

1. Introduction to the Oak Ridge Reservation

The Oak Ridge Reservation (ORR) consists of three major government-owned, contractor-operated facilities: the Y-12 National Security Complex, Oak Ridge National Laboratory, and East Tennessee Technology Park. The ORR was established in the early 1940s as part of the Manhattan Project, a secret undertaking that produced materials for the first atomic bombs. The reservation's role has evolved over the years, and it continues to adapt to meet the changing defense, energy, and research needs of the United States. Both the work carried out for the war effort and subsequent research, development, and production activities have involved, and continue to involve, the use of radiological and hazardous materials.

The *Oak Ridge Reservation Annual Site Environmental Report* and supporting data are available at http://www.ornl.gov/sci/env_rpt or from the project director.

1.1 Background

This document is prepared annually to summarize environmental activities, primarily environmental monitoring activities, on the Oak Ridge Reservation (ORR) and within the ORR surroundings. The document fulfills the requirement of Department of Energy (DOE) Order 231.1A, *Environment, Safety and Health Reporting*, for an annual summary of environmental data to characterize environmental performance. The environmental monitoring criteria are described in DOE Order 450.1A, *Environmental Protection Program*. The results summarized in this report are based on data collected prior to and through 2008. This report is not intended to provide the results of all sampling on the ORR. Additional data collected for other site and regulatory purposes, such as environmental restoration/remedial investigation reports, waste management characterization sampling data, and environmental permit compliance data, are presented in other documents that have been prepared in accordance with applicable DOE guidance and/or laws and are referenced herein as appropriate. Corrections to the report for the previous year are found in Appendix A. Appendix B contains a glossary of technical terms that may be useful for clarifying some of the language used in this document.

Environmental monitoring on the ORR consists primarily of two major activities: effluent monitoring and environmental surveillance. Effluent monitoring involves the collection and analysis of samples or measurements of liquid and gaseous effluents at the point of release to the environment; these measurements allow the quantification and official reporting of contaminants, assessment of radiation and chemical exposures to the public, and demonstration of compliance with applicable standards and permit requirements. Environmental surveillance consists of the collection and analysis of environmental samples from the site and its environs; these activities provide direct measurement of contaminant concentrations in air, water, groundwater, soil, foods, biota, and other media. Environmental surveillance data provide information regarding conformity with applicable DOE orders and, combined with data from effluent monitoring, allow the determination of chemical and radiation dose/exposure assessments of ORR operations and effects, if any, on the local environment.

1.2 History of the Oak Ridge Reservation

Beginning in early 1943, thousands of scientists, engineers, and workers came from all over the United States to small crossroads communities such as Scarboro, Wheat, Robertsville, and Elza to build and operate three huge facilities that would change the history of the region and the world forever. These people came to rural East Tennessee to do whatever was necessary to end World War II and, as part of the then secret Manhattan Project, helped produce the first nuclear weapons.

The site was selected for use by the Manhattan Project because the Clinch River provided ample supplies of water, nearby Knoxville was a good source of labor, and the Tennessee Valley Authority (TVA) could supply the huge amounts of electricity needed. About 3,000 residents received court orders

to vacate within weeks the homes and farms that their families had occupied for generations. Very soon afterwards, the site was given its wartime name of “Clinton Engineering Works.”

The workers’ city, named Oak Ridge, was established on the reservation’s northern edge. The “Secret City” grew to a population of 75,000 and was the fifth-largest city in Tennessee; however, it was not shown on any map. At the Y-12 National Security Complex (Y-12 Complex or Y-12), south of the city, an electromagnetic method was used to separate uranium-235 (^{235}U) from natural uranium. At its peak operation, the Y-12 Complex employed 22,000 workers. A gaseous diffusion plant, later known as K-25, was built on the reservation’s western edge and included a multistory process building covering more area than any other structure ever built. At that time, operated by 12,000 workers, the K-25 Plant separated ^{235}U from ^{238}U . Near the reservation’s southwest corner, about 16 km from Y-12, was a third facility, known as X-10 (or Clinton Laboratories), where the Graphite Reactor was built. Employing only about 1,500 people during the war, X-10 was a pilot plant for the larger plutonium production plant built at Hanford, Washington. The Graphite Reactor used neutrons emitted in the fission of ^{235}U to convert ^{238}U into a new element, plutonium-239 (^{239}Pu).

The primary missions of the three sites have evolved during the past 60+ years and continue to adapt to meet the changing defense, energy, and research needs of the United States. The ORR contains three major DOE installations: the Y-12 Complex, formerly the Y-12 Plant; Oak Ridge National Laboratory (ORNL), formerly the X-10 site; and the East Tennessee Technology Park (ETTP), formerly the K-25 Site. DOE also operates a number of facilities in addition to the major installation sites (see Sect. 1.4).

1.3 Site Description

1.3.1 Location and Population

The city of Oak Ridge lies within the Great Valley of Eastern Tennessee between the Cumberland and Great Smoky Mountains and is bordered on two sides by the Clinch River (Fig. 1.1). The Cumberland Mountains are 16 km to the northwest; the Great Smoky Mountains are 51 km to the southeast. The ORR encompasses about 13,619 ha (approximately 33,653 acres) of mostly contiguous land owned by DOE in the Oak Ridge area. Most of it lies within the corporate limits of the city of Oak Ridge; some of the area west of ETTP lies outside the city limits. The residential section of Oak Ridge forms the northern boundary of the reservation. The TVA’s Melton Hill and Watts Bar reservoirs on the Clinch and Tennessee rivers form the southern and western boundaries (Fig. 1.2). The population of the 10-county region surrounding the ORR is about 927,200 with about 1.5% of its labor force employed on the reservation (Fig. 1.3). Other towns close to the reservation include Oliver Springs, Clinton, Lake City, Lenoir City, Farragut, Kingston, and Harriman (Fig. 1.4).

Knoxville, the major metropolitan area nearest Oak Ridge, is located about 40 km to the east and has a population of about 183,550. Except for the city of Oak Ridge, the land within 8 km of the ORR is semirural and is used primarily for residences, small farms, and cattle pasture. Fishing, boating, water skiing, and swimming are popular recreational activities in the area.

1.3.2 Climate

The climate of the Oak Ridge region may be broadly classified as humid subtropical and is characterized by significant temperature changes between summer and winter. The 30 year mean temperature for the period of 1978 to 2007 is 14.6°C. The average temperature for the Oak Ridge area during 2008 was 14.8°C. The coldest month is usually January, with temperatures averaging about 2.8°C. During 2008, January temperatures averaged near normal at 2.8°C. July tends to be the warmest month, with average temperatures of 25.5°C. July 2008 temperatures averaged 25.2°C, slightly below the 30 year mean for July.

