1. Site and Operations Overview

The Oak Ridge Reservation (ORR), a government-owned, contractor-operated facility, contains three major operating sites: 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/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 450.1, "Environmental Protection Program." The results summarized in this report are based on data collected prior to and through 2005. 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. Corrections to the report for the previous year are found in Appendix A.

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 Description of Site Locale

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 13,401 hectares 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; 243 hectares west of the East Tennessee Technology Park (ETTP) are outside the city limits. The residential section of Oak Ridge forms the northern boundary of the reservation. The Tennessee Valley Authority's (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 ten-county region surrounding the ORR is about 884,960 with about 4% of its labor force employed on the reservation (Fig. 1.3). Other towns

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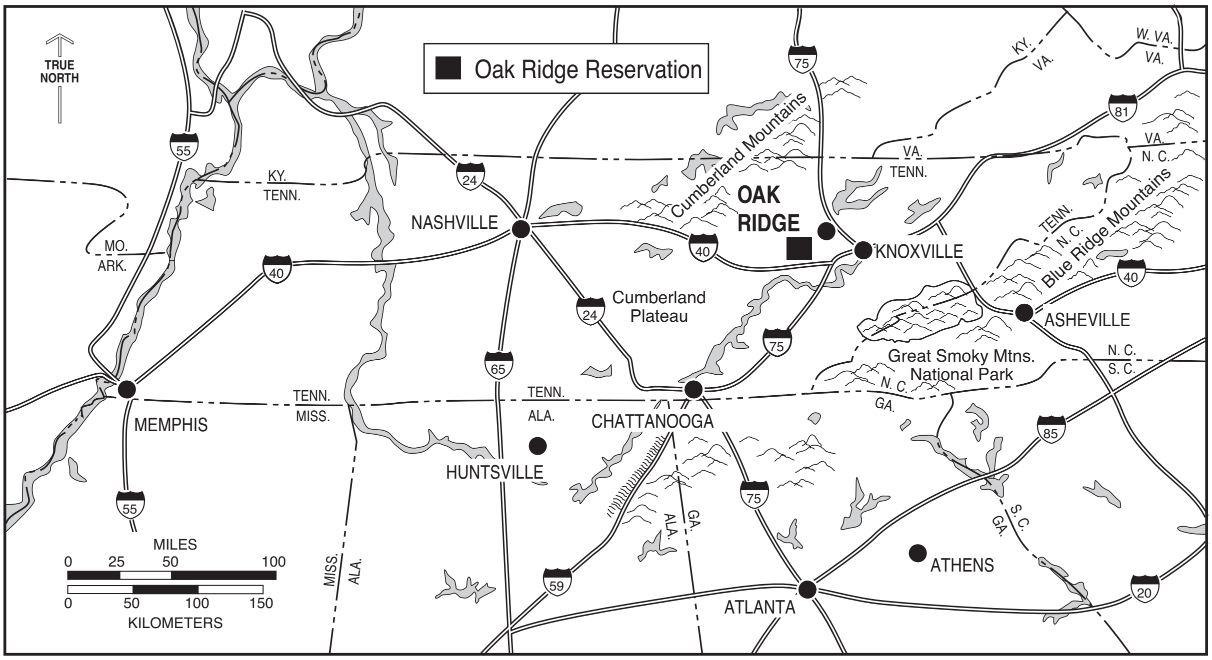

Fig. 1.1. Location of the city of Oak Ridge.

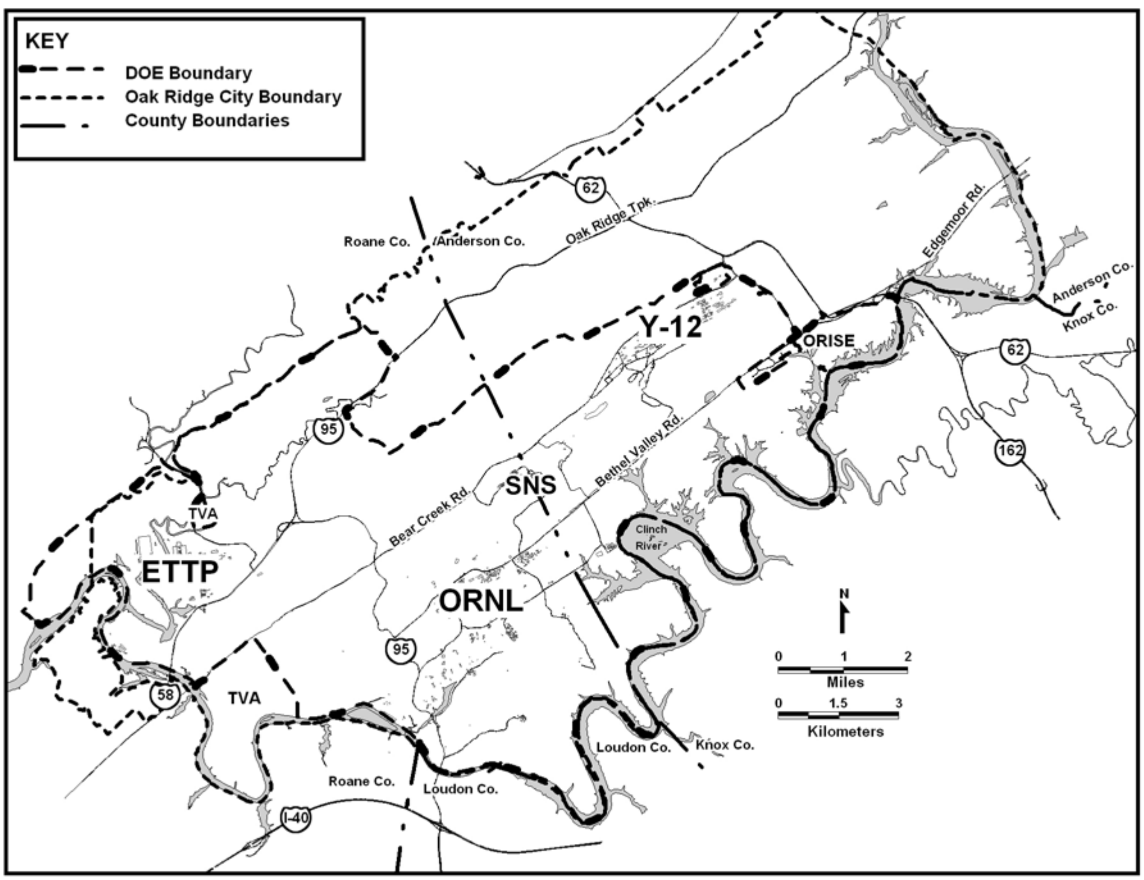

Fig. 1.2. The Oak Ridge Reservation.

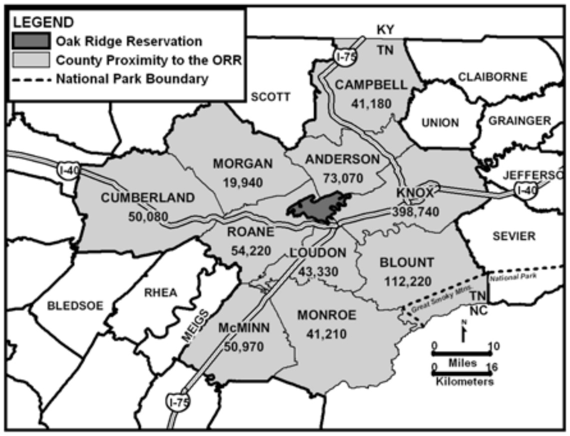

Fig. 1.3. The ten-county region surrounding the Oak Ridge Reservation (UTK 2006).

close to the reservation include Oliver Springs, Clinton, Karns, Lenoir City, Farragut, Kingston, and Harriman (Fig. 1.4).

