5. Oak Ridge National Laboratory

ORNL is the largest science and energy national laboratory in the DOE system. ORNL’s scientific programs focus on materials, neutron science, energy, high-performance computing, systems biology, and national security. ORNL partners with the State of Tennessee, universities, and industry to solve challenges in energy, advanced materials, manufacturing, security, and physics. The laboratory's science and technology innovations are translated into applications for economic development and global 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 SNS and HFIR. ORNL hosts a DOE leadership computing facility, home of the Titan supercomputer; one of DOE’s nanoscience centers, the Center for Nanophase Materials Sciences; one of DOE’s energy research centers, the BioEnergy Science Center; and the Consortium for Advanced Simulation of Light-Water Reactors, a DOE innovation hub. ORNL operates nine user facilities that draw thousands of research scientists and visitors each year.

- Building Technologies Research and Integration Center
- Center for Nanophase Materials Sciences
- Center for Structural Molecular Biology
- HFIR
- High Temperature Materials Laboratory
- National Center for Computational Sciences
- National Transportation Research Center (NTRC)
- Shared Research Equipment Collaborative Research Center
- SNS

ORNL is managed by UT-Battelle, LLC, a partnership between the University of Tennessee and Battelle Memorial Institute. During 2012 the ORNL operations of UT-Battelle, WAI, UCOR, Isotek, and SEC were conducted in compliance with contractual and regulatory environmental requirements with the exception of five issues identified during a joint EPA-TDEC-RCRA inspection. There were no NOVs or penalties issued by the regulatory agencies.

Because of differing permit reporting requirements and instrument capabilities, various units of measurement are used in this report. The list of units of measure and conversion factors provided on pages xxv and xxvi is intended to help readers convert numeric values presented herein as needed for specific calculations and comparisons.

5.1 Description of Site, Mission, and Operations

ORNL, which is managed for DOE by UT-Battelle, LLC, a partnership of the University of Tennessee and Battelle Memorial Institute, lies in the southwest corner of the DOE ORR (Fig. 5.1) and includes facilities in two valleys (Bethel and Melton) and on Chestnut Ridge. ORNL was established in 1943 as a part of the secret Manhattan Project to pioneer a method for producing and separating plutonium. During the 1950s and 1960s, and with the creation of DOE in the 1970s, ORNL became an international center for the study of nuclear energy and related research in the physical and life sciences. By the turn of the century, the laboratory supported the nation with a peacetime science and technology mission that was just as important as, but very different from, the work carried out in the days of the Manhattan Project.

ORNL 2011-G00538/chj

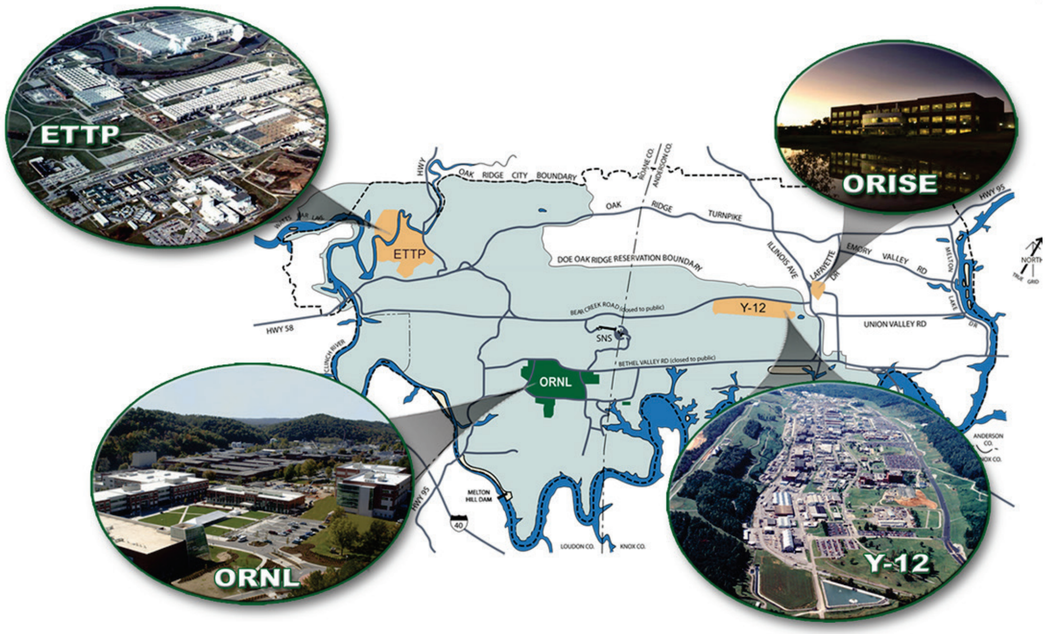

Fig. 5.1. Location of ORNL within the Oak Ridge Reservation and its relationship to other local Department of Energy facilities.

UT-Battelle also manages several facilities located off the main ORNL campus. These include several buildings and trailers located at the Y-12 Complex, at the American Museum of Science and Energy in the city of Oak Ridge, and several other locations around the Oak Ridge vicinity.

NTRC, an alliance among UT-Battelle; the University of Tennessee; 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 ha (6-acre) site in the Pellissippi Corporate Center and is leased to UT-Battelle and the University of Tennessee separately by Pellissippi Investors LLC.

TWPC, managed by WAI for DOE, is located on the western boundary of ORNL on about 10 ha (25 acres) of land adjacent to the Melton Valley Storage Tanks along State Route 95. TWPC's mission is to receive TRU wastes for processing, treatment, repackaging, and shipment to designated facilities for final disposal. TWPC consists of the waste processing facility, the personnel building, and numerous support buildings and storage areas. TWPC began processing supernatant liquid from the Melton Valley Storage Tanks in 2002, contact-handled (CH) debris waste in December 2005, and remote-handled (RH) debris waste in May 2008. Based on the definition of TRU waste, some waste being managed as TRU is later determined to be LLW or mixed LLW.

In March 2007, Isotek assumed responsibility for the Building 3019 Complex at ORNL, where the national repository of ^{233}U has been kept since 1962. A letter from the Deputy Secretary of Energy, dated November 24, 2010, directed the conduct of an "alternatives analysis" to determine whether there were more efficient methods available for ^{233}U disposition. In April 2011, the Deputy Secretary of Energy endorsed the recommendations in the final draft ^{233}U alternatives analysis phase I report (DOE 2011). The phase I recommendations included the following: (1) proceed with a direct disposition campaign involving the transfer of Zero Power Reactor (ZPR) plate canisters to NNSA for future reuse and disposal of canisters of Consolidated Edison Uranium Solidification Project material at NNSS and (2) conduct a phase II alternatives analysis to determine the best approach for processing the remaining 50% of the inventory. In December 2011, Isotek initiated the transfer of ZPR plate canisters to the NNSA Critical Safety Program located at the Device Assembly Facility at NNSS. Isotek completed the transfer of ZPR plate canisters in June 2012.

Since 2010 SEC has performed deactivation, demolition, and removal/disposition activities for multiple facilities at ORNL. To accomplish this, SEC was awarded two separate contracts, the

Miscellaneous Facilities Decontamination and Decommissioning (D&D) project and the Hot Cell project, to perform work activities and removal actions regulated by CERCLA. In performing both of these contracts, SEC closely coordinated with UT-Battelle and DOE on numerous environmental issues, including sitewide environmental monitoring and reporting.

The Miscellaneous Facilities D&D project, involved D&D of 34 buildings, totaling almost 10,779 m^2 (115,902 ft^2), in three areas of the ORNL Central Campus: the Southeast Contaminated Laboratory Complex, General Maintenance Facilities Complex, and Small Facilities Complex. Historically, these facilities were used in support of reactor area operations and for various laboratory support activities. The project included characterization, abatement, and removal of radioactive and hazardous materials; deactivation of buildings; removal of equipment; and demolition of facilities to grade level.

The objective of the Hot Cell project was to perform decommissioning of the Building 3026 C/D hot cell complex and legacy material removal from Building 3038 at ORNL. Building 3026 C/D facilities were to be brought down to their concrete foundation slabs.

The Miscellaneous Facilities project was completed in June of 2012. As a result of budget constraints the Hot Cell project was curtailed in February 2013 when partially completed. It has since been turned over to UCOR to be managed under a surveillance and maintenance agreement.

UT-Battelle performs air and water quality monitoring for the Building 3019 complex and water quality monitoring for TWPC. TWPC air monitoring information is included in the ORR RadNESHAPs annual report. Therefore, the UT-Battelle air and water monitoring discussions in this chapter include the results for the Isotek and WAI operations at ORNL.

About 5 ha (12 acres) in the central portion of ORNL has been leased to Halcyon, LLC, a CROET subsidiary, for development into ORSTP. ORSTP provides space for private companies doing research at ORNL, partner universities, start-up companies built around ORNL technologies, and ORNL contractors to conduct business within a short distance of ORNL researchers and DOE user facilities such as SNS, the Center for Nanophase Materials Sciences, and HFIR. Construction of the first ORSTP facility, Pro2Serve's 115,000 ft^2 National Security Engineering Center, was completed in 2009, and the company is now well-established in the building. In addition, the former Building 2033, also leased to Halcyon, LLC, is now known as HCC and continues to attract tenants. The largest tenant in HCC is Roane State Community College, which is offering job training classes on-site in the areas of carbon fiber manufacturing and solar energy technology. Other HCC tenants include several consulting firms and a carbon fiber manufacturer that is partnering with UT-Battelle for materials research. Expansion of ORSTP will continue as more environmental cleanup in ORNL's central campus is completed. EPA has designated ORSTP lessees as collocated workers since they are located on DOE property and are issued security badges to access the facilities.

5.2 Environmental Management Systems

An important priority for DOE contractors performing management and operations activities at ORNL is the demonstration of environmental excellence through high-level policies that clearly state expectations for continual improvement, pollution prevention, and compliance with regulations and other requirements.

In accordance with DOE O 436.1, *Departmental Sustainability* (DOE 2011b), UT-Battelle, WAI, UCOR and Isotek have implemented EMSs, modeled after ISO 14001:2004 (ISO 2004), to measure, manage, and control environmental impacts. An EMS is a continuing cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental goals. UT-Battelle's EMS was initially registered to the ISO 14001 standard by a third-party registrar in 2004 and was reregistered in June 2007 and June 2010 by NSF International Strategic Registrations, Ltd (NSF-ISR). No nonconformities were identified during the most recent reregistration audit. Detailed information on the UT-Battelle EMS is provided in Sections 5.2.1 through 5.2.1.7. WAI's EMS for activities at TWPC was registered to the ISO 14001:2004 standard by NSF-ISR in May 2008. NSF-ISR conducted a recertification audit for the WAI EMS program in May 2011, and no nonconformities or issues were identified and several significant practices were noted. Section 5.2.2 describes the WAI EMS and associated implementation activities. In June 2009, DOE conducted an external validation audit and concluded "that Isotek has implemented an Environmental Management System (EMS) that is consistent with the requirements of DOE O 450.1A, *Environmental Protection Program*" (DOE 2008). In May 2012, DOE conducted another validation audit and issued a memorandum documenting that Isotek's EMS for the U-233 Disposition Project conforms to the ISO 14001:2004 standard.

Consistent with the SEC environmental policy, SEC is committed to protecting and sustaining human, natural, and cultural resources and to completing the project safely to protect the public, the workers, and the environment. SEC has developed and implemented processes and procedures that minimize exposure to ionizing radiation for employees, the public, and the environment to levels that are as low as reasonably achievable (ALARA).

5.2.1 UT-Battelle Environmental Management System

The UT-Battelle 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. Through the UT-Battelle Standards-Based Management System (SBMS), EMS establishes environmental policy and translates environmental laws, applicable DOE orders, and other requirements into laboratory-wide subject area documents (procedures and guidelines). SBMS information is based on an evaluation of external requirements (i.e., directives and federal, state, and local laws), corporate policies, and best management practices that have been determined applicable to UT-Battelle operations and processes. Through environmental protection officers, environmental compliance representatives, and waste services representatives, EMS assists the line organizations in identifying and addressing environmental issues in accordance with SBMS requirements.

5.2.1.1 Integration with Integrated Safety Management System

The UT-Battelle EMS and ISMS are integrated to provide a unified strategy for the management of resources, the control and attenuation of risks, and the establishment and achievement of the organization's ES&H goals. ISMS and EMS both strive for continual improvement through "plan-do-check-act" cycles. Under ISMS, the term "safety" also encompasses environmental safety and health, including pollution prevention, waste minimization, and resource conservation. Therefore, the guiding principles and core functions in ISMS apply both to the protection of the environment and to safety. Figure 5.2 depicts the relationship between EMS and ISMS.

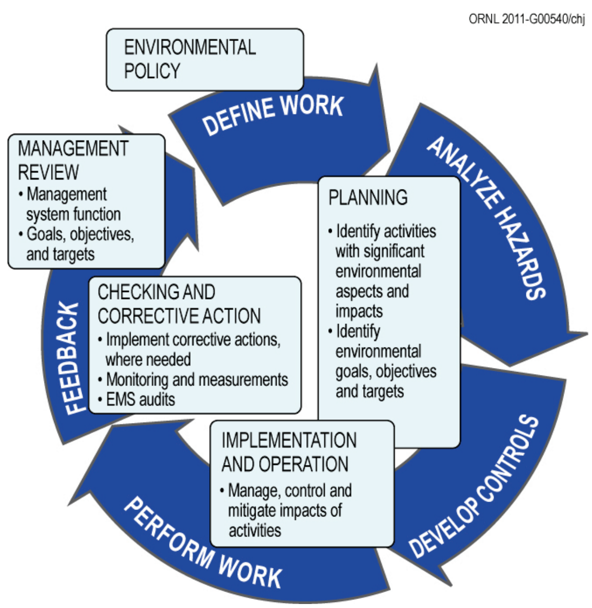

Fig. 5.2. The relationship between the UT-Battelle Environmental Management System and the Integrated Safety Management System.

The UT-Battelle EMS is consistent with ISMS and includes the following elements:

- environmental policy;
- planning;
- legal and other requirements;
- objectives, targets, and programs;
- implementation and operation;
- resources, roles, responsibility, and authority;
- competence, training, and awareness;
- communication;
- documentation;
- control of documents;
- operational control;
- emergency preparedness and response;
- checking;
- monitoring and measurement;
- evaluation of compliance;
- nonconformity, corrective action, and preventative action;
- control of records;
- internal audit; and
- management review.

5.2.1.2 UT-Battelle Policy for Oak Ridge National Laboratory

The UT-Battelle environmental policy statements (Fig. 5.3) are part of the UT-Battelle Policy for ORNL, which is the highest level statement of how UT-Battelle conducts business. By clearly stating expectations, the policy provides the framework for setting and reviewing environmental objectives and targets.

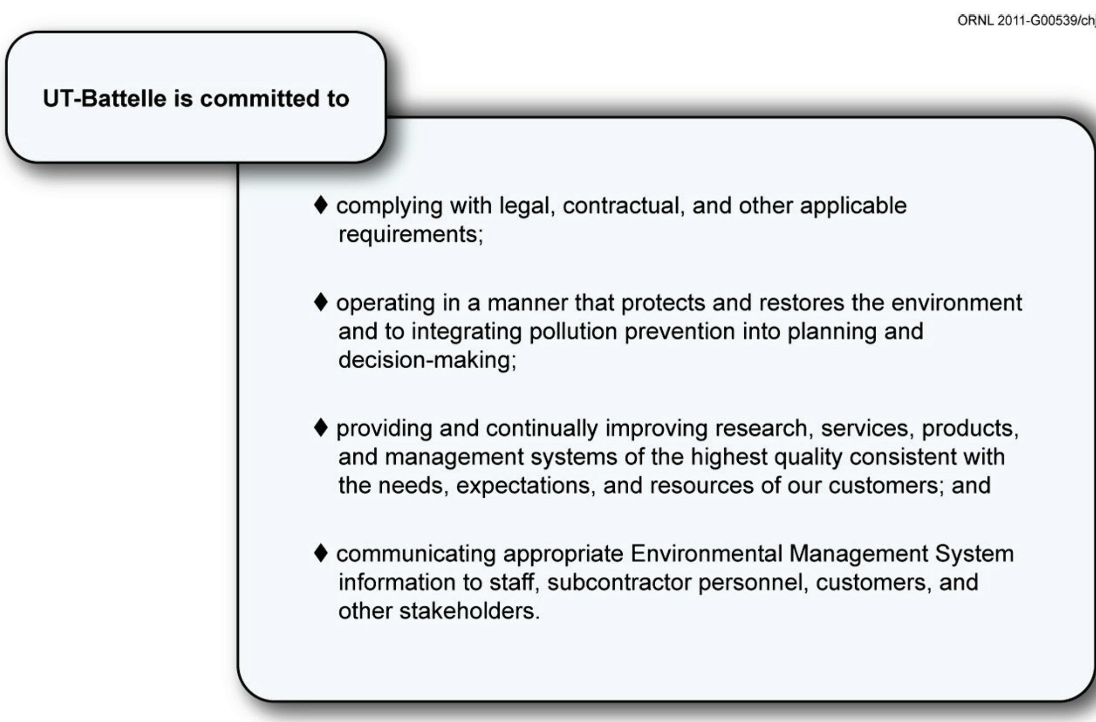

Fig. 5.3. UT-Battelle environmental policy statements.

5.2.1.3 Planning

5.2.1.3.1 UT-Battelle Environmental Aspects

Environmental aspects are elements of an organization's activities, products, or services that can interact with the environment. Environmental aspects associated with UT-Battelle activities, products, and services have been identified at both the project and activity level. Activities that are relative to any of these aspects are carefully controlled to minimize or eliminate impacts to the environment. The following aspects have been identified as potentially having significant environmental impacts:

- hazardous waste,
- radioactive waste,
- mixed waste,
- energy use/intensity,
- GHG emissions,
- permitted air emissions,
- regulated liquid discharges, and
- storage or use of chemicals or radioactive materials.

5.2.1.3.2 UT-Battelle Legal and Other Requirements

Legal and other requirements that apply to the environmental aspects identified by UT-Battelle include federal, state, and local laws and regulations; environmental permits; applicable DOE orders; UT-Battelle contract clauses; waste acceptance criteria; and voluntary requirements such as ISO 14001:2004. UT-Battelle has established procedures to ensure that all applicable requirements are reviewed and that changes and updates are communicated to staff and incorporated into work-planning activities. UT-Battelle's environmental compliance status is discussed in Section 5.3.

5.2.1.3.3 UT-Battelle Objectives and Targets

To improve environmental performance, UT-Battelle has established and implemented objectives, targets, and performance indicators for appropriate functions and activities. In all cases, the objectives, targets, and performance indicators are consistent with the UT-Battelle Policy for ORNL and are supportive of the laboratory mission, and where practical, they are measurable. These objectives and targets are entered into a commitment tracking system and tracked to completion. In 2011, laboratory- and organization-level objectives and targets focused on chemical inventory reduction, energy conservation, waste minimization, and recycling.

5.2.1.3.4 UT-Battelle Programs

UT-Battelle has established an organizational structure to ensure that environmental stewardship practices are integrated into all facets of UT-Battelle's missions at ORNL. This includes programs led by experts in environmental protection and compliance, energy and resource conservation, pollution prevention, and waste management to ensure that laboratory activities are conducted in accordance with the environmental policy outlined in Fig. 5.3. Information on UT-Battelle's 2011 compliance status, activities, and accomplishments is presented in Section 5.3.

The environmental protection staff provides critical support services in the following areas:

- waste management,
- NEPA compliance,
- air quality compliance,
- water quality compliance,
- US Department of Agriculture (USDA) compliance,
- environmental sampling and data evaluation, and
- CERCLA interface.

The UT-Battelle staff also includes experts who provide critical waste management and disposition support services to research, operations, and support divisions. These include

- waste services representatives who work with waste generators to identify, characterize, package, and certify wastes for disposal;
- the waste-handling team, which performs waste-packing operations and conducts inspections of waste items, areas, and containers;
- the waste and materials disposition team, which coordinates off-site disposition of UT-Battelle's newly generated waste;
- the hazardous material spill response team, which is the first line of response to hazardous materials spills at ORNL and controls and contains such spills until the situation is stabilized; and
- the Environmental Management Program Office (EMPO), which coordinates and directs specific CERCLA decommissioning and demolition work being done on the UT-Battelle site. EMPO activities include developing and implementing interface agreements applicable to multiple contractors, CERCLA ARARs, and project work plans.

5.2.1.4 UT-Battelle Sustainable Campus Initiative

The Sustainable Campus Initiative is an ORNL-wide effort that builds upon the laboratory's strength as a premier science and technology organization in integrating energy efficiency, cutting-edge technologies, and operational and business processes to achieve sustainability. The ultimate goal is to achieve benchmark sustainability in campus operation and in the research, development, and deployment of key technologies by 2018. The initiative was launched in October 2008 and continues a modernization program that began in 2000.

Seventy years after its establishment, ORNL has been transformed from a single-purpose facility to a center for multiple world-leading scientific research initiatives. Over the last decade, major science program investments, including the $1.4B SNS and more than $750M in modernization projects, have produced a modern, world-class research campus.

Modernization successes in 2012 include completion of the Maximum Energy Efficiency Laboratory and CFTF. Multiple site infrastructure modernization projects included the Building 2519 renovation, Building 1505 fire barrier upgrades, Building 8600 fifth floor office improvements, expanded parking for Chestnut Ridge Campus, Building 3000 area utilities improvements, 0901 Switchyard upgrade, and replacement of the heating boiler for Building 7603. Figure 5.4 demonstrates the focus of the modernization and revitalization campaign at ORNL during 2012.

UT-Battelle has achieved numerous other sustainability successes during FY 2012 that are detailed throughout this document and in greater detail at http://sustainability-ornl.org. The following is an abbreviated list of highlights.

- Commissioned the Biomass Steam Plant, a key to exceeding Scope 1 GHG reduction goals
- Positioned the ORNL campus to reduce energy intensity by at least 30% by 2015
- Completed four additional HPSBs
- Achieved water use reduction of 35% to date, exceeding the FY 2020 goal
- Surpassed the goal for electric use by achieving 91.7% of individual building metering goal
- Achieved 78.6% of the construction and demolition diversion rate for debris, surpassing the 50% goal
- Received seven external awards and certificates for sustainability achievements (e.g., from the DOE Sustainability Performance Office, Tennessee Chamber of Commerce and Industry, and East Tennessee US Green Buildings Council)

Table 5.1 summarizes progress toward attainment of DOE sustainability goals at ORNL in 2012.

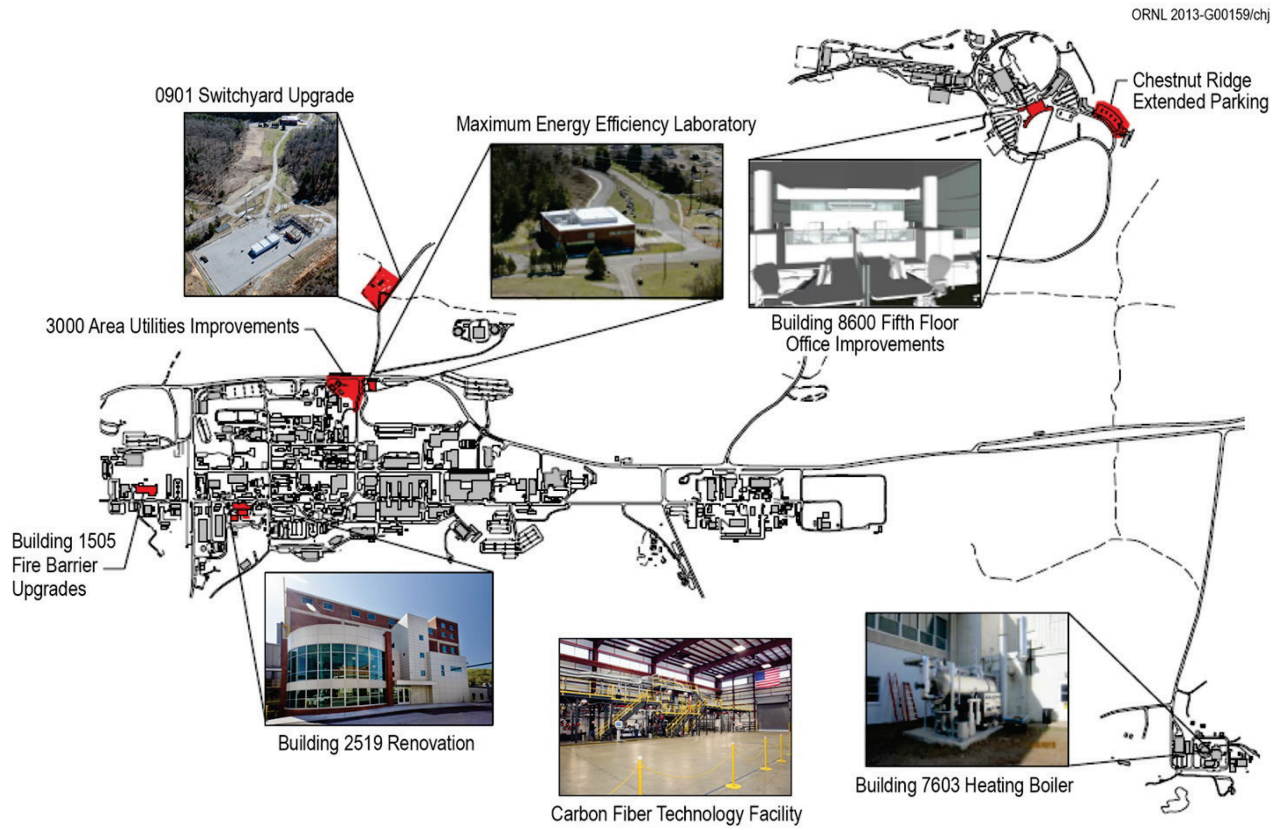

Fig. 5.4. Modernization and facilities revitalization.

Table 5.1. 2012 UT-Battelle progress toward attainment of DOE sustainability goals

Performance area	DOE goal	Performance status
Greenhouse Gas Reduction and Comprehensive Greenhouse Gas Inventory		
Energy Intensity Reduction	30% Energy Use Intensity Reduction by FY 2015 from a FY 2003 baseline.	UT-Battelle is on track to meet or exceed this goal (Fig. 5.5) by continuing construction of new energy-efficient facilities, repurposing existing facilities, and demolishing inefficient legacy facilities. Aggressive energy reduction activities in current facilities will be combined with ongoing audits and the ECMs program, new efforts in building commissioning, benchmarking energy consumption, and best management practices. As demonstrated in Fig. 5.6, over the past decade the footprint of offices and laboratories at ORNL has increased 50%, accompanied by a 7.3% decrease in energy consumption (excluding biomass consumption). Based on FY 2012 data, Buildings Category energy usage at ORNL is 1.210709 × 1012 Btu (not considering excluded facilities as defined by EPAct 1992) or biomass fuel consumption). Given an area of 4,462,777 gsf of energy-consuming buildings, trailers, and other structures/facilities, the FY 2012 calculated energy intensity was 254,203 Btu/gsf, which represents a 13.5% reduction from FY 2011.
RE Consumption	7.5% of annual electricity consumption from renewable sources by FY 2013 and thereafter (5% FY 2010–2012).	Multiple sources of RE are used at ORNL. The electricity produced on-site from three solar arrays accounted for about 0.023% of electrical consumption at ORNL in FY 2012. Another 675 MWh was procured through the Tennessee Valley Authority's Green Power Switch Program, along with the purchase of 31,829 MWh of RE credits from wind resources. Total RE sources at ORNL in FY 2012 contributed 32,747 MWh or 6.23% of total electricity consumption, exceeding the 5% FY 2012 goal.
SF_6 Reduction (Scope 1 GHG)	28% reduction in SF_6 emissions by FY 2020 from a FY 2008 baseline.	The SF_6 inventory at ORNL at the end of FY 2012 was about 209,800 lb. Losses during the year totaled 1,700 lb., which is less than the facility baseline of 2,500 lb/year established in 2008.
Metering for Individual Buildings	Individual buildings or processes metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015).	In 2012, 91.7% of ORNL buildings and processes had individual metering of electricity, 7.2% for steam, 95.8% for natural gas and 65% for chilled water.
Cool Roofs	All new roofs must meet cool roof standards and have thermal resistance of at least R-30.	In FY 2012, 58,789 ft^2 of cool roof construction was completed at ORNL including new building and reroofing projects. More than 97% of new roofing projects (new structure or reroofed structures), including the Building 4020 MAXLAB project and two new research platform buildings, meet total or partial cool roof standards.

Table 5.1. (continued)

Performance area	DOE goal	Performance status
Training	Ensure facility energy managers can demonstrate the core competencies for facility managers.	A UT-Battelle energy efficiency manager is responsible for identifying and managing energy efficiency projects for ORNL facilities and related infrastructure. The energy efficiency manager holds the following qualifications and certifications. • International Facilities Management Association Certified Facility Manager • Association of Energy Engineers Certified Energy Manager • Building Owners & Managers Institute Systems Maintenance Administrator and Facility Management Administrator) designations • Green Buildings Council LEED Accredited Professional Operations + Maintenance designation. Other key facility operations and management staff have also obtained several of these qualifications and certifications, and all have completed training in energy-efficiency-related topics.
Net Zero Energy	Net zero energy in new or major renovation facilities.	Planning efforts for all new facilities or major renovations at ORNL include exploring research and design concepts that use a combination of conservation measures and on-site RE.
Facility Energy Evaluations	Each year, evaluate a minimum of 25% of 75% of facility energy use over a 4-year cycle per Energy Independence and Security Act Section 432.	In FY 2012, UT-Battelle completed a 4-year energy audit cycle. An ESPC evaluation performed by Johnson Control, Inc., in FY 2008 provided the first 100% audit of the ORNL campus.
GHG—Scope 3	13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline.	In FY 2012 total Scope 3 GHG emissions were estimated at 44,247 MT CO_2e. The Scope 3 inventory has grown by 8% from the FY 2008 baseline and is not on target to meet the 13% reduction goal. Table 5.2 demonstrates that while employee commutes, business air travel, and business ground travel categories have improved, a 31% growth in transmission and distribution loss limits the overall performance.
GHG—Scopes 1 & 2	28% Scopes 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline.	Table 5.3 lists each major component of Scope 1 and Scope 2 GHG emissions and shows the FY 2012 performance result of each category in terms of increase/decrease in MT of CO_2e from the FY 2008 baseline and the percentage gain/loss of each category.

