



Signs such as this were common in the city of Oak Ridge during the Manhattan Project era and for years afterward.

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Introduction to the Oak Ridge Reservation

It was not shown on any maps. No visitors were allowed without special approval. US Army guards were posted at the entrances to the city, and all residents were required to wear badges at all times outside their homes. Thus Oak Ridge existed for seven years, from 1942 to 1949, as a truly secret city. It was here and also in supporting locations where humankind made the leap from candlepower to nuclear power in a single generation. The engineering marvel that materialized in the Secret City changed the world, helped end World War II, and launched life-saving diagnostic tools such as magnetic resonance imaging and nuclear medicine. Today the former Secret City exists in two parts: the City of Oak Ridge and the Oak Ridge Reservation (ORR). ORR's mission continues to evolve as it adapts to meet the changing basic and applied research and national security needs of the United States.

ORR covers a little over 50 square miles of land in Anderson and Roane counties and is home to two major US Department of Energy (DOE) operating facilities: the Oak Ridge National Laboratory (ORNL) and the Y-12 National Security Complex (Y-12). Other ORR facilities include the East Tennessee Technology Park (ETTP), the site of a former gaseous diffusion plant that has undergone significant environmental cleanup and transitioned to a private sector business and industrial park; the Oak Ridge Institute for Science and Education (ORISE) South Campus, which includes training, laboratory, and support facilities; the government-owned, government-operated Agent Operations Eastern Command (AOEC) of the National Nuclear Security Administration (NNSA) Office of Secure Transportation (OST); the Transuranic Waste Processing Center (TWPC); and small government-owned, contractor-operated environmental cleanup facilities.

Due to different permit reporting requirements and instrument capabilities, this report uses various units of measurement. The lists of units of measure and conversion factors on pages xxx and xxxi are included to help readers convert numeric values as needed for specific calculations and comparisons.

1.1. Background

The ORR Annual Site Environmental Report (ASER) is a summary of environmental data that characterizes environmental performance, lists environmental occurrences reported during the year, confirms compliance with environmental standards and requirements, and highlights significant environmental program activities. The ASER meets the requirements of DOE Order 231.1B, *Environment, Safety, and Health Reporting*, and its Attachment 2 (DOE 2012) regarding the preparation of an integrated annual site environmental report.

Summary results in this report are based on data collected before and continuing through 2022. Not all results of the environmental monitoring associated with ORR are reported here, and this is not intended to be a comprehensive monitoring report. Data collected for other site and regulatory purposes, such as environmental restoration and 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 laws, regulations, policies, and guidance. These data are referenced herein as appropriate.

Environmental monitoring of ORR activities consists primarily of effluent monitoring and environmental surveillance. Effluent monitoring involves the collection and analysis of samples or measurements of liquid and gaseous effluents at the points of their release to the environment. These measurements allow quantification and official reporting of contaminant levels, assessment of public exposures to radiation (see Appendix E) and chemicals (see Appendix F), and demonstration of compliance with applicable standards and permit requirements.

Environmental surveillance consists of direct measurement, collection, and analysis of samples taken from the site and its environs, exclusive of effluents. These surveillance activities provide information on contaminant concentrations in air, water, groundwater, soil, foods, biota, and other media. Other environmental surveillance data

support environmental compliance and, when combined with data from effluent monitoring, also support chemical and radiation dose and exposure assessments of any potential effects of ORR operations on the local environment.

1.2. History of the Area around the Oak Ridge Reservation

Native Americans first inhabited the ORR area during the Woodland Period (c. 900 BC to AD 1000). Descendants of these early dwellers, whose ancestors were Neolithic and Stone Age people, still lived in the East Tennessee region when European settlers arrived in the late 1700s. The Cherokee Nation controlled the region at this time, but the 1791 Treaty of the Holston and the 1798 Treaty of Tellico allowed for European settlement, which forever altered the landscape. As settlements continued to grow in numbers, new counties were formed including Roane County and Anderson County in 1801. Early European settlers of the area lived on farms or in four small communities named Elza, Robertsville, Wheat, and Scarborough. These villages served primarily as gathering centers and usually contained one or two churches and a general store. About one thousand families inhabited the area in the early 1940s (Souza 2001, Hogan 2021).

In 1939 President Franklin D. Roosevelt received the famous Einstein-Szilard letter informing him that German scientists were working on a nuclear weapon. In utmost secrecy, he formed the Advisory Committee on Uranium, a team of scientists and military officials tasked with researching uranium's potential role as a weapon, which later evolved into the Office of Scientific Research and Development. After the United States was thrust into World War II following the Japanese attack on Pearl Harbor, the Manhattan Project emerged in 1942 as a full-scale program to build an atomic bomb. The super-secret code name gave no indication of the classified activities it carried out, and was so named because of the location of its original headquarters at 270 Broadway in New York City's Manhattan district. In the summer of 1943, the project moved to East

Tennessee where construction of America's first full-scale gaseous diffusion plant was underway, to fulfill the mission of isolating ^{235}U for the first atomic bomb.

The selection of the area now known as ORR for the nuclear development site was largely due to the vision of General Leslie Groves. The presence of abundant water from the Clinch River, a good source of labor in nearby Knoxville, railroad accessibility, and a supply of ample amounts of electricity from the Tennessee Valley Authority were viewed as key assets. Moreover, the parallel northeast-to-southwest valleys separated by 200-300 foot ridges were seen as useful to segregate the production areas and to provide protection in case of a catastrophe within any one of them. The federal government's acquisition of property for the uranium enrichment plants and a pilot scale nuclear reactor took place through eminent domain and immediately affected more than 3,000 individuals, many whose families had occupied homes and farms for generations. Although the families were compensated by the federal government, the urgency of the eviction was difficult for the landowners, who were forced to abandon their houses and crops. Many property owners also felt they were underpaid for the value of their homes and land, although many later successfully appealed the initial land valuations offered to them.

The site's wartime name was Clinton Engineer Works, and the area now known as Oak Ridge was the workers' city on the reservation's northern edge. Although Oak Ridge did not appear on any map until 1949, it quickly grew to a population of 75,000, becoming the fifth largest city in Tennessee. To the south of the residential area at the Y-12 Complex, an electromagnetic method separated ^{235}U from natural uranium. The K-25 gaseous diffusion plant was built on the reservation's western edge. Near the reservation's southwest corner, about 16 km (10 mi) from the Y-12 Complex, a third facility—known as X-10 or Clinton Laboratories—housed the experimental

graphite reactor. X-10 served as a pilot scale facility for the larger plutonium production facilities built at Hanford, Washington (Olwell 1999, Broad 2007, Reed 2014, Johnson 2018).

The missions of the three major ORR installations have continued to evolve and operations have adapted to meet America's changing defense, energy, and research needs. Section 1.4 describes the current missions of these and several smaller ORR facilities and activities.

1.3. Location and Description

Situated in the Great Valley of East Tennessee between the Cumberland and Great Smoky Mountains, ORR borders the Clinch River (see Figures 1.1 and 1.2). The Cumberland Mountains are 16 km (10 mi) to the northwest and the Great Smoky Mountains are 51 km (31.6 mi) to the southeast. Except for the city of Oak Ridge, the land within 8 km (5 mi) of ORR is semirural and is used primarily for residences, small farms, and cattle pasture. Fishing, hunting, boating, water skiing, and swimming are popular recreational activities. ORR encompasses a little over 13,000 hectares (32,258.54 acres) of mostly contiguous, federally owned land in Anderson and Roane Counties, and is under the management of DOE.

1.3.1. Population

As reported in *US Department of Energy FY 2020 Economic Impact in Tennessee* (East Tennessee Economic Council), ORR supported nearly 43,000 members of the region's labor force. The Vintage 2022 US Census Population Estimate for the Knoxville Metropolitan Statistical Area, including Oak Ridge, was 907,968.¹ The combined US Census Vintage 2022 Population Estimate for the 10 counties surrounding ORR (Anderson, Blount, Campbell, Cumberland, Knox, Loudon, McMinn, Monroe, Morgan, and Roane) was 1,053,497. Knoxville, the nearest major city, is about 40 km (25 mi) to the east and had a population of

¹ Vintage 2022 is the base population of the 2020 census plus estimates from the time series starting April 1, 2020 through July 1, 2022.

195,889, according to the US Census Vintage 2022 Population Estimate. Other municipalities within about 30 km (18.6 mi) of ORR include Oliver

Springs, Clinton, Rocky Top, Lenoir City, Farragut, Kingston, and Harriman.



