



Tennessee Valley Authority, 1101 Market Street, LP 5A, Chattanooga, Tennessee 37402-2801

June 27, 2008

10 CFR 52.80

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

In the Matter of)
Tennessee Valley Authority)

Docket Numbers 52-014 and 52-015

NUCLEAR REGULATORY COMMISSION (NRC) – BELLEFONTE NUCLEAR
PLANT (BLN) – RESPONSE TO NRC INFORMATION NEED RELATED TO
ALTERNATIVES – CLINCH RIVER BREEDER REACTOR SITE INFORMATION

Reference: Letter from Ashok Bhatnagar (TVA) to Mr. R. William Borchardt (NRC),
“Application for Combined License for BLN Units 3 and 4,”
dated October 30, 2007.

The purpose of this letter is to provide a response to the NRC Alternatives information need that was identified by the NRC reviewers during the Environmental Report (ER) site audit conducted at the Tennessee Valley Authority (TVA) Bellefonte Nuclear Plant, Units 3 and 4 (BLN) site during the week of March 31 through April 4, 2008. This response provides the information requested to support an alternative site evaluation for the Clinch River Breeder Reactor site in Oak Ridge, Tennessee.

By the referenced letter, TVA submitted an application for a combined license for two AP1000 advanced passive pressurized-water reactors at the BLN site. Included in the review of a combined license application (COLA) is a week-long environmental site audit during which the NRC staff tours the proposed plant site and environs and reviews the applicable documents that support the information provided in the ER. At the April 4, 2008 exit meeting for the BLN site audit, the NRC staff provided a list of information that was determined to be necessary to complete the review of the ER.

DOB5
NRO

The enclosure to this letter provides the TVA response to the NRC Alternatives (Alt) Information Need Alt-32, which requests Clinch River Breeder Reactor (CRBR) site-specific information to enable the staff to evaluate this site as an alternative to the preferred Bellefonte Nuclear Plant site in Hollywood, Alabama. Based on the staff's clarification that the alternative site evaluation, if necessary, will be performed by the NRC staff, the enclosure does not include an evaluation of the CRBR site, nor does it include any changes to the BLN ER.

If there are any questions regarding this application, please contact Phillip Ray at 1101 Market Street, LP 5A, Chattanooga, Tennessee 37402-2801, by telephone at (423) 751-7030, or via email at pmray@tva.gov.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 27th day of June, 2008.



Andrea L. Sterdis
Manager, New Nuclear Licensing and Industry Affairs
Nuclear Generation Development & Construction

Enclosure:

Response to NRC Environmental Report Information Need – Clinch River Breeder Reactor Alternative Site Specifics

Attachment:

Summary of Information for the Clinch River Breeder Reactor Site, June 2008

cc: (Enclosure)

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**RESPONSE TO NRC
ENVIRONMENTAL REPORT
INFORMATION NEED**

**CLINCH RIVER BREEDER REACTOR
ALTERNATIVE SITE SPECIFICS**

This enclosure provides the BLN response to an NRC information need related to the review of Alternatives (Alt) in the Bellefonte Nuclear Plant, Units 3 and 4 (BLN) Environmental Report (ER).

Updated Status of "Alt" Information Needs

**NRC Information
Need Number**

Status

- Alt-32 Response provided in this enclosure.

TVA Letter Dated: June 27, 2008

Response to NRC Environmental Report Information Need (Alt-23)

NRC Review of the BLN Environmental Report

NRC Information Needs - BLN ER Site Audit Exit Meeting

NRC Environmental Category: ALTERNATIVES

During the BLN Environmental Report site audit exit meeting on April 4, 2008, the NRC staff identified the following information need:

Clinch River specifics requested.

BLN INFORMATION NEED: Alt-32

BLN RESPONSE:

During the week of March 31 through April 4, 2008, the NRC staff conducted an audit of the BLN site, including a review of the documentation supporting the BLN ER. At the site audit exit meeting, NRC alternative site reviewers requested site-specific information for TVA's Clinch River Breeder Reactor (CRBR) site in Oak Ridge, Tennessee. The NRC staff clarified this request during the alternate sites visit during the week of May 12 through May 15, 2008. Based on this clarification, TVA understands that the staff's needs will be satisfied if the information provided is of a similar level-of-detail to that provided in the BLN ER for the currently evaluated alternate sites. Furthermore, the staff clarified that TVA needs to provide the CRBR site-specific information only; the alternate site comparison will be performed by the NRC reviewers, if necessary. TVA understands that the information needs identified by Alt-32, including subsequent clarifications, are satisfied by the CRBR site-specific information provided in Attachment A to this enclosure.

ASSOCIATED BLN COL APPLICATION REVISIONS:

None.

ATTACHMENTS:

The following document is provided as an attachment to this enclosure:

Summary of Information for the Clinch River Breeder Reactor Site, June 2008.

ATTACHMENT
TENNESSEE VALLEY AUTHORITY
"SUMMARY OF INFORMATION FOR THE CLINCH RIVER BREEDER REACTOR SITE"
JUNE 2008

Summary of Information for the Clinch River Breeder Reactor Site

June 2008

Table of Contents

<u>Section</u>	<u>Page</u>
Table of Contents	i
List of Tables	ii
List of Figures	iii
Description of the Clinch River Breeder Reactor Site	1
Safety Criteria	2
Environmental Criteria	6
Socioeconomic Criteria	19
Engineering and Cost-Related Criteria	23

LIST OF TABLES

<u>Table</u>	<u>Page</u>
Table 1. Flood Information, Clinch River Breeder Reactor Site	3
Table 2. Recent (1994-2006) RFAI Ratings for Watts Bar Reservoir, Clinch River	9
Table 3. Fish Species collected during Vital Signs Monitoring on Watts Bar Reservoir, Clinch River	9
Table 4. State-listed Fish Species Reported from Roane County	12
Table 5. State-listed Terrestrial Animal Species Known from Roane County	14
Table 6. State-listed Plant Species Known from Within 5 Miles of the CRBR Site	14
Table 7. Densities of Young of Year Fish and Standing Stocks of Fish in the Reservoir, Clinch River Breeder Reactor Site	17
Table 8. Clinch River Breeder Reactor Site - Population Data	21

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
Figure 1: Clinch River Breeder Reactor Site 20 and 50-Mile Radius	28
Figure 2: Clinch River Breeder Reactor Site 6-Mile Vicinity	29
Figure 3: Minority Population, Area around Clinch River Breeder Reactor Site	30
Figure 4: Population below Poverty Level, Area around Clinch River Breeder Reactor Site	31
Figure 5: Clinch River Breeder Reactor Site Aerial Photo with Site Boundaries	32
Figure 6: Clinch River Breeder Reactor Site Land Ownership Status	33

Description of the Clinch River Breeder Reactor Site

This document provides the descriptive characterization of the Clinch River Breeder Reactor (CRBR) site complementary to, and to an equivalent level of detail for, criteria used to rate or rank sites as presented in the Applicant's Environmental Report (ER) for the Combined License Application (COLA) for Bellefonte Nuclear Plant, Units 3 and 4 (BLN) and the document titled, "Criteria and Basis for Comparative Ratings Among Alternative Brownfield and Greenfield Sites." The latter document was prepared 1) to respond to an NRC staff information need regarding the description of criteria; and 2) to update alternative site information. That document compared the BLN, Hartsville Nuclear (HVN), Phipps Bend Nuclear (PBN), Yellow Creek Nuclear (YCN) and Murphy Hill (MH) sites. This document provides the information necessary to provide a basis for comparing the CRBR site to the five other sites based upon those criteria.

The reference material upon which this CRBR site description is based was reviewed to confirm its current applicability, and updated as necessary to reflect new information or data required to accurately depict current conditions for the CRBR site and environs.

The CRBR site is in Roane County, Tennessee. It is situated on the north shore of the Clinch River (Watts Bar Reservoir) between approximately Clinch River miles (CRM) 14 and 19. The site is within the boundaries of the City of Oak Ridge, a short distance west of Oak Ridge National Laboratory and approximately 10 miles southwest of the business district of Oak Ridge. TVA owns a total of about 1,255 acres at this site. In its Land Management Plan for Watts Bar Reservoir, TVA is considering designation of approximately 1,065 acres for TVA Project Operations, 43 acres for Industrial/Commercial use, and 147 acres for Sensitive Resource Management. There is a 2.6-acre strip along part of the eastern end of the site that is a navigation safety harbor for barge traffic. The electrical service provider for this site is the City of Oak Ridge Electric Department. The site is now crossed by two energized transmission lines, a 161-kV line and a 500-kV line, which cross each other on the site. A 161-kV substation is located off Bear Creek Road near the site. Much of the south end of the site has soil disturbance and excavation that occurred in preparing the site for the earlier proposed breeder reactor project. This site is also currently under consideration as a possible site for a small-scale demonstration spent nuclear fuel reprocessing facility. Should the site be used for this purpose, it would be part of a collaborative effort with the U.S. Department of Energy (USDOE) to demonstrate the feasibility of reprocessing. The USDOE has recently funded \$4 million for TVA to develop a conceptual design for a plant to reprocess spent nuclear fuel. The final location of a recycling facility, if funded, has not been determined.

Safety Criteria

This discussion encompasses the information that serves as the basis for criteria and ratings related to safety, i.e., geologic evaluation; cooling system suitability; flooding potential; accident effects including effects on populations, emergency planning and atmospheric dispersion; and operational effects.

Geologic Evaluation:

Although nuclear plants are designed to withstand a certain earthquake hazard, the prediction of earthquake timing and severity is subject to many uncertainties. Consequently, the objective of this criterion is to assess plant risk related to proximity to seismological hazards. Sites with the least seismic risk are rated the highest.

The Modified Mercalli (MM) Scale is one measure of the intensity of an earthquake. The scale quantifies the effects of an earthquake on the Earth's surface, humans, objects of nature, and fabricated structures using a scale of 1 through 12, with 1 denoting the weakest earthquake and 12 denoting the earthquake that causes the greatest destruction. The lower degrees of the MM scale generally pertain to the manner in which the earthquake is felt by people. The higher numbers of the scale are based on observed structural damage. This value is translated into a peak ground acceleration (PGA) value to measure the maximum force experienced. The PGA is measured in terms of percent of "g," the acceleration due to gravity. As an exclusionary criterion, the maximum level of ground motion suggested by EPRI (2002) is a PGA of 0.30 g (30 percent g) at a probability of exceedance (PE) of 2 percent in 50 years, translating to once in 2500 years. The PGA at the CRBR site (Latitude 35.8, Longitude 84.45) is 0.22 (USGS 2008 seismic hazard maps).