Table 5.1. (continued)

Performance area	DOE goal	Performance status
Buildings, High-Performance Sustainable Buildings, Energy Savings Performance Contract Initiative, and Regional and Local Planning		
Existing Buildings—Comply with HPSB Guiding Principles	15% of existing buildings (greater than 5,000 gsf) to comply with the five guiding principles of HPSB by FY 2015, with progress to 100% thereafter.	In FY 2012, four facilities at ORNL (Buildings 1061, 1520, 4007, and 6008) were evaluated and brought into compliance with the guiding principles for federal leadership in HPSB. Currently, there are 18 HPSBs at ORNL, which is 82% of the 2015 goal of 22 HPSBs.
New Construction and Major Renovations—Comply with HPSB Guiding Principles for New Construction and Major Renovation	All new construction, major renovations, and alterations of buildings greater than 5,000 gsf must comply with the guiding principles.	As of the end of FY 2012, 15 facilities have been constructed to LEED standards at ORNL. LEED certification has either been received or is in progress for the following facilities. • Building 1521—ORNL West End Research Support Facility (LEED Certified) • Building 3625 (expansion)—Advanced Materials Characterization Laboratory (LEED Silver) • Building 4020—MAXLAB (LEED Gold, pending) • Building 4100—Chemical and Materials Science Laboratory (LEED Gold) • Building 5100—Joint Institute for Computational Sciences (LEED Silver) • Building 5200—ORNL Conference Center (LEED Certified) • Building 5300—Multi-Program Research Facility (LEED Gold) • Building 5600—Computational Sciences Building (LEED Certified) • Building 5600 (expansion)—Multi-program Office Complex (LEED Gold, pending) • Building 5700—Research Office Building (LEED Certified) • Building 5800—Engineering Technology Facility (LEED Certified) • Building 7990—Melton Valley Warehouse (LEED Certified) • Building 7995—Melton Valley Maintenance Facility (LEED Gold) • Building 8630—Joint Institute for Neutron Sciences (LEED Certified) • Building 8640—ORNL Guest House (LEED Gold)
ESPC Initiative (i.e., Third Party)	Nonquantitative goal.	Although informal discussions have been held with energy service companies, no notice of opportunity has been submitted.

Table 5.1. (continued)

Performance area	DOE goal	Performance status
Regional and Local Planning	Active engagement in regional and local planning for transportation options as well as outreach activities for the enhancement of sustainability effort in the entire southeast region. (Nonquantitative goal.)	FY 2012 regional sustainability planning efforts included the following. • Regional partnerships with Smart Trips and Knoxville Area Transit. • Participation in development of the Knoxville Regional Transit Development Plan. • Participation in the five-county East Tennessee Sustainability Initiative. • Discussions with the East Tennessee Human Resource Agency regarding vanpools. • Hosting the second ORNL Sustainability Summit for roughly 125 participants from the Southeast. • Participation in developing an umbrella approach to sustainability in the Southeast. • Work-for-others agreement between UT-Battelle and Indian River State College to develop an umbrella approach to sustainability and provide expertise on power grid management.
Fleet Management		
Fleet Alternative Fuel Consumption	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline.	In 2005, 38% of the fuel used at ORNL was alternative fuel; this increased to 75.5% in FY 2012, representing a 50% increase since 2005. An idle reduction guide was created to promote a culture of reducing unnecessary idling for all nonemergency vehicles operating on- and off-campus.
Fleet Petroleum Consumption	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline.	Between 2005 and 2012, a 21% reduction in fleet petroleum consumption was realized. To ensure that future reductions are realized, UT-Battelle is continuing to increase the use of alternative fuels, increase the fuel economy of fleet vehicles, and reduce the number of vehicle miles driven. Between FY 2011 and FY 2012 vehicle miles were reduced by 15%.
Purchase of light duty AFVs	100% of light duty vehicle purchases must consist of AFVs by FY 2015 and thereafter (75% FY 2000–2015).	UT-Battelle purchased two light-duty vehicles in FY 2012; both were AFVs (Fig 5.7).
Rightsizing the Fleet	Submit a fleet rightsizing management plan and identify mission critical/non-mission-critical vehicles by December 31, 2012.	UT-Battelle submitted a fleet rightsizing management plan to DOE in 2012 and reduced the vehicle fleet by 58 vehicles.

Table 5.1. (continued)

Performance area	DOE goal	Performance status
	Water Use Efficiency and Management	
Potable Water Use Intensity	26% potable water intensity (gallons per gross square foot) reduction by FY 2020 from a FY 2007 baseline.	UT-Battelle has implemented an aggressive plan to reduce water consumption. In FY 2012 water use intensity was 114 gal/gsf, exceeding the FY 2020 goal (a reduction of 35% to date). Significant progress toward identifying and repairing leaks was made in 2012, and a Fix-A-Leak initiative directed at the entire work force heightened staff awareness of the need to identify and repair water leaks both at home and at work. The reduction of OTC is a major UT-Battelle water conservation goal. The 2011 completion of Building 4100 enabled discontinuing heavy water use operations in Buildings 3137, 3150, 4508, 4500N, and 4500S. Plans are under way to reduce the use of OTC in Building 6000 by installing flow control valves and eliminating cooling water entirely where air-cooled fans can be used. A water-metering plan has been implemented at ORNL and includes priorities for meter installations. Thirty-three ORNL facilities account for more than 90% of water use. Seventeen of these facilities have been metered, and plans are in place to install seven water meters at strategic locations within the water utilities distribution system. Fourteen meters were installed at building locations in FY 2012.
ILA Water Consumption	20% consumption reduction of ILA water by FY 2020 from a FY 2010 baseline.	ILA water is nonpotable freshwater used in processes such as cooling, washing, and manufacturing or for irrigation and agriculture. All water procured at ORNL is potable water; therefore this goal is not applicable.
	Waste Reduction	
Nonhazardous Solid Waste (other than construction waste)	Divert at least 50% of nonhazardous solid waste, excluding construction and demolition debris, by FY 2015.	UT-Battelle's FY 2012 diversion rate for municipal solid waste was 33%. While less than the FY 2015 50% goal, this represents an increase from the 26% realized in FY 2011.
Nonhazardous Construction and Demolition Materials and Debris	Divert at least 50% of construction and demolition materials and debris by FY 2015.	UT-Battelle's diversion rate for construction and demolition debris has consistently exceeded the 50% goal. • FY 2010—85.6% • FY 2011—61.9% • FY 2012—78.6%

Table 5.1. (continued)

Performance area	DOE goal	Performance status
	Sustainable Acquisition	
Sustainable Acquisitions and Procurements	Procurements meet requirements by including necessary provisions and clauses (sustainable procurements/ biobased procurements).	100% of all UT-Battelle FY 2012 procurement transactions (excluding purchase card purchases) contained terms and conditions requiring sustainable acquisitions.
	Electronic Stewardship and Data Centers	
Meters for the Measurement of PUE	All data centers are metered to measure monthly PUE (100% by FY 2015).	UT-Battelle has introduced a standard for metered power strips that capture amperage, humidity, and temperature data, and plans are in place for the installation of additional Btu meters on chilled water lines.
Annual Weighted PUE Goals	Maximum annual weighted average PUE of 1.4 by FY 2015.	The calculated PUE value at the end of FY 2012 was 1.29 for the Building 5300 data center and 1.26 for the Building 5600 data center.
Electronic Stewardship	100% of eligible equipment with power management actively implemented and in use by FY 2012.	All eligible PCs and monitors are actively power-managed.
	Agency Innovation and Governmentwide Support	

Local Innovation	Support US global leadership in science, engineering, sustainability, and energy management.	Key FY 2012 activities at ORNL included the following.
		Oak Ridge Reservation Sustainability in Natural Resources Management and ORNL Landscaping, including
		• development of a generic riparian landscape plan;
		• updating of the ORNL campus landscaping plan;
		• installation of interpretive signs for rain gardens, edge habitat, and riparian landscaped areas;
		• cosponsorship of a community workshop “Dealing with Invasive Plants”; and
		• preparation of a draft forest management plan that includes
		  ○ an approach for monitoring forest pests (hemlock wooly adelgid, emerald ash borer, thousand canker disease, gypsy moth, etc.);
		  ○ strategies for identification, enhancement, and protection of special plant and wildlife habitat such as migratory bird habitat, wetlands, and native grass/meadow communities;
		  ○ treatment of invasive plant infestations; and
		  ○ sequestering carbon in forests and soils

Table 5.1. (continued)

Performance area	DOE goal	Performance status
		Integration of Pest Management Practices, including • an indoor integrated pest management program that focuses on pest management inside buildings and facilities and • an exterior integrated pest management program that focuses both on areas around buildings and structures on the ORNL site and on reservationwide pest management.

Abbreviations

AFV = alternative fuel vehicle
Btu = British thermal unit
CO_2e = carbon dioxide equivalent
DOE = US Department of Energy
ECM = energy conservation measure
EPAct = Energy Policy Act
ESPC = Energy Savings Performance Contract
FY = fiscal year
GHG = greenhouse gas
gsf = gross square feet
HPSB = High Performance Sustainable Buildings
ILA = industrial, landscaping, and agricultural
LEED = Leadership in Energy and Environmental Design
MAXLAB = Maximum Energy Efficiency Laboratory
MT = metric ton
MWh = megawatt-hour
ORNL = Oak Ridge National Laboratory
OTC = once-through-cooling
PUE = power usage effectiveness
RE = renewable energy
T&D = transmission and distribution

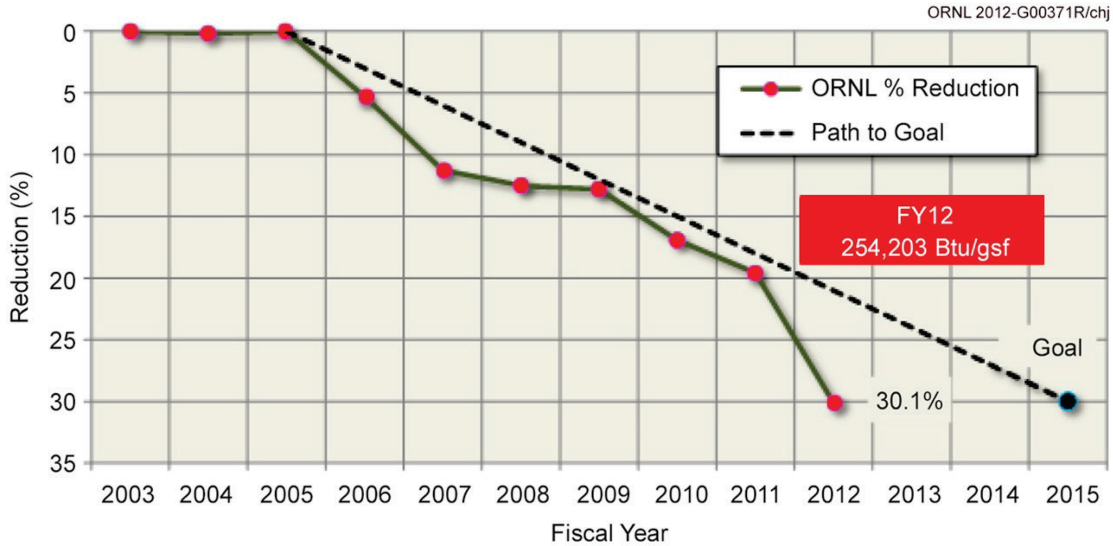

Fig. 5.5. Summary of energy intensity reduction results and progress toward goal. [Black dotted line = the path to the goal (30% reduction); gsf = gross square foot.]

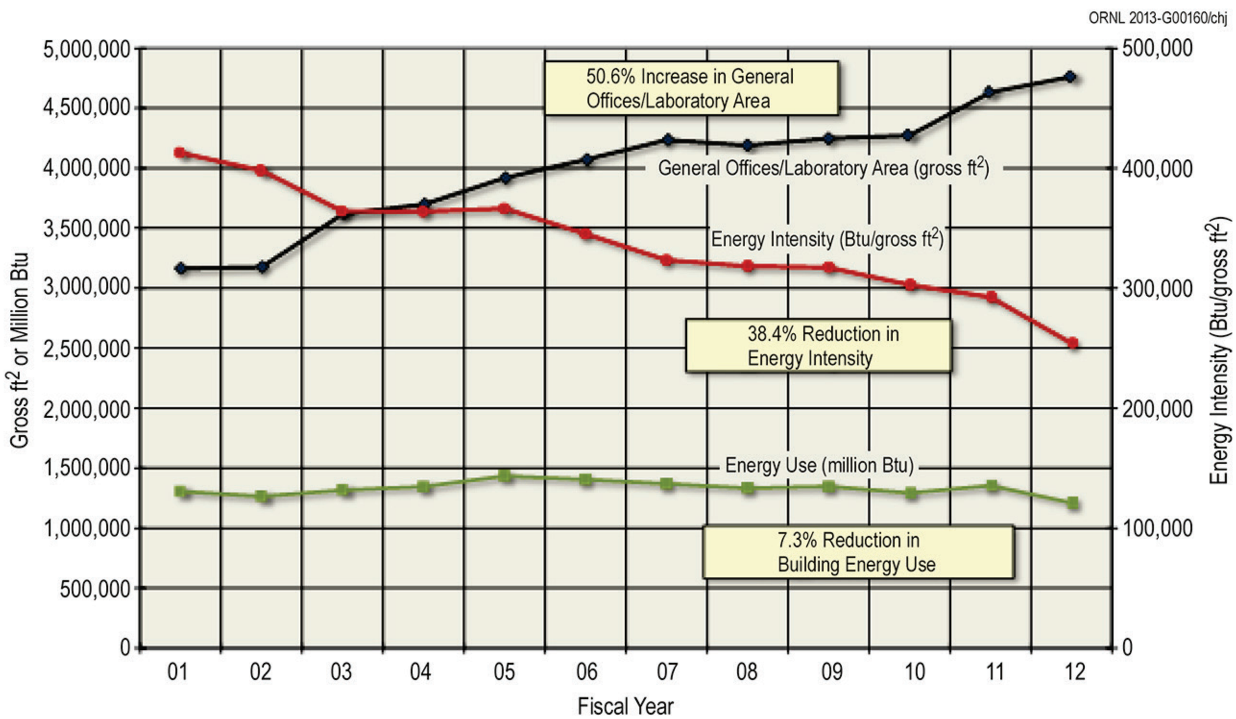

Fig. 5.6. ORNL building energy performance from FY 2001 through FY 2012.

Table 5.2. Scope 3 greenhouse gas emissions performance status

GHG emissions category	Emissions[a]		Increase (decrease)[a]	Difference (%)
	FY 2008	FY 2012		
T&D Losses	16,429	21,499	5,070	+31
Employee Commute	16,193	15,177	(1,016)	−6
Business Air Travel	7,204	6,545	(695)	−9
Business Ground Travel	1,169	1,060	(109)	−9
Other	44	47	3	+7
FY 2012 Scope 3 Performance	41,039	**44,328**	**3,289**	**+8**

[a]Numbers are metric tons of carbon dioxide equivalent.

Abbreviations
FY = fiscal year
GHG = greenhouse gas
T&D = transmission and distribution

Table 5.3. Scopes 1 and 2 greenhouse gas emissions performance status

GHG emissions category	Emissions[a]		Increase (decrease)[a]	Difference (%)
	FY 2008	FY 2012		
Scope 1				
Natural Gas, Facilities	48,563	36,398	(12,165)	−25
SF_6 Process Losses	27,102	18,429	(8,673)	−32
Other Fugitive Losses	10,660	3,277	(7,383)	−69
Fuel Oil, Facilities	1,968	1,294	(674)	−34
Fleet Fuels	1,104	944	(160)	−14
Other Facility Fuels	203	301	98	+48
BioMass Boiler	—	614	614	NA
FY 2012 Scope 1 Performance	89,600	**61,257**	**(28,343)**	**−32**
Scope 2				
Purchased Electricity	249,407	326,388	76,981	+31
Purchased RECs—GHG Avoided	—	(31,311)	(31,311)	NA
FY 2012 Scope 2 Performance	249,407	**295,077**	**45,670**	**+18**
Total Scopes 1 and 2 GHG Emissions				
All Sources, Combined	339,007	**356,334**	**17,327**	**+5**

[a]Numbers are metric tons of carbon dioxide equivalent.

Abbreviations
FY = fiscal year
GHG = greenhouse gas
NA = not applicable
REC = renewable energy certificate

ORNL 2011-P01054

Fig. 5.7. Plug-in vehicles highlighted at the Oak Ridge National Laboratory sustainability summit. Photo: Jason Richards

5.2.1.4.1 Pollution Prevention and Waste Reduction

UT-Battelle implemented 37 new pollution prevention projects at ORNL during 2012, eliminating more than 51 million kg (about 114 million lb) of waste, which included about 11.8 million gal of wastewater. Excluding the wastewater efforts, these projects eliminated about 7 million kg (about 15 million lb) of waste. In total, all of these projects led to cost savings/avoidance of more than $8 million (including ongoing reuse/recycle projects). In addition to the successful resource conservation and sustainable transportation initiatives discussed previously, source reduction actions such as efforts related to medical radioisotopes; resource efficient supercomputing; and recycling programs for lead, electronics, and construction and demolition debris were also implemented during 2012 (Fig 5.8). During the year UT-Battelle aggressively supported the recycling program at ORNL with more than 68% of FY 2012–generated materials being diverted for recycle or beneficial use. Large construction projects incorporated comprehensive project-specific recycling efforts.

ORNL 2012-G00347R/chj

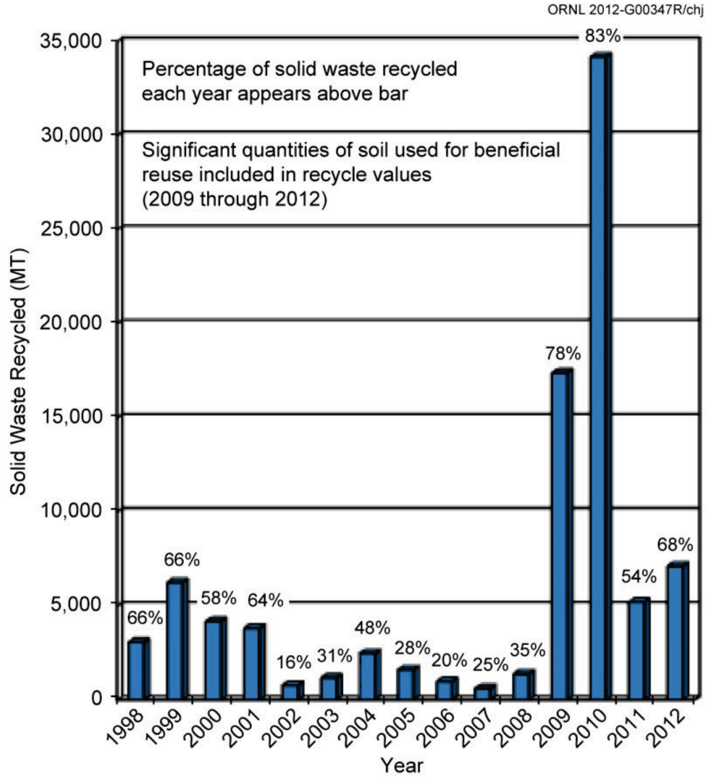

Fig. 5.8. Solid waste recycled at Oak Ridge National Laboratory as a result of recycling programs.

ORNL Site Pollution Prevention Awards

- 2012 DOE Bronze GreenBuy Award—for sustainable acquisition activities at ORNL.
- 2012 DOE Sustainability Award—for water resource management efforts at ORNL.
- 2012 DOE Sustainability Award—for UT-Battelle's work in championing sustainable energy and water efforts at ORNL.
- 2012 Tennessee Chamber of Commerce and Industry Air Quality Excellence Achievement Certificate—for UT-Battelle's involvement in the statewide installation of solar assisted charging stations.
- 2012 Tennessee Chamber of Commerce and Industry Water Quality Excellence Achievement Certificate—for several water conservation projects at ORNL including cooling water reductions, low-flow fixtures, and leak repair.
- 2012 Tennessee Chamber of Commerce and Industry Environmental Excellence Achievement Certificate—for energy efficiency improvements in super computers at ORNL and the efficiency impacts from the research conducted by using these super computers.
- *HPCwire* Readers' Choice Award—for best application of green computing in high-performance computing (Titan supercomputer).
- Federal Laboratory Consortium 2012 Award for Excellence in Technology Transfer—for excellence in technology transfer for a clean-burning cook stove designed for the developing world (UT-Battelle, Envirofit International, and Colorado State University jointly received this award).

5.2.1.4.2 Storm Water Management and the Energy Independence and Security Act of 2007

EISA Section 438 stipulates that the sponsor of any development or redevelopment project involving a federal facility with a footprint exceeding 5,000 ft^2 shall use site planning, design, construction, and maintenance strategies to maintain or restore, to the maximum extent feasible, the predevelopment hydrology of the property. For the purposes of this provision development or redevelopment is defined as "any action that results in the alteration of the landscape during construction of buildings or other infrastructure such as parking lots, roads, etc., (e.g., grading, removal of vegetation, soil compaction, etc.) such that the changes affect runoff volumes, rates, temperature, and duration of flow. Examples of projects that would fall under 'redevelopment' include structures or other infrastructure that are being reconstructed or replaced and the landscape is altered. Typical patching or resurfacing of parking lots or other travel areas would not fall under this requirement."

Strategic plans for demolition and renovation of old facilities and construction of new facilities at ORNL incorporate green infrastructure and low impact development (GI/LID) practices to infiltrate, evapotranspire, and/or harvest and use storm water on-site to the maximum extent feasible. GI/LID approaches and technologies have been used to mimic the natural hydrologic cycle processes of infiltration, evapotranspiration and use. GI/LID practices that have been incorporated at ORNL include the following.

- Trees and tree boxes
- Rain gardens
- Vegetated swales
- Pocket wetlands
- Infiltration planters
- Porous and permeable pavements
- Vegetated median strips
- Reforestation and revegetation
- Protection of riparian buffers and floodplains
- Retention ponds
- Water reuse (e.g., tanks in restrooms to collect water for reuse in irrigation)

At ORNL, a three step approach is used to evaluate and satisfy the requirements of EISA Section 438. Evaluation occurs

1. within the project boundaries. If the necessary volume of runoff cannot be infiltrated or retained on-site, then
2. on land immediately adjacent to the project boundaries. If the necessary volume of runoff cannot be infiltrated or retained on land immediately adjacent to the project boundaries, then
3. within the same valley or ridge area (e.g., within Bethel Valley if the project is within Bethel Valley; within Melton Valley if the project is within Melton Valley).

In addition to the GI/LID practices mentioned above, the projects may remove impervious areas and reestablish pervious areas to allow infiltration or evapotranspiration to occur.

In 2012, EISA requirements applied to two projects at ORNL. The first was declared a "Technical Infeasibility" due to utility restrictions and other site restrictions. The second project satisfied EISA Section 438 requirements by converting two existing sediment basins on the SNS site into permanent retention ponds.

5.2.1.5 Emergency Preparedness and Response

The Emergency Management System supplies the resources and capabilities to provide emergency preparedness services and, in the event of an accident, emergency response services. Emergency preparedness personnel perform hazard surveys and hazard assessments to identify potential emergency situations. Procedures and plans have been developed to prepare for and respond to a wide variety of potential emergency situations. Training is provided to ensure appropriate response and performance during emergency events. Frequent exercises and drills are scheduled to ensure the effective performance of the procedures and plans. An environmental subject matter expert is a member of the emergency response team and participates in drills and exercises to ensure that environmental requirements are met and that environmental impacts from the event (and the response) are mitigated.

5.2.1.6 Checking

5.2.1.6.1 Monitoring and Measurement

UT-Battelle has developed monitoring and measurement processes for each operation or activity that can have a significant impact on the environment. Several SBMS subject areas include requirements for managers to establish performance objectives, indicators, and targets; conduct performance assessments to collect data and monitor progress; and evaluate the data to identify strengths and weaknesses in performance and areas for improvement.

5.2.1.6.2 Environmental Management System Assessments

Several methods are used by UT-Battelle to evaluate compliance with legal and other environmental requirements. Most of the compliance evaluation activities are implemented through EMS or are a part of line-organization assessment activities. Should a nonconformance be identified, the ORNL issues management process requires that any regulatory or management system nonconformance be reviewed for cause and corrective and/or preventive actions developed. These actions are then implemented and tracked to completion.

The SBMS "Assessments" subject area requires organizations to perform periodic environmental assessments that cover both legal and other requirements and requires management system owners to conduct annual self-assessments of their systems to ensure the systems are effective and are continually improving.

UT-Battelle also uses the results from numerous external compliance inspections conducted by regulators to verify compliance with requirements. In addition to regulatory compliance assessments, there are internal and external EMS assessments performed annually to ensure the UT-Battelle EMS continues to conform to ISO requirements. In 2012, an internal audit and an external surveillance audit were conducted and verified that EMS continued to conform to ISO 14001:2004. In addition to verifying conformance, these management system assessments also identify continual improvement opportunities.

5.2.2 Environmental Management System for the Transuranic Waste Processing Center

The WAI EMS for activities at TWPC was registered to the ISO 14001:2004 Standard by NSF-ISR in May 2008 and is integrated with ISMS to provide a unified strategy for the management of resources, the control and reduction of risks, and the establishment and achievement of the organization's ES&H goals. The EMS and ISMS are incorporated into the *Integrated Safety Management System Description* (BJC 2009); a "plan-do-check-act" cycle is used for continual improvement in both. NSF-ISR conducted a recertification audit in May 2011, and no nonconformances or issues were identified and several significant practices were noted.

The WAI EMS incorporates applicable environmental laws, DOE orders, and other requirements (i.e., directives and federal, state, and local laws) through WAI's requirements management document (WAI 2012) and regulatory management plan (WAI 2012a), which dictate how the various requirements are incorporated into subject area documents (procedures and guidelines). EMS assists line organizations in identifying and addressing environmental issues.

Environmental aspects are elements of an organization's activities, products, or services that can interact with the environment. WAI has identified environmental aspects associated with TWPC activities, products, and services at both the project and activity level and has identified waste management activities, air emissions, storm water contamination, pollution prevention, habitat alteration, and energy consumption as potentially having significant environmental impacts. Activities that are relative to any of those aspects are carefully controlled to minimize or eliminate impacts to the environment.

WAI has established and implemented objectives and measurable performance indicators for the targets associated with the identified significant impacts.

The pollution prevention programs at TWPC involve waste reduction efforts and implementation of sustainable practices that reduce the environmental impacts of the activities conducted at TWPC. The WAI EMS establishes annual goals and targets to reduce the impact of TWPC's environmental aspects.

WAI has a well-established recycling program at TWPC and continues to identify new material-recycling streams and to expand the types of materials included in the program. Currently, recycle streams at TWPC range from office materials such as paper, aluminum cans, plastic drinking bottles, Styrofoam cups, alkaline batteries, and toner cartridges to operations-oriented materials such as scrap metal, cardboard, construction debris, and batteries. WAI has established a "single stream" recycling program that allows the mixing of multiple types of recyclables that increases the population of recyclable items and improves compliance. A construction debris recycling program began in September 2011 and has resulted in about 82 tons being diverted from the landfill to date.

"Environmentally preferable purchasing" is a term used to describe an organization's policy to reduce packaging and to purchase products made with recycled material or bio-based materials and other environmentally friendly products. WAI ensures environmentally preferable products are purchased by incorporating the green procurement requirements in WAI procurement procedures.

Several methods are used by WAI to evaluate compliance with legal and other requirements. Most of these compliance evaluation activities are implemented by internal and external environmental and management assessment activities and routine reporting and reviews. WAI also uses the results from numerous external compliance inspections conducted by regulators and contractors to verify compliance with requirements.

5.3 Compliance Programs and Status

During 2012 UT-Battelle, UCOR, WAI, Isotek, and SEC operations were conducted in compliance with contractual and regulatory environmental requirements with the exception of one issue identified during a TDEC Air Pollution Control inspection. This issue is summarized in Section 5.3.3.

There were no NOVs or penalties issued by the regulatory agencies. Table 5.4 presents a summary of environmental audits conducted at ORNL in 2012.

Table 5.4. Summary of regulatory environmental audits, evaluations, inspections, and assessments conducted at ORNL, 2012

Date	Reviewer	Subject	Issues
January 4	Knox County	Construction Permit Inspection for NTRC	0
February 6	TDEC	Inspection of ORNL USTs	0
March 22	TDEC	Follow-up RCRA Inspection	0
May 14	Knox County	Annual CAA Inspection for NTRC	0
July 31	TDEC	Annual CAA Inspection	1
November 13–15	TDEC	Annual RCRA Inspection of UT-Battelle facilities at Y-12 Complex	0

Abbreviations
CAA = Clean Air Act
ORNL = Oak Ridge National Laboratory
NTRC = National Transportation Research Center
RCRA = Resource Conservation and Recovery Act
TDEC = Tennessee Department of Environment and Conservation
UST = underground storage tank
Y-12 Complex = Y-12 National Security Complex

No RCRA Subtitle D disposal facilities are operated at ORNL. Industrial solid waste is sent to the Y-12 Complex industrial solid waste disposal landfills. ORNL complies with the requirements by meeting the waste acceptance criteria at the Y-12 facilities.

The following discussions summarize the major environmental programs and activities carried out at ORNL during 2012 and provide an overview of the compliance status for the year.

5.3.1 Environmental Permits

Table 5.5 contains a list of environmental permits that were effective in 2012 at ORNL.

