followed by government (16.9 percent) and retail trade (12.5 percent). Farming, manufacturing, retail trade, and government account for a greater share of employment in Jackson County than they do at either the state or national level (see Table 3-10). The private service sector accounts for a smaller share. While the production of textile products dominates, other industries in Jackson County include paper products, machinery, and furniture and related products. Industries based in the town of Hollywood include structural steel fabrication, sheet metal works, automotive interior carpeting, and specialty signs. Both employment and income are discussed in the COLA ER, Subsection 2.5.2.1.

Table 3-10. Employment and Income in 2008

Category	Percent by Region		
	Jackson County	Alabama	United States
Farming	5.7	1.9	1.5
Mining	0.4	0.4	0.6
Construction	6.4	6.9	6.1
Manufacturing	22.8	11.1	7.8
Wholesale Trade	3.1	3.4	3.6
Retail Trade	12.5	11.0	10.4
Finance, Insurance, and Real Estate	4.6	7.7	9.6
Government	16.9	15.6	13.5
Other	27.5	42.0	46.9
Total Employment	25,841	2,640,717	181,755,100
Per Capita Personal Income	$28,842	$33,655	$40,166

Source: BEA 2010c

The manufacturing sector accounts for about 29 percent of total earnings in the county, considerably more than in the state as a whole (15 percent) and the nation (11 percent). Farm earnings accounted for almost 5 percent of total earnings in the county, compared to less than 1 percent in the state and less than 1 percent in the nation. (BEA 2010c)

3.13.2.2. Environmental Consequences

Alternative A
Under Alternative A, the No Action Alternative, no completion or construction and operation of a new plant would occur, and therefore there would be no impacts.

Alternatives B and C
Employment and income impacts of the employment increases are discussed in TVA's 1974 FES, Section 2.8; the CLWR FEIS, Subsection 5.2.3.8; and the Bellefonte Conversion

FEIS, Subsection 4.2.12. Under either Alternative B or Alternative C, the increase in employment for completion or construction of a single nuclear unit at BLN could result in creation of some new temporary secondary jobs, especially during and near peak employment. Many of these jobs would be temporary in nature, and the number of such jobs would vary depending on the level of employment. These impacts would be beneficial. Impacts from Alternative B are expected to be similar to, but somewhat smaller than, those discussed for the AP1000 in the COLA ER, Subsection 4.4.2.2. For both Action Alternatives, these beneficial impacts are considered to be moderate to significant in the county and minor regionally.

Impacts on employment and income in Jackson County were assessed using the BEA, Economics and Statistics Division's multipliers for industry jobs, earnings, and expenditures. The economic model is called regional input-output modeling system (RIMS II) and incorporates buying and selling linkages among regional industries creating multipliers for both jobs and monetary expenditures. The multiplier from RIMS II analysis for construction jobs is 1.4218. Thus, for every newly created construction job, an estimated additional 0.422 jobs are created in the region. The RIMS II (utilities) multiplier for operations jobs is 1.759. Thus, for every operations job, an estimated additional 0.759 jobs are created in the region. Operations jobs occur as the construction jobs approach the end of the construction phase, with some overlap.

Expenditures within the region for goods and services during construction of the BLN site would also have a small beneficial impact on income in the region under either Alternative B or Alternative C. This increase could be noticeable in the local area, especially for establishments providing frequently purchased items such as food, and would be considered moderate and beneficial.

Operation of the plant would result in creation of permanent jobs from the hiring of employees to supervise, operate, and maintain the plant. Impacts from the presence of operations employees are discussed in the TVA 1974 FEIS, Section 2.8; however, the expected number of employees estimated for that project was well below the approximately 800 (for Alternative B) or 650 (for Alternative C) workers that are currently anticipated during operation. The impacts likely would be more similar to the operations impacts discussed in the CLWR FEIS, Subsection 5.2.3.8, and similar to the upper end of the range discussed in the BLN Conversion FEIS, Subsection 4.2.12.2. The impacts should also be less than those discussed in the COLA ER, Subsection 5.8.2.2, because the employment level would be about 15 percent lower under Alternative B and 35 percent lower under Alternative C. The impacts would generally be beneficial, resulting in a small increase in the average income in the county, small increases in sales at retail and service establishments, and a temporary increase in home sales or rentals. These impacts could lead to some additional hiring, particularly at retail and service establishments, causing a small decrease in unemployment. Overall impacts on employment and income are expected to be small and beneficial in the region and moderate and beneficial in the county.

3.13.3. Low-Income and Minority Populations

3.13.3.1. Affected Environment

The minority population in Jackson County as of the 2000 Census was 8.8 percent of the total Jackson County population, well below the state average of 29.7 percent and the national average of 30.9 percent. The BLN site is located in Census Tract 9509, Block

Group 1. This block group had a minority population of 15.0 percent in 2000, higher than the county average but still well below the state and national averages (Census 2000b).

An in-depth analysis of the low-income and minority populations was conducted in 2008 in response to NRC sufficiency review comments on the COLA ER. In a letter to the NRC dated May 2, 2008, TVA responded and referred the reviewers to a paper titled "Bellefonte Nuclear Plant Environmental Justice Impact Assessment Methodology and Findings," dated April 2008 (TVA 2008f). That paper further discussed the methodology used to identify low-income and minority populations located on or near the BLN site, identified the agencies and other parties contacted to assist in identifying these populations, and provided an explanation of the environmental justice impacts assessments. The paper describes the method of assessment used to analyze possible pathways or vulnerabilities pertaining to the identified minority and low-income census blocks and block groups, and it includes two tables, one for construction and one for operation, which summarize impacts described in the ER that could potentially be associated with environmental justice. Each impact includes an assessment of potential pathways between the impact and the identified low-income or minority census block and block groups. The analysis results, which include degree and significance, are recorded in the "EJ Impact'" column of the tables.

In its May 2, 2008, letter, TVA noted that the BLN population analysis for the COLA ER was performed using the current decade U.S. Census Bureau data (2000 data) in conformance with NUREG-1555 guidance, and guidance provided by the Council on Environmental Quality. Eight years had passed since the 2000 Census, and TVA acknowledged that a substantial increase in area Hispanic population may have occurred, as noted by the NRC reviewers. However, given the qualitative nature of the available information about this increase, it was not incorporated into the statistical population analysis conducted for the COLA ER in conformance with NUREG-1555 guidance.

However, as discussed in the 2008 paper (TVA 2008f), during the development of the COLA ER, various organizations were contacted to help locate and assess uniquely vulnerable minority and low-income populations that do not rely on the mainstream economy for all of their income and can be more difficult to find. In addition, local and county services and resources were contacted because managers of these services and resources are closest to the communities and may have knowledge about cultural practices that help identify these populations in ways that federal databases and current literature do not. Research was further extended to contacting local sporting goods and bait and tackle shops in an effort to help identify low-income or subsistence populations that historically obtain or supplement their food supply through hunting and fishing.

Based on the demographic and environmental justice analyses set forth above, TVA is not aware of any subsistence resource dependencies, practices, or other circumstances that could result in disproportionate impacts to minority or low-income populations. Specifically, TVA identified no low-income populations within 2 miles of the BLN center point where potential plant-related impacts would be expected to be most significant. Four minority census blocks located within 2 miles of the BLN site center point were identified in COLA ER, (Figures 2.5-9 through 2.5-26). Subsection 2.5.4.3 of the COLA ER describes these census blocks and their demography. In brief, the sizes of populations in the census blocks are equivalent to single families, and each of these identified blocks are dispersed within a collection of nonminority census blocks.

As reflected in COLA ER, Figures 2.5-27 and 2.5-28, low-income populations identified within the BLN 50-mile region are located primarily within urban areas, where subsistence dependence on natural resources (e.g., fish, game, agricultural products, and natural water sources) is difficult to identify or quantify. To the extent that fishing, hunting, or gardening occur in the BLN vicinity or region, it is difficult to differentiate between those activities that are recreational in nature, as opposed to those that are subsistence practices. No quantifiable data have been identified that associates subsistence practices with any TVA-identified minority or low-income groups.

Estimates of minority population in 2008 indicate an increase in the national minority share to 34.4 percent, the state share to 31.6 percent, and the county share to 9.7 percent (Census 2008a). Estimates are not available for smaller areas. However, it is highly likely that any local increase would still result in the block group share remaining below the state and national averages. Should the number of blocks containing minorities increase, there is no evidence suggesting that this distribution trend would be any different from what was found with the 2000 Census.

The latest estimates for number of persons below poverty level indicate that in 2008, 13.2 percent of the population was below the poverty level nationally, compared to 15.9 percent in the state of Alabama and 16.9 percent in Jackson County (Census 2008b). These estimates are not available for smaller areas. However, the 2000 Census showed a poverty level in Census Tract 9509, Block Group 1, of 3.4 percent. This was below the 5.1 percent level in Census Tract 9509 and well below the 13.7 percent level in Jackson County, the 16.1 percent in Alabama, and the 12.4 percent nationally (Census 2000c). As described in Subsection 4.4.3 of the COLA ER, the nearest low-income population is in Scottsboro, 6 miles away from the BLN site.

3.13.3.2. Environmental Consequences

Alternative A
Under Alternative A, the No Action Alternative, no completion or construction and operation of a plant would occur, and therefore there would be no impacts from construction or operation.

Alternatives B and C
Environmental justice impacts were not evaluated in TVA's 1974 FES. However, they were evaluated in the BLN Conversion EIS, Section 4.9, and in the CLWR FEIS, Subsection 5.2.3.10, and in Appendix G. The COLA ER evaluated potential environmental justice impacts from construction in Subsection 4.4.3. It was determined that socioeconomic impacts other than transportation, housing, and education would be small, and due to the spatial distribution of minorities and low-income population in the region, the potential for disproportionate socioeconomic impacts in these categories on minority and low-income populations would be small. Transportation, housing, and education were identified as the socioeconomic impact categories with the greatest potential to affect minorities and low-income populations disproportionately during construction.

Although there are two minority populations identified on the opposite side of Town Creek, none are located adjacent to site access roads. Thus, the minority populations are not expected to be impacted adversely by the construction traffic. The May 2, 2008, environmental justice impact assessment paper (TVA 2008f) identified one pathway that showed a potential relationship between housing costs during construction and the

identified low-income block groups. Subsection 4.4.3.2 of the COLA ER described the potential housing impact on low-income populations from construction. The COLA ER determined that because available housing in the vicinity is limited, there is a potential for increased demand from the influx of plant construction workers to result in rental rate and housing cost increases. Any such increases would affect the low-income population in the vicinity disproportionately to higher income groups, which could better absorb the increased costs. However, with mitigation measures, such as those described in the COLA ER, Subsection 4.4.2.4, and Subsection 3.13.4.2 of this SEIS, this impact could be reduced to small to moderate. TVA would review the availability of housing prior to the construction phase to assess the need for mitigation.

During construction, the impacts on the local education system are expected to be moderate to large, but the effects are also expected to be temporary. Because education impacts would affect every school in Jackson County, there would be no disproportionate impact on minority or low-income populations.

Beneficial socioeconomic impacts from construction of a nuclear unit at the BLN site were described in the COLA ER, Subsection 4.4.2. They are principally applicable to the counties in the region and include increased employment opportunities, potentially greater income, both directly and indirectly related to plant construction. These beneficial impacts also would be realized by minority and low-income populations and would not be disproportionate to minority and low-income populations in the vicinity and region.

Environmental justice impacts from operation were not evaluated in TVA's 1974 FES but were evaluated in the BLN Conversion EIS, Section 4.9, and in the CLWR FEIS, Subsection 5.2.3.10, and in Appendix G. The COLA ER evaluated operational and socioeconomic impacts on low-income and minority populations in Subsection 5.8.3 and concluded that, overall, impacts would be minor, and given the distribution of minority and low-income populations, the potential for disproportionate impacts to those populations would be small.

TVA did not identify any location-dependent, disproportionate high and adverse impacts to minority and low-income populations. Overall, socioeconomic impacts other than education impacts would be minor, and given the distribution of minority and low-income populations, the potential for disproportionate impacts to those populations would be small. Based on the analysis in the COLA ER, Subsection 2.5.4, no significant natural resource dependencies in any population were identified in the 50-mile region.

Beneficial impacts from the operation of a nuclear unit at the BLN site to the surrounding vicinity and region include the addition of new jobs, revenues paid by TVA, and taxes paid by BLN workers, which in turn benefit local public services and the local education systems. These beneficial impacts also would be realized by minority and low-income populations, and would not be disproportionate to minority and low-income populations in the vicinity and region.

3.13.4. Housing

3.13.4.1. Affected Environment

Housing is discussed in TVA's 1974 FES, Section 2.8. It also is discussed in the CLWR FEIS, Subsection 4.2.3.8, and in the BLN Conversion FEIS, Subsection 3.1.12. Based on prior TVA evaluations, no more than half of the BLN construction workers are expected to

need housing in the area (TVA 1985a; 2008a). For most movers, Jackson County is expected to be the preferred location if accommodations are available, for both construction and operations workers. As of the 2000 Census, Jackson County had 2,553 vacant housing units, with 894 housing units available, either for sale or for rent (Census 2000d). Temporary housing is also available at local hotels/motels in the Scottsboro area, and other temporary housing is available at local campgrounds and recreational vehicle (RV) parks. The Census Bureau 2006-2008 estimates indicate 3,831 housing units are available in Jackson County, but the estimate does not provide the percent available for rent or sale (Census 2010). As described in Subsection 4.4.2.4 of the COLA ER, as of July 2008, there were approximately 330 hotel guest rooms. However, the addition of two recently opened hotels in Scottsboro brings the total number of guest rooms to approximately 470. There are also 320 campsites in Jackson County. Housing is discussed in greater detail in the COLA ER, Subsection 2.5.2.6.

As described in the COLA ER, the real estate market in Jackson County, Alabama, remained fairly steady between 2000 and 2007, and in April 2008, 141 houses in Jackson County were listed by realtors. Approximately 12 properties were available near the Mud Creek embayment, and the Creeks Edge development had 73 lots available for purchase. A new subdivision called Riverside, located in Scottsboro, was in the first phase of development, with 45 lots available. Riverside is a 200-acre planned residential development with many amenities, and seven phases of development are planned.

In addition, the COLA ER identified Goose Pond Island as a lake community (housing development) on the northern end of the 2,700-acre wooded island in the Tennessee River at Scottsboro, with more than 250 home sites. More than 75 percent of the home sites are sold. The City of Scottsboro still owns the remaining 1,500 acres on the island and plans to develop the acreage as a complement to the housing on the north side of the island.

3.13.4.2. Environmental Consequences

Alternative A
Under the No Action Alternative, there would be no construction and no new plant and, therefore, no impacts.

Alternatives B and C
During construction under either Alternative B or C, the majority of the BLN employees are expected to live in Jackson County. Workers who do not find acceptable facilities in Jackson County would likely locate to the west in Madison County, south or east in Marshall or DeKalb counties, or to the north in Tennessee. Impacts of in-migration are discussed in TVA's 1974 FES, Section 2.8, and have been updated in the BLN Conversion FEIS, Subsection 4.2.12.1; the CLWR FEIS, Subsection 5.2.3.8; and Subsection 4.4.2.4 of the COLA ER. The impacts of Alternative B or C are expected to be similar to those described in the COLA ER, Subsection 4.4.2.4. That analysis concluded that the impacts in Jackson County are expected to be moderate to large, but that mitigation could reduce these impacts to a small to moderate range. If either Action Alternative were implemented, TVA would review the availability of housing prior to the construction phase to assess the need for mitigation, which could include housing assistance for employees, transportation assistance for commuting employees, or remote parking areas with shuttles. No known changes in the amount of available housing or expectations of in-migration would lead TVA to modify this conclusion under either Alternative B or Alternative C.

Housing impacts during operations are discussed in TVA's 1974 FES, Section 2.8. They are also discussed in the BLN Conversion FEIS, Subsection 4.2.12.2, and in the CLWR FEIS, Subsection 5.2.3.8. The impacts of either proposed action are expected to be similar to those discussed in the COLA ER, Subsection 5.8.2.3.2, where a number of operations workers moving into Jackson County were accounted for during the construction phase. Based on availability of housing units and rental units in Jackson County in relation to the number of remaining operations workers expected to arrive after construction, the analysis concludes that the impact on housing would be minor and insignificant in the 50-mile region and in the county. There are no known changes that would modify this conclusion under either Alternative B or Alternative C.

3.13.5. Water Supply and Wastewater

3.13.5.1. Affected Environment

There are several water systems in Jackson County, including the Scottsboro Municipal Water System, the Stevenson Water System, the Bridgeport Water System, and the Section/Dutton Water System. Wastewater is treated by a combination of wastewater treatment facilities and septic tanks. Industrial and public water supply, but not wastewater, was discussed in TVA's 1974 FES, Section 1.2. Water supply and quality were also discussed in the CLWR FEIS in Subsection 4.2.3.4. Water supply and usage, but not wastewater, were described in the BLN Conversion FEIS (Subsections 3.1.6 and 3.1.8). Water supply and wastewater treatment are also described in the COLA ER, Subsections 2.3.2 and 2.5.2.7.1. Subsection 3.1.2 of this SEIS updates the surface water use and trends for the Guntersville watershed. Table 3-2 identifies the water users, the supply source, and water demands in 2005 and projections for 2030. The COLA ER, Subsection 4.2.1.3, provides a discussion on the supply of water for construction activities, such as concrete batching and dust suppression.

Potable water at the BLN site is currently supplied by the Jackson County Water Authority. Wastewater (sanitary waste) treatment is currently provided by the Jackson County Water Authority at the County Road 33 wastewater treatment plant. This plant has a capacity of 125,000 gallons per day (Robert Hill, Jackson County Water Authority, personal communication, January 2010). Under normal conditions, the County Road 33 plant treats approximately 30,000 gallons per day.

During construction of either a B&W or an AP1000 unit, the construction field workforce would use portable toilets, which would be supplied by vendors licensed by the Alabama Onsite Wastewater Board. There would be no sanitary system discharge from the portable toilets at the construction site into the effluent stream. Sanitary waste from the construction administration and office buildings (used by plant personnel) would be routed to the County Road 33 treatment plant. As construction is completed, sanitary waste from new buildings, such as the maintenance building, would also be routed to the County Road 33 treatment plant.

During operation of either Alternative B or C, potable water would be supplied by the Jackson County Water Authority, which receives 100 percent of its water supply from the Scottsboro Municipal Water System (TVA 2008a). Sanitary waste treatment would be supplied by the Jackson County Water Authority, using the County Road 33 treatment plant. Plant staff for one unit would contribute an additional approximate 40,000 gallons per day to the County Road 33 wastewater treatment plant's daily load. Even with some local

growth, the County Road 33 treatment plant should have adequate capacity to handle the increase from TVA's operations workforce.

Currently, Jackson County Water Authority reports water infiltration problems at the County Road 33 wastewater treatment plant during wet weather. The county reported it will repair this problem in the near future. Should capacity at the County Road 33 plant become an issue prior to BLN operation, TVA has the option of connecting to the Scottsboro Wastewater Treatment Facility. As described in Subsection 2.5.2.7.1 of the COLA ER, the Scottsboro Wastewater Treatment Facility has a maximum capacity of 5 MGD and is currently operating at approximately 4 MGD. The facility is permitted for up to 15 MGD, but there are no current plans to expand the facility.

3.13.5.2. Environmental Consequences

Alternative A
Under the No Action Alternative, because no construction would occur and there would be no new plant, there would be no impacts to the supply of water or management of wastewater.

Alternatives B and C
Water supply and wastewater impacts were not explicitly addressed in TVA's 1974 FES, except for a commitment to handle on-site sewage properly (Subsection 2.7.1.4). These issues are addressed in the BLN Conversion FEIS (Subsection 4.2.6) and in the CLWR FEIS (Subsection 5.2.3.4). For completion of a single BLN unit, these impacts are expected to be similar to those discussed in the COLA ER, Subsection 4.4.2.3. No concerns were identified with water supplies, as county water systems and wastewater treatment facilities are generally not operating at or near capacity. Local communities are adequately served by the existing water supplies, and there are no plans, or needs, to expand. Therefore, impacts to water supplies and wastewater treatment would be insignificant in the county and in the region under either Alternative B or Alternative C.

Impacts from operation are briefly addressed in the BLN Conversion FEIS (Subsection 4.2.6.2). However, the COLA ER addresses operations impacts to these services in Subsection 5.8.2.3.1. No concerns were identified. As discussed in the COLA ER, existing systems are expected to be adequate to handle the increased need resulting from operation of the plant. Therefore, impacts to water suppliers would be minor in the county and in the region under either Alternative B or Alternative C.

3.13.6. Police, Fire, and Medical Services

3.13.6.1. Affected Environment

Jackson County, as of February 2010, has a total of 102 sworn officers and approximately 500 firefighters (K. Stapleton, Enercon, personal communications, February 2010). Local police and fire protection are currently considered adequate, but future expansion and facility upgrades may be needed to accommodate future population growth.

In addition to the Jackson County Sheriff's Department (38 officers), there are seven local police departments in the county. These seven departments have the following number of law enforcement officers: Hollywood (2), Scottsboro (47), Section (1), Woodville (1), Skyline (1), Stevenson (5), and Bridgeport (7), with jurisdiction within and around their

respective city/town limits. Scottsboro city jurisdiction extends 3 miles beyond the city limits. (K. Stapleton, Enercon, personal communications, February 2010)

There are 25 fire departments in the county and 31 fire stations (includes Scottsboro's three stations). There are 38 paid firefighters and approximately 480 volunteer firefighters (no less than 10 per station). Fire departments receive grant money from the county and forestry commission, so each station must maintain no less than 10 firefighters, but each usually has approximately 13 volunteer firefighters. Some communities may have as many as 30 volunteers. (K. Stapleton, Enercon, personal communications, February 2010)

The Hollywood Fire Department would be the first responder for the BLN site (see COLA ER Subsection 2.5.2.7.2.), and the department is a volunteer fire department with 12 firefighters, one brush truck, three pumper trucks, and two response vehicles (one medical and one with overall supplies). Hollywood has two fire stations. The closest station is located at the municipal building on U.S. Highway 72 west of the intersection of U.S. Highway 72 and County Road 33, approximately 2 miles measured in a straight line from the BLN site. The second fire station is located in downtown Hollywood, east of the intersection of County Road 33 and Rail Road Street, approximately 3 miles measured in a straight line from the BLN site. Three other municipalities in Jackson County provide firefighters: Scottsboro (36 paid firefighters); Bridgeport (19 volunteer firefighters, and a paid fire chief and deputy fire chief); and Stevenson (10 volunteer firefighters) (K. Stapleton, Enercon, personal communications, February 2010). The balance of firefighters are volunteers, as noted above.

The single hospital in Jackson County, Highlands Medical Center, is located in Scottsboro. The center currently has 39 doctors and employs approximately 700 staff, (including nursing home and part-time). Approximately 95 beds are currently occupied, but the center is licensed for 170 beds (K. Stapleton, Enercon, personal communication, February 2010). The center also operates Highlands Health & Rehab, a 50-bed short-term rehabilitation and long-term nursing home facility (Highlands Medical Center 2010). The Jackson County Health Department provides general medical services for approximately 6,100 individuals per year as discussed in the COLA ER Subsection 2.5.2.7.2.

Police, fire, and medical services, including other nursing home facilities, are discussed in greater detail in the COLA ER, Subsection 2.5.2.7.2.

3.13.6.2. Environmental Consequences

Alternative A
Under the No Action Alternative, the in-migration of people associated with construction and plant operation would not occur. Therefore, there would be no additional demand for public services under Alternative A.

Alternatives B and C
Impacts to these services are not analyzed in the earlier studies, except for fire, which was discussed in the Conversion FEIS (TVA 1997), Subsection 4.2.12. The COLA ER, Subsection 4.4.2.3, concludes that construction at BLN would result in a minor, short-term increase in the ratio of population to police officers and to firefighters. Likewise, the COLA ER, Subsection 5.8.2.3.1, concludes that operation of BLN would result in a small increase in the ratio of population to those services. However, these ratios would still be within existing guidelines. Impacts from completion of a single BLN unit should be similar to those

in the COLA ER. Therefore, under either Alternative B or C, the impacts of on-site construction and operation of a nuclear plant on local police and firefighters are expected to be insignificant and offset by increased tax revenue.

Regarding medical services, the shortage of physicians is a statewide problem in Alabama, including Jackson County. Minor injuries to workers would be treated by on-site medical personnel. Other injuries likely would be treated at Highlands Medical Center. Construction of a single BLN unit would have a minor effect on the already-existing physician shortage. Overall, as discussed in the COLA ER, Subsection 4.4.2, the impact of plant construction on medical services likely would be minor under either Alternative B or Alternative C. The COLA ER, Subsection 5.8.2, concludes that operation of BLN would have a small impact on the already-existing physician shortage. Furthermore, employment levels for single unit operation would be less than two-unit operation employment levels described in the COLA ER, which would reduce anticipated impacts on demand for physicians relative to the impact reported in the COLA ER. Increased need for hospital services would impact Highlands Medical Center, which currently has adequate beds and staff. Overall, under either Alternative B or Alternative C, the impact of plant operations on medical services likely would be minor and insignificant.

3.13.7. Schools

3.13.7.1. Affected Environment

Public schools are discussed in TVA's 1974 FES, Section 2.8. Schools are also discussed in the BLN Conversion FEIS, Subsection 3.1.12.3, and in the CLWR FEIS, Subsection 4.2.3.8. There are two school systems within Jackson County—Jackson County Schools and Scottsboro City Schools—both providing K-12 education. Jackson County Schools has 19 schools under its jurisdiction, while Scottsboro City Schools has six schools under its jurisdiction. For the 2007-08 school year, these districts had 5,998 and 2,681 enrolled students, respectively.

There are 50 school districts associated with the counties and cities that are either wholly or partially within the 50-mile radius of the BLN site center point. According to the National Center for Education Statistics, more than 297,091 students were enrolled in these school districts for the 2004-2005 school year. School districts within the 50-mile radius do not, in general, have a maximum capacity. Instead, virtually no student is turned away.

The COLA ER, Subsection 2.5.2.8.2, provides a detailed discussion on K-12 schools in Jackson County, nearby vocational and technical schools, and community colleges and universities within the 50-mile region. Also included in the COLA ER, Subsection 2.5.2.8.2, is a brief discussion on entry-level training in the duties for various positions specific to operations and maintenance of their facilities that is periodically offered by TVA.

3.13.7.2. Environmental Consequences

Alternative A

Under the No Action Alternative, no construction would occur, and the population increase associated with operation of a nuclear plant would not occur. Therefore, there would be no additional demand for public schools.

Alternatives B and C
In TVA's 1974 FES, Section 2.8, it was concluded that the school system could handle the additional students with ease. The BLN Conversion FEIS, Subsection 4.2.12.1, concluded that the system would have adequate space for the projected increase. However, the CLWR FEIS, Subsection 5.2.3.8.1, concluded that while long-term receipts from TVA would offset additional cost, there would be a short-term gap in costs that would need to be filled. A more current analysis in the COLA ER, Subsection 4.4.2.5., concluded that the impact would be potentially significant but temporary, depending on the speed with which current school district expansion plans are implemented. Under either Alternative B or Alternative C, the impact from construction of a single BLN unit is expected to be moderate to significant, as concluded in the COLA ER.

The TVA 1974 FES did not evaluate operations impacts on schools. In the CLWR FEIS, Subsection 5.2.3.8.1, it was concluded that over the long term, increased school receipts from TVA in-lieu-of-tax payments would exceed increased costs. The BLN Conversion FEIS, Subsection 4.2.12.2, noted that operations impacts should present no special problems. Under either Alternative B or Alternative C, the impact from operation of a single BLN unit is expected to be similar to, but less than, the impact discussed in the COLA ER, Subsection 5.8.2.3.3, where it was estimated that operation of BLN 3&4 would result in about 340 additional school-age children. This impact is considered small to moderate.

3.13.8. Land Use

3.13.8.1. Affected Environment

Jackson County, Alabama, in which the plant would be located, has an area of approximately 1,127 square miles.

Scottsboro, the county seat of Jackson County, is the largest city in the county, with an estimated 2008 population of 14,994. As described in Subsection 2.5.2.4 of the COLA ER, the city has a well-developed zoning plan and supporting zoning laws in place for land inside the city limits.

Hollywood, immediately to the west of the site, is the closest town to the site, with an estimated 2008 population of 924. The town of Hollywood, Alabama, has basic zoning laws, which designate agricultural, residential, or business zones within the city limits; however, no detailed zoning information is available. Areas outside of incorporated communities in Jackson County, including the Bellefonte site, do not have zoning laws. In Alabama and specifically Jackson County, because there is little zoning or designated land use outside of the communities, code and regulation enforcement is administered through the appropriate town or city, county, state, or federal governmental agency with the appointed oversight powers.

Land use is discussed in detail in TVA's 1974 FES, Section 1.2 and Appendix A, as well as in the CLWR FEIS, Subsection 4.2.3.1, and the BLN Conversion FEIS, Subsection 3.1.14. These describe the surrounding area as largely forest and agriculture or undeveloped, with development concentrated largely along the Scottsboro-Stevenson-Bridgeport corridor around U.S. Highway 72. Since these studies were completed, there has been a noticeable increase in development, primarily commercial, along U.S. Highway 72 through most of Jackson County. The COLA ER, Section 2.2 and Subsection 2.5.2.4, contain a recent description of land use. Section 3.9 of this FSEIS discusses recreational land use within

the 50-mile region, and Figure 3-14 illustrates the distance from the site to recreational locations within the 6-mile vicinity.

3.13.8.2. Environmental Consequences

Alternative A
Under the No Action Alternative, no construction would occur, and there would be no new plant. Therefore, there would be no impacts to land use.

Alternatives B and C
Impacts of plant construction on land use were discussed in TVA's 1974 FES, Section 2.9. They are also discussed in the CLWR FEIS, Subsection 5.2.3.1, and in the Conversion FEIS, Subsection 4.2.14.1. Under either Alternative B or Alternative C, the proposed construction would require no changes in designated land use, no additional land acquisition, and no road relocations. No new transmission lines or other uses of off-site land related to construction are proposed. According to COLA ER, Figure 2.5-29, the nearest residence is located across Town Creek, 2,309 feet from the north cooling tower location. The demand for housing could convert some land in the area to residential housing or to use for temporary housing units, such as mobile homes or RVs. To a great extent, this conversion likely would be an acceleration of the longer-term trend reflecting growth in the area and likely would not significantly alter the long-term trends in land use. These impacts are expected to be minor and similar to those described in more detail in the COLA ER, Section 4.1.

Impacts of plant operation on land use were discussed in TVA's 1974 FES, Sections 2.9 and 3.0. They are also discussed in the CLWR FEIS, Subsection 5.2.3.1, and in the Conversion FEIS, Subsection 4.2.14.2. Under either Alternative B or Alternative C, adverse impacts to land use from operation of a single BLN unit would be insignificant. A detailed discussion of these impacts is included in the COLA ER, Section 5.1. No additional land is expected to be disturbed after the construction phase.

3.13.9. Local Government Revenues

3.13.9.1. Affected Environment

Local government revenues are not discussed in TVA's 1974 FES. They are discussed in the CLWR FEIS in Subsection 4.2.3.8, but not in the BLN Conversion FEIS. A more recent and extensive discussion is included in the COLA ER, Subsection 2.5.2.3, and the TVA in-lieu-of-tax payments are discussed in detail in that subsection. These payments are made to eight states, including Alabama. The State of Alabama allocates its payments in accordance with state law (Title 40 "Revenue and Taxation"). The state distributes 78 percent of the payments to the 16 TVA-served counties based on the book value of TVA power property and TVA power sales in each of these counties. A portion of the county receipts is then shared with cities, schools, hospitals, etc., within their boundaries. In fiscal year 2007, TVA paid the state $112.1 million, of which $87.4 million was paid to the TVA-served counties, including Jackson County, which received $10.4 million. As discussed in the COLA ER, the book value of the partially completed BLN 1&2 is used in determining the payment to Jackson County. The book value of these units is likely to be entirely or largely depreciated by the time the proposed unit would be operational.