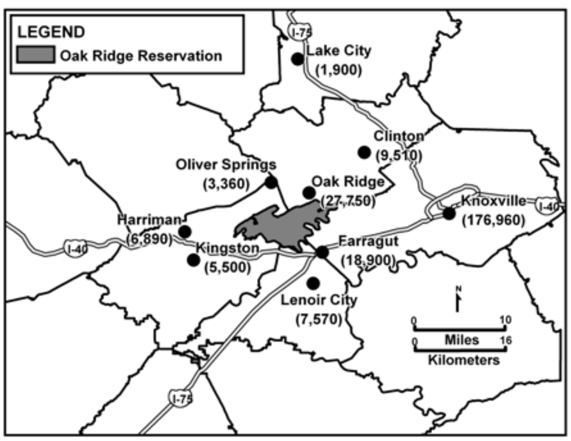

Fig. 1.4. Locations and populations of towns nearest to the Oak Ridge Reservation (UTK 2006).

Knoxville, the major metropolitan area nearest Oak Ridge, is located about 40 km to the east and has a population of about 176,960. 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 Climate

The climate of the Oak Ridge region may be broadly classified as humid subtropical. The term "humid" indicates that the region receives a surplus of precipitation compared to the level of evapotranspiration that is normally experienced throughout the year. The "subtropical" nature of the local climate indicates that the region experiences warm to hot summers and cool to cold winters. Such areas typically experience significant changes in temperatures between summer and winter.

Local winters are characterized by synoptic weather systems that often produce significant precipitation events every 3 to 5 days. Although infrequent, these wet periods may be followed by arctic air outbreaks. While snow and ice are not usually associated with these systems, there is an occasional snowfall each winter. Winter cloud cover tends to be enhanced by the region's terrain.

Severe thunderstorms are most frequent during spring, although the Cumberland Mountains and the Cumberland Plateau usually inhibit the intensity of severe systems that traverse the region. Summers are characterized by warm, humid conditions. Occasional frontal systems may produce organized lines of thunderstorms (and rare damaging tornados). More frequently, however, summer precipitation is due to "air mass" thundershowers that result from daytime heating and rising humid air. Although ample precipitation usually occurs during the fall, October tends to be the driest month of the year. The occurrence of precipitation during the fall tends to be less cyclic than during other seasons, although it may be occasionally enhanced by decaying tropical systems moving north from the Gulf of Mexico. During November, winter-type cyclones again begin to dominate the weather.

Terrain often exhibits a significant influence on local climate. Primarily, these effects result in seasonal changes to cloud cover, precipitation, air mass, and wind flow regimes. These effects vary with season.

1.3.1 Temperature

The mean annual temperature for the Oak Ridge area is 14.4°C (30-year average based on data from 1976 to 2005). The coldest month is typically January, with temperatures averaging about 2.3°C. However, the minimum temperature once dipped as low as –31°C (in 1985). July tends to be the warmest month of the year, with temperatures averaging 25.3°C and on rare occasions peaking as high as 37°C.

The 2005 average temperature measured at the official Oak Ridge meteorological tower (KOQT), near the DOE Oak Ridge Office (DOE-ORO) Headquarters, was 15.2°C and the mean difference between maximum and minimum daily temperatures averages 12.6° C. Over the last 30 years, decadal temperature averages have increased by 1.8°C in Oak Ridge. Summaries of normal and extreme temperature conditions for Oak Ridge can be found in greater detail in Appendix B, Table B.1, and specific information on the frequency of subfreezing temperatures is given in Appendix B, Table B.2.

Although average daily temperatures across the ORR are not significantly affected by the local terrain, noticeable differences do occur with respect to maximum and minimum temperatures. This can result in significant temperature variations with changes in elevation as small as 10 to 20 m. This type of phenomenon occurs most frequently during night time hours (especially near sunrise) but may also occur during the approach of large-scale low pressure areas as warm air advection interacts with the local ridge-and-valley terrain.

1.3.2 Winds

Complex terrain significantly affects wind patterns in Oak Ridge and its environs. These factors result primarily from the presence of the Cumberland Plateau, the Cumberland Mountains, the Great Smoky Mountains, the orientation axis of the Great Valley, and the local ridge-and-valley terrain structure. Although surface winds tend to follow the axes of the valleys, winds above the ridge-and-valley terrain (altitudes of 100 m or more) often blow from significantly different directions than the surface winds due to several wind "forcing" mechanisms created by regional terrain. A more detailed and important discussion on local wind regimes can be found in Appendix B.

Wind speeds at 10 m above the ground averaged 1.4 m/s at Oak Ridge National Laboratory (ORNL) Tower C during 2005 [1.3 m/s at Sites A (MT4), B (MT3), C (MT2), 1208 (MT1) , and 1209 (MT7) combined; see Fig. 7.1]. This value increases to about 3 m/s for winds at 100 m above the ground (about the height of local ridgetops). The presence of the ridge-and-valley terrain reduces average wind speeds at local valley bottoms sites. This results in frequent periods of near calm conditions (particularly during clear, early morning hours). During 2005, wind speeds less than 0.5 m/s occurred 10.6% of the time. Wind direction and speed frequencies for Tower C at 10, 30, and 100 m above the ground can be found in Appendix B (Figs. B.1 thru B.3).

Although Figs. B.1 through B.3 generally represent winds on the ORR, significant variation in wind direction and speed frequency occurs between some sites on it (depending on the specific site relationship to local terrain).

1.3.3 Precipitation

The 30-year annual average precipitation (1976–2005) is 1374.3 mm, including about 27.4 cm of snowfall (NOAA 2006). Total rainfall during 2005 measured at the Oak Ridge meteorological tower on Laboratory Road (near the DOE-ORO Headquarters) was 1146.2 mm. Snowfall measured only 2.5 cm. During 2005, Oak Ridge precipitation was 228.2 mm below normal. Monthly summaries of precipitation averages, extremes, and 2005 values can be found in Appendix B, Table B.1.

1.3.4 Evapotranspiration

Evapotranspiration is defined as the total amount of water that is transferred from the earth's surface to the atmosphere from surface water and ice and from the transpiration of plants (transpiration refers to the process through which water vapor is released by plants to the atmosphere). Regionally, annual evapotranspiration has been estimated to range from 81 to 89 cm, or 60 to 65% of rainfall (Farnsworth et al. 1982). More specifically, evapotranspiration in the Oak Ridge area has been estimated at 74 to 76 cm, or 55 to 56% of annual precipitation (TVA 1972, Moore 1988, and Hatcher et al. 1989).

Evapotranspiration is greatest during the growing season, which in the vicinity of the ORR encompasses about 220 days, from late March through mid-October. During the growing season, evapotranspiration may exceed the rate of precipitation, resulting in soil moisture deficits.

1.3.5 Mixing Heights

The mixing height (atmospheric layer nearest the earth's surface where active diffusion and mixing occur) varies significantly with respect to time of day, synoptic weather, season, and proximity to terrain. The depth of the surface mixing layer is usually correlated to atmospheric stability (the tendency of the atmosphere to mix vertically). Local ridge-and-valley terrain primarily affects stability through the reduction of surface winds, which tends to allow for the development of very stable surface layers (strong temperature inversions) at night, particularly under clear skies and light background winds. Hourly mixing height statistics for the ORR during 2005 are given in Appendix B, Table B.3. Data were derived primarily from hourly sonic detection and ranging (sodar) data (< 500 m) and from the National Weather Service Rapid Update Cycle forecast model initializations (> 500 m). The annual average mixing height for 2005 was 768 m (standard deviation 773 m).