Figure 1.1. Location of the Oak Ridge Reservation in Tennessee

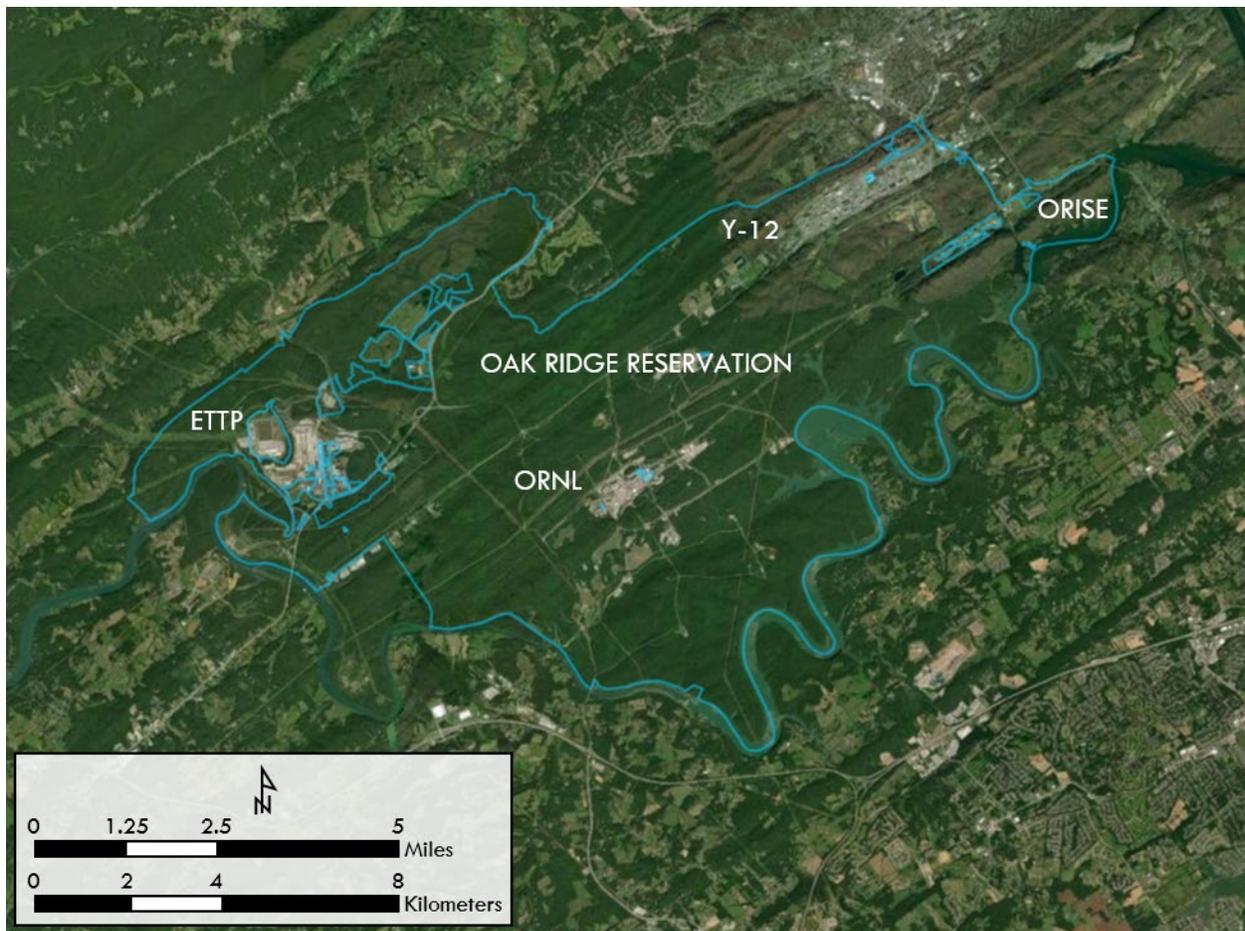


Figure 1.2. Map of the Oak Ridge Reservation

1.3.2. Climate

Although it features significant temperature changes between summer and winter, the climate of the Oak Ridge region qualifies as humid subtropical. The 30-year average temperature for 1991–2020 was 14.9°C (58.8°F). The average temperature for the Oak Ridge area in 2022 was 14.0°C (57.2°F). January temperatures were coldest in 2022, averaging -2.8°C (27.0°F). July was the warmest month, with an average temperature of 31.5°C (88.7°F). Monthly summaries of temperature averages, extremes, and 2022 values are provided in Appendix B, Table B.1.

Average annual precipitation in the Oak Ridge area for the 30-year period from 1991 to 2020 was 1,417.8 mm (55.82 in.), including about 14.5 cm (5.7 in.) of snowfall. Total precipitation during 2022 as measured at meteorological tower (MT)2 was 1482.0 mm (58.35 in.), which is 5 percent above the 30-year average. Monthly summaries of precipitation averages, extremes, and 2022 values can also be found in Appendix B, Table B.1.

The average annual wind data recovery rates (a measure of acceptable data) across locations used for modeling during 2022 were greater than 89.2 percent for wind sensors at the ORNL sites (towers MT2, MT3, MT4, and MT12). All other (MT6, MT9, MT11, and MT13) instrument recoveries were above 81.7 percent for annual values.

The local ridge-and-valley terrain reduces average wind speeds at valley bottoms, resulting in frequent periods of calm or near-calm conditions, particularly during clear early morning hours in weak synoptic weather environments. Wind direction frequencies with respect to precipitation hours for the ORR towers may be reviewed [here](#) under the heading 2022 Annual Precipitation Wind Roses–Oak Ridge Reservation.

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) and in Appendix B of this report. An in-depth analysis of wind patterns for

ORR conducted from 2009 to 2011 and documented in “Wind Regimes in Complex Terrain in the Great Valley of Eastern Tennessee” (Birdwell 2011) is available online [here](#).

1.3.3. Regional Air Quality

The US Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards set national ambient air quality standards (NAAQS) for key principal pollutants, also known as criteria pollutants. These key pollutants are sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, ozone, particulate matter with an aerodynamic diameter less than or equal to 10 µm (PM₁₀), and fine particulate matter with an aerodynamic diameter less than or equal to 2.5 µm (PM_{2.5}). EPA evaluates NAAQS based on ambient, or outdoor, levels of the criteria pollutants. Areas that satisfy NAAQS are classified as attainment areas, and areas that exceed NAAQS for a particular pollutant are considered non-attainment areas for that pollutant.

As of August 30, 2017, EPA designated Anderson, Knox, Blount, and Roane Counties as attainment areas for the PM_{2.5} air quality standard. (ORR is located in Anderson and Roane Counties.) The greater Knoxville and Oak Ridge area is a NAAQS attainment area for all other criteria pollutants for which EPA has made attainment designations (EPA 2022).

1.3.4. Surface Water

The ORR area comprises a series of drainage basins or troughs containing numerous small streams that feed the Clinch River. Surface water on ORR drains into a series of tributaries, streams, or creeks in different watersheds. Each of these watersheds drains into the Clinch River, which in turn flows into the Tennessee River. The Tennessee Valley Authority reported 55 inches of precipitation in 2022 for the Tennessee River Valley region (TVA 2023). Although this amount of rainfall was about 28 percent less than the record-breaking 70.36 inches of rainfall in 2020, it was the sixth straight year of exceeding the average annual rainfall of 51 inches in this region.

The largest of the ORR drainage basins is Poplar Creek, which receives drainage from a 352 km² (136 mi²) area including the northwestern sector of ORR. Flow is from northeast to southwest, roughly through the center of ETTP, and the creek discharges directly into the Clinch River.

East Fork Poplar Creek, which discharges into Poplar Creek east of ETTP, originates within the Y-12 Complex and flows northeast along the south side of the complex. Bear Creek also originates within the Y-12 Complex and flows southwest. Bear Creek is 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 (WOC) drainage basin, which covers 16.5 km² (6.4 mi²). The headwaters of WOC originate on Chestnut Ridge, north of ORNL and near the Spallation Neutron Source site. The creek flows west along the southern boundary of the developed area of the ORNL site, then flows southwest through a gap in Haw Ridge to the western portion of Melton Valley, forming a confluence with Melton Branch. The headwaters of Melton Branch originate in Melton Valley east of the High Flux Isotope Reactor complex, and the area of the drainage basin is about 3.8 km² (1.47 mi²). The waters of WOC enter White Oak Lake, an impoundment formed by White Oak Dam. Water flowing over White Oak Dam enters the Clinch River after passing through the WOC embayment area.

1.3.5. Geological Setting

ORR is in the Tennessee portion of the Valley and Ridge Physiographic Province, which is part of the southern Appalachian fold-and-thrust belt. Thrust faulting, associated fracturing of the rock, and differential erosion rates created a series of parallel valleys and ridges that trend southwest to northeast.

Two geologic units on ORR, the Knox Group and the Maynardville Limestone of the Upper

Conasauga Group, consist of dolostone and limestone, respectively, and make up the most significant water-bearing hydrostratigraphic units in the Valley and Ridge Province (Zurawski 1978) and on ORR. Composed of moderately soluble minerals, these bedrock formations are prone to dissolution as slightly acidic rainwater and percolating recharge water come in contact with the mineral surfaces. This dissolution increases fracture apertures and can, under some circumstances, form caverns and extensive solution conduit networks. This hydrostratigraphic unit is locally known 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 (91.5 to 122 m, or 300 to 400 ft) in the Knox Aquifer. The Knox Aquifer is the primary source of groundwater (base flow) for many streams, and most large springs on ORR receive discharge from the Knox Aquifer. Yields of some wells penetrating larger solution conduits exceed 3,785.4 liters per minute (1,000 gallons per minute). The high productivity of the Knox Aquifer results from 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 ORR (the Rome Formation, the Conasauga Group below the Maynardville Limestone, and the Chickamauga Group) are composed predominantly of shale, siltstones, and sandstones with a subordinate and locally variable amount of carbonate bedrock. These formations are primarily composed of insoluble minerals such as clays and quartz that were derived from ancient continental erosion. Groundwater occurs in and moves through fractures in these bedrock units. Groundwater availability in such settings depends on the abundance and interconnectedness of fractures and the connection of fractures to sources of recharge, such as alluvial soils along streams, which 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 localized areas where carbonate beds may provide greater groundwater storage than adjacent clastic bedrock. Detailed information on ORR groundwater hydrology and flow is available in *Oak Ridge Reservation Physical Characteristics and Natural Resources* (Parr and Hughes 2006).