Table 5.5. Oak Ridge National Laboratory environmental permits, 2012

Regulatory driver	Permit title/description	Permit number	Issue date	Expiration date	Owner	Operator	Responsible contractor
CAA	Title V Operating Permit	562765	08-16-11	08-15-16	DOE	UT-B	UT-B
CAA	Carbon Fiber Technology Facility (Construction Permit)	965013P	03-27-12	04-04-13	DOE	UT-B	UT-B
CAA	NTRC	0941-05[a]	10-23-12	Annually[b]	DOE	UT-B	UT-B
CAA	TN Operating Permit (emissions source)	06331P	03-07-12	03-01-22	DOE	WAI	WAI
CAA	Title V Operating Permit (UCOR)	562860	07-16-10	07-15-15	DOE	UCOR	UCOR
CAA	TN Operating Permit	057077P	04-13-04	10-13-14	DOE	WAI	WAI
CAA	Title V Operating Permit	560898	07-27-09	07-26-14	DOE	Isotek	Isotek
CWA	ORNL NPDES Permit (ORNL sitewide wastewater discharge permit)	TN0002941	07-01-08	07-30-13	DOE	DOE	UT-B, UCOR, WAI
CWA	Tennessee General (NPDES) Permit TNR10-0000, Storm Water Discharges from Construction Activities—Spallation Neutron Source	TNR139975	10-10-00	05-23-16	DOE	DOE	UT-B
CWA	Tennessee General (NPDES) Permit TNR10-0000, Storm Water Discharges from Construction Activities—ORNL Modernization of Laboratory Facilities	TNR133485	05-29-09	05-23-16	DOE	DOE	UT-B
CWA	Tennessee General Permit TNR10-0000, Storm Water Discharges from Construction Activity—ORNL Decommissioning & Demolishing Buildings	TNR1301343	05-26-05	NA	DOE	DOE	UT-B
CWA	Tennessee Storm Water Multi-Sector General Permit for Industrial Activities for Storm Water Discharges Associated with Construction Activity (CGP)—0975 Water Reservoir	TNR133727	07-08-10	05-14-14	DOE	DOE	UT-B
CWA	Tennessee General (NPDES) Permit TNR10-0000, Storm Water Discharges from Construction Activities—ORNL Melton Valley Access Road and Parking Lot	TNR133893	08-30-11	05-23-16	DOE	DOE	UT-B
CWA	Tennessee General (NPDES) Permit TNR10-0000, Storm Water Discharges from Construction Activities—Biomass Gasification System Project	TNR133428	06-09-10	05-23-16	DOE	DOE	JCI
CWA	Tennessee General (NPDES) Permit TNR10-1000, Storm Water Discharges from Construction Activities – Maximum Energy Efficiency Building Research Laboratory	TNR133932	05-24-11	05-23-16	DOE	DOE	UT-B

Table 5.5. (continued)

Regulatory driver	Permit title/description	Permit number	Issue date	Expiration date	Owner	Operator	Responsible contractor
CWA	Industrial and Commercial User Waste Water Discharge Permit (Carbon Fiber Technology Facility, located near ETTP)	1-12	10-15-12	03-31-15	UT-B	UT-B	UT-B
CWA	Tennessee General (NPDES) Permit TNR10-0000, Storm Water Discharges from Construction Activities—Pro2Serve National Security Engineering Center		10-06	NA	DOE	DOE	CROET
CWA	TN Operating Permit (sewage)	SOP-02056	02-01-08	12-31-12	DOE	WAI	WAI
CWA	Tennessee General Permit TNR10-0000, Storm Water Discharges from Construction Activity—Site Expansion Project	TNR 133560	08-31-09	NA	DOE	WAI	WAI
CWA	Aquatic Resource Alteration Permit for Maintenance of the Flume at White Oak Creek Headwaters Monitoring Station	ARAP NR1103.115	10-11-11	10-11-12	DOE	UT-B	UT-B
CWA	Aquatic Resource Alteration Permit for Temporary Disturbance To 0.02 Acres of Wetland at Melton Branch Circle	ARAP NR1203.123	09-13-12	09-13-13	DOE	UT-B	UT-B
RCRA	Hazardous Waste Transporter Permit	TN1890090003	01-25-12	01-31-13	DOE	DOE	UT-B, UCOR, Isotek
RCRA	Hazardous Waste Corrective Action Permit	TNHW-121	09-28-04	09-28-14	DOE	DOE/all[c]	DOE/all
RCRA	Hazardous Waste Container Storage and Treatment Units	TNHW-134	09-26-08	09-26-18	DOE	DOE/UT-B	UT-B
RCRA	Hazardous Waste Container Storage and Treatment Units	TNHW-145	02-03-10	02-03-20	DOE	DOE/ UCOR/WAI	UCOR/WAI

[a]Permit issued by Knox County Department of Air Quality Management.
[b]Continued construction/operation under an expired permit is allowed under air pollution control regulations when timely renewal or construction permit applications are submitted.
[c]DOE and Oak Ridge Reservation contractors are co-operators of hazardous waste permits.

Abbreviations

ARAP = Aquatic Resource Alteration Permit
CAA = Clean Air Act
CGP = Construction General Permit
CROET = Community Reuse Organization of East Tennessee
CWA = Clean Water Act
DOE = US Department of Energy
ETTP = East Tennessee Technology Park
Isotek = Isotek Systems LLC
JCI = Johnson Controls, Inc.
NPDES = National Pollutant Discharge Elimination System
NTRC = National Transportation Research Center
ORNL = Oak Ridge National Laboratory
RCRA = Resource Conservation and Recovery Act
UCOR = URS | CH2M Hill Oak Ridge LLC
UT-B = UT-Battelle
WAI = Wastren Advantage, Inc.

5.3.2 National Environmental Policy Act/National Historic Preservation Act

NEPA provides a means to evaluate the potential environmental impact of proposed federal activities and to examine alternatives to those actions. UT-Battelle, WAI, and Isotek maintain compliance with NEPA through the use of site-level procedures and program descriptions that establish effective and responsive communications with program managers and project engineers to establish NEPA as a key consideration in the formative stages of project planning. Table 5.6 summarizes NEPA activities conducted at ORNL during 2012.

Table 5.6. National Environmental Policy Act (NEPA) activities, 2012

Types of NEPA documentation	Number of instances
Oak Ridge National Laboratory	
Approved under general actions[a] or generic CX determinations	51
Wastren Advantage, Inc.	
Approved under general actions[a] or generic CX determinations	2

[a]Projects that were reviewed and documented through the site NEPA compliance coordinator.

Abbreviations
CX = categorical exclusion

During 2012, UT-Battelle and WAI continued to operate under site-level procedures that provide requirements for project reviews and NEPA compliance. These procedures call for a review of each proposed project, activity, or facility to determine the potential for impacts to the environment. To streamline the NEPA review and documentation process, the DOE Oak Ridge Office has approved generic CX determinations that cover proposed bench- and pilot-scale research activities and generic CXs that cover proposed nonresearch activities (e.g., maintenance activities, facilities upgrades, personnel safety enhancements). A CX is one of a category of actions defined in 40 CFR 1508.4 that does not individually or cumulatively have a significant effect on the human environment and for which neither an environmental assessment nor an environmental impact statement is normally required.

UT-Battelle uses SBMS as the delivery system to manage and control work at ORNL. NEPA is an integral part of SBMS, and a UT-Battelle NEPA coordinator works with principal investigators, environmental compliance representatives, and environmental protection officers within each UT-Battelle division to determine appropriate NEPA decisions.

Compliance with NHPA at ORNL is achieved and maintained in conjunction with NEPA compliance. The scope of proposed actions is reviewed in accordance with the *Cultural Resource Management Plan* (DOE 2001).

5.3.3 Clean Air Act Compliance Status

CAA, passed in 1970 and amended in 1977 and 1990, forms the basis for the national air pollution control effort. This legislation established comprehensive federal and state regulations to limit air emissions and includes four major regulatory programs: the National Ambient Air Quality Standards, State Implementation Plans, New Source Performance Standards, and NESHAPs. Airborne discharges from DOE Oak Ridge facilities, both radioactive and nonradioactive, are subject to regulation by EPA and the TDEC Division of Air Pollution Control. The first sitewide operating air permit was issued in 2004. To demonstrate compliance with this Title V Major Source Operating Permit, more than 1,500 data points are collected and reported every year. In addition, there are three continuous monitors for criteria pollutants, nine continuous samplers for radionuclide emissions, 15 minor radionuclide sources, and numerous demonstrations of compliance with generally applicable air quality protection requirements (asbestos, stratospheric ozone, etc.). Also, Knox County Air Quality permits are maintained for the off-site NTRC. In 2012, an annual emissions analysis report was submitted for this permit. In summary, there were no UT-Battelle, Isotek, or WAI CAA violations or exceedances in 2012. The TDEC Division of Air Pollution Control issued an NOV to UCOR on August 31, 2012, for failure to conduct an initial VEE at stack 3039 and to report this omission as a deviation in the corresponding semiannual and annual compliance certification reports for permit number 568860. This permit was originally issued to the previous contractor at stack 3039 who failed to perform the VEE and to report the missed test as a deviation. However, UCOR was the operator on the permit at the time the deviation was identified. Consequently, upon discovery, a VEE was conducted and UCOR submitted the revised semiannual and annual compliance certification reports to the Division of Air Pollution Control. No further enforcement actions were taken.

Section 5.4 provides detailed information on 2012 activities conducted by UT-Battelle in support of CAA.

5.3.4 Clean Water Act Compliance Status

The objective of CWA is to restore, maintain, and protect the integrity of the nation's waters. This act serves as the basis for comprehensive federal and state programs to protect the nation's waters from pollutants. (See Appendix C for water quality reference standards.) One of the strategies developed to achieve the goals of CWA was EPA's establishment of limits on specific pollutants allowed to be discharged to US waters by municipal STPs and industrial facilities. EPA established the NPDES permitting program to regulate compliance with pollutant limitations. The program was designed to protect surface waters by limiting effluent discharges into streams, reservoirs, wetlands, and other surface waters. EPA has delegated authority for implementation and enforcement of the NPDES program to the State of Tennessee.

In 2012, compliance with the ORNL NPDES permit was determined by about 2,300 laboratory analyses and field measurements. The NPDES permit limit compliance rate for all discharge points for 2012 was nearly 100%, with only one measurement exceeding numeric NPDES permit limits. On May 24, 2012, effluent from the new ORNL Melton Valley Steam Plant (MVSP), discharged through NPDES outfall 585, exceeded the permit limit for pH. The exceedance was due to the greater percentage of higher-pH boiler blowdown that is present in the outfall 585 effluent during the warmer months compared to the heating season. To correct this situation, MVSP was shut down until a pump and underground piping could be installed to reroute the MVSP effluent to the ORNL STP for treatment. Section 5.5 contains detailed information on the activities and programs carried out in 2011 by UT-Battelle in support of CWA.

5.3.5 Safe Drinking Water Act Compliance Status

ORNL's water distribution system is designated as a "nontransient, noncommunity" water system by TDEC's Bureau of Environment Division of Water Supply. TDEC's Bureau of Environment Division of Water Supply rules, Chapter 400-45-01, Public Water Systems (TDEC 2012), sets limits for biological contaminants and for chemical activities and chemical contaminants. TDEC requires sampling for the following constituents for compliance with state and federal regulations:

- residual chlorine,
- bacterial (total coliform)
- disinfectant by-product (trihalomethanes and haloacetic acids), and
- lead and copper

The city of Oak Ridge supplies potable water to the ORNL water distribution system and meets all regulatory requirements for drinking water. The water treatment plant, located on ORR, north of the Y-12 Complex, is owned and operated by the City of Oak Ridge.

In 2012, sampling results for ORNL's water system residual chlorine levels, bacterial constituents, lead and copper, and disinfectant by-products were all within acceptable limits.

5.3.6 Resource Conservation and Recovery Act Compliance Status

The Hazardous Waste Program under RCRA establishes a system for regulating hazardous wastes from the initial point of generation through final disposal. In Tennessee, TDEC has been delegated authority by EPA to implement the Hazardous Waste Program; EPA retains an oversight role. In 2012, DOE and its contractors at ORNL were jointly regulated as a large-quantity generator of hazardous waste under EPA ID TN1890090003 because, collectively, they generated more than 1,000 kg of hazardous/mixed wastes in at least 1 calendar month during 2012. Mixed wastes are both hazardous (under RCRA regulations) and radioactive. Hazardous/mixed wastes are accumulated in SAAs, less-than-90-day accumulation areas, and are stored and/or treated in RCRA-permitted units. In addition, hazardous/mixed wastes are shipped off-site for treatment and storage. The RCRA units operate under three permits at ORNL, TNHW-145, TNHW-134, and TNHW-121, as shown in Table 5.7. In 2012, UT-Battelle, UCOR, and Isotek were permitted to transport hazardous wastes under an EPA ID number issued for ORNL activities, and UT-Battelle was registered to operate a transfer facility for temporary storage (less than 10 days) of hazardous wastes transported from off-site locations such as NTRC.

Reporting is required for hazardous waste activities on 42 active waste streams at ORNL, some of which are mixed wastes. The quantity of hazardous/mixed waste generated at ORNL in 2012 was 765,327 kg (843.6 tons). Mixed wastewater accounted for 550,826 kg (607.2 tons). Excluding the wastewater generation, which remains fairly constant from year to year, 2012 hazardous waste generation increased about 12%. The increase is attributed to debris from building cleanout, renovation, and demolition. ORNL generators treated 8,319 kg (9.2 tons) of hazardous/mixed waste by elementary neutralization and silver recovery; and 518 kg (0.6 tons) of hazardous/mixed waste was received from UT-Battelle generators at the Y-12 Complex—which was stored at ORNL and will be processed at TWPC. The quantity of hazardous/mixed waste treated in RCRA-permitted treatment facilities at ORNL in 2012 was 35,400 kg (39.0 tons). This includes waste treated by macroencapsulation, size reduction, and stabilization/solidification. In addition, 550,826 kg (607.2 tons) of mixed waste was treated at an on-site wastewater treatment facility. The amount of hazardous/mixed waste shipped off-site to commercial treatment, storage, and disposal facilities decreased about 6% to 244,735 kg (269.8 tons) in 2012.

In March 2012, TDEC conducted a RCRA inspection that was a follow-up to the December 2011 joint EPA and TDEC RCRA inspection of ORNL generator areas; battery collection areas; RCRA-permitted treatment, storage, and disposal facilities; and RCRA records. During the March inspection, all activities and records were found to be in compliance with RCRA regulations and the RCRA permits, and no NOVs or penalties were associated with this inspection.

At NTRC DOE and UT-Battelle were regulated as "conditionally exempt small-quantity generators" in 2012, meaning that less than 100 kg (220.5 lb) of hazardous waste per month was generated.

No hazardous/mixed wastes were generated, accumulated, or shipped by DOE or UT-Battelle at the DOE Office of Scientific and Technical Information or the 0800 Area in 2012. The 0800 Area is a location on ORR adjacent to ORNL that has been assigned EPA identification number TNR000019760.

Table 5.7. Oak Ridge National Laboratory Resource Conservation and Recovery Act operating permits, 2012

Permit number	Building/description
	Oak Ridge National Laboratory
TNHW-134	Building 7651 Container Storage Unit Building 7652 Container Storage Unit Building 7653 Container Storage Unit Building 7654 Container Storage Unit Portable Unit 2 Storage & Treatment Unit
TNHW-145	Portable Unit 1 Storage Unit Building 7572 Container Storage Unit Building 7574 Container Storage Unit Building 7823 Container Storage Unit Building 7855 Container Storage Unit Building 7860A Container Storage Unit Building 7879 Container Storage Unit Building 7883 Container Storage Unit Building 7880A TWPC-1 (Contact-Handled Storage Area) Container Storage Unit TWPC-2 (Second Floor WPB) Container Storage Unit TWPC-3 (Drum Aging Criteria) Container Storage Unit TWPC-4 (First Floor WPB) Container Storage Unit TWPC-5 (Container Storage Area) Container Storage Unit Building 7880BB TWPC-6 (Contact-Handled Marshaling Building) Container Storage Unit Building 7880AA TWPC-7 (Drum Venting Building) Container Storage Unit Building 7880QQ TWPC-8 (Multi-Purpose Building) Container Storage Unit Macroencapsulation T-1 Treatment Unit Amalgamation T-2[a] Treatment Unit Solidification/Stabilization T-3[a] Treatment Unit Hot Cell Table T-4[a] Treatment Unit Size Reduction T-5[a] Treatment Unit Groundwater Filtration T-6
	Oak Ridge Reservation
TNHW-121	Hazardous Waste Corrective Action Permit

[a]Treatment operating units within Building 7880.

Abbreviations
TWPC = Transuranic Waste Processing Center
WPB = Waste Processing Building

5.3.7 Oak Ridge National Laboratory RCRA-CERCLA Coordination

The ORR FFA is intended to coordinate the corrective action processes of RCRA required under the Hazardous and Solid Waste Amendments permit with CERCLA response actions. Annual updates for 2012 for ORNL's Solid Waste Management Units and Areas of Concern were consolidated with updates for ETTP, Y-12 Complex, and ORR and were reported to TDEC, DOE, and EPA Region 4 in January 2013.

In May 2005, Bechtel Jacobs, Inc., LLC, applied for a RCRA postclosure permit for solid waste storage area (SWSA) 6, which has not been issued to date. The current contractor, UCOR, submits an annual RCRA groundwater monitoring report for SWSA 6 to TDEC.

Periodic updates of proposed construction and demolition activities and facilities at ORNL have been provided to managers and project personnel from the TDEC DOE Oversight Division and EPA Region 4. A CERCLA screening process is used to identify proposed construction and demolition projects and facilities that warrant CERCLA oversight. The goal is to ensure that modernization efforts do not impact the effectiveness of previously completed CERCLA environmental remediation actions and do not adversely impact future CERCLA environmental remediation actions.

The UT-Battelle EMPO manages or performs an integration function for the DOE Office of Environmental Management (EM)-funded Integrated Facility Disposition project and ARRA work at ORNL. Although the conduct of EM-related work (i.e., environmental remediation and building decontamination and demolition) is not a UT-Battelle core business function, UT-Battelle has endorsed participation in ARRA-funded cleanup work to accelerate ORNL revitalization by completing the upgrading and reconfiguration of the 4500 Area Central Ventilation System resulting in removal of the dependency on the 3039 stack and cleanout of the 4556 filter pit. This reduces the liabilities and risks to current and future ORNL science missions. During 2012, EMPO supported other DOE contractors in the removal of five radioisotope thermoelectric generators for shipment to NNSS and the demolition of six buildings/sets of hot cells in the ORNL Central Campus area, including Buildings 3102, 3503, 3508, 3543, and 3605 and the hot cells in 3026C. These activities and other 2012 EM accomplishments at ORNL are discussed in more detail in Section 5.8 and in the FY 2012 cleanup progress annual report to the Oak Ridge community (DOE 2011a).

5.3.7.1 Resource Conservation and Recovery Act Underground Storage Tanks

USTs containing petroleum and hazardous substances are regulated under RCRA Subtitle I (40 CFR 280). TDEC has been granted authority by EPA to regulate USTs containing petroleum under TDEC Rule 400-18-01; however, hazardous-substance USTs are still regulated by EPA.

ORNL has four USTs registered with TDEC under Facility ID 0-730089. A summary of the USTs follows.

- Two are in service (petroleum) and meet the current UST standards.
- One has been placed into a “temporary closure” status in accordance with the regulations pending permanent closure in the future.
- One is a wastewater treatment tank that is currently deferred from regulation. This UST is inactive.

5.3.8 Comprehensive Environmental Response, Compensation, and Liability Act Compliance Status

CERCLA, also known as Superfund, was passed in 1980 and was amended in 1986 by SARA. Under CERCLA, a site is investigated and remediated if it poses significant risk to health or the environment. The EPA NPL is a comprehensive list of sites and facilities that have been found to pose a sufficient threat to human health and/or the environment to warrant cleanup under CERCLA.

In 1989, ORR was placed on NPL. In 1992, the ORR FFA among EPA, TDEC, and DOE became effective and established the framework and schedule for developing, implementing, and monitoring remedial actions on ORR. The on-site CERCLA EMWMF is operated by UCOR for DOE. Located in Bear Creek Valley, EMWMF is used for disposal of waste resulting from CERCLA cleanup actions on ORR, including ORNL. EMWMF is an engineered landfill that accepts low-level radioactive, hazardous, asbestos, and PCB wastes and combinations of the aforementioned wastes in accordance with specific waste acceptance criteria under an agreement with state and federal regulators.

5.3.9 Toxic Substances Control Act Compliance Status

PCB waste generation, transportation, and storage at ORNL are regulated under EPA ID TN1890090003. In 2012, UT-Battelle operated about 29 PCB waste storage areas in generator buildings. When longer term storage was necessary, PCB/radioactive wastes were stored in RCRA-permitted storage buildings at ORNL. Three PCB waste storage areas were operated at UT-Battelle facilities at the Y-12 Complex. The continued use of authorized PCBs in electrical systems and/or equipment (e.g., transformers, capacitors, rectifiers) is regulated at ORNL. The majority of equipment at ORNL that required regulation under TSCA has been disposed of. However, some of the ORNL facilities at the Y-12 Complex continue to use (or store for future reuse) PCB equipment.

Because of the age of many of the ORNL facilities and the varied uses for PCBs in gaskets, grease, building construction, and equipment, DOE self-disclosed unauthorized use of PCBs to EPA in the late 1980s. As a result, DOE and ORNL contractors negotiated a compliance agreement with EPA (see Table 2.1) to address the compliance issues related to these unauthorized uses and to allow for continued use pending decontamination or disposal. As a result of that agreement, DOE continues to notify EPA when additional unauthorized uses of PCBs, such as PCBs in paint, adhesives, electrical wiring, or floor tile, are found at ORNL. In 2012, no unauthorized uses of PCBs were discovered.

5.3.10 Emergency Planning and Community Right-to-Know Act Compliance Status

EPCRA and Title III of SARA require that facilities report inventories and releases of certain chemicals that exceed specific release thresholds. The reports are submitted to the local emergency planning committee and the state emergency response commission. Table 5.8 describes the main elements of EPCRA. UT-Battelle complied with these requirements in 2012 through the submittal of reports under EPCRA Sections 302, 303, 311, and 312. These reports reflect information pertinent to all DOE prime contractors and their subcontractors who reported activities at the ORNL site.

ORNL had no releases of extremely hazardous substances, as defined by EPCRA, in 2012.

Table 5.8. Main elements of the Emergency Planning and Community Right-to-Know Act (EPCRA)

Title	Description
Sections 302 and 303, Planning Notification	Requires that local planning committee and state emergency response commission be notified of EPCRA-related planning
Section 304, Extremely Hazardous Substance Release Notification	Addresses reporting to state and local authorities of off-site releases
Sections 311–312, Material Safety Data Sheet/Chemical Inventory	Requires that either material safety data sheets or lists of hazardous chemicals for which they are required be provided to state and local authorities for emergency planning. Requires that an inventory of hazardous chemicals maintained in quantities over thresholds be reported annually to EPA
Section 313, Toxic Chemical Release Reporting	Requires that releases of toxic chemicals be reported annually to EPA

Abbreviations
EPA = US Environmental Protection Agency

5.3.10.1 Material Safety Data Sheet/Chemical Inventory (Section 312)

Inventories, locations, and associated hazards of hazardous and extremely hazardous chemicals were submitted in an annual report to state and local emergency responders as required by the EPCRA Section 312 requirements. In 2012, 19 hazardous or extremely hazardous chemicals were located at ORNL in quantities above EPCRA reporting thresholds.

Private-sector lessees associated with the reindustrialization effort were not included in the 2012 submittals. Under the terms of their leases, lessees must evaluate their own inventories of hazardous and extremely hazardous chemicals and must submit information as required by the regulations.

5.3.10.2 Toxic Chemical Release Reporting (EPCRA Section 313)

DOE submits annual toxic release inventory reports to EPA and TDEC on or before July 1 of each year. The reports cover the previous calendar year and address releases of certain toxic chemicals to air, water, and land and waste management, recycling, and pollution prevention activities. Threshold determinations and reports for each of the ORR facilities are made separately. Operations involving toxic release inventory chemicals were compared with regulatory thresholds to determine which chemicals exceeded the reporting thresholds based on amounts manufactured, processed, or otherwise used at each facility. After threshold determinations were made, releases and other waste management activities were calculated for each chemical that exceeded one or more of the thresholds.

5.3.11 US Department of Agriculture/Tennessee Department of Agriculture

USDA, through Animal and Plant Health Inspection Services, issues permits for the import, transit, and controlled release of regulated animals, animal products, veterinary biologics, plants, plant products, pests, organisms, soil, and genetically engineered organisms. The Tennessee Department of Agriculture issues agreements and jointly regulates domestic soil. In 2012, UT-Battelle personnel had a combined 54 permits and agreements for the receipt, movement, or controlled release of regulated articles.

5.3.12 Wetlands

Activities conducted at ORNL in 2012 in support of wetlands management are discussed below.

Vegetation parameters were measured at the ORNL parking structure wetland (P2) about 1 year after mitigation. Percent cover by species was measured for each plot. Information was also taken on any fauna present at the time of the survey. Second year data obtained for P2 showed excellent overall vegetation coverage, providing good quality habitat. Vegetation growing in the wetland included both planted and volunteer plant species. A good variety of fauna was noted in and around the wetland, including mammals, birds, frogs, and insects.

Stream habitat assessments were conducted at both First Creek and White Oak Creek (WOC) reaches using Habitat Assessment Data Sheets found in the Tennessee Mitigation Guidelines. Metrics evaluated at both sites included epifaunal substrate, embeddedness (amount of silt, etc. between rocks), velocity/depth regime, sediment deposition, channel flow, frequency of riffles, bank stability, and vegetative cover. These parameters were measured using rapid bioassessment protocols for use in wadeable streams and rivers (Barbour et al. 1999).

First Creek mitigation activities had already been completed before the first habitat assessment, which was conducted in 2011. The 2012 survey represented the second formal assessment of post-mitigation conditions. Pre-mitigation conditions for First Creek are discussed qualitatively based on information contained in previous reports. The 2012 WOC habitat assessment was based on habitat conditions about 1 year after mitigation.

Riparian zone vegetation surveys were conducted by establishing 10 m by 5 m (32.8 ft by 16.4 ft) plots about 10 m (32.8 ft) apart (First Creek—east bank, WOC—north and south banks). A total of 11 plots were established at First Creek, and 13 plots were established at WOC. For each plot the following parameters were measured: trees (≥ 3 in. diameter at breast height)—measured, shrub stems (< 3 in. diameter at breast height)—counted, percent groundcover, percent canopy cover, canopy height, vegetation overhang (in centimeters) for each stream bank.

Fish and benthic community monitoring results were evaluated as an indicator of whether or not the stream sections were functioning as suitable habitat for instream organisms. Benthic macroinvertebrate community data were gathered at First Creek (July 6, 2012) and WOC (July 6, 2012) using an EPA approved rapid qualitative assessment technique. At each site seven aquatic habitats were identified and sampled for aquatic macroinvertebrates, riffles, leaf packs, woody debris, rocks, root wads, aquatic vegetation, and instream sediment deposition. These habitats were located within 100 m (328 ft) upstream and downstream of the sampling site established along each reach. Habitats missing from the site were not sampled. After all habitats were sampled, a tally of each insect family was completed to determine the number of families represented by EPT. BMAP fish survey data used for evaluation of First Creek were from close proximity to the subject reach. The fish community data used for evaluation of the WOC site were from data taken during routine BMAP surveys within the creek. The fish communities within these reaches were monitored using a multiple pass removal estimate method (Ryon 2011). The sample sites were isolated by block nets, multiple passes were made using backpack or barge electrofishers, and all stunned fish were collected. Fish were identified by species, measured for length and weight, and returned to the site.

The results of habitat measurements conducted along the First Creek reach in 2012 showed that the creek continued to provide good overall habitat and remained in a nonimpaired state. The relatively linear condition of the creek was evidence of past channelization with the development of the area. Relatively narrow riparian zones are a weakness of the site from the perspective of providing good quality habitat. However, riparian zones in this area are restricted by paved and landscaped areas because the creek runs through a developed area. Mitigation plantings on the east side of the creek have improved habitat quality in that area over original habitat conditions that included large mowed turf grass areas and a high number of invasive plant species. The riparian zone on the west side is highly restricted because of the close proximity of landscaped and parking areas associated with a building complex. Cover is maintained to the maximum extent possible in this narrow zone. The presence of invasive plants such as winter creeper and thorny olive in these zones is a potential concern.

The survival rates of east side First Creek riparian plantings have been good thus far. In general, planted vegetation appears to be thriving. However, some areas of dead plant growth were noted during the 2012 survey. Dense growths of shrubs previously existing on the site (e.g., silky dogwood, spicebush) provided significant cover along the creek banks, particularly along northern portions of the study area. Overall conditions at the site related to vegetation growth and success remain very good. There are plans to replace some of the dead plants to further improve coverage.

A moderately diverse benthic macroinvertebrate population was recorded at the First Creek site in 2012, although somewhat lower than at some reference sites. This included some less tolerant taxa typically found in clear streams. Fish population densities (sampled upstream and downstream of the site) fell within the ranges of densities observed in certain reference streams on ORR. The number of fish species at both upstream and downstream sampling locations was lower than numbers observed in reference streams.

The third year of post-mitigation monitoring for the First Creek site will be conducted in the summer of 2013.

The results of habitat measurements conducted along the WOC reach showed that the creek provided average to good overall habitat in the post-mitigation condition and remained in a nonimpaired state. Epifaunal substrate was somewhat lacking in the presence of logs and snags; however, the creek provided numerous riffles, some undercut banks, a variety of particle sizes, and overhanging branches. One velocity/depth regime (fast-deep) was missing from the reach. Channel alteration from past development of the area was evident along some areas of the reach. Vegetative protection at the banks had greatly improved due to the presence of significantly fewer invasive plants, a result of the mitigation efforts taken. Riparian vegetative zone width had also significantly improved over the 2011 pre-mitigation conditions. Plant species diversity was significantly higher and invasive species presence significantly lower in the WOC riparian zone for the 2012 survey period, mainly due to mitigation completed after the 2011 survey. Areas of higher habitat quality were found directly adjacent to the creek, where green ash, black willow, eastern redbud, and silky dogwood were prevalent.

A moderately diverse benthic macroinvertebrate population was recorded at the WOC site in 2012. This included some of the more tolerant taxa found in ORR streams. Fish population densities sampled within the reach were within the ranges of reference streams on ORR. The number of fish species recorded tended to be lower than reference streams.

The second year of post-mitigation monitoring for the WOC site will be conducted in the summer of 2013.

Wetland assessments were conducted for four sites at ORNL during 2012 to determine whether jurisdictional wetlands were present in areas adjacent to proposed projects. These included a power line right-of-way maintenance project, a sanitary sewer system tie-in for a new lift station, two access roads, and a parking lot. These sites were checked to see whether any areas satisfied USACE wetland protocols for soils, hydrology, and vegetation. Small areas of wetlands were flagged at each site, and riparian zones along creeks were also evaluated at two of the sites.