The CRBR site is located in the Appalachian Highland Physiographic Division of the eastern United States, near the western border of the Appalachian geosyncline. The site is situated between the traces of two inactive tectonic structures: the Copper Creek and Whiteoak Mountain thrust faults; investigation of these faults suggest no reason to suspect any post-Paleozoic activity associated with them.

Cooling System Suitability

Cooling system requirements are important siting considerations for new power generating facilities. The surrounding atmosphere serves as the post-accident ultimate heat sink for the AP1000 plant. The objective of this subsection is to rate the candidate sites with respect to their ability to satisfy specific cooling system requirements.

In light of existing water quality standards, which limit increases in downstream temperatures and increases above ambient upstream temperature, the supply of available cooling water has become less important in plant siting because these standards tend to force the use of some form of auxiliary cooling. Heat exhausted by the same design plant (i.e., AP1000) at different site locations would be generally of uniform temperature, and makeup water for the auxiliary cooling systems would remain essentially unchanged between sites. Sites with larger amounts of available cooling water are, however, rated higher due to reduced risk of low flow considerations.

The CRBR site is located on the north shore of Watts Bar Reservoir on the riverine portion of the Clinch River between Clinch River Mile (CRM) 14.5 and CRM 18.6. The Clinch River is a tributary to the Tennessee River. Flow at the site is regulated upstream by TVA's Melton Hill Dam (dam closure on May 1, 1963) and downstream by TVA's Watts Bar Dam (dam closure on January 1, 1942). Flow statistics

were computed for two time periods with the Environmental Protection Agency's DFLOW program using TVA's water records of total flow (turbine and spill) from Melton Hill Dam. Based upon the entire historical record (1970-2007), the average regulated flow for the site is 5,050 cfs; the 7Q10 is about 170 cfs and the 3Q20 is 0 cfs. However, beginning in 1991 and continuously since 1992, TVA has targeted a minimum flow release of 400 cfs daily average minimum flow release from Melton Hill Dam. Analysis of the TVA Water Records indicate that for the period 1992 – 2007, the 7Q10 was 390 cfs and the daily average flow was 4,590 cfs. This minimum flow release was formally incorporated into TVA reservoir operations by the TVA Reservoir Operations Study EIS (14). Low flow statistics for this site are reflective of the manner in which TVA River Operations operates the multipurpose Melton Hill Dam to pass cold water stored further upstream in Norris Reservoir. Because of its typically cold temperature, this water is one of the most valuable sources of cooling water available in the TVA reservoir system. It is stored and routed by TVA River Operations to assist multiple TVA fossil and nuclear facilities in meeting their thermal compliance requirements. These characteristics make the CRBR site viable and acceptable as a candidate site, and on these criteria the rating would be similar to that for the PBN site.

Plant Safety Evaluation - Flooding Potential

This section reviews the flooding potential of candidate sites. Sites that were issued construction permits met the desired exclusionary and avoidance siting criteria. These criteria exclude potential sites within major wetlands and areas less than 1 ft. above the elevation of probable maximum flood (PMF). The PMF is the flood that can be expected from the most severe meteorologic and hydrologic conditions that are reasonably possible for an area. PMF values are typically used in the design of major dams and nuclear power plants.

The CRBR site grade, at 815 ft. msl, is approximately 37 ft. above the PMF of about 778 ft (Table 1). It therefore is not excluded on this criterion and would rate favorably compared to other candidate sites.

Clinch River Mile	100-Year Elevation (feet)	500-Year Elevation (feet)	Probable Maximum Flood Elevation (feet)
14.50	749.9	752.8	
14.70	750.0	753.0	
15.75	750.4	753.6	
16.00			776.0
16.80	751.0	754.2	
17.85	752.0	755.5	
18.00			777.5
18.60	752.6	756.2	

Accident Effects Evaluation

To evaluate sites with respect to the effects of design-related accidents, three site characteristics relevant to these effects are considered: population, emergency planning considerations, and atmospheric dispersion. Each is evaluated and assigned a set of ratings.

Population

The CRBR site is about 25 mi. from Knoxville, Tennessee, and the population within a 50-mi. radius is estimated to be 1 million people (Figure 1). A six-mile radius vicinity map is provided as Figure 2. The site is located within the boundaries of the city of Oak Ridge. However, the area adjacent to the site is part of the Oak Ridge Reservation, which houses Oak Ridge National Laboratory and other federal facilities. These facilities are owned by the U. S. Government and are currently operated by private companies under guidance of the U. S. Department of Energy. Based upon population data, the site meets the need for exclusionary control and low population zone.

Emergency Planning

The CRBR Site has an estimated population of approximately one million within 50 miles. The site is about 5 driving miles from Interstate 40 via either S. R. 58 or S. R. 95 to Bear Creek Road, which is almost adjacent to the site. Secondary road access along Bear Creek Road to the site is adequate; the road would need no more than minor upgrade.

Atmospheric Dispersion

The Clinch River site is located in a valley between two ridges up to 575 ft. above plant grade. The Clinch River cuts through these ridges and permits a significant cross-valley flow. The meteorology of the site provides a limited range of atmospheric conditions for transport and dispersion of plant emissions because the narrow valleys would tend to channel emissions into particular directions and the high ridges could prevent lateral spreading during inversion conditions (Reference 8).

Operational Effects Evaluation

The impacts of severe accidents at each site would be similar. Since the site does not affect the design of the plant, the frequency and source term of severe accidents would be similar at each site. Furthermore, the differences in population are not sufficiently significant to affect the overall risk, which would be SMALL at each site.

Although the release pathways would be somewhat different at each site, the radiological impacts of normal operation at each site would be similar. The doses would be required to be maintained within regulatory limits, which will ensure that the impacts are SMALL.

The BLN alternative sites considered would be bounded by the analysis for operational effects of transportation and the uranium fuel cycle, and are therefore assigned the same rating. No further comparison is made of these considerations at this time.

Transportation Safety Evaluation - Cooling Tower Drift

Operating plant cooling systems have the potential to create fog and ice hazards for local transportation routes. Sites with high frequencies of naturally occurring fog and ice events could be more adversely affected by cooling tower operations; sites with lower frequencies are rated higher.

Meteorological conditions at a site are monitored and evaluated as part of determining suitability for siting of nuclear plants. The observation of temperature and wind conditions over time provides input into statistical models. The models can be used to help estimate the effects of cooling tower drift. Topographic conditions also influence extreme weather and temperature variations. Sites with more favorable meteorological conditions are rated higher.

The CRBR site is located in a valley between two ridges up to 575 ft. above plant grade. The Clinch River cuts through these ridges and permits a significant cross-valley flow. However, the meteorology of the CRBR site provides a more limited range of atmospheric conditions for cooling tower drift. This situation may contribute to an increased severity and duration of ice and fog events.

Environmental Criteria

This discussion encompasses the information that serves as the basis for criteria and ratings related to Proximity to Natural Areas; Construction-Related Effects on Aquatic Ecology and Terrestrial Resources; Operations-Related Effects on Aquatic Ecology and Terrestrial Resources.

Proximity to Natural Areas

The site alternatives were reviewed (1) to identify natural areas in the proximity of each site, and (2) to prioritize the sites according to their environmental superiority. In the case of natural areas, the environmentally superior ranking would be based on the number, proximity, and sensitivity of natural areas to the site alternatives.

A review of the TVA Regional Natural Heritage database indicates that four natural areas occur at or adjacent to the CRBR site. These are:

- The Oak Ridge State Wildlife Management Area, a 37,000-acre area managed by Tennessee Wildlife Resources Agency for special shotgun, muzzleloader, and archery deer hunts. It is located at CRMs 18.8 to 14.5 on the right descending shoreline of Clinch River primarily on the USDOE's Oak Ridge Reservation and also includes some TVA lands, i.e., it is within the CRBR site.
- The Grassy Creek TVA Habitat Protection Area (HPA), located on Grassy Creek at CRM 14.5 on the right descending shoreline of Clinch River, abuts the proposed site. In the TVA Watts Bar Reservoir Land Plan (Draft Environmental Impact Statement) (August 2007), an additional 166 acres has been proposed to be added to this 99-acre tract to provide a buffer to sensitive habitat. Appalachian bugbane (*Cimicifuga rubifolia*), a state-listed threatened species, has been reported on this site.
- The Oak Ridge Reservation, adjacent to the proposed site, is located on the Clinch River at CRMs 23.2 to 18.9, excluding the CRBR site. USDOE manages this 34,000-acre area, which is used variously for manufacture, laboratory research, managed forest, and ecosystem process research.
- The Oak Ridge National Environmental Research Park (and Biosphere Reserve), adjacent to the proposed site, contains many natural areas, sensitive ecological sites, and research plots. This area contains approximately 20,000 acres and is within the boundaries of the Oak Ridge Reservation. The park is used as an outdoor laboratory for studying present and future environmental consequences from energy-related issues. It provides protected land for the use of education and research in environmental sciences. Managed by the Oak Ridge National Laboratory for USDOE, it is located on the Clinch River at CRMs 21.0 to 18.9 and on Melton Hill Reservoir at CRMs 33.2 to 23.0 on the right-descending shoreline.

Additionally, two Designated State Natural Areas are within a three-mile radius of the CRBR site. These are:

- The Campbell Bend Barrens Designated State Natural Area is approximately 1.7 miles northwest of and across the Clinch River from the proposed site. This 35-acre area, managed by the Tennessee Department of Environment and Conservation (TDEC), consists of a small barrens area, which is a rare community type in a region where much of the land base has been developed or converted to agriculture. Eastern red cedar, white pine, post oak, dwarf chinquapin oak, and other hardwoods are scattered throughout the open grassland community. The dominant grasses include little and big bluestem and side-oats gramma. The barrens community within the nature area is approximately four to six acres.

- The Crowder Cemetery Cedar Barrens Designated State Natural Area is approximately 1.8 miles west of and across the Clinch River from the proposed site. This 15-acre area, managed by TDEC, has grasslands in a matrix of mixed oak-pine with eastern red cedar and other hardwoods that are scattered throughout the barrens. Grasses include little bluestem and side-oats gramma and rare plants include slender blazing star and prairie dock. The dwarf chinquapin oak, which is uncommon in Tennessee, is also found here.