1.3.6. Natural, Cultural, and Historic Resources

ORR has an exceptional variety of natural, cultural, and historic resources. Ongoing efforts continue to focus on preserving the rich diversity of these resources.

1.3.6.1. Wetlands

Wetlands occur across ORR at low elevations, primarily in riparian zones of headwater streams and receiving streams and in the Clinch River embayments, as shown in Figure 1.3. Surveys of wetland resources presented in *Identification and Characterization of Wetlands in the Bear Creek Watershed* (Rosensteel and Trettin 1993), *Wetland Survey of the X-10 Bethel Valley and Melton Valley Groundwater Operable Units at Oak Ridge National Laboratory, Oak Ridge, Tennessee* (Rosensteel 1996), and *Wetland Survey of Selected Areas in the Oak Ridge Y-12 Plant Area of Responsibility, Oak Ridge, Tennessee* (Rosensteel 1997) serve as references to support wetland assessments for upcoming projects and activities.

About 243 hectares (600 acres) of potential wetlands (jurisdictional and non-jurisdictional wetland areas) have been identified on ORR; most are classified as forested palustrine, scrub/shrub, and emergent wetlands. Wetlands identified to date range from several square meters at small seeps and springs to about 10 hectares (25 acres) at White Oak Lake. The Tennessee Department of Environment and Conservation's wetland mitigation aquatic resource alteration permits, required by Section 401 of the Clean Water Act (CWA 1972), entail monitoring restored or

created wetland mitigation sites for five years. Activities and conditions in and around ORR wetlands are verified by site inspections when appropriate.

1.3.6.2. Wildlife and Endangered Species

Animals listed as species of concern by state, federal, or international organizations and known to have occurred on the reservation (excluding the Clinch River bordering the reservation) are listed, along with their status, in Table 1.1. Some of these, such as hellbender, have been seen only once or a few times; others, including wood thrush, are comparatively common and widespread on ORR. As of April 2023, Tennessee had 58 species listed under the federal Endangered Species Act (ESA 1973), including 25 endangered and 33 threatened species. The complete Tennessee Threatened and Endangered List–New Rules is available [here](#) (TDEC 2023a).

Birds, fish, reptiles and amphibians, and aquatic invertebrates are the most thoroughly surveyed animal groups on ORR. Nevertheless, the only federally listed animal species observed on ORR in recent years are mammals. The only federally listed animal species known to occur on the ORR in recent years are bat species. Endangered gray bats have been detected in acoustic surveys and mist net captures for more than 30 years. Endangered Indiana bats and northern long-eared bats have been detected in acoustic surveys and mist net captures since 2013 (McCracken et al. 2015). Surveys conducted in 2022 indicate use of several caves on the ORR by gray bats and other bat species. Suitable roosting and foraging habitat for the three federally listed bat species is abundant across the ORR. Additional bat species found on the ORR include tricolored bat (state-listed as threatened and proposed for federal listing), little brown bat (state-listed as threatened and under consideration for federal listing), Rafinesque's big-eared bat (state-listed as in need of management), and eastern small-footed bat (state-listed as in need of management) (TDEC 2023a, TDEC 2023b).

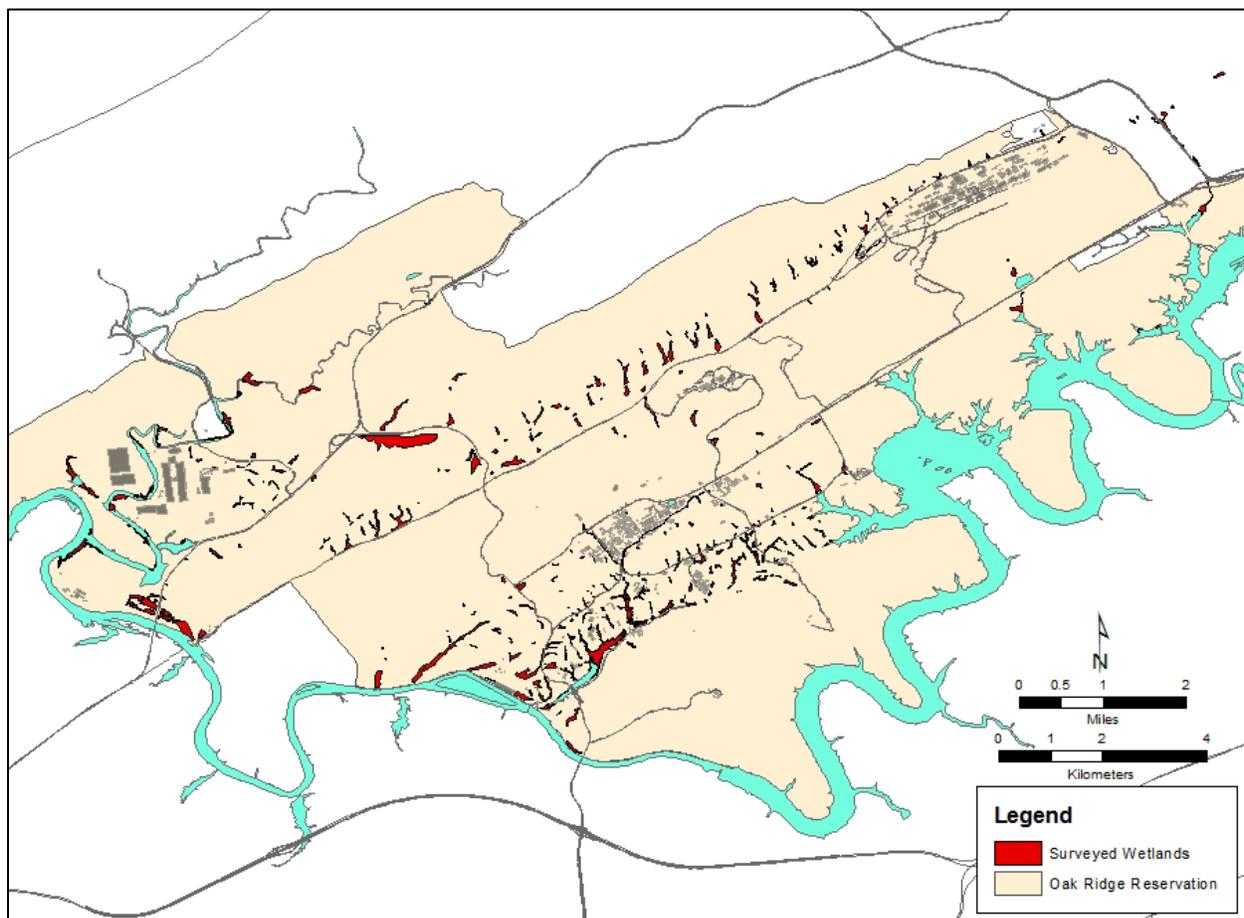


Figure 1.3. Location of Oak Ridge Reservation wetlands

Table 1.1. Animal species of special concern reported on ORR^a

| Scientific name | Common name | Status ^b | | | |
|--|------------------------------|---------------------|----|--------------------------|------------------|
| | | Federal | TN | NatureServe ^c | PIF ^d |
| FISH | | | | | |
| <i>Phoxinus tennesseensis</i> | Tennessee dace | | NM | S3 | |
| AMPHIBIANS AND REPTILES | | | | | |
| <i>Cryptobranchus alleganiensis</i> | Hellbender | | E | S3 | |
| <i>Hemidactylum scutatum</i> | Four-toed salamander | | NM | S3 | |
| <i>Ophisaurus attenuatus longicaudus</i> | Eastern slender glass lizard | | NM | S3 | |
| <i>Pituophis melanoleucus</i> | Northern pinesnake | | T | S3 | |
| BIRDS | | | | | |
| Swans, Geese, and Ducks | | | | | |
| <i>Branta canadensis</i> | Canada goose | BMC, OA | | S5 | |
| <i>Aix sponsa</i> | Wood duck | BMC | | S5 | |
| <i>Mareca strepera</i> | Gadwall | BMC | | S4 | |

Table 1.1. Animal species of special concern reported on ORR^a (continued)