1.3.6 Stability

Stability describes the tendency of the atmosphere to mix or overturn. Consequently, dispersion parameters are influenced by the stability characteristics of the atmosphere. Stability classes range from "A" (very unstable) to "G" (very stable). The "D" stability class represents a neutral state. The local ridge-and-valley terrain plays a role in the development of stable surface air under certain conditions and influences the dynamics of air flow.

Table B.4 in Appendix B shows the frequency of stability class by hour of the day for ORNL's Tower C during 2005. More than 54% of all hours during 2005 were categorized as stable (Categories E, F, and G). About 25% of the hours were characterized by unstable conditions (Categories A, B, and C).

1.3.7 Physiography

The ORR lies within the Valley and Ridge Physiographic Province, which has developed on thick, folded beds of sedimentary rock deposited during the Paleozoic era. The long axes of the folded beds control the shapes and orientations of a series of long, narrow parallel ridges and intervening valleys. These axes of the ridge-and-valley terrain within the ORR lie approximately along an east northeast–west southwest axis (60°–240°). The differing degrees of resistance to erosion of the shales, sandstones, and carbonate rocks comprised in the lithology determine local relief.

1.4 Regional Air Quality

The Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards has set National Ambient Air Quality Standards (NAAQSs) for key principal pollutants, which are called "criteria" pollutants. These pollutants are sulfur dioxide (SO_2), carbon monoxide (CO), carbon dioxide (CO_2), nitrogen dioxide (NO_2), lead (Pb), ozone (O_3), particulate matter with aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), and particles with an aerodynamic diameter less than or equal to 10 microns in diameter (PM_{10}). EPA evaluates NAAQS based on levels of ambient (outdoor) levels of the criteria pollutants. Areas that satisfy NAAQS are classified as attainment areas, and 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 that encompasses several counties. For all other criteria pollutants, for which EPA has made attainment designations, existing air quality in the greater Knoxville and Oak Ridge area is in attainment with the NAAQS.

1.5 Surface Water Setting

Waters drained 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 National Security Complex (Y-12 Complex) near the former S-3 Ponds and flows northeast along the south side of the Y-12 Complex. Various Y-12 Complex wastewater discharges to the upper reaches of East Fork Poplar Creek from the late 1940s to the early 1980s left a legacy of contamination [e.g., mercury, polychlorinated biphenyls (PCBs), uranium] that has been the subject of water quality improvement initiatives over the past 12 to 15 years. 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 stormwater 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 Oak Ridge National Laboratory (ORNL) are in the White Oak Creek drainage basin, which has an area of 16.5 km^2. 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 east 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.

1.6 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 Conasauga Group, both consisting of dolostone and limestone, constitute the Knox Aquifer. A combination of fractures and solution conduits in this 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 3784 L/min.

The remaining geologic units on the ORR (the Rome Formation, the Conasauga Group below the Maynardville Limestone, and the Chickamauga Group) constitute the ORR Aquitards, which consist mainly of siltstone, shale, sandstone, and thinly bedded limestone of low to very low permeability (Fig. 1.5). Nearly all groundwater flow in the ORR Aquitards occurs through fractures. The typical yield of a well in the ORR Aquitards is less than 3.8 L/min, and the base flows of streams draining areas underlain by the ORR Aquitards are poorly sustained because of such low flow rates.

1.6.1 Hydrogeological Setting

1.6.1.1 Groundwater Hydrology

A portion of the rainwater that falls on the land surface accumulates as groundwater by infiltrating into the subsurface. The accumulation of groundwater in pore spaces of sediments and bedrock creates sources of usable water; the water flows in response to external forces. Groundwater eventually reappears at the surface in springs, swamps, stream and river beds, and pumped wells. Thus, groundwater is a reservoir for which the primary input is recharge from infiltrating rainwater, and the output is discharged to springs, swamps, rivers, streams, and wells.

Because groundwater distribution and movement on the ORR are quite complex and are key components of the pollution potential of

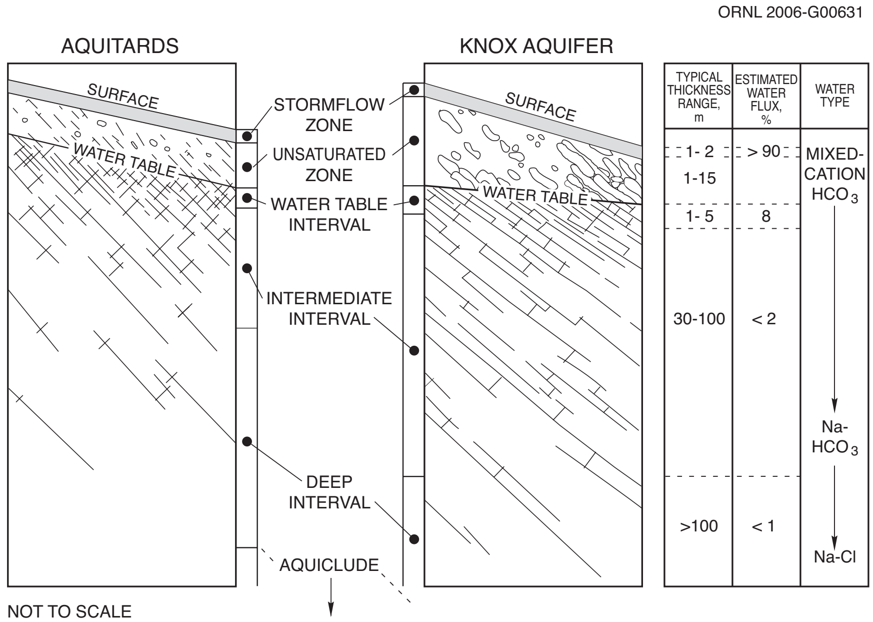

Fig. 1.5. Vertical relationships of flow zones of the ORR: estimated thicknesses, water flux, and water types.

the ORR, it is important to discuss some of the technical essentials necessary for understanding the role of groundwater in the overall existence and movement of contaminants on the reservation. Appendix C contains a glossary of technical terms that may be useful for clarifying some of the language used in this section.

Groundwater on the ORR occurs both in the unsaturated zone as transient, shallow subsurface stormflow and within the deeper saturated zone. An unsaturated zone of variable thickness separates the stormflow zone and water table. Adjacent to surface water features or in valley floors, the water table is found at shallow depths, and the unsaturated zone is thin. Along the ridgetops or near other high topographic areas, the unsaturated zone is thick, and the water table often lies at considerable depth (15 to 50 m deep). In low-lying areas where the water table occurs near the surface, the stormflow zone and saturated zone are indistinguishable.

Two broad hydrologic units are identified on the ORR: the Knox Aquifer, which includes the Maynardville Limestone and is highly permeable, and the ORR Aquitards, which consist of less permeable geologic units. The geologic regime referred to as the ORR Aquitards comprises bedrock and residuum of the Cambrian age Rome formation and Conasauga Group (excluding the Maynardville Limestone) and the Chickamauga Group. Bedrock included in these formations is predominantly clastic sediment (shales, siltstones, well-cemented sandstones, and argillaceous to silty limestones). The ORR Aquitards include local zones where groundwater occurs in quantities sufficient to provide a potential resource of limited use. These zones typically occur within karstic carbonate members of the clastic bedrock formations. Although marginal localized groundwater resources occur within the ORR Aquitards, these formations are far less important to regional water resources, including being a source of potable water for private and public water supply and a source of baseflow to regional surface water bodies, than is the Knox Aquifer. Figure 1.6 is a generalized map showing surface distribution of the Knox/Maynardville Aquifer and the ORR Aquitards. Many waste areas on the ORR are located in areas underlain by the ORR Aquitards.