Construction-Related Effects on Aquatic Ecology

Many factors can be involved in the disruption of important aquatic species and their habitats. The objective of this subsection is to evaluate the candidate sites with respect to potential construction-related effects on important freshwater or marine species and their habitats.

Regulatory Guide 4.7 (RG 4.7), *General Site Suitability Criteria for Nuclear Power Stations*, defines important plant and animal species if one or more of the following conditions apply:

- Species is commercially or recreationally valuable.
- Species is officially listed as endangered or threatened.
- Species presence ensures the well-being of another species indicated by either of the two bulleted items above.
- Species is a critical component of the structure and function of a valuable ecosystem.
- Species is a biological indicator of radionuclides in the environment.

Of particular concern are potential effects to habitat areas used by important species. These areas include those used in the following ways: breeding and nursery; nesting and spawning; wintering; and feeding.

The following siting criteria were used to evaluate the candidate sites:

- Exclusionary – Designated critical habitat of endangered species.
- Avoidance – Areas where threatened and endangered species are known to occur on-site.
- Suitability – Areas where limited potential effects are expected.

The candidate sites were evaluated with respect to information available on important species and habitats. Information on important species was obtained from previous environmental studies (References 1, 5, 7, 15, 16, 17, and 18). During this evaluation, no information was identified indicating that the CRBR site or any of the other sites met the exclusionary and avoidance criteria cited above. Therefore, the suitability of a site was evaluated according to the number of areas where limited potential effects are expected, as directly correlated to the number of important aquatic resources that may occur at the site.

For purposes of comparing sites, information was grouped into two suitability factors which influenced the overall site ratings for this criterion. The following discussion is structured to provide the information and comparable basis for a rating to be identified for two areas: 1) potential to affect threatened or endangered species or their habitat; and 2) potential to affect other important key species, habitats or ecosystem functions.

Potential to Affect Federal-listed Threatened or Endangered Aquatic Species or Their Habitat

The TVA Regional Natural Heritage database indicates no areas of designated critical habitat for federally listed species in Roane County. Individuals or populations of federally listed mussels are present in the mainstem of the Clinch River between Melton Hill Dam and Poplar Creek (CRM 22 to CRM 12). One federally listed mussel (pink mucket) and one federal candidate species (sheepnose) occur in the Clinch River downstream of Melton Hill Dam. Surveys (16) in the Clinch River have resulted in the collection of only a few, older individuals of these species. No evidence of reproduction has been seen in these populations, and mussel densities are extremely low. While live individuals of these species persist, it is not likely that a viable population of these species is present in this reach of the Clinch River. Habitat alteration (including impoundment of Watts Bar Reservoir, Melton Hill Reservoir, and Fort Loudoun Reservoir, cold water releases from Norris Reservoir and subsequent displacement of host fish for these species) has likely rendered these areas unsuitable for successful reproduction of these species. Relict shells of several other federally listed or candidate species (fanshell, ring pink, orangefoot pimpleback, shiny pigtoe, fine-rayed pigtoe, and Alabama lampmussel) have been collected from this reach, but no live individuals have been reported (References 1 and 5).

Potential to Affect Other Important Aquatic Species, Habitats or Ecosystem Functions

Habitats and topography at the CRBR site has already been heavily disturbed during the original construction activities at this brownfield site. Some recovery of habitat or addition of habitat type (e.g., wetlands) may have occurred over time in minor areas of the site. It is assumed that as for the other alternative sites: 1) applicable regulatory standards and permit requirements and conditions would be met for any site chosen; and 2) that best management and construction practices similar to those described in subsequent environmental documents (the TVA ER submitted for the COLA and subsequent NRC EIS under development) for the BLN site and associated ancillary infrastructure would also apply at the alternative sites if one were chosen. This screening level of information is not intended to be exhaustive, but is intended to communicate what is known about the sites and whether or not the project design features and characteristics of habitat or communities known to occur at or near a site would indicate potential for impacts to important resources or habitats of special concern.

Using available information the candidate CRBR site was characterized to discern 1) whether or not other important species and habitats were present, and 2) whether or not these species and habitats were likely to be affected by locating nuclear generation there. Information on important species was obtained and communities characterized from the previous environmental studies conducted for the original ER for the site (Reference 7). Where noted in the text, other available information sources, such as that from the TVA Vital Signs Monitoring Program, Regional Natural Heritage data base or State agencies were utilized to update. For discussion of federal-listed species see the previous section of this document. The suitability of a site was evaluated according to the number of resource areas in which limited potential effects are expected, as directly correlated to the number of important or unique aquatic resources that may occur at the site. Based on the information for aquatic resources discussed below, selection and construction activity at the CRBR site would likely have only minor effects on aquatic resources.

Benthic macroinvertebrate (e.g., lake bottom dwelling, readily visible, aquatic worms, snails, crayfish, and mussels) samples were taken in four areas of Watts Bar Reservoir during even numbered years from 1994 to 2004, as part of TVA's Reservoir Vital Signs Monitoring Program. One of these sampling areas is on the Clinch River at CRM 19, just upstream from the eastern boundary of the CRBR site. Bottom dwellers are included in aquatic monitoring programs because of their importance to the aquatic food chain and because they have limited capability of movement, thereby preventing them from avoiding undesirable conditions. Per the TVA ranking criteria of the referenced documents, ratings in this area were "fair" in 2002 and 2004 and "poor" in earlier years.

The Reservoir Vital Signs Monitoring Program also included fish sampling on Watts Bar Reservoir. The reservoir has six sampling sites, of which three are on the Clinch River. Of these, one is at CRM 19.0, just east of the CRBR site, and was sampled biennially from 1994 through 2006 as part of the long-term monitoring program. The other two sites are downstream at CRM 4.4 and 1.5 and were sampled in 2003, 2005, and 2007 to meet specific needs. Fish are included in aquatic monitoring programs because they are important to the aquatic food chain and because they have a long life cycle which allows them to reflect water quality conditions over time. Fish are also important to the public for aesthetic, recreational and commercial reasons. The condition of the fish community is assessed using a multi-metric index known as the Reservoir Fish Assemblage Index (RFAI). The RFAI rates the fish community based primarily on fish community structure and function. Also considered in the rating are the overall number of fish collected and the occurrence of fish with anomalies such as diseases, lesions, parasites, deformities, etc. (Reference 17). The fish community at the CRBR site (CRM 19.0) rated good in 1994 and 1996 and fair thereafter (Table 2). The fish communities at CRM 1.5 and 4.4 rated fair for each of the survey years (TVA 2008). A list of species collected at each site during Vital Signs monitoring (Reference 18) is provided in Table 3. Bluegill, largemouth bass, and redear sunfish were the most common game fish at each site and gizzard shad was consistently the most common non-game fish.

Station	1994	1996	1998	2000	2002	2003	2004	2005	2006	2007
Clinch River Mile 19.0	Good	Good	Fair	Fair	Fair	--	Fair	--	Fair	--
Clinch River Mile 4.4	--	--	--	--	--	Fair	--	Fair	--	Fair
Clinch River Mile 1.5	--	--	--	--	--	Fair	--	Fair	--	Fair

Common (Scientific) Name	CRM 19.0	CRM 4.4	CRM 1.5
Paddlefish (<i>Polyodon spathula</i>)	-	-	X
Spotted gar (<i>Lepisosteus oculatus</i>)	-	X	X
Longnose gar (<i>Lepisosteus osseus</i>)	-	X	X
Skipjack herring (<i>Alosa chrysochloris</i>)	X	X	X
Alewife (<i>Alosa pseudoharengus</i>)	X	-	-
Gizzard shad (<i>Dorosoma cepedianum</i>)	X	X	X
Threadfin shad (<i>Dorosoma petenense</i>)	X	X	X
Mooneye (<i>Hiodon tergisus</i>)	-	X	X
Common carp (<i>Cyprinus carpio</i>)	X	X	X
Golden shiner (<i>Notemigonus crysoleucas</i>)	-	X	X
Emerald shiner (<i>Notropis atherinoides</i>)	X	X	X
Striped shiner (<i>Luxilus chrysocephalus</i>)	X	-	-

Table 3. Fish Species collected during Vital Signs Monitoring on Watts Bar Reservoir, Clinch River			
Common (Scientific) Name	CRM 19.0	CRM 4.4	CRM 1.5
Spotfin shiner (<i>Cyprinella spiloptera</i>)	X	X	X
Steelcolor shiner (<i>Cyprinella whipplei</i>)	-	-	X
Bluntnose minnow (<i>Pimephales notatus</i>)	X	X	X
Bullhead minnow (<i>Pimephales vigilax</i>)	-	X	-
Northern hog sucker (<i>Hypentelium nigricans</i>)	X	-	X
River carpsucker (<i>Carpiodes carpio</i>)	X	X	-
Quillback (<i>Carpiodes cyprinus</i>)	-	X	-
Smallmouth buffalo (<i>Ictiobus bubalus</i>)	X	X	X
Black buffalo (<i>Ictiobus niger</i>)	X	X	X
Spotted sucker (<i>Minytrema melanops</i>)	X	X	X
Silver redhorse (<i>Moxostoma anisurum</i>)	X	X	-
Shorthead redhorse (<i>Moxostoma macrolepidotum</i>)	X	-	-
River redhorse (<i>Moxostoma carinatum</i>)	X	X	-
Black redhorse (<i>Moxostoma duquesnei</i>)	X	X	-
Golden redhorse (<i>Moxostoma erythrurum</i>)	X	X	X
Blue catfish (<i>Ictalurus furcatus</i>)	-	X	X
Channel catfish (<i>Ictalurus punctatus</i>)	X	X	X
Flathead catfish (<i>Pylodictis olivaris</i>)	X	X	X
White bass (<i>Morone chrysops</i>)	X	X	X
Yellow bass (<i>Morone mississippiensis</i>)	X	X	X
Striped bass (<i>Morone saxatilis</i>)	X	X	X
Hybrid striped x white bass (<i>Hybrid morone (chrysops x sax)</i>)	X	X	-
Rock bass (<i>Ambloplites rupestris</i>)	X	-	-
Warmouth (<i>Lepomis gulosus</i>)	X	X	-
Redbreast sunfish (<i>Lepomis auritus</i>)	-	-	X
Green sunfish (<i>Lepomis cyanellus</i>)	X	X	X
Bluegill (<i>Lepomis macrochirus</i>)	X	X	X
Longear sunfish (<i>Lepomis megalotis</i>)	-	X	X
Redear sunfish (<i>Lepomis microlophus</i>)	X	X	X
Hybrid sunfish (<i>Hybrid lepomis spp.</i>)	X	-	-
Smallmouth bass (<i>Micropterus dolomieu</i>)	X	X	X