3.13.9.2. Environmental Consequences

Alternative A
Under the No Action Alternative, tax revenues would continue to decrease slowly due to depreciation, because the plant would not be constructed or operated.

Alternatives B and C
Under either Alternative B or C, construction activities and purchases and expenditures by workers and their families would increase revenues on various state and local taxes. These impacts, including TVA in-lieu-of-tax payments, are discussed in the CLWR FEIS, Subsection 5.2.3.8.1, but not in the Bellefonte Conversion FEIS. These impacts would be similar to those described in the COLA ER, Subsection 4.4.2.2.1. They are expected to be moderate to significant and beneficial in Jackson County, but minor and beneficial in the region.

Under either Alternative B or C, revenues from state and local taxes would increase during operations, although to a lesser extent than during construction. TVA in-lieu-of-tax payments to the State of Alabama also would increase. As a result, the amount allocated from these payments to Jackson County would increase. These impacts are discussed in the CLWR FEIS, Subsection 5.2.3.8.1. The amount of the increase has not been estimated; however, it would be a noticeable increase. These impacts would be similar to those described in the COLA ER, Subsection 5.8.2.2.1, considered moderately beneficial in Jackson County. As discussed in the COLA ER, Subsection 5.8.2.2.1, the increase in tax-equivalent payments to Jackson County due to construction of two units has been estimated to be about $3.2 million. The increase from one unit would be expected to be somewhat larger than half of this amount, because the cost of constructing one unit likely would be more than half the cost of two at the same site. However, many other factors would affect the actual payment. Completion of the Watts Bar Nuclear Unit 2 and other construction of TVA facilities outside of Alabama would somewhat decrease the Alabama share of the total TVA payments, thereby decreasing the BLN-related payment. Other future events would also affect this payment, such as fluctuations or growth in revenue from power sales, plant retirements, and future depreciation of assets. In addition to the direct effects of the proposed plant, other state and local tax revenues would see small increases due to increased employment and population in the county. Because of the many variables involved, the final net impact could vary considerably, but the result would be a moderate positive impact to local government revenues.

3.13.10. Transportation

3.13.10.1 Affected Environment

Transportation was discussed in TVA's 1974 FES, Section 1.2. U.S. Highway 72 was identified as the primary highway near (within 2 miles of) the BLN site and was being widened to four lanes with unlimited access. Two access roads to the BLN site were identified: one via existing roads on the south end of the site and a second new permanent access road (Bellefonte Road) from U.S. Highway 72 on the north end of the site. No new roads or general upgrading of existing roads were planned, but repairs were anticipated due to abnormal use (construction traffic). TVA's 1997 Bellefonte Conversion Project FEIS, Subsections 3.1.13.1 and 4.2.1.3, provided a detailed description of the major highways and local roads near the BLN site. In that study, the Alabama Department of Transportation (ALDOT) 1994 Average Annual Daily Traffic (AADT) count indicated a traffic count of 12,910 vehicles on U.S. Highway 72 in the vicinity of the intersection of U.S. Highway 72

and the south access road. A traffic count of 9,670 vehicles was reported on U.S. Highway 72 approximately 1.5 miles northeast of that intersection. The CLWR FEIS (DOE 1999), Subsection 4.2.3.8, identified primary transportation routes and effect on transportation related to the operation of at least one unit at the BLN site for the production of tritium.

Most recently, the COLA ER (TVA 2008a), Subsection 2.5.2.2, described the transportation network of federal and state highways within the BLN region, as well as local roads in Jackson County. Within Jackson County, Alabama, the one federal highway, U.S. Highway 72, runs east across the county into the city of Scottsboro, Alabama, then northeast through the town of Hollywood, Alabama, into the state of Tennessee. U.S. Highway 72, the closest major road to BLN, is a four-lane divided highway that connects the BLN site to Interstate 24 in Marion County, Tennessee, and to Interstate 565 in Madison County, Alabama, as shown in Figure 1-1. Numerous state routes traverse the county, providing rural areas access to the larger populated areas as shown in Figure 3-16. A small vehicular public transportation system exists in Jackson County, which transports residents from rural portions of the county into Scottsboro for shopping.

Vehicle volume on roads, obtained from estimated AADT counts from ALDOT, reflects the urban and rural traffic characteristics of the county. AADT counts in 2008 indicate that approximately 16,600 vehicles travel on U.S. Highway 72 at Mile 145.4 (west of the site). Approximately 4,900 vehicles travel on Alabama State Route 279 at Mile 9.0 (west of the site), which is located before east-bound traffic on Alabama State Route 279 merges with U.S. Highway 72. Approximately 5,600 vehicles travel on Alabama State Route 40 at mile 1.7 (south of the site). On average, 13,700 vehicles travel past Mile 148.2 (north of the site) on U.S. Highway 72. These counts are slightly lower than the 2005 traffic counts reported in the COLA ER.

No road modifications near the BLN site are planned; however, several road construction projects have been planned and/or completed in Jackson County. As noted in the COLA ER, the existing truss bridge over the Tennessee River on Alabama State Route 35 was scheduled for replacement, and the highway was to be widened to four lanes between the Tennessee River and Section, Alabama. There are also plans to build a west bypass around the city of Scottsboro, Alabama (ALDOT 2006). Replacement of the bridge on Alabama State Route 35 over the Tennessee River is estimated to be completed in spring 2010 (ALDOT 2009a). In addition, the bridge on Alabama State Route 35 over Roseberry Creek west of Scottsboro is scheduled for replacement (ALDOT 2009b).

Both construction workers and truck deliveries would access the site via U.S. Highway 72 and County Road 33. Operations workers and security personnel are expected to access the site during construction and operations using U.S. Highway 72 and Bellefonte Road.

3.13.10.2 Environmental Consequences

Alternative A

Under the No Action Alternative, no construction would occur, and no new plant would be operated. Therefore, there would be no impacts on transportation.

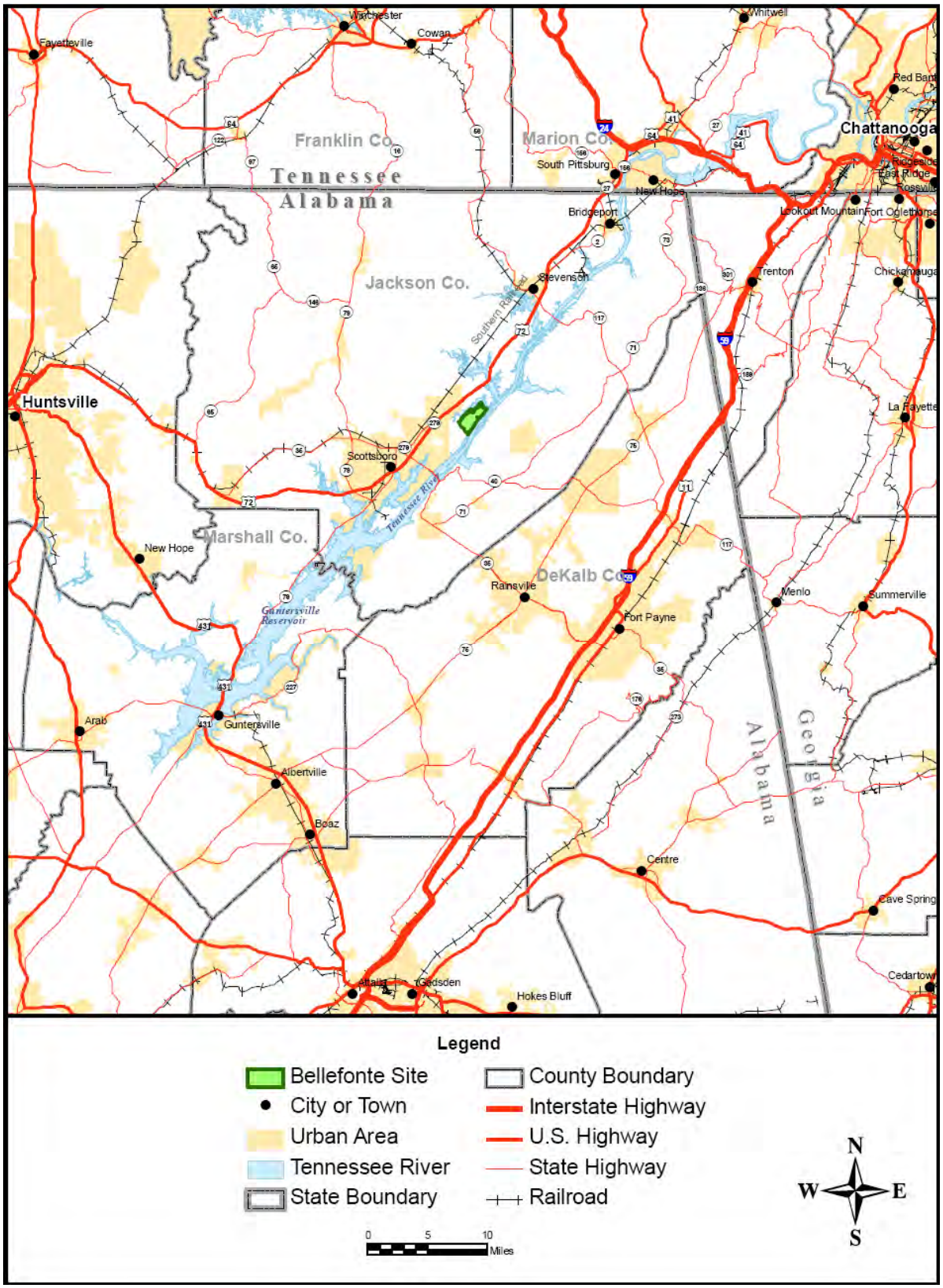


Figure 3-16. Road and Highway System in Jackson County Providing Access to the BLN Site

Alternatives B and C

Plant construction at the BLN site would increase traffic on local roads. TVA's 1974 FES estimated approximately 1,200 worker vehicles (TVA and contractor employees) would travel to and from the BLN site at the peak of construction and reported a 1970 daily traffic count on U.S. Highway 72 past the plant of approximately 3,700. As a result, increased traffic, some congestion, and delays were anticipated. Because most equipment was expected to be shipped by rail or barge, numerous truck shipments of equipment were not expected; however, deliveries of concrete aggregate, cement, etc., were expected to require many shipments by truck. For the Bellefonte Conversion Project (TVA 1997), increased traffic during construction was expected to affect primarily U.S. Highway 72 and the access roads leading off the highway to the plant. It was also noted that effects on the local road network during construction might require mitigation measures to improve future service levels on Bellefonte Road and County Road 33 (e.g., physical improvements to the local road network to increase capacity, employee programs that offer flexible work hours, incentives for ride-sharing, and bus and/or van pool programs. In the CLWR FEIS, DOE concluded that traffic generated by construction activities could strain the local road network and would be temporary, but similar to the effects identified in the Bellefonte Conversion FEIS.

The COLA ER (TVA 2008a) described planned road use for the construction of AP1000 units, which is also applicable to the completion of a B&W unit. All construction workers and plant staff would commute to the site, because there are no provisions for housing at the BLN site. The construction workers and plant staff who live in Jackson County, Alabama, are anticipated to commute from two major areas, western Jackson County (areas west of the Tennessee River) and eastern Jackson County (areas east of the Tennessee River). The roads and highways in Jackson County that provide vehicular access to the BLN site are illustrated in Figure 3-16. For the construction workers and plant staff who would live outside Jackson County, including those who might commute from the suburbs of Chattanooga, Tennessee, and Huntsville, Alabama, an adequate road network is already present to allow these workers to commute to the BLN as discussed above.

County Road 33 is planned to be used as the sole access road for construction workers. During peak construction period, a single "construction" shift of 10 hours during daylight hours would be scheduled. However, to accommodate construction traffic converging on the site during this shift, TVA expects to use staggered shift start times (over a two-hour period). Using staggered shifts also allows for extra road capacity that could prove useful for scheduling flexibility and the occasional delivery during dayshift start times. As construction ramps up, scheduling of a nightshift dedicated to preparation of the site for the next day's construction work is expected. Approximately 70 percent of the construction workers would work the dayshift and approximately 30 percent would work the nightshift. Truck deliveries would occur during daytime hours and in-bound shipments would occur outside of the startup shift hours. These deliveries include shipments of materials, trash removal, etc. In addition to the construction workers, the peak on-site construction workforce would include operations engineering and testing and security workforce that would access the site during the construction period using Bellefonte Road.

For both Alternatives B and C, impacts on transportation corridors from the construction period workforce and deliveries are considered minor for all roads except Jackson County Road 33, where impacts are expected to be temporary, but minor to moderate, during the construction period. Should traffic counts exceed predicted levels, TVA would meet with local officials to determine an appropriate solution. Potential mitigation measures include

establishing a temporary centralized parking area away from the site and shuttling construction workers to the site, mandatory carpooling, installing traffic-control lighting and directional signage, county road modifications, and further staggering of shifts further to avoid traditional traffic congestion time periods.

Plant operation would increase traffic on local roads. The 1974 FES (TVA 1974a), Bellefonte Conversion FEIS (TVA 1997), and CLWR FEIS (DOE 1999) all indicated commuter traffic generated by operation of a plant at the BLN site would increase traffic loads on the local road network and decrease availability capacity of the roads. However, the effects of commuter traffic during operations would be less than during the construction phase, especially peak construction. The Bellefonte Conversion FEIS indicated that any mitigation efforts accomplished for the construction phase were expected only to improve the capacity levels during operation. The CLWR FEIS offered mitigation measures for transportation effects similar to those discussed in the Bellefonte Conversion FEIS.

The COLA ER (TVA 2008a) noted that impacts on transportation and traffic from operating nuclear units at the BLN site would be greatest on the rural roads of Jackson County and during shift changes. Impacts on traffic are determined by (1) number of operations workers and their vehicles on the roads, (2) number of shift changes for the operations workforce, (3) projected population growth rate in the region, and (4) capacity of the roads.

For plant operations, it was assumed that the BLN site would operate in three shifts. The dayshift would comprise 60 percent of the workers, the nightshift would comprise 30 percent of the workers, and the midnight (graveyard) shift would comprise 10 percent of the workers. The largest number of the worker vehicles is expected to be on the roadway at the end of the dayshift and start of the nightshift (shift change). Other impacts may be present during outages and during refueling periods when more workers are present. Additional information on transportation is discussed in the COLA ER, Subsection 2.5.2.

Because approximately half of the B&W operations workers and half of the AP1000 operations workers are expected to be temporally phased in during the construction stage, the initial impact on transportation from worker vehicular traffic at the start of BLN operations would be lessened. Given the volume of traffic on the road network (indicated by AADT counts discussed in Subsection 3.13.10.1), the impact on transportation from the addition of operations worker vehicles on the roadway during shift change between dayshift and nightshift would be minor. Should traffic concerns arise, TVA would meet with local officials to determine an appropriate solution. Potential mitigation measures could include mandatory carpooling, staggering outage shifts opposite traditional high-traffic periods, and busing in employees, if necessary.

3.13.11. Cumulative Socioeconomic Effects

TVA's 1974 FES did not address cumulative effects, other than radiological impact on the Tennessee River (see Appendix J of the FES). They were discussed in the CLWR FEIS, Section 5.3, and in the BLN Conversion FEIS, Subsection 4.4.2. In the COLA ER, Subsection 4.7.3, the only foreseeable project identified as having the potential to contribute to cumulative socioeconomic effects within 50 miles of BLN was the realignment of Redstone Arsenal as part of the *Base Realignment and Closure Act of 2005*. Because Redstone Arsenal is located at the periphery of the 50-mile BLN region and the construction periods of Redstone Arsenal and BLN would not likely coincide, BLN is not likely to result in significant cumulative impacts on socioeconomics. The impacts would be similar to those discussed in more detail in the COLA ER, Section 4.7.

Several other projects are now identified that will be occurring within the 50-mile radius. In Chattanooga, Tennessee, a new Volkswagen manufacturing plant will be completed in early 2011, and Alstom has announced it will build a new facility to manufacture turbines and other major components for U.S. power generation facilities. Construction of the Alstom plant is expected to be complete in late 2010. Another company is said to be planning construction of a facility in Marion County, Tennessee, to begin in the near future. In Madison County, Alabama, the University of Alabama-Huntsville has some large construction projects underway. In DeKalb County, a small metal fabrication facility is under construction that will employ 25 people beginning in March 2010. The county is also recruiting a Canadian automotive supplier that would employee 158 initially and up to 350 in the long term. Additionally, the local highway projects described in Subsection 3.13.10.1 are either underway or could occur within the project time period.

Because all of these efforts are either underway, or will likely be completed before the construction workforce begins to grow at the Bellefonte site, it is unlikely that these facilities and highway projects would impact recruiting for construction for a nuclear reactor at Bellefonte. None of these projects are close enough to Hollywood, Alabama, to contribute co-impact community services or traffic congestion on local roads, including any traffic congestion due to the road projects discussed in Subsection 3.13.10.1, which are located near Scottsboro. If the local highway projects are completed by peak construction for either alternative, the cumulative effects of traffic would be reduced due to these improvements.

No cumulative effects on socioeconomics are expected from construction or completion and operation of a single nuclear unit at the BLN site in combination with the projects described above.

For over a decade, the Federal Highway Administration has discussed the need for a new interstate highway connecting Memphis, Tennessee, to Atlanta, Georgia, via Huntsville, Alabama. This project was tabled before the 2008-2009 recession and is not likely to be funded and under construction until after the construction at the Bellefonte site would be completed.

3.14. Solid and Hazardous Waste

3.14.1. Affected Environment

The earliest BLN NEPA document, TVA's 1974 FES, addressed expected solid waste generation resulting from plant construction, normal plant activities, and transmission line clearing and maintenance practices, and the proposed disposal of those wastes.

Plant construction solid waste, such as metal, lumber scrap, and other salvageable material, was to be collected periodically for sale or removal from the site. Trees having no commercial value and stumps were cut, piled, and burned in accordance with federal, state, and local air quality regulations. Broken concrete, rock, and residue from wood burning were "used in landfill material" on site.

Normal nonradiological solid wastes included sludge from water treatment plant filters and demineralizers, paper, soft drink cans, glass, wood, and to a much lesser extent garbage. Scrap metals (other than cans) were to be salvaged and sold. Scrap lumber was to be salvaged for TVA use, or made available to scavengers, and the remainder disposed of with other solid waste. It was anticipated that this solid waste would be disposed of at either a TVA sanitary landfill operated by TVA personnel in accordance with EPA

regulations, or in a state-approved landfill operated on non-TVA property by a municipality, county, or private contractor. Economics was expected to be a major determinant of the option selected for disposal.

The 1974 FES analysis formed the general basis (template) for the evaluation of the management and disposal of solid waste in the subsequent NEPA documents, addressing the various phases and alternative options for the use of the plant and the site. Thus, while the nominal categories changed over time, the general assemblage of wastes remained largely the same. Furthermore, the manner/location of disposal varied, with off-site disposal retained as the favored option, but with disposal of various wastes on site being maintained as an option. Actual and planned disposal was always in accordance with existing applicable environmental regulations.

TVA 1976 restated the solid waste categories as demolition/construction waste, domestic (municipal type) waste, clearing and demolition/construction waste, and added the category nonradiological hazardous waste or problem waste.

An exhaustive list of typical domestic waste was provided: garbage, paper, plastic, packing materials (metal-retaining bands, excelsior, cardboard), leather, rubber, glass, soft drink and food cans, dead animals and fish, oil and air filters, floor sweepings, ashes, wood, textiles, and scrap metal. Domestic waste, by this definition, was listed as the largest type of nonradiological solid waste. Domestic and demolition/construction wastes were to be disposed of in a local, state-approved sanitary landfill.

Broken concrete and bricks, waste concrete, asphalt, rocks, and dirt, along with the residue from burning clearing wastes, were used as unclassified fill material on site. In addition, there was no planned disposal of domestic solid waste or hazardous wastes in the fill area. All lumber used for forms, scaffolding, etc., was reused as long as practical and then offered to the general public for firewood or other use. Unwanted scrap lumber from the salvaging operation was disposed of in an unclassified fill area. Scrap metals and other recyclable materials were collected, offered for periodic sale, and removed from the site.

Nonradiological hazardous wastes were represented as those that require special handling and/or disposal methods to avoid illness or injury to persons or damage to the environment. Examples of hazardous waste were empty containers from paints, solvents, pesticides, acids, oils, PCBs, chemical grouts, as well as the materials themselves. Problem wastes were those wastes that are difficult to handle by conventional means. Examples of problem wastes were sludges from water and wastewater treatment plants, tires, materials from intake screens, and materials used in the clean up of chemical or oil spills. It should be noted that the RCRA regulations (40 CFR Parts 260-273), the basis for current hazardous waste management, were not yet in force at the time of TVA's 1976 final environmental report.

The TVA white paper (TVA 1993a), was developed to determine if the 1974 FES needed to be supplemented for the proposed change from deferred status, and it added asbestos materials to the list of BLN wastes. For the disposal of certain nonradiological nonhazardous waste, the intent was to be able to dispose of these wastes either off site in state-approved sanitary landfills or in on-site approved landfills, depending on the economics. Any hazardous wastes would be disposed of or treated off site at state-approved treatment/disposal facilities.

The BLN Conversion FEIS (TVA 1997) addressed solid and hazardous wastes generated by five fossil-based alternatives to the exclusion of the nuclear option for the BLN plant. Only relatively small quantities of solid hazardous and nonfossil-based nonhazardous wastes were generated at the BLN site at that time, as the existing plant was in regulatory deferred status. In addition to large-volume solid wastes associated with the fossil-based options, the typical hazardous and nonhazardous waste generation was discussed.

Discussions of the tritium option (TVA 2000), in addition to a relisting of the likely solid wastes, included estimates of the hazardous and nonhazardous waste generated by the completion of Unit 1 and Units 1&2.

In the 2006 final environmental assessment, solid and hazardous waste generation was included in the discussion of impacts associated with the cancellation of construction of the existing facility and withdrawal of the construction permits. This action was taken to pursue other site alternatives. Further details are presented and discussed in the Environmental Consequences section below.

Most recently, the COLA ER provided a description of the estimated solid waste generation associated with the construction and operation of BLN 3&4 (two AP1000 units), including a discussion on the types of solid waste and the quantities. Further details are presented and discussed under Alternative C below.

The changes in solid and hazardous waste generation at BLN from the earlier NEPA review conditions are the result of further reduction of plant activities from those prevailing under the deferred status (TVA 2006) and reflect changes primarily in the quantitative distribution of wastes rather than changes in the types of wastes.

With the plant in deferred status, the solid waste generated is minimal, commensurate with the low level of activity at the plant. Typical sanitary solid waste is routinely put in dumpsters on site and subsequently disposed of off site in an approved sanitary landfill. Within the last three years (2007 to present), nonhazardous waste generated at BLN included four roll-offs (20 cubic yards each) of roofing materials (flashing, felt, etc.), 11 roll-offs (20 cubic yards each) of asbestos waste generated from the repair and upkeep of plant buildings, and one roll-off (20 cubic yards) of oily debris (dirt and gravel). Material contained in the roll-offs was disposed of at the ADEM-approved Sand Valley Landfill in Collinsville, Alabama. This landfill has available capacity for the disposal of solid waste for the next 59 years, at the current disposal rates.

Other nonhazardous solid waste generated at BLN during the same period, included 1,392 kg of used oil (used oil, oily water, used grease, etc.) in large part from the decommissioning of plant operating equipment; 2,489 kg of oily debris (oily rags, pads, and absorbents); and 125 kg of non-PCB ballasts. These drummed nonhazardous materials were shipped to the TVA Hazardous Waste Storage Facility (HWSF) for disposal or recycling, as appropriate. The TVA HWSF provides interim storage of some of TVA's nonhazardous waste prior to disposal.

As with solid waste, the hazardous waste generated is minimal, again commensurate with the reduced level of activity at the plant. The BLN site is a conditionally exempt small quantity generator (CESQG). A CESQG generates hazardous waste at a rate of less than 100 kg (220 pounds [lb)]) in any calendar month and manages the waste in a manner specified by the EPA (40 CFR §261.5). Within the last three years (2007 to present),

761 kg of hazardous waste were shipped to the TVA HWSF for disposal. These hazardous wastes included paints, paint-related materials, solvents, corrosive liquids, aerosol cans, discarded chemicals, and broken fluorescent bulbs. Drummed PCB ballasts (268 kg), which can be described as toxic rather than hazardous in terms of the regulations, were also sent to the TVA HWSF for disposal. Just as for the solid waste, the TVA HWSF manages a number of waste management contracts that provide TVA with a variety of hazardous waste disposal options approved by regulators (Table 3-11).

The TVA HWSF is located in Muscle Shoals, Alabama, and provides interim storage of most of the TVA hazardous wastes and some other wastes, pending shipment to permitted commercial facilities for appropriate disposal.

Table 3-11. Hazardous Waste Storage/Disposal Capacity Available to BLN

Facility	Specialty	Capacity
TVA HWSF	Interim storage prior to shipment for disposal	720 55-gallon (gal) equivalent containers
Veolia Environmental Services RMI, Morrow, Georgia	Fuel blending	87,750 gal/day treatment in containers 110,000 gal/day treatment in tanks 167,500 gal storage in containers 176,598 gal storage in tanks
Veolia Environmental Services TWI, Sauget, Illinois	Incineration	4x63 cubic yards solid bulk[a] 300,000 gallons liquid bulk[a] 11,380 55-gal containers[a]
Chemical Waste Management Emelle, Alabama	Stabilization and landfilling	~ 800,000 tons/year for 10 to 20 years

[a] Maximum to be held on site at any one time.

3.14.2. Environmental Consequences

3.14.3. Alternative A

For this alternative, there would be no construction activity beyond routine maintenance of the physical plant. Any construction/demolition waste would be minimal and would be disposed of in a state-approved landfill. A minor amount of construction-related hazardous waste is anticipated for this alternative beyond paint-related waste, and this would be sent to the TVA HWSF for disposal. There would be limited quantities of solid waste for disposal and, with regard to hazardous waste, the plant would continue to be a CESQG.

Alternative B

The quantities and types of solid waste generated by this option during the construction phase would be determined primarily by the number of buildings demolished and/or renovated to meet the needs of the new generation system and the equipment that must be taken out and replaced. In the CLWR FEIS, DOE estimated that 392 cubic meters of concrete waste and 208 tons of steel waste would be generated for the completion of BLN Unit 1 for the duration of the construction period (DOE 1999). Under Alternative B, no major buildings would be demolished. However, it is expected that scrap metal waste would be generated from the replacement of old equipment and components. Therefore, it is expected that a large number of motors would be discarded, producing steel and copper for recycling. Other sources for scrap metal for recycling include steel from the replacement of the steam generator, copper from the replacement of electrical cables, and sheet metal from the renovation of the Control Room/Building. This material would be

recycled as much as practicable. In addition, as indicated in the COLA ER, the intended use of an existing cooling tower would require some maintenance and refurbishment. This renovation would include removal of asbestos fill material and replacement with a nonhazardous material. This process would generate asbestos waste for disposal. Any construction/demolition wastes generated during the building/renovation process would be managed through the existing TVA waste disposal contracts to access permitted disposal capacity or recycling facilities, as needed.

Likely hazardous wastes generated during the construction phase would include paint wastes, paint thinners, dried paint, and parts cleaning liquids. In the CLWR FEIS, DOE estimated that 6.3 tons of solid hazardous waste and 56.7 tons of liquid hazardous waste would be generated for the completion of BLN Unit 1 for the duration of the construction period (DOE 1999). These hazardous wastes would be sent to the TVA HWSF for disposal.

Although the exact calculations of the quantities of solid and hazardous waste that would be generated during operation are yet to be determined by the DSEP process, indications can be gleaned from the ongoing experience of existing nuclear plants. Solid wastes generated currently by the TVA nuclear plants include oily debris (absorbent, boom, rags from cleanup, oily gravel and dirt), spent resin, desiccant, and alkaline batteries. These wastes are shipped to the TVA HWSF for disposal by contractor in a permitted landfill. Wood waste that cannot be recycled also goes to a permitted landfill. Scrap metal is recycled. Based on waste generated at SQN from 2004 through 2008, the estimated quantity of solid nonhazardous, nonradiological waste generated annually during operation of a single B&W unit would be approximately 500 tons.

Types of hazardous waste generated currently by the TVA nuclear plants include paint, paint thinners, paint solids, discarded laboratory chemicals, spent fixer (X-ray solution), parts washer liquid, hydrazine, rags from hydrazine cleanup, and sulfuric acid and sodium hydroxide waste from demineralizer beds and makeup water treatment, and broken fluorescent bulbs. These operating plants tend to be EPA hazardous waste small quantity generators (SQGs) (i.e., they generate between 100 kg and 1,000 kg of hazardous waste per calendar month). During outages, these plants may temporarily become EPA hazardous waste large quantity generators (greater than 1,000 kg per calendar month) for the period of the outage. The operating TVA nuclear plants providing these generation rates are multiunit plants, thus it is likely that the proposed single unit plant would have a lower generation rate, and it is likely that the single unit plant would be a CESQG during normal operation. Based on waste totals from SQN from 2004 through 2008, operation of a single B&W unit would generate approximately 1,300 lb (approximately 600 kg) of hazardous, nonradiological per year.

Regardless, the hazardous wastes are shipped to the TVA HWSF in Muscle Shoals, Alabama, for interim storage prior to disposal at a permitted facility. The TVA HWSF has contracts for hazardous waste disposal by a number of methods (Table 3-11) with companies with significant disposal capacity.

In summary, under Alternative B, recycling of potential waste materials such as oils, wood/lumber, and scrap metal, reduces the pressure on sanitary and other landfill capacity, ultimately mitigating any potential adverse disposal effects. Furthermore, the likely implementation of a chemical traffic control program at the plant minimizes the discarded chemicals hazardous waste stream, reducing the pressure on hazardous waste disposal

landfill capacity, ultimately mitigating any potential adverse disposal effects. Because all of the solid and hazardous wastes would be disposed of off site, there would be no direct effects. Because the disposal of the solid and hazardous wastes from construction and operation would be in accordance with the applicable regulations and at permitted facilities, and these facilities currently have adequate capacity to serve BLN needs, any adverse effects from the generation, management, and disposal of these wastes are likely to be small. In addition, cumulative effects would be minimized by the use of permitted landfills. These facilities would provide substantive barriers separating the waste from the at-risk groundwater and would be capped as well, minimizing the cumulative effect of placing BLN and non-BLN waste in the same facility.

Alternative C

During the initial phase of construction, solid waste for this alternative would be generated from the demolition of several existing buildings, the construction of the new plant, and the clearing and grubbing of a limited amount of additional acreage. Based on a comparison of the existing structures on the Alternative B and Alternative C site plans (Figures 2-1 and 2-12), several buildings including the existing turbine building and the office and service building would need to be demolished.

Construction/demolition wastes are likely to include scrap metal, masonry, broken concrete, wallboard, lumber, manufactured wood products, cardboard, plastics, broken glass, roofing material, and such. The additional acreage to be disturbed is currently covered in overgrowth and some forestation (TVA 2008a). As a result, site preparation would generate some wood and other vegetative waste from the clearing and grubbing. As stated for Alternative B, the intended use of an existing cooling tower would require some maintenance and refurbishment and would result in similar effects. All solid wastes would be disposed of in state-approved landfills, as needed.