Portions of the ORR underlain by carbonate bedrock commonly exhibit karst geomorphic features. About 60% of the ORR is underlain by carbonate-dominated bedrock. Karst geomorphic features form in carbonate-rich bedrock and are evident as sinkholes, solution caverns, and sinking creeks. In addition to creation of subsurface voids in bedrock, the weathering process leaves behind the insoluble mineral components of the rock that combine with organic residues of de

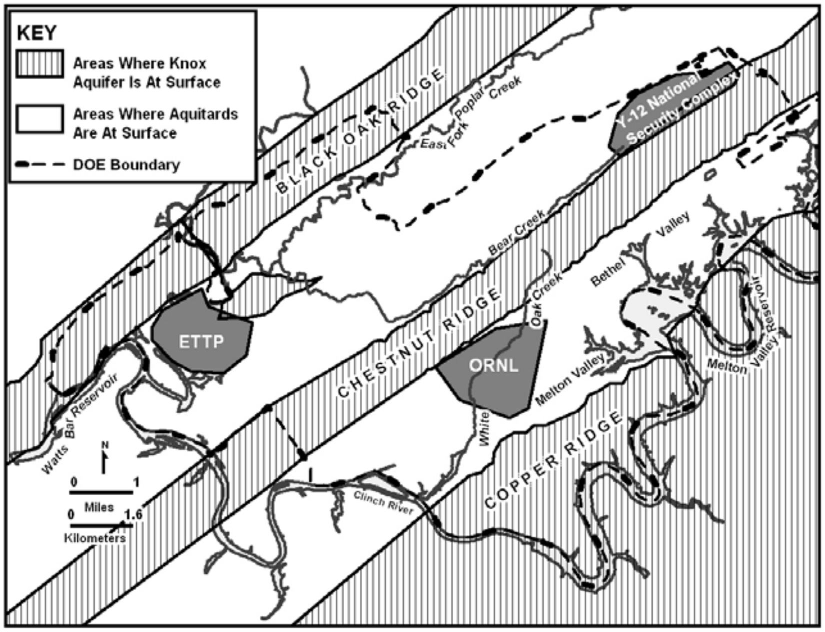

Fig. 1.6. The Knox Aquifer and the ORR Aquitards on the Oak Ridge Reservation.

caying plant materials to form a soil mantle over most of the ORR. The soil mantle forms a physical and geochemical filter that reduces the direct infiltration of rainfall and contaminants into the groundwater system. Geochemical retardation of contaminants in the soil mantle reduces the mobility of many types of contaminants. Groundwater flow in most of the carbonates is quite different from flow in porous media, where advective flow conditions largely govern flow and solute transport. Groundwater flow in karst terranes manifests itself in multiple scales of porosity, such as diffusion in intergranular pores of weathered or inherently porous bedrock, flow by seepage in rock fractures with water and rock matrix interaction on fracture surfaces, or flow in conduits where rapid velocities limit the interaction between the water and bedrock. Groundwater discharge from springs and seeps is abundant on the ORR and accounts for the normal baseflow of natural stream systems in the area. Most recharge to the groundwater system occurs through dispersed percolation of rainwater through the soil mantle and via capture in surface dolines during the winter and early spring months, when evapotranspiration losses of soil moisture are negligible. Groundwater storage in thick soil profiles and in the weathered bedrock zone of the Knox Group outcrop areas such as Blackoak, Chestnut, and Copper Ridges provides most of the dry season baseflow and feeds the area’s largest springs. Most groundwater flow in the carbonate bedrock groundwater basins on the ORR originates as intergranular or fracture seepage through the soil mantle, and flow progresses through coalescing networks of conduits that culminate at spring discharges. Baseflow springs often occur near major geologic outcrop boundaries, where semiconfining bedrock lithologies tend to limit the orientation of conduit development and promote upward flow of groundwater to discharge at the land surface. In portions of the ORR underlain by shale-rich bedrock, such as the Conasauga Group bedrock of Bear Creek Valley and Melton Valley, groundwater seepage is typically through fractures in weathered bedrock with discharge to nearby streams. Discrete baseflow springs are not common in the shale-dominated outcrop areas; however, small seeps are abundant.

1.6.1.2 Unsaturated Zone Hydrology

Terrain at the ORR is hilly with slopes that average about 7.5% and that range from less than 3% to more than 50%. Because ORR landforms consist almost entirely of sloping land surfaces, the concepts of hillslope hydrology are appropriate to describe the active hydrologic process. Based on soil percolation capacity and soil structure, as well as direct measurement of water transmission in soil test areas, it is estimated that in undisturbed, naturally vegetated areas on the ORR, about 90% of the infiltrating precipitation does not reach the water table but travels through the 1- to 2-m stormflow zone, which approximately corresponds to the root zone. This condition exists because of the permeability contrast between the shallow stormflow zone and the underlying unsaturated zone.

Recharge of the groundwater system is strongly seasonal at the ORR, and percolation processes in the shallow soil are moderated by the amount of soil moisture present. During the active growing season (April through October) moisture evapotranspiration by plants removes moisture from the soil within the root zone. When soil moisture levels are low, any percolating rainwater is absorbed in the root zone to replenish the soil moisture deficit. During that phase little or no water reaches the water table. When rainfall amounts exceed any existing soil moisture deficits and saturation of the shallow soils begins to occur, seepage of water begins. When saturation of the shallow soils occurs on sloping land, the downslope gradient allows lateral drainage of water through macropores (e.g., holes left by decay of dead plant roots, animal burrows) as well as vertical seepage to the water table through pervious zones. During the nongrowing season (November through March), there is little evapotranspiration to remove water from the root zone, and saturation of the shallow soils occurs more rapidly than during the summer months. Typical evapotranspiration losses from the root zone range from a low of about 0.01 in./day rainfall equivalent during January and February to a high of about 0.16 in./day rainfall equivalent during July. Thus, development of a 1-in. water deficit would require only a week without rainfall during July but would require over two months without rainfall during the winter.

The amount of water that actually recharges the groundwater zone is highly variable across the ORR, depending on shallow soil characteristics, permeability and degree of fracturing of regolith beneath the surface soils, presence of dolines that capture stormflow and focus recharge in small areas, and the presence of paved or covered areas, where little or no rainfall infiltration occurs. Higher recharge is expected in areas of karst hydrogeology such as the Knox Aquifer because of internal drainage through dolines than in areas underlain by the clastic bedrock formations.

1.6.1.3 Saturated Zone Hydrology

As shown in Fig. 1.5, the saturated zone on the ORR can be divided conceptually into four flow zones in a vertical cross section: an uppermost water table interval, an intermediate interval, a deep interval, and an aquiclude. The presence and thickness of any zone may vary across the ORR. Available evidence indicates that most water in the saturated zone in the ORR Aquitards is transmitted through a 1- to 6-m layer of closely spaced, well-connected fractures near the water table (the water table interval) as shown in Fig. 1.7.