Table 3. Fish Species collected during Vital Signs Monitoring on Watts Bar Reservoir, Clinch River

Common (Scientific) Name	CRM 19.0	CRM 4.4	CRM 1.5
Spotted bass (<i>Micropterus punctulatus</i>)	X	X	X
Largemouth bass (<i>Micropterus salmoides</i>)	X	X	X
White crappie (<i>Pomoxis annularis</i>)	X	X	X
Black crappie (<i>Pomoxis nigromaculatus</i>)	X	X	X
Snubnose darter (<i>Etheostoma simoterum</i>)	X	-	-
Yellow perch (<i>Perca flavescens</i>)	X	X	X
Logperch (<i>Percina caprodes</i>)	X	X	X
Sauger (<i>Stizostedion canadense</i>)	X	X	X
Walleye (<i>Stizostedion vitreum</i>)	X	X	X
Freshwater drum (<i>Aplodinotus grunniens</i>)	X	X	X
Mottled sculpin (<i>Cottus bairdi</i>)	X	-	-
Banded sculpin (<i>Cottus carolinae</i>)	X	-	-
Brook silverside (<i>Labidesthes sicculus</i>)	X	X	X
Inland silverside (<i>Menidia beryllina</i>)	X	X	X
Chestnut lamprey (<i>Ichthyomyzon castaneus</i>)	X	-	-

The TVA Regional Natural Heritage database indicates that three state-listed fish species are reported from Roane County (Table 4). The blue sucker is the only state-listed fish species likely to occur in the Clinch River adjacent to the site. Neither of the other fish species is known or likely to occur on or adjacent to the site.

Table 4. State-listed Fish Species Reported from Roane County		
Common/ScientificName	State Status	Federal Status
Blue Sucker (<i>Cycleptus elongatus</i>)	Threatened	-
Tangerine Darter (<i>Percina aurantiaca</i>)	In Need of Management	-
Tennessee Dace (<i>Phoxinus tennesseensis</i>)	In Need of Management	-

Construction-Related Effects on Terrestrial Ecology

Many factors can be involved in disruption of important terrestrial species and their habitats. The objective of this subsection is to evaluate the candidate sites with respect to potential construction-related effects on important terrestrial species and their habitats.

During this evaluation no information was identified that indicated that the CRBR site or any of the other sites met general exclusionary or avoidance criteria for terrestrial impacts, which were defined above under the section, "Construction-Related Effects on Aquatic Ecology." For purposes of comparing sites, information was basically grouped into two suitability factors which influenced the overall site ratings. The following discussion is structured to provide the information and comparable basis for a rating to be identified for two areas: 1) potential to affect threatened or endangered species or their habitat; and 2) potential to affect other important key species, habitats or ecosystem functions.

Potential to Affect Federal-listed Threatened or Endangered Terrestrial Species or Their Habitat

The TVA Regional Natural Heritage database indicates no areas of designated critical habitat for federally listed terrestrial species in Roane County. No populations of plants listed under the Federal Endangered Species Act as threatened or endangered are known to occur on or immediately adjacent to the CRBR site.

No populations of terrestrial animals federal-listed as threatened or endangered are known to occur on or immediately adjacent to the site. The federal-listed gray bat is known from Roane County and, due to its foraging habitat, could potentially occur along the river on or near the site. Gray bats roost in caves and forage over open water habitats. They have been reported from six caves within the vicinity of Watts Bar Reservoir. Only one of these caves is located on Watts Bar Reservoir land, in the Marble Bluff Habitat Protection Area, which is on the Tennessee River near the Roane-Loudon County line. This species has not been observed on the CRBR site nor is it known to occupy the site.

Potential to Affect Other Important Key Terrestrial Species, Habitats or Ecosystem Functions

Many factors can be involved in disruption of important terrestrial species and their habitats. The objective of this subsection is to characterize the candidate sites as to whether or not there are types of important species, resources or habitats present and susceptible to potential impacts. See the previous discussion of

RG 4.7 for the definition of important plant and animal species. For a discussion of federal-listed terrestrial species see the previous section of this document.

As for the alternative sites, the CRBR site was evaluated with respect to information available on important species/ habitats, groundcover, and NWI mapped wetlands (following section). Data and information utilized was predominantly obtained from: 1) recent data searches for each candidate site for listed species or occurrences of important species or resources (e.g., rookeries) in the TVA Regional Natural Heritage data base; 2) the previous TVA environmental studies originally conducted for the ER or FES for the site; and 3) where noted in the text, more recent environmental reviews or surveys. During this evaluation, no information was found to indicate that the CRBR site or any of the other sites met the exclusionary and avoidance criteria; the evaluation was thereby focused on the relative suitability of each site. The available information (primarily that of the earlier TVA ER prepared for the site) indicates that for the terrestrial habitats, available terrestrial wildlife habitats on the brownfield sites are not of high quality because of formerly intense uses, as well as clearing and major site alteration for construction of the previously permitted CRBR. Except for the TVA-designated Habitat Protection Area (HPA), remaining habitats support common assemblages of terrestrial plant and animal species for the vicinity. The HPA is so designated because of the presence of Appalachian bugbane and ginseng on the ridge slopes to the northwest edge of the site. The river/reservoir shoreline is also TVA-designated as a Sensitive Resource Area for protection of the floodplain, wetlands and cultural resources.

This site is comprised of several parcels as noted in the Draft Watts Bar Reservoir Land Management Plan and EIS. The site supports several different habitat types and ecological conditions ranging from upland hardwoods, mixed pine/hardwood, bottomland and riparian zone hardwoods, planted loblolly pine stands (some of which were previously harvested), early succession shrub/scrub vegetation, and grassland/forbs and old field areas associated with the previously disturbed construction area portion of the site.

Distinct groups or guilds of terrestrial wildlife are associated with the vegetation cover types and successional ages on the CRBR site. The upland hardwood habitats support a wide array of wildlife species including amphibians and reptiles such as American toad, Cope's gray tree frog, box turtle and black rat snakes; birds such as Northern cardinal, red-bellied woodpeckers, Carolina chickadee, broad-winged hawk and Eastern wild turkey; upland mammals include Eastern gray squirrel, woodland vole, Eastern chipmunk, gray fox and white-tailed deer. Riparian habitats and associated wetlands support a different array of species including amphibians and reptiles such as bullfrog, green frog, red spotted newt and northern water snake; birds such as Carolina wren, white-eyed vireo, barred owl, red-shouldered hawk and American woodcock; and mammals such as raccoon, muskrat, beaver, and white-tailed deer. Grassland/forbs and old field early succession habitats on the area support a variety of wildlife species including black racer, song sparrow, Eastern towhee, prairie warbler, white-footed mouse, eastern cottontail rabbit, red fox and coyote.

The Grassy Creek Habitat Protection Area has been designated on a parcel within the CRBR site. This area, which includes a north-facing slope with rock outcrops and moist cove habitats, supports state listed plant species including Appalachian bugbane, ginseng and false foxglove. This area also has habitat suitable for use by the State listed Eastern small-footed myotis. The adjacent USDOE Oak Ridge Reservation supports numerous State listed plant and animals species. The CRBR site provides potential habitat for several of these species; however systematic rare plant and animals surveys of the entire area have not been conducted.

The CRBR site, through a revocable land use permit with the Tennessee Wildlife Resources Agency (TWRA), has been incorporated into the boundaries of the Oak Ridge Wildlife Management Area for

several years. Currently TWRA conducts approximately four white-tailed deer and three Eastern wild turkey quota hunts annually on the Oak Ridge WMA, which includes the CRBR site. The CRBR site is popular with hunters selected for these hunts as it provides a diversity of habitats and dense populations of both deer and turkey.

For the terrestrial habitats, a common theme of “available wildlife habitats on the site are not of high quality because of former clearing for plant construction” was noted. Little, if any, additional impact would appear likely to occur to important or unique terrestrial resources due to the use of the CRBR site or other alternative brownfield sites. Further construction for the CRBR site would not substantially disrupt any uncommon, unique or special wildlife habitats available in the area.

Eight state-listed terrestrial animal species are known from Roane County (Table 5), according to the TVA Regional Heritage Data Base. None of these species is currently known to occupy the site.

Common (Scientific) Name	State Status	Federal Status
Birds		
Bachman's Sparrow (<i>Aimophila aestivalis</i>)	Endangered	-
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	In Need of Management	-
Osprey (<i>Pandion haliaetus</i>)		
Mammals		
Gray Bat (<i>Myotis grisescens</i>)	Endangered	Endangered
Southeastern Shrew (<i>Sorex longirostris</i>)	In Need of Management	-
Salamanders		
Four-toed Salamander (<i>Hemidactylium scutatum</i>)	In Need of Management	-
Hellbender (<i>Cryptobranchus alleganiensis</i>) ^a	In Need of Management	-
Tennessee Cave Salamander (<i>Gyrinophilus palleucus</i>)	Threatened	-

a Hellbender is an aquatic salamander, but is listed as a terrestrial animal.

Twenty-four state-listed plant species are known from within five miles of the site (Table 6); only one of these (Appalachian bugbane) has been reported from the site.