| Scientific name | Common name | Status ^b | | | |
|--|---------------------------|---------------------|----|--------------------------|------------------|
| | | Federal | TN | NatureServe ^c | PIF ^d |
| <i>Mareca americana</i> | American wigeon | BMC | | S4 | |
| <i>Anas rubripes</i> | American black duck | BMC | | S3 | IM |
| <i>Anas platyrhynchos</i> | Mallard | BMC | | S5 | |
| <i>Spatula discors</i> | Blue-winged teal | BMC | | S2 | |
| <i>Anas crecca</i> | Green-winged teal | BMC | | S4 | |
| <i>Spatula clypeata</i> | Northern shoveler | BMC | | S4 | |
| <i>Anas acuta</i> | Northern pintail | BMC | | S4 | |
| <i>Aythya valisineria</i> | Canvasback | BMC | | S3 | |
| <i>Aythya americana</i> | Redhead | BMC | | S4 | |
| <i>Aythya collaris</i> | Ring-necked duck | BMC | | S5 | |
| <i>Aythya affinis</i> | Lesser scaup | BMC | | S4 | |
| Grebes | | | | | |
| <i>Podilymbus podiceps</i> | Pied-billed grebe | BMC | | S4 | |
| <i>Podiceps auritus</i> | Horned grebe | BMC | | S4 | |
| Frigatebirds, Boobies, Cormorants | | | | | |
| <i>Nannopterum auritum</i> | Double-crested cormorant | BMC, OA | | S2 | |
| Bitterns and Herons | | | | | |
| <i>Ixobrychus exilis</i> | Least bittern | BMC | NM | S2 | |
| <i>Egretta caerulea</i> | Little blue heron | BMC | NM | S2 | |
| <i>Nycticorax nycticorax</i> | Black-crowned night heron | BMC | NM | S2 | |
| <i>Butorides virescens</i> | Green heron | | | S4 | MA |
| <i>Mycteria americana</i> | Wood stork | T | | S3 | |
| Kites, Hawks, Eagles, and Allies | | | | | |
| <i>Haliaeetus leucocephalus</i> | Bald eagle | BMC ^e | | S3 | |
| Rails, Gallinules, and Coots | | | | | |
| <i>Rallus limicola</i> | Virginia rail | BMC | | S1 | |
| <i>Porzana carolina</i> | Sora | BMC | | S1 | |
| <i>Fulica americana</i> | American coot | BMC | | S2 | |
| <i>Tringa solitaria</i> | Solitary sandpiper | BMC, BCC | | S5 | |
| <i>Tringa flavipes</i> | Lesser yellowlegs | BMC, BCC | | S5 | |
| <i>Scolopax minor</i> | American woodcock | BMC | | S4 | MA |
| Grouse, Turkey, and Quail | | | | | |
| <i>Colinus virginianus</i> | Northern bobwhite | BMC, BCC, E | | S2 | CR |
| Pigeons and Doves | | | | | |
| <i>Zenaida macroura</i> | Mourning dove | BMC | | S5 | |
| Cuckoos and Roadrunners | | | | | |
| <i>Coccyzus americanus</i> | Yellow-billed cuckoo | BMC, BCC, T | | S4 | IM |

Table 1.1. Animal species of special concern reported on ORR^a (continued)

| Scientific name | Common name | Status ^b | | | |
|---|-------------------------|---------------------|----|--------------------------|------------------|
| | | Federal | TN | NatureServe ^c | PIF ^d |
| Goatsuckers | | | | | |
| <i>Anrostomus carolinensis</i> | Chuck-will's widow | BMC, BCC | | S3 | IM |
| <i>Anrostomus vociferus</i> | Eastern whip-poor-will | BMC, BCC | | S3 | IM |
| <i>Chordeiles minor</i> | Common nighthawk | BCC | | S4 | IM |
| Swifts | | | | | |
| <i>Chaetura pelagica</i> | Chimney swift | BCC | | S5 | IM |
| Kingfishers | | | | | |
| <i>Megaceryle alcyon</i> | Belted kingfisher | BCC | | S5 | MA |
| Woodpeckers | | | | | |
| <i>Melanerpes erythrocephalus</i> | Red-headed woodpecker | BMC, BCC | | S4 | PR |
| <i>Colaptes auratus</i> | Northern flicker | BMC | | S5 | MA |
| Tyrant Flycatchers | | | | | |
| <i>Contopus virens</i> | Eastern wood-pewee | | | S5 | MA |
| <i>Empidonax virescens</i> | Acadian flycatcher | | | S5 | MA |
| <i>Contopus cooperi</i> | Olive-sided flycatcher | BMC, BCC | | S1 | PR |
| <i>Empidonax trailii</i> | Willow flycatcher | BMC, BCC, E | | S2 | |
| Swallows | | | | | |
| <i>Progne subis</i> | Purple martin | | | S5 | MA |
| <i>Hirundo rustica</i> | Barn swallow | | | S5 | MA |
| Kinglets, Gnatcatchers, and Thrushes | | | | | |
| <i>Hylocichla mustelina</i> | Wood thrush | BMC, BCC | NM | S4 | MA |
| Shrikes | | | | | |
| <i>Lanius ludovicianus</i> | Loggerhead shrike | BMC, BCC, E | NM | S1 | |
| Wood Warblers | | | | | |
| <i>Vermivora chrysoptera</i> | Golden-winged warbler | BMC, BCC | T | S3 | IM |
| <i>Setophaga cerulea</i> | Cerulean warbler | BMC, BCC | NM | S3 | IM |
| <i>Setophaga discolor</i> | Prairie warbler | BMC, BCC | | S3 | MA |
| <i>Mniotilta varia</i> | Black-and-white warbler | | | S4 | MA |
| <i>Protonotaria citrea</i> | Prothonotary warbler | BMC, BCC | | S4 | MA |
| <i>Geothlypis formosa</i> | Kentucky warbler | BMC, BCC | | S4 | MA |
| <i>Cardellina canadensis</i> | Canada warbler | BMC, BCC | | S3 | MA |
| <i>Icteria virens</i> | Yellow-breasted chat | BCC | | S4 | MA |
| Tanagers | | | | | |
| <i>Piranga rubra</i> | Summer tanager | BMC | | S4 | MA |
| Towhees, Sparrows, and Allies | | | | | |
| <i>Pipilo erythrophthalmus</i> | Eastern towhee | | | S5 | MA |
| <i>Spizella pusilla</i> | Field sparrow | BMC, BCC | | S4 | MA |
| <i>Ammodramus savannarum</i> | Grasshopper sparrow | BMC, BCC | | S4 | IM |
| <i>Ammodramus henslowii</i> | Henslow's sparrow | BMC, BCC | T | S1 | IM |

Table 1.1. Animal species of special concern reported on ORR^a (continued)

| Scientific name | Common name | Status ^b | | |
|---------------------------------|-------------------------------|---------------------|----|---|
| | | Federal | TN | NatureServe ^c PIF ^d |
| MAMMALS | | | | |
| <i>Myotis grisescens</i> | Gray bat | E | E | S2 |
| <i>Myotis lucifugus</i> | Little brown bat ^f | | T | S3 |
| <i>Myotis sodalis</i> | Indiana bat ^g | E | E | S1 |
| <i>Myotis septentrionalis</i> | Northern long-eared bat | E | E | S1 |
| <i>Myotis leibii</i> | Eastern small-footed bat | | NM | S2 |
| <i>Perimyotis subflavus</i> | Tri-colored bat ^f | | T | S2 |
| <i>Corynorhinus rafinesquii</i> | Rafinesque's big-eared bat | | NM | S3 |
| <i>Sorex dispar</i> | Long-tailed shrew | | NM | S2 |

^a Land and surface waters of the Oak Ridge Reservation (ORR) exclusive of the Clinch River, which borders ORR.

^b Status codes:

E = endangered (TDEC 2023a, TDEC 2023b, FWS 2021)

T = threatened (TDEC 2023a, TDEC 2023b, FWS 2021)

S1 = critically imperiled (NatureServe 2023, TDEC 2023b)

S2 = imperiled (NatureServe 2023, TDEC 2023b)

S3 = vulnerable (NatureServe 2023, TDEC 2023b)

S4 = apparently secure (NatureServe 2023, TDEC 2023b)

S5 = secure (NatureServe 2023, TDEC 2023b)

BMC = Birds of management concern (FWS 2011)

BCC = Birds of conservation concern (FWS 2021)

NM = in need of management (TDEC 2023a, TDEC 2023b)

OA = overly abundant (FWS 2011)

CR = critical recovery for Bird Conservation Region (BCR) 28 (Appalachian Mountains Bird Conservation Region) (PIF 2021)

IM = immediate management for BCR28 (PIF 2021)

MA = management attention for BCR28 (PIF 2021)

PR = planning and responsibility for BCR28 (PIF 2021)

^c NatureServe works with over 60 network organizations and over 1,000 conservation scientists to collect, aggregate, and standardize biodiversity statistics.

^d Partners in Flight (PIF) is an international organization devoted to conserving bird populations in the Western Hemisphere.

^e The bald eagle was federally delisted effective August 9, 2007.

^f Under review for federal listing.

^g A single specimen was captured in a mist net bordering the Clinch River in June 2013.

Birds recorded on ORR and its boundary waters include the 228 species documented by Roy et al. (2014) plus the cackling goose (*Branta hutchinsii*), purple gallinule (*Porphyrio martinicus*), American bittern (*Botaurus lentiginosus*) and federally threatened wood stork (*Mycteria Americana*) for a total of 235 species. Most of these species are protected under the Migratory Bird Treaty Act (MBTA 1918) and Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds* (EO 2001). DOE's updated memorandum of understanding on migratory birds with the US Fish and Wildlife Service (FWS) (DOE-FWS 2013) strengthens migratory bird conservation on ORR through enhanced collaboration between DOE and FWS.

Breeding bird surveys conducted along varying numbers of up to 10 routes on ORR provide data for the Partners in Flight Program. Public nature walks normally organized by ORNL did not take place in 2022 due to the COVID-19 pandemic. In previous years, these walks began in the late winter and carried through mid-summer, and covered topics such as the American woodcock (shown in Figure 1.4), birds of prey, frog calls, inventories of reptiles and amphibians, and the history of ORR. In past years ORR has been nominated for the Presidential Migratory Bird Federal Stewardship Award. A technical manuscript, *Oak Ridge Reservation Bird Records and Population Trends* (Roy et al. 2014), documents known ORR bird records since 1950 and population trends for 32 species of birds.

Several state-listed bird species such as the golden-winged warbler, cerulean warbler, and little blue heron are uncommon migrants or visitors to the reservation. The cerulean warbler, listed by the state as in need of management, often appears during the breeding season on ORR but is currently listed as a potential breeding bird on the reservation (Roy et al. 2014) as its actual breeding status is still uncertain.