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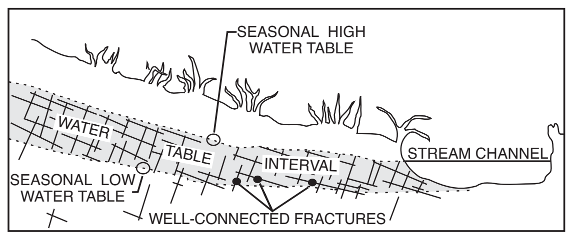

Fig. 1.7. Water table interval.

As in the stormflow zone, the bulk of groundwater in the saturated zone resides within the pore spaces of the rock matrix. The rock matrix typically forms blocks that are bounded by fractures. Contaminants migrating from sources by way of the fractures typically occur in higher concentrations than in the matrix; thus, the contaminants tend to move (diffuse) into the matrix. This process, termed “diffusive exchange” or “matrix diffusion,” between water in matrix pores and water in adjacent fractures reduces the overall contaminant migration rates relative to groundwater flow velocities. For example, the leading edge of a geochemically nonreactive contaminant mass such as tritium (3H) may migrate along fractures at a typical rate of 1 m/day; however, the center of mass of a contaminant plume typically migrates at a rate less than 0.66 m/day

In the ORR Aquitards, chemical characteristics of groundwater change from a mixed-cation-HCO_3 water type at shallow depth to an Na-

HCO_3 water type at deeper levels (30.5 m). This transition, not marked by a distinct change in rock properties, serves as a useful marker and can be used to distinguish the more active water table and intermediate groundwater intervals from the sluggish flow of the deep interval. There is no evidence of similar change with depth in the chemical characteristics of water in the Knox Aquifer; virtually all wells are within the monitoring regime of Ca-Mg-HCO_3 type water. Although the mechanism responsible for this change in water types is not quantified, it most likely is related to the amount of time that the water is in contact with a specific type of rock.

Most groundwater flow in the saturated zone occurs within the water table interval. Most flow is through weathered, permeable fractures and matrix rock and within solution conduits in the Knox Aquifer. The range of seasonal fluctuations of water table depth and rates of groundwater flow vary significantly across the reservation. In areas underlain by the Knox Aquifer, seasonal fluctuations in water levels average 5.3 m, and mean discharge from the active groundwater zone is typically 322 L/min per 2.6 km^2. In the ORR Aquitards of Bear Creek Valley, Melton Valley, East Fork Valley, and Bethel Valley, seasonal fluctuations in water levels average 1.5 m, and typical mean discharge is 98 L/min per 2.6 km^2.

In the intermediate interval, groundwater flow paths are products of fracture density and orientation. Groundwater movement occurs primarily in permeable fractures that are poorly connected. In the Knox Aquifer, a few cavity systems and fractures control groundwater movement in this zone, but in the ORR Aquitards, the bulk of flow is through fractures, along which permeability may be increased by weathering.

The deep interval of the saturated zone is delineated by a change to an Na-Cl water type. Hydrologically active fractures in the deep interval are significantly fewer and shorter than in the other intervals, and the spacing is greater. Wells finished in the deep interval of the ORR aquitards typically yield less than 1.1 L/min and thus are barely adequate for water supply.

In the ORR Aquitards, saline water characterized by total dissolved solids ranging up to 275,000 mg/L and chlorides generally in excess of 50,000 mg/L (ranging up to 163,000 mg/L) lies beneath the deep interval of the groundwater zone, delineating an aquiclude. Chemically, this water resembles brines typical of major sedimentary basins, which originated from evaporating water bodies. The brines are thought to have been pushed westward and trapped by overthrusting rock during the formation of the Appalachian Mountains (about 250 million years ago). The chemistry suggests extremely long residence times (i.e., very low flow rates); however, some mixing with shallow groundwater has been observed (Nativ, Halleran, and Hunley 1997).

The aquiclude has been encountered at depths of 122 and 244 m in Melton and Bethel Valleys, respectively (near ORNL), and it is believed to approach 305 m in portions of Bear Creek Valley (near the Y-12 Complex) underlain by aquitard formations. The depth to the aquiclude in areas of the Knox Aquifer is not known but is believed to be greater than 366 m. The depth to the aquiclude has not been established in the vicinity of the ETTP.

1.6.2 Groundwater Flow

Many factors influence groundwater flow on the ORR. Topography, surface cover, geologic structure, karst features (see Sect.1.6.1.1), and rock type exhibit especially strong influences on the hydrogeology. Variations in these features result in variations of the total amount of groundwater moving through the system (flux). (Average flux ratios for the ORR Aquitards and the Knox Aquifer formations are shown in Fig. 1.5.) As an example, the overall decrease in open fracture density with depth results in a decreased groundwater flux with depth.

Topographic relief on the ORR is such that most active subsurface groundwater flow occurs at shallow depths. U.S. Geological Survey modeling (Tucci 1992) suggests that 95% of all groundwater flow occurs in the upper 15 to 30 m of the saturated zone in the ORR Aquitards. As a result, flow paths in the active-flow zones (particularly in the aquitards) are relatively short, and nearly all groundwater discharges to local surface water drainages on the ORR. Conversely, in the Knox Aquifer it is believed that solution conduit flow paths may be considerably longer, perhaps as much as 1.6 km long in the along-strike direction. No evidence at this time substantiates the existence of any deep, regional flow off the ORR or between basins within the ORR in either the Knox Aquifer or the ORR Aquitards. Data collected in calendar year (CY) 1994 and CY 1995, however, have demonstrated that groundwater flow and contaminant transport occur off the ORR in the intermediate interval of the Knox Aquifer, near the east end of the Y-12 Complex.

Migration rates of contaminants transported in groundwater are strongly influenced by natural chemical and physical processes in the subsurface (including diffusion and adsorption). Peak concentrations of solutes, including contaminants such as tritium moving from a waste area, for instance, can be delayed for several to many decades in the ORR Aquitards, even along flow paths as short as a few hundred feet. The processes that naturally retard contaminant migration and store contaminants in the subsurface are less effective in the Knox Aquifer than in the ORR Aquitards because rapid flow along solution features allows minimal time for diffusion to occur.

1.6.3 Groundwater Monitoring Considerations

The groundwater monitoring programs on the ORR were designed to gather information to determine the effects of past and present DOE operations on groundwater quality. Because of the complexity of the hydrogeologic framework on the ORR, groundwater flow, and, therefore, contaminant transport are difficult to predict on a local scale. Also, detailed delineation of groundwater contaminant plumes is not always feasible. Monitoring wells and piezometers are used to perform ongoing surveillance and characterization of groundwater flow and quality. Since stormflow and most groundwater discharge to ORR surface water drainages, springs, and seeps, these features are monitored for water quality to assess the extent to which groundwater from a large portion of the ORR transports contaminants.

1.6.3.1 Groundwater Monitoring Programs on the ORR

Groundwater monitoring programs at each of the major ORR facilities are discussed in the facility-specific chapters: Sect. 4.9 for the ETTP, Sect. 5.11 for ORNL, and Sect. 6.10 for the Y-12 Complex.

1.7 Description of Site Facilities and Operations

1.7.1 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 23,600-hectare site, known during the war years as Clinton Engineering Works, 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 TVA could supply the huge amounts of electricity needed. About 3000 residents received court orders to vacate the homes and farms that their families had occupied for generations.