5.3.13 Radiological Clearance of Property at Oak Ridge National Laboratory

5.3.13.1 General Property Clearance Processes

DOE O 458.1, *Radiation Protection of the Public and the Environment* (DOE 2011c), replaced DOE O 5400.5 for reporting year 2012. Like DOE O 5400.5, DOE O 458.1 established standards and requirements for operations of DOE and its contractors with respect to protection of members of the public and the environment against undue risk from radiation. In addition to discharges to the environment, the release of property containing residual radioactive material is a potential contributor to the dose received by the public, and DOE O 458.1 established requirements for clearance of property from DOE control and for public notification of clearance of property.

At ORNL, UT-Battelle uses a graded approach for release of material and equipment for unrestricted public use. Material that may be released to the public has been categorized so that in some cases an administrative release can be accomplished without a radiological survey. Such material originates from nonradiological areas and includes items such as the following:

- documents, mail, diskettes, compact disks, and other office media;
- nonradioactive items or materials received that are immediately (within the same shift) determined to have been misdelivered or damaged;
- personal items or materials;
- paper, plastic products, ABCs, toner cartridges, and other items released for recycling;
- office trash;
- housekeeping materials and associated waste;
- breakroom, cafeteria, and medical wastes;
- medical and bioassay samples; and
- other items with an approved release plan.

Items originating from nonradiological areas within the site's controlled areas not in the listed categories are surveyed before release to the public, or a process knowledge evaluation is conducted to ensure that material has not been exposed to radioactive material or beams of radiation capable of creating radioactive material. In some cases both a radiological survey and a process knowledge evaluation are performed (e.g., a radiological survey is conducted on the outside of the item and a process knowledge form is signed by the custodian for inaccessible surfaces). A similar approach is used for material released to state-permitted landfills on ORR. The only exception is for items that could be internally contaminated; these items are also sampled by laboratory analysis to ensure that landfill permit criteria are met.

When the process knowledge approach is used, the item's custodian is required to sign a statement that specifies the history of the material and confirms that no radioactive material has passed through or contacted the item. This process knowledge certification is more stringent than what is allowed by DOE O 458.1 (DOE 2011c) in that ORNL requires an individual to take personal responsibility and accountability for knowing the complete history of an item before it can be cleared using process knowledge alone. DOE O 458.1 allows use of procedures for evaluating operational records and operating history to make process knowledge release decisions, but UT-Battelle has chosen to continue to require personal certification of the status of an item. This requirement ensures that each individual certifying the item is aware of the significance of this decision and encourages the individual to obtain a survey of the item if he or she is not 100% confident that the item can be certified as free of contamination.

For large recycling programs or clearance of bulk items with low contamination potential a survey and release plan may be developed to direct the radiological survey process. For such projects, survey and release plans are developed based on guidance from MARSSIM or MARSAME (NRC 2000, 2009). MARSSIM and MARSAME allow for statistically based survey protocols that typically require survey measurements for a representative portion of the items being released. The survey protocols are documented in separate survey and release plans, and the measurements from such surveys are documented in radiological release survey reports.

UT-Battelle continues to use the preapproved authorized limits for surface contamination previously established in Table IV-1 of DOE O 5400.5 and the November 17, 1995, Pelletier memorandum (Pelletier

1995) for TRU alpha contamination. UT-Battelle also continues to follow the requirements of the scrap metal suspension. No scrap metal directly released from radiological areas is being recycled.

In 2012, UT Battelle cleared more than 20,000 items through the excess items and property sales processes. A summary of items requested for release through these processes (including donations, transfers, landfill, reutilization, and sales) is shown in Table 5.9.

Items advertised for public sale via an auction are also surveyed independently on a random basis by State of Tennessee personnel, giving further assurance that contaminated material and equipment are not being inadvertently released.

Table 5.9. Excess items requested for release and/or recycling, calendar year 2012

	Process knowledge	Radiologically surveyed
Release request totals for calendar year 2012		
Computers-for-Learning	319	53
DOE—Donations	1	0
Donations	992	736
LEDP (donations to colleges/universities)	0	3
Other Federal Agencies Transfers	256	110
DOE Transfers	382	233
Landfill	42	13
Reutilization at ORNL	2,204	1,140
Sales	10,377	5,015
Totals	14,573	7,303
Recycling request totals for calendar year 2012		
Used Oils (gallons)	19,552[a]	25,830[b]
Scrap Metal (nonradiological areas) (tons)	283.56	
Used Tires (each)	867	
Used Auto Cores and Batteries (pounds)	25,888	

[a]Less than 2 ppm PCBs.
[b]Greater than 2 ppm and less than 50 ppm PCBs.

Abbreviations
DOE = US Department of Energy
LEDP = Laboratory Equipment Donation Program
ORNL = Oak Ridge National Laboratory
PCB = polychlorinated biphenyl

5.3.13.2 Authorized Limits Clearance Process for Spallation Neutron Source and High Flux Isotope Reactor Neutron Scattering Experiment Samples

The SNS and HFIR facilities provide unique neutron scattering experiment capabilities that allow researchers to explore the properties of various materials by exposing samples to well-characterized neutron beams. Because materials exposed to neutrons can become radioactive, a process has been developed to evaluate and clear samples for release to off-site facilities. DOE regulations and orders governing radiological release of material do not specifically cover items that may have radioactivity distributed throughout the volume of the material. To address sample clearance, activity-based limits were established using the authorized limits process originally defined in DOE O 5400.5 (later replaced by DOE O 458.1) and associated guidance. The sample clearance limits were based on an assessment of potential doses against a threshold of 1 mrem/year to an individual and evaluation of other potentially applicable requirements (i.e., US Nuclear Regulatory Commission licensing regulations). Implementation of the clearance limits involves use of unique instrument screening and sample activity prediction methods to provide an efficient and defensible process to release neutron scattering experiment samples to researchers without further DOE control.

In 2012 the authorized limits process for clearing SNS and HFIR neutron scattering samples was updated and revised to incorporate improvements in the regulatory notification component based on experience gained over about 2 years of implementation.

UT-Battelle initiated an effort to make direct contact with each institution's radiation safety officer (RSO) or health and safety official for the initial authorized limit sample clearance to that institution. The purpose of this approach was to ensure that a responsible official at the institution was informed of and understood the regulatory requirements associated with clearance of samples under the approved authorized limits. This "direct contact" approach proved to be much more effective than the previous approach of relying on use of the official user agreement to ensure that regulatory requirements were understood by the receiving institution. On May 2, 2012, UT-Battelle requested DOE approval of a minor change to the SNS and HFIR sample authorized limits process to replace the user agreement form as the primary regulatory notification tool with initial direct contact with an RSO or other health and safety official at the institution. This change was approved by DOE on May 22, 2012. No changes were made to the sample clearance activity thresholds or to the basic process for evaluating samples for clearance previously approved by DOE.

In 2012 ORNL cleared seven samples from neutron scattering experiments using the SNS and HFIR sample authorized limits process.

5.4 Air Quality Program

5.4.1 Construction and Operating Permits

Permits issued by the State of Tennessee convey the clean air requirements that are applicable to ORNL. New projects are governed by construction permits until converted to operating status. The sitewide Title V Major Source Operating Permit includes requirements that are generally applicable to large operations such as a national laboratory (e.g., asbestos and stratospheric ozone), as well as specific requirements directly applicable to individual air emission sources. Source-specific requirements include Rad-NESHAPs (see Section 5.4.3), requirements applicable to sources of ambient air criteria pollutants, and requirements applicable to sources of other HAPs (nonradiological). In April 2009, an application was submitted to the State of Tennessee to renew this sitewide permit and the application was also updated in September 2010. As a result, the State of Tennessee issued a new sitewide Title V Operating Permit to DOE–UT-Battelle on September 1, 2011.

In 2012 UT-Battelle applied for and received a construction permit for CFTF. CFTF is located off-site at the Heritage Center, in Oak Ridge, Tennessee. CFTF, which is expected to start up in April 2013, will be a Title V Major Source Facility. The Knox County Department of Air Quality Management worked with site personnel to incorporate one construction permit and three operating permits into one consolidated operating permit for all permitted activities at CFTF, thereby streamlining future permitting and annual reporting for this facility.

DOE-WAI has an operating air permit for one emission source at TWPC. DOE-Isotek has a Title V Major Source Operating permit for the Radiochemical Development Facility (Building 3019 complex). During 2012, no permit limits were exceeded.

5.4.2 National Emission Standards for Hazardous Air Pollutants—Asbestos

Numerous facilities, structures, and facility components and various pieces of equipment at ORNL contain ACM. UT-Battelle's Asbestos Management Program manages the compliance of work activities involving the removal and disposal of ACM, which includes notifications to TDEC for all demolition activities and required renovation activities, approval of asbestos work authorization requests, current use of engineering controls and work practices, inspections, air monitoring, and waste tracking of asbestos-contaminated waste material. No releases of reportable quantities of ACM occurred at ORNL during 2012.

5.4.3 Oak Ridge National Laboratory Radiological Airborne Effluent Monitoring

Radioactive airborne discharges at ORNL consist primarily of ventilation air from radioactively contaminated or potentially contaminated areas, vents from tanks and processes, and ventilation for hot cell operations and reactor facilities. (See Appendix E, Table E.1, for a list of radionuclides and associated radioactive half-lives.) The airborne emissions are treated and then filtered with high-efficiency particulate air filters and/or charcoal filters before discharge. Radiological airborne emissions from ORNL consist of solid particulates, adsorbable gases (e.g., iodine), tritium, and nonadsorbable gases (e.g., noble gases).

The major radiological emission point sources for ORNL consist of the following six stacks located in Bethel and Melton Valleys and the SNS Central Exhaust Facility stack located on Chestnut Ridge (Fig. 5.9).

- 2026 Radioactive Materials Analytical Laboratory
- 3020 Radiochemical Development Facility
- 3039 central off-gas and scrubber system, which includes the 3500 and 4500 areas' cell ventilation system, isotope solid-state ventilation system, 3025 area cell ventilation system, 3042 ventilation system, and 3092 central off-gas system
- 7503 Molten Salt Reactor Experiment Facility
- 7880 TWPC
- 7911 Melton Valley complex, which includes HFIR and the Radiochemical Engineering Development Center (REDC)
- 8915 SNS Central Exhaust Facility stack

In 2012 there were 20 minor point/group sources, and emission calculations/estimates were made for each of them.

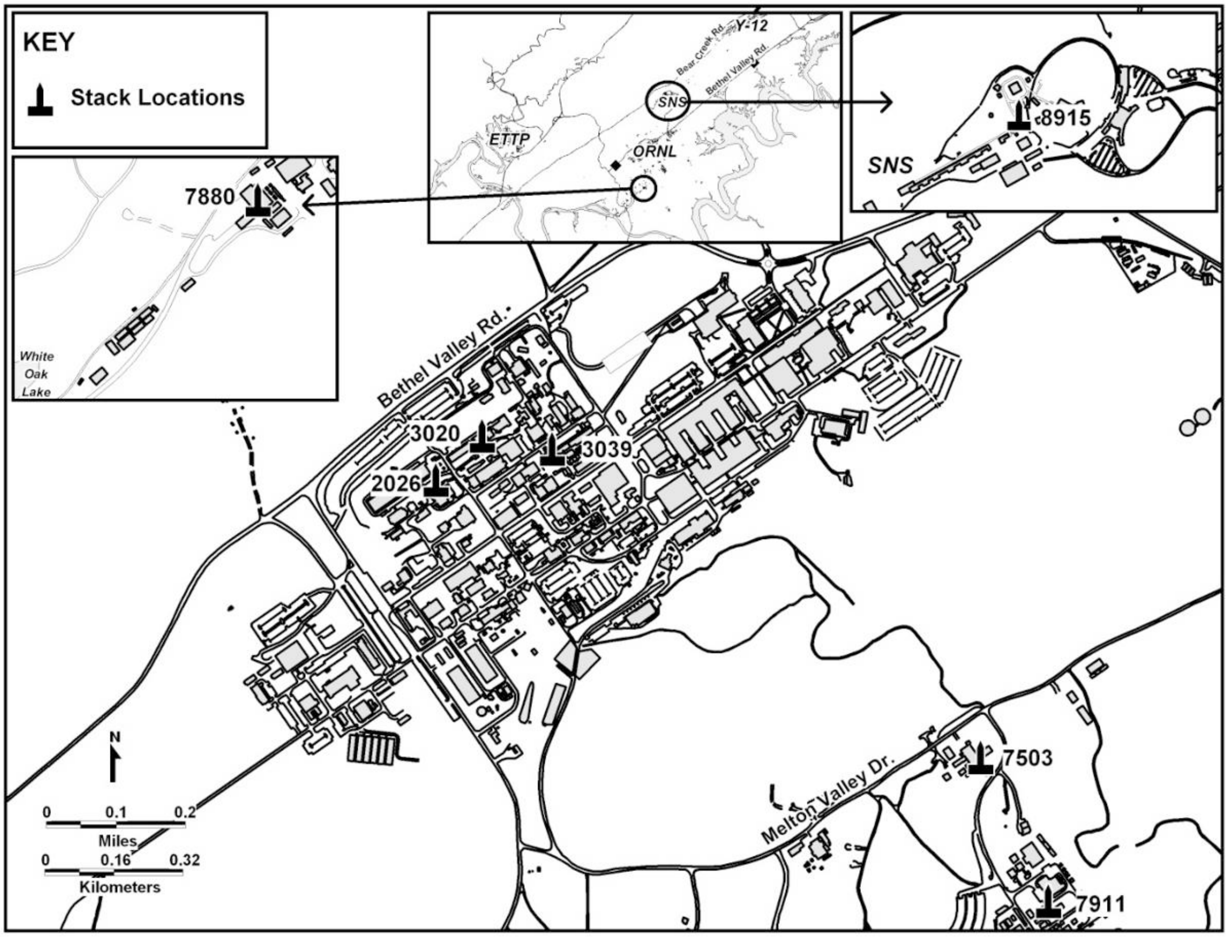

Fig. 5.9. Locations of major radiological emission points at Oak Ridge National Laboratory.

5.4.3.1 Sample Collection and Analytical Procedure

Four of the major point sources (2026, 3020, 3039, and 7503) are equipped with in-stack source-sampling systems that comply with criteria in the American National Standards Institute (ANSI) standard ANSI N 13.1-1969 (ANSI 1969). The sampling systems generally consist of a multipoint in-stack sampling probe, a sample transport line, a particulate filter, activated charcoal cartridges, a silica-gel cartridge (if required), flow-measurement and totalizing instruments, a sampling pump, and a return line to the stack. The 7911 (Melton Valley complex) and 7880 (TWPC) stacks are equipped with in-stack source-sampling systems that comply with criteria in the ANSI Health Physics Society standard ANSI/HPS N13.1-1999 (ANSI 1999). The 7911 sampling system has the same components as the ANSI 1969 sampling systems but uses a stainless-steel-shrouded probe instead of a multipoint in-stack sampling probe. The sampling system also consists of a high-purity germanium detector with a NOMAD analyzer, which allows continuous isotopic identification and quantification of radioactive noble gases (e.g., ^{41}Ar) in the effluent stream. The 7880 sampling system consists of a stainless-steel-shrouded probe, an in-line filter-cartridge holder placed at the probe to minimize line losses, a particulate filter, a sample transport line, a rotary vane vacuum pump, and a return line to the stack. The sample probes from both the ANSI 1969 and ANSI 1999 stack sampling systems are removed, inspected, and cleaned annually. The 8915 (SNS Central Exhaust Facility) stack is equipped with an in-stack radiation detector that complies with criteria in ANSI/HPS N13.1-1999. The detector monitors radioactive gases flowing through the exhaust stack and provides a continual readout of detected activity using a scintillator probe. The detector is calibrated to correlate with isotopic emissions.

Velocity profiles are performed quarterly following the criteria in EPA Method 2 (EPA 2010) at major and some minor sources. The profiles provide accurate stack flow data for subsequent emission-rate calculations. An annual leak-check program is carried out to verify the integrity of the sample transport system. For the 7880 stack, an annual comparison between the effluent flow rate totalizer and EPA Method 2 is performed. The stack effluent-flow-rate monitoring system response is checked quarterly against the manufacturer's instrument test procedures. The stack sampler rotameter is calibrated at least quarterly in comparison with a secondary (transfer) standard. Only a certified secondary standard is used for all rotameter tests.

In addition to the major sources, ORNL has a number of minor sources that have the potential to emit radionuclides to the atmosphere. A minor source is defined as any ventilation system or component such as a vent, laboratory hood, room exhaust, or stack that does not meet the approved regulatory criteria for a major source but that is located in or vents from a radiological control area as defined by Radiological Support Services of the UT-Battelle Nuclear and Radiological Protection Division. Various methods are used to determine the emissions from the various minor sources. Methods used for minor source-emission calculations comply with EPA criteria. The minor sources are evaluated on a 1- to 5-year basis. Emissions, major and minor, are compiled annually to determine the overall ORNL source term and associated dose.

The charcoal cartridges, particulate filters, and silica-gel traps are collected weekly to biweekly. The use of charcoal cartridges is a standard method for capturing and quantifying radioactive iodine in airborne emissions. Gamma spectrometric analysis of the charcoal samples quantifies the adsorbable gases. Analyses are performed weekly to biweekly. Particulate filters are held for 8 days before a weekly gross alpha and gross beta analysis to minimize the contribution from short-lived isotopes such as ^{220}Rn and its daughter products. At stack 7911, a weekly gamma scan is conducted to better detect short-lived gamma isotopes. The filters are then composited quarterly or semiannually and are analyzed for alpha-, beta-, and gamma-emitting isotopes. At stack 7880, the filters are composited monthly and analyzed for alpha-, beta-, and gamma-emitting isotopes. The sampling system on stack 7880 requires no other type of radionuclide collection media. Compositing provides a better opportunity for quantification of the low-concentration isotopes. Silica-gel traps are used to capture water vapor that may contain tritium. Analysis is performed weekly to biweekly. At the end of the year, the sample probes for all of the stacks are rinsed, except for 8915 and 7880, and the rinsate is collected and submitted for isotopic analysis identical to that performed on the particulate filters. A probe-cleaning program has been determined unnecessary for 8915 because the sample probe is a scintillator probe used to detect radiation and not to extract a sample of stack exhaust emissions. It is not anticipated that contaminant deposits would collect on the scintillator probe. A probe-cleaning program for 7880 has established that rinse analysis has historically shown no detectable contamination. Therefore, the frequency of probe rinse collection and analysis is no more often than every 3 years unless there is an increase in particulate emissions, increase in detectable radionuclides in the sample media, or process modifications.

The data from the charcoal cartridges, silica gel, probe wash, and filter composites are compiled to give the annual emissions for each major source and some minor sources.

5.4.3.2 Results

Annual radioactive airborne emissions for ORNL in 2012 are presented in Table 5.10. All data presented were determined to be statistically different from zero at the 95% confidence level. Any number not statistically different from zero was not included in the emission calculation. Because measuring a radionuclide requires counting random radioactive emissions from a sample, the same result may not be obtained if the sample is analyzed repeatedly. This deviation is referred to as the "counting uncertainty." Statistical significance at the 95% confidence level means that there is a 5% chance that the results could be erroneous.

Table 5.10. Radiological airborne emissions from all sources at ORNL, 2012 (Ci)[a]

Isotope	Inhalation form[b]	Chemical form	Stack								
			X-2026	X-3020	X-3039	X-7503	X-7880	X-7911	X-8915	Total minor source	ORNL total
^{225}Ac	M	unspecified								3.63E-08	3.63E-08
^{228}Ac	M	unspecified								1.75E-06	1.75E-06
^{110m}Ag	M	unspecified								1.39E-08	1.39E-08
^{110m}Ag	S	unspecified					8.03E-06			2.24E-08	8.05E-06
^{241}Am	M	unspecified	3.10E-07	4.81E-07				6.10E-07		1.67E-07	1.57E-06
^{241}Am	F	unspecified			1.13E-06	1.90E-07	1.65E-06			6.08E-07	3.58E-06
^{243}Am	M	unspecified								1.02E-08	1.02E-08
^{41}Ar	G	unspecified						6.69E+02	9.50E+00		6.79E+02
^{139}Ba	M	unspecified						1.92E-01			1.92E-01
^{140}Ba	S	unspecified					1.83E-04				1.83E-04
^{140}Ba	M	unspecified						3.23E-04		1.54E-10	3.23E-04
^{7}Be	M	unspecified	1.55E-07	1.45E-07				4.24E-07		2.21E-06	2.94E-06
^{7}Be	S	unspecified			6.26E-06	7.48E-08	8.06E-05			5.80E-06	9.27E-05
^{211}Bi	M	unspecified								5.82E-11	5.82E-11
^{212}Bi	S	unspecified								2.84E-13	2.84E-13
^{214}Bi	M	unspecified								6.08E-07	6.08E-07
^{249}Bk	M	unspecified								7.00E-11	7.00E-11
^{11}C	G	dioxide							3.34E+03		3.34E+03
^{14}C	G	dioxide								5.00E-10	5.00E-10
^{14}C	M	particulate								1.39E-18	1.39E-18
^{45}Ca	M	unspecified								3.36E-13	3.36E-13
^{141}Ce	M	unspecified								2.06E-08	2.06E-08
^{144}Ce	M	unspecified								4.09E-07	4.09E-07
^{249}Cf	F	unspecified								1.11E-13	1.11E-13
^{252}Cf[c]	M	unspecified						4.59E-09		5.83E-08	6.29E-08
^{36}Cl	M	unspecified								5.00E-10	5.00E-10
^{242}Cm	M	unspecified								3.01E-11	3.01E-11
^{243}Cm	M	unspecified						4.40E-08		3.83E-08	8.22E-08
^{243}Cm	F	unspecified				1.16E-08	7.60E-07			1.55E-08	7.87E-07
^{244}Cm	F	unspecified			1.37E-07	1.16E-08	7.60E-07			3.45E-06	4.35E-06

Table 5.10. (continued)

Isotope	Inhalation form[b]	Chemical form	Stack								
			X-2026	X-3020	X-3039	X-7503	X-7880	X-7911	X-8915	Total minor source	ORNL total
^{244}Cm	M	unspecified	3.47E-07	2.49E-08				4.40E-08		7.43E-07	1.16E-06
^{245}Cm	M	unspecified								1.03E-09	1.03E-09
^{246}Cm	M	unspecified								3.73E-13	3.73E-13
^{247}Cm	M	unspecified								6.84E-14	6.84E-14
^{248}Cm[d]	F	unspecified								1.11E-13	1.11E-13
^{57}Co	M	unspecified								5.07E-07	5.07E-07
^{57}Co	S	unspecified								2.30E-14	2.30E-14
^{58}Co	S	unspecified								7.58E-13	7.58E-13
^{58}Co	M	unspecified								2.09E-11	2.09E-11
^{60}Co	M	unspecified								3.48E-05	3.48E-05
^{60}Co	S	unspecified			6.97E-07		1.11E-05			3.80E-07	1.22E-05
^{51}Cr	M	unspecified								7.80E-10	7.80E-10
^{134}Cs	F	unspecified								3.69E-07	3.69E-07
^{134}Cs	S	unspecified					7.81E-06			2.03E-13	7.81E-06
^{137}Cs	F	unspecified	1.11E-06	1.27E-06				4.63E-06		9.17E-05	9.87E-05
^{137}Cs	S	unspecified			8.16E-05	1.77E-08	9.43E-06			7.00E-04	7.91E-04
^{138}Cs	F	unspecified						5.47E+02			5.47E+02
^{138}Cs	S	unspecified			7.72E-02						7.72E-02
^{253}Es	M	unspecified								6.24E-10	6.24E-10
^{152}Eu	M	unspecified								2.21E-07	2.21E-07
^{154}Eu	M	unspecified								2.02E-07	2.02E-07
^{155}Eu	M	unspecified								1.00E-08	1.00E-08
^{55}Fe	M	unspecified								1.23E-08	1.23E-08
^{59}Fe	M	unspecified								1.36E-08	1.36E-08
^{59}Fe	S	unspecified								6.50E-14	6.50E-14
^{153}Gd	M	unspecified								2.15E-10	2.15E-10
^{3}H	V	vapor	8.03E-02		4.73E+00	1.55E+00		1.39E+02	2.89E+02	7.68E-01	4.35E+02
^{175}Hf	M	unspecified								1.22E-12	1.22E-12
^{181}Hf	M	unspecified								1.22E-08	1.22E-08
^{203}Hg	M	inorganic								2.16E-07	2.16E-07
^{166m}Ho	M	unspecified								1.00E-04	1.00E-04

Table 5.10. (continued)

Isotope	Inhalation form[b]	Chemical form	Stack								
			X-2026	X-3020	X-3039	X-7503	X-7880	X-7911	X-8915	Total minor source	ORNL total
^{123}I	V	vapor							1.17E+00		1.17E+00
^{124}I	F	particulate								5.48E-09	5.48E-09
^{125}I	V	vapor							1.77E-01		1.77E-01
^{125}I	F	particulate								9.43E-07	9.43E-07
^{126}I	F	particulate								4.64E-06	4.64E-06
^{129}I	F	particulate					7.78E-06			1.26E-09	7.78E-06
^{129}I	V	vapor								5.56E-05	5.56E-05
^{130}I	F	particulate								2.68E-10	2.68E-10
^{131}I	F	particulate			7.57E-03		9.28E-05	1.09E-01		3.00E-02	1.47E-01
^{132}I	F	particulate			1.95E-03			5.68E-01			5.70E-01
^{133}I	F	particulate			7.77E-05			3.91E-01		2.05E-10	3.91E-01
^{134}I	F	particulate						1.42E+00			1.42E+00
^{135}I	F	particulate						1.08E+00		1.87E-32	1.08E+00
^{192}Ir	M	unspecified								2.35E-07	2.35E-07
^{40}K	S	unspecified								3.69E-07	3.69E-07
^{40}K	M	unspecified								8.25E-06	8.25E-06
^{79}Kr	G	unspecified								1.46E-13	1.46E-13
^{81}Kr	G	unspecified								4.21E-12	4.21E-12
^{85}Kr	G	unspecified						5.99E+02		4.20E-04	5.99E+02
^{85m}Kr	G	unspecified						2.56E+00	6.27E+00		8.83E+00
^{87}Kr	G	unspecified						3.20E+01			3.20E+01
^{88}Kr	G	unspecified						4.75E+01	6.19E+00		5.37E+01
^{89}Kr[e]	G	unspecified						2.95E+01			2.95E+01
^{140}La	S	unspecified					7.10E-05				7.10E-05
^{140}La	M	unspecified						6.83E-04		1.95E-10	6.83E-04
^{54}Mn	S	unspecified					8.94E-06			2.52E-13	8.94E-06
^{54}Mn	M	unspecified								9.23E-10	9.23E-10
^{93}Mo	M	unspecified								1.72E-14	1.72E-14
^{13}N	G	unspecified							7.31E+01		7.31E+01
^{22}Na	M	unspecified								3.72E-14	3.72E-14
^{93m}Nb	M	unspecified								6.87E-13	6.87E-13

Table 5.10. (continued)

Isotope	Inhalation form[b]	Chemical form	Stack								
			X-2026	X-3020	X-3039	X-7503	X-7880	X-7911	X-8915	Total minor source	ORNL total
^{94}Nb	S	unspecified								1.25E-08	1.25E-08
^{94}Nb	M	unspecified								1.24E-17	1.24E-17
^{95}Nb	M	unspecified								3.90E-09	3.90E-09
^{95m}Nb	M	unspecified								6.58E-18	6.58E-18
^{147}Nd	M	unspecified								1.88E-12	1.88E-12
^{59}Ni	M	particulate								4.65E-21	4.65E-21
^{63}Ni	M	particulate								6.49E-09	6.49E-09
^{237}Np	M	unspecified								8.05E-08	8.05E-08
^{239}Np	M	unspecified								3.06E-09	3.06E-09
^{191}Os	M	unspecified						4.18E-08			4.18E-08
^{191}Os	S	unspecified								9.84E-13	9.84E-13
^{32}P	M	unspecified								2.31E-17	2.31E-17
^{33}P	M	unspecified								2.17E-22	2.17E-22
^{210}Pb	M	unspecified								2.53E-11	2.53E-11
^{212}Pb	M	unspecified	5.33E-01	5.37E-01				1.94E-02		2.20E-06	1.09E+00
^{212}Pb	S	unspecified			9.04E-01	1.28E-01				3.17E-02	1.06E+00
^{214}Pb	M	unspecified								2.50E-13	2.50E-13
^{147}Pm	M	unspecified								1.41E-14	1.41E-14
^{215}Po	M	inorganic								3.24E-10	3.24E-10
^{216}Po	M	inorganic								2.16E-10	2.16E-10
^{238}Pu	F	unspecified			3.57E-07	5.57E-08	1.49E-06			2.76E-07	2.18E-06
^{238}Pu	M	unspecified	1.07E-07	1.43E-07				2.45E-07		2.24E-07	7.19E-07
^{239}Pu	F	unspecified			1.71E-06	3.43E-08	6.55E-07			1.24E-07	2.52E-06
^{239}Pu	M	unspecified	1.13E-07	2.23E-07				3.52E-08		6.08E-08	4.32E-07
^{240}Pu	F	unspecified					6.55E-07			9.79E-09	6.65E-07
^{240}Pu	M	unspecified						3.52E-08		4.97E-08	8.49E-08
^{241}Pu	F	unspecified								4.17E-11	4.17E-11
^{241}Pu	M	unspecified								6.88E-10	6.88E-10
^{242}Pu	M	unspecified								4.27E-09	4.27E-09
^{223}Ra	M	unspecified								4.64E-11	4.64E-11
^{224}Ra	M	unspecified								1.44E-12	1.44E-12

Table 5.10. (continued)