Average annual precipitation in the Oak Ridge area for the 30 year period from 1978 to 2007 was 1,340.3 mm, including about 27.9 cm of snowfall annually (NOAA 2009). Total rainfall during 2008, (measured at the Oak Ridge National Weather Service meteorological tower), was 1,184.3 mm, and total

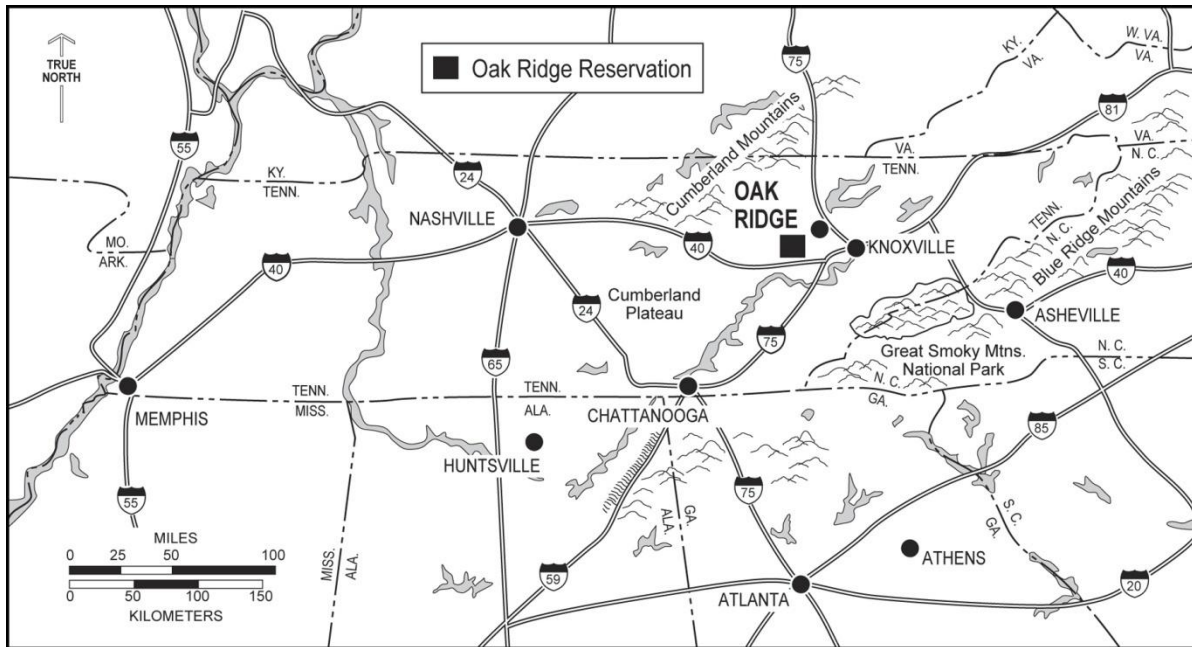


Fig. 1.1. Location of the city of Oak Ridge.

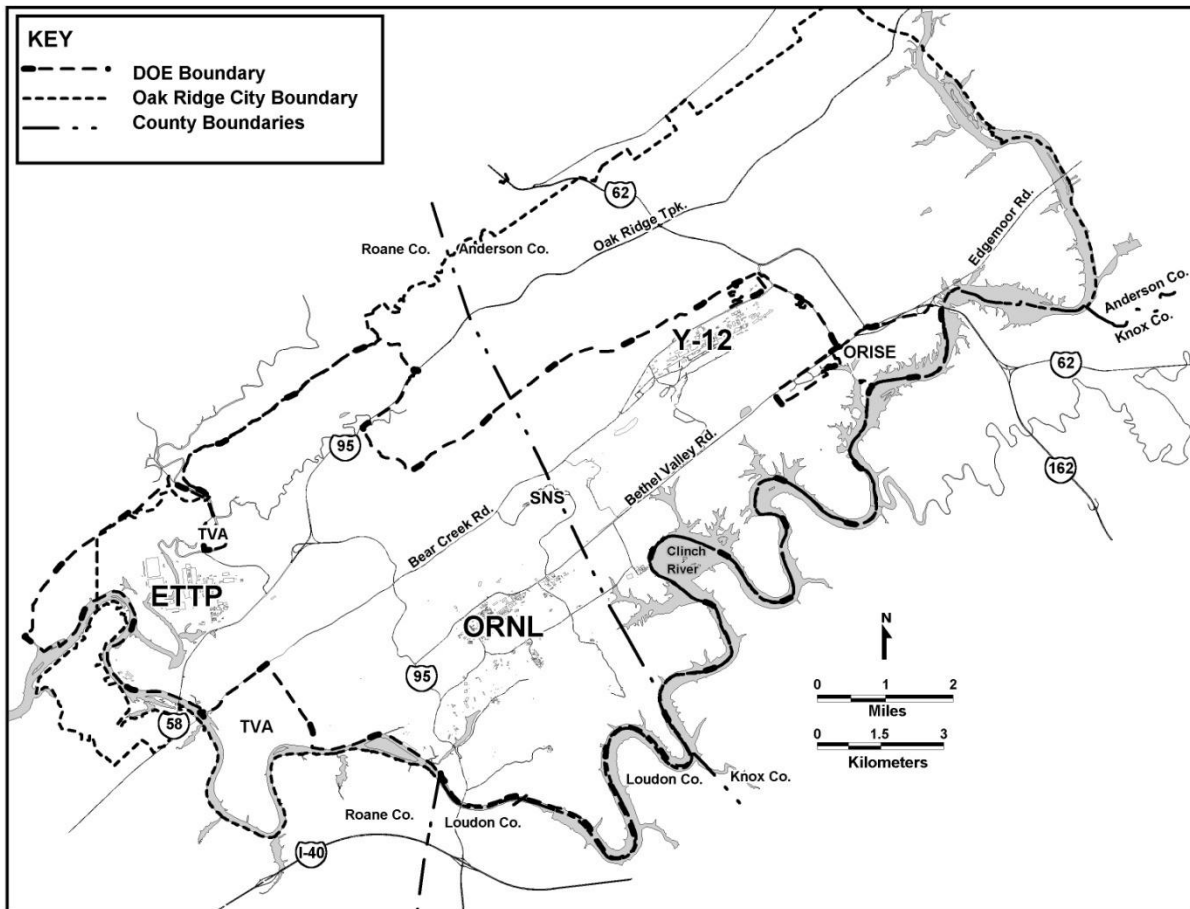


Fig. 1.2. The Oak Ridge Reservation.