The workers’ city, named Oak Ridge, was established on the reservation’s northern edge. The ”Secret City” grew to a population of 75,000, used one-seventh of the electrical power generated in the country at the time, and was the fifth-largest city in Tennessee; however; it was not shown on any map. At the Y-12 Plant, south of the city, an electromagnetic method was used to separate fissionable isotopes of uranium (^{235}U) from natural uranium. At its peak operation, the Y-12 Plant 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. Operated by 12,000 workers, the K-25 Plant separated ^{235}U from ^{238}U. Near the reservation’s southwest corner, about 10 miles (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 1500 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 reservation contains three major DOE installations: the Y-12 National Security Complex (former Y-12 Plant), ORNL (former X-10 site), and ETTP (former K-25 site). DOE also operates a number of facilities in addition to the major installation sites.

1.7.2 The Y-12 National Security Complex

The Y-12 National Security Complex (Y-12 Complex) (Fig. 1.8), operated by BWXT Y-12 for the National Nuclear Security Administration (NNSA) within DOE, is a one-of-a-kind manufacturing facility that plays an important role in the U.S. national security and is dedicated to making our nation and the world a safer place. With more than 60 years of experience to draw from, Y-12 is uniquely qualified to address the existing and emerging security challenges facing our nation and the world today. Today Y-12's roles include

- providing critical elements of NNSA's missions that ensure the safety, reliability, and performance of the U.S. nuclear weapons deterrent;
- supplying the special nuclear material for use in naval reactors;
- promoting international nuclear safety and nonproliferation;
- reducing global dangers from weapons of mass destruction; and
- supporting U.S. leadership in science and technology.

Presently, the Y-12 Complex is pursuing an aggressive program of infrastructure reduction, modernization, and investment in technology to make the site as safe and efficient as possible and to improve production capabilities. The *Y-12 National Security Complex Ten-Year Comprehensive Site Plan* (Y-12 2005) outlines the new construction, recapitalization, maintenance requirements, and excess facility demolition required to modernize the Y-12 Complex. The Y-12 Complex is making all these improvements while maintaining safety, security, and environmental stewardship as its highest priorities.

1.7.3 East Tennessee Technology Park

The ETTP was built as the home of the Oak Ridge Gaseous Diffusion Plant (ORGDP) (Fig. 1.9). The plant's original mission was production of highly enriched uranium for nuclear weapons.

Enrichment was initially carried out in two process buildings, K-25 and K-27. Later, the K-29, K-31, and K-33 buildings were built to increase the production capacity of the original facilities by raising the assay of the feed material entering K-27. After military production of highly enriched uranium was concluded in 1964, the two original process buildings were shut down. For the next 20 years, the plant's primary missions were production of only slightly enriched uranium to be fabricated into fuel elements for nuclear reactors and the recycling of fuel elements from nuclear reactors. Other missions during the latter part of this 20-year period included development and testing of the gas centrifuge method of uranium enrichment and the laser isotope separation research and development (R&D).

By 1985, demand for enriched uranium had declined, and the gaseous diffusion cascades at ORGDP were placed in standby mode. That same year, the gas centrifuge program was canceled. The decision to permanently shut down the diffusion cascades was announced in late 1987, and actions necessary to implement that decision were initiated soon thereafter. Because of the termination of the original and primary missions, ORGDP was renamed the "Oak Ridge K-25 Site" in 1990. In 1997, the K-25 Site was named the "East Tennessee Technology Park" to reflect its new mission.

DOE's long-term goal for ETTP is to convert the site into a private industrial park. The site is undergoing environmental cleanup, which is now expected to be completed on an accelerated schedule. The new accelerated closure plan will achieve cleanup several years ahead of the original plan, and thereby will reduce environmental and safety risks more quickly and will

Y-12 PHOTO 306208

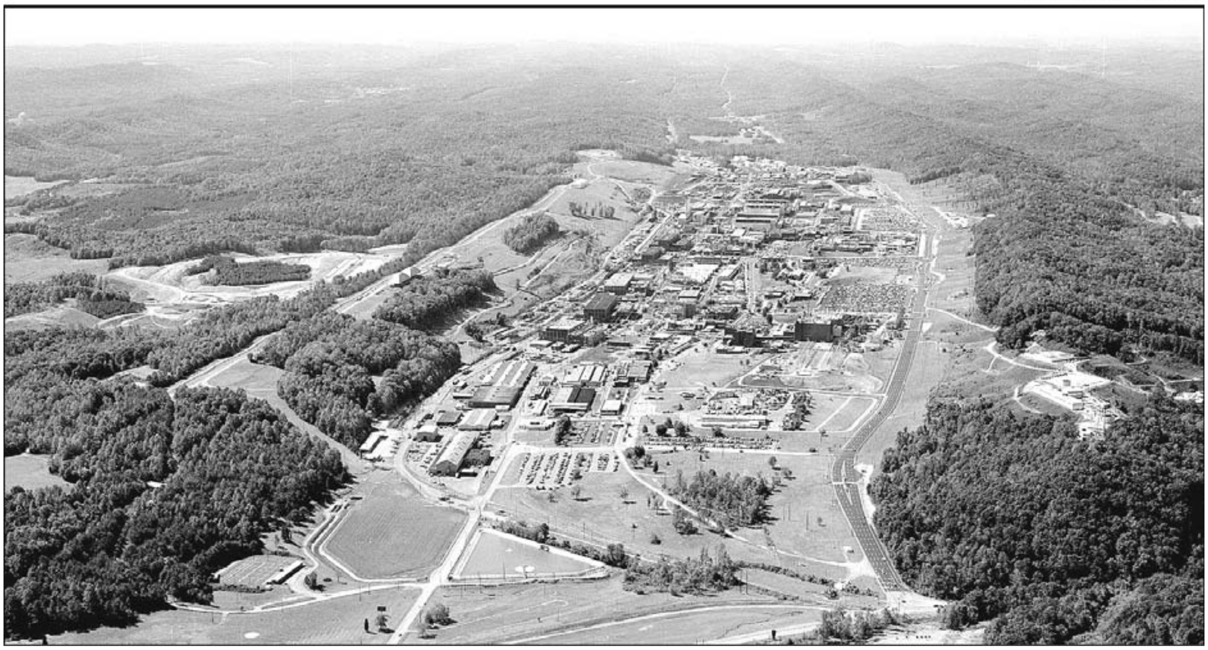

Fig. 1.8. The Y-12 National Security Complex.

ORNL 1439-2005

Fig. 1.9. The East Tennessee Technology Park.

reduce long-term maintenance costs. The reuse of key site facilities through title transfer is part of the closure plan for the site. The accelerated cleanup approach makes land and various types of buildings (e.g., office, manufacturing) suitable for private industrial use and suitable for title transfer to the Community Reuse Organization of East Tennessee (CROET) or other entities, such as the city of Oak Ridge. The facilities may then be subleased or sold, with the goal of stimulating private industry and recruiting business to the area.

The ETTP mission is to reindustrialize and reuse site assets through leasing of excess or underutilized land and facilities and incorporation of commercial industrial organizations as partners in the ongoing environmental restoration, decontamination and decommissioning, and waste treatment and disposal. During 2005, four office buildings were transferred from DOE ownership to CROET. Similar to the CROET leasing process for federally owned facilities, CROET also subleases transferred facilities.

George Jones Memorial Baptist Church, commonly called the Wheat Church (part of the early Wheat Community), located within the ETTP, predates World War II and is included in the *National Register of Historic Places* (National Park Service 2003).