Common (Scientific) Name	State Status	Federal Status
Earleaf foxglove (<i>Agalinis auriculata</i>)	Endangered	-
Spreading False-foxglove (<i>Aureolaria patula</i>)	Special Concern	-
River bulrush (<i>Bolboschoenus fluviatilis</i>)	Special Concern	-
Heavy-fruited Sedge (<i>Carex gravida</i>)	Special Concern	-

Table 6. State-listed Plant Species Known from Within 5 Miles of the CRBR Site		
Common (Scientific) Name	State Status	Federal Status
Hairy sharp-scaled Sedge (<i>Carex oxylepis</i> var. <i>pubescens</i>)	Special Concern	-
Appalachian bugbane (<i>Cimicifuga rubifolia</i>)	Threatened	-
Pink Lady-slipper (<i>Cypripedium acaule</i>)	Special Concern	-
Tall larkspur (<i>Delphinium exaltatum</i>)	Endangered	-
Branching Whillow-wort (<i>Draba ramosissima</i>)	Special Concern	-
Waterweed (<i>Elodea nuttallii</i>)	Special Concern	-
McDowell sunflower (<i>Helianthus occidentalis</i>)	Special Concern	-
Goldenseal (<i>Hydrastis canadensis</i>)	Special Concern	-
Butternut (<i>Juglans cinerea</i>)	Threatened	-
Short-head Rush (<i>Juncus brachycephalus</i>)	Special Concern	-
Slender Blazing-star (<i>Liatris cylindracea</i>)	Threatened	-
Canada lily (<i>Lilium canadense</i>)	Threatened	-
Loesel's twayblade (<i>Liparis loeselii</i>)	Threatened	-
American ginseng (<i>Panax quinquefolius</i>)	Special Concern	-
Pale green orchid (<i>Platanthera flava</i> var. <i>herbiola</i>)	Threatened	-
Heller's catfoot (<i>Pseudognaphalium helleri</i>)	Special Concern	-
Pursh's Wild-petunia (<i>Ruellia purshiana</i>)	Special Concern	-
Prairie goldenrod (<i>Solidago ptarmicoides</i>)	Endangered	-
Shining Ladies'-tresses (<i>Spiranthes lucida</i>)	Threatened	-
Three-parted Violet (<i>Viola tripartita</i> var. <i>tripartita</i>)	Special Concern	-

Construction-Related Effects on Wetlands:

Wetlands are recognized as a vital part of the ecosystem. Activities in wetlands are regulated under Section 404 and Section 401 of the Clean Water Act, and Executive Order 11990. Section 404 implementation requires activities in jurisdictional wetlands be authorized through a Nationwide General Permit or Individual Permit issued by the U.S. Army Corps of Engineers (USACE). Section 401 requires water quality certification by the States for projects permitted by the federal government. In Tennessee, activities that may alter aquatic resources, (e.g., wetlands) are also regulated by the Tennessee Department of Environment and Conservation through the Aquatic Resource Alteration Permit program, under the authority of the Tennessee Water Quality Control Act of 1977. Executive Order 11990 requires federal agencies to minimize wetland destruction, loss, or degradation, and preserve and enhance natural and beneficial wetland values, while carrying out agency responsibilities (Reference 13).

The objective of this subsection is to evaluate the CRBR site with respect to potential impacts from construction-related dewatering or filling activities on area wetlands. Information about wetlands at the CRBR site was obtained using current data from the draft TVA Watts Bar Land Management Plan (Reference 15, unpublished), National Wetland Inventory data, soil survey data (Reference 19), and hydric soil lists for Tennessee (http://soils.usda.gov/soil_use/hydric/main.htm). For the CRBR site, approximately 30 acres of scrub-shrub and forested wetlands exist within the site boundary. These are associated with the shoreline of the Tennessee River and also Grassy Creek embayment.

Stringent environmental laws regulate dewatering or filling of most wetlands. For purposes of this comparison, most potential construction areas are located sufficiently far away that it would be possible to avoid most wetlands. Thus, potential adverse impacts from dewatering or filling are expected to be avoided or minimized such that any potential impacts would be insignificant, and the CRBR site is no better or worse than the other sites with regard to potential for impacts to wetlands.

Operations-Related Effects on Aquatic Ecology

The discussion and evaluation of the operations-related effects on aquatic ecology are primarily related to environmental effects from the operation of condenser cooling water systems. These typically include expected thermal release effects, as well as entrainment and impingement effects.

Thermal Release Effects

The objective of this subsection is to address the relative suitability of the CRBR site with respect to potential thermal release effects on the receiving water body (i.e. the Clinch River arm of the Watts Bar Reservoir.) The AP1000 plant design needs no external ultimate heat sink. During normal operation, the AP1000 uses external cooling water. Heat removed by the condenser cooling water system generates the majority of the thermal releases. An important consideration in evaluating the suitability of the sites was the proposed design of the condenser cooling water system at each site. Heat rejected by the same plant at different locations would remain virtually unchanged, and makeup water for the auxiliary cooling systems would be essentially the same at each site. The use of closed-cycle cooling is a best available technology for minimizing the amount of water withdrawal required.

The effect of returning unconsumed water (primarily that which is not evaporated from the cooling towers) to the receiving water body would be primarily a function of 1) the percentage of total flow that heated return water constituted in comparison to average and low flow in the receiving water body, and 2) whether or not the receiving water body is a reservoir, regulated river or free-flowing river. An additional factor would be the thermal limits imposed by the plant's NPDES permit. Since the purpose of such thermal limits at any site is to be protective of aquatic and water resource values, the flow comparison becomes the primary factor to consider. Because it was determined that no exclusionary or avoidance criteria were exceeded by these thermal discharges, sites with larger amounts of available cooling water would be rated higher. The CRBR site has the lowest 7Q10 flow statistic of all the sites (see section on Safety Criteria, Cooling System Suitability). As such, on this basis it would comparatively be rated slightly less suitable among the candidate sites. This situation is, however, somewhat a reflection of the current manner in which TVA manages the river flow as described under the Cooling Water Suitability section of this document.

Entrainment and Impingement Effects--When cooling water is pumped from water bodies, two environmental effects of concern can occur. Entrainment refers to the removal of small, drifting organisms within the cooling water. Small fish, fish eggs, plankton, and other aquatic/marine organisms experience high mortality rates as they pass through cooling water pumps and heat exchangers.

Impingement refers to larger organisms that are screened out of the cooling water at the intake structure. Impinged organisms can include large fish, crustaceans, turtles, and other aquatic/marine organisms that are unable to avoid high intake velocities near the intake structure, and are thereby trapped on the intake screens.

No exclusionary or avoidance criteria apply to entrainment and impingement effects from the operation of condenser cooling water systems, similar to the above discussion on thermal discharges. The objective of this subsection is to address the relative suitability of the candidate sites with respect to potential entrainment and impingement effects.

Concerns about entrainment and impingement losses are resource-dependent and vary on a site-to-site basis. Typically, power plants with once-through cooling water systems have greater entrainment and impingement effects than power plants with closed-cycle cooling water systems. Low-flow conditions can also increase the potential for entrainment and impingement to occur

Three factors influence the potential for effects from entrainment or impingement: 1) the presence of endangered species that could be entrained or impinged; 2) relative densities of young fish (as shown in Table 7); and 3) potential for occurrence of low flow situations exacerbating the potential for increased entrainment/impingement. As for the other alternative sites, the CRBR site was evaluated with respect to the relative potential for entrainment and impingement effects from closed-cycle cooling water systems. In general, closed cycle cooling, which utilizes much less water than open cycle cooling systems, substantively reduces the potential for entrainment and impingement impacts. The CRBR site has no aquatic federal-listed species and a low density of young fish, but has characteristically lower low-flows relative to the other alternative sites.

Young of Year (YOY) Fish – Years Samples	Annual Average Total Numbers YOY Fish Per 1000 m ³ Water Volume	Standing Stock Years Sampled	Standing Stock Densities of Fish (by weight) kg/ha
1975	1577*	1974 - 1975	1,134 fish total. No Density info available

* Reference 20.

Operations-Related Effects on Terrestrial Ecology - Cooling Tower Drift

This subsection evaluates the effects of cooling tower drift. In every cooling tower, there is a loss of water to the environment from the evaporative cooling process. This evaporated water leaves the tower in a pure vapor state and presents no threat to the environment. Small unevaporated water droplets are also exhausted through the cooling tower, causing a phenomenon known as drift. These unevaporated water droplets carry minerals, debris, microorganisms, and water treatment chemicals, potentially affecting the environment. High drift losses are typically caused by fouled, inefficient, or damaged drift eliminators, excessive exit velocities, or imbalances in water chemistry.

Minimizing drift losses in a cooling tower reduces the risk of affecting the environment. The principle concern with cooling tower drift effects is related to the downwind deposition of cooling water salts. Salt deposition can adversely affect sensitive plant and animal communities through changes in water and soil chemistry. Information about the important terrestrial and aquatic plant and animal communities, habitats, and wetlands near the candidate sites has already been discussed.

As mentioned in the fog and ice safety subsection above, meteorological conditions at a site are monitored and evaluated as part of determining the suitability of nuclear plant siting. The observation of temperature and wind conditions over time provides input into statistical models. The models can be used to help predict the probable path and dispersion of cooling tower drift. Topographic conditions also influence extreme weather and temperature variations. Sites with better meteorological conditions are rated higher. The Clinch River site is located in a valley between two ridges up to 575 ft. above plant grade. The Clinch River cuts through these ridges and permits a significant cross-valley flow. However, the meteorology of the CRBR site provides a more limited range of atmospheric conditions that can negatively affect transport and dispersion of cooling tower drift, because the narrow valleys tend to channel emissions into particular directions and the high ridges could prevent lateral spreading during inversion conditions (Reference 8). Therefore, the most favorable dispersion conditions will occur only during limited periods as compared to other locations with more favorable terrain.

Socioeconomic Criteria

This discussion encompasses the information that serves as the basis for criteria and ratings related to factors substantively affecting the Socioeconomic conditions: Construction-Related Effects; Highway Access; Operations Related Effects; Environmental Justice; Land Use; and Cultural Resources.

Construction-Related Effects

During construction of a nuclear power plant, the local population increases from the workers and families who relocate to the area, and the local community grows to support these people. A site is rated on its estimated ability to handle the number of construction workers who would move into the plant site vicinity with their families and the capacity of the communities surrounding the plant site to absorb this temporary (in-migrant) population. Higher ratings are given to the sites better able to accommodate the increases in population.

The number of in-migrant workers is dependent on labor availability within commuting distance of the plant site. If an adequate supply of workers were available within reasonable commuting distance, few (if any) workers would choose to relocate to the site. The issue in siting, therefore, is the potential socioeconomic effects associated with any temporary influx of construction workers who live too far away to commute daily from their residence.

The capacity of communities to absorb an increase in population depends on the availability of sufficient resources such as adequate housing and community services (e.g., schools, hospitals, police, transportation systems, and fire protection) to support the influx without straining existing services. The factors that should be considered in rating sites from the perspective of construction effects includes labor requirements, location of labor pool, number of immigrants, and the economic structure of affected communities. Regardless of the site chosen, construction employment would be approximately the same, whereas in-migration would be dependent upon the availability of local workers.

The CRBR site is located near Knoxville, Tennessee. Except for YCN (which has a lower population total), the population within 50 miles of the CRBR site is similar to that of the other candidate sites, i.e., estimated to be slightly greater than 1,000,000 (Figure 1). The area can supply a substantial number of construction workers, and is capable of adequately handling an increase in population due to construction worker influx, as well as the corresponding demand on housing and related services.