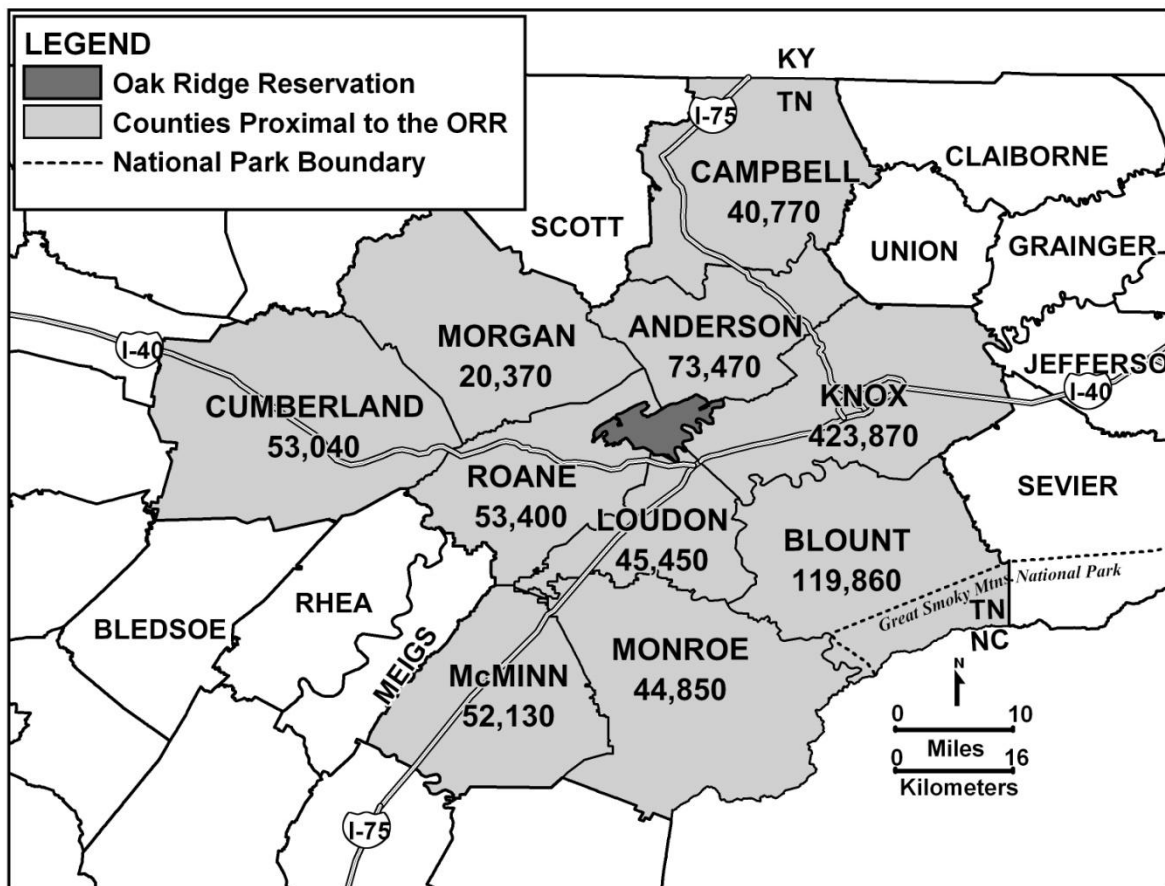


Fig. 1.3. Population by county in the ten-county region surrounding the Oak Ridge Reservation.

2008 snowfall was 2.0 cm. Although precipitation during 2008 was much higher than 2007, it still ranks over 12% below average. Monthly summaries of precipitation averages, extremes, and 2008 values are provided in Appendix C, Table C.1.

In 2008, wind speeds at ORNL Tower C (MT2) measured at 10 m above ground level averaged 1.2 m/s. This value increases to about 3.0 m/s for winds at 100 m above the ground (about the height of local ridgetops). The local ridge-and-valley terrain reduces average wind speeds at valley bottoms, resulting in frequent periods of nearly calm conditions, particularly during clear, early morning hours. Wind direction and speed frequencies for ORR towers during 2008 can be found in Appendix C (Figs. C.1–C.17). Wind direction and speed frequencies during precipitation events over the previous 10 years can be found in Appendix C (Figs. C.18–C.21). In Appendix C, Figs. C.22–C.28 provide information on wind direction and speed with respect to stability class during 2008.

More detailed information on the climate of the Oak Ridge area is available in *Oak Ridge Reservation Physical Characteristics and Natural Resources* (Parr and Hughes 2006).

1.3.3 Regional Air Quality

The Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards has set National Ambient Air Quality Standards (NAAQS) for key principal pollutants, which are called “criteria” pollutants. These pollutants are sulfur dioxide (SO₂); carbon monoxide (CO); carbon dioxide (CO₂); nitrogen dioxide (NO₂); lead (Pb); ozone (O₃); particles with an aerodynamic diameter less than or equal to 10 μm (PM₁₀); and the new, stricter federal standard, fine particulate matter with an aerodynamic