1.7.4 Oak Ridge National Laboratory

ORNL is DOE's largest science and energy laboratory (Fig. 1.10). Managed since April 2000 by a partnership of the University of Tennessee and Battelle, ORNL was established in 1943 as a part of the secret Manhattan Project to pioneer a method for producing and separating plutonium. ORNL's involvement with nuclear weapons ended after the war, and the laboratory's scientific expertise shifted in the 1950s and 1960s to peacetime research in medicine, biology, materials and physics. The Graphite Reactor evolved from a wartime role to produce the world's first medical radioisotopes for treating cancer. Following the creation of DOE in 1977, ORNL's mission broadened to include research in energy production, transmission, and consumption. The end of the Cold War and the growth of international terrorism led to a further expansion of research into a range of national security technologies. As the laboratory entered the twenty-first century, new cross-disciplinary programs in nanophase materials, computational sciences, and biology led to the term "nano-info-bio" to describe the emerging synthesis in ORNL's research agenda. As ORNL's missions have changed over the years to meet the nation's priorities and needs, the laboratory's underpinning standards in science and public service have remained.

ORNL supports DOE ORO in its responsibilities for land use planning, land management activities, and natural resource management for the ORR. ORNL also coordinates research and its associated operational and maintenance activities within the National Environmental Research Park.

The SNS site is located on approximately 35 hectares of Chestnut Ridge near ORNL. The SNS, an accelerator-based neutron source, is currently operating at low power, and will provide neutron beams with up to ten times more intensity than any other such source in the world. Construction began in 1999 and was completed in May, 2006 at a total cost of $1.4 billion. Design and construction was performed by a partnership of six DOE national laboratories (Argonne, Brookhaven, Jefferson, Lawrence Berkeley, Los Alamos, and Oak Ridge). At present, limited operational experiments are being conducted at the SNS. Once the SNS reaches full power in 2008–2009, it will attract scientists and engineers from universities, industries, and government laboratories in the United States and abroad.

1.7.5 Oak Ridge National Environmental Research Park

In 1980, DOE established the Oak Ridge National Environmental Research Park (Fig. 1.11). Consisting of about 8,094 hectares, 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 these 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. In fiscal year (FY) 2005 almost $10 million was spent on DOE-supported environmental field-based research directly dependent on the ORR land base. This expenditure is independent of construction of new facilities such as the SNS. The Office of Science considers the research and science value of the ORR to be critical and provides primary operations funding. The Oak Ridge Research Park is one of the few sites in the nation where large-scale eco-

ORNL 5753-2005A

Fig. 1.10. The Oak Ridge National Laboratory.

ORNL 2006-G00633

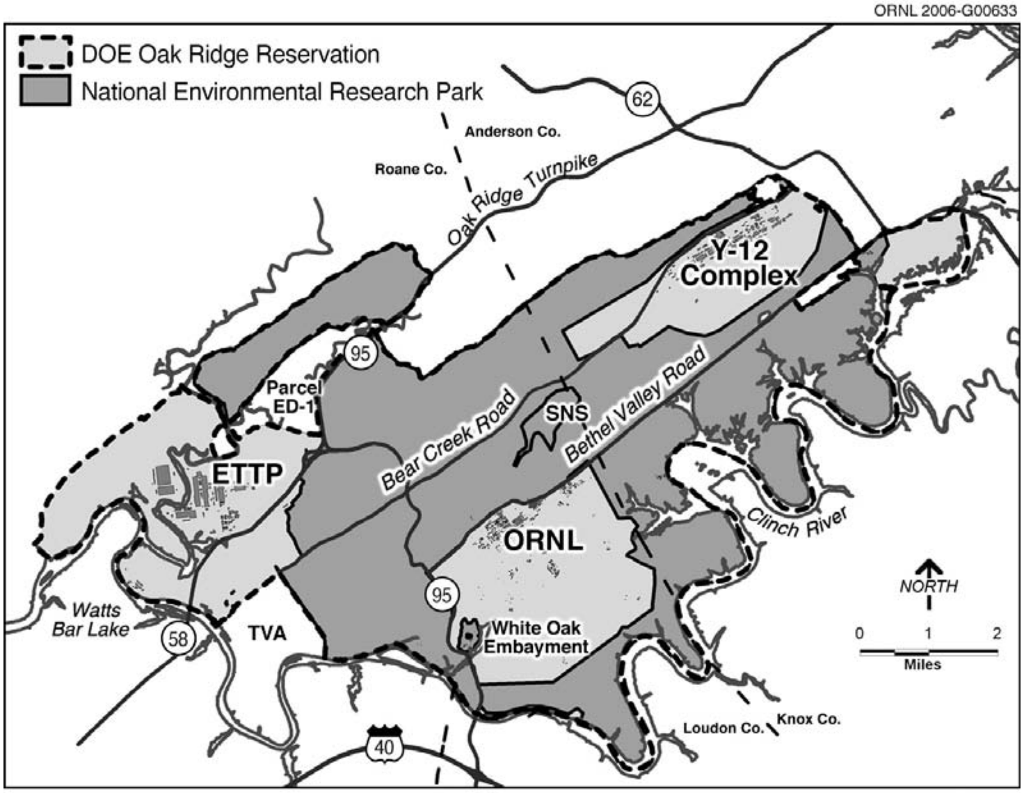

Fig. 1.11. The Oak Ridge National Environmental Research Park covers about 8,094 hectares (about 20,000 acres) on the reservation.

logical research, environmental technology, and measurement science are integrated with 40 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.

The Oak Ridge National Environmental Research Park is a DOE national user facility that has attracted more than 1200 users from ORNL, 150 colleges, universities, industries, and other state and federal agencies over the past 5 years. The 270 users during 2005 represented 50 organizations, including educational institutions, state and federal agencies, and others.

1.7.6 Oak Ridge Institute for Science and Education

The Oak Ridge Institute for Science and Education (ORISE) is managed for DOE by Oak Ridge Associated Universities (ORAU), a nonprofit consortium of 91 doctoral-granting members and 10 associate members. ORISE includes 94 hectares 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 (UT).

The ORISE South Campus lies immediately southeast of the intersection of Bethel Valley Road and Pumphouse Road. 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.

For more information, visit the ORAU home page at http://www.orau.org and the ORISE home page at http://www.orau.gov/orise.htm.

1.7.7 Other Sites

DOE operates a number of facilities in addition to the major installation sites. They are described in the following sections. Two sites formerly operated by DOE, the Water Intake Station, located at Solway Bend, and the Water Treatment Plant, located on Pine Ridge just north of the Y-12 Complex, were transferred to the city of Oak Ridge on April 1, 2000.

1.7.7.1 American Museum of Science and Energy

The American Museum of Science and Energy occupies a 7-hectare (17.3-acre) site contiguous to the ORAU campus, on South Tulane Avenue in Oak Ridge. In 1975, the American Museum of Science and Energy was moved from its previous facility (55–59 Jefferson Circle) to a masonry structure with about 53,000 ft^2. In addition to the main museum facility, the site contains the Energy House which is licensed to the city of Oak Ridge for use by the Convention and Visitors' Bureau. The museum also has warehouse space in the Office of Scientific and Technical Information (OSTI) Building 1916T-2 complex. The museum is managed by UT-Battelle.

1.7.7.2 Atmospheric Turbulence and Diffusion Division—National Oceanic and Atmospheric Administration Facility

The Atmospheric Turbulence and Diffusion Division—National Oceanic and Atmospheric Administration (ATDD-NOAA) Facility is composed of a wood-frame building built in the 1940s and several smaller buildings at 456 South Illinois Avenue in Oak Ridge. ATDD conducts meteorological and atmospheric diffusion research that is jointly supported by DOE and NOAA. It also provides services to other DOE contractors and operates the Weather Instrument Telemetering Monitoring System for DOE.