If the project were located at the CRBR site, the allocation process for TVA in lieu of tax payments would be governed by Tennessee law. Under state law, cities and counties receive, first, the amount they were receiving in FY 1977. Of the amount the state receives over and above what it received in FY 1977, 48.5 percent is allocated to counties and incorporated cities in the state. This redistribution is based solely on population for cities, which receive 30 percent. Counties receive 70 percent, based on population (30 percent), total acres in the county (30 percent), and TVA-owned acres in the county (10 percent). The total payment to the state by TVA would increase as a result of the increase in book value of TVA property in the state relative to other states. The county would receive a somewhat larger payment due to the increased TVA payment to the state and to a small extent any increase in TVA-owned acres in the county.

Highway Access

In reviewing access effects, nuclear plant construction requires dependable highway access for large vehicles. Sites with available access are rated higher. Access by highway is available for vehicles of all expected sizes at the CRBR site. The CRBR site is about 1.25 miles north of Interstate Highway 40 (I-40). The closest interchanges on I-40 are with State Route 58, to the west, and State Route 95, to the east. Both interchanges are within 3 to 4 miles from the site. Access to the site is off Bear Creek Road, which runs northeast-southwest near the northwestern edge of the site. Some road upgrade or construction on this secondary road likely would be necessary to support construction and operation of a new nuclear power plant. The necessary access development would be relatively small.

Operations-Related Effects

The socioeconomic effects of operations relate primarily to the impacts and benefits afforded to local communities as a result of constructing the plant. These benefits are generally not indicative of inherent site conditions that affect the relative suitability of sites. Increase in local tax revenue generated by workers and their families and increased in-lieu-of-tax revenues, as discussed below, typically mitigate impacts or benefit local communities and infrastructure once a plant is operational. As a result, all sites, including the CRBR site, would be rated equally high on this criterion.

TVA In-Lieu-of-Tax Payments During Operations -- As directed by Section 13 of the TVA Act, TVA pays in-lieu-of-tax payments equal to 5 percent of its gross proceeds from the sale of power (excluding sales to federal agencies). Once a plant begins operating, these payments are made to state governments, except for small amounts paid directly to certain counties under the provisions of the TVA Act. The amount paid to each state and its counties is determined equally by two factors: the gross proceeds of TVA power sales within the state as a share of the total TVA gross proceeds, and the total book value of TVA power property within a state as a share of total TVA power property. Amounts paid directly to counties are deducted from the state total. If the project were located at the CRBR site, the allocation process would be governed by Tennessee law (Tennessee Code Annotated, Title 67, Taxes and Licenses, Chapter 9, Payments in Lieu of Taxes, Part 1, Tennessee Valley Authority). Under state law, cities and counties receive, first, the amount they were receiving in FY 1977. Of the amount the state receives over and above what it received in FY 1977, 48.5 percent is allocated to counties and incorporated cities in the state. This redistribution is based solely on population for cities, which receive 30 percent. Counties receive 70 percent of the redistribution, based on population (30 percent), total acres in the county (30 percent), and TVA-owned acres in the county (10 percent). The total payment to the state by TVA would increase as a result of the increase in book value of TVA property in the state relative to other states. The county would receive a somewhat larger payment due to the increased TVA payment to the state and to a small extent the increase in TVA-owned acres in the county.

Environmental Justice

The objective of the environmental justice (EJ) evaluation is to determine if the effects of proposed actions could result in disproportionate adverse effects to minority and low-income communities. In comparing sites, this principle is evaluated based on whether any disproportionate effects to these communities are significantly different when comparing one site to another.

In order to determine if a site presents EJ concerns, a determination of whether the proposed action results in significant adverse effects is necessary. If not (i.e., no significant health and safety effects are identified), then there are no EJ concerns, regardless of the percentage of minority or low-income populations identified within the surrounding communities of a site.

If significant adverse health or safety effects are expected, then EJ concerns may be relevant to site comparison. However, a significance finding based on EJ considerations would be true only if disproportionate adverse effects on minority or low-income populations are identified at one or more sites, thereby resulting in significant differences between sites.

The next step is to compare population data for minorities and low-income populations among sites. Data from the U.S. Census Bureau (Table 8) indicate that the percentages of minorities and low-income populations are relatively small among the counties around the CRBR site. Additionally, EPA's Enviromapper program indicates no significant concentrations of minority or low income populations at the block group level for the CRBR site (Figures 3 and 4). The census data indicate that , if selected, the CRBR site does not present an EJ issue.

Table 8. Clinch River Breeder Reactor Site - Population Data

COUNTY	Total population (2006)	White, not Hispanic (%) (2006)	Black (%) (2006)	Asian (%) (2006)	Hispanic (%) (2006)	Other (%) (2006)	% Below Poverty (2004)
Anderson	73,579	91.7	4.1	1.1	1.5	1.6	14.6
Knox	411,967	86.1	8.9	1.7	2.0	1.3	13.8
Loudon	44,566	93.3	1.4	0.5	3.8	1.0	11.1
Morgan	20,108	95.8	2.3	0.2	1.0	0.7	18.7
Roane	53,293	94.3	2.7	0.5	0.9	1.6	14.7

Source: U. S. Census Bureau, www.census.gov.

Land Use

The CRBR site is owned by TVA and it has been previously disturbed by early phases of preparation for use as a breeder reactor site (Figures 5 and 6). No further land acquisitions would be required. The site has been allocated by TVA for industrial development or similar uses. The property surrounding the site above the Clinch River is part of the Oak Ridge Reservation and is owned by the federal government and, therefore, is not subject to local zoning and land use policies. Roane County government has authority over zoning on the south side of the Clinch River. Property across the river to the south and west is largely zoned residential, although some of the property along the eastern portion of the bend is zoned for agriculture. This area is generally somewhat sparsely populated. Land to be used for new nuclear units would already be owned or acquired, if needed, by TVA and would already be zoned for uses compatible with development of a new unit.

Three areas are of interest when considering the potential for land use conflicts: current state of disturbance of the site; potential degree of disturbance to current uses by siting a nuclear generation facility; and status of ownership. For the CRBR site, which is owned by TVA, previously disturbed (except for northwest ridge edge area), and currently designated predominantly for TVA project operations, there is only minor potential for conflict with existing uses.

Cultural Resources

The preservation of cultural heritage is important to our understanding of the development of human civilizations. This section provides a description of the cultural resources identified at the CRBR site. A consideration in the relative suitability of the CRBR site would be the number and extent of identified cultural resources identified for the site. This criterion would be rated upon those factors also as an indicator of the potential for encountering new unknown cultural sites during development of the CRBR site. As described below, a relatively high number (compared to the other candidate sites) of archaeological sites have been identified at the CRBR site (References 3, 4, 6, 9, 10, 11, and 12). East Tennessee has been an area of human occupation for the last 12,000 years. Prehistoric land use and settlement patterns vary during each period, but short- and long-term habitation sites are generally located on flood plains and alluvial terraces along rivers and tributaries. Specialized campsites tend to be located on older alluvial terraces and in the uplands. In East Tennessee, during the 17th and 18th centuries, Europeans and Native Americans began interacting through the fur trading industry. Euro-American settlement increased in the early 19th century as the Cherokee were forced to give up their land. Three treaties were made between Euro-American settlers and the Cherokee Nation that allowed the settlers to occupy lands in the Roane County area. These treaties included the Treaty of 1794, the Third Tellico Treaty of 1805 and the Hiwassee Purchase which was made through the Calhoun Treaty of 1819. Roane County was established in 1801 with Kingston as its county seat. During the Civil War, the Roane Iron Company was founded when local mineral deposits became commercially valuable. Industry was also established in Harriman. The County also received prominence through the small town of Oliver Springs, which was used as a mineral spring resort in the late 19th century.

Archaeological investigations of the Watts Bar Reservoir began as early as 1886 with a visit by Cyrus Thomas, well known ethnologist and early avocational anthropologist who traveled along the Tennessee River recording archaeological resources. During his visit he noted the presence of archaeology along the Clinch River, but did not record any sites on the CRBR site property. Further archaeological investigations did not take place until the early 1940s prior to the construction of Watts Bar dam. A number of sites were recorded within the proposed reservoir, five of these located within the bounds of the CRBR site. Very little archaeological work was conducted at these specific sites and a reservoir basin report was never prepared due to lack of funding and World War II. When TVA considered the construction of the CRBR Project in the 1970s, archaeological investigations occurred on the property again. During that time, a number of archaeological surveys and testing programs were conducted at this location beginning in 1972. These investigations identified new sites and revisited previously recorded sites. A total of 36 archaeological resources have been recorded on the property as a result of these investigations.

Nineteen properties have been listed on the National Register of Historic Places in Roane County. None of these sites are located near the CRBR property. Although a significant amount of archaeological work has been conducted within the confines of the site, no systematic Phase I archaeological deep testing has been completed on the property. A total of 36 archaeological sites are recorded thus far and 24 of these are located in what is currently being considered for Project Operations at the site. Additional archaeological investigations would be required at these sites should TVA decide to use the property for future power generation.

Engineering and Cost-Related Criteria

This discussion encompasses the information that serves as the basis for criteria and ratings related to factors substantively affecting: Water Supply; Transportation Access including Highways, Rail, Barge and Transmission; Site Preparation including Land Use and Ownership Assessment, Topographic Modifications, Flood Protection, and Cooling Water Costs.

Water Supply

The purpose of this criterion is to evaluate relative differences in the design and construction factors affecting costs for developing water supply facilities. Sites with local conditions that would require additional engineering costs to develop water supply capability (e.g., reservoirs to address water supply limitations) or reliability issues (e.g., low-flow constraints) are rated lower than sites with no such requirements.

The CRBR site has access to cooling water sources that would provide adequate supply volume and reliability, such that no significant differential costs should be required for purchasing water rights or constructing on-site reservoirs. No groundwater usage would be required. Because of historical low flows, the CRBR site could experience a greater potential for operational limitations due to low flows (see discussion under cooling system suitability) that could potentially reduce its availability for generation.

Transportation - Highway

Sites are compared with respect to factors affecting costs for providing access by highway, rail, and barge. Thus, three transportation criteria are considered. The purpose of the first transportation criterion is to rate sites based on the length of additional or new highway construction required to provide car and truck access. The CRBR site is about 1.25 miles north of Interstate Highway 40. The closest interchanges on I-40 are with State Route 58, to the west, and State Route 95, to the east. Both interchanges are within 3 to 4 miles from the site. Access to the site is off Bear Creek Road, which runs northeast-southwest near the northwestern edge of the site. Some minor road upgrade or construction on this secondary road likely would be necessary to support construction and operation of a new nuclear power plant.