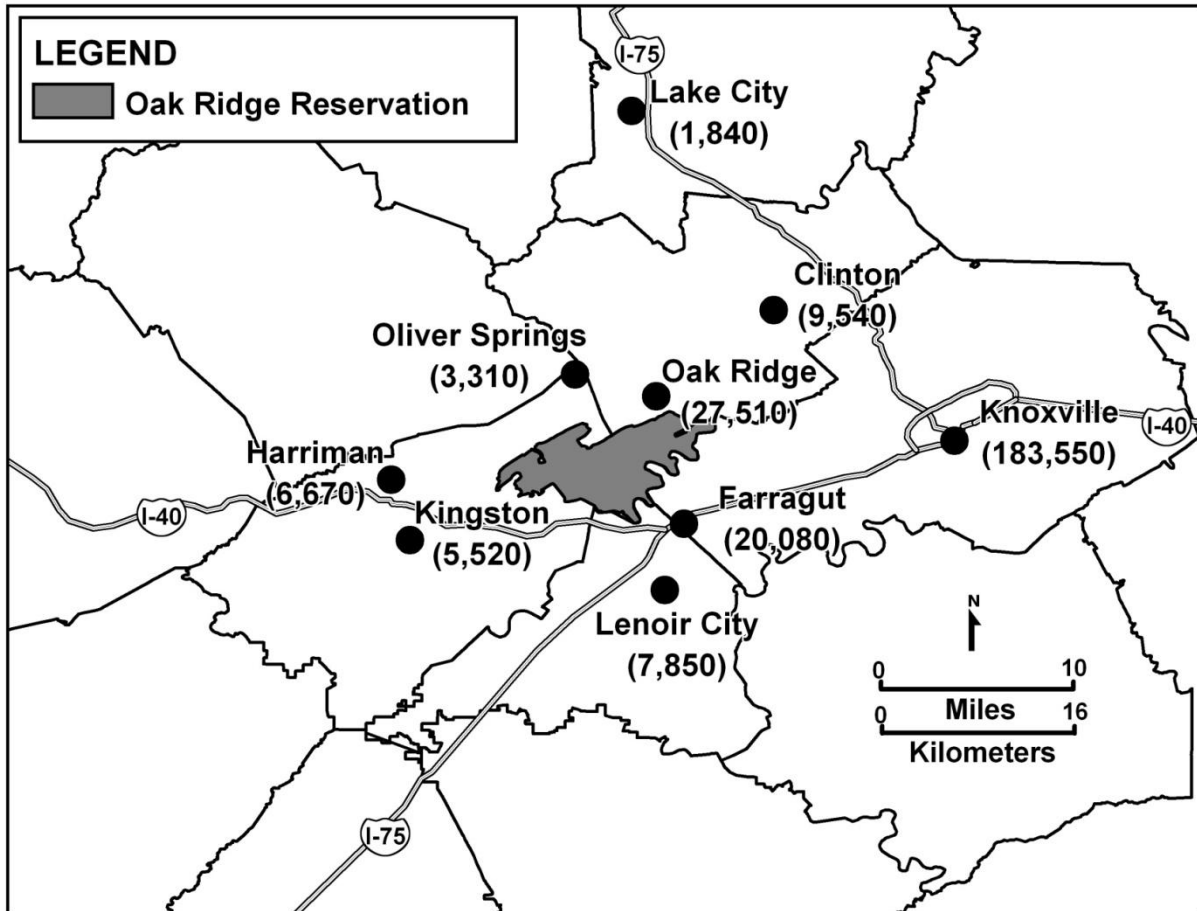


Fig. 1.4. Locations and populations of towns nearest to the Oak Ridge Reservation.

diameter less than or equal to $2.5 \mu\text{m}$ ($\text{PM}_{2.5}$). EPA evaluates NAAQS based on ambient (outdoor) levels of the criteria pollutants. Areas that satisfy NAAQS are classified as attainment areas whereas areas that exceed the NAAQS for a particular pollutant are classified as nonattainment areas for that pollutant.

The ORR is located in Anderson and Roane counties in Air Quality Control Region 207 (East Tennessee–Southeastern Virginia). The EPA has designated Anderson County as a basic nonattainment area for the 8 h O_3 standard as part of the larger Knoxville 8 h basic O_3 nonattainment area, which encompasses several counties. In addition, the EPA has designated Anderson, Knox, and Blount counties as a nonattainment area for the $\text{PM}_{2.5}$ air quality standard. EPA designated the portion of Roane County surrounding the Kingston Steam Plant as a nonattainment area as well. Air quality in the greater Knoxville and Oak Ridge area is in attainment with the NAAQS for all other criteria pollutants for which EPA has made attainment designations.

1.3.4 Surface Water

Waters that drain from the ORR eventually reach the Tennessee River via the Clinch River, which forms the southern and western boundaries of the ORR (Fig. 1.2). The ORR lies within the Valley and Ridge Physiographic Province, which is composed of a series of drainage basins or troughs containing many small streams feeding the Clinch River. Surface water at each of the major facilities on the ORR drains into a tributary or series of tributaries, streams, or creeks within different watersheds. Each of these watersheds drains into the Clinch River.

The largest of the drainage basins is that of Poplar Creek, which receives drainage from a 352 km^2 area, including the northwestern sector of the ORR. It flows from northeast to southwest, approximately through the center of the ETTP, and discharges directly into the Clinch River.

East Fork Poplar Creek, which discharges into Poplar Creek east of the ETTP, originates within the Y-12 Complex near the former S-3 Ponds and flows northeast along the south side of the Y-12 Complex. Bear Creek also originates within the Y-12 Complex with headwaters near the former S-3 Ponds, where the creek flows southwest. Bear Creek is mostly affected by storm water runoff, groundwater infiltration, and tributaries that drain former waste disposal sites in the Bear Creek Valley Burial Grounds Waste Management Area and the current Environmental Management Waste Management Facility (EMWMF).

Both the Bethel Valley and Melton Valley portions of ORNL are in the White Oak Creek drainage basin, which has an area of 16.5 km². White Oak Creek headwaters originate on Chestnut Ridge, north of ORNL, near the Spallation Neutron Source (SNS) site. At the ORNL site, the creek flows west along the southern boundary of the developed area and then flows southwesterly through a gap in Haw Ridge to the western portion of Melton Valley, where it forms a confluence with Melton Branch. The waters of White Oak Creek enter White Oak Lake, which is an impoundment formed by White Oak Dam. Water flowing over White Oak Dam enters the Clinch River after passing through the White Oak Creek embayment area.

1.3.5 Geological Setting

The ORR is located in the Tennessee portion of the Valley and Ridge Physiographic Province, which is part of the southern Appalachian fold-and-thrust belt. As a result of thrust faulting and differential erosion rates, a series of parallel valleys and ridges have formed that trend southwest–northeast.

Two geologic units on the ORR, designated as the Knox Group and the Maynardville Limestone of the Upper Conasauga Group, consisting of dolostone and limestone, respectively, comprise the most significant water-bearing hydrostratigraphic unit in the Valley and Ridge Province (Zurawski 1978) as well as on the ORR. Being composed of the fairly soluble minerals, these bedrock formations are prone to dissolution as slightly acidic rainwater and percolating recharge water come in contact with mineral surfaces. This dissolution increases fracture apertures and can form caverns and extensive solution conduit networks under some circumstances. This hydrostratigraphic unit is referred to locally as the “Knox Aquifer.” A combination of fractures and solution conduits in the aquifer control flow over substantial areas, and large quantities of water may move long distances. Active groundwater flow can occur at substantial depths in the Knox Aquifer (91.5 to 122 m deep). The Knox Aquifer is the primary source of groundwater to many streams (base flow), and most large springs on the ORR receive discharge from the Knox Aquifer. Yields of some wells penetrating larger solution conduits are reported to exceed 3,784 L/min. The high productivity of the Knox Aquifer is attributed to the combination of its abundant and sometimes large solution conduit systems and frequently thick overburden soils that promote recharge and storage of groundwater.

The remaining geologic units on the ORR (the Rome Formation, the Conasauga Group below the Maynardville Limestone, and the Chickamauga Group) are composed predominantly of shales, siltstones, and sandstones with a subordinate and locally variable amount of carbonate bedrock. These formations are predominantly composed of insoluble minerals such as clays and quartz that were derived from ancient continental erosion. Groundwater occurs and moves through fractures in those bedrock units. Groundwater availability in such settings is dependent on the abundance and interconnectedness of fractures as well as connection of fractures to sources of recharge, such as alluvial soils along streams that can provide some sustained infiltration. The shale and sandstone formations are the poorest aquifers in the Valley and Ridge Province (Zurawski 1978). Well yields are generally low in the Rome, Conasauga, and Chickamauga bedrock formations except in very localized areas, where carbonate beds may provide greater groundwater storage than adjacent clastic bedrock (Fig. 1.5). Detailed information on ORR groundwater hydrology and flow is available in *Oak Ridge Reservation Physical Characteristics and Natural Resources* (Parr and Hughes 2006).