1.7.7.3 Buildings 2714 and 2715

Building 2714 (the "Laboratory Road Facility") and Building 2715 are DOE-owned facilities that DOE shares with ORISE. The facilities are used for general offices and hands-on, laboratory-based training in the areas of radiation safety (health physics). The ORISE-occupied facilities comprise about 25,477 ft^2 and are located in Oak Ridge immediately south of the Federal Office Building.

1.7.7.4 Central Training Facility

The Central Training Facility, used primarily by security forces, consists of a small office building, an indoor firing range, two classroom/storage trailers, on-site parking, fitness facilities (an outdoor track), and numerous outdoor firing ranges. The site, including a buffer area, is south of Bear Creek Road, less than 1.6 km southeast of ETTP, and currently occupies about 61 hectares (about 151 acres).

1.7.7.5 Checking Stations

Three checking stations (gatehouses), which are DOE-ORO properties, are included in the *National Register of Historic Places* (National Park Service 2003): (1) the Oak Ridge Turnpike Checking Station (Turnpike Checking Station), (2) the Scarboro Road Checking Station (Midway Checking Station), and (3) the Bethel Valley Road Checking Station. Although these structures are listed as checking stations in the *National Register*, they were originally called “gatehouses.” The main building of the Bethel Valley Road Checking Station is located on a parcel of land that was transferred to the city of Oak Ridge. However, the small associated block building just opposite the main structure is still owned by DOE-ORO.

1.7.7.6 Clark Center Recreation Park

Clark Center Recreation Park, an area containing about 32 hectares, is currently being used for recreational park purposes and is available to DOE and its contractor personnel and to the public on a limited basis. The area lies within landholding under the jurisdictional control of DOE and is managed by DOE.

1.7.7.7 DOE Information Center

The DOE Information Center, located at 475 Oak Ridge Turnpike, provides centralized public access to DOE documents and information. The Information Center consolidates Freedom of Information Act documents that were previously available at the DOE Public Reading Room and information about the DOE Environmental Management (EM) Program that was previously located at the Information Resource Center. The building, which is leased to DOE by R&R Rental Properties, has about 8000 ft^2 of space and provides public meeting rooms and office space for the Oak Ridge Site Specific Advisory Board.

1.7.7.8 Federal Office Building

The Federal Office Building, located in Oak Ridge and owned by the General Services Administration, is maintained by DOE. DOE-ORO offices occupy the vast majority of the 113,000 ft^2 of space in the building.

1.7.7.9 National Transportation Research Center

The National Transportation Research Center (NTRC), an alliance among ORNL, UT, the DOE, NTRC, Inc., and the Development Corporation of Knox County is the site of activities that span the whole range of transportation research. The center is an 85,000-ft^2 building, located on a 2.4-hectare site in the Pellissippi Corporate Center and is leased to ORNL and UT separately by Pellissippi Investors LLC.

1.7.7.10 Office of Scientific and Technical Information

The Office of Science and Technical Information (OSTI) is located in Buildings 1916T-1 and 1916T-2, two masonry buildings constructed as warehouses in the 1940s. Building 1916T-1 houses the main OSTI functions as well as other occupants. Portions of it were converted to office space in the 1950s, and additional bays were added in the 1950s and 1960s. Currently, the building has one office bay and seven other bays, for a total space of 135,000 ft^2.Building 1916T-2 houses DOE-ORO operations, including warehousing and maintenance staff. The two DOE buildings are located on an about 3-hectare tract that parallels the Oak Ridge Turnpike about 3.2 km east of the Federal Office Building. Because of their age and configuration, they are classified as Class B buildings (i.e., semipermanent buildings, constructed primarily of wood, which may need to be renewed, renovated, or rehabilitated in the near future) but are deemed adequate for current functions.

1.7.7.11 The Horizon Center

The Horizon Center (previously known as ED-1), was leased to CROET, effective April 28, 1998, and 198 hectares were transferred (by quit claim deed) to CROET in April 2003. The developable portions of the parcel were transferred. The other portions (the natural area that surrounds the East Fork Poplar Creek floodplain and other locations), remain part of the CROET leasehold. CROET may sublease the land transferred to it or may sell it to others for purposes of economic development. CROET is responsible for the protection and maintenance of all portions of the property.

1.7.7.12 Parcel ED-2

Parcel ED-2, which includes the K-1252 barge facility and an adjacent laydown/access area, is about 4 hectares in size. ED-2 is located in the K-700 area west of the main ETTP site, and it has been leased to CROET. CROET has changed its long-range plan for the barge facility and adjoining property. The current plan recognizes the advent of Rarity Ridge, a residential community across the river from the barge facility. CROET wishes to ensure that future use and further development of the peninsula would be achieved in a manner compatible with this evolving residential community and will be in contact with Rarity Ridge as plans for the barge area are identified.

1.7.7.13 Office of Secure Transportation Firing Range

The Office of Secure Transportation Firing Range, located to the east of the Central Training Facility, is operated by the NNSA Albuquerque Service Center. The surface danger zones for the Central Training Facility and the Office of Secure Transportation Firing Range overlap and together comprise about 1012 hectares.

1.7.7.14 Office of Secure Transportation Vehicle Maintenance Facility

The Office of Secure Transportation Vehicle Maintenance Facility is located on an 8-hectare site about 1.6 km east of ETTP, on the south side of State Route 58 (Oak Ridge Turnpike), near the intersection with Blair Road. The building has undergone major modifications, including the addition of security fencing, paved parking, and paved access around the building. The total site area constitutes about 40 hectares. The facility is maintained by the Y-12 Complex's Facilities, Infrastructure, and Services Organization and is funded by the NNSA Albuquerque Service Center.

1.7.7.15 Union Valley Facility

The Union Valley Facility, located on Union Valley Road, is a leased facility operated by the Y-12 Analytical Chemistry Organization. Analytical Chemistry provides a wide range of routine and nonroutine analytical services for environmental and hazardous waste programs of NNSA, DOE, and other customers.

1.7.7.16 Vance Road Facility

The DOE-owned Vance Road Facility is operated by ORISE. The 59,800 ft^2 building is located in the middle of the Oak Ridge Methodist Medical Center complex. ORISE vacated this building before June 30, 2005, to allow DOE to make it available for community reuse. A Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA) 120h report was approved by the Tennessee Department of Environment and Conservation (TDEC), and the transfer for community reuse has been completed.

1.7.7.17 Transuranic Waste Processing Center

The TRU Waste Processing Center (TWPC), managed by Foster-Wheeler Environmental Company, LLC, is located at 100 Wipp Road, in Lenoir City, Tennessee. The site is located on about 2 hectares of leased land adjacent to the

Melton Valley Storage Tanks, along SR-95 on the western boundary of ORNL.

The TWPC's mission is to receive current inventories of retrievably-stored and legacy transuranic (TRU) wastes and future wastes to be generated from decontamination and decommissioning, remediation, and ongoing mission operations at the ORNL complex. TWPC processes, treats, repackages and ships the waste for final disposal at the Waste Isolation Pilot Plant (WIPP), Nevada Test Site, or any other designated disposal facility. The TWPC is the only facility of its type in the region specifically designed to accomplish this mission. Low-level radioactive waste, and low-level mixed wastes generated as by-products of TRU process operations are also processed for shipment to the Nevada Test Site or other appropriate disposal facility.

The TWPC consists of the Waste Processing Facility, the Contact-Handled Staging Area, the Personnel Building, and numerous support buildings and storage areas. The TWPC began processing supernatant liquid from the Melton Valley Storage Tanks in 2002, and contact-handled solids in December 2005.