Source: Sarah Darling, ORNL

Figure 1.4. American woodcock fledgling on ORR

The bald eagle (Figure 1.5), which was removed from the federal list of threatened and endangered species on August 9, 2007, is a year-round resident in Tennessee, though it can be difficult to find on the reservation from September through November. At least three bald eagle nests were confirmed on the reservation in 2022, all located along the Clinch River/Melton Hill Lake, between Gallaher Bend and Melton Hill Dam. One nest was first observed in 2011 near the mouth of Walker Branch and has remained active every year since, and another nest near Melton Hill Dam has been documented by an area nature photographer for several years. More than two dozen eaglets fledged in East Tennessee during 2017, according to bald eagle information published by the East Tennessee State University College of Arts and Sciences Biological Sciences department.

Other bird species of interest include the migratory wood thrush and barn swallow which have been observed nesting on the reservation. The Lincoln's sparrow (*Melospiza lincolni*) (no listed status) was sighted on ORR in May 2014. Barn owls were documented nesting on the reservation in 2019.



Source: Kelly Roy, ORNL

Figure 1.5. Bald eagle photographed on ORR

Uncommon birds for ORR recorded in recent years include several species associated with wetland habitats. Due to efforts in the early 2000s to mitigate ETP's K1007 P-1 pond into high-quality wildlife habitat, Greater scaup (*Aythya marila*) and redhead (*Aythya americana*) made appearances in 2022. The common gallinule (*Gallinula galeata*), seen as recently as October 2022, is a fairly common migrant throughout Tennessee that is seldom seen on ORR. The least bittern (*Ixobrychus exilis*), an uncommon migrant and summer resident in Tennessee, was documented in 2022 at P-1 Pond on ETP. While collaborating on detection methodologies for secretive marsh birds, researchers from ORNL and Charles Sturt University in New South Wales, Australia, photographed a purple gallinule (*Porphyrio martinicus*) on a trail camera at the Heritage Center Greenway Powerhouse Trail in 2017 (Figure 1.6). This was the first documented appearance of a purple gallinule on ORR.

ORNL increased monitoring of amphibians and reptiles over the past two years. The ORR contains some of the highest densities of state-listed four-toed salamanders (*Hemidactylium scutatum*) in eastern Tennessee, which are considered by the state as in need of management. Several of their largest subpopulations on the ORR occur in areas that are slated for development. ORNL has also documented what appear to be state-listed black mountain salamanders (*Desmognathus welteri*,



Figure 1.6. Purple gallinule caught on a trail surveillance camera at ETP in 2017

considered by the state as in need of management) on the ORR, just south of the Horizon Center. Two state-listed reptiles have inhabited the ORR: the northern pinesnake (*Pituophis melanoleucus melanoleucus*, state-listed as threatened) and the eastern slender glass lizard (*Ophisaurus attenuatus longicaudus*, state-listed as in need of management). However, there is limited evidence to suggest the number of either species on the reservation.

Several fish species listed and noted for management concern are known to inhabit areas in and around the ORR. One fish species, the spotfin chub (*Erimonax monachus*), 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 may be present on ORR. The tangerine darter (*Percina aurantiaca*), a species listed by the state as in need of management, has also been recorded in close proximity to ORR. The lake sturgeon (*Acipenser fulvescens*), state-listed as endangered, is known to inhabit the adjacent Clinch River. The Tennessee dace, listed by the state as in need of management, appears in the Bear Creek watershed, tributaries to the lower East Fork watershed, and Ish Creek. The Tennessee dace also occurs in some sections of Grassy Creek upstream of Scientific Ecology Group, Inc. and International Technology Corporation at Clinch River kilometer 23, south of

west Bear Creek Road near Grassy Creek sampling point 1.9.

1.3.6.3. Threatened and Endangered Plants

Four plant species known to be on ORR (spreading false foxglove, Appalachian bugbane, tall larkspur, and butternut) have been under review for federal listing and were previously listed under the C2 candidate designation. FWS now informally refers to these as special concern species.

The state of Tennessee lists 16 plant species occurring on ORR as endangered, threatened, or of special concern; these are included in Table 1.2. An additional 10 threatened, endangered, or special concern species occur in the area and may be present on ORR, although currently unconfirmed. These are also included in Table 1.2. Other plant populations currently under study on ORR may be added to the table in future years (TDEC 2021, TDEC 2023b).

Table 1.2. Vascular plant species of special concern sighted or reported on or near ORR

| Species | Common name | Habitat on ORR | Status/rank code ^{a,b} |
|--|---------------------------|------------------------|---------------------------------|
| Currently known to be or previously reported on ORR | | | |
| <i>Aureolaria patula</i> | Spreading false foxglove | River bluff | S, S3 |
| <i>Berberis canadensis</i> | American barberry | Rocky bluff | S, S2 |
| <i>Bolboschoenus fluvialis</i> | River bulrush | Wetland | S, S1 |
| <i>Delphinium exaltatum</i> | Tall larkspur | Barrens and woodlands | E, S2 |
| <i>Diervilla lonicera</i> | Northern bush-honeysuckle | Rocky river bluff | T, S2 |
| <i>Draba ramosissima</i> | Branching whitlow-grass | Limestone cliff | S, S2 |
| <i>Elodea nuttallii</i> | Nuttall waterweed | Pond, embayment | S, S2 |
| <i>Eupatorium godfreyanum</i> | Godfrey's thoroughwort | Dry woods edge | S, S1 |
| <i>Fothergilla major</i> | Mountain witch-alder | Woods | T, S2 |
| <i>Helianthus occidentalis</i> | Naked-stem sunflower | Barrens | S, S2 |
| <i>Juglans cinerea</i> | Butternut | Lake shore | T, S3 |
| <i>Juncus brachycephalus</i> | Small-head rush | Open wetland | S, S2 |
| <i>Liparis loeselii</i> | Fen orchid | Forested wetland | T, S1 |
| <i>Panax quinquefolius</i> | American ginseng | Rich woods | S, S3 |
| <i>Platanthera flava</i> var. <i>herbiola</i> | Tuberculed rein-orchid | Forested wetland | T, S2 |
| <i>Spiranthes lucida</i> | Shining ladies'-tresses | Boggy wetland | T, S1 |
| Rare plants that occur near and could be present on ORR | | | |
| <i>Agalinis auriculata</i> | Earleaf false foxglove | Calcareous barren | E, S2 |
| <i>Allium burdickii</i> ^c | Narrow-leaf Ramps | Moist woods | T, CE, S1 |
| <i>Allium tricoccum</i> ^c | Ramps | Moist woods | S, CE, S1 |
| <i>Lathyrus palustris</i> | Marsh pea | Moist meadows | S, S1 |
| <i>Liatris cylindracea</i> | Slender blazing star | Calcareous barren | T, S2 |
| <i>Lonicera dioica</i> | Mountain honeysuckle | Rocky river bluff | S, S2 |
| <i>Meehania cordata</i> | Heartleaf meehania | Moist calcareous woods | T, S2 |
| <i>Pedicularis lanceolata</i> | Swamp lousewort | Calcareous wet meadow | S, S1 |

Table 1.2. Vascular plant species of special concern sighted or reported on or near ORR (continued)

| Species | Common name | Habitat on ORR | Status/rank code ^{a,b} |
|---------------------------------|------------------------|------------------------|---------------------------------|
| <i>Pseudognaphalium helleri</i> | Heller's catfoot | Dry woodland edge | S, S2 |
| <i>Pycnanthemum torreyi</i> | Torrey's mountain-mint | Calcareous barren edge | E, S1 |

^a State status codes (TDEC 2021):

CE = Status due to commercial exploitation

E = Endangered in Tennessee

S = Special concern in Tennessee

T = Threatened in Tennessee

^b State conservation status (NatureServe 2023):

S1 = Critically imperiled

S2 = Imperiled

S3 = Vulnerable

^c Ramps have been reported near ORR, but there is not sufficient information to determine which of the two species is present or whether the occurrence may have been the result of planting.

Acronym: ORR = Oak Ridge Reservation

1.3.6.4. Historical and Cultural Resources

Efforts continue to preserve ORR's rich prehistoric and historic cultural resources. Compliance with the National Historic Preservation Act of 1966 (NHPA 1966) is maintained in conjunction with the National Environmental Policy Act (NEPA 1969) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA 1980). The scope of proposed actions is reviewed in accordance with the Cultural Resource Management Plan, DOE Oak Ridge Reservation, Anderson and Roane Counties, Tennessee (DOE 2001). ORR has several facilities that were eligible for inclusion on the National Register of Historic Places (NRHP), a National Park Service program to identify, evaluate, and protect historic and archeological resources in the United States, as well as numerous facilities that were not eligible for NHRP inclusion. The reservation contains more than 44 known prehistoric sites (primarily archeological evidence of former structures), 254 historic pre-World War II structures, 32 cemeteries, and several historically significant structures from the Manhattan Project era.

The National Defense Authorization Act of 2015 (NDAA 2014), passed by Congress and signed into law on December 19, 2014, included provisions authorizing the Manhattan Project National

Historical Park. An agreement by the Secretaries of Energy and Interior established the Manhattan Project National Historical Park on November 10, 2015 (DOE-DOI 2015). The Park includes facilities and lands in Los Alamos, New Mexico, and Hanford, Washington, as well as Oak Ridge. On ORR, the National Park includes the X-10 Graphite Reactor, Buildings 9731 and 9204-3 at the Y-12 Complex, and the K-25 Building Site at ETTP.