Isotope	Inhalation form[b]	Chemical form	Stack								
			X-2026	X-3020	X-3039	X-7503	X-7880	X-7911	X-8915	Total minor source	ORNL total
^{225}Ra	M	unspecified								4.62E-06	4.62E-06
^{228}Ra	M	unspecified								1.75E-06	1.75E-06
^{88}Rb	M	unspecified							7.78E-01		7.78E-01
^{186}Re	M	unspecified								1.03E-18	1.03E-18
^{219}Rn	G	unspecified								3.80E-11	3.80E-11
^{103}Ru	M	particulate								6.88E-09	6.88E-09
^{103}Ru	S	particulate					1.14E-05				1.14E-05
^{106}Ru	M	particulate								2.81E-06	2.81E-06
^{106}Ru	S	particulate					7.09E-05			1.00E-12	7.09E-05
^{35}S	M	inorganic								5.03E-10	5.03E-10
^{124}Sb	M	unspecified								2.02E-07	2.02E-07
^{124}Sb	S	unspecified			6.30E-06						6.30E-06
^{125}Sb	S	unspecified			2.48E-06					5.24E-07	3.00E-06
^{125}Sb	M	unspecified								1.41E-08	1.41E-08
^{46}Sc	M	unspecified								5.20E-18	5.20E-18
^{75}Se	S	unspecified			1.90E-04		8.24E-06				1.98E-04
^{32}Si	M	unspecified								4.64E-22	4.64E-22
^{113}Sn	M	unspecified								2.84E-11	2.84E-11
^{117m}Sn	M	unspecified								5.78E-12	5.78E-12
^{119m}Sn	M	unspecified								1.00E-18	1.00E-18
^{121m}Sn	M	unspecified								1.12E-12	1.12E-12
^{89}Sr	M	unspecified	1.36E-07	5.55E-07				1.25E-05		5.78E-12	1.31E-05
^{89}Sr	S	unspecified			9.90E-05	2.50E-08				4.65E-05	1.46E-04
^{90}Sr	M	unspecified	1.36E-07	5.55E-07				1.25E-05		1.91E-04	2.04E-04
^{90}Sr	S	unspecified			9.90E-05	2.50E-08	8.48E-06			1.62E-04	2.69E-04
^{179}Ta	M	unspecified								5.95E-14	5.95E-14
^{182}Ta	M	unspecified								3.59E-11	3.59E-11
^{99}Tc	S	unspecified					1.02E-05				1.02E-05
^{99}Tc	M	unspecified								3.20E-08	3.20E-08
^{125m}Te	M	particulate								1.44E-12	1.44E-12
^{129m}Te	M	particulate								7.52E-07	7.52E-07

Table 5.10. (continued)

Isotope	Inhalation form[b]	Chemical form	Stack								
			X-2026	X-3020	X-3039	X-7503	X-7880	X-7911	X-8915	Total minor source	ORNL total
^{227}Th	S	unspecified								3.00E-08	3.00E-08
^{228}Th	S	unspecified	1.12E-09	1.40E-08	4.52E-08	5.59E-09		3.68E-08		1.07E-07	2.10E-07
^{229}Th	S	unspecified								3.33E-12	3.33E-12
^{230}Th	S	unspecified	3.55E-09	1.63E-09				5.48E-09		7.10E-08	8.17E-08
^{230}Th	F	unspecified			4.18E-09	1.21E-09				2.75E-08	3.29E-08
^{232}Th	F	unspecified			3.10E-09	3.61E-10				4.50E-09	7.96E-09
^{232}Th	S	unspecified	5.48E-10	1.31E-09				1.99E-09		1.00E-03	1.00E-03
^{234}Th	S	unspecified								8.12E-06	8.12E-06
^{208}Tl	M	unspecified								1.11E-13	1.11E-13
^{232}U	M	unspecified								4.48E-14	4.48E-14
^{233}U	S	unspecified				1.23E-08	5.45E-07			7.06E-06	7.62E-06
^{233}U	M	unspecified						6.10E-08		1.12E-11	6.10E-08
^{234}U	M	unspecified	7.41E-08	9.43E-08				6.10E-08		1.58E-04	1.58E-04
^{234}U	S	unspecified			8.96E-08	1.23E-08	5.45E-07			7.48E-06	8.12E-06
^{235}U	M	unspecified	3.78E-09	2.32E-08				3.40E-08		2.64E-05	2.65E-05
^{235}U	S	unspecified			1.05E-08	4.17E-09	1.16E-06			7.13E-07	1.89E-06
^{236}U	S	unspecified								3.92E-07	3.92E-07
^{238}U	M	unspecified	3.94E-09	1.39E-08				2.87E-08		1.22E-03	1.22E-03
^{238}U	S	unspecified			3.32E-08	3.08E-09	1.03E-06			9.23E-07	1.99E-06
^{181}W	M	unspecified								2.23E-11	2.23E-11
^{185}W	M	unspecified								8.44E-11	8.44E-11
^{188}W	M	unspecified								6.15E-14	6.15E-14
^{123}Xe	G	unspecified							1.06E+01		1.06E+01
^{125}Xe	G	unspecified							1.48E+01		1.48E+01
^{127}Xe	G	unspecified								7.16E-08	7.16E-08
^{129m}Xe	G	unspecified								4.91E-06	4.91E-06
^{131m}Xe	G	unspecified						1.66E+02		9.10E-04	1.66E+02
^{133}Xe	G	unspecified						9.14E+00		1.03E-02	9.15E+00
^{133m}Xe	G	unspecified						2.39E+01		9.84E-05	2.39E+01
^{135}Xe	G	unspecified						2.56E+01		9.79E-24	2.56E+01
^{135m}Xe	G	unspecified						2.15E+01			2.15E+01

Table 5.10. (continued)

Isotope	Inhalation form[b]	Chemical form	Stack								
			X-2026	X-3020	X-3039	X-7503	X-7880	X-7911	X-8915	Total minor source	ORNL total
^{137}Xe[f]	G	unspecified						5.48E+01			5.48E+01
^{138}Xe	G	unspecified						7.20E+01			7.20E+01
^{88}Y	F	unspecified					1.07E-05				1.07E-05
^{91}Y	M	unspecified								2.64E-11	2.64E-11
^{65}Zn	F	unspecified					2.08E-05			6.28E-13	2.08E-05
^{65}Zn	M	unspecified								3.59E-09	3.59E-09
^{93}Zr	M	unspecified								4.05E-19	4.05E-19
^{95}Zr	M	unspecified								6.35E-09	6.35E-09
^{95}Zr	S	unspecified					1.78E-05				1.78E-05
Totals			6.13E-01	5.37E-01	5.72E+00	1.68E+00	6.48E-04	2.44E+03	3.75E+03	8.46E-01	6.20E+03

[a]Emissions given in curies (Ci). 1 Ci = 3.7E+10 Bq.

[b]For particulates, fast (F), moderate (M), or slow (S) refers to the form of the isotope inhaled [associated with the rate of dissolution and level of absorption into the blood (EPA 1999)]. For nonparticulates, (G) or (V) refers to the form in which the isotope was inhaled, gas or vapor, respectively.

[c]Californium-248 surrogate for Californium-252

[d]Curium-245 surrogate for Curium-248

[e]Krypton-88 surrogate for Krypton-89

[f]Xenon-135 surrogate for Xenon-137

Abbreviations

ORNL = Oak Ridge National Laboratory

Historical trends for ^{3}H and ^{131}I are presented in Figs. 5.10 and 5.11. For 2012, ^{3}H emissions totaled about 435.1 Ci (Fig. 5.10), an increase from 2011; ^{131}I emissions totaled 0.15 Ci (Fig. 5.11), which was in line with 2011 emissions. The increase in ^{3}H was due to SNS operations and research activities at REDC involving the processing of heavy element targets. For 2012, the major dose contributors to the off-site dose at ORNL were ^{11}C, ^{212}Pb, ^{232}Th, and ^{138}Cs, with dose contributions of about 31%, 24%, 19%, and 6%, respectively. Emissions of ^{11}C result from SNS operations and research activities. Emissions of ^{212}Pb result from the radiation decay of legacy material stored on-site and contamination areas containing isotopes of ^{228}Th, ^{232}Th, and ^{232}U. Emissions of ^{212}Pb were from the following stacks: 2026, 3020, 3039, 7503, 7856, 7935, and 7911, and the STP sludge drier. Emissions of ^{232}Th come from a number of operations and research activities on the ORNL site. Emissions of ^{138}Cs were primarily due to research activities at REDC, which exhaust through the 7911 Melton Valley complex stack. In 2012, ^{138}Cs was also emitted from the 3039 stack. For 2012, ^{11}C emissions totaled 3,340 Ci, ^{212}Pb emissions totaled 2 Ci, ^{232}Th emissions totaled 1.00E−03 Ci, and ^{138}Cs emissions totaled 547 Ci (Fig. 5.12). Emissions of ^{41}Ar totaled 679 Ci and were in line with 2011.

The calculated radiation dose to the maximally exposed individual (MEI) from all radiological airborne release points at ORR during 2012 was 0.3 mrem. The dose contribution to MEI from all ORNL radiological airborne release points was 0.298 mrem. This dose is well below the NESHAPs standard of 10 mrem and is less than 0.1% of the roughly 300 mrem that the average individual receives from natural sources of radiation. (See Section 7.1.2 for an explanation of how the airborne radionuclide dose was determined.)

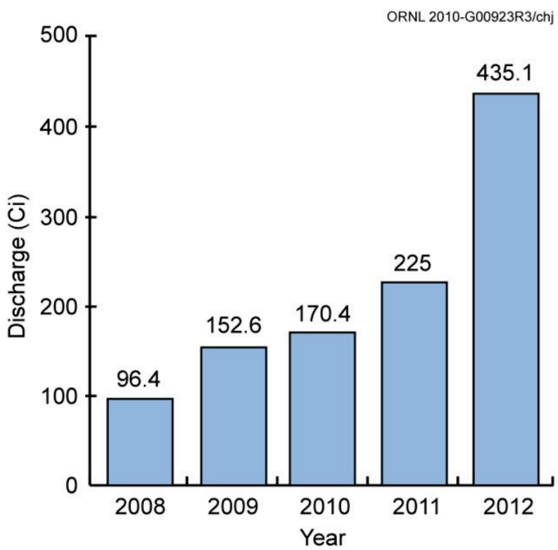

Fig. 5.10. Total curies of ^{3}H discharged from Oak Ridge National Laboratory to the atmosphere, 2008–2012.

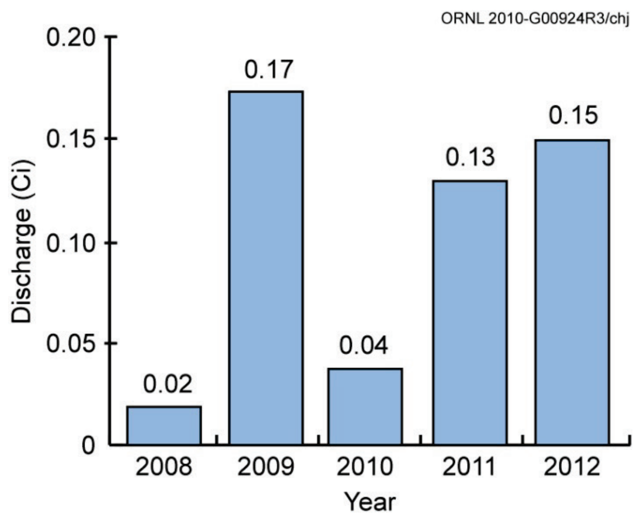

Fig. 5.11. Total curies of ^{131}I discharged from Oak Ridge National Laboratory to the atmosphere, 2008–2012.

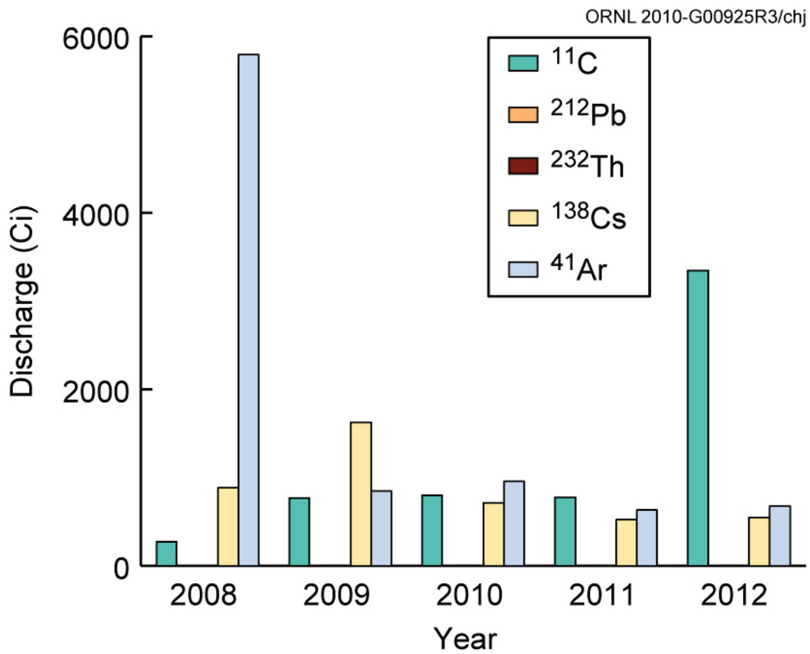

Fig. 5.12. Total curies of ^{41}Ar, ^{138}Cs, ^{212}Pb, ^{125}I, ^{11}C, and ^{238}U discharged from Oak Ridge National Laboratory to the atmosphere, 2007–2011. (Note: Levels of ^{212}Pb and ^{232}Th discharged were too low to accurately depict on this figure (2 Ci and 1.00E−03, respectively.)

5.4.4 Stratospheric Ozone Protection

As required by the CAA Title VI Amendments of 1990, actions have been implemented to comply with the prohibition against intentionally releasing ODSs during maintenance activities performed on refrigeration equipment. In addition, service requirements for refrigeration systems (including motor vehicle air conditioners), technician certification requirements, and labeling requirements have been implemented. ORNL has implemented a plan to phase out the use of all Class I ODSs. All critical applications of Class I ODSs have been eliminated, replaced, or retrofitted with other materials. Work is progressing as funding becomes available for noncritical applications.

5.4.5 Ambient Air

The objectives of the ORNL ambient air monitoring program are to collect samples at site PAM stations located in areas most likely to show impacts of airborne emissions from ORNL and to provide information to support emergency response activities. Four stations, identified as stations 1, 2, 3, and 7, make up the ORNL PAM network (Fig. 5.13). During 2012, sampling was conducted at each station to quantify levels of tritium; uranium; and gross alpha-, beta-, and gamma-emitting radionuclides (Table 5.11).

The sampling system consists of a low-volume air sampler for particulate collection in a 47 mm glass-fiber filter. The filters are collected biweekly, composited annually, then submitted to the laboratory for analysis. A silica-gel column is used for collection of tritium as tritiated water. These samples are typically collected biweekly or weekly, depending on ambient humidity levels, and composited quarterly for tritium analysis.

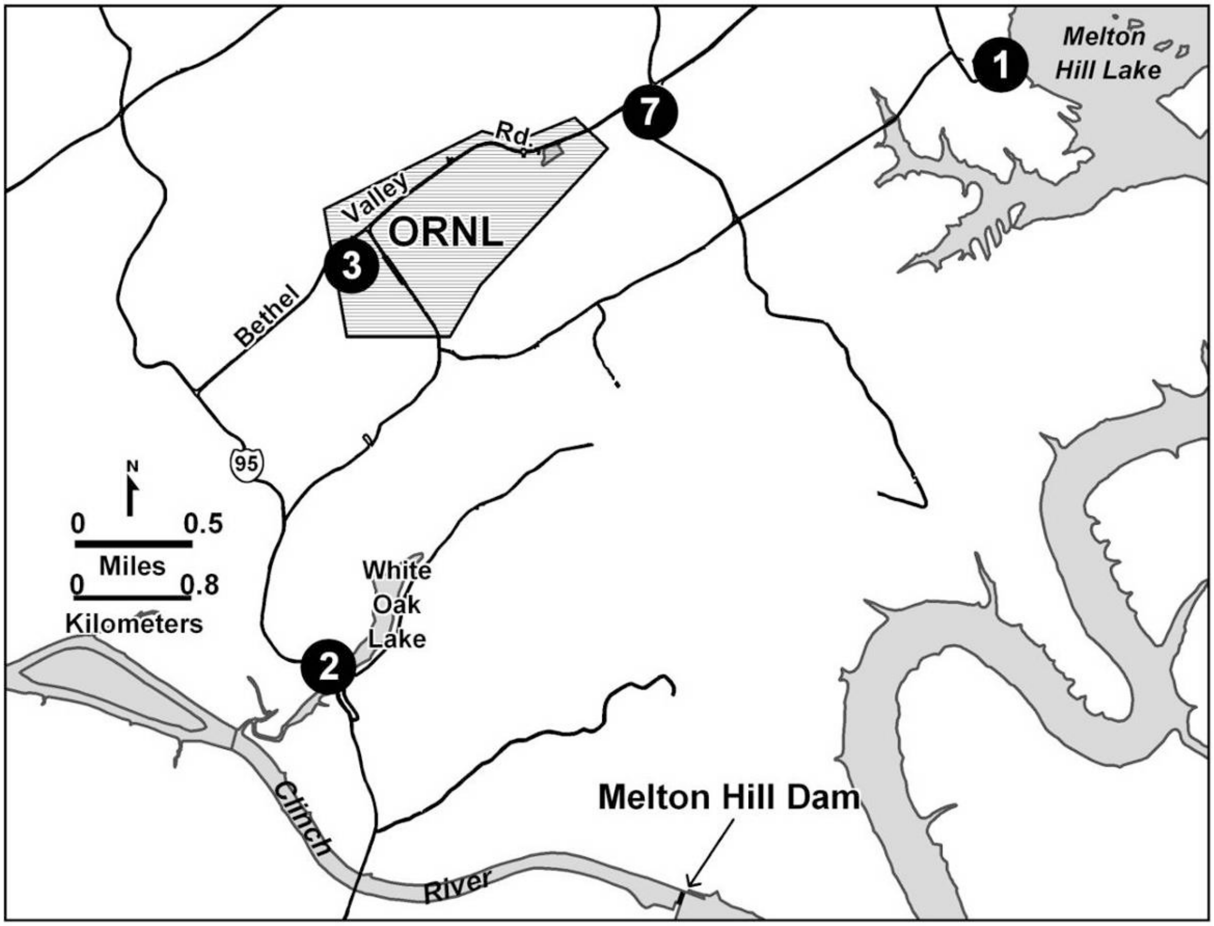

Fig. 5.13. Locations of ambient air monitoring stations at Oak Ridge National Laboratory.

Table 5.11. Radionuclide concentrations (pCi/mL)[a] measured at Oak Ridge National Laboratory perimeter air monitoring stations, 2012

Parameter	Number detected/ sampled	Concentration		
		Average	Minimum	Maximum
		Station 1		
Alpha	4/4	2.34E-09	2.17E-09	2.61E-09
^{7}Be	4/4	4.24E-08	2.48E-08	5.07E-08
Beta	4/4	1.05E-08	9.44E-09	1.15E-08
^{3}H	2/4	4.27E-06	1.14E-06	8.29E-06
^{40}K	0/0	-2.56E-10	-4.75E-10	-1.23E-10
^{234}U	4/4	2.98E-12	2.28E-12	3.71E-12
^{235}U	1/4	2.49E-13	9.91E-14	4.09E-13
^{238}U	4/4	2.21E-12	1.88E-12	2.43E-12
Total U	4/4	5.44E-12	4.68E-12	5.39E-12
		Station 2		
Alpha	1/1	5.04E-09	*b*	*b*
^{7}Be	1/1	1.84E-08	*b*	*b*
Beta	1/1	1.94E-08	*b*	*b*
^{3}H	3/4	3.16E-06	-2.67E-10	1.83E-05

Table 5.11. (continued)

Parameter	Number detected/ sampled	Concentration		
		Average	Minimum	Maximum
^{40}K	0/1	-4.39E-10	*b*	*b*
^{234}U	0/1	3.14E-12	*b*	*b*
^{235}U	0/1	2.35E-12	*b*	*b*
^{238}U	0/1	3.71E-12	*b*	*b*
Total U	0/1	9.19E-12	*b*	*b*
		Station 3		
Alpha	1/1	3.48E-09	*b*	*b*
^{7}Be	1/1	1.83E-08	*b*	*b*
Beta	1/1	1.82E-08	*b*	*b*
^{3}H	2/4	8.77E-07	-2.45E-08	6.77E-06
^{40}K	0/1	1.05E-09	*b*	*b*
^{234}U	0/1	5.97E-12	*b*	*b*
^{235}U	0/1	-1.28E-12	*b*	*b*
^{238}U	1/1	7.07E-12	*b*	*b*
Total U	1/1	1.18E-11	*b*	*b*
		Station 7		
Alpha	1/1	7.95E-09	*b*	*b*
^{7}Be	1/1	2.18E-08	*b*	*b*
Beta	1/1	2.06E-08	*b*	*b*
^{3}H	3/4	9.79E-06	2.59E-06	1.65E-05
^{40}K	0/1	-1.56E-10	*b*	*b*
^{234}U	1/1	4.47E-12	*b*	*b*
^{235}U	0/1	3.73E-13	*b*	*b*
^{238}U	1/1	6.05E-12	*b*	*b*
Total U	1/1	1.09E-11	*b*	*b*

[a] 1 pCi = 3.7×10^{-2} Bq.
[b] Not applicable.

5.4.5.1 Results

The ORNL PAM stations are designed to provide data for collectively assessing the specific impact of ORNL operations on local air quality. Sampling data from the ORNL PAM stations (Table 5.11) are compared with the derived concentration standards (DCSs) for air established by DOE as guidelines for controlling exposure to members of the public. During 2012, average radionuclide concentrations measured for the ORNL network were less than 1% of the applicable DCS in all cases.

5.5 Oak Ridge National Laboratory Water Quality Program

The NPDES permit issued to DOE for the ORNL site, TN 0002941, was renewed by the State of Tennessee in 2008 and includes requirements for discharging wastewaters from the three ORNL on-site wastewater treatment facilities and for the development and implementation of a water quality protection plan (WQPP). The permit calls for WQPP to "establish better linkages between water quality monitoring and detecting and abating water quality and ecological impact." Rather than prescribing rigid monitoring schedules, the ORNL WQPP is flexible, allows an annual assessment of all outfalls, and focuses on significant findings. The WQPP goals are to meet the requirements of the NPDES permit, improve the quality of aquatic resources on the ORNL site, prevent further impacts to aquatic resources from current activities, identify the stressors that contribute to impairment of aquatic resources, use available resources efficiently, and communicate outcomes with decision makers and stakeholders.

The ORNL WQPP was developed by UT-Battelle and approved by TDEC in 2008, and WQPP monitoring was initiated in 2009. WQPP incorporated several control plans that were required under the previous NPDES permit, including a BMAP (ORNL 1986), a chlorine control strategy, an SWPPP (ORNL 2007), a non-storm-water best management practices plan (ORNL 1997), and an NPDES radiological monitoring plan (ORNL 2008). WQPP has been reviewed and revised annually and submitted to TDEC for review and comment.

To prioritize the stressors and/or contaminant sources that may be of greatest concern to water quality and to define conceptual models that would guide any special investigations, the WQPP strategy was defined using EPA's *Stressor Identification Guidance Document* (EPA 2000). Figure 5.14 summarizes this process. The process involves three major steps for identifying the cause of any impairment:

1. list candidate causes of impairment (based on historical data and a working conceptual model),
2. analyze the evidence (using both case study and outside data), and
3. characterize the causes.

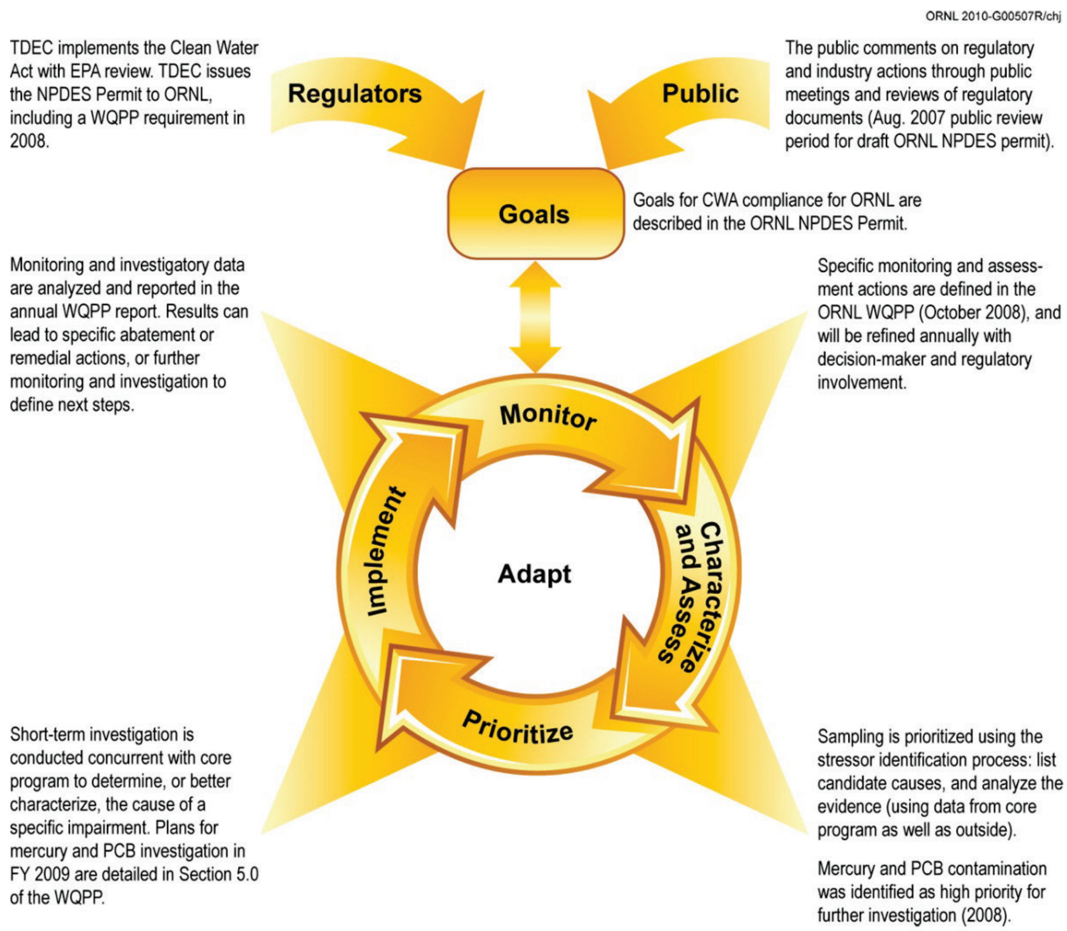

Fig. 5.14. Diagram of the adaptive management framework, with step-wise planning specific to the Oak Ridge National Laboratory Water Quality Protection Plan. [Adapted from the EPA stressor guidance document (EPA 2000).]

The first two steps of the stressor identification process were initiated in 2009, focusing first on mercury impairment (Fig. 5.15) and then on PCBs because mercury and PCB concentrations in fish from WOC are at or near human health risk thresholds (e.g., EPA AWQC and TDEC fish advisory limits). Some of the major sources of mercury to biota in the WOC watershed are known, providing a good basis from which to define an appropriate conceptual model for mercury contamination in WOC. A list of potential causes of PCB contamination was also developed.

After listing potential causes and analyzing the available evidence on mercury and PCB contamination in the WOC watershed, it was clear that additional investigation was needed to complete the third step of the stressor identification process, "characterizing the cause." Special investigations were designed to identify specific source areas and to revise the conceptual model of the major causes of contamination in the WOC watershed.

At the end of each year, monitoring and investigation data collected under the ORNL WQPP will be analyzed, interpreted, reported, and compared with past results in the WQPP annual report. This information will provide a solid, overall assessment of the status of ORNL's receiving-stream watersheds and the impact of ongoing efforts to protect and restore those watersheds and will guide efforts to improve the water quality in the watershed.

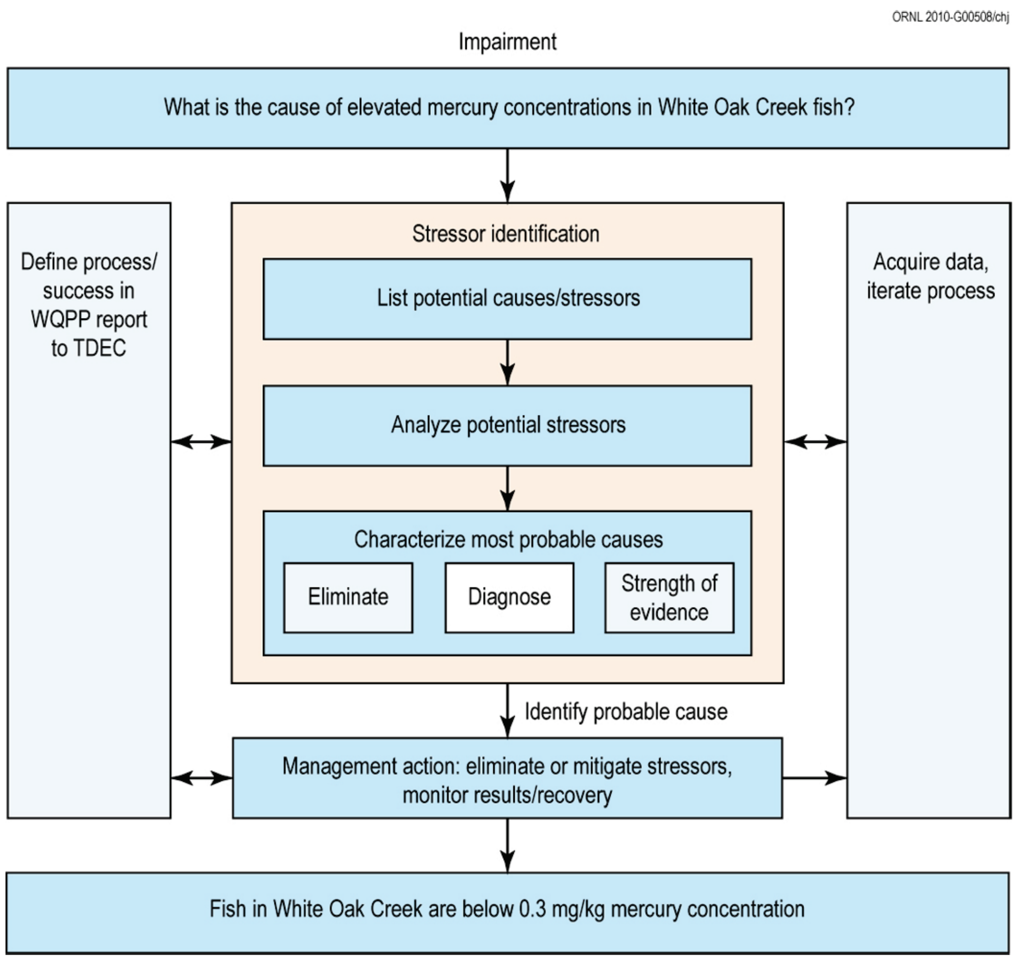

Fig. 5.15. Application of stressor identification guidance to address mercury impairment in the White Oak Creek watershed. [Modified from Figure 1-1 in the EPA stressor guidance document (EPA 2000).]