Hazardous waste generated during construction would include paint wastes, paint thinners, dried paint, and parts cleaning liquids. The COLA ER estimated that 5,000 lb (2,230 kg) of hazardous waste per year would be generated during the construction of a two-unit AP1000 plant. This translates into about 2,500 lb (1,115 kg) per year for Alternative C. Assuming a uniform distribution of the hazardous waste generation over the year would make the plant a CESQG. Therefore, based upon the assumption that construction of the AP1000 would last 6.5 years, an estimated 16,250 lb (8.1 tons) of hazardous waste would be generated during construction of the AP1000.

Anticipated nonradioactive waste for the operation of an AP1000 would include typical industrial wastes such as metal, wood, and paper, as well as process wastes such as nonradioactive resins, filters, and sludge (TVA 2008a). That study estimated “the plant [Units 3&4] would generate approximately 800 tons of nonhazardous, nonradiological solid waste (i.e., trash) during each year of plant operation.” Based on this estimate for two AP1000 units, the estimated quantity of nonhazardous, nonradiological solid waste generated annually during operation of a single AP1000 unit would be approximately 400 tons. Based on TVA’s experience, additional smaller amounts of nonhazardous waste, such as oily debris and desiccant, would be expected also.

Hazardous waste generated during normal plant operation would include paint wastes, paint thinners, dried paint, parts cleaning liquids, discarded chemicals, waste acid and waste base. Based on waste totals from SQN from 2004 through 2008, operation of a single AP1000 would generate about 1,300 lb (approximately 600 kg) of hazardous,

nonradiological waste per year. Assigning a uniform distribution of the hazardous waste generation over the year would make the plant a CESQG. Hazardous wastes would be shipped to the TVA HWSF for disposal.

As with Alternative B, the direct and cumulative effects on the environment from disposal of solid and hazardous waste disposal would be small.

3.15. Seismology

3.15.1. Affected Environment

TVA's 1974 FES describes the maximum historical Modified Mercalli Intensity (MMI, a scale of earthquake effects that ranges from Roman numeral I through XII) experienced at BLN from nearby earthquakes. Section 2.5 of the BLN FSAR (TVA 1986) describes the geology and seismicity in the vicinity of BLN and contains a summary of significant regional earthquakes through 1973. The seismic history of the region around BLN from 1974 through January 2005 is contained in Appendix 2AA of the COLA FSAR. Table 3-12 lists the most recent seismic history (February 2005 through December 2008) for earthquakes within 200 miles of BLN having magnitudes of 2.5 or greater based on the earthquake catalog maintained by the Advanced National Seismic System (ANSS) 2010.

Table 3-12. Earthquakes Within 200 Miles of BLN (February 2005-December 2008)[1]

Date	Time (Universal Coordinated Time)	Latitude (Degrees North)	Longitude (Degrees West)	Depth (km)	Magnitude	Magnitude Type
03/18/2005	01:02:16.3	35.723	-84.164	9.1	2.7	Md
03/22/2005	08:11:50.5	31.836	-88.060	5.0	3.3	ML
04/05/2005	20:37:42.6	36.147	-83.693	10.0	2.9	Md
04/14/2005	15:38:15.7	35.468	-84.091	15.5	2.8	Md
06/07/2005	16:33:36.7	33.531	-87.304	5.0	2.8	ML
10/12/2005	06:27:30.1	35.509	-84.544	8.1	3.3	Md
10/25/2005	05:18:10.5	34.429	-85.315	9.1	2.6	Md
10/28/2005	21:05:40.3	33.003	-83.094	14.4	2.7	Md
10/29/2005	23:46:20.7	33.034	-83.156	17.1	2.5	Md
03/11/2006	02:37:20.1	35.192	-87.996	0.0	2.9	Md
03/11/2006	08:08:54.2	32.712	-88.159	30.7	2.6	Md
04/11/2006	03:29:20.8	35.362	-84.480	19.6	3.3	Md
05/10/2006	12:17:29.2	35.533	-84.396	24.7	3.2	Md
05/16/2006	05:23:19.9	32.850	-88.087	20.5	2.5	Md
06/16/2006	00:57:26.8	35.512	-83.203	1.4	3.4	Md
07/11/2006	13:45:40.7	33.606	-87.146	1.0	2.8	ML
08/07/2006	08:44:27.7	34.937	-85.461	14.2	2.9	Md
09/05/2006	04:32:42.6	33.705	-82.992	10.2	2.5	Md
10/02/2006	19:56:19.2	35.468	-84.984	8.7	2.5	Md
12/18/2006	08:34:26.5	35.356	-84.351	17.7	3.3	Md
01/03/2007	23:05:44.7	35.916	-83.955	15.3	2.7	Md
01/30/2007	21:20:29.4	33.664	87.107	1.0	2.6	ML
02/07/2007	00:34:53.6	34.607	-85.308	10.7	2.6	Md
03/23/2007	14:15:33.3	33.652	-87.067	5.0	2.6	ML
05/04/2007	16:16:28.2	33.797	-87.299	5.0	3.0	ML
06/19/2007	18:16:26.8	35.793	-85.362	1.2	3.5	Md

Date	Time (Universal Coordinated Time)	Latitude (Degrees North)	Longitude (Degrees West)	Depth (km)	Magnitude	Magnitude Type
07/27/2007	17:16:39.8	33.834	-87.329	1.0	2.6	ML
10/23/2007	05:16:11.6	35.591	-84.104	21.3	2.8	Md
11/17/2007	19:22:55.7	37.393	-83.087	1.0	2.5	ML
01/01/2008	10:59:53.0	37.039	-88.894	4.0	2.5	Md
01/04/2008	14:55:28.5	33.106	-86.161	5.0	2.5	ML
01/23/2008	22:22:13.8	33.739	-87.180	1.0	2.8	ML
02/23/2008	17:03:18.5	33.864	-87.165	1.0	2.6	ML
04/08/2008	17:43:44.4	33.649	-87.502	1.0	2.6	ML
05/07/2008	16:44:35.1	33.691	-87.211	1.0	2.7	ML
05/10/2008	17:52:49.6	34.350	-88.835	0.0	3.1	Md
05/16/2008	18:39:14.9	31.773	-88.203	5.0	3.1	ML
06/23/2008	23:30:20.0	34.925	-84.841	8.8	3.1	Md
06/28/2008	01:40:36.5	33.276	-87.396	5.0	3.1	ML
08/19/2008	01:47:58.0	34.276	-87.988	0.0	2.6	Md
10/25/2008	23:47:17.3	36.052	-83.604	15.8	2.5	Md
10/31/2008	16:37:34.0	35.768	-84.000	7.6	2.9	Md
11/10/2008	02:29:00.8	35.766	-84.591	25.1	2.5	Md
12/18/2008	00:05:07.1	36.050	-83.592	9.5	3.3	Md

Md = Duration magnitude (USGS 2010)
ML = Local magnitude (USGS 2010)
[1] Source: Advanced National Seismic System Earthquake Catalog (2010)

The most significant earthquake to occur near BLN since 1973 was the Fort Payne earthquake, which occurred on April 29, 2003, in northeastern Alabama, near the Georgia border. This earthquake has a measured Lg wave magnitude (mbLg) of 4.9 and a moment magnitude (M) of 4.6 (USGS 2009). The Fort Payne earthquake caused minor damage, including damage to chimneys, cracked walls and foundations, broken windows, and collapse of a sinkhole 9 meters (29 feet) wide near the epicenter (Geological Survey of Alabama 2009). Based on reconnaissance in the epicentral area, no landslides were reported, and damage to chimneys was observed only for chimneys with masonry in poor/weakened condition. Other masonry, including chimneys in good condition, and several old masonry buildings did not appear to be damaged. The earthquake occurred at a depth of about 8 to 15 km (5.0 to 9.3 miles) (Kim 2009; USGS 2009). Based on the U.S. Geological Survey's Community Internet Intensity Map, the observed MMI at BLN would have been IV to V (USGS 2009). The Fort Payne earthquake's magnitude is still lower than that of the maximum historical earthquake in the southern Appalachians, which was the 1897 Giles County, Virginia, earthquake. The 1897 earthquake had a maximum MMI of VIII and an estimated body wave magnitude of 5.8. Therefore, the 2003 Fort Payne earthquake is well within the known historical maximum magnitude earthquake in the southern Appalachian region and is consistent with the earthquake history of the region described in TVA's 1974 FES, 1986 BLN FSAR, and 2009 BLN FSAR.

As the record of recent earthquakes indicates, small to occasionally moderate earthquakes continue to occur in the southern Appalachians. Data from regional seismic monitoring networks, which have been in operation since the 1980s, indicate that the vast majority of these earthquakes occur within the basement rocks of the southern Appalachians at depths from 5 to 26 km (3.1 to 16.1 miles). Reactivation of zones of existing weaknesses within

the basement rocks are believed to be responsible for present day earthquake activity in the region (Algermissen and Bollinger 1993).

3.15.2. Environmental Consequences

Alternative A
Under the No Action Alternative, because there would be no completion or construction and operation of a new plant, there would be no impacts.

Alternatives B and C
Given the historic record of seismic activity in the BLN region described above, TVA believes the basis for the safe shutdown earthquake described in Section 2.5 of the BLN FSAR (TVA 1986) is still valid. The largest historical earthquake in the Southern Appalachian Tectonic Province remains the 1897 Giles County, Virginia, earthquake.

TVA has performed feasibility studies relative to a comparison of the original seismic design basis spectra (NRC Regulatory Guide 1.60 Rev 1) (NRC 1973) to 10 CFR Part 50, Appendix S (Regulatory Guide 1.208 and Interim Staff Guidance) (NRC 2007a). The present regulatory requirements apply to new generation plant sites; however, TVA felt it prudent to perform analyses to understand how the BLN 1&2 original design and construction compared to the latest requirements. Based on results of these studies, it can be demonstrated that the existing seismic Category I structures compare favorably with the latest requirements (AREVA 2009b). At such time that an agreed regulatory framework is established for the completion of either BLN 1 or 2 under Alternative B, design-basis analyses would be performed to demonstrate compliance with regulatory requirements.

As a standard plant, the seismic adequacy of the AP1000 design proposed under Alternative C is addressed through the NRC's review and approval of the vendor-supplied Design Control Document (DCD).

3.16. Climatology and Meteorology, Air Quality, and Global Climate Change

The COLA ER contains an extensive discussion of the meteorology, air quality, and climatology for the BLN site. The COLA ER used information contained in TVA's 1974 FES, on-site data from 1979 to 1982, more recent climatological records, and on-site data for 2006-2007. This information is supplemented in the following sections by data collected for 15 additional months, into 2008.

3.16.1. Climatology and Meteorology

3.16.1.1. Affected Environment

Regional Climatology
The overall regional climate description in the COLA ER remains accurate, as conditions since the application was submitted are consistent with those reported. The COLA ER acknowledged the 2006-2008 drought; however, it was not possible to make substantive conclusions about the impacts of the drought because it was ongoing. Since the application was submitted, the drought has ended, and conditions have returned to near normal. Although this drought represented extreme conditions for northeast Alabama and adjacent areas, it was not as intense as the other regional droughts discussed in the COLA ER in terms of magnitude and duration.

Local Meteorology

The meteorological data collected from the BLN meteorological facility have been expanded by an additional 15 months beyond the 2006-2007 period used in the COLA ER. The data for the full 2006-2008 period are presented in Appendix I. The different data periods (1979-1982, 2006-2007 COLA, and 2006-2008 full period) are compared in Appendix J. The differences between the three data periods are within the normal year-to-year variation for Bellefonte. The conclusions in the COLA ER are updated as discussed below.

The COLA ER discussed only the winds measured at 10 meters above the ground (10-meter winds) and atmospheric stability represented by temperatures measured between 55 and 10 meters above the ground (55-10 meter atmospheric stability), because only that information was relevant to the AP1000 units. However, because of the potential for elevated releases of radioactive effluent from the B&W reactor (releases into the air that rise above the influence of the plant structures), it is also necessary to examine the winds measured at 55 meters above the ground (55-meter winds).

10-meter winds--For the entire 2006-2008 sampling period of 27 months, the most frequent wind directions at 10 meters are from the north-northeast at 13.15 percent and from the south-southwest at 12.54 percent. This is consistent with the downvalley-upvalley flow pattern in the COLA ER and the earlier 1979-1982 data collected at BLN.

The average wind speed of 4.11 miles per hour (mph) equals the value in the COLA ER but is less than the 4.95 mph for the 1979-1982 data. The frequency of calms (defined as wind speeds less than 0.6 mph decreased from 0.753 percent in 1979-1982 to 0.397 percent in 2006-2008.

55-10 meter atmospheric stability--The 2006-2008 data were measured for a 55-10 meter layer, while the 1979-1982 data were measured for a 60-10 meter layer. This slight difference in layer depth should have minimal impact on stability class.

The differences between the 1979-1982 data, the BLN COLA ER data, and the data for the entire 2006-2008 sampling period of 27 months are summarized in Table 3-13.

Table 3-13. Comparison of Atmospheric Stability Data Collected at BLN (Percent Occurrence)

Stability Classification	1979-1982	2007 COLA ER	2006-2008
Unstable (Classes A, B, and C)	8.93	7.3	7.63
Neutral (Class D)	48.75	44.4	44.11
Stable (Classes E, F, and G)	42.33	48.2	48.27

Notes: 1979-1982 data were measured for a 60-10 meter layer above ground. 2006-2007 and 2006-2008 data were measured for a 55-10 meter layer above ground. The 2006-2007 data were used in the COLA ER. The 2006-2008 includes the COLA ER data plus an additional 15 months of data.

The COLA ER states “stability class frequency distributions show that the BLN site data gathered over both time periods (1979-1982 and 2006-2007) are relatively similar.” Because the data for the entire 2006-2008 period agree closely with the COLA ER, this conclusion still applies.

55-meter winds--The 2006-2008 data were measured at 55 meters above ground, while the 1979-1982 data were measured at 60 meters above ground. This slight difference in elevation should have minimal impact on interpretation of wind data.

For the entire 2006-2008 sampling period of 27 months, the most frequent wind directions at 55 meters are from the northeast at 18.35 percent, from the north-northeast at 15.13 percent, and from the south-southwest at 11.97 percent. This is consistent with the downvalley-upvalley flow pattern in the 1979-1982 data.

The average wind speed of 6.46 mph is less than the 7.13 mph for the 1979-1982 data. The frequency of calms (defined as wind speeds less than 0.6 mph) decreased from 0.085 percent in 1979-1982 to 0.005 percent in 2006-2008.

Severe Weather
During 1980-2008, 17 tornadoes occurred in Jackson County, including two storms with a strength of F4/EF-4. Of these tornadoes, seven (including one EF-4 tornado) had tracks (all or part) within 10 miles of the BLN site. Appendix K lists these tornadoes.

In addition to tornadoes, numerous other significant weather events were identified for Jackson County during 1980-2008 from the National Climatic Data Center (NCDC) Storm Events Web site (NCDC 2010). These include the following events:

- 22 Months of Drought (March 2007-December 2008)
- 17 Flood
- 1 Funnel Cloud
- 73 Hail (0.75-2.75 in)
- 3 Hurricane and Tropical Storm
- 10 Lightning
- 3 Precipitation (Heavy Rain)
- 21 Snow and Ice
- 5 Temperature Extremes (3 cold, 2 hot)
- 144 Thunderstorm and High Wind

These are generally typical numbers of events for the region based on equivalent information from surrounding counties.

Subsection 2.7.1.2 of the COLA ER describes possible impacts of hurricanes, tornadoes, thunderstorms, and hail at BLN. This section remains accurate with the exception of the tornado probability discussion in Subsection 2.7.1.2.2.

The COLA ER estimate is based on 1950-2005 data. Based on data from Jackson County alone, the probability of a tornado striking the site is calculated as 2.84E-4 (or a 0.000284/1 chance of a tornado striking the site within any single year). This converts to a tornado striking the site every 3,516 years (i.e., recurrence interval of 3,516 years). For data based on Jackson County and five surrounding counties, this probability is 6.44E-4 with a recurrence interval of 1,552 years.

When the tornado database extends to 2008, the probability calculation changes to 4.1E-4 with a recurrence interval of 2,460 years (for Jackson County only). For data based on Jackson County and five surrounding counties, this probability is 6.7E-4 with a recurrence interval of 1,482 years.

3.16.1.2. Environmental Consequences

Alternative A
Under the No Action Alternative, because there would be no completion or construction and operation of a new plant, there would be no impacts.

Alternatives B and C
Atmospheric dispersion, or the transport and dilution of radioactive materials in the form of aerosols, vapors, or gasses released into the atmosphere from a nuclear power station are a function of the state of the atmosphere along the plume path, the topography of the region, and the characteristics of the effluents themselves. The downwind concentrations of released materials are estimated by atmospheric dispersion models and analysis. Atmospheric dispersion analysis considers two categories of radiological releases: routine and accident. The atmospheric dispersion (χ/Q) values for the B&W units were estimated for both release types using meteorological data collected at BLN during 2006-2008. The AP1000 atmospheric dispersion (χ/Q) values were estimated using meteorological data collected at BLN during 2006-2007 in order to maintain consistency with the atmospheric dispersion (χ/Q) values reported in the BLN COLA. Low atmospheric dispersion (χ/Q) values are indicative of better transport and dilution of released effluents. In all cases, the atmospheric dispersion characteristics of the BLN site result in off-site doses within the regulatory limits of 10 CFR Part 100 for accident effluent releases and 10 CFR Part 20 for normal effluent releases (see Section 3.17).

Routine Releases
For routine airborne releases, the concentration of the radioactive material in the surrounding region depends on the amount of effluent released, the height of the release, the momentum and buoyancy of the emitted plume, the wind speed, atmospheric stability, airflow patterns of the site, and various effluent removal mechanisms. Geographic features and surface roughness can also influence dispersion and airflow patterns.

NRC Regulatory Guide 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors” (NRC 1977b), identifies types of atmospheric transport and diffusion models, source configuration, removal mechanisms, and input data that are acceptable to the NRC for use in providing assessments of potential annual radiation doses to the public resulting from routine releases of radioactive materials in gaseous effluents. The guidance on acceptable models and necessary input data provided in Regulatory Guide 1.111 are utilized in the calculation of annual average relative concentration (χ/Q) and annual average relative deposition (D/Q) values for gaseous effluent routine releases from BLN.

The XOQDOQ software, “Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations,” which is provided under NUREG/CR-2919 (NRC 1982b) and implements the guidance in Regulatory Guide 1.111, was used to develop these χ/Q and D/Q values. This program is used by the NRC meteorology staff in their independent evaluation of routine or anticipated intermittent releases at nuclear power plants.

Figures 3-17 and 3-18 provide the site layout and distances to the EAB for the B&W and AP1000 reactor units, respectively. Figures 3-19 and 3-20 provide the release vents and building heights for the B&W and AP1000 reactor units, respectively. Figure 3-21 provides the off-site receptor locations.

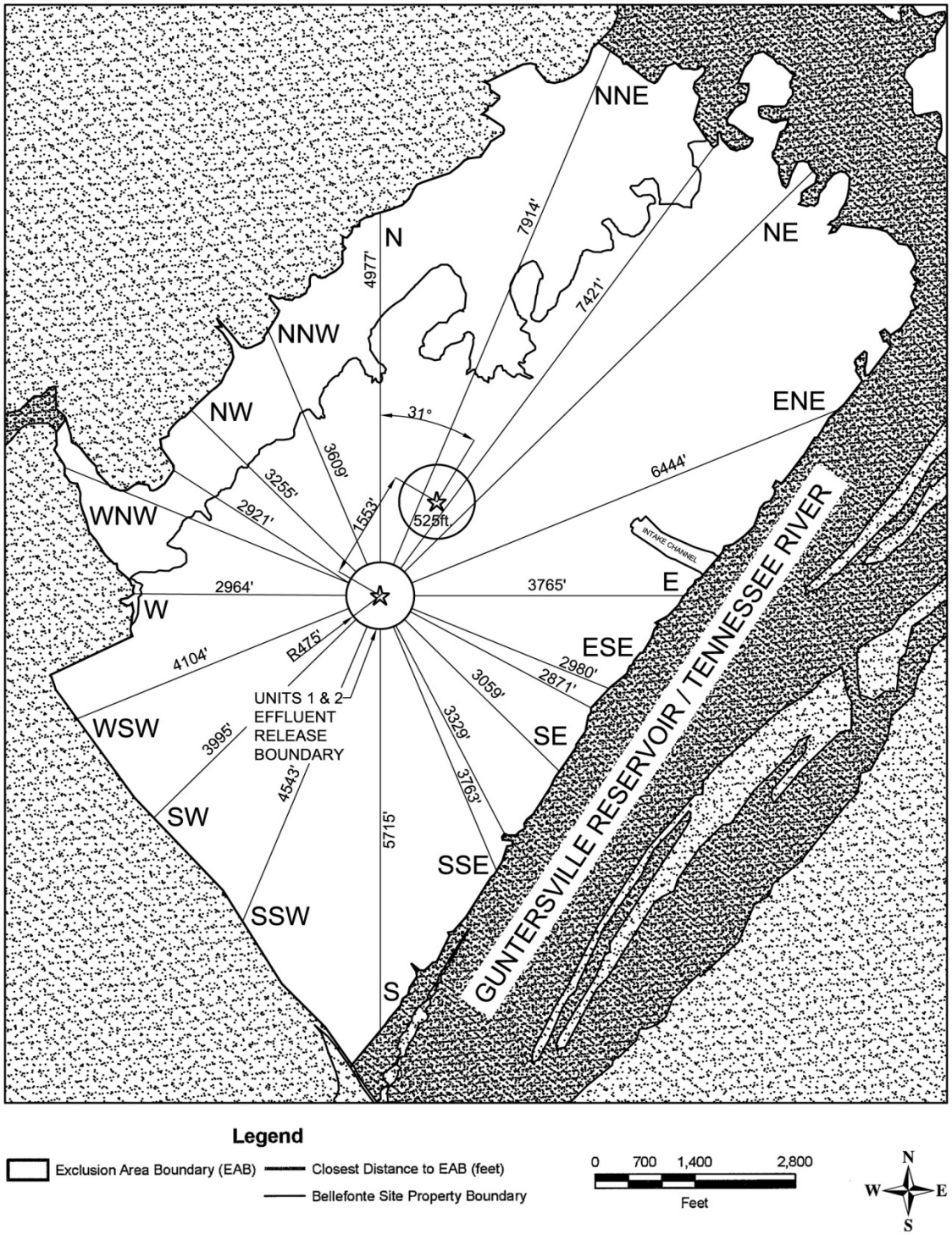


Figure 3-17. EAB Distance for B&W Reactor Unit Layout

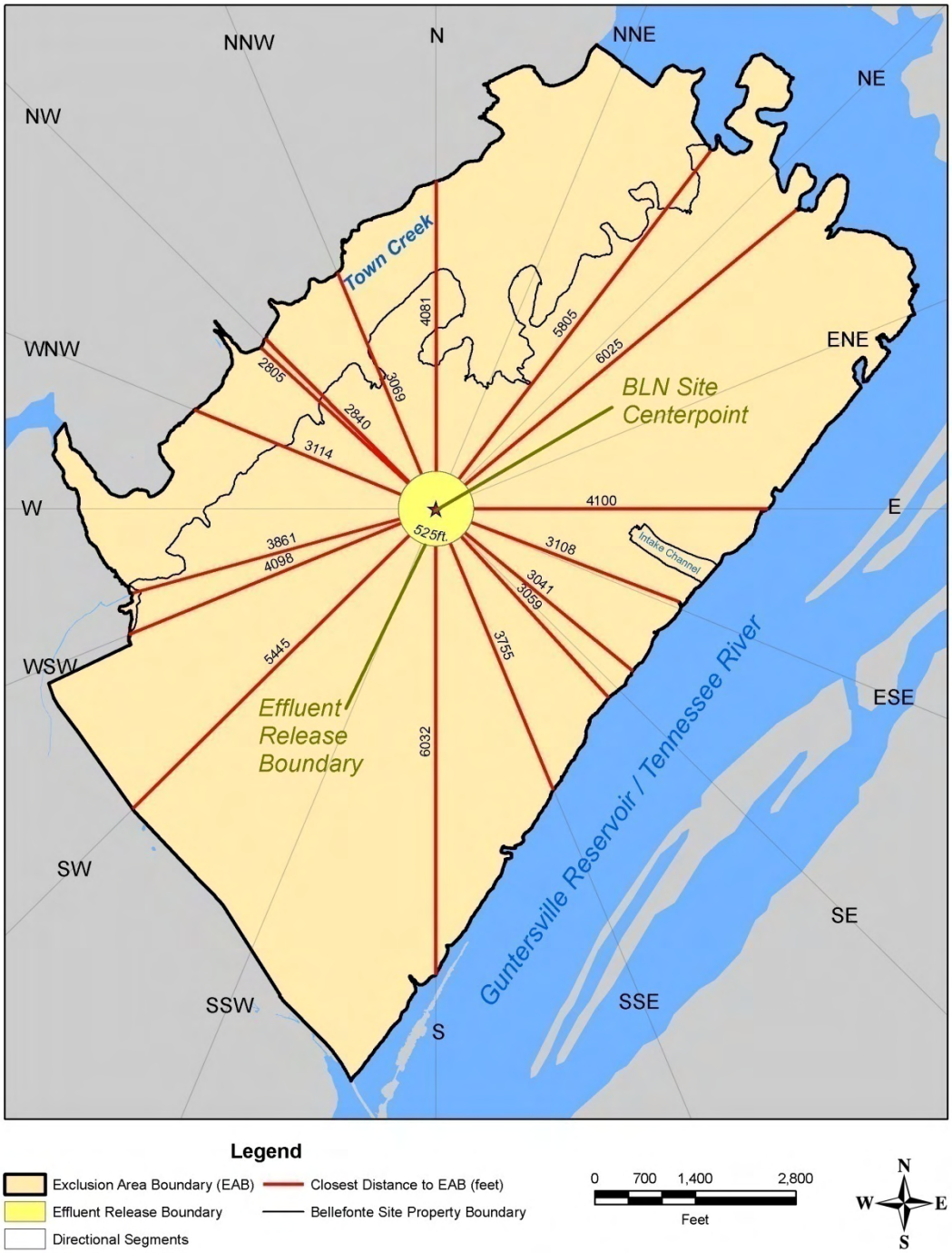


Figure 3-18. EAB Distance for AP1000 Reactor Units

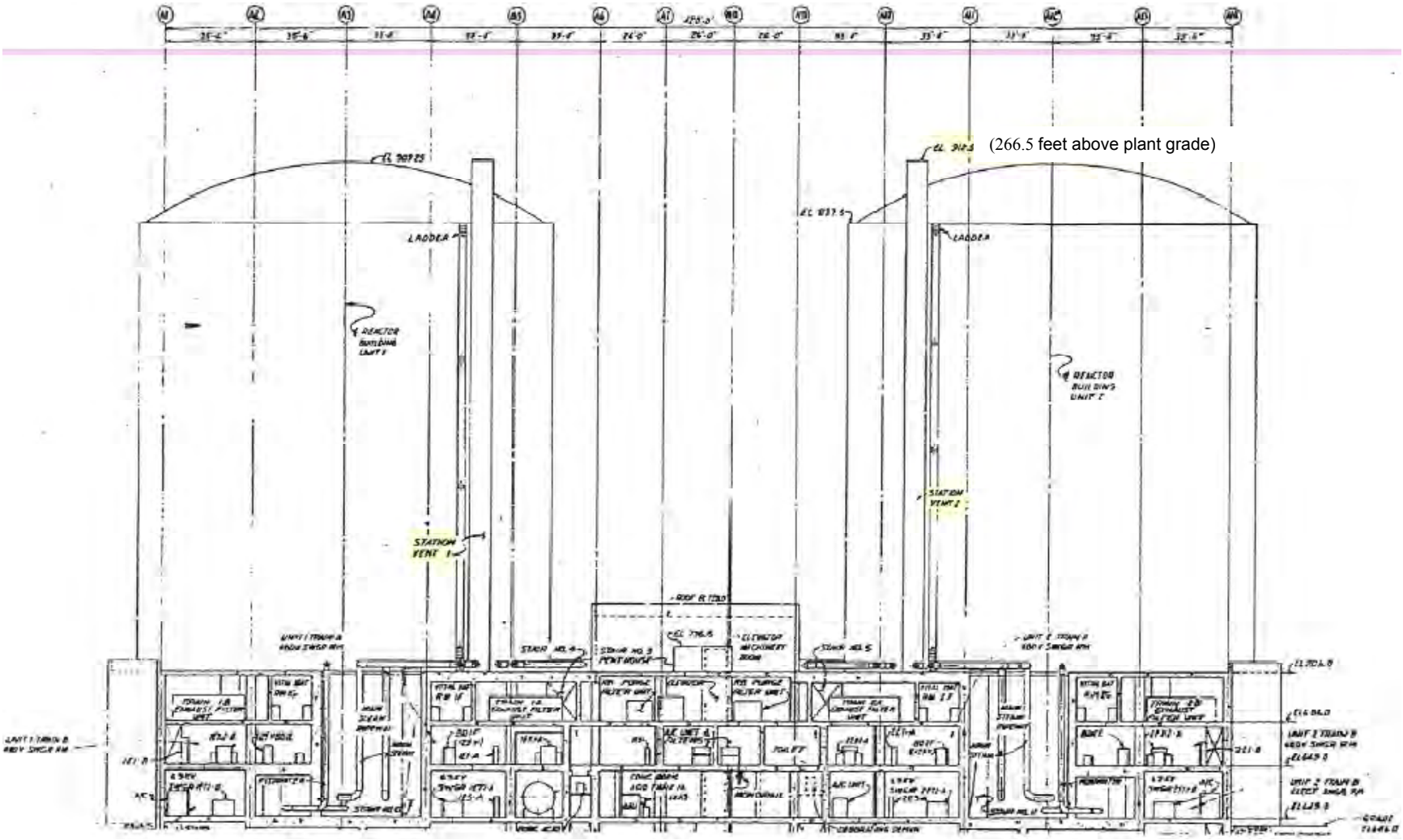
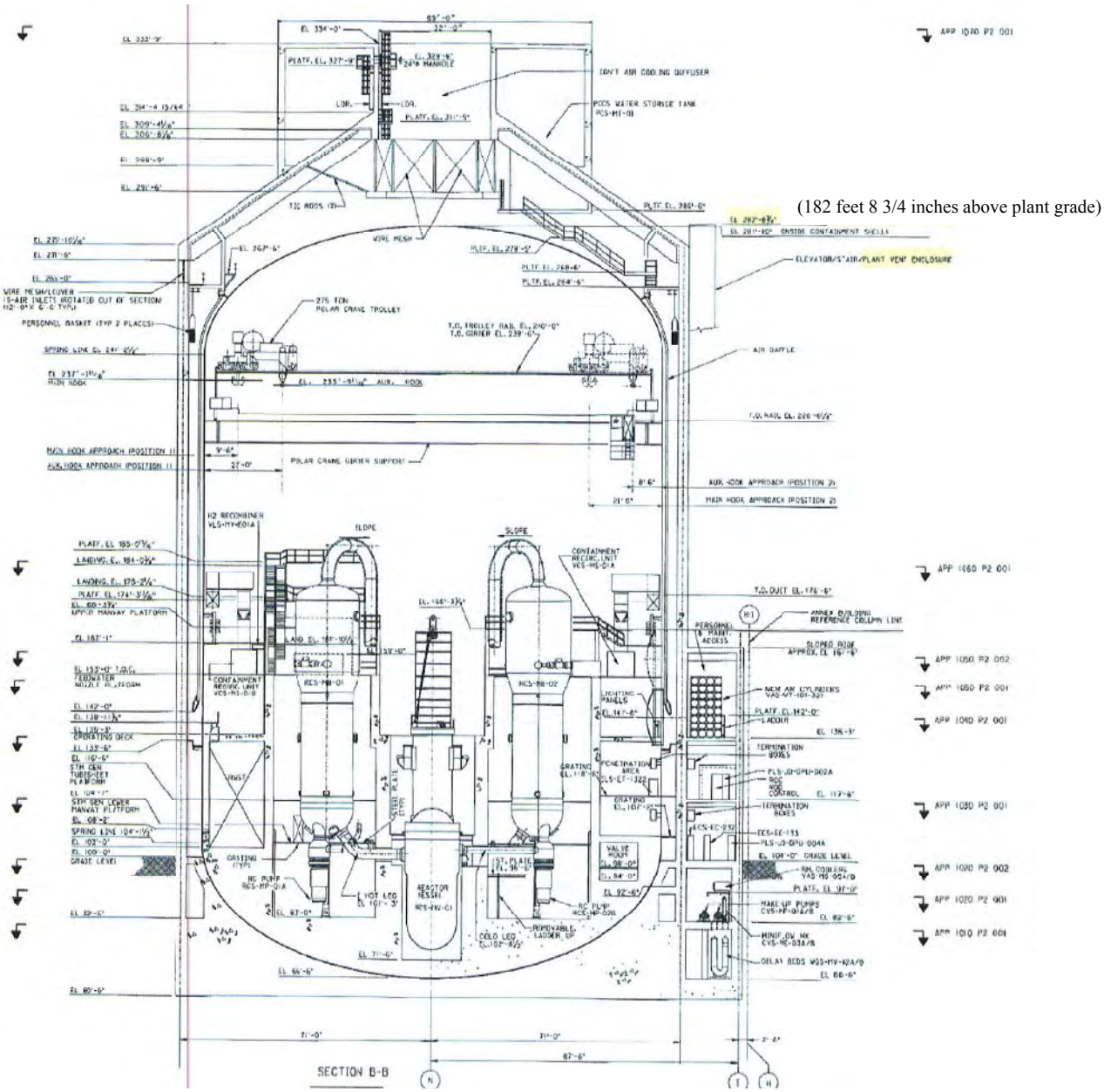
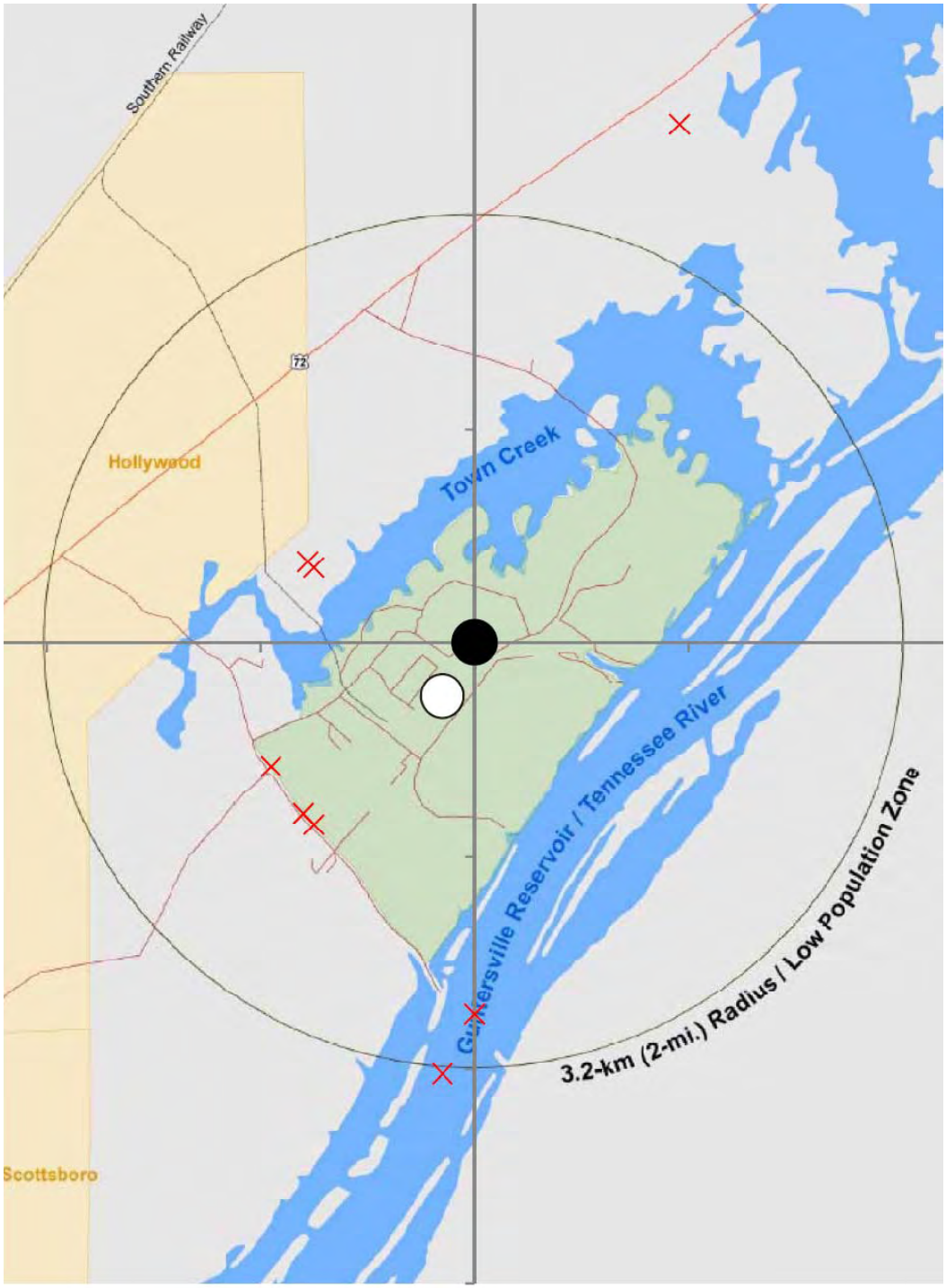