The X-10 Graphite Reactor building has been a National Historic Landmark since 1966, and has been open for public access in various ways since that time. Enhancing access and improving the visitor experience are important DOE objectives as it moves forward in implementing the National Park.

Occasional public access to Buildings 9731 and 9204-3 at the Y-12 Complex last occurred on November 12, 2015, when DOE facilitated public tours of both buildings to celebrate the establishment of the National Park. By helping to develop the National Park, DOE aims to enhance safe access to these buildings while protecting the agency's mission capabilities.

A memorandum of agreement signed in 2012 between DOE Oak Ridge Office, the State Historic Preservation Officer, the Advisory Council on Historic Preservation, the City of Oak Ridge, and the East Tennessee Preservation Alliance ensures

consistent interpretation of site historic properties at ETTP. The memorandum of agreement is being implemented through the National Historic Preservation project that developed the K-25 History Center, and serves to highlight the historic aspects of ETTP and of the communities that were displaced during the construction of the site. On December 16, 2022, the US Army Corps of Engineers issued a solicitation for construction bids to select a contractor to build the K-25 Viewing Platform overseeing the building's original footprint. Exhibits inside the K-25 Viewing Platform will enrich the visitor experience by providing photos, facts, view scopes, and a scale model of the K-25 Building.

The K-25 History Center and Viewing Platform complement the Manhattan Project National Historic Park established in 2015, which includes the footprint of the former K-25 Building (DOE 2015). The National Park Service is assisting in historic interpretation of the site, although the K-25 Building site is already undergoing extensive historic interpretation activities separate and independent from the National Park. As part of the activities to establish the park, DOE launched the K-25 Virtual Museum which details the history of the K-25 Gaseous Diffusion Plant through narrative and photographs, which can be viewed [here](#).

In addition to the X-10 Graphite Reactor, six additional historic ORR properties are listed individually in the planning for a History Center:

- Freels Bend Cabin
- New Bethel Baptist Church and Cemetery
- Oak Ridge Turnpike Checking Station
- George Jones Memorial Baptist Church and Cemetery
- Bear Creek (Scarboro) Road Checking Station
- Bethel Valley Road Checking Station

Although not yet included on the NRHP, an area known as the Wheat Community African Burial

Grounds was dedicated in June 2000, and a memorial monument was erected.

ORNL and Y-12 programmatic agreements and memorandums of agreement among DOE, the State of Tennessee, the Advisory Council on Historic Preservation, and consulting parties serve to provide a system of review for projects that may potentially affect historic and archaeological resources on the ORR. The ORNL and Y-12 programmatic agreements are currently being updated to reflect new architectural building surveys and revisions to each site's Historic Preservation Plans. In 2022, a new memorandum of agreement was executed to address planned mitigation for the planned demolition of Buildings 3005, 3009, 3010, 3010A, 3107, and 9213 on the ORR. These historic contaminated buildings were determined to pose excessive environmental risks (DOE-TSHPO 2022).

1.4. Oak Ridge Sites

ORR includes a number of sites critical to the mission of DOE. Eight of these sites are described in this section: ORNL, the Y-12 Complex, ETTP, EMWMF, the Oak Ridge National Environmental Research Park, ORISE, NNSA OST AOEC, and the TWPC.

United Cleanup Oak Ridge LLC (UCOR) is the new lead DOE ORR cleanup contractor as of May 2022. The company is a new configuration of the former UCOR, and is now led by Amentum, Jacobs, and Honeywell. The new contract expands cleanup operations at ORNL and Y-12, in addition to the continuing final soil and groundwater remediation at ETTP. The TWPC also became a part of UCOR in October 2022.

The scope of UCOR activities includes characterization and cleanup of former production facilities, building pads, and impacted environmental media; management and maintenance of active ORR facilities; long-term management of inactive waste disposal sites; and water quality monitoring. The *2022 Cleanup Progress: Annual Report on Oak Ridge Reservation Cleanup* (UCOR 2022) provides detailed

information on UCOR activities at the ORR and is available [here](#).

1.4.1. Oak Ridge National Laboratory

ORNL (shown in Figure 1.7) is managed for DOE by UT-Battelle, LLC, a partnership between the University of Tennessee and the Battelle Memorial Institute. The largest science and energy national laboratory in the DOE system, ORNL conducts basic and applied research to deliver transformative solutions to compelling problems in energy and security. The laboratory is home to several of the world's top supercomputers and is a leading neutron science and nuclear energy research facility that includes the Spallation Neutron Source and the High Flux Isotope Reactor. ORNL hosts a DOE leadership computing facility, home of the Frontier supercomputer; one of DOE's nanoscience centers, the Center for Nanophase Materials Sciences; one of DOE's energy research centers; and the Bio-Energy Science Center. UT-Battelle, LLC also manages the US ITER project (formerly the International Thermonuclear Experimental Reactor project) for DOE.

Formerly known as X-10, ORNL was established in 1943 to support the Manhattan Project. From an early focus on chemical technology and reactor development, ORNL's research and development portfolio broadened to include programs supporting DOE missions in scientific discovery and innovation, clean energy, and nuclear security. Today ORNL employs about 5,800 workers, and the laboratory's extensive capabilities in scientific discovery and innovation are applied to the delivery of mission outcomes for DOE and other sponsors.

Isotek Systems, LLC (Isotek) began processing operations on the remaining inventory of ^{233}U stored at ORNL in 2022. Crews began the campaign by transferring a canister of ^{233}U oxide from Building 3019 into an adjacent, newly upgraded hot cell facility for downblending processing. The heavily shielded hot cells protect workers and allow them to handle the material using remote manipulators. This upcoming phase will enable Isotek to enhance productivity by

processing larger amounts of ^{233}U and extracting more medical isotopes than the previous phase that involved processing material in glove boxes. They also completed an operational readiness review that will allow for the processing and disposal of the remaining high-dose ^{233}U inventory stored at ORNL.

UCOR continued to carry out characterization and deactivation of former reactors and isotope production facilities in 2022, many which are slated for demolition in 2023. Deactivation activities took place at multiple facilities, including the Low Intensity Test Reactor, the Oak Ridge Research Reactor, and a group of buildings called "Isotope Row" that were constructed in the 1950s and early 1960s to process radioisotopes. This work focuses on asbestos, lead, and universal waste removal to eliminate high-risk contaminated structures and to open up space for future research missions at ORNL.

Demonstrating environmental excellence through high-level policies that clearly state expectations for continual improvement, pollution prevention, and compliance with regulations and other requirements is a priority at ORNL. Implementing an environmental management system (EMS) allows environmental impacts to be systematically measured, managed, and controlled. UT-Battelle's EMS is a fully integrated set of environmental management services for UT-Battelle activities and facilities. Services include pollution prevention, waste management, effluent management, regulatory review, reporting, permitting, and other environmental management programs.

Examples of environmental performance optimization during fiscal year (FY) 2022 include the following:

- The calculated energy use intensity was 234,194 Btu/gross square foot. This is a 2.8 percent decrease from 2021, and a cumulative reduction of 35.6 percent since the DOE baseline target year of FY 2003.



Figure 1.7. Aerial view of the Oak Ridge National Laboratory

- The diversion rate for municipal solid waste at ORNL was 70.8 percent in FY 2022. Sustainable Campus Initiative staff plan to work with Procurement staff to continue to employ terms and conditions within construction contracts to manage construction waste and recycling.
- UT-Battelle implemented 26 ongoing and new pollution prevention projects at ORNL during 2022, which eliminated more than 3.6 million kg of waste.
- Eighty-two percent of all ORNL vehicles are alternative fuel vehicles, with 90 percent of all replacements over the past two fiscal years being alternative fuel or electric vehicles. One hundred percent of light-duty vehicles operate on alternative fuels, exceeding DOE fleet management goals.

See Section 5.2.1.4 for additional details on ORNL environmental sustainability performance data for FY 2022.

1.4.2. Y-12 National Security Complex

The Y-12 Complex (shown in Figure 1.8) was originally constructed as part of the World War II Manhattan Project and began operations in November 1943. The first site mission was the separation of ^{235}U from natural uranium by an electromagnetic separation process. At its peak in 1945, more than 22,000 workers were employed at the Y-12 site.

Today, as part of the NNSA Nuclear Security Enterprise, the Y-12 Complex is a leader in materials science and precision manufacturing. As the main storage facility for the nation's supply of enriched uranium, Y-12 serves as the nation's only source of enriched uranium nuclear weapons components and provides enriched uranium for the US Navy. The Y-12 Complex also supports efforts to reduce the risk of nuclear proliferation and performs complementary work for other government agencies.

In December 2017, UCOR issued the *Construction Execution/Management Plan, Outfall 200 Mercury Treatment Facility at the Y-12 National Security Complex, Oak Ridge, Tennessee* (UCOR 2017). The Outfall 200 Mercury Treatment Facility is a vital piece of infrastructure that will open the door for demolition of Y-12's large, deteriorated, mercury-contaminated facilities and subsequent soil remediation by providing a mechanism to limit potential mercury releases into Upper East Fork Poplar Creek. The west end Y-12 storm drain system discharges to Upper East Fork Poplar Creek at Outfall 200, and mercury from historic operations is present at Outfall 200 where storm water enters Poplar Creek.