5.5.1 Treatment Facility Discharges

Three on-site wastewater treatment systems were operated at ORNL in 2012 to provide appropriate treatment of the various R&D, operational, and domestic wastewaters generated by site staff and activities. All three were permitted to discharge treated wastewater and were monitored under NPDES permit TN0002941, issued to DOE for the ORNL site by TDEC. These are the ORNL STP (outfall X01), the ORNL Steam Plant Wastewater Treatment Facility (SPWTF; outfall X02), and the ORNL Process Waste Treatment Complex (PWTC; outfall X12). The ORNL NPDES permit requirements include monitoring the three ORNL wastewater treatment facility effluents for conventional, water-quality-based, and radiological constituents and for effluent toxicity, with numeric parameter-specific compliance limits established by TDEC as determined to be necessary.

The results of field measurements and laboratory analyses to assess compliance for the parameters required by the NPDES permit and rates of compliance with numeric limits established in the permit are also provided in Table 5.12. In 2012, the SPWTF was taken out of service, as modernization of the ORNL Steam Plant included a new reverse-osmosis boiler-water softening system, which eliminated the need for the SPWTF. The SPWTF treatment components were taken offline and are being removed, the SPWTF settling ponds were remediated and backfilled, and the outfall X02 discharge pipe was sealed shut. There will be no discharges from ORNL outfall X02 in the future. ORNL facilities achieved 99.9% compliance with permit limits and conditions in 2012.

Table 5.12. National Pollutant Discharge Elimination System compliance at Oak Ridge National Laboratory, 2012 (NPDES permit effective August 1, 2008)

Effluent parameters	Permit limits					Permit compliance		
	Monthly average (lb/d)	Daily max. (lb/d)	Monthly average (mg/L)	Daily max. (mg/L)	Daily min. (mg/L)	Number of noncompliances	Number of samples	Percentage of compliance[a]
				Outfall 585 (Melton Valley Steam Plant)				
pH (standard units)				9	6	1[b]	6	83.3
				X01 (ORNL STP)				
LC_{50} for *Ceriodaphnia* (%)					69.4	0	2	100
LC_{50} for fathead minnows (%)					69.4	0	2	100
Ammonia, as N (summer)	6.26	9.39	2.5	3.75		0	27	100
Ammonia, as N (winter)	13.14	19.78	5.25	7.9		0	25	100
Carbonaceous biological oxygen demand	19.2	28.8	10	15		0	52	100
Dissolved oxygen					6	0	52	100
Escherichia coliform (col/100 mL)			941	126		0	52	100
IC_{25} for *Ceriodaphnia* (%)					15.5	0	2	100
IC_{25} for fathead minnows (%)					15.5	0	2	100
Oil and grease	19.2	28.8	10	15		0	12	100
pH (standard units)				9	6	0	52	100
Total suspended solids	57.5	86.3	30	45		0	52	100
				X02 (ORNL SPWTF)				
pH (standard units)				9.0	6	0	51	100
Total suspended solids				50		0	6	100
Conductivity				Report		0	51	100
				X12 (PWTC)				
LC_{50} for *Ceriodaphnia* (%)					100	0	2	100
LC_{50} for fathead minnows (%)					100	0	2	100

Table 5.12. (continued)

Effluent parameters	Permit limits					Permit compliance		
	Monthly average (lb/d)	Daily max. (lb/d)	Monthly average (mg/L)	Daily max. (mg/L)	Daily min. (mg/L)	Number of noncompliances	Number of samples	Percentage of compliance[a]
Arsenic, total			0.007	0.014		0	6	100
Cadmium, total	1.73	4.60	0.003	0.038		0	6	100
Chromium, total	11.40	18.46	0.22	0.44		0	6	100
Copper, total	13.8	22.53	0.07	0.11		0	6	100
Cyanide, total	4.33	8.00	0.008	0.046		0	2	100
Lead, total	2.87	4.60	0.028	0.69		0	6	100
IC_{25} for *Ceriodaphnia* (%)					30.5	0	2	100
IC_{25} for fathead minnows (%)					30.5	0	2	100
Oil and grease	66.7	100	10	15		0	12	100
pH (standard units)				9.0	6.0	0	52	100
Temperature (ºC)				30.5		0	52	100
Instream chlorine monitoring points								
Total residual oxidant			0.011	0.019		0	288	100

[a]Percentage compliance = 100 [(number of noncompliances/number of samples) × 100].

[b]The exceedance of an effluent pH limit that occurred at the new ORNL Melton Valley Steam Plant outfall 585 was attributed to the percentage of boiler blowdown in the outfall 585 effluent. As corrective action, the MVSP was shut down until a pump and piping could be installed to redirect the effluent to the ORNL STP for treatment.

Abbreviations

LC_{50} = the concentration (as a percentage of full-strength wastewater) that kills 50% of the test species in 48 h.
IC_{25} = inhibition concentration; the concentration as a percentage of full-strength wastewater that caused 25% reduction in survival, reproduction, or growth of the test organisms.
MVSP = Melton Valley Steam Plant
NPDES = National Pollutant Discharge Elimination System
ORNL = Oak Ridge National Laboratory
PWTC = Process Waste Treatment Complex
SPWTF = Steam Plant Wastewater Treatment Facility
STP = Sewage Treatment Plant

Toxicity testing provides an assessment of any harmful effects that could occur from the total combined constituents in discharges from ORNL wastewater treatment facilities. Effluents from STP and SPWTF have been tested for toxicity to aquatic species under the NPDES permit every year since 1986, and effluents from PWTC have been tested since it went into operation in 1990. Test species have been *Ceriodaphnia dubia*, an aquatic invertebrate, and fathead minnow (*Pimephales promelas*) larvae. These have been tested using EPA chronic and acute test protocols at frequencies ranging from two to four times per year. Test results have been excellent. SPWTF and PWTC effluent have always been shown to be nontoxic. STP has shown isolated indications of effluent toxicity, none recent, but confirmatory tests conducted as required by the permit have shown that either the result of the routine test was an anomaly or that the condition of toxicity that existed at the time of the routine test was temporary and of short duration.

Toxicity test requirements under the current NPDES permit include testing the ORNL STP and PWTC twice per year each, using two test species. As previously mentioned, the ORNL SPWTF was taken permanently out of service in 2012. In 2012, toxicity test results for the ORNL wastewater treatment facilities were once again favorable, with no indication of toxicity in any of the tests that were conducted (Table 5.12).

5.5.2 Residual Bromine and Chlorine Monitoring

Chlorine is added to drinking water as a disinfectant prior to consumption. Chlorine and bromine are added to cooling system water to prevent bacterial growth in the system. When waters are discharged to streams, residual chlorine and bromine can be toxic to fish and other aquatic life. The ORNL NPDES permit controls the discharge of chlorinated and brominated waters, reported as "total residual oxidant" (TRO), by limiting the TRO mass loading from outfalls and the TRO concentration instream. Outfalls with lower potential to discharge chlorinated water are generally monitored semiannually; outfalls with known sources that are dechlorinated are monitored more frequently to ensure operational integrity of the dechlorinator. Instream locations are monitored bimonthly.

NPDES permit outfalls are monitored for TRO to ensure effective operation of cooling towers and dechlorination systems and maintenance of waterlines. When the permit action level of 1.2 g/day is exceeded at an outfall, the staff investigates and implements treatment and reduction measures. TRO is also monitored at instream points twice per month to verify that releases are not creating adverse conditions for fish and other aquatic life.

Thirty-three individual outfalls are checked for TRO semiannually, quarterly, monthly, or bimonthly. Flow was detected 254 times. Table 5.13 lists instances in 2012 where outfalls were found to be in excess of the TRO action level. Five outfalls, 265 and 363 on Fifth Creek, 082 on Melton Branch, and 227 and 312 on WOC, exceeded the action level during 2012. The sources for outfalls 265, 207, and 081 have been determined to be aging underground water pipes that are leaking drinking water.

Table 5.13. Outfalls exceeding total residual oxidant (TRO) action level[a] in 2012

Sample date	Outfall	TRO concentration (mg/L)	Flow (gpm)	Load (grams/ day)	Receiving stream	Downstream integration point	Instream TRO point
2/6/2012	265	1.1	15	89.93	Fifth Creek	FFK 0.2	X19
2/6/2012	312	0.2	8	6.54	White Oak Creek	WCK 3.9	X21
4/12/2012	265	0.8	8	32.70	Fifth Creek	FFK 0.2	X19
7/19/2012	082	1.5	20	163.50	Melton Branch	MEK 2.1	N/A
7/19/2012	312	0.3	25	34.06	White Oak Creek	WCK 3.9	X21
7/19/2012	363	0.9	12	55.59	Fifth Creek	FFK 0.2	X19
9/4/2012	227	0.4	50	109.00	White Oak Creek	WCK 3.9	X21
9/12/2012	312	0.2	10	8.18	White Oak Creek	WCK 3.9	X21
10/15/2012	265	0.4	18	34.34	Fifth Creek	FFK 0.2	X19

[a]1.2 g/day

Abbreviations
FFK = Fifth Creek kilometer
MEK = Melton Branch kilometer
TRO = total residual oxidant
WCK = White Oak Creek kilometer

5.5.3 Cooling Tower Blowdown Whole Effluent Toxicity Monitoring

As part of the ORNL WQPP, samples of blowdown from three cooling towers/cooling tower systems (5600, 5807, and 4510-4521) were tested for whole effluent toxicity (WET) in August 2012. This was done primarily in support of the WQPP investigation to identify the causes of biological community impairments in the WOC watershed. That investigation is initially focusing on the reach of WOC that encompasses WOC (stream) kilometer 3.9 (WCK 3.9). The towers chosen for WET testing were those thought to have the greatest influence on water quality in that stream reach.

In WET testing, standard test organisms are exposed to multiple concentrations of effluent under standard test conditions, and the organisms' responses (e.g., survival, reproduction) are measured. The cooling tower blowdown samples evaluated in 2012 were tested with *Ceriodaphnia dubia* using a three-brood survival and reproduction test, which is a chronic toxicity test that has been shown to be more sensitive for testing cooling tower blowdown effluents than are acute tests using fathead minnows (*Pimephales promelas*).

Two of the tested tower systems discharge through outfalls where blowdown is mixed with other types of effluent before the blowdown reaches the receiving stream, so effluents from those outfalls were also tested for WET during the same time period in which the towers were tested. The outfalls tested were outfall 227, which receives blowdown from the 5600 cooling tower, and outfall 231, which receives blowdown from the 5807 tower. Blowdown from 4510-4521 is discharged through outfall 014 but is not blended with other wastewaters before discharge; therefore, it was not necessary to perform an additional test on outfall 014 effluent. WET test results are shown in Table 5.14.

Table 5.14. Summary results of chronic *Ceriodaphnia dubia* toxicity tests of Oak Ridge National Laboratory cooling towers and outfalls conducted during August 2012

Location	NOEC[a]	IC_{25}[b]	96 h LC_{50}[c]
Cooling Tower 4510-4521	25%	32%	89%
Cooling Tower 5600	100%	>100%	>100%
Outfall 227	100%	>100%	>100%
Cooling Tower 5807	25%	50.2%	>100%
Outfall 231	100%	>100%	>100%

[a]NOEC = No observed effect concentration for survival and reproduction.
[b]IC_{25} = Inhibition concentration that would cause a 25% reduction in mean young per female.
[c]LC_{50} = Lethal concentration that would cause a 50% reduction in survival in 96 h (estimated, with this type of chronic test).

Results were similar for two of the tower systems, 4510-4521 and 5807. The results for the 5600 tower were considerably different from the other two, which was unexpected because all three tower systems are operated and maintained similarly (they receive the same chemical treatments and the towers are operated within similar ranges of specific conductivity). Evidence suggests that the results obtained for the 5600 tower are an anomaly. Water quality measurements made on test samples as they were received at the testing laboratory revealed considerably lower specific conductivity than the samples from the other two towers and much lower specific conductivity than the conductivity setting on the tower's blowdown control system. It is theorized that the sampler intake in the tower 5600 basin may have been located such that the samples were enriched in tower makeup water (water added from the potable water system to replace water lost to evaporation). Therefore, the samples that were collected are not thought to be representative of the blowdown. If the tower 5600 samples would have been representative of the blowdown, that tower would likely have tested similarly to the others. It should be noted that samples were collected from the basins under the towers instead of directly from the blowdown lines because of difficulty accessing closed blowdown piping systems for sampling with an automatic sampler.

To summarize, the results in Table 5.14 indicate that if *Ceriodaphnia dubia* were to be continually exposed to a mixture of water composed of somewhere between roughly 25% and 50% blowdown from these cooling towers (the remaining 50% to 75% of the water mixture being natural stream water for example), after a long enough period of time their reproduction would be negatively affected. At concentrations approaching 100%, survival may also be affected. In the driest summer conditions in WOC, it is possible for concentrations of blowdown in the receiving stream [instream waste concentration (IWC)] to be as high as 40%. However, more work needs to be done to determine whether such impacts (to *Ceriodaphnia dubia* and other organisms) are actually occurring in the stream. As mentioned previously, the WET tests that were performed are chronic tests, which measure impacts to organisms under a continuous exposure scenario for several days or longer. In reality, discharges of cooling tower blowdown are intermittent, triggered by a control system that uses measurements of specific conductivity to control opening and closing of the discharge valve. In addition, WET tests done in the past have generally showed that when actual stream water is used as the diluent when making up the various dilutions to be tested (as opposed to the standard degassed mineral water as the diluent), the organisms tend to fair better. The blowdown samples that were tested were prepared with standard diluent.

Two outfalls receiving these blowdown discharges were tested for WET as well. Those test results reveal that when blowdown sources are mixed with other wastewaters before discharge, significant improvements in toxicity are realized. No toxicity was detected at the two outfalls receiving blowdown from towers 5600 and 5807. This may be the result of simple dilution but could involve some beneficial chemical or physical interactions that result from the mixing of effluents. Blowdown from the 4510-4521 tower complex is not blended with other wastewaters before discharge and therefore does not have this benefit.

Before these tests were conducted, it was anticipated that if toxicity were to be observed, the toxicity might be the result of increased concentrations of dissolved metals in the blowdown due to evaporation of water from the tower and due to tower water coming into contact with metals in materials of construction. Additional samples of 100% blowdown were treated with ethylenediaminetetraacetic acid (EDTA) to chelate commonly encountered metals and were tested alongside the untreated samples. EDTA treatment did not improve toxicity, indicating that metals (at least the metals that can be removed with EDTA) were not responsible for the observed toxicity.

More work is planned to resolve some of the uncertainties described above and to gather the information needed to determine appropriate management actions if cooling tower blowdown is confirmed as a likely contributor to the biological impairments observed in WOC. This work will likely include data gathering and model simulations to better understand realistic exposure scenarios in WOC (i.e., more accurate determination of IWCs) and performing additional WET tests. Additional WET testing will be performed to confirm the initial results and to learn more about the constituents in the blowdown that are contributing to toxicity.

During the period in which the towers were undergoing WET testing, they were also monitored with grab samples for field parameters (conductivity, dissolved oxygen, pH, and temperature), chemical oxygen demand, total metals, and total suspended solids. Results of that monitoring are shown in Table 5.15.

Table 5.15. Field parameters and results from laboratory analyses of blowdown from Oak Ridge National Laboratory cooling towers
(Sampled August 21, 2012)

Parameter	Cooling towers sampled		
	4510-4521	5600	5807
Conductivity (mS/cm)	1.12	0.295	1.07
Dissolved Oxygen (mg/L)	8.2	9.1	8.8
pH (standard units)	8.6	8.7	8.7
Temperature (°C)	23.1	17.5	19.7
Chemical Oxygen Demand (mg/L)	66.8	26.8	89.3
Total Suspended Solids (mg/L)	< 2	< 2	< 2
Ag (mg/L)	< 0.000619	0.00186	< 0.000619
As (mg/L)	< 0.001	< 0.001	< 0.001
Be (mg/L)	< 0.000686	< 0.000686	< 0.000686
Ca (mg/L)	128	29.2	132
Cd (mg/L)	< 0.000782	< 0.000782	< 0.000782
Cr (mg/L)	< 0.001	< 0.001	< 0.001
Cu (mg/L)	0.0027	0.0013	0.0093
Fe (mg/L)	< 0.0206	< 0.0206	< 0.0206
Mg (mg/L)	38.2	8.69	39
Mn (mg/L)	0.00154	0.00127	0.00769
Mo (mg/L)	0.19	< 0.000931	0.26
Ni (mg/L)	< 0.00138	< 0.00138	< 0.00138

Table 5.15. (continued)

Parameter	Cooling towers sampled		
	4510-4521	5600	5807
Pb (mg/L)	< 0.001	< 0.001	< 0.001
Sb (mg/L)	0.0027	< 0.00081	< 0.00081
Se (mg/L)	< 0.0406	< 0.0406	< 0.0406
Zn (mg/L)	0.283	0.128	0.319

5.5.4 Radiological Monitoring

At ORNL, monitoring of effluents and instream locations for radioactivity is conducted under the ORNL WQPP. Table 5.16 details the monitoring frequencies and target analyses for 3 treatment facility outfalls, 3 instream monitoring locations, and 22 category outfalls (outfalls which are categorized into groups with similar effluent characteristics for the purposes of setting monitoring and reporting requirements in the site NPDES permit). Dry-weather discharges from category outfalls are primarily cooling water, groundwater, and condensate. Low levels of radioactivity can be discharged from category outfalls in areas where groundwater contamination exists and where contaminated groundwater enters category outfall collection systems from building and facility sumps, building footer drains, and direct infiltration. In 2012, dry-weather grab samples were collected at 16 of the 22 category outfalls targeted for sampling. Four category outfalls (203, 205, 241, and 284) were not sampled because there was no discharge present during sampling attempts. Monitoring requirements were eliminated for two outfalls (217 and 219) in a monitoring plan update implemented in mid-2012.

Table 5.16. Radiological monitoring conducted under the Oak Ridge National Laboratory (ORNL) Water Quality Protection Plan, 2012

Location	Frequency	Gross alpha/beta[a]	Gamma scan	^{3}H	Total rad Sr	Isotopic uranium	^{14}C	$^{243/244}Cm$
Outfall 001	Annually	X						
Outfall 080	Monthly	X	X	X	X			X
Outfall 081	Annually	X						
Outfall 085	Quarterly	X	X	X	X	X[b]		
Outfall 203[c]	Annually	X	X		X			
Outfall 204	Semiannually	X	X		X			
Outfall 205[c]	Annually	X						
Outfall 207	Quarterly	X	X[b]		X[b]			
Outfall 211	Annually	X						
Outfall 217	Annually	X[b]						
Outfall 219	Annually	X[b]						
Outfall 234	Annually	X						
Outfall 241[c]	Quarterly	X	X[b]	X[b]	X	X		
Outfall 265	Annually	X						
Outfall 281	Quarterly	X		X				
Outfall 282	Quarterly	X						
Outfall 284[c]	Annually	X						
Outfall 302	Monthly	X	X	X	X	X		
Outfall 304	Monthly	X	X	X	X	X		
Outfall 365	Semiannually	X						

Table 5.16. (continued)

Location	Frequency	Gross alpha/beta[a]	Gamma scan	^{3}H	Total rad Sr	Isotopic uranium	^{14}C	$^{243/244}Cm$
Outfall 368	Annually	X						
Outfall 383	Annually	X		X				
STP (X01)	Monthly	X	X	X	X		X	
SPWTF (X02)[c, d]	Monthly	X			X			
PWTC (X12)	Monthly	X	X	X	X	X		
Melton Branch 1 (X13)	Monthly	X	X	X	X			
WOC (X14)	Monthly	X	X	X	X			
WOD (X15)	Monthly	X	X	X	X			

[a]Isotopic analyses are performed to identify contributors to gross activities when results exceed screening criteria described in the Water Quality Protection Plan, October 2008.
[b]Monitoring for this parameter was discontinued beginning June 30, 2012.
[c]No discharge present during sampling attempts.
[d]Outfall X02 was removed from the ORNL NPDES permit in July 2012.

Abbreviations
NPDES = National Pollutant Discharge Elimination System
PWTC = Process Waste Treatment Complex
SPWTF = Steam Plant Wastewater Treatment Facility
STP = Sewage Treatment Plant
WOC = White Oak Creek
WOD = White Oak Dam

Two ORNL treatment facilities were monitored for radioactivity in 2012: STP (outfall X01) and PWTC (outfall X12). Operations at SPWTF (which formerly discharged through outfall X02) were permanently discontinued in 2011, and therefore there were no discharges from that facility in 2012. The three instream locations that were monitored were X13 on Melton Branch, X14 on WOC, and X15 at White Oak Dam (WOD) (Fig. 5.16). At each treatment facility and instream monitoring location, monthly flow-proportional composite samples were collected using dedicated automatic water samplers.

Radioisotope specific guideline concentration values are published in DOE directives and are used to evaluate discharges of radioactivity from DOE facilities. DCSs were developed for evaluating effluent discharges and are not intended to be applied to instream values, but these comparisons can provide a useful frame of reference. It should be noted that though effluents and instream concentrations are compared to DCSs, neither ORNL effluents nor ambient surface waters are direct sources of drinking water. Four percent of the DCS is roughly equivalent to the 4 mrem dose limit on which the EPA radionuclide drinking water standards are based and is a convenient comparison point. The annual average concentration of at least one radionuclide exceeded 4% of the relevant DCS concentration in dry-weather discharges from NPDES outfalls 080, 081, 085, 204, 302, 304, X01, and X12 and at instream sampling location X15 (Fig. 5.17). In 2012, no outfalls had a mean radioactivity concentration greater than 50% of the applicable DCS for an individual radioisotope, nor a sum-of-fractions (summation of DCS percentages of multiple radiological parameters measured at a given location) greater than 100%.

The total annual discharges (or amounts) of radioactivity measured in stream water at WOD, the final monitoring point on WOC before the stream flow leaves ORNL, were calculated from concentration and flow. Results of those calculations for each of the past 5 years are shown in Figs. 5.18 through 5.22. Because discharges of radioactivity are somewhat correlated to stream flow, annual flow volumes measured at the WOD monitoring station are given in Fig. 5.23. Discharges of radioactivity at WOD in 2012 continue to be generally lower than in the years preceding completion of the waste area caps in Melton Valley.

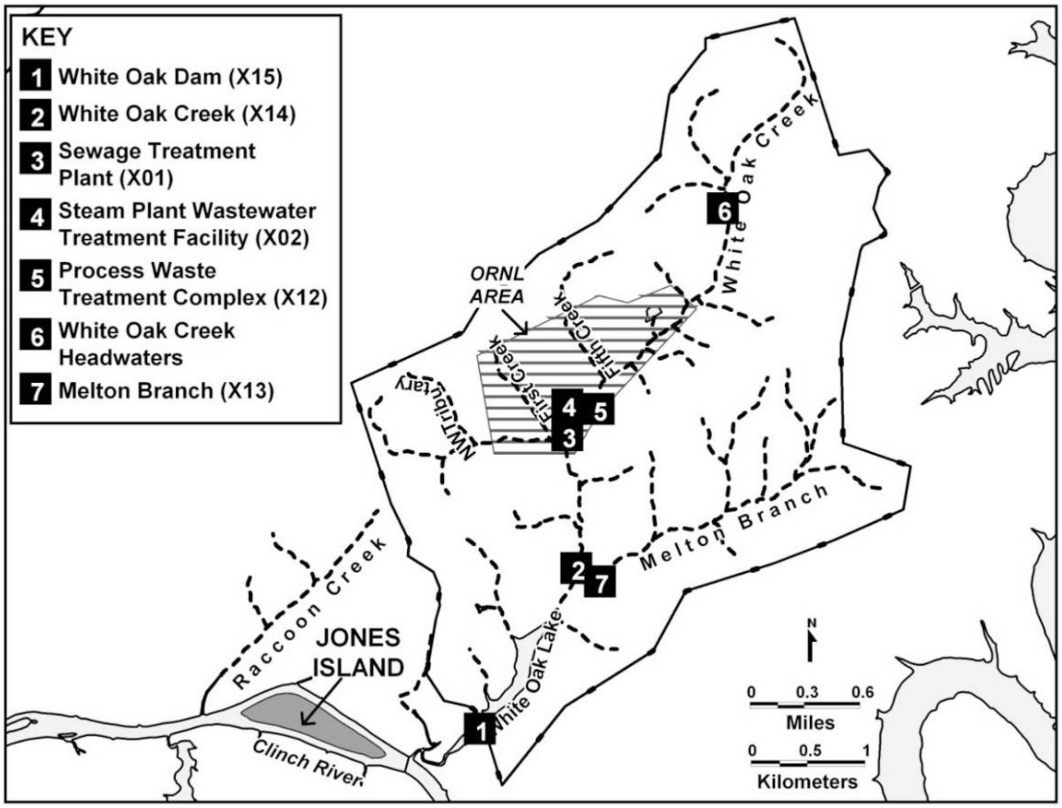

Fig. 5.16. Oak Ridge National Laboratory surface water, National Pollutant Discharge Elimination System, and reference sampling locations.

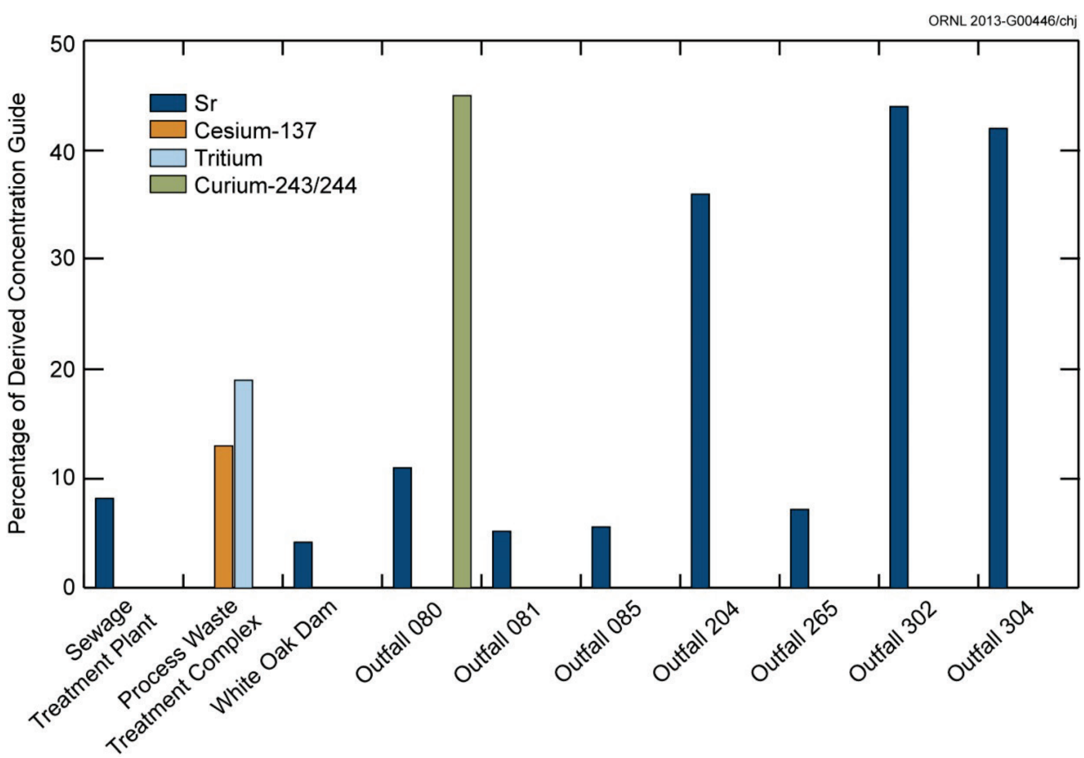

Fig. 5.17. Radionuclides at Oak Ridge National Laboratory sampling sites having average concentrations greater than 4% of the relevant derived concentration guides in 2012.

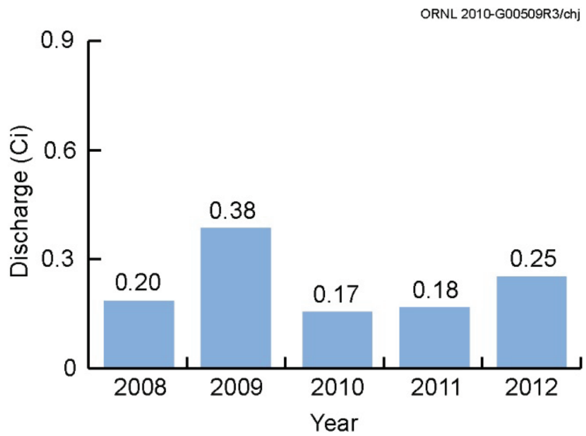

Fig. 5.18. Cesium-137 discharges at White Oak Dam, 2008–2012.

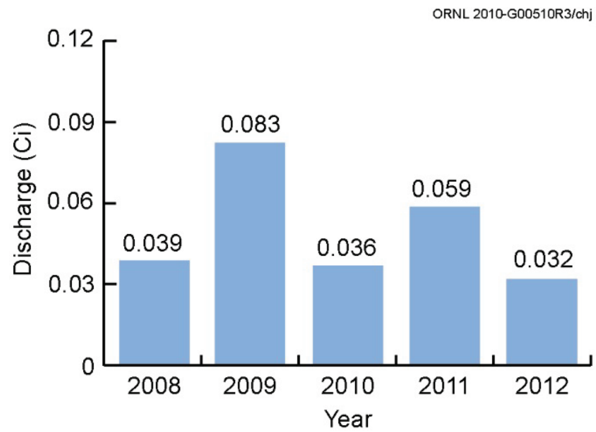

Fig. 5.19. Gross alpha discharges at White Oak Dam, 2008–2012.