Figure 3-19. B&W Reactor Plant Vents and Building Heights



Source: WEC 2008

Figure 3-20. AP1000 Reactor Plant Vents and Building Heights



✕ Maximum Receptor Locations ● AP1000 ○ B&W

Note that the more conservative atmospheric dispersion (χ/Q) value of either a physical receptor location or a peak (χ/Q) value location were used for each pathway and dose analysis. Because peak (χ/Q) value locations do not represent a physical receptor type and are dependent only on meteorological conditions, distance from the release point, and release point conditions, the physical peak (χ/Q) locations may exist over water. These values and locations are used, regardless, for conservatism.

Figure 3-21. Maximum Atmospheric Dispersion (χ/Q) Value Receptor Locations

The atmospheric dispersion factors for normal releases were determined to provide a conservative estimate of the off-site doses due to normal airborne effluent releases. The locations with the highest χ/Q and D/Q values outside the EAB result in the most conservative off-site doses. Normally, the atmospheric dispersion factors decrease linearly with distance from the site such that larger distances produce lower concentrations (i.e., smaller χ/Qs). However, because a mixed-mode release is used for the station vent, there are locations outside of the site boundary where the χ/Q and D/Q values peak due to aerodynamic downwash. Therefore, the atmospheric dispersion (χ/Q) value used for each receptor type is the more conservative of the maximum peak χ/Q value or the χ/Q value for the actual receptor.

The dose pathways are evaluated at the most conservative location outside the EAB where a receptor currently exists. Because a mixed-mode release is also used, there are locations outside of the site boundary where the χ/Q and D/Q values peak. However, a comparison of the locations of the peaks to the locations of the nearest receptors in each sector demonstrates that the peaks occur at distances closer than the nearest receptor identified in the appropriate sectors. Because there are no actual receptors at the peak locations, the receptor location with the maximum χ/Q and D/Q values was used to evaluate all pathways except doses due to immersion in the plume. The highest χ/Q and D/Q values occur at the nearest garden in the southwest sector.The calculated atmospheric dispersion (χ/Q) values are a means of quantifying the relative concentration of released effluents. These values, in conjunction with the isotopic source description of the released effluents, are used to produce doses due to the released effluents. In order to account for radioisotope removal mechanisms accurately, atmospheric dispersion (χ/Q) values are calculated taking into account radioisotope removal via decay in transit corresponding to noble gas radionuclide Xe-133m decay (2.26-day half-life) [see Tables 3-14, 3-15, and 3-16, 2.26-day decay undepleted χ/Q values]. Atmospheric dispersion factors with decay and depletion are used in population dose calculations. For this case, radiological decay in transit is included corresponding to radioiodine I-131 (8-day half-life). Ground deposition factors (D/Qs) are used in population dose calculations. The ground deposition factors do not include radiological decay.

The B&W unit uses two main release locations, the station vent (266 feet above plant grade) and the turbine building vent (152 feet above plant grade). In accordance with the guidance from NRC Regulatory Guide 1.111, the station vent was modeled as a mixed-mode release because the release height is above the height of adjacent buildings. The turbine building vent was modeled as a ground level release because the release height is less than the containment building elevation. The locations with the Maximally Exposed Individual (MEI) doses are presented in Table 3-14 (station vent) and Table 3-15 (turbine building). In Tables 3-14 and Table 3-16, the column titled “Maximum Receptor Type Values” indicates whether the value selected represents an actual receptor location or whether the peak value is conservatively used as a surrogate location. This distinction is not necessary for Table 3-15 because the turbine building releases are ground level releases that do not exhibit off-site peak values. The distances given in Tables 3-14 and 3-15 are relative to the center point between Units 1 and 2. Likewise, the distances given in Table 3-16 are relative to the center point between Units 3 and 4.

The AP1000 unit uses the plant vent release location (182.6 feet above grade), which was modeled as a mixed-mode release as it is near the elevation of the tallest adjacent building. The locations with the MEI doses are presented in Table 3-16. In this table, the cow, goat,

and house receptor locations were assumed to be at the garden location to maximize the resulting doses even though these receptors do not occur at this location.

Table 3-14. B&W Unit Station Vent χ/Q Values Used for Calculating MEI Doses at BLN

Receptor Type Analyzed	Direction	Maximum Receptor Type Values	Distance (miles)	χ/Q (sec/m^3) No Decay Undepleted	χ/Q (sec/m^3) 2.26 Day Decay Undepleted	χ/Q (sec/m^3) 8.00 Day Decay Depleted	D/Q (m^{-2})
EAB	S	PEAK	1.77	2.4E-06	2.3E-06	2.3E-06	4.1E-09
GARDEN	SW	GARDEN	0.85	1.2E-06	1.2E-06	1.1E-06	8.3E-09
COW	S	PEAK	1.77	2.4E-06	2.3E-06	2.3E-06	4.1E-09
GOAT	S	PEAK	1.77	2.4E-06	2.3E-06	2.3E-06	4.1E-09
HOUSE	S	PEAK	1.77	2.4E-06	2.3E-06	2.3E-06	4.1E-09

Note: Receptor locations with maximum D/Q or χ/Q values for each receptor type for the station vent mixed-mode release

Table 3-15. BLN B&W Unit Turbine Building Vent χ/Q Values Used for Calculating MEI Doses

Type of Location	Sector	Distance (miles)	χ/Q (sec/m^3) No Decay Undepleted	χ/Q (sec/m^3) 2.26 Day Decay Undepleted	χ/Q (sec/m^3) 8.00 Day Decay Depleted	Max D/Q (m^{-2})
EAB	W	0.56	2.9E-05	2.9E-05	2.6E-05	2.9E-08
GARDEN	SW	0.85	2.0E-05	2.0E-05	1.7E-05	3.8E-08
COW	NW	0.89	6.1E-06	6.1E-06	5.4E-06	7.9E-09
GOAT	NNE	2.9	1.9E-06	1.8E-06	1.5E-06	1.9E-09
HOUSE	NW	0.81	7.8E-06	7.7E-06	6.9E-06	1.0E-08

Note: Receptor locations with maximum D/Q or χ/Q values for each receptor type for the turbine building ground-level release

Table 3-16. BLN AP1000 Unit χ/Q Values Used for Calculating MEI Doses

Receptor Type Analyzed	Direction	Maximum Receptor Type Values	Distance (miles)	χ/Q (sec/m^3) No Decay Undepleted	χ/Q (sec/m^3) 2.26 Day Decay Undepleted	χ/Q (sec/m^3) 8.00 Day Decay Depleted	D/Q (m^{-2})
EAB	S	PEAK	1.74	2.8E-06	2.7E-06	2.7E-06	4.8E-09
GARDEN	SW	GARDEN	1.13	1.1E-06	1.1E-06	1.0E-06	4.8E-09
COW	SW	GARDEN	1.13	1.1E-06	1.1E-06	1.0E-06	4.8E-09
GOAT	SW	GARDEN	1.13	1.1E-06	1.1E-06	1.0E-06	4.8E-09
HOUSE	SW	GARDEN	1.13	1.1E-06	1.1E-06	1.0E-06	4.8E-09

Reference: BLN AP1000 COL Application, Environmental Report Table 2.7-125

Note: Receptor locations with maximum D/Q or χ/Q values for each receptor type for the station vent mixed-mode release

As shown in Subsection 3.17.3.1, the favorable atmospheric dispersion characteristics presented in the above tables result in annual gaseous-effluent doses within the limits of Appendix I of 10 CFR Part 50 to any individual in unrestricted areas. Because of the favorable atmospheric dispersion at the BLN site, the doses due to routine gaseous effluents, when added to the doses due to liquid effluent releases, meet the requirements of 10 CFR §20.1301 and are not significant. The direct, indirect, and cumulative effects of routine gaseous and liquid effluent releases are expected to be minor.

Accidental Releases

The accident χ/Q values were determined for time periods of two hours, eight hours, 16 hours, four days, and 30 days, in accordance with the guidance of Regulatory Guide 1.145 and Regulatory Guide 1.70. The releases were conservatively modeled as ground-level releases because the highest release location, the plant vent, is less than 2.5 times the height of adjacent buildings.

For accidental releases to the EAB, the χ/Q calculations use a release boundary to determine distances. The release boundaries define the perimeters around all of the release locations for each unit. Therefore, all potential release locations would be contained within this release boundary. Receptor distances are then calculated based on the distance from the closest point on the release boundary perimeter to the EAB. For each of the 16 direction sectors, the distance used in this analysis represents the minimum distance to the EAB within a 45-degree sector centered on the compass direction of interest. This approach conservatively encompasses all release locations and results in higher accident χ/Q values at the EAB. For the B&W unit, a release boundary with a radius of 475 feet centered near the midpoint of the turbine building was used. For the AP1000 Unit, a release boundary with a radius of 525 feet centered on the BLN 3&4 site center was used.

For accidental releases to the Low Population Zone (LPZ), a circle with a 2-mile radius from the BLN site center is used, as shown in Figure 3-21.

In accordance with Regulatory Guide 1.145, the 50 percent probability χ/Q values were determined to provide more realistic doses (Tables 3-17 and 3-18).

Table 3-17. BLN B&W Unit 50 Percent Probability-Level Accident χ/Q Values (sec/m3)

Affected Area	0-2 Hours	0-8 Hours	8-24 Hours	24-96 Hours	96-720 Hours
EAB	1.07E-04				
LPZ		9.39E-06	8.09E-06	5.84E-06	3.66E-06

Table 3-18. BLN AP1000 Unit 50 Percent Probability-Level Accident χ/Q Values (sec/m3)

Affected Area	0-2 Hours	0-8 Hours	8-24 Hours	24-96 Hours	96-720 Hours
EAB	1.04E-04				
LPZ		9.65E-06	8.35E-06	6.09E-06	3.88E-06

The favorable atmospheric dispersion characteristics presented in the above tables result in accident doses at the EAB and LPZ that are well within the limits of 10 CFR Part 100, thereby demonstrating site suitability. The design-basis Loss-of-Coolant Accident (LOCA) dose results presented in Subsection 3.19.1 show that the highest EAB dose is 1.2 rem Total Effective Dose Equivalent (TEDE), compared with the 25 rem TEDE regulatory limit. As another means of comparison, the annual average dose per person from all sources is about 360 mrem (0.36 rem). Therefore, the doses due to accidental releases are not significant.

3.16.2. Air Quality

3.16.2.1. Affected Environment

The 1974 TVA FES identified anticipated gaseous emission rates from auxiliary systems for particulate matter (PM), sulfur dioxides, carbon monoxide, hydrocarbons, and nitrogen oxides. In the intervening years, different air quality standards and criteria have been developed and implemented. According to the 1974 FES, the oil-fired auxiliary steam generators would, at peak load, release sulfur oxides to the atmosphere from a 125-foot stack at a rate of almost 143 lb/hour or 18 grams/second. The maximum SO_2 concentration was calculated to be 0.12 ppm. This peak would occur quite close to the plant stack and decrease quite rapidly with distance. At the time of the 1974 FES, the State of Alabama SO_2 standard was 0.15 ppm for a 24-hour average. The current EPA NAAQS for SO_2 is 0.14 ppm for a 24-hour average. The 1974 FES concluded that the SO_2 releases from the oil-fired auxiliary steam generators were acceptable. The COLA ER Regional Air Quality section updated and discussed recent air quality criteria and attainment status of the area. It references an 8-hour ozone standard of 0.08 ppm, which is the 1997 standard. The newly revised 2008 8-hour ozone standard is 0.075 ppm. The $PM_{2.5}$ 24-hour standard has also been lowered from 65 micrograms per cubic meter (μg/m^3) to 35 μg/m^3, although this standard was not specifically referenced in the COLA ER.

A pertinent “air-shed” for the BLN site cannot be defined as parcels of air move among undefined boundaries, and regional pollutants are capable of long-range transport. However, the COLA ER identifies Jackson County as being located within the Tennessee River Valley (Alabama)-Cumberland Mountains (Tennessee) Interstate Air Quality Control Region. This region includes Colbert, Cullman, DeKalb, Franklin, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marion, Marshall, Morgan, and Winston counties in Alabama and Bledsoe, Coffee, Cumberland, Fentress, Franklin, Grundy, Marion, Morgan, Overton, Pickett, Putnam, Scott, Sequatchie, Warren, White, and Van Buren counties in Tennessee (40 CFR §81.72). Typically, Class 1 areas are only identified within a 100-km radius of the site. The two Class 1 areas nearest to BLN are the Cohutta Wilderness, located in north Georgia, and the Sipsey Wilderness, located in north Alabama. Both are outside the 100-km radius from BLN. This information is shown on Figure 3-22.

The COLA ER identified Jefferson and Shelby counties in Alabama as being designated nonattainment for 8-hour ozone. Since the COLA ER, some of the nonattainment designations have changed for ozone. The original implementation schedule for the new NAAQS required states to send their recommended designations to EPA in March 2009 with EPA finalizing designations in March 2010. However, EPA is now reconsidering the ground-level ozone standards set in 2008. EPA is proposing to strengthen the 8-hour “primary” ozone standard to a level within the range of 0.060-0.070 ppm and to establish a distinct cumulative, seasonal “secondary” standard within the range of 7-15 ppm-hours. EPA will issue final standards by August 31, 2010. If the EPA issues different ozone

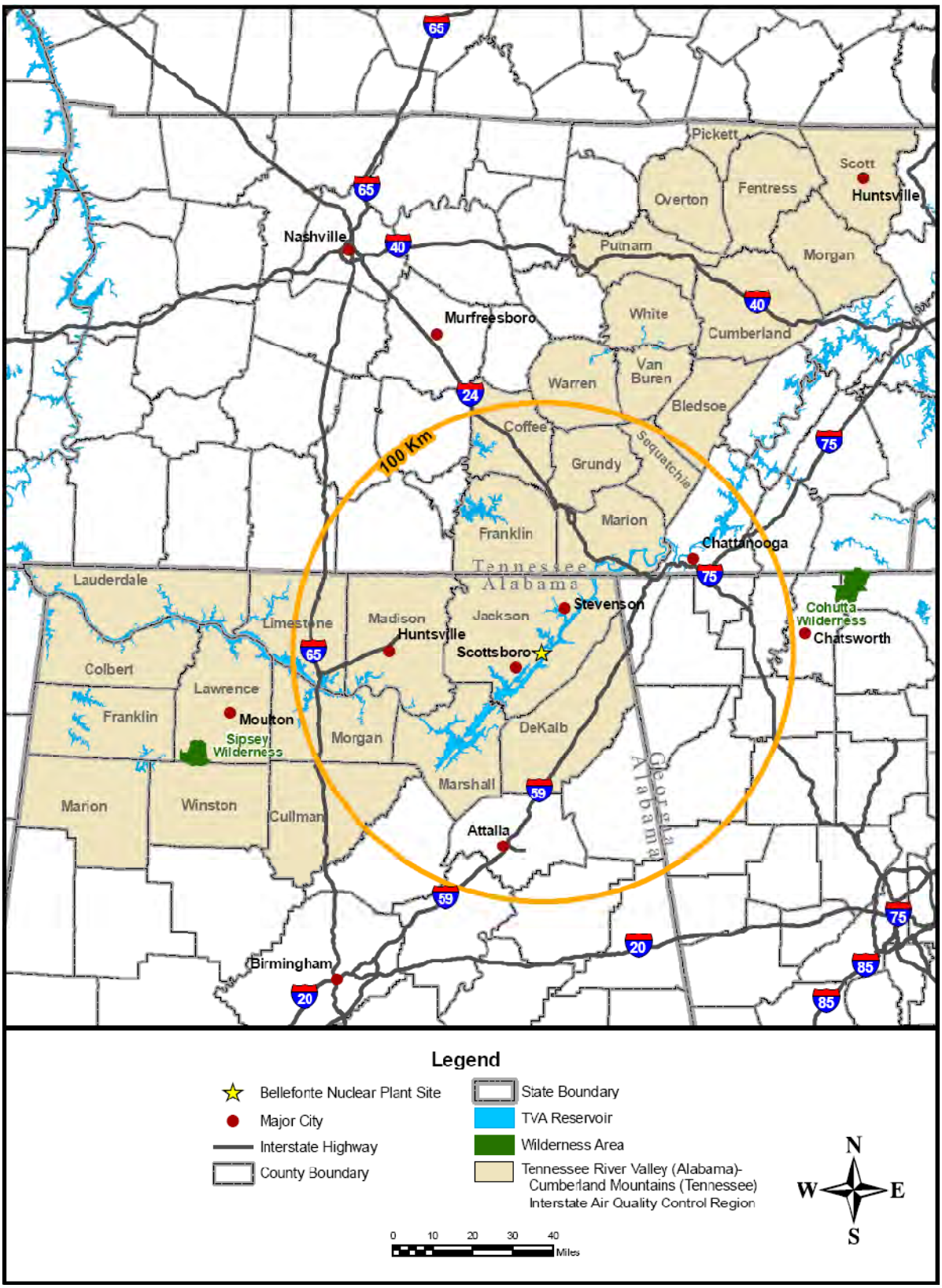


Figure 3-22. BLN 100 Kilometer Wilderness Area

standards at that time, an accelerated schedule for designating areas for the primary standard has been proposed. State recommendations would be due by January 2011, with EPA making final area designations by July 2011. As shown in Table 3-19, areas recommended for nonattainment designation in the vicinity of the Bellefonte site are located in north Alabama, north Georgia, and southeast Tennessee.

Table 3-19. Current Ozone Nonattainment State Recommendations Near BLN

County	State Recommendations	City/State
Jefferson County, Alabama	Ozone - Whole County	Birmingham, Ala.
Shelby County, Alabama	Ozone - Whole County	Birmingham, Ala.
Madison County, Alabama	Ozone - Whole County	Huntsville, Ala.
Murray County, Georgia	Ozone - Partial County	Georgia
Hamilton County, Tennessee	Ozone - Whole County	Chattanooga, Tenn.
Meigs County, Tennessee	Ozone - Whole County	Chattanooga, Tenn.

Source: EPA 2008b

The COLA ER identified the Birmingham area counties of Jefferson, Shelby, and part of Walker as being designated nonattainment for 24-hour $PM_{2.5}$. In addition, part of Jackson County was designated nonattainment due to Chattanooga exceeding the annual $PM_{2.5}$ NAAQS. As discussed previously, the $PM_{2.5}$ 24-hour standard was lowered in 2006 from 65 µg/m^3 to 35 µg/m^3, with EPA finalizing designations in December 2008. At this time, EPA retained the 1997 annual fine particle standard of 15 µg/m^3, with designations effective since 2005. As shown in Table 3-20, the nearest nonattainment areas to the Bellefonte site are located in central Alabama and east Tennessee. It should be noted that the portion of Jackson County that is listed as nonattainment does not encompass the area around the Bellefonte site.

Table 3-20. Current $PM_{2.5}$ Nonattainment Designations Near BLN

County	Designation	City/State
Jefferson County, Ala.[1]	$PM_{2.5}$ - Whole County	Birmingham, Ala.
Shelby County, Ala.[1]	$PM_{2.5}$ - Whole County	Birmingham, Ala.
Walker County, Ala.[1]	$PM_{2.5}$ - Partial County	Birmingham, Ala.
Jackson County, Ala.[2]	$PM_{2.5}$ - Annual Only - Partial County	Chattanooga, Tenn.-Ga.
Catoosa County, Ga.[2]	$PM_{2.5}$ - Annual Only - Whole County	Chattanooga, Tenn.-Ga.
Walker County, Ga.[2]	$PM_{2.5}$ - Annual Only - Whole County	Chattanooga, Tenn.-Ga.
Hamilton County, Tenn.[2]	$PM_{2.5}$ - Annual Only - Whole County	Chattanooga, Tenn.-Ga.

[1] EPA 2006
[2] EPA 1997

3.16.2.2. Environmental Consequences

Alternative A
Under the No Action Alternative, the equipment would not be replaced nor operated, and there would be no increase in vehicular traffic; therefore, these emissions would not occur.

Alternatives B and C
Under Alternative B, construction activities and intermittent operation of emergency diesel generators and potentially the auxiliary boilers would emit small amounts of air pollutants as addressed in the 1974 TVA FES. Adoption of Alternative C would involve more construction activities than Alternative B, while activities related to operations of Alternative C would be roughly equivalent to, or slightly less than, those under Alternative B.

The current EPA NAAQS for SO_2 is 0.14 ppm for a 24-hour average. The 1974 FES concluded that the SO_2 releases from the oil-fired auxiliary steam generators were acceptable. Even with the slightly lower NAAQS, it is still believed that these releases are acceptable. The auxiliary oil-fired boilers associated with the B&W auxiliary steam generators have since been sold and various options for their replacement are being considered, including an electric boiler, which would have no emissions. Because the AP1000 also utilizes an electric boiler, no emissions would occur from the auxiliary boiler with Alternative C. Therefore, operational activities, emissions, and impacts related to Alternative C would be roughly equivalent to, or less than those under Alternative B. The emissions related to either alternative would be controlled to meet applicable regulatory requirements such that resulting impacts are minor.

According to workload projections for Alternative B, an estimated peak of approximately 3,000 personnel would be on site during construction, and approximately 800 personnel would be on site once the plant is operational. Based on these projections and ALDOT statistics for Jackson County, anticipated vehicular traffic would increase as much as 21 percent during peak construction and as much as 6 percent after the plant becomes operational. According to workload projections for Alternative C, an estimated peak of approximately 3,000 personnel would be on site during construction, and approximately 650 personnel would be on site once the plant is operational. Based on these projections and ALDOT statistics for Jackson County, anticipated vehicular traffic would increase as much as 20 percent during peak construction and as much as 5 percent after the plant becomes operational. These percentages are “worst case” meaning they assume that none of the added workforce is local, and therefore not already accounted for in the current traffic statistics, and no carpooling.

The personal vehicle emissions related to either alternative would likely be only for a few hours each day, during shift changes. Gasoline and diesel emissions, in personal vehicles and construction vehicles and equipment, related to either alternative would be controlled to meet current applicable regulatory requirements such as those found in EPA 40 CFR Part 80, which provides regulations concerning fuel and fuel additives. Due to fuel regulations and the intermittent nature of the emissions, the resulting impacts are minor.

Cumulative impacts on local or regional air quality during the course of construction and operation of a single unit at the BLN site would likely be minor and insignificant.

3.16.3. Global Climate Change

3.16.3.1. Affected Environment

Global Climate Change and Relationship to Greenhouse Gases
The topic of greenhouse gases (GHG) and global climate change (GCC) was not discussed in the original 1974 FES for BLN. In common usage, “global warming” often refers to the warming of the earth that can occur as a result of emissions of GHG in the atmosphere. Global warming can occur from a variety of both natural and anthropogenic causes. “Climate change” refers to any substantive change in measures of climate, such as temperature, precipitation, or wind. The two terms are often used interchangeably, but the climate change is broader as it conveys that there are other changes in addition to rising atmospheric temperature.

The following carbon cycle and CO_2 discussion is based primarily on TVA’s supplemental environmental assessment for the Tenaska Site (TVA 2008g). It is believed that certain

substances present in the atmosphere act like the glass in a greenhouse to retain a portion of the heat that is radiated from the surface of the earth. The common term for this phenomenon is the "greenhouse effect," and it is essential for sustaining life on earth. Water vapor and, to a lesser extent, water droplets in the atmosphere are responsible for 90 to 95 percent of the greenhouse effect. The most abundant long-lived GHG are carbon dioxide (CO_2), methane, and nitrous oxide. Both man-made and natural processes produce GHG. According to some sources, increases in the earth's average surface temperatures are linked in part to increasing concentrations of GHG, particularly CO_2, in the atmosphere. This has been a cause for concern among scientists and policymakers. On the international level, this phenomenon has been studied since 1992 by the United Nations Framework Convention on Climate Change, Intergovernmental Panel on Climate Change (IPCC).

The global carbon cycle is made up of large carbon sources and sinks. Billions of tons of carbon in the form of CO_2 are absorbed by oceans and living biomass (i.e., sinks) and are emitted to the atmosphere annually through natural and man-made processes (i.e., sources). When in equilibrium, carbon fluxes among these various reservoirs are roughly balanced. According to the IPCC (2007), since the Industrial Revolution (i.e., about 1750), global atmospheric concentrations of CO_2 have risen about 36 percent, principally due to the combustion of fossil fuels.

Greenhouse Gas Emissions

The primary GHG emitted by electric utilities is CO_2 produced by the combustion of coal and other fossil fuels; others include methane and nitrous oxide. Nuclear power plants do not emit large amounts of GHG in the normal course of reactor operations. However, fossil fuels are often used as part of the infrastructure needed to operate a nuclear power facility, primarily for the manufacture of the fuel that is used in the facility. Nuclear energy life-cycle emissions include emissions associated with construction of the plant, mining and processing the fuel, routine operation of the plant, waste disposal, and decommissioning. On a life-cycle-based comparison, nuclear-generated electricity emits about the same amount of GHG per kWh as renewable energy sources and far less than fossil fuel sources. This will be discussed in more detail in a later section.

Worldwide man-made annual CO_2 emissions from utilities are estimated at 29 billion tons, with the United States responsible for 20 percent. U.S. electric utilities, in turn, emit 2.5 billion tons, roughly 39 percent of the U.S. total. Figure 3-23 shows how TVA's approximately 114 million tons of annual CO_2 emissions from energy production ranked in terms of worldwide, national, and industry emissions in 2004.