Transportation – Railroad

The purpose of the second transportation criterion is to rate sites according to the relative costs associated with providing rail access. Sites are rated in accordance with the length of additional or new rail spur construction required to provide rail access. The nearest rail access is Norfolk Southern's Blair Junction at Harriman and the CSX line at Oak Ridge. Connection to either would require construction of about 10 miles of new rail line to provide service to the site.

Transportation – Barge

The purpose of the third transportation criterion is to rate sites according to the relative costs associated with providing barge access. Sites are rated from highest to lowest in accordance with the estimated costs of constructing new barge access. The water body at the CRBR site is sufficient to accommodate barge traffic. Currently there is no barge access at the CRBR site. The shoreline adjacent to the site has sensitive resource issues that would require extensive analysis before it could be used for this purpose. There is an unimproved USDOE barge location near the northwest corner of the site; however, extensive work would also be required to develop a suitable facility at this location. Another possible site for downloading from barge to truck would be at the general purpose dock at the TVA Bull Run Fossil (BRF)

Plant, which is located about 10 to 12 miles from the site. Some upgrading of the barge unloading facility might be necessary at the BRF barge facility.

Transmission Access

Transmission facilities must be constructed or adapted to accommodate plant generation. These costs are substantial and increase per linear mile. For this criterion, characteristics such as mileage of new transmission ROW and line required or need for construction of a new transmission switchyard are generally indicative of greater cost for transmission access. These two factors would influence the rating for this site: i.e., 1) whether or not there is need to acquire and construct additional transmission facilities (i.e., 500-kV and 161-kV lines or switchyards), and 2) the estimated extent of such transmission lines or facilities required. Sites with characteristics indicating lower transmission construction costs are rated higher. Preliminary estimates for new transmission lines necessary to connect the CRBR site with the existing transmission network are as follows. These estimates, as well as those for the other candidate sites, are considered indicative of the comparative differences between the sites rather than the optimum choice for routing of transmission lines from a particular site. More detailed surveys and analyses would be required to determine an exact route and interconnection for each line.

Both a 161kV transmission line and a 500kV line already cross over the CRBR site. These lines cross each other at roughly the middle of the site. There is a 161kV substation off Bear Creek Road near the site. To accommodate anticipated generation, the CRBR site would require construction of a new 500-kV transmission line, approximately 70 miles in length, from TVA's Roane, TN 500-kV substation to the AEP-owned Pineville, Kentucky 500-kV substation. This transmission line would occupy a new right of way, which would be at least 175 feet wide and occupy approximately 1500 acres. The installation of a second 500/161-kV transformer bank would be needed at the Bull Run 500-kV substation, which would require some modification to the existing substation in order to deliver the new generation to the load. No other transmission line work is anticipated at this site. A new detailed interconnection study for this site would be necessary if it were selected; updated results would dependent upon what conditions for the transmission system changed in the interim.

Site Preparation - Land Use and Ownership Assessment

The bases for rating this criterion are three factors: 1) degree of change to current land use; 2) ownership of the proposed site; and 3) opportunity to use other existing assets (i.e., existing components of major infrastructure in addition to land). Between the sites that were previously issued a construction permit, a higher rating would be given to a site where TVA now owns and controls all or a portion of the land, or where a change in land use would be less dramatic. Staff of TVA Realty conducted a due diligence review of ownership for the CRBR site.

The CRBR site is still owned by TVA and is currently allocated for industrial development, with some sensitive resource management parcels. TVA is currently developing an update to the existing land plan that will place a majority of the land in project operations, with an increase in sensitive resource management parcels along the periphery to protect significant resources. A small amount of land is being allocated for industrial development to support existing industry.

Topographic Modifications

The relative costs associated with site grading and earthmoving necessary to prepare the site for construction of a nuclear power plant varies by topography. Sites are rated from highest to lowest in accordance with presence of factors affecting estimated grading costs. Similar to the other brownfield sites, construction was begun, and the topography has already been altered for the construction of a nuclear facility. The footprint area of the CRBR site includes a relatively flat area with a large partially excavated area near the middle. Grading and earthmoving comparable to that for the other candidate sites would also be necessary at this site.

Flood Protection Cost

The purpose of this criterion is to rate sites with respect to differential costs associated with construction of flood protection structures necessary to address probable maximum floods at the sites under consideration. Sites with the largest differences between site grade elevation and likely flood elevations are rated highest; sites with plant grade at or near flood level are rated lowest. The site grade at the CRBR site is 815 feet msl, about 37 feet above PMF and about 59 feet above the 500-year flood elevation. It is expected that this characteristic would result in a comparatively favorable rating for the CRBR site on this criterion.

Cooling Water

For cooling water availability, the factors affecting cost are similar across the alternative sites, including the CRBR site. Sufficient water volume exists at all sites to accommodate expected closed cooling water systems, with no substantive differences between factors affecting cost of accessing (e.g., need for constructing a reservoir or taking other measures to ensure adequate water supply) and making that water available for on-site use. There are no substantive differences between on-site infrastructure needed for the CRBR site and the other alternative sites; therefore, it is expected that the CRBR site would be rated the same as other candidate sites regarding need for on-site infrastructure.

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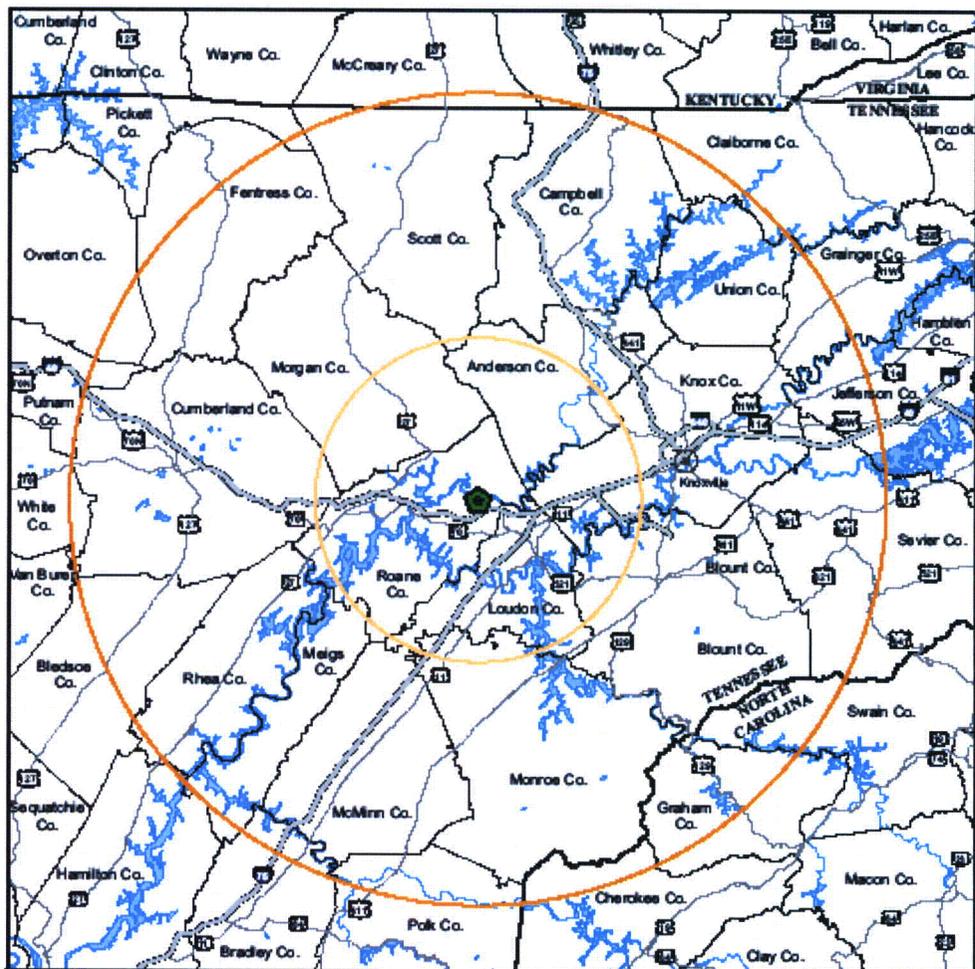


Figure 1
Clinch River Breeder Reactor Site
10 and 50 Mile Radius

-  Clinch River Breeder Site
-  20 Mile Zone
-  50 Mile Zone

Estimated population (Based on 2000 Census)
 within the 20 Mile zone: 295,765
 within the 50 Mile zone: 1,038,458



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FIGURE 1-10. CLINCH RIVER BREEDER REACTOR SITE, 10 AND 50 MILE RADIUS

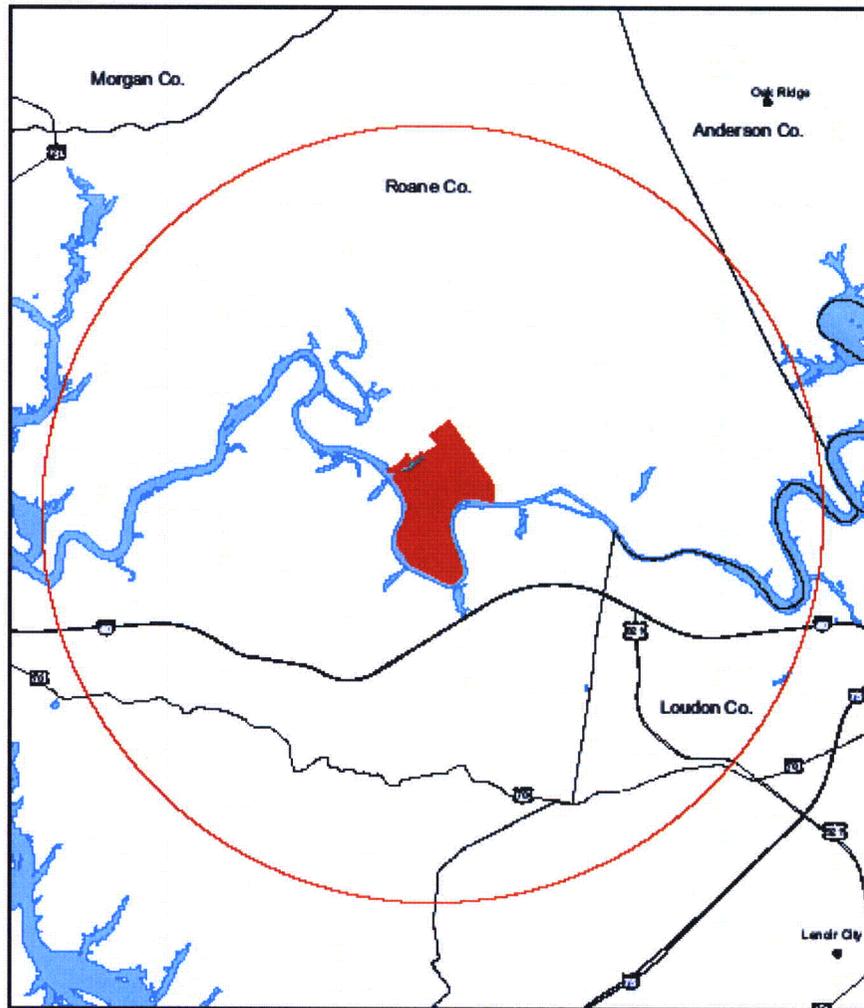
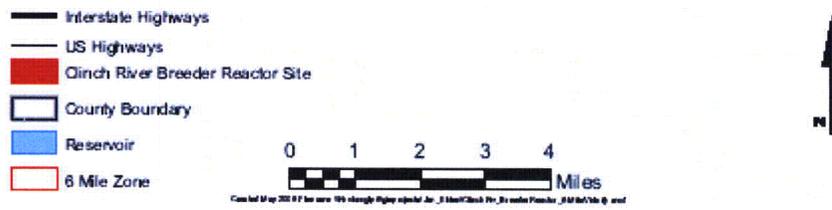