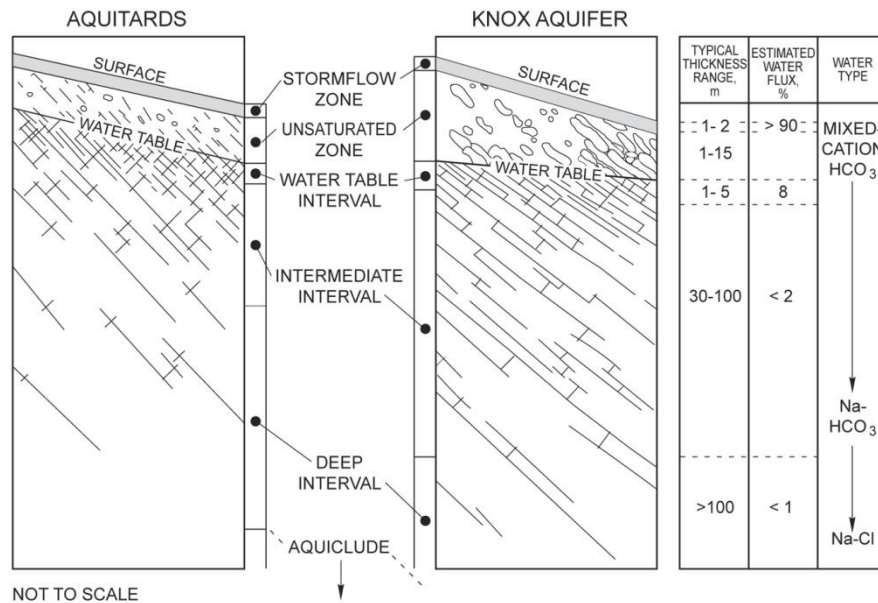


Fig. 1.5. Vertical relationships of flow zones of the ORR: estimated thicknesses, water flux, and water types.

1.3.6 Natural, Cultural, and Historic Resources

The ORR contains a unique variety of natural, cultural, and historic resources. Ongoing efforts continue to focus on preserving the rich diversity of resources found on the reservation.

1.3.6.1 Wetlands

About 243 ha (600 acres) of wetlands have been identified on the ORR, most being classified as forested palustrine, scrub/shrub, and emergent wetlands. Wetlands occur across the ORR at low elevation, primarily in riparian zones of headwater streams and receiving streams as well as in the Clinch River embayments. Wetlands identified to date range in size from several square meters at small seeps and springs to approximately 10 ha at White Oak Lake. Surveys of wetlands resources presented in *Identification and Characterization of Wetlands in the Bear Creek Watershed* (MMES 1993), *Wetland Survey of Selected Areas in the Oak Ridge Y-12 Plant Area of Responsibility, Oak Ridge, Tennessee* (LMES 1997), and *Wetland Survey of the X-10 Bethel Valley and Melton Valley Groundwater Operable Units at Oak Ridge National Laboratory* (Rosensteel 1996), serve as reference documents to support wetlands assessments for upcoming projects and activities. A detailed wetland map of the ETPP area of responsibility has also been developed and is periodically revised and updated as needed.

1.3.6.2 Wildlife/Endangered Species

Animals listed as species of concern known to be present on the reservation (excluding the Clinch River bordering the reservation) are given along with their status in Table 1.1. The list illustrates the diversity of birds on the ORR, which is also habitat for many unlisted species, some of which are in decline nationally or regionally. Some of these (e.g., anhinga) have been seen only once or a few times; others (e.g., sharp-shinned hawk, southeastern shrew) are comparatively common and widespread on the reservation. Other listed species may also be present, although they have not been observed recently. These include several species of mollusks (such as the spiny river snail), amphibians (such as the hellbender), birds (such as Bachman's sparrow), and mammals (such as the smoky shrew).

Table 1.1. Animal species of concern reported from and sensitive wildlife species recently found on the Oak Ridge Reservation^a

Scientific name	Common name	Status ^b		
		Federal	State	PIF ^c
MAMMALS				
<i>Myotis grisescens</i>	Gray bat	E	E	
<i>Sorex longirostris</i>	Southeastern shrew		NM	
FISH				
<i>Phoxinus tennesseensis</i>	Tennessee dace		NM	
AMPHIBIANS AND REPTILES				
<i>Cryptobranchus alleganiensis</i>	Hellbender	MC	NM	
<i>Hemidactylium scutatum</i>	Four-toed salamander		NM	
BIRDS				
Darters				
<i>Anhinga anhinga</i>	Anhinga		NM	
Bitterns and Herons				
<i>Ardea alba</i>	Great egret		NM	
<i>Egretta caerulea</i>	Little blue heron		NM	
<i>Egretta thula</i>	Snowy egret		NM	
Kites, Hawks, Eagles, and Allies				
<i>Haliaeetus leucocephalus</i>	Bald eagle ^d		NM	
<i>Circus cyaneus</i>	Northern harrier		NM	
<i>Accipiter striatus</i>	Sharp-shinned hawk		NM	
<i>Buteo platypterus</i>	Broad-winged hawk			RI
Falcons				
<i>Falco peregrinus</i>	Peregrine falcon ^e		E	RI
Grouse, Turkey, and Quail				
<i>Bonasa umbellus</i>	Ruffed grouse			RI
<i>Colinus virginianus</i>	Northern bobwhite			RI
Rails, Gallinules, and Coots				
<i>Gallinula chloropus</i>	Common moorhen		NM	
Owls				
<i>Aegolius acadicus</i>	Northern saw-whet owl	MC	T	RI
<i>Tyto alba</i>	Barn owl		NM	

Table 1.1 (continued)