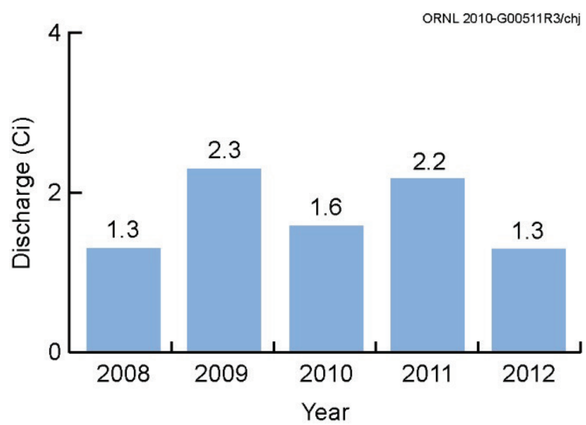

Fig. 5.20. Gross beta discharges at White Oak Dam, 2008–2012.

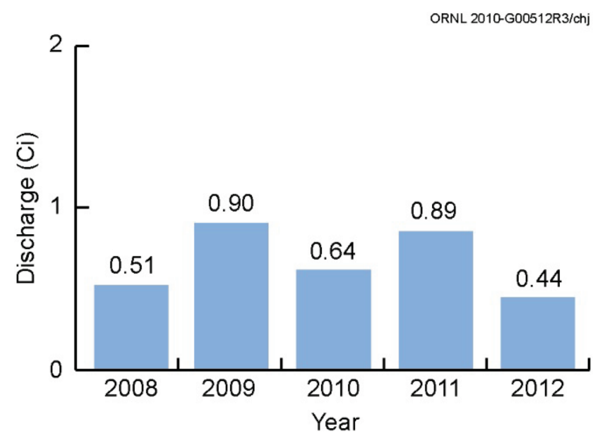

Fig. 5.21. Total radioactive strontium discharges at White Oak Dam, 2008–2012.

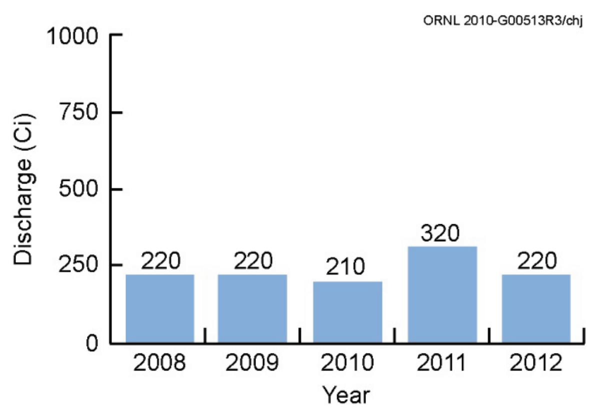

Fig. 5.22. Tritium discharges at White Oak Dam, 2008–2012.

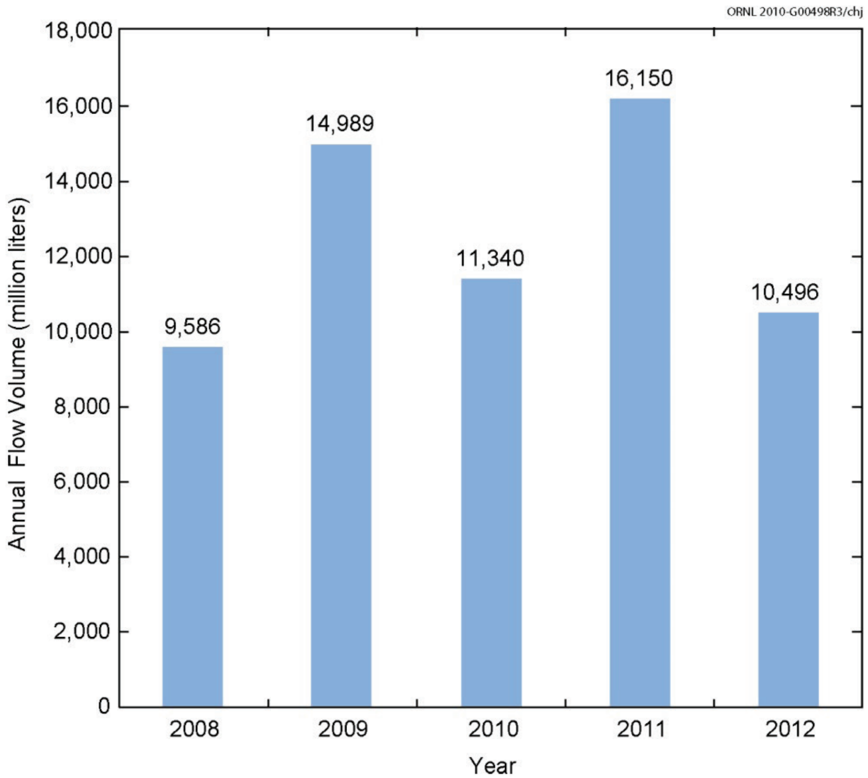

Fig. 5.23. Annual flow volume at White Oak Dam, 2008–2012.

5.5.5 Mercury in the White Oak Creek Watershed

Legacy mercury environmental contamination exists at ORNL, largely as a result of spills and releases that occurred in the 1950s during isotope separation pilot-scale work in Buildings 3503, 3592, 4501, and 4505. Because of this, mercury is present in soils and groundwater in and around these four facilities. Buildings 3592 and 3503 were taken down and removed under the CERCLA remedial process in 2011 and 2012, respectively. Mercury also is present in Fifth Creek and WOC surface streams that receive surface runoff and groundwater flow from the area of these buildings.

In the past, process wastewater drains and building sumps from Buildings 4501 and 4505, the facilities where most of the ORNL mercury work was conducted, were routed via underground collection-system piping to the ORNL PWTC for treatment to remove constituents, including mercury, before discharge to WOC. Since 2007, three additional groundwater sumps have been redirected to receive treatment for mercury removal, and a mercury pretreatment system was installed on one of these sumps, in Building 4501. These recent actions have significantly diminished the release of legacy mercury contamination from the ORNL site to the WOC watershed (Fig. 5.24).

For the mercury-investigation component of WQPP, data collected during initial monitoring indicates effluent sampling at additional outfalls and instream reaches needs to be incorporated in future WQPP revisions to help prioritize future abatement actions and to delineate mercury sources.

In 2012, monitoring conducted under WQPP included dry-weather sampling at a number of instream points in the WOC watershed upstream, within, and downstream from ORNL and ORNL NPDES outfalls where previous monitoring or site history has shown the potential for effluent mercury. Flow measurements were made for instream and outfall sampling locations. Concentration and flux values were measured and calculated. Selected results of the 2012 monitoring are shown in Fig. 5.25, and complete mercury monitoring results are available in the Oak Ridge Environmental Information System (OREIS). Access to this system can be requested via email (oreis@ettp.doe.gov) or by telephone (865-574-3257).

Monitoring results for 2012 indicated that Tennessee mercury criteria were largely met at instream locations. As a result of 2011 targeted stream-reach mercury investigations, a storm drain outfall on Fifth Creek, outfall 265, was found to be a more significant source of mercury release than had previously been known. In 2012 this outfall's network of underground piping and catch basins was investigated using a remote video camera. Locations where water was infiltrating the network were discovered. One source, a leaking valve associated with underground fire protection water piping, was excavated and repaired, and a second source also associated with that system is planned for repair in 2013. It is believed that the water in leakage contributes to mobilization of legacy mercury contamination in or near the outfall 265 underground pipe network. Since the first water source was repaired in September 2012, mercury concentrations in outfall 265 effluent have declined but will continue to be monitored under the WQPP program in the future.

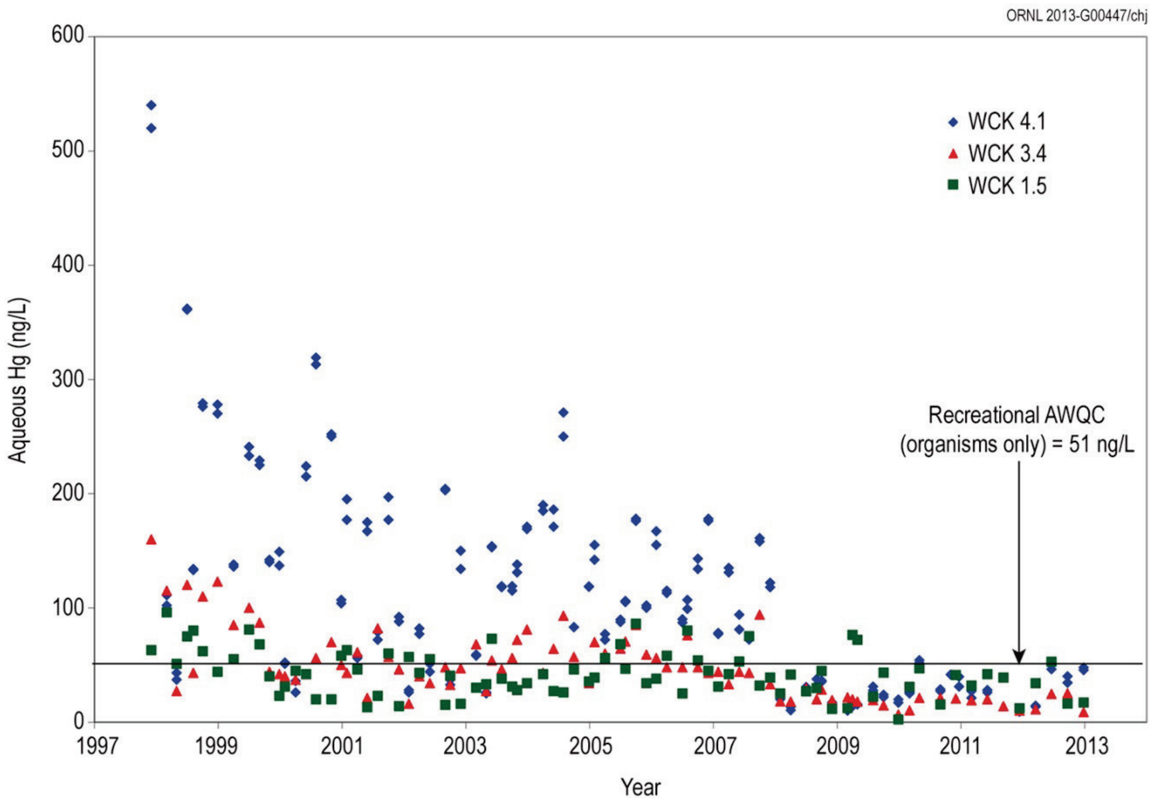

Fig. 5.24. Total aqueous mercury concentrations at sites in White Oak Creek downstream from Oak Ridge National Laboratory, 1997–2012. (AWQC = ambient water quality criterion; WCK = White Oak Creek kilometer.)

In 2012, WQPP mercury investigative efforts also focused on legacy-mercury-bearing sediment, a sediment-clogged dechlorination unit, and effluent mercury concentrations, all associated with storm water outfall 211. Plans for 2013 include replacing the outfall 211 dechlorinator unit with a system that is less susceptible to clogging by sediment and gravel. An ongoing mercury-characterization monitoring protocol, which has been maintained at various instream- and outfall-monitoring locations in the WOC watershed since 2009, will be continued in 2013.

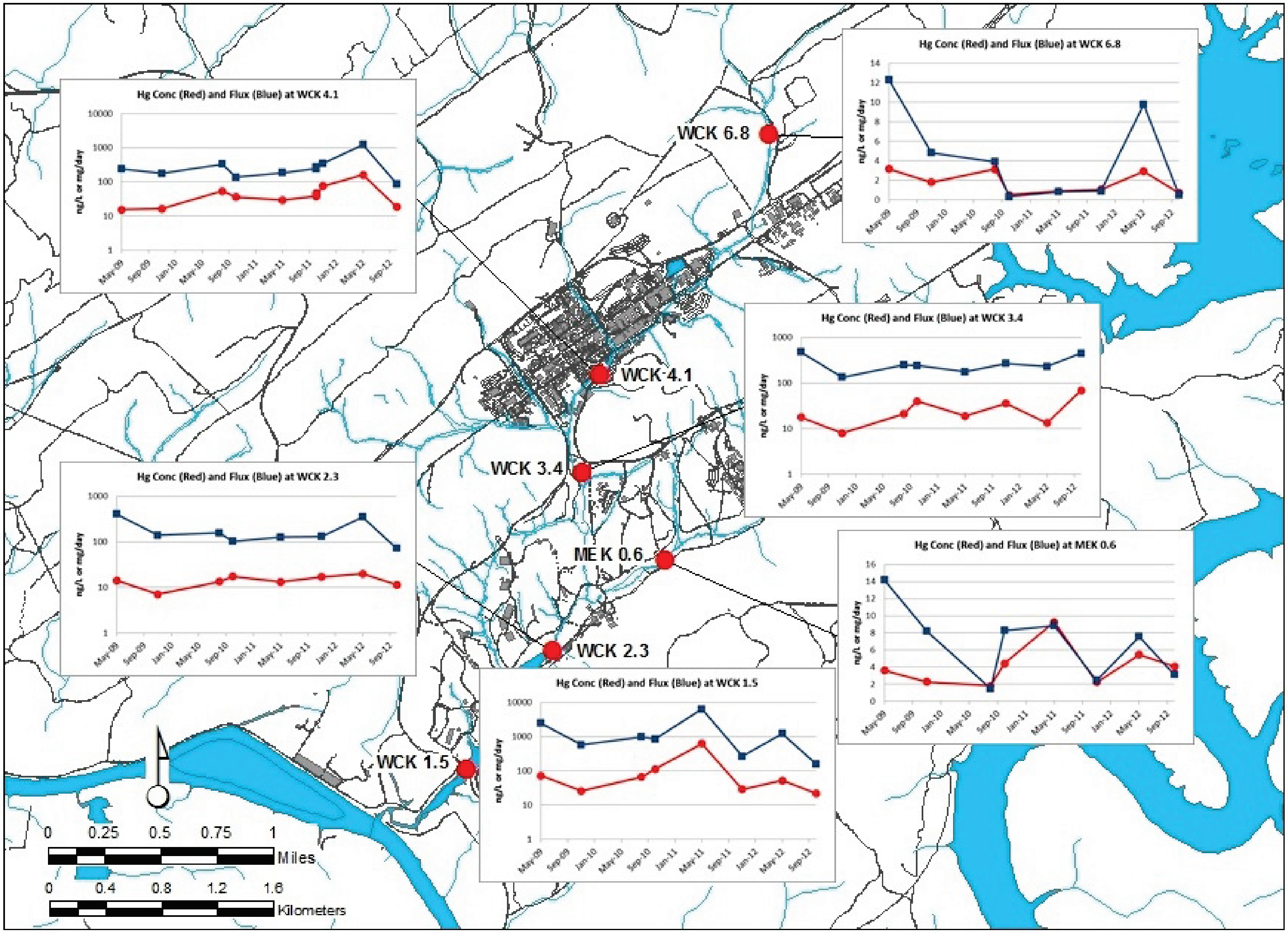

Fig. 5.25. Total mercury concentration and flux at selected Oak Ridge National Laboratory instream locations, 2009 through 2012.

5.5.6 Water Quality Assessment of Selected Stream Reaches in the Oak Ridge National Laboratory Main Campus Area

In 2012, monitoring was conducted under the ORNL WQPP to characterize water quality in selected stream reaches in WOC (Fig. 5.26) and Melton Branch (Fig. 5.27). The WOC stream reach was monitored in wet-weather (storm runoff) conditions; dry-weather water quality monitoring was conducted for the same reach of WOC in 2011 and was not repeated in 2012. The sampled reach of WOC receives storm water runoff from heavily industrialized portions of the ORNL campus including research and support facilities in the 4000, 5000, and 6000 areas, facility maintenance and storage facilities in the 7000 area, and SNS and Center for Nanophase Materials Sciences on Chestnut Ridge. The Melton Branch stream reach was monitored in 2012 in both dry-weather and wet-weather conditions. The monitored reach of Melton Branch receives discharges from HFIR, REDC, and TWPC.

Both instream and outfall locations were sampled during each monitoring event. Outfalls and instream locations within these geographic areas were monitored concurrently to more directly assess the influence of outfall discharges on instream water quality. The outfalls selected for monitoring were judged to be the most significant in terms of potential to affect water quality in the monitored stream reaches. The primary objective of this monitoring was to support one of the overall WQPP objectives: to discover the reasons for biological community impairments and to ultimately eliminate or reduce those impairments.

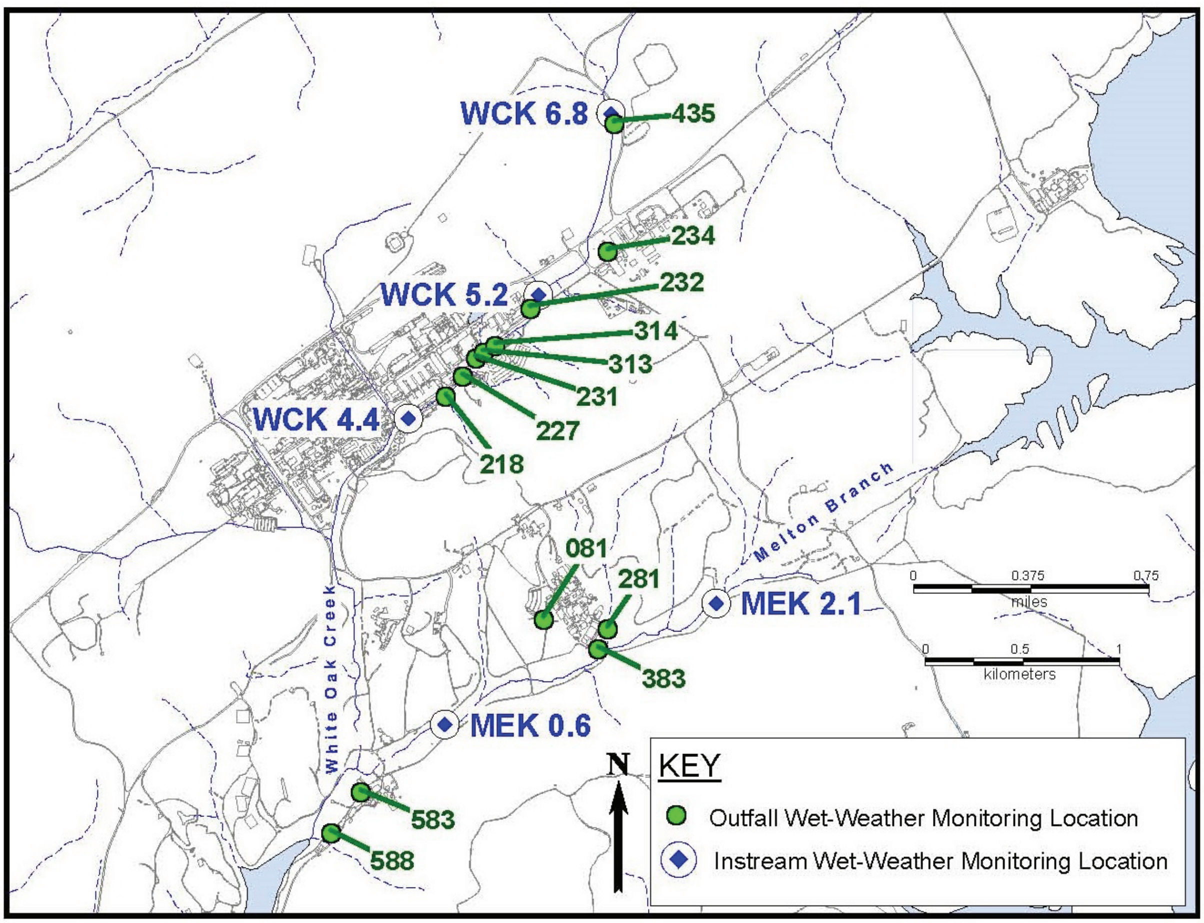

Fig. 5.26. Instream locations and outfalls sampled for water quality parameters under the Oak Ridge National Laboratory Water Quality Protection Plan during wet-weather conditions, 2012.

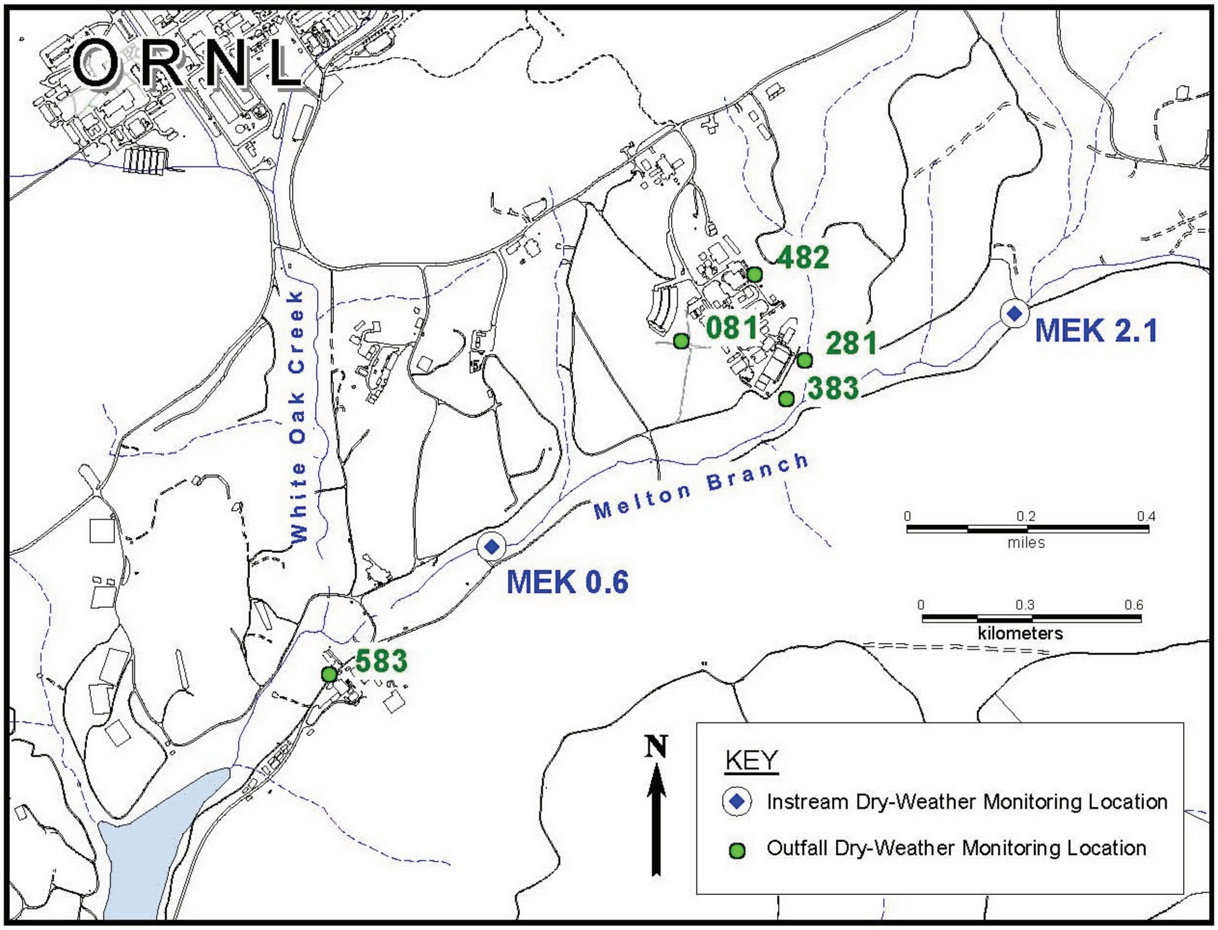

Fig. 5.27. Instream locations and outfalls sampled for water quality parameters under the Oak Ridge National Laboratory Water Quality Protection Plan during dry-weather conditions, 2012.

In both wet- and dry-weather conditions, samples were collected for solids (suspended and dissolved), metals (total and dissolved), and nutrients (total phosphorus, Kjeldahl nitrogen, nitrate+nitrite nitrogen, and ammonia). The Melton Branch locations were also sampled for radioactivity (gross alpha, gross beta, gamma scan, total radioactive strontium, and tritium). Dry-weather samples were 24 h time-proportional composite samples for both instream and outfall locations. Wet-weather samples for instream locations were flow-proportional composites. For outfall locations, both flow-proportional composite and first flush grab samples were collected. At all locations, in both wet- and dry-weather conditions, grab sample field measurements were made for conductivity, dissolved oxygen, flow, pH, temperature, and turbidity.

The results from this water quality sampling are being used to guide future efforts under WQPP and will be useful in determining causes of biological community impairments in the WOC watershed. None of the measurements made in 2012 exceeded any applicable water quality criteria. Radionuclides at all Melton Branch locations (radionuclides were not sampled at WOC locations) were well below DOE DCS levels. The data collected to date suggest that parameters warranting additional study under WQPP are nutrients and metals (particularly copper in WOC near the main plant area).

5.5.7 Storm Water Surveillances and Construction Activities

Figure 5.28 depicts the location of construction sites that were considered significant in 2012 because of the need to be covered under the general Tennessee NPDES permit for construction activities and/or an aquatic resource alteration permit or because they had a footprint of greater than 0.405 ha (1 acre). (Construction areas that are part of CERCLA remediation follow substantive requirements of the appropriate water pollution control permits but are not required to obtain official permit coverage). Four of these sites were inspected in 2012 to evaluate overall effectiveness of the best management practices in use. In general, while some short-term impacts to receiving streams were noted, no long-term adverse impacts were observed.

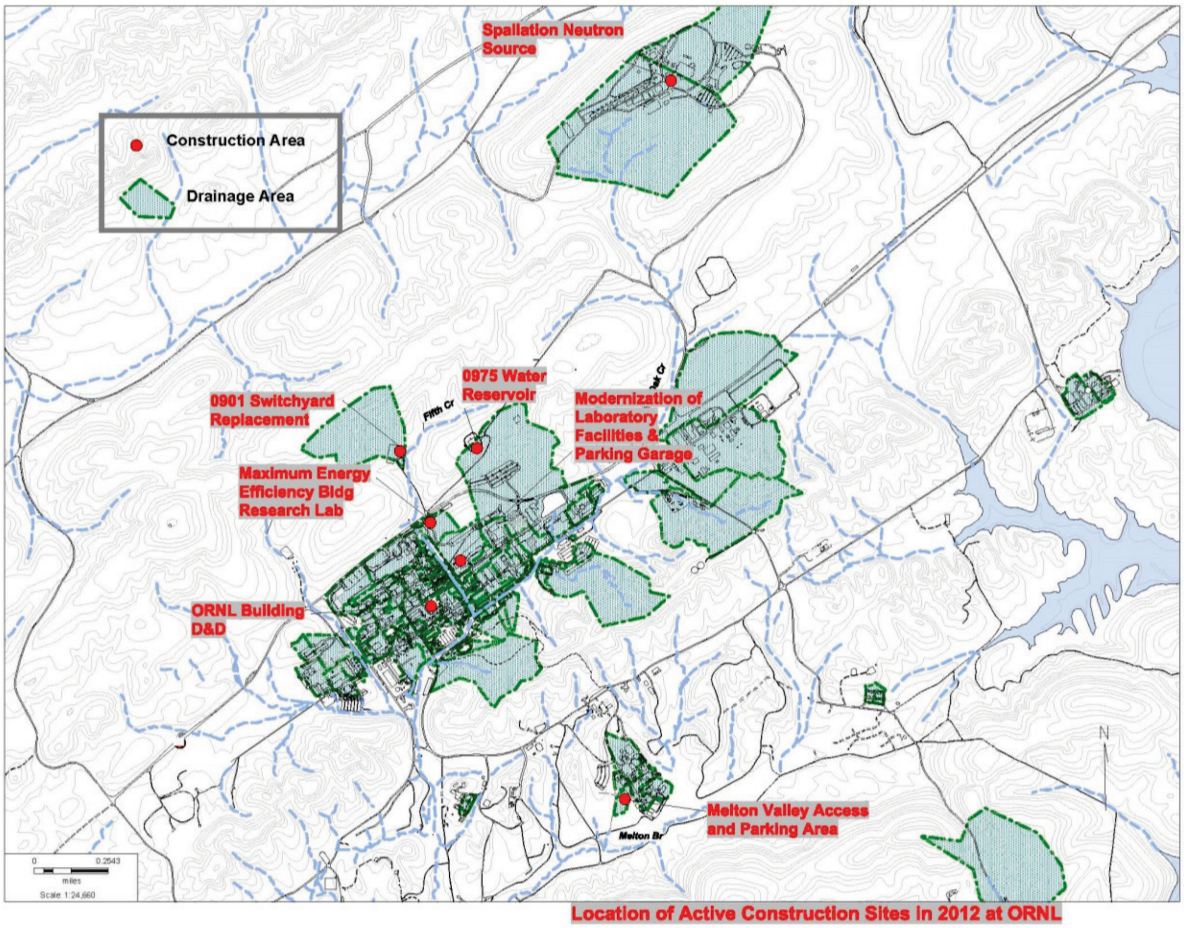

Fig. 5.28. Active construction sites and WQPP monitoring locations at ORNL, 2012.

Land use within drainage areas is typical of office/industrial settings with surface features including laboratories, support facilities, paved areas, and grassy lawns. Outdoor material storage is most prevalent in the 7000 Area on the east end of the main ORNL facility (where most of the craft and maintenance shops are located), with other smaller outdoor storage areas located throughout the facility in and around loading docks and material delivery areas at laboratory and office buildings. The types of materials stored outside include metal items (sheeting, pipes, and parts); equipment awaiting use, disposal, or repair; construction material; and deicer product. Flaking paint on some buildings (slated to be dismantled in the near future) also poses a potential mobile storm water pollutant source.

Some construction activities are performed on third-party-funded construction projects under agreement with other local, state, and federal agencies on the DOE reservation. There are mechanisms in place for ensuring effective storm water controls at these third-party sites, one of which includes staff from UT-Battelle acting as points of contact for communication interface on environmental, spill/emergency response, and other key issues.

Certain instream and outfall locations identified under WQPP were monitored in 2012 in storm conditions. A more detailed description of the WQPP wet-weather monitoring scenario can be found in Section 5.5.6.