Figure 2
Clinch River Breeder Reactor Site 6-Mile Vicinity



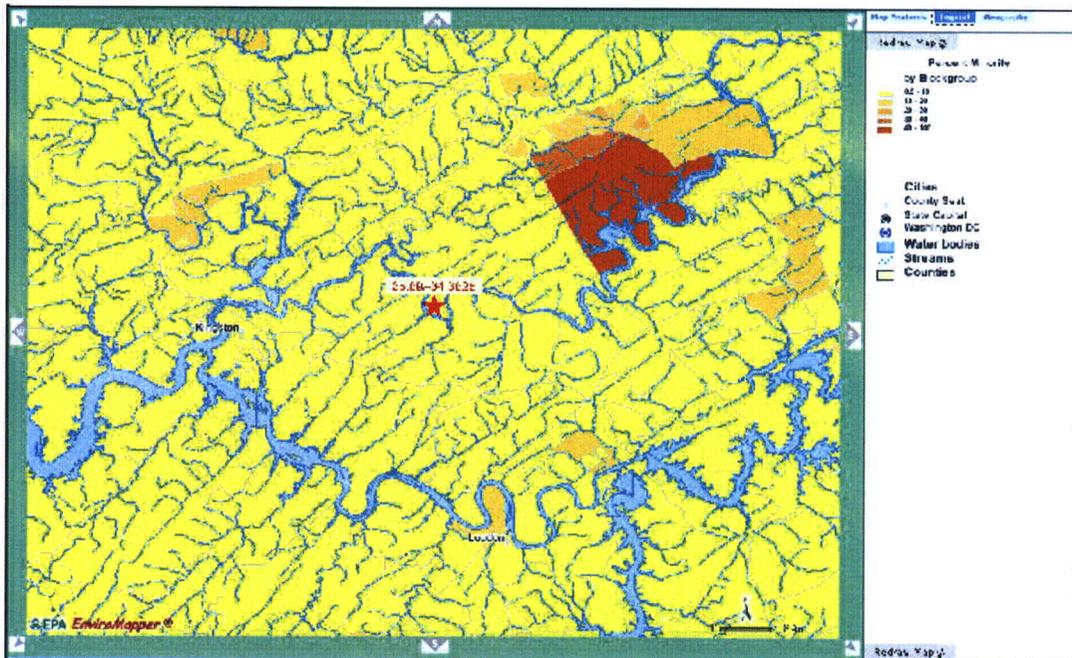


Figure 3
Clinch River Breeder Reactor Site
Minority Population (percent)

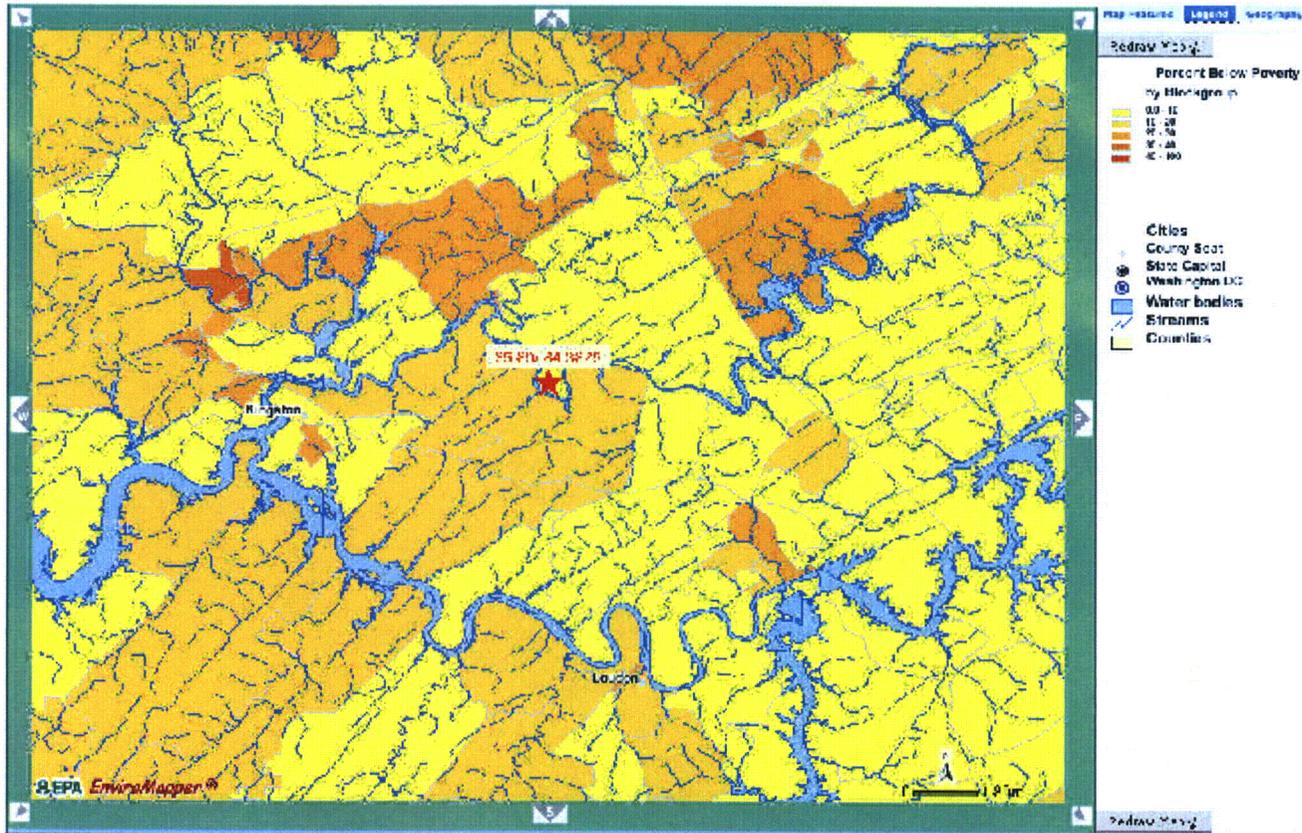


Figure 4
Clinch River Breeder Reactor Site
Population Below the Poverty Level (percent)

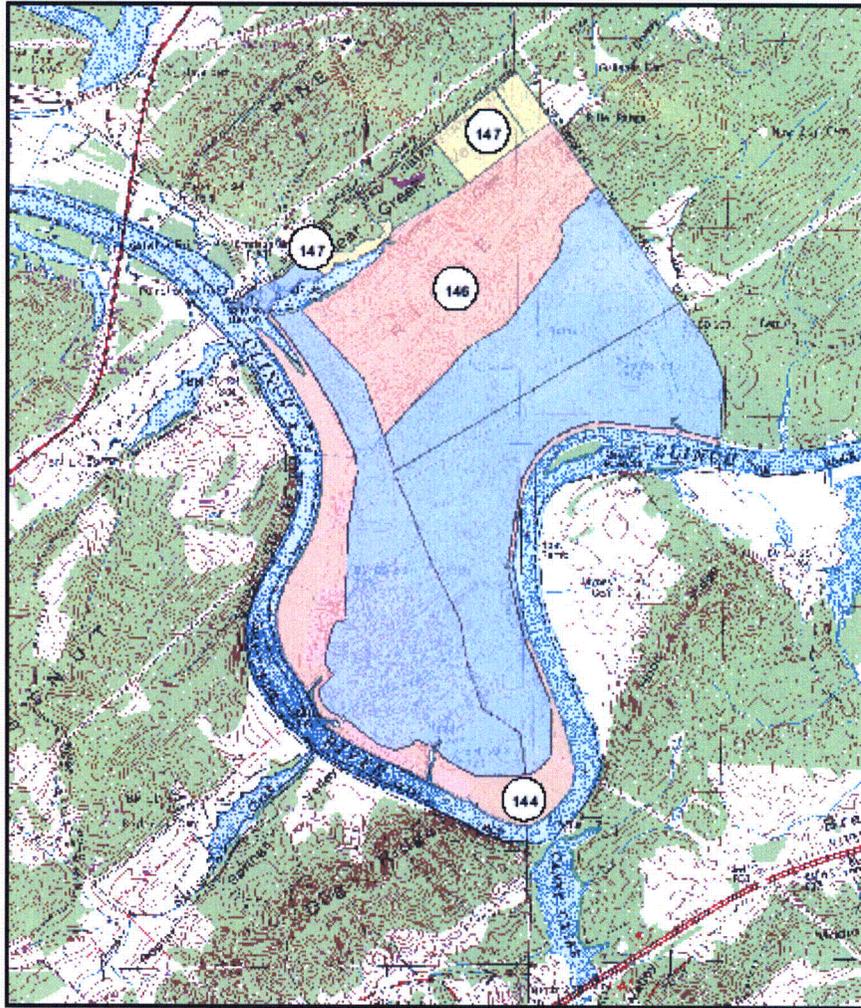


Figure 6
Clinch River Breeder Reactor Site
Land Ownership Status