In FY 2022, progress continued on construction of the Outfall 200 Mercury Treatment Facility, DOE Environmental Management research in new remediation technologies to address mercury releases into the environment from past operations, and contracting for the first mercury remediation technology demonstration. Shoring and major excavations were completed at the headworks site. Crews continued placing concrete pads and walls of the treatment plant. Crews also began erecting structural steel and continued installing underground utilities. The new facility is slated to be operational in 2025. Scientists have also prepared a report titled *Mercury Remediation Technology Development for Lower East Fork Poplar Creek—FY 2021 Update* (Mathews et al. 2021) that provides findings from studies at the Aquatic Ecology Laboratory. As part of the technology demonstration initiative, an existing ORR facility is being evaluated for the necessary modifications to carry out the proposed demonstration of mercury treatment technologies.

In FY 2022, UCOR workers finished removing the remaining slabs at the now demolished Biology Complex, readying the land for transfer to Y-12. The land is expected to be the site of the new Lithium Processing Facility. Crews completed backfilling and seeding the portion of the site where the last two buildings (Buildings 9207 and 9210) once stood. Subsequently, slabs remaining from previous demolition of buildings at the

location were removed and their footprints backfilled and graveled. Between removal of those slabs and the slabs at Buildings 9207 and 9210, more than 6,141 yd³ of waste and debris were removed.

Y-12's environmental policy reflects a commitment to providing sound environmental stewardship practices through the implementation of its EMS. At the end of FY 2022, the Y-12 Complex had achieved seven of eleven established environmental targets driven by the EMS, and the remaining targets were carried into future years. Highlights of achievements include the following (further details and additional successes are presented in Chapter 4 of this report):

- **Clean air:** Y-12 completed a project to seal the Stack 11 basin and identified improved mission operations and improvements to air emissions.
- **Energy efficiency:** Y-12 completed a project to upgrade power lines to 13.8-kV service on Second and Third Street, as well as projects to upgrade cooling towers and heating, ventilation, and air conditioning systems in two areas.
- **Hazardous materials:** A project to disposition and ship legacy mixed waste according to the site treatment plan continued, and 50 items were shipped in FY 2022 to meet plan milestones. Unneeded materials and equipment were dispositioned from Building 9998 and two tanker trailers in FY 2022. Y-12 improved waste characterization processes and implemented real-time radiography to improve control and management of low-level radioactive waste.
- **Land, water, and natural resources:** Y-12 completed upgrading sanitary sewer networks in two areas as part of a project to protect the sanitary sewer lines from infill and infiltration. Y-12 also completed assessments on 34 aboveground inactive tanks and dikes in FY 2022.



Figure 1.8. Aerial view of the Y-12 National Security Complex

Y-12 continues to strive to reduce impacts on the environment through increased use of environmentally friendly products and processes and reductions in waste and emissions. In FY 2022, the Y-12 Complex implemented 107 pollution prevention initiatives that resulted in a reduction of more than 11.3 million lb of waste and projected cost efficiencies of more than \$2.5 million. Also in 2022, Y-12 diverted 55.8 percent of municipal and 7.5 percent of construction and demolition waste from landfill disposal through reuse and recycle. In FY 2022, Y-12 diverted more than 3.6 million lb of municipal materials from landfill disposal through source reduction, reuse, and recycle. More than 4.7 million lb of construction and demolition materials were diverted from landfill disposal.

Compared to the FY 2003 baseline year, Y-12 has seen an energy intensity reduction of 50.93 percent as of FY 2022. During FY 2022, energy intensity was 205,343 Btu/gross square foot, a full 1.1 percent above the prior year (203,085

Btu/gross square foot). The upward trend in the site energy intensity figures is largely attributed to the height of the pandemic occurring during FY 2020 and then having a larger portion of the plant population returning to the site, thus increasing infrastructure use. Sustainability goals and performance status for the Y-12 Complex are listed in Chapter 4, Table 4.1.

1.4.3. East Tennessee Technology Park

ETTP (see Figure 1.9), originally named K-25, is the site of the nation's first gaseous diffusion uranium enrichment plant. It was established as part of the World War II Manhattan Project. Additional uranium enrichment facilities K-29, K-31, and K-33 were built adjacent to K-25 during the Cold War, and these facilities formed a complex officially known as the Oak Ridge Gaseous Diffusion Plant. Uranium enrichment operations at the site ceased in 1986, and restoration and decontamination and decommissioning activities began soon after in

preparation for ultimate conversion of the site to a private sector industrial park to be called the Heritage Center. Reindustrialization of the site began in 1996, when it was renamed the East Tennessee Technology Park.

ETTP completed several soil remedial actions in 2022 that help protect groundwater. The site is divided into two cleanup regions: Zone 1, a 1,400-acre area outside the main plant area; and Zone 2, the 800-acre area that comprises the main plant area. The areas in these zones are divided into Exposure Units (EUs) that vary in size from 6 to 38 acres.

The EU-25 remedial action centered on the slab, foundation, and underlying soil of the former K-1413 Building, which was constructed in the 1950s and operated until the early 1980s for a range of chemical waste processing activities. This project was completed in 2022 with over 18,000 yd³ of concrete and soil removed from the site.

EU-13 has several excavation areas for ongoing soil remediation at the sites of the former buildings designated as K-413, K-1131, and K-631. This area near Poplar Creek once housed many of the gaseous diffusion and uranium hexafluoride enrichment support facilities. Workers also removed the K-1131 ash pit and surrounding soils in that area, for a total of approximately 13,000 yd³ in 2022.

Remediation was also underway within EU-21, an area that is located in the middle of the K-25 footprint, which is part of the Manhattan Project National Historical Park. Characterization sampling was performed as part of the overall cleanup of the ETTP site. Based on results of model calculations, workers are set to excavate 16,000 yd³ of soil to eliminate risks to groundwater.

The EU-35 remedial action was conducted on the site of the former K-1407-K Building. This facility contained six 500-gal tanks and a system used for mixing chemical solutions. Four of the tanks were used to convert dry chemicals into solutions; two tanks were used to hold rinse water. Concrete and

soil in the footprint of the former building were found to contain methylene chloride and tetrachloroethylene that exceed site groundwater screening levels. Approximately 800 yd³ of soil and concrete was removed from the area.

The EU-42 area is the site of the former K-1004-J Building, a laboratory that was part of the now-demolished Centrifuge Complex. Remediation was performed on the former slab and soils remaining after demolition. Research conducted in the former facility resulted in discharges to drain lines and neutralization pits that contaminated the concrete and soil in the area with radioactive isotopes. Remedial actions in this EU removed more than 6,200 yd³ of concrete and soil.

The UCOR EMS environmental sustainability principles incorporate the procurement of environmentally preferable products, recycling, and pollution prevention and waste minimization practices in work processes and activities at ETTP. UCOR recycles much of its universal waste, municipal solid waste, and scrap metal; reuses large amounts of construction and demolition debris; and encourages the reduction of waste wherever possible. In 2022, more than 226 metric tons of greenhouse gas emissions, 273,490 metric tons of waste, 282,000 gallons of wastewater, and \$777,850 in travel costs were avoided as a result of ETTP projects implementing pollution prevention measures. In addition to lessening the impact on the environment, these pollution prevention measures also saved more than \$1.6 million. UCOR's pollution prevention and waste minimization practices at ETTP are detailed further in Section 3.2.1.

DOE Oak Ridge Office of Environmental Management (OREM) continued to see significant momentum in the Reindustrialization Program at ETTP. The former government-owned uranium enrichment complex is being turned into a multiuse industrial park that includes national historic preservation and conservation and greenspace areas. To date, OREM has successfully transferred almost 1,300 acres at ETTP for beneficial reuse and is working to complete transfer of the remaining acreage at the site.



Figure 1.9. Aerial view of East Tennessee Technology Park

During 2022, the Reindustrialization team advanced the regulatory review of seven land transfer packages. This includes areas such as the former Powerhouse area, the Centrifuge area, and the K-1037 and the Toxic Substances Control Act Incinerator area. OREM and UCOR continued to partner with the Community Reuse Organization of East Tennessee to identify remaining available property, coordinate schedules, and support new businesses as they set up operations. DOE also continued to support the proposed general aviation airport project, which is in the planning stage.

1.4.4. Environmental Management Waste Management Facility

The EMWMF (shown in Figure 1.10) is located in eastern Bear Creek Valley near the Y-12 Complex and is managed by UCOR. The EMWMF was built for the disposal of waste resulting from CERCLA cleanup actions on ORR. The original design was for the construction, operation, and closure of a projected 1.3 million cubic meter (1.7 million cubic yard) disposal facility. The approved

capacity was subsequently increased to 1.8 million cubic meters (2.4 million cubic yards) to maximize use of the footprint designated in a 1999 record of decision. The facility currently consists of six disposal cells.

The EMWMF is an engineered landfill that accepts low-level, mixed low-level, and hazardous wastes from CERCLA cleanup activities on ORR that meet specific waste acceptance criteria developed in accordance with agreements with state and federal regulators. Waste types that qualify for disposal include soil, dried sludge and sediment, solidified waste, stabilized waste, building debris, scrap equipment, and secondary waste such as personal protective equipment, all of which must meet land disposal restrictions. In addition to the solid waste disposal facility, the EMWMF operates a leachate collection system. In 2022, the facility collected, analyzed, and disposed of approximately 3.30 million gallons of leachate. The leachate is treated at the ORNL Liquids and Gaseous Treatment Facility, which is also operated by UCOR (UCOR 2022).