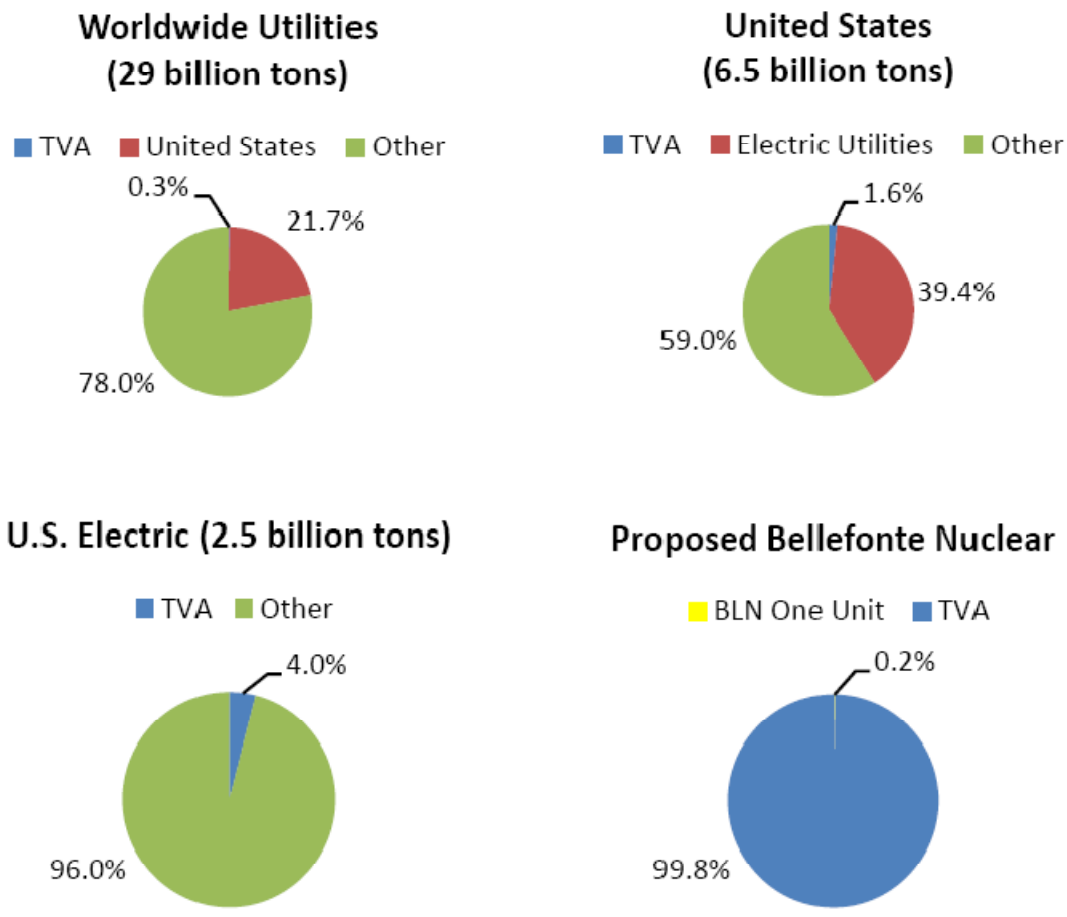


Figure 3-23. Man-Made Carbon Dioxide Emission Percentages in 2004

Regional Climate Change in the Southeast and the Tennessee River Valley
Compared to the rest of the United States, the climate of the Southeast is warm and wet, with high humidity and mild winters. The present-day regional climate specific to the Tennessee Valley and local meteorology are described in Subsection 3.16.1, along with air quality in Subsection 3.16.2. Average annual temperature across the southeastern United States did not change significantly over the last century; however, since 1970, annual average temperature has risen about 2°F. The greatest seasonal increase in temperature has been during the winter months. Since the 1970s, the number of freezing days in the Southeast has declined by four to seven days per year for most of the region. Average autumn precipitation has increased by 30 percent for the region since 1901. There has been an increase in heavy downpours in many parts of the region, while at the same time the percentage of the region experiencing moderate to severe drought increased over the past three decades (Global Climate Change Impacts 2009).

In order to understand future climate scenarios in the TVA region better, TVA contracted with the EPRI to prepare a report on the impacts of global climate change on various resources throughout the Tennessee Valley, including water and air, which could be

reasonably anticipated to occur over the 21st century (EPRI 2009b). Emphasis was placed on the near future (through 2050) as high uncertainty exists for longer-range predictions. The basis for this report is the United Nations IPCC's Fourth Assessment Report, published in 2007, and assumes a medium GHG emissions projection, which does not reflect additional efforts to reduce GHG emissions. In addition to this report, TVA received and reviewed comments (Christy 2009) on the 2009 EPRI report (EPRI 2009b). The 2009 EPRI report forecasts temperatures to increase as much as +0.8°C between 1990 and 2020, and +4°C by the end of the 21st century in the TVA region. Christy (2009) presented two arguments regarding these estimates. First, based on historical climate records, a change of +0.8°C in 30 years is within the natural climate variations of the region. Second, the +4°C estimate is an "up to" result that is the least likely to occur. Furthermore, evidence suggests that climate models are often too sensitive to CO_2 and therefore overestimate temperature rise (Spencer 2008). Precipitation forecasts are more uncertain and vary depending on location in the Valley and time of year. According to the EPRI report, precipitation is forecast to increase in the winter across the Valley as a whole, while in the western portion of the Valley, summers may be drier, and in the eastern portion of the Valley, summers may remain unchanged. Changes in water resource practices may become necessary to adapt to changes in the temporal distribution of precipitation across the region. It is important to emphasize that the current scientific knowledge of climate change is improving but still contains a great amount of uncertainty.

3.16.3.2. Environmental Consequences

Alternative A

In order to meet its obligation to provide safe, reliable power to the region, TVA would need to either purchase the power from other sources, or build elsewhere to create the additional generating capacity identified in the Need for Power discussion. As part of the diverse mix of TVA generation assets, this capacity would be above and beyond that which was obtained from other sources such as energy efficiency efforts or purchase of power from renewable energy sources (see Section 1.4). If purchased, assuming such power would be regionally available when needed, the probable sources of that power would be other base load sources, either fossil-fueled (gas-fired) or nuclear generation from other neighboring utilities. Additionally this No Action Alternative does not meet the portion of TVA's purpose and need of maximizing use of existing TVA assets. If TVA had to construct such nuclear capacity elsewhere, the amounts of GHG created would be greater than those created by the completion of a B&W unit at the BLN site, because it is already partially completed. Furthermore, if a fossil fuel-fired source were constructed to fill this need, as discussed below, the emission of GHG during construction or operation of the facility and from other aspects of the associated fuel cycle would be substantially greater.

Alternatives B and C

There are primarily two ways in which one BLN unit would potentially interact with GHG and GCC. The first is the emissions of GHG resulting from the construction and operation of one BLN unit operation; as noted above, these emissions would occur through the life cycle of the plant, including the uranium fuel cycle (UFC). The second is the manner in which climate change could affect operations of the BLN facility itself.

Lifecycle Nuclear Greenhouse Gas Production & Mitigation Potential

As discussed previously, nuclear power plants do not emit GHG in large quantities during the normal course of operations. However, fossil fuels are used as part of the infrastructure needed to operate a nuclear power facility, primarily for the manufacture of the fuel that is used in the facility. Nuclear energy life-cycle emissions include emissions associated with construction of the plant, mining and processing the fuel, routine operation of the plant, waste disposal, and decommissioning. Numerous studies demonstrate that over the life cycle of the fuel, electricity generated from nuclear power results in emissions of about the same amount of GHG per kWh as renewable energy sources and far less than fossil fuel sources. One such study is Meier (2002). Using data from that study, Figure 3-24 displays the life-cycle GHG emissions of various energy sources. The GHG emissions are expressed in terms of CO_2 equivalents, in which the emissions of the various GHG are weighted according to their global warming potential relative to the global warming potential of CO_2. The largest variables in life-cycle GHG emissions of a nuclear plant, aside from the operating lifetime, electrical output, and capacity factor, are the type of uranium enrichment process and the source of power for enrichment facilities. Current enrichment facilities use the energy-intensive gaseous diffusion process largely powered by fossil fuels. New enrichment facilities currently under construction will use much less energy-intensive processes resulting in reduced nuclear plant life-cycle GHG emissions. Although the construction-related life-cycle GHG emissions of the Alternative B B&W unit would be slightly less than those of the Alternative C AP1000 unit because the B&W unit would require less construction of new facilities, the difference in overall life-cycle GHG emissions would be negligible.

According to the U.S. Department of Energy (DOE) and NRC estimates, approximately 115,747 tons of carbon would be produced for every 1,000 MW of power produced from a nuclear power plant operating year-round (NRC 2008). Using these estimates, the addition of one unit at the BLN site operating in a projected maximum capacity mode would increase TVA's total CO_2 emissions by approximately 150,000 tons annually. This is less than 0.5 percent of TVA's total output of CO_2.

Even considering life-cycle emissions, the resulting emissions GHG (in CO_2 equivalents) would overall be substantially less than that of a comparable 1,100-1,200 MW coal-fired plant supplying equivalent base load power. As such, nuclear power (i.e., BLN for example), is an effective alternative to help TVA reduce GHG emissions. Given the need for additional capacity (i.e., beyond what can be offset by energy-efficiency efforts), the nuclear option overall leads to substantially lower emissions of GHG than other major sources of new generation in the Tennessee Valley and adjoining service areas in the Southeast and Central United States.

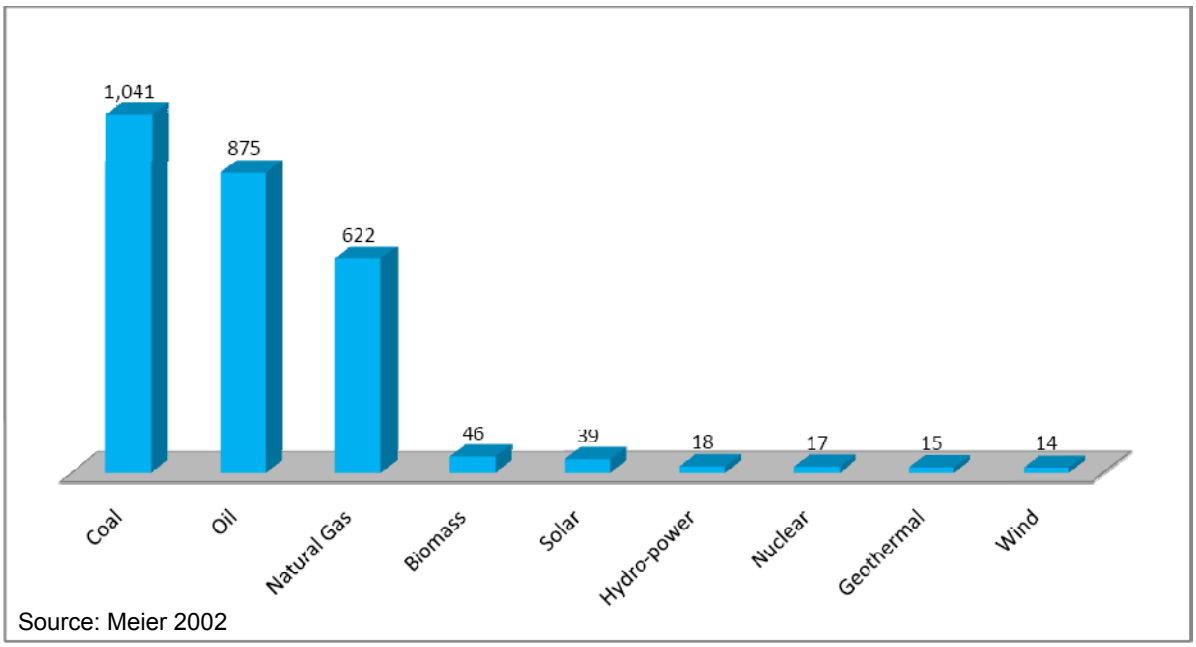


Figure 3-24. Tons of CO_2 Equivalent Emitted per Gigawatt Hour

Potential for Effects of Climate Change on BLN Operations

Higher air and water temperatures and altered frequency of precipitation resulting from climate change can influence processes for maintaining compliance with environmental and safety standards at nuclear (and fossil) plants, as well as the efficiency of plant operations. Similar to other TVA nuclear plants, BLN would withdraw cooling water from the Tennessee River to operate the plant condenser cooling water system. However, as compared to a once-through, open cooling system, the amount of water needed for the operation of BLN would be reduced considerably by the use of a closed-cycle cooling system. For closed-cycle cooling, water containing waste heat from the condensers is conveyed through cooling towers where the waste heat is rejected to the atmosphere by evaporation. The cooled water, exiting the towers, is then returned and reused in the condensers. This design feature significantly reduces the volume of water needed from the river. Essentially, the water required for secondary plant systems, and that necessary to replenish the loss due to evaporation and cooling tower blowdown, constitute the makeup water. On a daily average basis, the makeup water for a closed-cycle system is typically less than 5 percent of the volume of water that would be required for once-through system. The BLN operation would be less susceptible to climate change influences because it is equipped with a closed-cycle cooling system.

Regulatory requirements for environmental compliance prescribe the maximum temperature of water that could be released from BLN into the Tennessee River. Additional information concerning the BLN requirements for water temperature and the expected impact of the plant releases on the river are discussed in Subsection 3.1.3.

At generating plants with closed-cycle cooling such as BLN, the cooling towers are operated continuously. Increased temperature of the makeup water from the river reduces the efficiency of the power production cycle. In general, hotter, more humid air is less

receptive to evaporation, thereby also reducing the efficiency of cooling tower performance and potentially reducing power output. This is expected to be the case for the hyperbolic, natural draft cooling towers that currently exist at BLN.

When cooling water intake temperatures are high at a closed-cycle plant, derating would be an option available to avoid exceeding the thermal limits of the current NPDES permit, as well as other environmental and safety limits addressed in Subsection 3.1.3. The estimated need for derating of BLN under baseline conditions and current meteorology would occur approximately 0.04 percent of the time under both Alternatives B and C. The construction of additional cooling capacity is a possibility if such derating events become operationally or financially unacceptable.

TVA has previous operational experience in managing the river system during extended, extreme meteorological events. In response to a record drought in the 1980s in the Tennessee River Valley, TVA conducted a multiphase study to assess the impacts of extreme meteorology on the TVA reservoir system and power supply (Miller et al. 1993). The base study examined effects to power operations during representative years in which air temperatures were 3°F cooler and 25 percent wetter (1974), as well as years that were 2°F warmer and 60 percent drier (1986) than normal, in combination with modeled projections. The analysis identified the interrelationship, resiliency, and vulnerabilities of the reservoir and power supply systems to meteorological extremes. Important general trends and critical operating thresholds were also identified. Because the vulnerability of specific plants is a function of plant design, location, and stringency of regulatory constraints, the results of this multiphase study can only provide general indicators of how operations of a closed-cycle plant, such as BLN, located on the midreach of the Tennessee River could be affected.

The Miller study (1993) showed that in the upper Tennessee River drainage, for each 1°F increase in air temperature (April through October), water temperatures increased by 0.25°F to almost 0.5°F, depending upon year and location in the TVA reservoir system. In general, air temperature effects cascaded down the reservoir system. In the Tennessee River system, for both closed- and open-cycle TVA nuclear plants in Tennessee (on or above Chickamauga Reservoir) and in Alabama (on Wheeler Reservoir below both Chickamauga Reservoir and Guntersville Reservoir where BLN is situated), this study found that the incremental impact to operations from increased temperature were greatest during hot-dry years. Operation of nuclear facilities in the TVA power system was resilient to temperature increases during cold-wet and average meteorological years.

Given the general nature of this study (1993) and its uncertainties, some effects on BLN operations may be anticipated assuming an initial 40-year license that runs from approximately the 2018-2020 time frame to about 2058-2060. Thermal, mechanical, and operational limitations; cooling tower performance and use; and environmental and intake safety limits for water temperature would adversely affect the performance of the plant. While plant performance could potentially also be affected by climate change impacts, some of these impacts could be partially ameliorated by the flexibility that the ROS FEIS (TVA 2004) provides TVA in operating the Tennessee River and tributaries as an integrated system.

Based upon (1) the projected air temperature increases discussed in the EPRI report; (2) the relationship of plant performance to intake water temperatures indicated in the 1993 study (Miller et al. 1993); and (3) the existing NPDES permit requirements for BLN, the use of cooling towers in closed-cycle operation in combination with derates would enable BLN

to remain in regulatory and safety compliance during the initial 40-year licensing period. However, during the licensed period of 40 years, an incremental increase should be anticipated in the frequency of derate events to avoid exceeding thermal limits, slightly more for Alternative B than for Alternative C.

3.17. Radiological Effects of Normal Operations

This section discusses the potential radiological dose exposure to the public during normal operation of a BLN B&W unit or an AP1000 unit. The impact of the B&W units was assessed in TVA's 1974 FES and reviewed in the AEC's 1974 FES. In the FES the AEC concluded, "No significant environmental impacts are anticipated from normal operational releases of radioactive materials. The estimated dose to the public within 50 miles from operation of the plant is about 2 man-rems/year, less than the normal fluctuations in the 144,000 man-rems/year background dose this population would receive."

Although the BLN B&W unit FES and AEC's review predated the issuance of Appendix I of 10 CFR Part 50 (NRC 2007b), when compared to the Appendix I guidance, the BLN B&W unit would fully comply. Appendix I provides numerical guides for design objectives and limiting conditions for operation to meet the criterion "as low as reasonably achievable" (ALARA) for radioactive material in light-water cooled nuclear reactor effluents. The new analyses presented in Subsection 3.17.2 regarding the BLN B&W unit are in agreement with the earlier assessments; doses to the public resulting from the discharge of radioactive effluents from a BLN B&W unit would be a small fraction of the NRC guidelines given in 10 CFR Part 50, Appendix I.

The impact of the AP1000 units was assessed in the COLA ER. TVA has determined that the doses to the public resulting from the discharge of radioactive effluents from an AP1000 unit would be a small fraction of the NRC guidelines given in 10 CFR Part 50, Appendix I.

3.17.1. Affected Environment

Exposure Pathways

Evaluation of the potential impacts to the public from normal operational releases is based upon the probable pathways to individuals, populations, and biota near the BLN site. The exposure pathways, described in NRC Regulatory Guides 1.109 and 1.111 (NRC 1977a; 1977b), are illustrated in Figure 3-25. The critical pathways to humans for routine radiation releases from a facility at the BLN site are exposure from radionuclides in the air, inhalation of contaminated air, drinking milk from a cow that feeds on open pasture near the site, eating vegetables from a garden near the site, and eating fish caught in the Tennessee River.

Radiation exposure pathways to biota other than members of the public were assessed to determine if the pathways could result in doses to biota greater than those predicted for humans. This assessment used surrogate species that provide representative information on the various dose pathways potentially affecting broader classes of living organisms. Surrogates are used because important attributes are well defined and are accepted as a method for judging doses to biota. Surrogate biota used includes algae (surrogate for aquatic plants), invertebrates (surrogate for fresh water mollusks and crayfish), fish, muskrat, raccoon, duck, and heron.

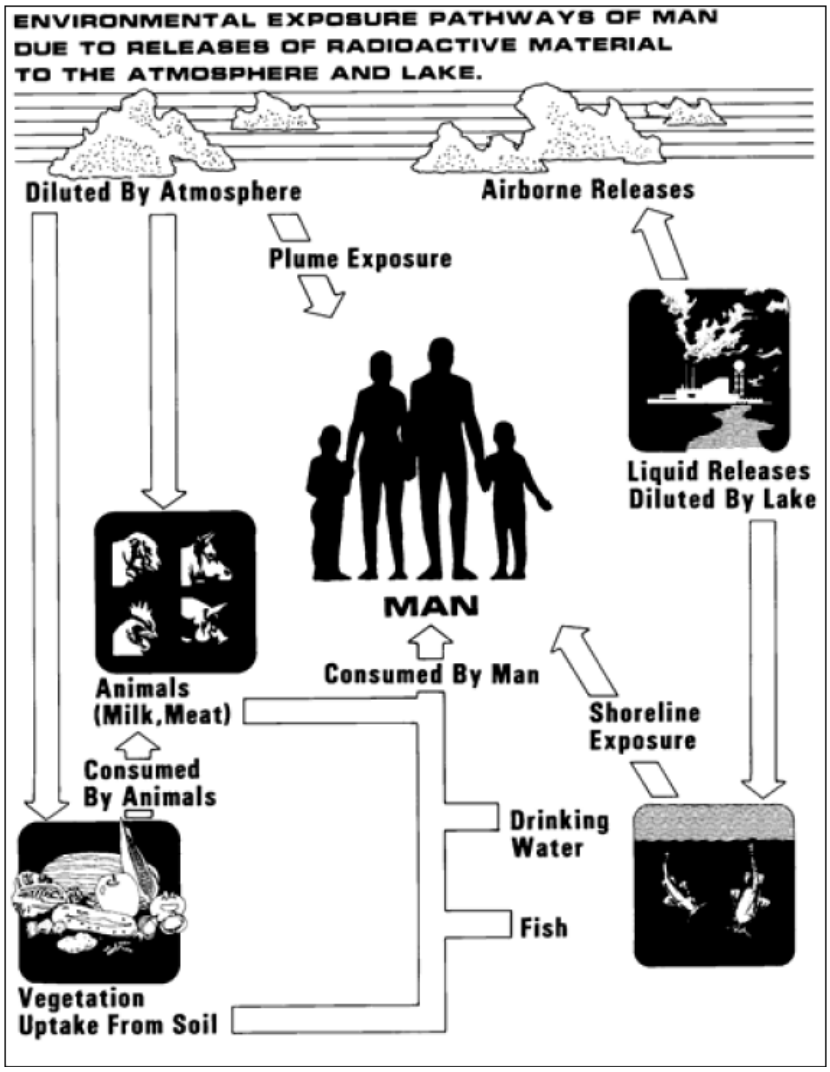


Figure 3-25. Possible Pathways to Man Due to Releases of Radioactive Material

The exposure pathways to humans that were used in the B&W unit 1974 FES and the COLA ER analyses for liquid effluents remain valid and include the following:

- External exposure to contaminated water by way of swimming, boating, or walking on the shoreline.
- Ingestion of contaminated water.
- Ingestion of aquatic animals exposed to contaminated water.

Exposure pathways considered include external doses due to noble gases, internal doses from particulates due to inhalation, and the ingestion of milk, meat, and vegetables (including grains) within a 50-mile radius around the BLN site.

Exclusion Area Boundary
As defined in 10 CFR Part 100, the EAB identifies the area surrounding the reactor, in which TVA has the authority to determine all activities including exclusion or removal of

personnel and property from the area. The boundary on which limits for the release of radioactive effluents are based is the site EAB as shown in Figure 2-3. The EAB follows the site property boundary on the land-bound side and the Tennessee River side. The EAB also extends across the site property boundary to the opposite shore of Town Creek on the northwest side of the property. There are no residents living in this exclusion area. No unrestricted areas within the site boundary area are accessible to members of the public. The Town Creek portion of the EAB is controlled by TVA. Access within the site property boundary is controlled. Areas outside the exclusion area are unrestricted areas in the context of 10 CFR Part 20 and open to the public.

3.17.2. Environmental Consequences

Alternative A
Under the No Action Alternative, completion or construction and operation of a new nuclear plant would not occur; therefore, there would be no radiological impacts.

Alternatives B and C
Estimates of doses to the MEI and the general population during routine operations for Alternatives B and C, and for both the liquid and gaseous effluent pathways, are described in the following paragraphs.

Radiation Doses Due to Liquid Effluents
The release of small amounts of radioactive liquid effluents is permitted for the new facility at the BLN site, as long as releases comply with the requirements specified in 10 CFR Part 20. The liquid effluent exposure pathways given in Subsection 3.17.1 were considered in the evaluation of radiation doses to the public resulting from radioactive liquid effluent releases. Current analyses of potential doses to members of the public due to releases of radioactivity in liquid effluents are calculated using the models presented in NRC Regulatory Guide 1.109 (NRC 1977a). These models are essentially those used in the 1974 FES, and are based on the International Commission on Radiological Protection Publication 2 (ICRP 1959). Changes in the model and inputs since the 1974 FES include the following:

- Doses to additional organs (kidney and lung) have been calculated.
- River water use (ingestion, fishing) and recreational use data have been updated (see Tables 3-21 and 3-22).
- Decay time between the source and consumption is as described in NRC Regulatory Guide 1.109.
- Only those doses within a 50-mile radius of BLN are considered in the population dose.
- The population data are updated and projected through 2057.

The location of public water suppliers and the estimated 2057 populations are given in Table 3-21 and recreational users are given in Table 3-22.

Table 3-21. Public Water Supplies Within a 50-Mile Radius Downstream of BLN

Location	Tennessee River Mile	Estimated 2057 Population
Fort Payne, Alabama	387	29,412
Scottsboro, Alabama	385.8	24,059
Section and Dutton, Alabama	382	12,941
Albertville, Alabama	361	58,823
Guntersville, Alabama	357	7,647
Arab, Alabama	356	25,294

Table 3-22. Recreational Use of Tennessee River Within 50-Mile Radius Downstream of BLN

Pathway	Tennessee River Miles	Estimated 2057 Usage
Sport Fishing (Guntersville Reservoir)	391.5 - 349	73,440 visits/year
Shoreline Use (Guntersville Reservoir)	391.5 - 349	22,814,630 person-hour/year
Swimming (Guntersville Reservoir)	391.5 - 349	22,814,630 person-hour/year
Boating (Guntersville Reservoir)	391.5 - 349	22,814,630 person-hour/year

Other data used in the calculation of doses to the public such as transfer coefficients, consumption rates, and bioaccumulation factors are obtained from Regulatory Guide 1.109 (NRC 1977a).

The BLN 1&2 FSAR (TVA 1991) provided estimated liquid effluent releases based on the guidance given in NUREG-0017 (NRC 1976). The estimated liquid radioactive effluent releases used in the updated analyses are given in Table 3-23 for a B&W unit. As described in Subsection 3.18.1.2, these estimates are expected to envelope the effluent releases from the upgraded liquid radwaste system. The liquid radioactive effluent releases for an AP1000 unit given in Table 3-24 were obtained from Table 11.2-7 of the AP1000 DCD (WEC 2008).

Table 3-23. BLN Annual Discharge for a Single B&W Unit via Liquid Pathway

Nuclide	Total Release (Ci/y)	Nuclide	Total Release (Ci/y)
Br-84	2.295E-11	Sr-90	8.865E-09
I-129	3.744E-11	Sr-91	1.294E-07
I-131	2.737E-03	Sr-92	3.115E-09
I-132	1.376E-05	Y-90	3.766E-09
I-133	1.375E-03	Y-91m	5.075E-08
I-134	5.700E-08	Y-91	4.016E-08
I-135	2.966E-04	Zr-95	1.840E-03
Rb-88	5.715E-11	Nb-95	2.620E-03

Nuclide	Total Release (Ci/y)	Nuclide	Total Release (Ci/y)
Cs-134	1.743E-02	Mo-99	4.136E-05
Cs-136	3.886E-04	Tc-99m	1.806E-05
Cs-137	3.330E-02	Ru-103	1.840E-04
Cs-138	1.159E-08	Ru-106	3.150E-03
Cr-51	5.240E-07	Rh-106	5.590E-09
Mn-54	1.310E-03	Ag-110m	5.750E-04
Mn-56	2.451E-08	Ba-137m	5.925E-04
Fe-59	4.513E-08	Ba-140	2.980E-07
Co-58	5.250E-03	La-140	1.611E-07
Co-60	1.180E-02	Ce-144	6.550E-03
Sr-89	2.552E-07	Pr-144	1.706E-08
H-3	675.5		

Source: BLN 1&2 FSAR, Table 11.2.3-1

Table 3-24. BLN Annual Discharge for a Single AP1000 Unit via Liquid Pathway

Nuclide	Total Releases (Ci/y)	Nuclide	Total Releases (Ci/y)
Na-24	1.630E-03	Rh-106	7.352E-02
Cr-51	1.850E-03	Ag-110m	1.050E-03
Mn-54	1.300E-03	Ag-110	1.400E-04
Fe-55	1.000E-03	Te-129m	1.200E-04
Fe-59	2.000E-04	Te-129	1.500E-04
Co-58	3.360E-03	Te-131m	9.000E-05
Co-60	4.400E-04	Te-131	3.000E-05
Zn-65	4.100E-04	I-131	1.413E-02
W-187	1.300E-04	Te-132	2.400E-04
Np-239	2.400E-04	I-132	1.640E-03
Br-84	2.000E-05	I-133	6.700E-03
Rb-88	2.700E-04	I-134	8.100E-04
Sr-89	1.000E-04	Cs-134	9.930E-03
Sr-90	1.000E-05	I-135	4.970E-03
Sr-91	2.000E-05	Cs-136	6.300E-04
Y-91m	1.000E-05	Cs-137	1.332E-02
Y-93	9.000E-05	Ba-137m	1.245E-02
Zr-95	2.300E-04	Ba-140	5.520E-03
Nb-95	2.100E-04	La-140	7.430E-03
Mo-99	5.700E-04	Ce-141	9.000E-05
Tc-99m	5.500E-04	Ce-143	1.900E-04
Ru-103	4.930E-03	Pr-143	1.300E-04
Rh-103m	1.830E-03	Ce-144	3.160E-03
Ru-106	7.352E-02	Pr-144	3.160E-03
H-3	1010		

Source: AP1000 DCD Table 11.2-7

The LADTAP II computer program, as described in NUREG/CR-4013 (NRC 1986), was used to calculate the liquid pathway doses. The LADTAP II computer program implements the radiological exposure models described in Regulatory Guide 1.109 (NRC 1977a) for radioactivity releases in liquid effluent.

The resulting calculated doses to an individual due to liquid effluents for a BLN B&W unit are given in Table 3-25, and for an AP1000 unit in Table 3-26. The dose guidelines given by the NRC in 10 CFR Part 50, Appendix I, for any individual are 3 millirem (mrem) or less to the total body and 10 mrem or less to any organ, and are designed to assure that doses due to releases of radioactive material from nuclear power reactors to unrestricted areas are kept ALARA during normal conditions. The average annual radiation exposure from natural sources to an individual in the United States is about 300 mrem. Therefore, the Appendix I total body dose limit is about 1/100 of the normal background radiation.

Also shown in Tables 3-25 and 3-26 are the calculated doses to the total population due to liquid effluents for BLN B&W and AP1000 units.

Table 3-25. BLN Doses From Liquid Effluents for B&W Unit per Year

	Annual Dose Total Body	Maximum Organ (Liver) Dose	Maximum Thyroid Dose	TEDE Dose	Dose Limit[a]
Maximum Individual Dose (mrem/year)	0.27[b]	0.37[c]	0.021[d]	0.21	Total Body: 3 Any organ: 10
Population Dose (person-rem)	1.55	1.96	0.85	1.58	Not Applicable

Notes:

a. 10 CFR Part 50, Appendix I
b. An adult was found to receive the maximum individual total body dose.
c. A teenager was found to receive the maximum individual organ dose.
d. A child was found to receive the maximum individual thyroid dose.

Table 3-26. BLN Doses From Liquid Effluents for AP1000 Unit per Year

	Annual Dose Total Body	Maximum Organ (Liver) Dose	Maximum Thyroid Dose	TEDE Dose	Dose Limit[a]
Maximum Individual Dose (mrem/year)	0.21[b]	0.27[c]	0.05[d]	0.21	Total Body: 3 Any organ: 10
Population Dose (person-rem)	1.60	1.90	1.41	1.64	Not Applicable

Notes:
a. 10 CFR Part 50, Appendix I
b. An adult was found to receive the maximum individual total body dose.
c. A teenager was found to receive the maximum individual organ dose.
d. A child was found to receive the maximum individual thyroid dose.

Doses to terrestrial vertebrates (other than man) from the consumption of aquatic plants and doses to aquatic plants, aquatic invertebrates, and fish due to radioactivity in liquid effluents for either a B&W unit or an AP1000 unit would be small because doses to these organisms are less than or equal to the doses to humans. The International Council on Radiation Protection states that "...if man is adequately protected then other living things are also likely to be sufficiently protected" and uses human protection to infer environmental protection from the effects of ionizing radiation.

Four conclusions can be drawn from the results in Tables 3-25 and 3-26:

- Each unit would meet the dose guidelines given in 10 CFR Part 50, Appendix I.
- The dose estimates to the public are a small fraction of the Appendix I guidelines, and the analyses of the radiological impact to humans from liquid releases in the TVA FES and COLA ER continue to be valid.
- The collective population doses are low.
- The impact to members of the public resulting from normal liquid-effluent releases would be minor.