Scientific name	Common name	Status ^b		
		Federal	State	PIF ^c
Goatsuckers				
<i>Caprimulgus carolinensis</i>	Chuck-will's-widow			RI
<i>Caprimulgus vociferus</i>	Whip-poor-will			RI
Swifts				
<i>Chaetura pelagica</i>	Chimney swift			RI
Kingfishers				
<i>Ceryle alcyon</i>	Belted kingfisher			RI
Woodpeckers				
<i>Melanerpes erythrocephalus</i>	Red-headed woodpecker			RI
<i>Sphyrapicus varius</i>	Yellow-bellied sapsucker	MC	NM	
<i>Picoides pubescens</i>	Downy woodpecker			RI
<i>Colaptes auratus</i>	Northern flicker			RI
Tyrant Flycatchers				
<i>Contopus cooperi</i>	Olive-sided flycatcher		NM	RI
<i>Contopus virens</i>	Eastern wood-pewee			RI
<i>Empidonax trailii</i>	Willow flycatcher			RI
<i>Empidonax vireescens</i>	Acadian flycatcher			RI
Swallows				
<i>Progne subis</i>	Purple martin			RI
Titmice and Chickadees				
<i>Poecile carolinensis</i>	Carolina chickadee			RI
Nuthatches				
<i>Sitta pusilla</i>	Brown-headed nuthatch			RI
Kinglets, Gnatcatchers, and Thrushes				
<i>Hylocichla mustelina</i>	Wood thrush			RI
Thrashers and Mockingbirds				
<i>Toxostoma rufum</i>	Brown thrasher			RI
Shrikes				
<i>Lanius ludovicianus</i>	Loggerhead shrike	MC	NM	RI
Vireos				
<i>Vireo flavifrons</i>	Yellow-throated vireo			RI

Table 1.1 (continued)

Scientific name	Common name	Status ^b		
		Federal	State	PIF ^c
Wood Warblers				
<i>Vermivora chrysoptera</i>	Golden-winged warbler	MC	NM	RI
<i>Vermivora pinus</i>	Blue-winged warbler			RI
<i>Dendroica cerulea</i>	Cerulean warbler		NM	RI
<i>Dendroica discolor</i>	Prairie warbler			RI
<i>Dendroica fusca</i>	Blackburnian warbler			RI
<i>Mniotilta varia</i>	Black-and-white warbler			RI
<i>Helmitheros vermivorus</i>	Worm-eating warbler			RI
<i>Seiurus motacilla</i>	Louisiana waterthrush			RI
<i>Oporornis formosus</i>	Kentucky warbler			RI
<i>Wilsonia canadensis</i>	Canada warbler			RI
<i>Wilsonia citrina</i>	Hooded warbler			RI
<i>Icteria virens</i>	Yellow-breasted chat			RI
Tanagers				
<i>Piranga olivacea</i>	Scarlet tanager			RI
<i>Piranga rubra</i>	Summer tanager			RI
Cardinals, Grosbeaks, and Allies				
<i>Passerina cyanea</i>	Indigo bunting			RI
Towhees, Sparrows, and Allies				
<i>Pipilo erythrophthalmus</i>	Eastern towhee			RI
<i>Spizella pusilla</i>	Field sparrow			RI
<i>Ammodramus savannarum</i>	Grasshopper sparrow			RI
<i>Pooecetes gramineus</i>	Vesper sparrow		NM	
Blackbirds and Allies				
<i>Sturnella magna</i>	Eastern meadowlark			RI

^aLand and surface waters of the ORR exclusive of the Clinch River, which borders the ORR

^bStatus codes

E = endangered

T = threatened

MC = species of management concern

NM = in need of management

RI = regional importance

^cPartners in Flight was launched in 1990 in response to growing concerns about declines in the populations of many land bird species, and to emphasize the conservation of birds not covered by existing conservation initiatives.

^dThe bald eagle was federally delisted effective August 8, 2007.

^eThe peregrine falcon was federally delisted effective August 25, 1999.

Birds, fish, and aquatic invertebrates are the most thoroughly surveyed animal groups on the ORR. The only federally listed animal species that has recently been observed on the ORR is the gray bat, which was observed over water bordering the ORR (the Clinch River) in 2003 and over a pond on the ORR in 2004. Three gray bats were mist-netted outside a cave on the ORR in 2006. The peregrine falcon, listed by the state of Tennessee as endangered, and the northern saw-whet owl, listed by the state as threatened, are only very rare transients on the site. Similarly, several state-listed bird species, such as the anhinga, olive-sided flycatcher, and little blue heron, are currently uncommon migrants or visitors to the reservation; however, the little blue heron is probably increasing in numbers. The cerulean warbler, listed by the state as in need of management, has been recorded during the breeding season; however, this species is not actually known to breed on the reservation. The bald eagle, also listed by the state as in need of management, is increasingly seen in winter and may well begin nesting here within a few years. Others, such as the northern harrier, great egret, and yellow-bellied sapsucker, are migrants or winter residents that do not nest on the reservation. The golden-winged warbler, listed by the state as in need of management, has been sighted once on the reservation. Barn owls have been known to nest on the reservation in the past. One species, the spotfin chub (*Cyprinella monnacha*), which is listed as threatened by both the state and the federal government, has been sighted and collected in the city of Oak Ridge and is possibly present on the ORR. The Tennessee dace, listed by the state as being in need of management, has been found in some sections of Grassy Creek.

1.3.6.3 Threatened and Endangered Plants

There are currently 22 state listed plant species that have been observed in the last 10 years on the ORR; among them are the pink lady's-slipper and Canada lily (Table 1.2). Two species occurring on the ORR, Carey's saxifrage and the purple fringeless orchid, have been removed from the state list as of November 17, 1999. Big-tooth aspen was recently found on the ORR but was removed from the state list at the January 2007 meeting of the Tennessee Heritage Program scientific advisory committee, which produces the state list. Four species (spreading false-foxglove, Appalachian bugbane, tall larkspur, and butternut) have been under review for listing at the federal level and were listed under the formerly used "C2" candidate designation. These species are now informally referred to as "special concern" species by the U.S. Fish and Wildlife Service.

Two additional species listed by the state, the Michigan lily and the hairy sharp-scaled sedge, were identified in the past on the ORR; however, they have not been found in recent years. Several plant species listed by the state are currently found on adjacent lands and may be present on the ORR as well, although they have not been located (Table 1.2).

Several changes have been made to the 2008 ORR rare plant list (Table 1.2). In 2008, the naked-stem sunflower was added to the ORR list of state-protected plants (Table 1.2). This plant, found during botanical surveys, is listed as special concern by the state. Also a new site for a plant, spreading false-foxglove, which is special concern, was found. This plant is known from several other sites on the ORR. In addition the ORR list (Table 1.2) has been changed from the 2008 list to make it agree with changes by the state in scientific names used for plants.

1.3.6.4 Historical and Cultural Resources

The DOE Oak Ridge Office (ORO) *Cultural Resource Management Plan* (DOE 2001) was developed to identify, assess, and document historic and cultural resources on the ORR. These resources include the New Bethel Baptist Church and Cemetery (the church and two gravehouses), George Jones Memorial Baptist Church, Freels Cabin (a dwelling and one outbuilding), Bear Creek Road Checking Station, Bethel Valley Road Checking Station, and the Oak Ridge Turnpike Checking Station.