Figure 1.10. Aerial view of the Environmental Management Waste Management Facility

During FY 2022, the EMWMF received 7,172 waste shipments from cleanup projects at ETTP, ORNL, and Y-12. However, the EMWMF will reach its capacity before OREM completes its cleanup at Y-12 and ORNL, as the of 2.331 million yd³ design capacity is now over 82 percent filled. Planning continued in 2022 for another disposal facility, the Environmental Management Disposal Facility (EMDF), which is needed to provide the capacity required to complete Oak Ridge's cleanup. The EMDF Record of Decision was signed on September 30, 2022. This major milestone for the project allows OREM to begin site preparation activities and finalize the facility's design. OREM continues to work with EPA and TDEC on follow-on regulatory documents related to the project, including the Focused Feasibility Study for Water Management for the Disposal of CERCLA Waste (DOE 2022). This approval followed the dispute resolution for radiological discharge limits. The Focused Feasibility Study provides an evaluation of landfill wastewater treatment alternatives, and its approval was a prerequisite

for the EMDF Record of Decision signature by the Federal Facility Agreement parties. (UCOR 2022).

1.4.5. Oak Ridge Environmental Research Park

DOE established the Oak Ridge National Environmental Research Park (see Figure 1.11) in 1980. Managed for DOE by UT-Battelle, LLC, the research park serves as an outdoor laboratory to evaluate the environmental consequences of energy use and development and strategies to mitigate those effects. Its large blocks of forest and diverse communities of vegetation offer unparalleled resources for ecosystem-level and large-scale research. Major national and international collaborative research initiatives use it to address issues such as multiple stress interactions, biodiversity, sustainable development, tropospheric air quality, global climate change, innovative power conductors, solar radiation monitoring, ecological recovery, and monitoring and remediation.

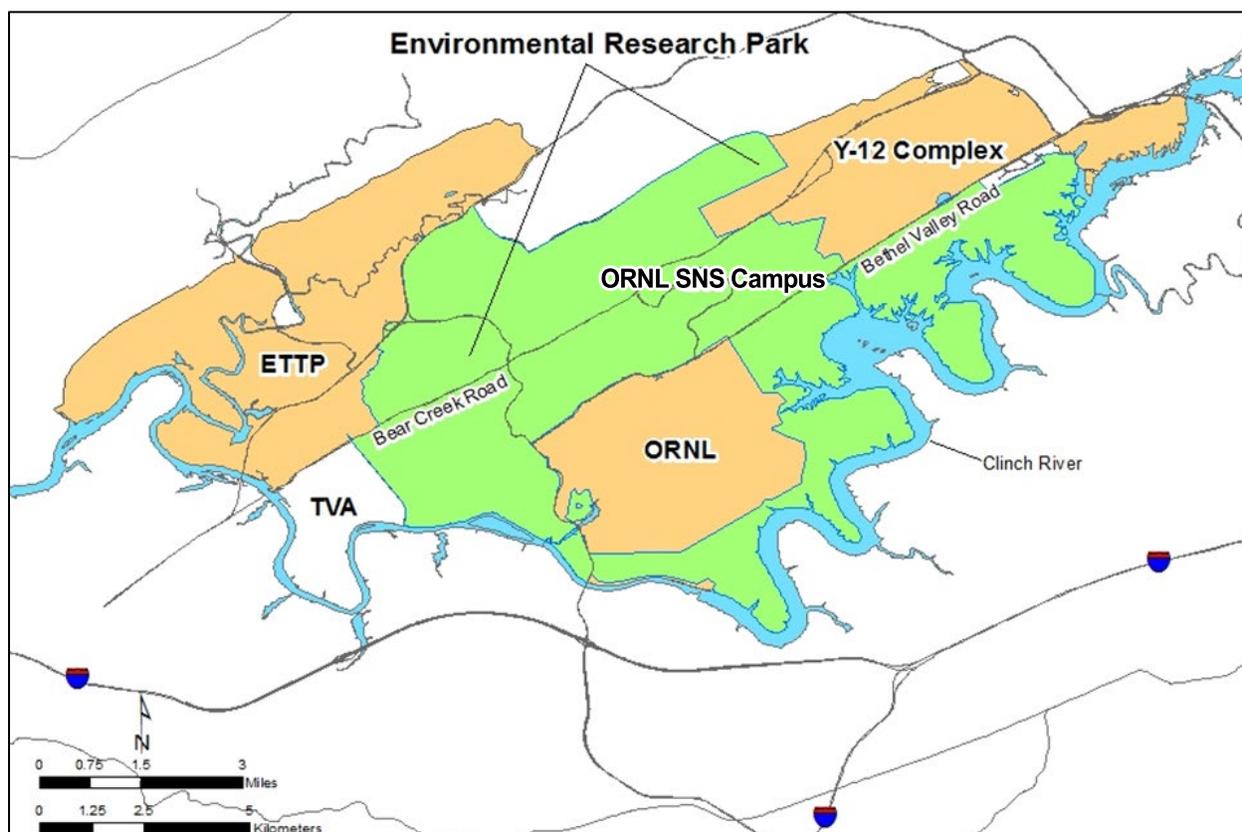


Figure 1.11. Location of the Oak Ridge National Environmental Research Park

Field sites at the research park provide maintenance and support facilities that permit sophisticated and well-instrumented environmental experiments. These facilities include elaborate monitoring systems that enable users to precisely and accurately measure environmental factors for extended periods. Because the park is under the jurisdiction of the federal government, public access is restricted and therefore experimental sites and associated equipment are not disturbed. National recognition of the research park's value has led to its use in both regional- and continental-scale research projects. Research Park sites offer opportunities for aquatic and terrestrial ecosystem analyses of topics such as biogeochemical cycling of pollutants resulting from energy production, landscape alterations, ecosystem restoration, wetland mitigation, and forest and wildlife management.

1.4.6. Oak Ridge Institute for Science and Education

ORISE is managed for DOE by Oak Ridge Associated Universities. The ORISE mission is to develop people and solutions to strengthen our nation's competitive advantage in science. ORISE accomplishes its mission by recruiting and preparing the next generation of our nation's scientific workforce; promoting sound scientific and technical investment decisions through independent peer reviews; facilitating and preparing for the medical management of radiation incidents in the United States and abroad; evaluating health outcomes in workers exposed to chemical and radiological hazards on the job; and ensuring public confidence in environmental cleanup through independent

environmental assessments. ORISE creates opportunities for collaboration through partnerships with other DOE facilities, federal agencies, academia, and industry consistent with DOE objectives and the ORISE mission.

ORISE is located in an area on the southeastern border of ORR that was part of an agricultural experiment station owned by the federal government from the late 1940s to the mid-1980s. It was operated by the University of Tennessee until 1981. The site houses offices, laboratories, and storage areas for ORISE program offices and support departments.

1.4.7. National Nuclear Security Administration Office of Secure Transportation, Agent Operations Eastern Command

Beginning in 1947, DOE and its predecessor agencies moved nuclear weapons, weapons components, special nuclear materials, and other important national security assets by commercial and government modes of transportation. In the late 1960s, worldwide terrorism and acts of violence prompted a review of procedures for safeguarding these materials. As a result, a comprehensive new series of regulations and equipment was developed to enhance the safety and security of these materials in transit. Modified and redesigned transport equipment was created to incorporate features that more effectively enhance self-protection and deny unauthorized access to the materials. Also during this time, the use of commercial transportation systems was abandoned and a totally federal operation was implemented. The organization responsible for this mission within DOE NNSA is the Office of Secure Transportation, or OST.

The NNSA OST AOEC Secure Transportation Center and Training Facility is situated on about 723 hectares (1,786 acres) at ORR. It operates under a user permit agreement with the DOE Oak Ridge Office. NNSA OST AOEC performs its assigned mission transportation operations, maintains applicable fleet and escort vehicles, and continues extensive training activities for its federal agents.

1.4.8. Transuranic Waste Processing Center

The TWPC is located on an approximately 10.5-hectare (26-acre) tract of land in the Melton Valley area of ORNL about 120 feet west of the existing Melton Valley Storage Tanks. Management of this facility for DOE was transferred from North Wind Solutions, LLC to UCOR in October 2022. The TWPC's mission is to receive transuranic waste for processing, treatment, repackaging, and shipment to designated facilities for final disposal.

Transuranic waste consists of materials and debris that are contaminated with elements that have a higher atomic mass and are listed after uranium on the periodic table. The majority of Oak Ridge's inventory of transuranic materials originated from previous research and isotope production missions at ORNL. Waste determined to be non-transuranic (e.g., low-level radioactive waste or mixed low-level waste) is shipped to the Nevada National Security Site or other approved facilities. The TWPC has processed approximately 98 percent of the contact-handled transuranic waste and 98 percent of the remote-handled transuranic waste, and has also completed key regulatory milestones in the *Site Treatment Plan for Mixed Wastes on the US Department of Energy Oak Ridge Reservation* (TDEC 2020) on schedule.



Figure 1.12. Transuranic Waste Processing Center

Key progress for the project during 2022 included the following actions (UCOR 2022):

- TWPC continued certification and shipment of 59.3 m³ of transuranic waste to the Waste Isolation Pilot Plant, 58.5 m³ mixed low-level waste to treatment and disposal, and 2.7 m³ of hazardous waste to treatment and disposal, eliminating 475 containers of the stored inventory.
- Construction of the Sludge Processing Mock Test Facility was completed in June 2022. OREM has been working since 2003 to process, repackage, and ship Oak Ridge's inventory of transuranic debris waste for permanent disposal at the Waste Isolation Pilot Plant. With that processing nearing completion, OREM is now working to address the site's 400,000-gallon inventory of transuranic sludge waste.

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