Radiation Doses Due to Gaseous Effluents

Gaseous effluents refer to the release of small quantities of gaseous aerosols and particulates associated with the normal operation of a B&W or an AP1000 unit. Gaseous effluents are normally released through the plant vent or the turbine building vent. The plant vent also provides the release path for containment venting releases, auxiliary building ventilation releases, and gaseous radwaste system discharge. The AP1000 also routes annex building and radwaste building releases through the plant vent. The turbine building vents provide the release path for the condenser air removal system, gland seal condenser exhaust and the turbine building ventilation releases.

The current analysis of potential doses to members of the public due to releases of radioactivity in gaseous effluents was performed using the GASPAR II (NRC 1987) computer program used by NRC staff to perform environmental dose analyses for releases of radioactive effluents from nuclear power plants into the atmosphere.

The GASPAR II model implements the radiological exposure models described in NRC Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," for radioactive releases in gaseous effluent. The exposure pathway models estimate the radiation dose to selected individuals and population groups. The exposure pathways considered in GASPAR II are external exposure to contaminated ground, external exposure to noble gas radionuclides in the airborne plume, inhalation of air, and ingestion of farm products grown in contaminated soil.

NRC guidance for determining the doses for releases of radioactive effluents from nuclear power plants into the atmosphere is provided in Regulatory Guide 1.109 (NRC 1977a). The gaseous-effluent releases used in the BLN B&W unit analysis are those for the annual average release of airborne radionuclides found in Table 11.3.3-1 of the BLN Units 1&2 FSAR. The gaseous-effluent releases used in the AP1000 unit analysis are those for the annual average release of airborne radionuclides found in Table 11.3-3 of the BLN COLA FSAR.

Radiation doses due to gaseous effluents are calculated using the maximum exposed individual as identified by the atmospheric dispersion (χ/Q) values presented in Subsection 3.16.2.1 for each respective reactor unit. The nearest garden, 1.13 miles southwest of the plant, results in the highest χ/Q values of any receptor and the highest D/Q value of a receptor location consisting of an actual ingestion pathway. Therefore, this location was conservatively evaluated for all exposure pathways except for the doses due to noble gases. This is conservative because it maximizes the doses from all pathways.

The purpose of this SEIS section is to revise the inputs and methodology used in the AEC's 1974 FES to use current values representing recent meteorological, population, and agricultural data. The methodology used in the FES is also revised to be consistent with the current regulatory guidance. Furthermore, this section also provides the gaseous-effluent doses for an AP1000 unit. For this SEIS, identical methodologies, in compliance with NRC Regulatory Guide 1.109, were used for both a B&W unit and an AP1000 unit. The calculated doses provide information for determining compliance with Appendix I of 10 CFR Part 50 (NRC 2007b) and 10 CFR §20.1301 (NRC 2002). When the calculated doses are compared to the 10 CFR Part 50, Appendix I, and 10 CFR §20.1301 allowable dose values, the B&W unit and AP1000 unit demonstrate full compliance.

10 CFR Part 50, Appendix I, defines design objective limits for radioactive material in gaseous effluents for both a B&W unit and an AP1000 unit. Meeting the limits presented in 10 CFR Part 50, Appendix I also meets the ALARA criterion for radioactive material in gaseous effluents. A tabulation of the resulting calculated gaseous doses to individuals for a B&W unit and the dose limits presented in 10 CFR Part 50, Appendix I, is given in Table 3-27. A tabulation of the resulting calculated gaseous doses to individuals for an AP1000 unit and the dose limits presented in 10 CFR Part 50, Appendix I, is given in Table 3-28. For most of the doses, the calculated values are somewhat higher for the Alternative B B&W unit than the Alternative C AP1000 unit. Based on these results, normal operation of a single unit at BLN under both Alternatives B and C would present minimal risk to the health and safety of the public.

Table 3-27. BLN Maximum Individual Doses From Gaseous Effluent for the B&W Unit Compared to the 10 CFR Part 50, Appendix I Limits

Description	Limit	Calculated Values
Noble Gases[1]		
Gamma Dose (millirad [mrad][2])	10	0.88
Beta Dose (mrad)	20	2.40
Total Body Dose (mrem)	5	0.53
Skin Dose (mrem)	15	1.49
Radioiodines and Particulates		
Total Body Dose (mrem)	-	0.57
Max to Any Organ[3] (mrem)	15	4.38

Notes:
1. Doses due to noble gases in the released plume are calculated at the location of maximum dose at or beyond the site boundary (location of highest dispersion and ground deposition values). This location is 1.77 miles south of the plant for the mixed-mode station vent release and 0.56 mile west-southwest of the plant for the ground-level turbine building vent release.
2. An mrad is a unit of adsorbed ionizing radiation dose equal to an adsorbed dose of 0.1 erg/gm.
3. The maximum dose to any organ is the dose to the thyroid of a child. This dose is calculated from the most conservative receptor locations.

Table 3-28. BLN Maximum Individual Doses From Gaseous Effluent for the AP1000 Unit Compared to the 10 CFR Part 50, Appendix I Limits

Description	Limit	Calculated Values
Noble Gases[1]		
Gamma Dose (mrad)	10	0.27
Beta Dose (mrad)	20	1.39
Total Body Dose (mrem)	5	0.16
Skin Dose (mrem)	15	0.96
Radioiodines and Particulates		
Total Body Dose (mrem)	-	0.40
Max to Any Organ[2] (mrem)	15	9.11

Notes:
1. Doses due to noble gases in the released plume are calculated at the location of maximum dose at or beyond the site boundary (location of highest dispersion and ground deposition values). This location is 1.74 miles south of the plant.
2. The maximum dose to any organ is the dose to the thyroid of an infant. This dose is calculated for the most conservative receptor location.

Dose limits for individual members of the public are given in 10 CFR §20.1301, which states that each licensee shall conduct operations so that the TEDE to individual members of the public from the licensed operation does not exceed 100 mrem in a year. The maximum individual dose from a B&W unit due to routine gaseous effluents was calculated to be 1.25 mrem TEDE. The maximum individual dose from an AP1000 unit due to routine gaseous

effluents was calculated to be 0.75 mrem TEDE. These calculated doses are well within the limits provided by 10 CFR §20.1301; therefore, normal operation of a single nuclear unit at BLN would present minimal risk to the health and safety of the public.

Additional dose limits are also provided in 40 CFR Part 190, which specifies environmental radiation protection standards for nuclear power operations. Table 3-29 summarizes the doses to the maximally exposed individual for the total body, thyroid, and bone (the worst-case organ) for a B&W unit along with the 40 CFR Part 190 limits. Table 3-30 summarizes the doses to the MEI for the total body, thyroid, and bone for an AP1000 unit along with the 40 CFR Part 190 limits. Based on comparison to the 40 CFR Part 190 limits, normal operation of either Alternative B or Alternative C would present minimal risk to the health and safety of the public.

Table 3-29. Collective Gaseous Doses for the BLN B&W Unit Compared to 40 CFR Part 190 Limits

Description	Limit	Calculated Values
Total body dose equivalent (mrem)	25	1.1
Thyroid dose (mrem)	75	4.9
Max to any other organ[1] (mrem)	25	2.93

Note:
1. The maximum dose to any organ other than the thyroid is the dose to the bone of a child.

Table 3-30. Collective Gaseous Doses for the AP1000 Unit Compared to 40 CFR Part 190 Limits

Description	Limit	Calculated Values
Total body dose equivalent (mrem)	25	0.56
Thyroid dose (mrem)	75	9.25
Max to any other organ[1] (mrem)	25	2.18

Note:
1. The maximum dose to any organ other than the thyroid is the dose to the bone of a child.

The individual doses due to normal liquid and gaseous-effluent releases under both Alternatives B and C were found to be insignificant and well below the regulatory guidelines in Appendix I of 10 CFR Part 50 and the regulatory standards of 10 CFR Part 20. In addition, the potential doses to the public due to the release of liquid and gaseous effluents meet the requirements of 10 CFR §20.1302 and 10 CFR §50.34a. The impact to the public due to operation of a single nuclear unit at the BLN site is minor.

Population Dose

Population dose calculations determine the cumulative dose to the population within 50 miles of the site for ALARA considerations. The estimated radiological impact from the normal gaseous releases from BLN B&W and AP1000 units using a 50-mile regional population projection for the year 2027 of 1,565,771 is presented in Table 3-31.

Table 3-31. Population Dose Summary for the BLN B&W and AP1000 Units

Organ	B&W Unit Dose (person-rem)	AP1000 Unit Dose (person-rem)
Total Body	5.92	3.00
Gastrointestinal Tract	5.92	3.00
Bone	11.1	8.03
Liver	5.93	3.01
Kidney	5.93	3.00
Thyroid	7.26	6.30
Lung	6.22	3.27
Skin	16.8	14.1
TEDE	6.14	3.19

For perspective, the total body dose from normal background radiation to individuals within the United States ranges from approximately 100 mrem to 300 mrem per year. The annual total body dose due to normal background for a population of 1,565,771 persons expected to live within a 50-mile radius of the BLN site in the year 2027 is calculated to be approximately 156,578 man-rem, assuming 100 mrem/year/individual. By comparison, the same general population would receive a total body dose of less than 7 man-rem from gaseous effluents released from either a B&W or an AP1000 unit.

Based on these results, normal operation of a single nuclear unit at the BLN site would present minimal risk to the health and safety of the public. The annual doses to the public from either Alternative B or Alternative C would be well within all regulatory limits, and there would be no observable health impacts on the public from construction and operation of a nuclear unit at the BLN site. Therefore, the radiation doses and resultant health impacts resulting from operation of the proposed plant at the BLN site are minor.

Radiological Impact on Biota Other Than Man

Radiation exposure pathways to biota other than man (i.e., animals) are examined to determine if the pathways could result in doses to biota greater than those predicted for man. This assessment uses surrogate species that provide representative information on the various dose pathways potentially affecting broader classes of living organisms. Surrogates are used because important attributes are well defined and are accepted as a method for judging doses to biota. Surrogate biota used for gaseous-effluent exposure includes muskrat, raccoon, fish, duck, and heron.

Liquid radioactive effluents from BLN are mixed with cooling tower blowdown and subsequently discharged into the Tennessee River. Other nonradioactive discharges may be combined with the cooling tower blowdown, but they are small in comparison and are ignored as a source of dilution. The LADTAP II (NRC 1986) computer program was used to calculate the liquid pathway doses. Release of radioactive materials in liquid effluents results in minimal radiological exposure to biota. Impacts on aquatic life from radiological releases are minor.

Doses from gaseous effluents contribute to terrestrial total body doses. External doses occur due to immersion in a plume of noble gases and deposition of radionuclides on the

ground. The inhalation of radionuclides followed by the subsequent transfer from the lung to the rest of the body contributes to the internal total body doses.

Immersion and ground deposition doses are largely independent of organism size, and the total body doses calculated for man can be applied. The external ground doses calculated using the GASPAR II computer code are increased to account for the closer proximity to ground of terrestrial biota. The inhalation pathway doses for biota are the internal total body doses calculated by the GASPAR II code for infants because breathing rate and body size are more similar to biota. The total body inhalation dose (rather than organ specific doses) is used because the biota doses are assessed on a total body basis.

The calculation of biota doses due to gaseous-effluent releases are based on the locations of the highest atmospheric dispersion (χ/Q) values at the EAB for both release types. The total body doses to biota for the B&W and AP1000 units' total liquid and gaseous-effluent releases are given in Table 3-32. These doses presented below incorporate biota doses due to routine liquid effluents from a B&W unit and an AP1000 unit, respectively, for comparison with the limits set forth in 40 CFR Part 190 as indicated by NUREG-1555, Subsection 5.4.4 (NRC 1999).

Table 3-32. Total Doses (Liquid and Gaseous) to Biota for Single Nuclear Unit as Compared to the Regulatory Limit

Biota	B&W Unit Total Dose (mrem)	AP1000 Unit Total Dose (mrem)	40 CFR Part 190 Limit (mrem)
Muskrat	5.49	4.10	50
Raccoon	2.76	1.87	50
Fish	2.15	2.15	50
Heron (Little Blue Heron)	25.45	17.70	50
Duck (Mallard)	5.43	3.82	50

Use of exposure guidelines, such as 40 CFR Part 190, which apply to members of the public in unrestricted areas, is considered very conservative when evaluating calculated doses to biota. The calculated biota doses are well below those specified in 40 CFR Part 190 and are well below any dose expected to have any noticeable acute effects. Based on the postulated biota doses presented above, the impact due to operation of a single nuclear unit at the BLN site is considered minor.

3.17.3. Radiological Monitoring

The Radiological Environmental Monitoring Program (REMP) will be conducted to provide the preoperational and operational monitoring of either BLN alternative. Preoperational monitoring will be conducted for at least two years prior to the start of operations. The BLN REMP will be designed to provide the monitoring necessary to document compliance with 10 CFR §20.1302, "Compliance with Dose Limits for the Individual Members of the Public," and to meet the requirements established by NRC Regulatory Guide 4.1, "Radiological Environmental Monitoring for Nuclear Power Plants." The REMP is designed to monitor the pathways between the plant and the general public in the immediate vicinity of the plant. Sampling locations, sample types, collection frequency, and sample analyses are chosen so that the potential for detection of radioactivity in the environment will be maximized. The BLN REMP will be designed based on the guidance provided in NUREG-1301, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for

Pressurized Water Reactors." Quality assurance and quality control procedures and processes will be implemented in accordance with NRC Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) -- Effluent Steams and the Environment."

Radiological Environmental Monitoring Program for Alternative B or C
An operating nuclear plant may release radioactivity into the environment as either gaseous or liquid effluents. Exposure pathways to the public from plant effluents consist of direct radiation, airborne, waterborne, and ingestion. The types of samples collected in BLN REMP are designed to monitor these pathways. The REMP for either Alternative B or C would include the following types of monitoring.

Direct Radiation Monitoring. Monitoring of direct radiation will be performed utilizing a network of environmental dosimeters. Two or more dosimeters will be placed at monitoring locations near the site boundary in each of the 16 meteorological sectors. A second outer ring of dosimeters will be located in each sector at the 4- to 5-mile range from the site. Environmental dosimeter monitoring stations will be placed at a minimum of eight other special interest locations including at least two control stations.

Airborne Pathway Monitoring. Sampling for air particulates and radioiodine will be performed at the following 10 locations: four locations in different sectors near the site boundary, four locations near area population centers, and two control locations greater than 10 miles from the site and in the least prevalent wind direction. The airborne pathway monitoring will be performed with continuous operating air samplers.

Waterborne Pathway Monitoring. Surface water sampling will be performed at a control location upstream of the plant and at one location downstream of the plant discharge beyond, but near the mixing zone. The sampling of surface water will be performed by automatic sequential-type samplers with composite samples analyzed monthly.

Drinking water sampling will be performed at the first potable water supply downstream from the plant using water from the Tennessee River. The sampling method and collection frequency utilized for surface water sampling will also be applied to this first downstream drinking water location. The upstream surface water control location will also serve as the control location for drinking water monitoring. Monthly grab samples will be collected from at least two additional water supply systems downstream of the plant.

Groundwater sampling will be conducted at one location on site downgradient from the plant and at a control location upgradient from the plant. If site groundwater hydrology data indicate that leaks or spills at the site might impact off-site groundwater, sampling of private wells will be added to the REMP.

Samples of shoreline sediment will be collected from the first downstream shoreline recreational use area and from a control location upstream of the plant.

Ingestion Pathway. Monitoring for the ingestion pathway will include milk sampling, sampling of fish from the Tennessee River, and sampling of vegetables from local gardens identified in the land use survey. Samples of milk produced for human consumption will be collected in each of three areas within the 5-mile radius of plant identified by the land use survey to have the highest potential doses and from at least one control location at 10 to 20 miles from the site in the least prevalent wind direction. Sampling of pasture vegetation will be performed at milk-producing locations when milk sampling cannot be performed.

Fish sampling will be performed on the plant discharge reservoir, Guntersville Reservoir, and on Nickajack Reservoir as a control location. Sampling will consist of one sample of commercially important species and one sample of recreationally important species.

Sampling of the principal garden vegetables grown in the area will be performed at private gardens identified by the annual land use survey. Sampling will be performed once during the normal growing season.

Land Use Survey. A land use survey will be conducted annually. The purpose of the survey is to identify changes in land use within a 5-mile radius of the plant that would require modifications to the REMP or the Offsite Dose Calculation Manual. The survey will identify the nearest resident, nearest animal milked for human consumption, and nearest garden of greater than 500 square feet with broadleaf vegetation in each of the 16 meteorological sectors. The results of the annual land use survey will be documented in the Annual Radiological Environmental Operating Report (AREOR).

Interlaboratory Comparison Program. The laboratory performing the analyses of the BLN REMP samples will participate in an Interlaboratory Comparison Program providing radiological environmental crosschecks representative of the types of samples and analyses in BLN REMP. The results of the analysis of the comparison program cross checks will be included in the AREOR.

3.18. Uranium Fuel Use Effects

3.18.1. Radioactive Waste

3.18.1.1. Affected Environment

Radioactive waste (radwaste) sources, treatment systems and potential for effects of operating a B&W plant were described in TVA's 1974 FES and updated in the CLWR FEIS (DOE 1999). Section 2.4 of the FES states that "TVA's policy is to keep the discharge of all wastes from its facilities, including nuclear plants, at the lowest practicable level by using the best and highest degree of waste treatment available under existing technology within reasonable economic limits." While this is still true, current practices for managing radioactive waste have evolved since the B&W units were designed. Subsection 5.2.3.11 of the CLWR FEIS briefly updated TVA's radwaste management practices and potential effects for the BLN B&W unit based on operating experience at SQN and WBN.

The management and effects of radwaste from operation of two B&W units is discussed in Chapter 11 of the BLN 1&2 FSAR. The management and effects of radwaste from operation of two AP1000 units is discussed in Subsections 5.5.2 and 5.7.1 of the BLN COLA ER and in Chapter 11 of the BLN COLA FSAR. Although quantities of radwaste produced by plant operation may differ between the two technologies, and for single unit operation, the method of handling the waste would be consistent with TVA's current practices at its operating plants.

The following information updates and compares the potential for environmental effects from plant operations regarding radwaste for Action Alternatives B and C. Because there has never been an operating nuclear plant on the BLN site, there would be no effect on the environment from radwaste under Alternative A (the No Action Alternative). Additionally, for Alternatives B and C (the Action Alternatives), no radwaste would be generated during construction activities.

3.18.1.2. Environmental Consequences

Alternative A
Under this alternative, no completion or construction and operation of a new nuclear plant would occur; therefore, there would be no impacts.

Alternatives B and C

Liquid Radioactive Waste Treatment Systems
For a B&W unit, the liquid waste disposal system is designed to collect, store, process, and dispose of liquid radwaste in such a manner as to keep the exposure to plant personnel and the releases of radioactive materials to the environment ALARA. The liquid radwaste includes tritiated waste, nontritiated waste, chemical waste, and detergent waste. All of the liquid radwaste would be generated as a result of normal operation and anticipated operational occurrences. Figures 3-26 and 3-27 from the TVA 1974 FES show sketches of the proposed Liquid Waste Disposal System for tritiated and nontritiated liquid, respectively. The disposal systems shown on these figures would likely be replaced by a system similar to upgrades implemented at other TVA nuclear power plants. The following analysis describes the environmental impacts of a future replacement disposal system, which would be designed to comply with all applicable regulations.

The system would be designed and operated to demonstrate continued compliance with requirements to maintain environmental releases of radioactive materials in liquid effluents ALARA in accordance with the requirements of 10 CFR §20.1302, 10 CFR §50.34a, 40 CFR Part 190, and Appendix I to 10 CFR Part 50. This conclusion is consistent with the conclusion of the TVA 1974 FES, which states that “the liquid waste disposal system, as it is now being designed, will reduce liquid emissions to a level which is as low as practicable.”

For an AP1000 unit, the liquid radioactive waste management systems include the systems that may be used to process and dispose of liquids containing radioactive material. The liquid radwaste system would be designed to control, collect, process, handle, store, and dispose of liquid radioactive waste generated as the result of normal operation, including anticipated operational occurrences. The liquid radwaste system would provide holdup tank capacity as well as permanently installed processing capacity of 75 gpm through the ion exchange/filtration train. This would be an adequate capacity to meet the anticipated processing requirements of the plant. The projected flows of various liquid waste streams to the liquid radwaste system under normal conditions are identified in the BLN COLA FSAR, Table 11.2-1. The site-specific impact is further evaluated in the BLN COLA ER 5.4. The liquid radwaste system design accommodates equipment malfunctions without affecting the capability of the system to handle both anticipated liquid waste flows and possible surge load due to excessive leakage. Figure 3-28 shows a drawing of the AP1000 liquid radwaste system.

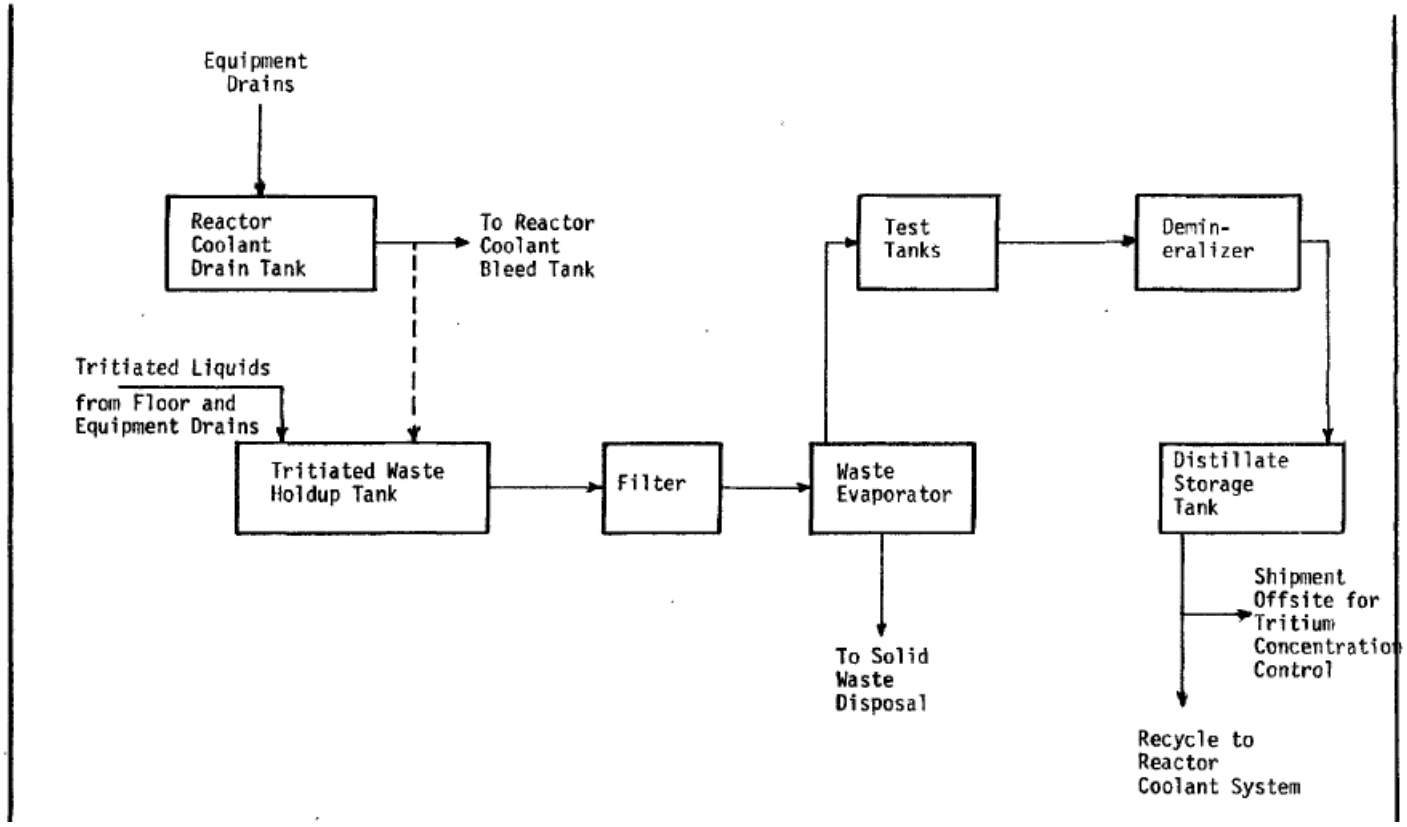


Figure 3-26. B&W Tritiated Liquid Waste Treatment System

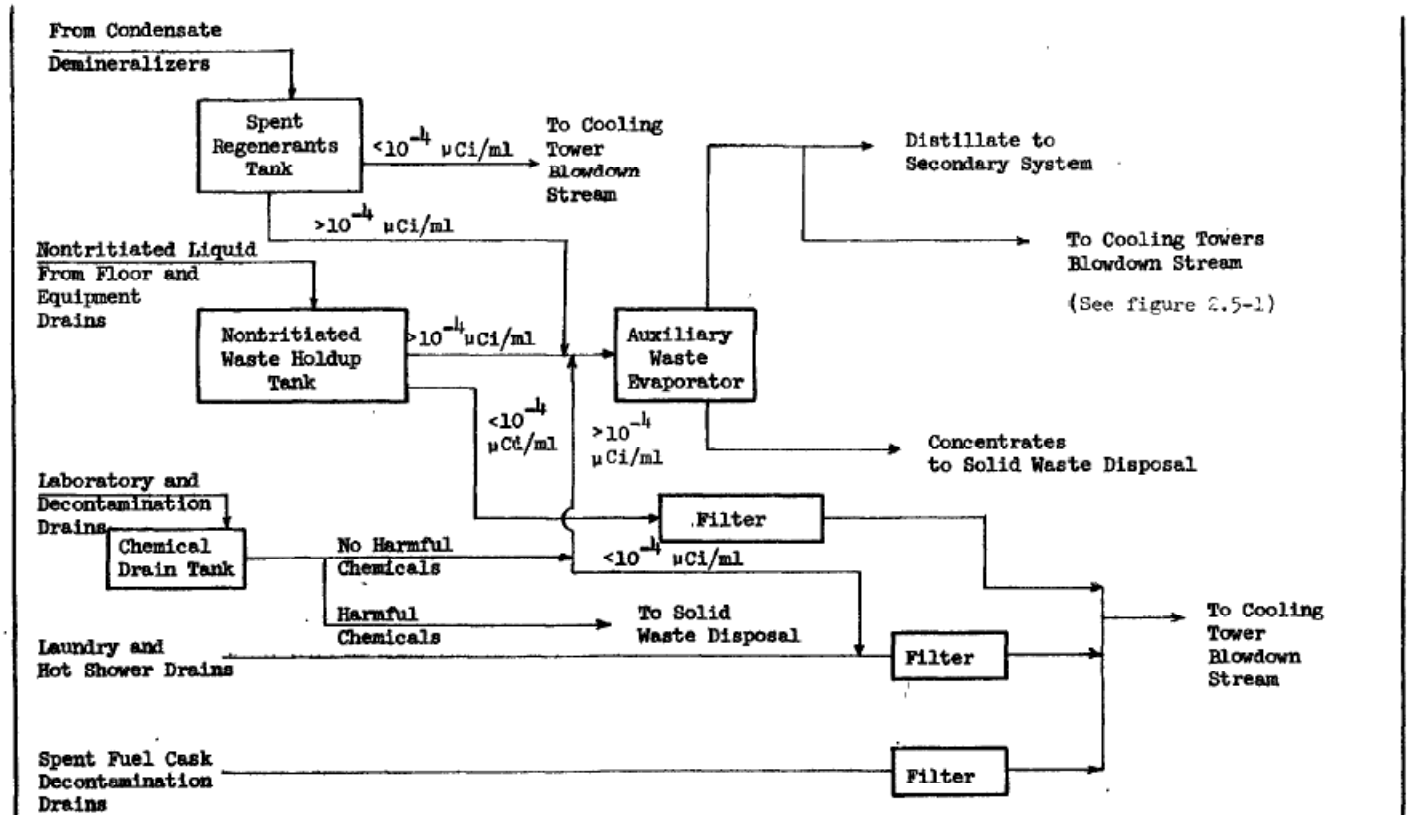


Figure 3-27. B&W Nontritiated Liquid Waste Disposal System

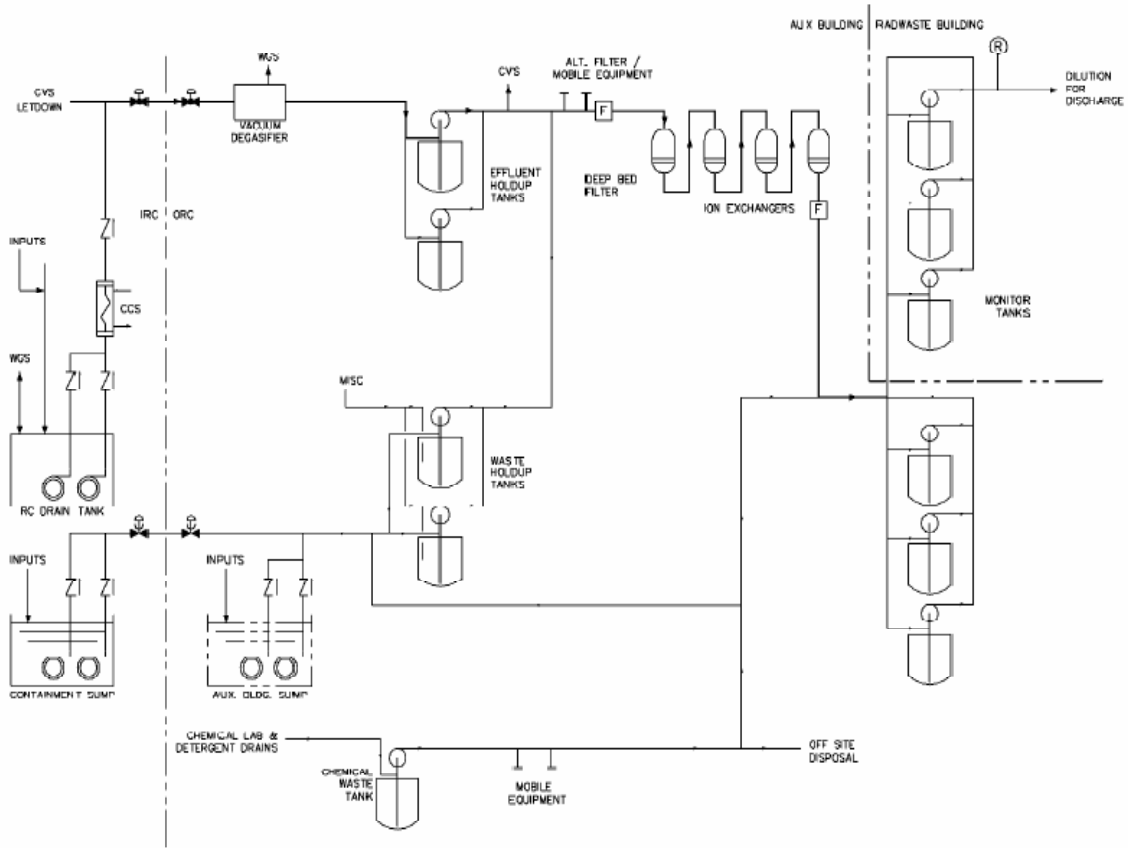


Figure 3-28. AP1000 Liquid Radwaste System

The liquid radioactive waste treatment system for the BLN AP1000 unit would be designed and operated to demonstrate continued compliance with requirements to maintain environmental releases of radioactive materials in liquid effluents ALARA in accordance with requirements of 10 CFR §20.1302, 40 CFR Part 190, 10 CFR §50.34a, and Appendix I to 10 CFR Part 50. As discussed in Section 3.17, the impact to members of the public resulting from normal liquid effluent releases would be minor.