Table 1.2. Vascular plant species listed by state or federal agencies, 2008

Species	Common name	Habitat on ORR	Status code ^a
Currently known or previously reported from the ORR			
<i>Aureolaria patula</i>	Spreading false-foxglove	River bluff	FSC, S
<i>Bolboschoenus fluviatilis</i>	River bulrush	Wetland	S
<i>Carex gravida</i>	Heavy sedge	Varied	S
<i>Carex oxylepis</i> var. <i>pubescens</i> ^b	Hairy sharp-scaled sedge	Shaded wetlands	S
<i>Cimicifuga rubifolia</i>	Appalachian bugbane	River slope	FSC, T
<i>Cypripedium acaule</i>	Pink lady's-slipper	Dry to rich woods	E, CE
<i>Delphinium exaltatum</i>	Tall larkspur	Barrens and woods	FSC, E
<i>Diervilla lonicera</i>	Northern bush-honeysuckle	River bluff	T
<i>Draba ramosissima</i>	Branching whitlow-grass	Limestone cliff	S
<i>Elodea nuttallii</i>	Nuttall waterweed	Pond, embayment	S
<i>Fothergilla major</i>	Mountain witch-alder	Woods	T
<i>Helianthus occidentalis</i>	Naked-stem sunflower	barrens	S
<i>Hydrastis canadensis</i>	Golden seal	Rich woods	S, CE
<i>Juglans cinerea</i>	Butternut	Slope near stream	FSC, T
<i>Juncus brachycephalus</i>	Small-head rush	Open wetland	S
<i>Lilium canadense</i>	Canada lily	Moist woods	T
<i>Lilium michiganense</i> ^c	Michigan lily	Moist woods	T
<i>Liparis loeselii</i>	Fen orchid	Forested wetland	E
<i>Panax quinquefolius</i>	Ginseng	Rich woods	S, CE
<i>Platanthera flava</i> var. <i>herbiola</i>	Tuberculed rein-orchid	Forested wetland	T
<i>Ruellia purshiana</i>	Pursh's wild-petunia	Dry, open woods	S
<i>Spiranthes lucida</i>	Shining ladies-tresses	Boggy wetland	T
<i>Thuja occidentalis</i>	Northern white cedar	Rocky river bluffs	S
<i>Viola tripartita</i> var. <i>tripartita</i>	Three-parted violet	Rocky woods	S
Rare plants that occur near and could be present on the ORR			
<i>Agalinis auriculata</i>	Earleaf false foxglove	Calcareous barren	FSC, E
<i>Allium burdickii</i> or <i>A. tricoccom</i> ^d	Ramps	Moist woods	S, CE
<i>Berberis canadensis</i>	American barberry	Rocky bluff, creek bank	S
<i>Pseudognaphalium helleri</i>	Heller's catfoot	Dry woodland edge	S
<i>Lathyrus palustris</i>	A vetch	Moist meadows	S
<i>Liatrix cylindracea</i>	Slender blazing star	Calcareous barren	E
<i>Lonicera dioica</i>	Mountain honeysuckle	Rocky river bluff	S
<i>Meehanian cordata</i>	Heartleaf meehania	Moist calcareous woods	T
<i>Pedicularis lanceolata</i>	Swamp lousewort	Calcareous wet meadow	T
<i>Pycnanthemum torrei</i>	Torrey's mountain-mint	Calcareous barren edge	S
<i>Solidago ptarmicoides</i>	Prairie goldenrod	Calcareous barren	E

^aStatus codes:

CE = Status due to commercial exploitation.

E = Endangered in Tennessee.

FSC = Federal Special of Concern; formerly designated as C2. See *Federal Register*, February 28, 1996.

S = Special concern in Tennessee.

T = Threatened in Tennessee.

^b*Carex oxylepis* var. *pubescens* has not been observed during recent surveys.

^c*Lilium michiganense* is believed to have been extirpated from the ORR by the impoundment at Melton Hill.

^dRamps have been reported near the ORR, but there is not sufficient information to determine which of the two species is present or if the occurrence may have been introduced by planting. Both species of ramps have the same state status.

1.4 DOE Offices and Sites

1.4.1 The DOE Oak Ridge Office

The ORR is home to a world-leading research and manufacturing park, with major federal programs in the areas of science, environmental management, nuclear fuel supply, and national security. The ORO oversees and manages these programs at three primary sites: ORNL, ETTP, and the Oak Ridge Institute for Science and Education (ORISE).

The DOE presence in Oak Ridge has a major financial impact on the area as well; it serves as an economic engine, driving local, regional, and statewide development. DOE is credited with providing a \$3.6 billion increase in the gross state product. It supports some 44,889 full-time jobs statewide, results in \$76.9 million in state and local sales tax, and is the fourth largest employer in Tennessee.

With a federal and contractor workforce in Oak Ridge of more than 12,000 people, DOE is committed to continuing its strong ties to the communities in East Tennessee. The support of local communities has enabled the ORO to undertake some of the most complex work in DOE, and there is more to come as the ORO advances in public and private sector growth in the areas of science, manufacturing, national security, and reindustrialization.

1.4.2 The National Nuclear Security Administration Y-12 Site Office

Established by Congress in 2000, the National Nuclear Security Administration (NNSA) is a semiautonomous agency within DOE that works in partnership with the U. S. Department of Defense, national laboratories, and production plants to conduct routine maintenance and repair; dismantle retired weapons; refurbish warheads through the Life Extension Program; and maintain the capability to design, manufacture, and certify new warheads for the foreseeable future.

As one of NNSA's major production facilities, the Y-12 National Security Complex is a diverse site that supports NNSA through manufacturing and reworking nuclear weapon components, dismantling nuclear weapon components returned from the national arsenal, serving as the nation's storehouse of special nuclear materials, and providing special production support to other programs.

The NNSA Y-12 Site Office (YSO) is responsible for operation of the Y-12 facilities. YSO employees perform program oversight, contract and administrative management, and technical evaluation and assessment to meet its mission.

1.4.3 Oak Ridge National Laboratory

ORNL, DOE's largest science and energy laboratory (Fig 1.6), has been managed since April 2000 by UT-Battelle, LLC, a partnership of the University of Tennessee and Battelle Memorial Institute. ORNL was established in 1943 as a part of the secret Manhattan Project to pioneer a method for producing and separating plutonium. Today the laboratory supports the nation with a peacetime science and technology mission that is just as important as, but very different from, its role during the Manhattan Project. As an international leader in a range of scientific areas that support DOE's mission, ORNL has six major mission roles: neutron science, energy, high-performance computing, systems biology, materials science at the nanoscale, and national security. ORNL's leadership role in the nation's energy future includes hosting the U.S. project office for the ITER international fusion experiment and the Bioenergy Science Center, which is sponsored by the DOE Office of Science.

1.4.4 The Y-12 National Security Complex

The Y-12 National Security Complex (Fig. 1.7) is a premier manufacturing facility dedicated to making the United States and the world safer places. Operated by Babcock & Wilcox Technical Services Y-12, L.L.C. (B&W Y-12) for NNSA, Y-12 plays a vital role in the DOE's nuclear security enterprise.