Gaseous Radioactive Waste Treatment Systems

During reactor operation, radioactive isotopes of xenon, krypton, and iodine are created as fission products. A portion of these radionuclides could be released to the reactor coolant due to the potential for a small number of fuel-cladding defects. Potential leakage of reactor coolant could result in a release of the radioactive gases to the containment atmosphere. Airborne releases can be limited both by restricting reactor coolant leakage and by limiting the concentrations of radioactive noble gases and iodine in the reactor coolant system.

For a B&W unit, the gaseous waste disposal system would be designed to collect the radioactive gases, compress the gases into holdup tanks for decay, sample the gases prior to discharge, and monitor the gases during the discharge period. In addition to the gaseous waste disposal system, various gaseous system leaks would be vented to various building ventilation systems. These releases would be processed and released through a monitored location at either the plant vent or the turbine building vent.

The gaseous waste disposal system for a B&W unit would be designed and operated to demonstrate continued compliance with requirements to maintain environmental releases of radioactive materials in gaseous effluents ALARA in accordance with the requirements of 10 CFR §20.1302, 40 CFR Part 190, 10 CFR §50.34a, and Appendix I to 10 CFR Part 50. This conclusion is consistent with the conclusion of the TVA 1974 FES, which states that "the gaseous waste disposal system, as it is now being designed, will reduce gaseous emissions to a level which is as low as practicable."

For an AP1000 unit, the gaseous radwaste system would be designed to collect gaseous wastes that are radioactive or hydrogen bearing along with processing and discharging the waste gas, keeping off-site releases of radioactivity within acceptable limits.

In addition to the gaseous radwaste system release pathway, release of radioactive material to the environment would occur through the various building ventilation systems. The estimated annual release includes contributions from the major building ventilation pathways. The gaseous radwaste system would be designed to receive hydrogen bearing and radioactive gases generated during normal plant operation. The radioactive gas flowing into the gaseous radwaste system enters as trace contamination in a stream of hydrogen and nitrogen.

The gaseous radwaste system for an AP1000 unit would be designed and operated to demonstrate continued compliance with requirements to maintain environmental releases of radioactive materials in gaseous effluents ALARA in accordance with the requirements of 10 CFR §20.1302, 40 CFR Part 190, 10 CFR §50.34a, and Appendix I to 10 CFR Part 50. As discussed in Section 3.17, the impact to members of the public resulting from normal gaseous-effluent releases would be minor.

Solid Radioactive Wastes
Two additional types of radwaste that could be generated at BLN under both Alternatives B and C are dry active waste (DAW) and Wet Active Waste (WAW). A solid radwaste disposal system would process and package the dry and wet solid radioactive waste produced through power generation for on-site packaging, storage, off-site shipment, and disposal. The solid radioactive handling information presented below is based on TVA operating experience with handling solid radioactive waste.

The DAW consists of compactable and noncompactable material. Compactable material includes paper, rags, plastic, mop heads, discarded clothing, and rubber boots. Noncompactable wastes include tools, pumps, motors, valves, piping, and other large radioactive components. DAW would be collected on site and packaged in appropriate containers to meet processor and/or burial site acceptance criteria. DAW would be placed into a strong, tight container for shipment to an off-site processor, or compacted into 55-gallon drums by a radwaste compactor.

The WAW consists of spent resins and filters. Spent resins would be generated primarily from the makeup and purification, liquid waste processing, and condensate systems. The makeup and purification resins would be sluiced to the spent resin storage tank for radiological decay and then sluiced into high-integrity containers (HICs). Liquid waste processing resins would be sluiced directly from the demineralizer into HICs. Resins would be dewatered prior to shipment for off-site processing or direct disposal.

Tank and sump sludge would be generated during the cleaning of various tanks and sumps located in the auxiliary and reactor buildings. The sludge would be transferred into suitable containers and dewatered. Sludge would be processed into a form suitable for disposal by off-site waste processors utilizing their Process Control Program (PCP) and applicable procedures. The waste processor's procedures and PCP will be approved by BLN prior to the solidification of waste.

Solidification would be performed off site at the waste processor facilities. Spent filters would be removed from service and stored to allow radioactive decay. Filters would be loaded for shipment into appropriate containers (e.g., HICs or 55-gallon drums).

Contaminated oil could be generated during pump oil changes and sump cleaning. This oil would be collected and sent to an off-site processor for disposition.

Throughout the packaging and shipping operations, radiation exposure to personnel would be minimized by the use of various ALARA techniques, as appropriate, including the following:

a. Administrative controls
b. A shielded cask in the truck loading area
c. A shielded drum storage area
d. Use of shielded carts for transporting plant filters

Waste containers would be surveyed for radiological conditions and stored in designated storage areas.

Radwaste is classified as either A, B, or C, with Class A being the least hazardous and Class C being the most hazardous. Class A includes both DAW and WAW. Classes B and

C are normally WAW. For both the B&W and the AP1000 unit, the majority of low-level radioactive waste (LLRW) generated would be Class A waste. Class B and C wastes would constitute a low percent by volume of the total LLRW. The estimated annual volumes of solid radioactive waste generated for the B&W unit and the AP1000 unit are given in Table 3-33 and Table 3-34, respectively.

For the B&W unit, the proposed amount of radwaste generated is taken from Table 11.4.1-1 of the BLN 1&2 FSAR. The amount of radwaste generated for one B&W unit shown below is approximately one-half of that reported in the BLN 1&2 FSAR. However, the sources for these volumes would be replaced by a system similar to upgrades implemented at other TVA nuclear power plants, and the environmental impacts are expected to be similar to those of the AP1000 shown in Table 3-34 below.

For the AP1000, the amount of radwaste generated is as reported for a single unit in the AP1000 DCD (WEC 2008).

Table 3-33. Estimated Volumes of Solid Radwaste for a Single BLN B&W Unit

Source	Volume (before solidification) feet^3/year
Spent resin (1.0 feet^3 water/feet^3 resin)	425
Waste evaporator bottoms	480
Miscellaneous solids - filter cartridges, paper, glassware, rags, equipment (compacted)	175
Spent high-efficiency particulate air (HEPA) and charcoal filters	1,050
Total	2,130
Secondary system - auxiliary evaporator, condensate polishing demineralizer regeneration solution, evaporator bottoms (40% solids)	6,000

Source: Table 11.4.1-1, BLN 1&2 FSAR

Table 3-34. Expected Volumes of Solid Radwaste for a Single AP1000 Unit

Source	Expected Generation (feet^3/year)	Expected Shipped Solid (feet^3/year)	Maximum Generation (feet^3/year)	Maximum Shipped Solid (feet^3/year)
Wet wastes				
Primary resins (includes spent resins and wet activated carbon)	400(2)	510	1700(4)	2160
Chemical	350	20	700	40
Mixed liquid	15	17	30	34
Condensate polishing resin(1)	0	0	206(5)	259
Steam generator blowdown(1)(6) Material (Resin and Membrane)	0	0	540(5)	680
Wet waste subtotals	765	547	3176	3173
Dry wastes				
Compactable dry waste	4750	1010	7260	1550
Noncompactable solid waste	234	373	567	910

Source	Expected Generation (feet^3/year)	Expected Shipped Solid (feet^3/year)	Maximum Generation (feet^3/year)	Maximum Shipped Solid (feet^3/year)
Mixed Solid	5	7.5	10	15
Primary Filters (includes high activity and low activity cartridges)	5.2(3)	26	9.4(3)	69
Dry Waste Subtotals	4994	1417	7846	2544
Total wet and Dry Wastes	5759	1964	11,020	5717

Source: Table 11.4-1 of AP1000 DCD (WEC 2008)

Notes:

1. Radioactive secondary resins and membranes result from primary to secondary systems leakage (e.g., SG tube leak).
2. Estimated activity basis is American National Standards Institute (ANSI) 18.1 source terms in reactor coolant.
3. Estimated activity basis is breakdown and transfer of 10 percent of resin from upstream ion exchangers.
4. Reactor coolant source terms corresponding to 0.25 percent fuel defects.
5. Estimated activity basis from AP1000 DCD Table 11.1-5, 11.1-7, and 11.1-8 and a typical 30-day process run time, once per refueling cycle
6. Estimated volume and activity used for conservatism. Resin and membrane will be removed with the electrodeionization units and not stored as wet waste. See AP1000 DCD Subsection 10.4.8.

Originally, TVA planned to send low-level radwaste to Barnwell, South Carolina, until a new disposal facility at Wake County, North Carolina, opened in mid-1998. The proposed disposal facility in Wake County was never opened, and the LLRW disposal facility in Barnwell, South Carolina, stopped accepting Class B and C radwaste from states outside the Atlanta Compact on September 29, 2009. Because Alabama is not a member of the Atlanta Compact, alternate LLRW disposal plans were necessary. All DAW is currently shipped to a processor in Oak Ridge, Tennessee, for compaction and then by the processor to Clive, Utah, for disposal. Since 2008, TVA has also shipped Class A WAW to the facility at Clive. Class B and C waste from SQN and WBN is currently stored at and shipped to SQN. For either Action Alternative, plans are to resume shipments of DAW and WAW as soon as an acceptable location becomes available.

Should there be no disposal facilities available to accept the Class B and C wastes at the time a nuclear unit begins operation at BLN, TVA has several options available for storage of this LLRW:

- One long-term plan would be to build and license a WAW facility to accept spent resins at the BLN site.
- For either the B&W or the AP1000 unit, TVA could construct or expand a storage facility at BLN or gain access to a storage facility at another licensed nuclear plant (i.e. SQN or BFN). For this option, BLN would have to be licensed by NRC to receive and store low-level radwaste.
- A new Class B and C disposal facility may be licensed that TVA could use as an alternative to on-site storage for the BLN site.

The impact to members of the public resulting from processing, storage, and transport of solid radwaste would be minor.

3.18.2. Spent Fuel Storage

3.18.2.1. Affected Environment

As discussed above, the TVA 1974 FES assumed that spent fuel would be shipped by rail to the reprocessing plant in Barnwell, South Carolina. TVA's 1993 review of the FES noted that reprocessing was no longer likely and that "TVA now expects to store spent fuel on site until the U.S. Department of Energy completes the construction of permanent storage facilities in accordance with the Nuclear Waste Policy Act of 1982." The revised plan was for TVA to provide additional storage capacity on site, if needed, until a licensed DOE facility became available. Subsection 2.1.1 of the 1974 FES stated that TVA would apply for a special nuclear license to receive, possess, and store fuel elements, and TVA received such a license (TVA 1993a). However, that license is no longer in effect.

The need to expand on-site spent fuel storage at TVA nuclear plants was addressed when DOE prepared the CLWR FEIS (DOE 1999). That FEIS analyzed spent fuel storage needs at WBN Unit 1, SQN 1&2, and BLN 1&2, and included a thorough review of the environmental effects of constructing and operating an on-site independent spent fuel storage installation (ISFSI). This FSEIS incorporates by reference the spent fuel storage impact analysis in the CLWR FEIS and updates the analysis to include operation of either one B&W reactor or one AP1000 reactor at the BLN site.

Operation of either a single B&W unit or a single AP1000 unit at the BLN site would result in the generation of spent fuel assemblies beyond the capacity of their respective spent fuel pools. A comparison of spent fuel production for the B&W and AP1000 is provided in Table 3-35. A comparison based on the number of fuel assemblies discharged over the 40-year lifetime can be misleading because of different fuel assembly length (B&W - 12 feet versus AP1000 - 14 feet) and power level (3,600 MW versus 3,400 MW). Fuel is limited in its burnup on a fuel rod to approximately 62,000 MWD/MTU. Allowing for power peaking factors, the average discharge burnup is expected to be 50,000 MWD/MTU for both the AP1000 and the B&W BLN plant designs. Because this fuel characteristic parameter is expected to be the same for both fuel designs, this indicates that the expected amount of fuel to be discharged is proportional to the amount of energy produced.

Table 3-35. Spent Fuel Quantity Determination for BLN Single Unit Operation

Data Parameter	BLN B&W	BLN AP1000	BLN AP1000 Normalized for Power
Core thermal power, MWt	3,600	3,400	3,600
Operating cycle length	18 months	18 months	N/A
Number of assemblies in the core	205[1]	157[2]	N/A
Number of fresh fuel assemblies per refueling cycle	80[3]	64[4]	N/A
Height of active fuel, feet	12	14	14
Number of refueling cycles in 40 years[5]	26	26	N/A
Number of fuel assemblies for 40-year operation[6]	2,285	1,821	N/A
Total Spent Fuel (MTU) for 40-year operation	946	894	946

[1] TVA 1978a
[2] TVA 2008a
[3] T A Keys, TVA, personal communication, September 3, 2009
[4] TVA 2008a
[5] Forty years of operation covers 26 refueling cycles and 27 operating cycles. Spent fuel is discharged a total of 27 times from each unit, which includes the last cycle discharge of the entire core.
[6] Number includes assemblies from 26 refueling cycles, plus assemblies in the core.

For the purpose of this SEIS, it is assumed that all spent nuclear fuel generated by the operation of one BLN unit would be accommodated at the site in a dry cask ISFSI. An ISFSI contains multiple dry casks for storage of spent nuclear fuel. This ISFSI would be designed to store the spent nuclear fuel assemblies (including assemblies in the core) required for 40-year, one-unit operation at the reactor site. To date, no ISFSI has been constructed at the BLN site.

The spent fuel pool capacity for the B&W unit is 1,058 assemblies (TVA 1982c), which accommodates approximately 10 refueling cycles plus the core (i.e., 80 assemblies per cycle x 10 cycles + 205 assemblies in the core). Assuming 18-month refueling cycles, the spent fuel pool for the B&W unit has the capacity for approximately 15 years of storage (i.e., 18 months per cycle x 10 cycles = 180 months/12 months per year = 15 years), plus the core. The AP1000 spent fuel pool capacity is 889 assemblies (TVA 2008a), which accommodates approximately 11 refueling cycles plus the core (i.e., 64 assemblies per cycle x 11 cycles + 157 assemblies in the core). Assuming 18-month refueling cycles, the spent fuel pool for the AP1000 unit has the capacity for approximately 16 years of storage of spent fuel (i.e., 18 months per cycle x 11 cycles = 198 months/12 months per year = 16.5 years), plus the core. Under the current schedule, assuming that one BLN unit would begin operation in 2018, the ISFSI would be needed by 2033 (B&W) or 2034 (AP1000).

The CLWR FEIS assessed the number of dry storage casks needed, per reactor, to accommodate tritium production at the BLN site based on the 24 spent fuel assembly design capacity of four of the ISFSI cask designs in the United States at the time. The estimated number of dry cask storage units that would be needed for 40 years of operation if a B&W unit were completed is 96, and for an AP1000 unit, it would be 76. These numbers are based on 24 fuel assembly cask designs. The SQN uses casks that contain 32 spent fuel assemblies, but this evaluation uses the more conservative 24 fuel assembly cask design capacity. Additional details on dry casks and ISFSI construction are provided in Table 3-36.

A number of ISFSI dry storage designs have been licensed by the NRC and are in operation in the United States, including facilities at TVA's SQN and BFN. Licensed designs include the metal casks and concrete casks. The majority of these operating ISFSIs use concrete casks. Concrete casks consist of either a vertical or a horizontal concrete structure housing a basket and metal cask that confines the spent nuclear fuel. Currently, there are three vendors with concrete pressurized water reactor spent nuclear fuel dry cask designs licensed in the United States: Holtec International, NAC International, and Transnuclear Inc. The Holtec International and NAC International designs are vertical concrete cylinders; whereas, the Transnuclear design is a rectangular concrete block. These designs store varying numbers of spent nuclear fuel assemblies, ranging from 24 to 37. However, because the Holtec design is currently being used at TVA's SQN and is representative of all other designs, the environmental impact of using the Holtec concrete dry storage ISFSI design has been addressed. As stated above, although the multipurpose canister (MPC)-32 is being used at SQN, this update has taken a more conservative approach using the MPC-24, because it would require more casks and correspondingly more concrete and steel. The environmental analysis of spent fuel storage in the CLWR FEIS, which focused on dry storage casks, is still valid. The following sections update information about the equipment vendors and processes that would be used at BLN and provide analysis of the effects of completing one BLN unit (B&W or AP1000) on construction and operation of a spent fuel storage facility.

Table 3-36. ISFSI Construction for a Single BLN Unit

Environmental Parameter	One B&W Unit	One AP1000 Unit
External appearance	96 vertical cylindrical storage modules (casks) placed on a concrete cask foundation pad of an approximate area of 29,760 square feet and 2 feet thick. Each cask would be a nominal 12 feet in diameter.[1]	76 vertical cylindrical storage modules (casks) placed on a concrete cask foundation pad of an approximate area of 23,560 square feet and 2 feet thick. Each cask would be a nominal 12 feet in diameter.[1]
Health and safety (only construction work performed subsequent to the loading of any storage modules with spent fuel may result in worker exposures from direct and skyshine radiation in the vicinity of the loaded horizontal storage modules)	Dose rate: 0.5 mrem per hour [2] Construction hours: 1,500 person-hours per cask/storage module[2] Total dose during construction: 72 person-rem	Dose rate: 0.5 mrem per hour [2] Construction hours: 1,500 person-hours per cask/storage module[2] Total dose during construction: 57 person-rem
Size of disturbed area	ISFSI footprint: 0.70 acre Total disturbed: 1.20 acres	ISFSI footprint: 0.55 acre Total disturbed: 0.94 acre
Materials (approximate)	Concrete: 14,760 tons Steel: 1,680 tons	Concrete: 11,685 tons Steel: 1,330 tons

[1] Numbers based on HI-STORM ISFSI dimensions described in TVA 2007
[2] DOE 1999

3.18.2.2. Environmental Consequences

Alternative A
Under this alternative, no completion or construction and operation of a new nuclear plant would occur; therefore, there would be no impacts.

Alternatives B and C
During their 40-year operating lifetimes, the Alternative B B&W unit would produce 946 MTU of spent fuel in 2,285 fuel assemblies (see Table 2-6). The Alternative C AP1000 unit would produce 894 MTU of spent fuel in 1,821 fuel assemblies. When normalized to account for the difference in power generated by the different design, the lifetime production of spent fuel is comparable. The remainder of this section compares the impacts of the construction and operation of the facilities proposed to store this spent fuel at the BLN site.

Construction of a spent fuel storage facility is addressed in the CLWR FEIS (DOE 1999), which describes a NUHOMS-24P horizontal spent fuel storage module. Currently, HI-STORM vertical storage modules are used at SQN. For the purposes of this analysis, it is assumed that the same type of vertical storage modules would be used at BLN for either Action Alternative. The modules used at SQN consist of cylindrical structures with inner and outer steel shells filled with concrete. The stainless steel MPC that contains the spent fuel assemblies is placed inside the vertical storage module. The MPC is fabricated off site.

Using the SQN ISFSI as a basis for calculating an appropriately sized pad, an area of approximately 29,760 square feet (0.70 acre) would be needed to store the 96 casks required to support operation of a B&W unit at the BLN site for 40 years. Approximately 23,560 square feet (0.55 acre) would be needed to store the 76 casks required to support operation of an AP1000 unit at the BLN site for 40 years. Assuming a proportionate ratio (1.71) of area required for construction disturbance, nuisance fencing, and transport activities (DOE 1999), a projected net disturbed area of approximately 1.20 acres would be required for a B&W unit. A projected net disturbed area of approximately 0.94 acre would be required for an AP1000 unit. The construction and environmental parameters for an ISFSI for one B&W or one AP1000 unit at the BLN site are provided in Table 3-36. The environmental effects of construction and installation of the HI-STORM modules would be similar to that described in the CLWR FEIS for the NUHOMS-24P. There is ample room at the BLN site to locate a spent nuclear fuel storage facility.

Operational impacts for spent fuel storage would be the same for both Action Alternatives. The NUHOMS horizontal storage module dry cask system described in the CLWR FEIS was designed and licensed to remove up to 24 kW of decay heat safely from spent fuel by natural air convection. The Holtec HI-STORM dry cask storage system currently in use at SQN is licensed to remove up to 28 kW of decay heat safely. Conservative calculations have shown that, for 24 kW of decay heat, air entering the cask at a temperature of 70°F would be heated to a temperature of 161°F. For a 28-kW maximum heat load, and assuming similar air mass flow rate through the cooling vents, the resulting temperature would be approximately 176°F. The environmental impact of the discharge of this amount of heat can be compared to the heat (336 kW) emitted to the atmosphere by an automobile with a 150–brake horsepower engine (DOE 1999). The heat released by an average automobile is the equivalent of as few as 12 ISFSI casks at their design maximum heat load of 28 kW. Therefore, the decay heat released to the atmosphere from the spent nuclear fuel ISFSI for a B&W unit is equivalent to the heat released to the atmosphere from approximately eight average-size cars. The decay heat released to the atmosphere from the spent nuclear fuel ISFSI for an AP1000 unit is equivalent to the heat released to the atmosphere from approximately six average-size cars.

SQN has proposed and the NRC is reviewing the use of storage casks with a licensed maximum heat load of up to 40 kW. The use of this higher allowable maximum heat load cask would result in an increase from the values reported in the paragraph above. For example, for a 40-kW maximum heat load and assuming similar air mass, flow rate through the cooling vents results in a projected temperature of approximately 221°F. The heat released by an average automobile is the equivalent of as few as nine ISFSI casks at their proposed higher design maximum heat load of 40 kW. The decay heat released to the atmosphere from the spent nuclear fuel ISFSI for a B&W unit would be equivalent to the heat released to the atmosphere from approximately 11 average-size cars. The decay heat released to the atmosphere from the spent nuclear fuel ISFSI for an AP1000 unit would be equivalent to the heat released to the atmosphere from approximately nine average-size cars. If approved, this type of cask could be used at BLN.

The CLWR FEIS concluded that the heat emitted from the ISFSI would have no effect on the environment or climate because of its small magnitude. The heat emitted by the fully loaded, largest projected ISFSI (ISFSI for one B&W unit), even at the maximum design-licensed decay heat level for each cask of 28 kW, would be approximately 2,700 kW (i.e., 96 casks x 28 kW = 2,688 kW or 2.69 MW), as compared to 2,000 kW for the system analyzed in 1999. This increase of 700 kW of heat added to the atmosphere is not large

enough to change the conclusion that this amount of heat is about 0.1 percent the heat released to the environment from any of the proposed nuclear power plants—on the order of 2,400,000 kW for an operating nuclear reactor. The actual decay heat from spent nuclear fuel in the ISFSI should be lower than 2,700 kW and would decay with time due to the natural decay of fission products in the spent nuclear fuel. As stated in the CLWR FEIS, the incremental loading of the ISFSI over a 40-year period would not generate the full ISFSI heat until 40 years after the initial operation.

The proposed use of casks with higher allowable maximum heat load (40 kW) would result in an increase from the values reported above. For example, for a 40-kW maximum heat load, a total of 3,840 kW (96 casks x 40 kW) would represent about 0.16 percent of the heat released to the environment from the proposed nuclear power plant (2,400,000 kW). Therefore, for the proposed 40-kW cask design, no noticeable effects on the environment or climate are expected.

The environmental impact of ISFSI operation for one unit at the BLN site is shown in Table 3-37. TVA has concluded that due to the small magnitude of the total potential dose, the radiation dose to workers from ISFSI operation would be minor. In general, the operational effects of the HI-STORM modules would be similar to that described in the CLWR FEIS for the NUHOMS-24P, as would be the environmental effects.

Table 3-37. Environmental Impact of ISFSI Operation for a Single BLN Unit

Environmental Parameter	One B&W Unit	One AP1000 Unit
Effects of operation of the heat dissipation system	Equivalent to heat emitted into the atmosphere by approximately 8 average-size cars, or approximately 11 cars if the higher maximum heat load (40-kW) cask at SQN is used.	Equivalent to heat emitted into the atmosphere by approximately 6 average-size cars, or approximately 9 cars if the higher maximum heat load (40-kW) cask at SQN is used.
Facility water use	Transfer cask decontamination water consumption of less than 1,521 cubic feet	Transfer cask decontamination water consumption of less than 1,204 cubic feet
Radiological impact from routine operation	Worker exposure: As the result of daily inspection of casks, during a 40-year life cycle, workers would be exposed to 91.5 person-rem. Public exposure: The regulatory limit for public exposure is 25 mrem per year. Doses to members of the public would be negligible.	Worker exposure: As the result of daily inspection of casks, during a 40-year life cycle, workers would be exposed to 72.5 person-rem. Public exposure: The regulatory limit for public exposure is 25 mrem per year. Doses to members of the public would be negligible.
Radwaste and source terms	Cask loading and decontamination operation generates less than 192 cubic feet of low-level radioactive waste.	Cask loading and decontamination operation generates less than 152 cubic feet of low-level radioactive waste.

Environmental Parameter	One B&W Unit	One AP1000 Unit
Climatological impact	Small (approximately 0.1 percent of the nuclear power plant's heat emission to the atmosphere, or approximately 0.16 percent if 40-kW cask are used)	Small (approximately 0.1 percent of the nuclear power plant's heat emission to the atmosphere, or approximately 0.13 percent if 40-kW cask are used)
Impact of runoff from operation	The storage cask surface is not contaminated. No contaminated runoff is expected.	The storage cask surface is not contaminated. No contaminated runoff is expected.

Postulated Accidents
The CLWR FEIS analyzed the postulated accidents that could occur at an ISFSI and concluded that the potential radiological releases would all be well within regulatory limits. The impact of the calculated doses, which were approximately 50 mrem or less for different scenarios, were compared with the natural radiation dose of about 300 mrem annually received by each person in the United States (DOE 1999). The storage casks proposed for use at BLN for a one-unit operation would be of similar or better design than those analyzed in the mid-1990s, and any accident doses resulting from such a postulated event would be consistent with doses previously determined.

3.18.3. Transportation of Radioactive Materials

3.18.3.1. Affected Environment

Postulated accidents due to transportation of radioactive materials were discussed in Section 2.1, "Transportation or Nuclear Fuel and Radioactive Wastes" in the TVA 1974 FES. Transportation accidents were also addressed in Section 7.2, "Transportation Accidents Involving Radioactive Materials" in AEC's 1974 FES. Normal risks associated with transportation of radioactive materials were discussed in Subsection 5.3.2.4.2, "Transportation of Radioactive Material," of the same AEC FES. Information for Transportation of Radioactive Materials for the AP1000 unit was presented in Sections 3.8 and 7.4 of the COLA ER. This section provides an updated discussion regarding the transportation of radioactive materials associated with a single unit operation.

The NRC evaluated the environmental effects of transportation of fuel and waste for light water reactors in the "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Plants" in WASH-1238 (AEC 1972) and "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants", Supplement 1 of NUREG-75/038 (NRC 1975), and found the impacts to be minor.

The NRC analyses presented in these reports (WASH-1238 and NUREG-75/038) provided the basis for Table S-4 in 10 CFR §51.52 (NRC 2007b), which summarizes the environmental impacts of transportation of fuel and radioactive wastes to and from a reference reactor. The table addresses two categories of environmental considerations: (1) normal conditions of transport and (2) accidents in transport. Subparagraphs 10 CFR §51.52(a)(1) through (5) delineate specific conditions the reactor licensee must meet to use Table S-4 as part of its environmental report. For reactors not meeting all of the conditions in paragraph (a) of 10 CFR §51.52, paragraph (b) of 10 CFR §51.52 requires a further analysis of the transportation effects.

The conditions in paragraph (a) of 10 CFR §51.52 establishing the applicability of Table S-4 relate to reactor core thermal power, fuel form, fuel enrichment, fuel encapsulation, average fuel irradiation, time after discharge of irradiated fuel before shipment, mode of transport for unirradiated fuel, mode of transport for irradiated fuel, radioactive waste form and packaging, and mode of transport for radioactive waste other than irradiated fuel. The following subsection describes the characteristics of a B&W unit and an AP1000 unit relative to the requirements of 10 CFR §51.52, which are necessary to use Table S-4.

Currently, there is not a repository in the United States where commercial spent fuel can be shipped. If at some point in the future a spent fuel repository is available, the risks associated with transport of radioactive materials are already evaluated in the following subsection. Information for the B&W unit's fuel design is taken from the BLN 1&2 FSAR. Information for the AP1000 unit's fuel design is taken from the BLN COLA FSAR.

3.18.3.2. Environmental Consequences

Alternative A
Under this alternative, no completion or construction and operation of a new nuclear plant would occur; therefore, there would be no impacts.

Alternatives B and C

Transportation of Unirradiated Fuel
Subparagraph 10 CFR §51.52(a)(5) requires that unirradiated fuel be shipped to the reactor site by truck. Table S-4 includes a condition that the truck shipments not exceed 73,000 pounds as governed by federal or state gross vehicle weight restrictions. New fuel assemblies would be transported to the BLN site by truck, in accordance with Department of Transportation (DOT) and NRC regulations.

The B&W unit's initial fuel load consists of 205 fuel assemblies. Every 18 months, refueling would require an average of 80 new fuel assemblies for one unit. The fuel assemblies would be fabricated at a fuel fabrication plant and shipped by truck to the BLN site before they are required.

For an AP1000 unit, the initial fuel load consists of 157 fuel assemblies for one unit. Every 18 months, refueling requires an average of 64 new fuel assemblies for one unit.

The details of the new fuel container designs, shipping procedures, and transportation route depends on the requirements of the suppliers providing the fuel fabrication and support services. Truck shipments would not exceed the applicable federal or state gross vehicle weight restrictions.

Transportation of Irradiated Fuel
For a B&W unit, spent fuel assemblies would be removed from the reactor and placed into the spent fuel pool during each refueling outage. The spent fuel storage pool has the capacity to store 1,058 fuel assemblies. Each refueling off load would average 80 fuel assemblies. Therefore, the spent fuel storage pool has the capacity for 10 refueling off loads, which represents approximately 15 years of operation, with a full core reserve. The spent fuel would remain on site for a minimum of five years between removal from the reactor and shipment off site. Packaging of the fuel for off-site shipment would comply with applicable DOT and NRC regulations for transportation of radioactive material. By law,

DOE is responsible for spent fuel transportation from reactor sites to a repository as provided in the *Nuclear Waste Policy Act of 1982,* Section 302, and DOE makes the decision on transport mode.

For an AP1000 unit, spent fuel assemblies would be discharged every refueling outage and placed into the spent fuel pool. The spent fuel storage pool has the capacity to store 889 fuel assemblies. Each refueling off load would discharge 64 fuel assemblies. Therefore, the spent fuel storage pool has the capacity for 11 refueling off loads, which represents approximately 16 years, plus a full core reserve. The spent fuel would remain on site for a minimum of five years between removal from the reactor and shipment off site to allow for adequate cooling. Packaging of the fuel for off-site shipment would comply with applicable DOT and NRC regulations for transportation of radioactive material. DOE would determine the transport mode for the AP1000 unit spent fuel. The following paragraphs compare the BLN site with 10 CFR §51.52(a) requirements.

Reactor Core Thermal Power. Subparagraph 10 CFR §51.52(a)(1) requires that the reactor have a core thermal power level not exceeding 3,800 MW.

A B&W unit has a thermal power rating of 3,600 MWt and would meet this condition. An AP1000 unit has a thermal power rating of 3,400 MWt and also would meet this condition.

Fuel Form. Subparagraph 10 CFR §51.52(a)(2) requires that the reactor fuel be in the form of sintered uranium dioxide (UO_2) pellets. A B&W unit and an AP1000 unit would use a sintered UO_2 pellet fuel form and would meet this requirement.

Fuel Enrichment. Subparagraph 10 CFR §51.52(a)(2) requires that the reactor fuel have a uranium-235 enrichment not exceed 4 percent by weight. A B&W unit's reactor fuel would meet the 4 percent U-235 requirement.

For an AP1000 unit, the enrichment of the initial core varies by region from 2.35 to 4.45 percent, and the average for reloads is 4.51 percent. Therefore, the AP1000 fuel would exceed the 4 percent U-235 requirement. NUREG-1555 states that the NRC has generically considered the environmental impacts of spent nuclear fuel with U-235 enrichment levels up to 5 percent and irradiation levels up to 62,000 MWD/MTU. The generic evaluation of high enrichment and high burnup fuel transport presented in NUREG-1555 determined that the environmental impacts of spent nuclear fuel transport are bounded by the impacts listed in Table S-4, provided that more than five years has elapsed between removal of the fuel from the reactor and any shipment of the fuel off site.

Five years is the minimum decay time expected before shipment of irradiated fuel assemblies from the BLN site. DOE's contract for acceptance of spent fuel, as set forth in 10 CFR Part 961, Appendix E, requires standard spent fuel to undergo a five-year cooling time. In addition, NRC specifies five years as the minimum cooling period when it issues certificates of compliance for casks used for shipment of power reactor fuel as stated in NUREG-1437, Addendum 1. A B&W unit and an AP1000 unit would have sufficient storage capacity to accommodate a five-year cooling of irradiated fuel prior to any transport off site. Therefore, both units would meet the requirements of Subparagraph 10 CFR §51.52(a)(2).

Fuel Encapsulation. Subparagraph 10 CFR §51.52(a)(2) requires that the reactor fuel pellets be encapsulated in Zircaloy rods. A B&W unit's reactor fuel would be encapsulated in Zircaloy fuel rods. Therefore, a B&W unit would meet this requirement.

An AP1000 unit's reactor fuel would be encapsulated in ZIRLO™ cladding. License amendments approving the use of ZIRLO™ rather than Zircaloy have not identified a significant increase in the amounts, or significant change in the types, of any effluents that may be released off site, or a significant increase in individual or cumulative occupational radiation exposure. Therefore, the use of ZIRLO™ cladding for an AP1000 unit would meet this subsequent evaluation requirement.

Average Fuel Irradiation. Subparagraph 10 CFR §51.52(a)(3) requires that the average fuel assembly burnup not exceed 33,000 MWD/MTU. The average fuel assembly burnup for a B&W unit and an AP1000 unit would exceed this requirement. As stated in NUREG-1555, the NRC has generically considered the environmental impacts of irradiation levels up to 62,000 MWD/MTU and found that the environmental impacts of spent nuclear fuel transport are bounded by the impacts listed in Table S-4, provided that more than five years has elapsed between removal of the fuel from the reactor and any shipment of the fuel off site. The B&W unit and the AP1000 unit would be bounded by the 62,000 MWD/MTU average burnup limit considered by the NRC and would therefore meet this requirement.

Transportation. Subparagraph 10 CFR §51.52(a)(5) allows for truck, rail, or barge transport of irradiated fuel. This requirement would be met for the BLN units. DOE is responsible for spent fuel transportation from reactor sites to the repository and makes decisions on transport mode as stated in 10 CFR §961.1. Should an off-site repository be established, the heat load of the spent fuel shipping casks and the doses to the general public would be bounded by the conditions of Table S-4.

Summary

A B&W unit would meet the conditions for average fuel irradiation as described in NUREG-1555 (NRC 1999) and would meet all other criteria outlined in 10 CFR §51.52(a). An AP1000 unit would meet the conditions for maximum fuel enrichment and average fuel irradiation as described in NUREG-1555 and would meet all other criteria outlined in 10 CFR §51.52(a). Therefore, no additional analyses of fuel transportation effects for normal conditions or accidents are required, because the risks of transporting radioactive materials would be bounded by Table S-4 of 10 CFR §51.52. Because a B&W unit or an AP1000 unit would be bounded by Table S-4, the environmental impact of any transportation of irradiated fuel would be minor as defined in 10 CFR §51.52.

3.19. Nuclear Plant Safety and Security

This section assesses the environmental impacts of postulated accidents involving radioactive materials at the BLN site and plant security including intentional destructive acts. It is divided into three subsections that address design-basis accidents, severe accidents, and plant security.

- Design-Basis Accidents (Subsection 3.19.1)
- Severe Accidents (Subsection 3.19.2)
- Plant Security (Subsection 3.19.3)

3.19.1. Design-Basis Accidents

3.19.1.1. Affected Environment

The potential consequences of postulated accidents are evaluated to demonstrate that a new unit could be constructed and operated at the BLN site without undue risk to the health

and safety of the public. These evaluations use a set of design-basis accidents (DBAs) that are representative of the reactor designs being considered for the BLN site. DBAs are those for which the risk is great enough that NRC requires plant design features and procedures to prevent unacceptable accident consequences. The set of DBAs considered covers events ranging from a relatively high probability of occurrence with relatively low consequences to relatively low probability events with high consequences.

A high degree of protection against the occurrence of postulated accidents is provided through quality design, manufacture, and construction, which ensures the high integrity of the reactor system and associated safety systems. Deviations from normal operations are handled by protective systems and design features that place and hold the plant in a safe condition. Notwithstanding this, it is conservative to postulate that serious accidents may occur, even though they are extremely unlikely. Engineered safety features are installed to prevent and mitigate the consequences of postulated events that are judged credible. The probability of occurrence of accidents and the spectrum of their consequences to be considered from an environmental impact standpoint have been analyzed using best estimates of probabilities, realistic fission product releases, and realistic transport assumptions.

The purpose of this SEIS section is to update the accident dose consequences given in the BLN 1&2 FSAR (TVA 1991) using updated atmospheric dispersion values based on current meteorological data and to present corresponding results for the AP1000 unit. This section also presents the calculated dose consequences and methodologies used for both the B&W unit and the AP1000 unit DBAs. The AP1000 unit DBA dose methodologies and results are as reported in the COLA ER.

Selection of Accidents

The site evaluations presented in the BLN 1&2 FSAR (TVA 1991) for the B&W unit and the BLN COLA FSAR for the AP1000 unit use conservative assumptions for the purpose of comparing calculated site-specific doses resulting from a hypothetical release of fission products against the 10 CFR §100.11 (NRC 2002) siting guidelines. Realistic computed doses that would be received by the population from the postulated accidents would be significantly less than those presented in the respective FSARs. The DBAs considered in this section come from Appendix A of NUREG-1555 Environmental Standard Review Plan (ESRP) Section 7.1 (NRC 1999) and apply to both the B&W unit and the AP1000 unit. The DBAs cover a spectrum of events, including those of relatively greater probability of occurrence and those that are less probable but with greater consequences. DBAs are postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety. The radiological consequences of the accidents listed in Appendix A of ESRP Section 7.1 are assessed to demonstrate that the selected unit can be sited and operated at the BLN site without undue risk to the health and safety of the public.

Evaluation Methodology

Section 7.1 of the BLN FES demonstrates that the calculated DBA doses for the B&W unit are within the limits of the more recently established 10 CFR §100.11. The analysis presented in this SEIS updates applicable inputs used in the previous dose assessments.

Section 7.1 of the BLN COLA ER demonstrates that the postulated DBA doses for the AP1000 are also within the limits of 10 CFR §100.11 using current inputs consistent with those described in this SEIS.

The basic scenario for each accident is that radioactive effluent is released at the accident location inside a building, and this radioactivity is eventually released to the environment. Chapter 15 of the BLN 1&2 FSAR presents conservative radiological consequences for the accidents identified for the B&W unit. Chapter 15 of the BLN COLA FSAR presents the conservative radiological consequences for the AP1000 unit.

Among the conservative assumptions in Chapter 15 of the BLN 1&2 FSAR and the BLN COLA FSAR is the use of time-dependent atmospheric dispersion (χ/Q) values, which are exceeded only 0.5 percent of the time, meaning that conditions would be more favorable for atmospheric dispersion 99.5 percent of the time. In addition to the use of atmospheric dispersion factors corresponding to adverse conditions, the analyses presented in Chapter 15 of the BLN 1&2 FSAR and the BLN COLA FSAR also used conservative assumptions for the radionuclide activity in the core and coolant, the types of radioactive materials released, and the release paths to the environment in order to calculate conservative dose estimates.

These conservative assumptions are maintained for the dose assessments presented in this section, except that realistic atmospheric dispersion factors are used. The doses in this SEIS section are calculated based on the 50th percentile (average) site-specific atmospheric dispersion (χ/Q) values reflecting more realistic meteorological conditions consistent with the guidance provided in the ESRP (NRC 1999). The χ/Q values are calculated using the guidance in NRC Regulatory Guide 1.145 (NRC 1982a) with site-specific meteorological data. The dose from the B&W unit for a given time interval is calculated by multiplying the BLN 1&2 FSAR accident dose by the ratio of the 50 percent probability-level χ/Q value to the BLN 1&2 FSAR χ/Q value. For the BLN AP1000 unit, the accident doses are obtained from the BLN COLA ER, which is based on 50 percent probability-level χ/Q values as required by the ESRP. All other input parameters and assumptions used for the accident analyses remain unchanged from the BLN 1&2 FSAR and BLN COLA FSAR.

Details on the methodologies and assumptions pertaining to each of the accidents, such as activity release pathways and credited mitigation features, are provided in Chapter 15 of the BLN 1&2 FSAR for the B&W unit and in Chapter 15 of the BLN COLA FSAR for the AP1000 unit. The atmospheric dispersion factors (χ/Q values) used to calculate conservative design-basis EAB and LPZ doses for the various postulated accidents for the B&W unit are obtained from Chapter 15 of the BLN 1&2 FSAR. The χ/Q values used to calculate conservative design-basis EAB and LPZ doses for the AP1000 unit are obtained from Chapter 15 of the BLN COLA FSAR. The 50 percent probability-level χ/Q values used to calculate realistic EAB and LPZ doses for the B&W unit are summarized in Table 3-38 and for the AP1000 unit in Table 3-39.

Table 3-38. B&W Unit 50 Percent Probability-Level χ/Q Values (sec/m^3)

Location	0-2 Hours	0-8 Hours	8-24 Hours	24-96 Hours	96-720 Hours
EAB	1.07E-04	–	–	–	–
LPZ	–	9.39E-06	8.09E-06	5.84E-06	3.66E-06

Table 3-39. AP1000 Unit 50 Percent Probability-Level χ/Q Values (sec/m^3)

Location	0-2 Hours	0-8 Hours	8-24 Hours	24-96 Hours	96-720 Hours
EAB	1.04E-04	–	–	–	–
LPZ	–	9.65E-06	8.35E-06	6.09E-06	3.88E-06

Differences between the χ/Q values for the B&W unit and the AP1000 unit are the result of differences in distances from the plants to the EAB and LPZ boundaries. The χ/Q values also differ from the values reported in the BLN 1&2 FSAR due to the usage of more current meteorological data.

3.19.1.2. Environmental Consequences

Alternative A
Under this alternative, no completion or construction and operation of a new nuclear plant would occur; therefore, there would be no impacts.

Alternatives B and C
The BLN site-specific radiological consequences of DBAs using the 50 percent probability-level χ/Q values are shown in Table 3-40 for the B&W unit and in Table 3-41 for the AP1000 unit. For each accident, the EAB dose shown is for a two-hour period and the LPZ dose shown is the integrated dose for the duration of the accident as specified in the ESRP. The B&W unit doses are presented as thyroid and whole-body doses as per the original B&W unit licensing basis and the BLN AP1000 unit doses are presented as TEDE.

The results presented in Tables 3-40 and 3-41 provide a realistic estimate of radiological consequences of the postulated accidents for a B&W unit and an AP1000 unit. In all cases, the doses to an assumed individual at the EAB and LPZ are a small fraction of the dose limits specified within 10 CFR §100.11. The results from this realistic analysis show that the environmental risks due to postulated radiological accidents are exceedingly minor. These results confirm the conclusion presented in the 1974 BLN FES.

Table 3-40. Summary of Design-Basis Accident Atmospheric Doses for a B&W Unit

Accident Description	Accident Dose					
	Thyroid (rem)			Whole-Body (rem)		
	EAB	LPZ	Limit[4]	EAB	LPZ	Limit[4]
Steam Line Break	1.14E+01[5]	1.28E-01	300	7.64E-03	7.34E-03	25
Feedwater Piping Break	Note 1	Note 1	300	Note 1	Note 1	25
Reactor Coolant Pump Shaft Seizure (Locked Rotor)	Note 2	Note 2	30	Note 2	Note 2	2.5
Reactor Coolant Pump Shaft Break	Note 3	Note 3	30	Note 3	Note 3	2.5
Failure of Small Lines Carrying Primary Coolant Outside Containment	4.62E-01	4.06E-02	300	4.22E-02	3.71E-03	25

Accident Description	Accident Dose					
	Thyroid (rem)			Whole-Body (rem)		
	EAB	LPZ	Limit[4]	EAB	LPZ	Limit[4]
Steam Generator Tube Failure	1.68E+00	8.26E-02	300	1.95E-02	9.58E-04	25
Loss-of-Coolant Accident	3.09E-01	1.51E-01	300	1.66E-03	2.18E-02	25
Fuel-Handling Accident	5.09E+00	4.46E-01	75	2.18E-01	1.91E-02	6

Notes:
1. The radiological consequences of a Feedwater Piping Break are bounded by a Steam Line Break, as indicated in Subsection 15.2.8.5 of the BLN 1&2 FSAR.
2. The radiological consequences of this accident will not exceed normal operating levels as no fuel barrier failures result from this transient, as indicated in Subsection 15.3.3.5 of the BLN 1&2 FSAR.
3. Radiological consequences of a Reactor Coolant Pump Shaft Break are bounded by Reactor Coolant Pump Shaft Seizure, as indicated in Subsection 15.3.4 of the BLN 1&2 FSAR.
4. Limits from 10 CFR §100.11.
5. 1.14E+01 is the same as $1.14 \times 10^{+01}$, or 11.4.

Table 3-41. Summary of Design-Basis Accident Doses for an AP1000 Unit

Accident Description	Accident Dose (rem TEDE)		
	EAB	LPZ	Limit[3]
Steam System Piping Failure			
Preexisting Iodine Spike	1.00E-01	2.00E-02	25
Accident-Initiated Iodine Spike	1.10E-01	5.00E-02	2.5
Feedwater System Pipe Break	Note 1	Note 1	
Reactor Coolant Pump Shaft Seizure			
No Feedwater	8.00E-02	1.00E-02	2.5
Feedwater Available	6.00E-02	2.00E-02	2.5
Reactor Coolant Pump Shaft Break	Note 2	Note 2	
Spectrum of Rod Cluster Control Assembly Ejection Accidents	3.70E-01	1.10E-01	6.3
Failure of Small Lines Carrying Primary Coolant Outside Containment	2.20E-01	2.00E-02	2.5
Steam Generator Tube Rupture			
Preexisting Iodine Spike	2.30E-01	2.00E-02	25
Accident-Initiated Iodine Spike	1.10E-01	2.00E-02	2.5
Loss-of-Coolant Accident Resulting from a Spectrum of Postulated Piping Breaks Within the Reactor Coolant Pressure Boundary	1.20E+00	0.31E+00	25
Fuel-Handling Accident	5.40E-01	5.00E-02	6.3

Notes:
1. Radiological consequences of a Feedwater System Pipe Break are bounded by Steam System Piping Failure, as indicated in Section 15.2 of the BLN COLA FSAR.
2. Radiological consequences of a Reactor Coolant Pump Shaft Break are bounded by Reactor Coolant Pump Shaft Seizure, as indicated in Subsection 15.3.4.2 of the BLN COLA FSAR.
3. NUREG-1555 specifies a dose limit of 25 rem TEDE for all DBAs. The more restrictive limits shown in the table apply to safety analysis doses, but they are shown here to demonstrate that even these more restrictive limits are met.

3.19.2. Severe Accidents

3.19.2.1. Affected Environment

The term "accident" refers to any unintentional event (i.e., outside the normal or expected plant operation envelope) that results in a release or a potential for a release of radioactive material to the environment. The NRC categorizes accidents as either design basis or severe. DBAs, described in Subsection 3.19.1, are those for which the risk is great enough that NRC requires plant design features and procedures to prevent unacceptable accident consequences. Severe accidents are those that NRC considers too unlikely to warrant normal design controls to prevent or mitigate the consequences. Severe accident analyses consider both the risk of a severe accident and the on-site and off-site consequences.

The risk of a severe accident associated with a B&W PWR is determined by a plant-specific probabilistic safety assessment, which provides a systematic and comprehensive methodology of determining the risks associated with the operation of a plant at the BLN site. Because the BLN 1&2 construction permits were deferred before consideration of severe accidents was required by the NRC, no probabilistic safety assessment model was developed for the specific units at the BLN site. However, such models exist for other B&W PWRs.

For this evaluation, the severe accident frequency analysis is based on the Arkansas Nuclear One (ANO) probabilistic safety assessment (PSA) model (ANO 2000). Use of the ANO probabilistic risk assessment (PRA) as a surrogate for the BLN B&W plant is acceptable because the important safety-related systems, structures, and components at the ANO B&W plant are the same as in the standard B&W design. Consequently the failure modes and frequencies modeled in the ANO PRA are applicable to the BLN B&W plant. The ANO PSA calculates the possible frequencies of four main categories of radioactive release types: early containment failure by leakage (CFEL), early containment failure by rupture (CFER), containment bypass (BP), and late containment failure (CFL). For this analysis, the release plume characteristics in the ANO PSA, such as isotope release fractions, plume size, delay, and duration, had to be proportioned for application to BLN due to the different core thermal power rating for ANO.

Westinghouse has developed a PRA for the AP1000 standard PWR plant design that determines the severe accident frequencies and release characterizations (isotope releases and the plume size and durations) (WEC 2008). The accidents are characterized by six major release types: early containment rupture after core relocation (CFI), early containment rupture before core relocation (CFE), normal leakage from an intact containment (IC), bypass of the containment (BP), containment isolation systems failure (CI), and late containment failure (CFL).

Two severe accident analyses were performed to estimate the human health impacts from potential accidents at BLN. One analysis considering the B&W PWR design, representative of either Units 1 or 2, was prepared to support this SEIS. A separate analysis, prepared in support of the COLA ER, considered the AP1000 design. Only severe reactor accident scenarios leading to core damage and significant off-site releases are presented here. Accident scenarios that do not lead to significant off-site releases are not presented due to significantly reduced risk of adverse public and environmental consequences.

The MELCOR Accident Consequence Code System (MACCS2) computer code (Version 1.13.1) (NRC 1998) was used to perform probabilistic analyses of radiological impacts. The

generic input parameters given with the MACCS2 computer code that were used in NRC's 1990 severe accident analysis (NUREG-1150) formed the basis for the analysis. These generic data values were supplemented with parameters specific to BLN and the surrounding area. Site-specific data included population distribution, economic parameters, and agricultural production. Plant-specific release data included nuclide release, release duration, release energy (thermal content), release frequency, and release category (i.e., early release, late release). These data, in combination with site-specific meteorology, were used to simulate the probability distribution of impact risks (exposure and fatalities) to the surrounding 80-kilometer (within 50 miles) population.

3.19.2.2. Environmental Consequences

Alternative A
Under this alternative, no completion or construction and operation of a new nuclear plant would occur; therefore, there would be no impacts.

Alternatives B and C
The consequences of a beyond-design-basis accident to the maximally exposed off-site individual, an average individual, and the population residing within an 80-kilometer (50-mile) radius of the reactor site are summarized in Tables 3-42 through 3-44. These analyses assumed average or mean meteorological conditions. The analysis also assumed that a site emergency would have been declared early in the accident sequence and that all nonessential site personnel would have evacuated the site in accordance with site emergency procedures before any radiological releases to the environment occurred. In addition, a 95 percent probability was assigned to the assumption that emergency action guidelines would have been implemented to initiate evacuation of the public within 16 kilometers (10 miles) of the plant. This is a reasonably conservative assumption, which implies that 5 percent of the population would not evacuate as directed.

Table 3-42. Severe Accident Analysis Results, Total Risks

Plant Design	Dose-Risk (Person-Rem/yr)	Dollar Risk ($/yr)	Affected Land (hectares per accident)	Early Fatalities (per year)	Latent Fatalities (per year)
B&W PWR	1.06E+00	2.18E+03	6.35E+04	0.00E+00	5.95E-04
AP1000	2.88E-02	7.68E+01	1.40E+05	0.00E+00	1.83E-05

Note: 2.88E-02 is equal to 2.88×10^{-2} or 0.0288

Table 3-43. Severe Accident Individual Annual Risks, B&W Unit

Release Category (frequency per reactor year)	Maximally Exposed Off-Site Individual		Average Individual Member of Population Within 80 Kilometers (50 miles)	
	Dose Risk[1] (rem/year)	Cancer Fatality[2]	Dose Risk[1] (rem/year)	Cancer Fatality[2]
CFER (2.91E-07)	1.73E-04	3.72E-09	1.32E-07	8.72E-11
CFEL (2.54E-07)	8.69E-06	6.96E-09	1.19E-07	6.01E-11
BP (3.59E-07)	3.77E-05	4.70E-09	2.09E-07	1.37E-10
CFL (1.42E-06)	3.99E-05	3.26E-09	3.54E-07	1.72E-10
Cumulative Total Individual Risk		1.86E-08		4.55E-10

Notes:
1. Includes the likelihood of occurrence of each release category
2. Increased likelihood of cancer fatality per year

Table 3-44. Severe Accident Individual Annual Risks, AP1000 Unit

Release Category (frequency per reactor year)	Maximally Exposed Off-Site Individual		Average Individual Member of Population Within 80 Kilometers (50 miles)	
	Dose Risk[1] (rem/year)	Cancer Fatality[2]	Dose Risk[1] (rem/year)	Cancer Fatality[2]
CFI (1.89E-10)	1.70E-07	2.29E-12	1.07E-10	8.56E-14
CFE (7.47E-09)	2.47E-06	3.34E-11	5.34E-09	2.97E-12
IC (2.21E-07)	1.76E-06	3.38E-11	7.54E-10	3.82E-13
BP (1.05E-08)	2.00E-05	2.35E-10	1.69E-08	1.11E-11
CI (1.33E-09)	7.49E-07	1.21E-11	7.66E-10	6.27E-13
CFL (3.45E-13)	2.95E-12	3.08E-16	2.84E-13	3.26E-16
Cumulative Total Individual Risk		3.17E-10		1.52E-11

Notes:
1. Includes the likelihood of occurrence of each release category
2. Increased likelihood of cancer fatality per year

The B&W unit results (Table 3-43) show that the highest risk to the maximally exposed off-site individual is one fatality every 54 million years (or 1.86×10^{-8} per year) while the risk to an average individual member of the public is one fatality every 2 billion years (or 4.55×10^{-10} per year). The AP1000 unit results (Table 3-44) show that the highest risk to the maximally exposed off-site individual is one fatality every 3 billion years (or 3.17×10^{-10} per year) while the risk to an average individual member of the public is one fatality every 66 billion years (or 1.52×10^{-11} per year). The risk associated with the AP1000 unit is lower due to its advanced design. However, for either a B&W or an AP1000 unit, the risk to the general population and individual members of the public is insignificant because of adherence to applicable radiological standards, specific plant design features in conjunction with a waste minimization program, and employee safety training programs and work procedures. Overall, the risk results presented above for both the B&W and the AP1000 unit are minor.

3.19.3. Plant Security

3.19.3.1. Affected Environment

Some nongovernmental entities and members of the public have expressed concern about the risks posed by nuclear generating facilities in light of the threat of terrorism. TVA believes that the possibility of a terrorist attack affecting operation of one or more units at

BLN is very remote and that postulating potential health and environmental impacts from a terrorist attack involves substantial speculation.

TVA has in place detailed, sophisticated security measures to prevent physical intrusion into all its nuclear plant sites, including BLN, by hostile forces seeking to gain access to plant nuclear reactors or other sensitive facilities or materials. TVA security personnel are trained and retrained to react to and repel hostile forces threatening TVA nuclear facilities. TVA's security measures and personnel are inspected and tested by the NRC. It is highly unlikely that a hostile force could successfully overcome these security measures and gain entry into sensitive facilities and even less likely that they could do this quickly enough to prevent operators from putting plant reactors into safe shutdown mode. However, the security threat that is more frequently identified by members of the public or in the media are not hostile forces invading nuclear plant sites but attacks using hijacked jet airliners, the method used on September 11, 2001, against the World Trade Center and the Pentagon. The likelihood of this now occurring is equally remote in light of today's heightened security awareness at airports, but this threat has been carefully studied.

The NEI commissioned EPRI to conduct an impact analysis of a large jet airliner being purposefully crashed into sensitive nuclear facilities or containers including nuclear reactor containment buildings, used fuel storage ponds, used fuel dry storage facilities, and used fuel transportation containers (NEI 2002). Using conservative analyses, EPRI concluded that there would be no release of radionuclides from any of these facilities or containers because they are already designed to withstand potentially destructive events. Nuclear reactor containment buildings, for example, have thick concrete walls with heavy reinforcing steel and are designed to withstand large earthquakes, extreme overpressures, and hurricane-force winds. The EPRI analysis used computer models, in which a Boeing 767-400 was crashed into containment structures that were representative of all U.S. nuclear power containment types. The containment structures suffered some crushing and chipping at the maximum impact point but were not breached.

The EPRI analysis is fully consistent with research conducted by NRC. When NRC recently considered such threats, NRC Commissioner McGaffigan observed:

> *Today the NRC has in place measures to prevent public health and safety impacts of a terrorist attack using aircraft that go beyond any other area of our critical infrastructure. In addition to all the measures the Department of Homeland Security and other agencies have put in place to make such attacks extremely improbable (air marshals, hardened cockpit doors, passenger searches, etc.), NRC has entered into a Memorandum of Understanding with NORAD/NORTHCOM to provide realtime information to potentially impacted sites by any aircraft diversion.*
>
> *As NRC has said repeatedly, our research showed that in most (the vast majority of) cases an aircraft attack would not result in anything more than a very expensive industrial accident in which no radiation release would occur. In those few cases where a radiation release might occur, there would be no challenge to the emergency planning basis currently in effect to deal with all beyond-design-basis events, whether generated by mother nature, or equipment failure, or terrorists* (NRC 2007c).

3.19.3.2. Environmental Consequences

Alternative A
Under this alternative, no completion or construction and operation of a new nuclear plant would occur, therefore, there would be no impacts.

Alternatives B and C
In the very remote likelihood that a terrorist attack did successfully breach the physical and other safeguards at BLN resulting in the release of radionuclides, the consequences of such a release are reasonably captured by the discussion of the impacts of severe accidents discussed above in Subsection 3.19.2.

Notwithstanding the very remote risk of a terrorist attack affecting operations, TVA increased the level of security readiness, improved physical security measures, and increased its security arrangements with local and federal law enforcement agencies at all of its nuclear generating facilities after the events of September 11, 2001. These additional security measures were taken in response to advisories issued by NRC. TVA continues to enhance security at its plants in response to NRC regulations and guidance. The security measures TVA has taken at its sites are complemented by the measures taken throughout the United States to improve security and reduce the risk of successful terrorist attacks. This includes measures designed to respond to and reduce the threats posed by hijacking large jet airliners.

3.20. Decommissioning

3.20.1. Affected Environment

Decommissioning is not addressed in TVA's 1974 FES. However, the AEC 1974 FES includes a brief discussion of both the process and the cost. The CLWR FEIS (DOE 1999, Subsection 5.2.5) includes discussion of decontamination and decommissioning, but does not mention costs. As these documents explain, at the end of the operating life of a nuclear unit, TVA would seek the termination of its operating license from NRC. Termination requires that the unit be decommissioned, a process that ensures the unit is safely removed from service and the site made safe for unrestricted use. A decommissioning plan would be developed for approval by NRC, with appropriate environmental reviews when TVA prepares to decommission the unit in the future.

For the purpose of this environmental review, the decommissioning process and requirements are essentially the same insofar as both alternative units are concerned. The partially completed B&W unit and the advanced design AP1000 unit are PWRs, which are treated similarly when factors such as minimum estimated decommissioning cost and planning are taken into account.

Methods
The three NRC-approved methods of decommissioning nuclear power facilities described in the CLWR FEIS (DOE 1999) are still viable alternatives:

1. **DECON**. The DECON option calls for the prompt removal of radioactive material at the end of the plant life. Under DECON, all fuel assemblies, nuclear source material, radioactive fission and corrosion products, and all other radioactive and contaminated materials above NRC-restricted release levels are removed from the plant. The reactor pressure vessel and internal components would be removed along with removal and

demolition of the remaining systems, structures, and components with contamination control employed as required. This is the most expensive of the three options.

2. **SAFSTOR**. SAFSTOR is a deferred decontamination strategy that takes advantage of the natural dissipation of almost all of the radiation. After all fuel assemblies, nuclear source material, radioactive liquid, and solid wastes are removed from the plant, the remaining physical structure would then be secured and mothballed. Monitoring systems would be used throughout the dormancy period and a full-time security force would be maintained. The facility would be decontaminated to NRC-unrestricted release levels after a period of up to 60 years, and the site would be released for unrestricted use. Although this option makes the site unavailable for alternate uses for an extended period, worker and public doses would be much smaller than under DECON, as would the need for radioactive waste disposal.

3. **ENTOMB.** As the name implies, this method involves encasing all radioactive materials on site rather than removing them. Under ENTOMB, radioactive structures, systems, and components are encased in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained and monitored until radioactivity decays to a level that permits termination of the license. This option reduces worker and public doses, but because most power reactors will have radionuclides in concentrations exceeding the limits for unrestricted use even after 100 years, this option may not be feasible under current regulation.

It is expected that by the time the BLN unit is decommissioned, new, improved technologies and efficiencies will have been developed and approved by NRC.

Cost

In AEC's FES the estimated cost of decommissioning was $25 million. NRC currently estimates that decommissioning a PWR would cost a minimum of $404 million per unit in today's dollars. TVA presently maintains a nuclear decommissioning trust to provide money for the ultimate decommissioning of its entire fleet of nuclear power plants. The fund is invested in securities generally designed to achieve a return in line with overall equity market performance. The estimated assets of the decommissioning trust fund as of March 31, 2010, totaled $908 million. This balance is above the present value of the estimated future nuclear decommissioning costs for TVA's operating nuclear units. TVA recently provided the NRC with a plan to ensure decommissioning funding assurance when eventual decommissioning activities take place. The plan describes an external sinking fund approach that provides funding assurance for each nuclear unit at the end of its respective term of licensed operation. A fund balance is projected for each remaining year of unit operation. In accordance with NRC regulations, TVA will annually review the minimum amount to be provided for decommissioning funding assurance and, as necessary, will make contributions to the funds for each unit, or apply another method or combination of methods of funding assurance consistent with NRC regulations and guidance. TVA monitors the assets of its nuclear decommissioning trust versus the present value of its liabilities in order to ensure that, over the long term and before cessation of nuclear plant operations and commencement of decommissioning activities, adequate funds from investments will be available to support decommissioning.

Prior to the time the BLN unit commences operation, TVA would create a separate trust account for the unit within the decommissioning trust fund. It also has the option of

applying another method or combination of methods of funding assurance to cover the costs of future decommissioning.

3.20.2. Environmental Consequences

Alternative A
Under this alternative, no completion or construction and operation of a new nuclear plant would occur; therefore, there would be no impacts.

Alternatives B and C
Environmental issues associated with decommissioning were analyzed in the *Generic Environmental Impact Statement for Licensing of Nuclear Power Plants*, NUREG–1437 (NRC 1996; 1999). The generic environmental impact statement included a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues were sorted into two categories. For those issues meeting Category 1 criteria, no additional plant-specific analysis is required by NRC, unless new and significant information is identified. Category 2 issues are those that do not meet one or more of the criteria of Category 1 and therefore require additional plant-specific review. Environmental analysis of the future decommissioning plan for either alternative BLN unit would tier from this or the appropriate NRC document in effect at the time.

TVA has not identified any significant new information during this environmental review that would indicate the potential for decommissioning impacts not previously reviewed. Therefore, TVA does not at this time anticipate any adverse effects from the decommissioning process. As stated earlier, further environmental reviews would be conducted at the time a decommissioning plan for the BLN unit is proposed.

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