Fig. 1.6. The Oak Ridge National Laboratory.



Fig. 1.7. Y-12 National Security Complex.

The complex was constructed as part of the World War II Manhattan Project. Construction for the Manhattan Project began with the first shovelful of dirt turned at Y-12 in February 1943, and operations began in November of that year. The first site mission was the separation of ^{235}U from natural uranium by the electromagnetic separation process. At its peak in 1945, more than 22,000 workers were employed at the site. Thirty months later the success of Y-12's mission was announced to the world when, after two atomic weapons (the uranium bomb, Little Boy, and the plutonium bomb, Fat Man) were detonated, the Empire of Japan surrendered, and World War II ended. Y-12 had separated the uranium used in Little Boy.

Since that time Y-12's missions have changed. Today, Y-12 is a unique national asset in the manufacture, processing and storage of special materials vital to our national security; contributes to the prevention of the spread of weapons of mass destruction; retrieves and stores nuclear materials; fuels the nation's naval reactors; and performs complementary work for other government and private-sector entities.

1.4.5 East Tennessee Technology Park

The ETTP was originally named the “Oak Ridge Gaseous Diffusion Plant” (Fig. 1.8) and began operations during World War II as part of the Manhattan Project. Its original mission was to produce enriched uranium for use in atomic weapons. After the war, the plant was renamed the “Oak Ridge K-25 Site” and produced enriched uranium for the commercial nuclear power industry. The plant was permanently shut down in 1987. DOE renamed the site the “East Tennessee Technology Park” in 1996 and began undergoing cleanup for ultimate conversion to a private sector industrial park called the “Heritage Center.” Restoration of the environment, decontamination and decommissioning of facilities, and disposition of wastes are currently the major activities at the site.



Fig. 1.8. East Tennessee Technology Park.

1.4.6 Oak Ridge National Environmental Research Park

In 1980, DOE established the Oak Ridge National Environmental Research Park (Fig. 1.9). Consisting of about 8,094 ha, the Research Park serves as an outdoor laboratory to evaluate the environmental consequences of energy use and development as well as the strategies to mitigate those effects. The combination of protected, undeveloped areas with disturbed, developed, or developing areas within the Research Park allows the demonstration and assessment of various environmental and land-use options.

Major DOE Office of Science research programs use the ORR land to meet mission objectives. The Office of Science considers the research and science value of the ORR to be critical and provides primary operations funding. The Oak Ridge National Environmental Research Park is one of the few sites in the nation where large-scale ecological research, environmental technology, and measurement science are integrated with almost 60 years of environmental monitoring and research.

The availability of the protected lands and field research sites on the ORR allows DOE to support major field experiments that could not be conducted if the lands and associated ecological systems were not protected and secured for such long-term studies. This research addresses fundamental questions about the effects of energy-related activities on ecological systems and compares such effects with the natural variation of ecological systems.

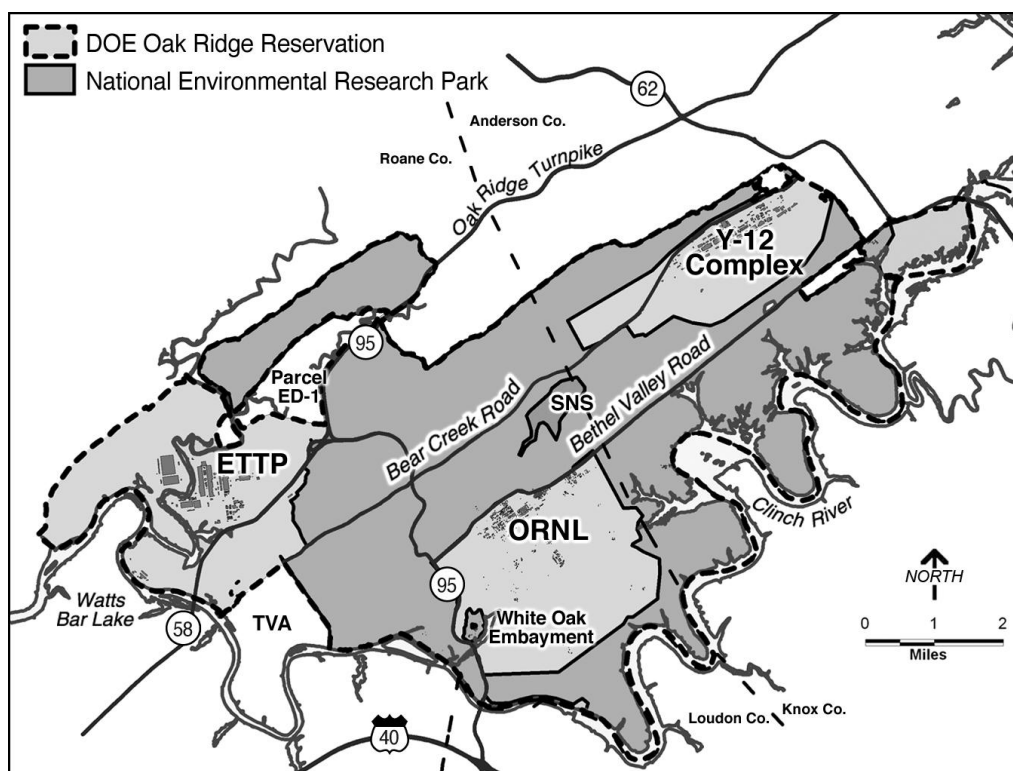


Fig. 1.9. The Oak Ridge National Environmental Research Park covers about 8,094 hectares on the reservation.

The Research Park has attracted more than 1,200 users from ORNL as well as from 150 colleges, universities, industries, and other state and federal agencies over the past 5 years. There were 335 users during 2008, representing 48 organizations, including educational institutions, state and federal agencies, and others.

1.4.7 Oak Ridge Institute for Science and Education

ORISE is managed for DOE by Oak Ridge Associated Universities (ORAU), a nonprofit consortium of 100 doctoral-granting members and 14 associate members. ORISE focuses on scientific initiatives to research health risks from occupational hazards, assess environmental cleanup, respond to radiation medical emergencies, support national security and emergency preparedness, and educate the next generation of scientists. ORISE includes a 94 ha area on the southeastern border of the ORR that from the late 1940s to the mid-1980s was part of an agricultural experiment station owned by the federal government and, until 1981, was operated by the University of Tennessee.

The ORISE South Campus lies immediately southeast of the intersection of Bethel Valley Road and Pumphouse Road (Fig. 1.2). The site houses offices, laboratories, and storage areas for the ORISE program offices and support departments, and it is being developed for other productive uses.

1.5 References

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