5.5.8 Biological Monitoring

5.5.8.1 Bioaccumulation Studies

The bioaccumulation task for BMAP addresses two NPDES permit requirements at ORNL: (1) evaluate whether mercury at the site is contributing to a stream at a level that will impact fish and aquatic life or violate the recreational criteria and (2) monitor the status of PCB contamination in fish tissue in the WOC watershed.

Mercury in Water. In continuation of a monitoring effort initiated in 1997, bimonthly water samples were collected from WOC at four sites in 2012. Stream conditions were selected to be representative of seasonal base-flow conditions (dry weather, clear flow) based on historical results that indicate higher mercury concentrations under these conditions.

The concentration of mercury in WOC upstream from ORNL was less than 5 ng/L in 2012. Long-term trends in waterborne mercury in the WOC system downstream of ORNL are shown in Fig. 5.24. Waterborne mercury downstream of ORNL declined abruptly in 2008 and remained low through 2012 as a result of rerouting highly contaminated sump water in Building 4501 to PWTC in December 2007. The mean total mercury concentration at WCK 4.1 was 27.5 ± 17.8 ng/L in 2012 compared with 108 ± 33 ng/L in 2007. The decrease was also apparent but less pronounced at WCK 3.4, with mercury averaging 17.7 ± 8.3 ng/L in 2012 versus 49 ± 23 ng/L in 2007. Mercury concentrations at these two sites were significantly lower than levels in 2007 and were slightly higher than in 2011. A pretreatment system for the sump water started operation on October 22, 2009, and will remove almost all of the mercury before sending the water to PWTC. This system reduces the mercury concentration in the PWTC influent and effluent. Average aqueous mercury concentration at WOD was 28.8 ± 7.9 ng/L in 2012, a level similar to results reported in recent years.

Bioaccumulation in Fish. In WOC, mercury and PCB concentrations in fish have been at or near human health risk thresholds [e.g., EPA recommended fish-based AWQC, TDEC fish advisory limits]. In 2010, mercury concentrations in redbreast sunfish fillets collected from WOC were below the 0.3 µg/g AWQC for the first time in 10 years, and this decreasing trend has continued through 2012 (Fig. 5.29). Mean fillet concentrations at WCK 3.9 decreased from 0.45 µg/g in 2007 to 0.19 µg/g in 2012, bringing the mean concentrations observed at this site below AWQC (Fig. 5.29). Because these trends have persisted for several years and because the decreases in fish tissue were more pronounced at upstream sites where the decreases in aqueous mercury concentrations were most evident suggests a causal response. Mercury concentrations in bluegill and largemouth bass collected from WCK 1.5 (White Oak Lake) continued to increase in 2012 such that mean concentrations in both species were the highest observed since 1998. The reason for the increase in the lower end of the WOC watershed is not known, but changes in sediment or mercury methylation rates within the lake could affect bioaccumulation.

Mean PCB concentrations in redbreast sunfish at WCK 3.9 and WCK 2.9 (0.76 and 0.30 µg/g, respectively) were comparable to recent years. Mean PCB concentrations in bluegill from WCK 1.5 (0.40 µg/g) were also comparable to concentrations observed in recent years. The mean PCB concentrations in bass collected from WCK 1.5 have been decreasing over the past 2 years but in 2012 remained near typical concentrations that result in a TDEC fish advisory limit (i.e., ~1 µg/g) (Fig. 5.30).

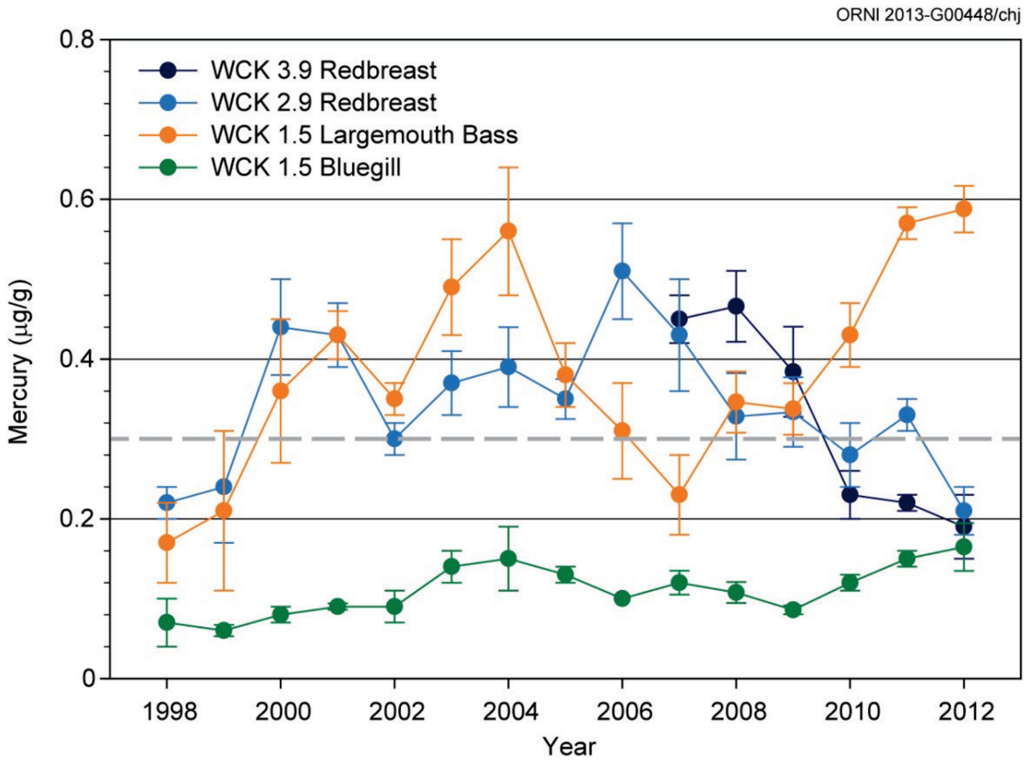

Fig. 5.29. Mean concentrations of mercury (± standard error, N = 6) in muscle tissue of sunfish and bass from White Oak Creek [White Oak Creek kilometers (WCKs) 3.9 and 2.9] and White Oak Lake (WCK 1.5), 1998–2012. [Dashed grey line indicates the EPA ambient water quality criterion for mercury (0.3 µg/g in fish tissue).]

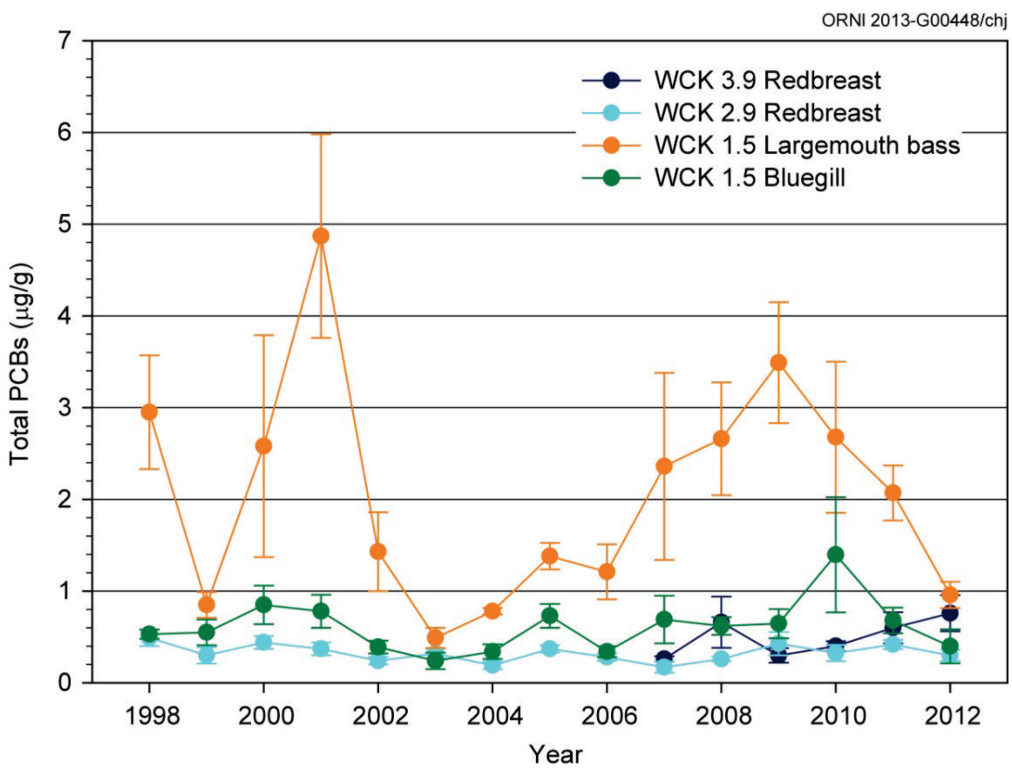

Fig. 5.30. Mean PCB concentrations (± standard error, N = 6) in fish fillets collected from the White Oak Creek watershed, 1998–2012. (WCK = White Oak Creek kilometer.)

5.5.8.2 Benthic Macroinvertebrate Communities

Monitoring of benthic macroinvertebrate communities in WOC, First Creek, and Fifth Creek continued in 2012. Additionally, monitoring of the macroinvertebrate community in lower Melton Branch [Melton Branch kilometer (MEK) 0.6] continued under the EM WRRP. Benthic macroinvertebrate samples are collected once annually following two protocols: protocols developed by ORNL and used since 1986 and TDEC protocols. ORNL protocols provide a continuous long-term data set that allows the most effective means of evaluating and verifying the effectiveness of pollution abatement and remedial actions taken at ORNL since 1986. These protocols also provide the most effective means of determining the significance of changes in trends relative to historical conditions. TDEC protocols, on the other hand, provide an estimate of the condition of a macroinvertebrate community relative to a state-derived reference condition. The results from both protocols are used to help assess ORNL compliance with current NPDES permit requirements. This report provides a summary of results through 2012 from both sets of protocols.

Compared with the TDEC derived reference condition, the only site monitored in the WOC watershed that has consistently rated as nonimpaired is WCK 6.8, which until construction of SNS had served as the reference site for WOC (Fig. 5.31). Except in 2009, when MEK 0.6 rated as nonimpaired and WCK 3.9 rated as moderately impaired, the invertebrate communities at the sites monitored using TDEC protocols have consistently rated as slightly impaired.

The benthic macroinvertebrate communities in First Creek, Fifth Creek, and WOC downstream of effluent discharges have recovered significantly since 1987, but community characteristics indicate that ecological impairment remains (Figs. 5.32, 5.33, and 5.34). Relative to reference sites, total taxonomic richness (i.e., the mean number of different species per sample) and richness of the pollution-intolerant taxa (i.e., the mean number of different mayfly, stonefly, and caddisfly species per sample or EPT richness) continue to be lower at these downstream sites. Fluctuations in metrics between years at First Creek kilometer (FCK) 0.1 continue to be inconsistent, thus suggesting that no major persistent changes have occurred at this site since the mid-1990s. In Fifth Creek at Fifth Creek kilometer (FFK) 0.2, a roughly twofold reduction in metric values after 2007 that was followed by only minimal increases in 2008 and 2009 suggested that a major change had occurred in the conditions at that site between 2007 and 2008. However, trends at that site since 2009 suggest that conditions may now be comparable to those present before 2008. Results for WCK 2.3 and WCK 3.9 suggest that no major environmental changes have occurred at those sites for roughly 10 years.

Macroinvertebrate community metrics for lower Melton Branch (MEK 0.6, Fig. 5.35) suggest that conditions at this site continue to be relatively stable, and taxa richness metrics continue to be similar to reference conditions. However, other macroinvertebrate community metrics (not shown here), such as unusually high total community density and densities of some of the most pollution-tolerant species (e.g., Orthocladiinae midges and aquatic worms) continue to suggest the presence of excessive amounts of nutrients (e.g., phosphorus and/or nitrogen). Potential sources of nutrients in lower Melton Branch may be from direct inputs (e.g., effluent discharges or storm water runoff from fertilized land) or indirect inputs (e.g., natural release from freshly disturbed soils or underdeveloped riparian areas).

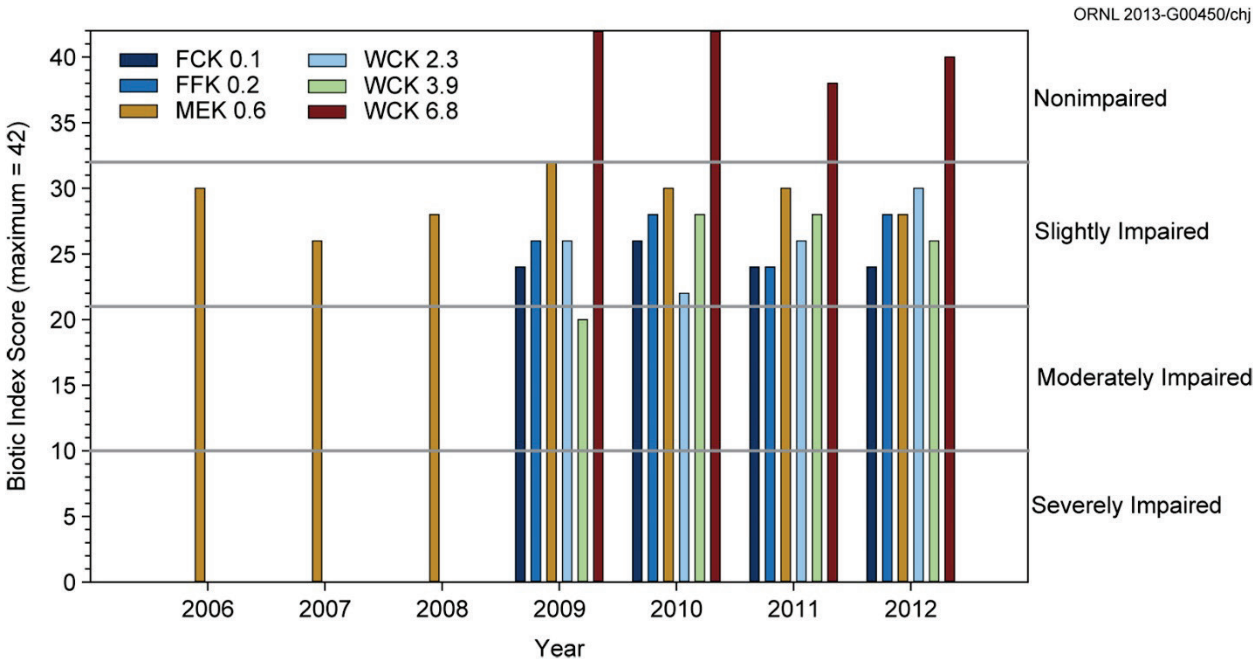

Fig. 5.31. Temporal trends in Tennessee Department of Environment and Conservation Biotic Index Scores for White Oak Creek watershed, August 2006–August 2012. Horizontal lines show the lower thresholds for biotic condition ratings for index scores; respective narrative ratings for each threshold are shown at right of graph. (FCK = First Creek kilometer; FFK = Fifth Creek kilometer; MEK = Melton Branch kilometer; WCK = White Oak Creek kilometer.)

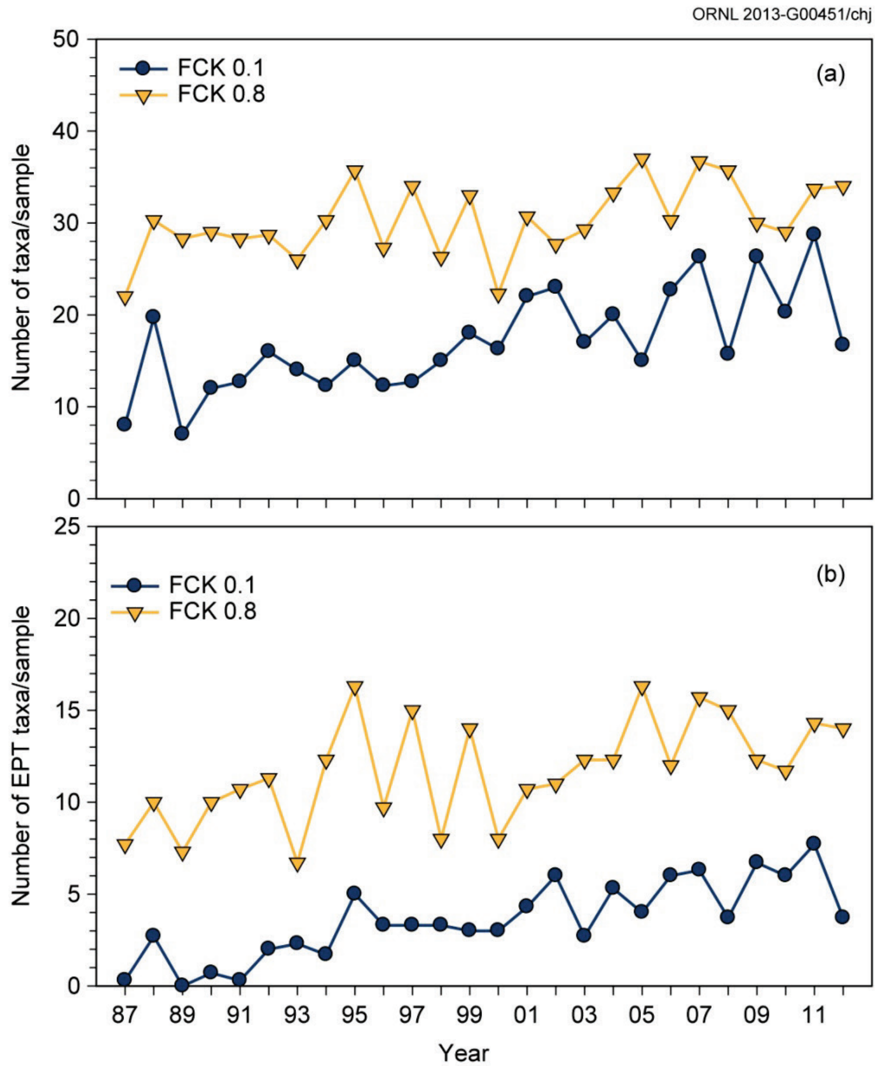

Fig. 5.32. Taxonomic richness (mean number of all taxa/sample) (a) and taxonomic richness of the pollution intolerant taxa, Ephemeroptera, Plecoptera, and Trichoptera [(EPT); mean number of EPT taxa/sample] (b) of the benthic macroinvertebrate community in First Creek, April sampling periods, 1987−2012. (FCK = First Creek kilometer; FCK 0.8 = reference site.)

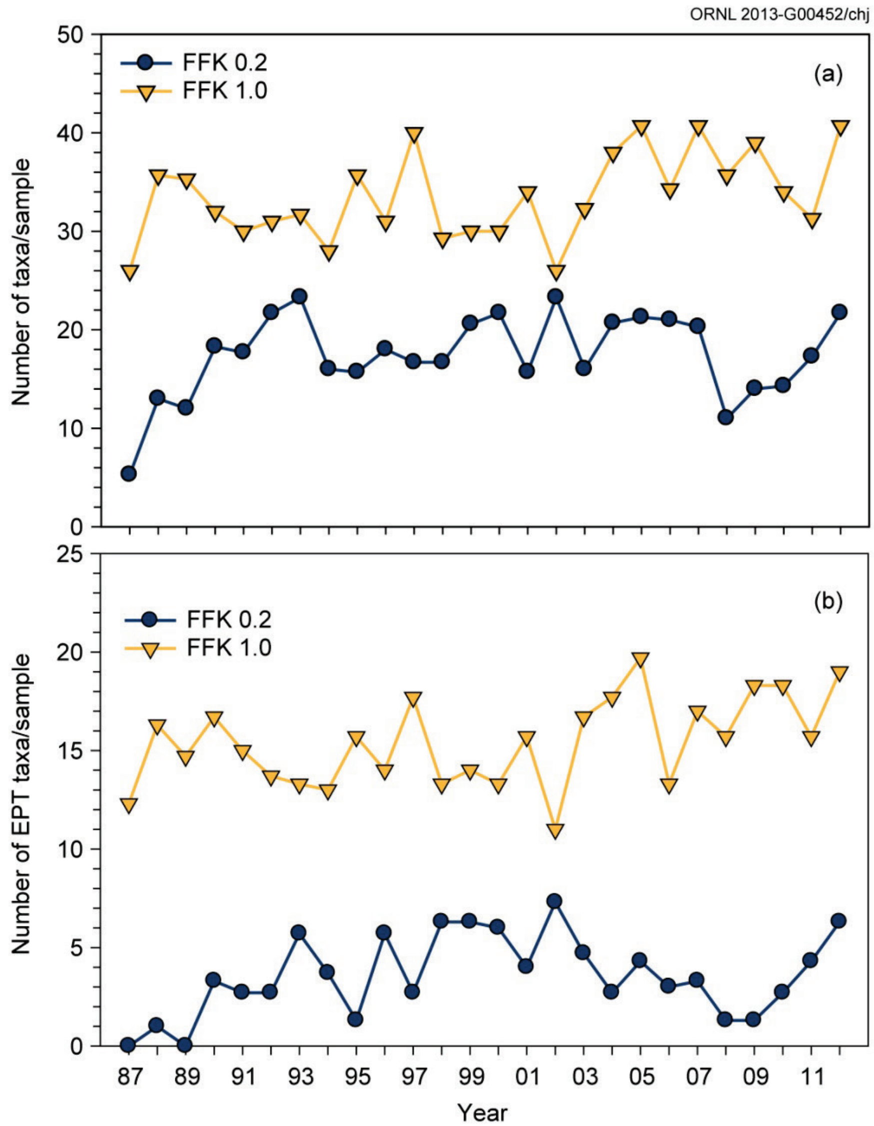

Fig. 5.33. Total taxonomic richness (mean number of all taxa/sample) (a) and taxonomic richness of the pollution intolerant taxa, Ephemeroptera, Plecoptera, and Trichoptera [(EPT) mean number of EPT taxa/sample], (b) of the benthic macroinvertebrate community in Fifth Creek, April sampling periods, 1987−2012. (FFK = Fifth Creek kilometer; FFK 1. 0 = reference site.)

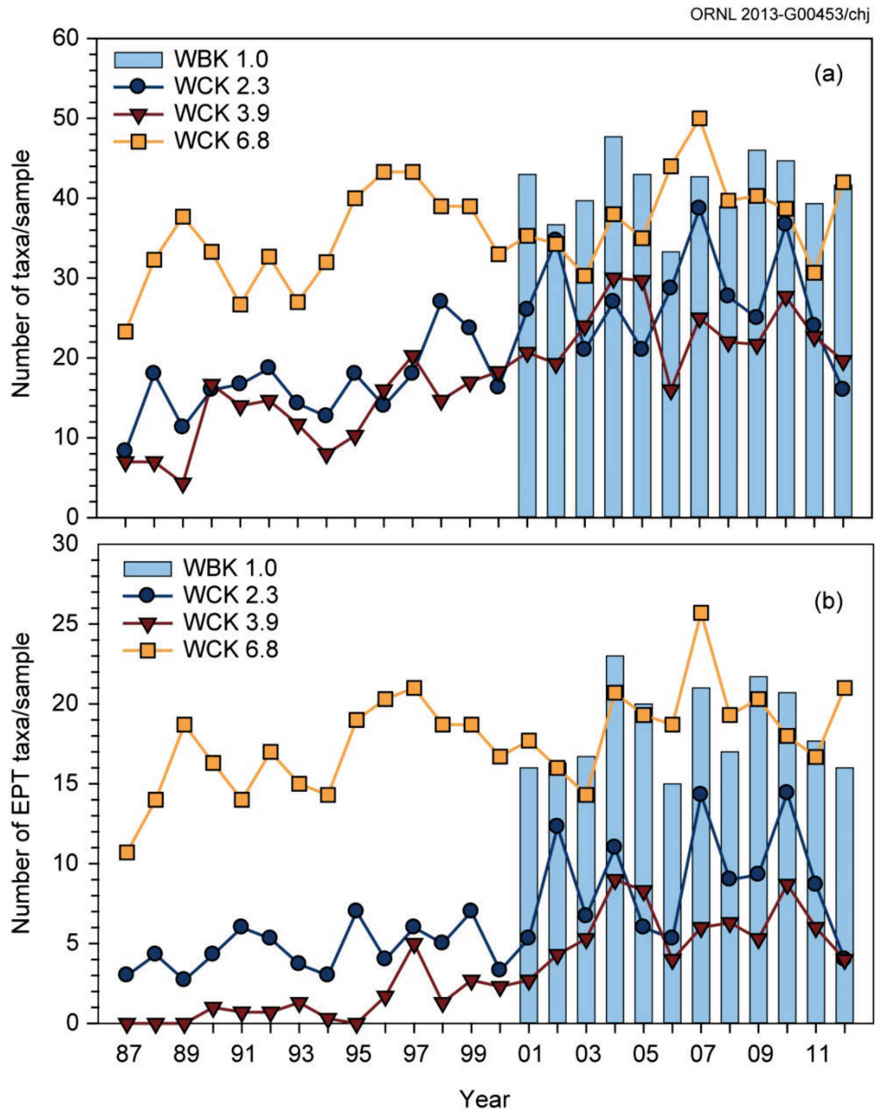

Fig. 5.34. Total taxonomic richness (mean number of all taxa/sample) (a) and taxonomic richness of the pollution intolerant taxa, Ephemeroptera, Plecoptera, and Trichoptera [(EPT); mean number of EPT taxa/sample], (b) of the benthic macroinvertebrate communities in White Oak Creek, April sampling periods, 1987−2012. (WCK = White Oak Creek kilometer; WBK = Walker Branch kilometer; WBK 1.0 = reference site.)

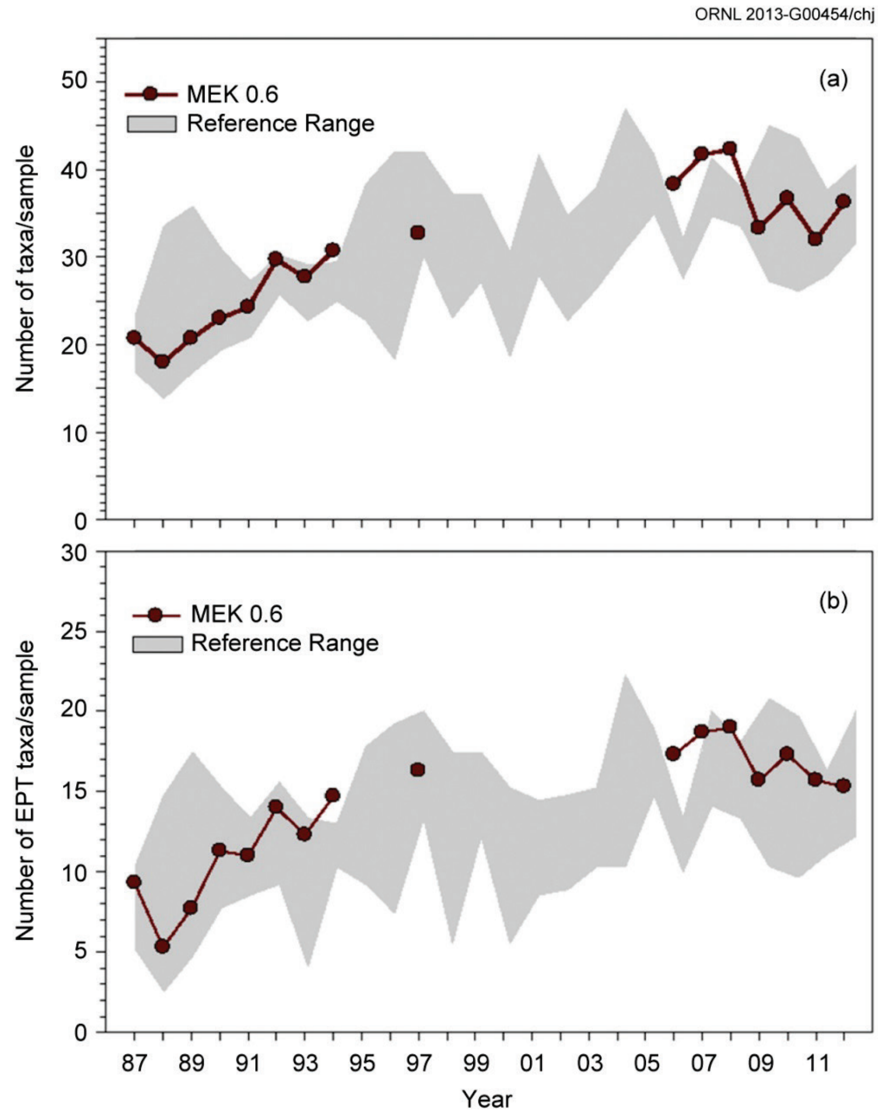

Fig. 5.35. Total taxonomic richness (mean number of all taxa/sample) (a) and taxonomic richness of the pollution intolerant taxa, Ephemeroptera, Plecoptera, and Trichoptera [(EPT); mean number of EPT taxa/sample], (b) of the benthic macroinvertebrate communities in lower Melton Branch, April sampling periods, 1987−2012. [MEK = Melton Branch kilometer; reference range = minimum and maximum values for Oak Ridge National Laboratory Biological Monitoring and Abatement Program reference sites on upper Melton Branch (1987–1997), First Creek and Fifth Creek (1987–2012), Walker Branch (2001–2012), and White Oak Creek (1987–2000, 2007–2012).]

5.5.8.3 Fish Communities

Monitoring fish communities in WOC and major tributaries continued in 2012. Fish samples were taken at 11 sites in the WOC watershed in the spring and fall. Streams located near or within the city of Oak Ridge (Mill Branch and Brushy Fork) were also sampled as reference sites.

In WOC, the fish community continued to be degraded in 2012 compared with communities in reference streams, with sites closest to the outfalls having lower species richness (number of species) (Fig. 5.36), fewer pollution-sensitive species, more pollution-tolerant species, and elevated density (number of fish per square meter) compared with similar-sized reference streams. Generally, the fish communities in tributary sites adjacent to and downstream of ORNL outfalls also remained impacted in 2012 relative to reference streams or upstream sites.

A project to introduce missing fish species into the watershed was initiated in 2008 by stocking six native species. Reproduction was noted for three of the species, and several species expanded their range beyond initial introduction sites. In general introduced species have done better at downstream sites, with a few number of species established further upstream near ORNL facilities.

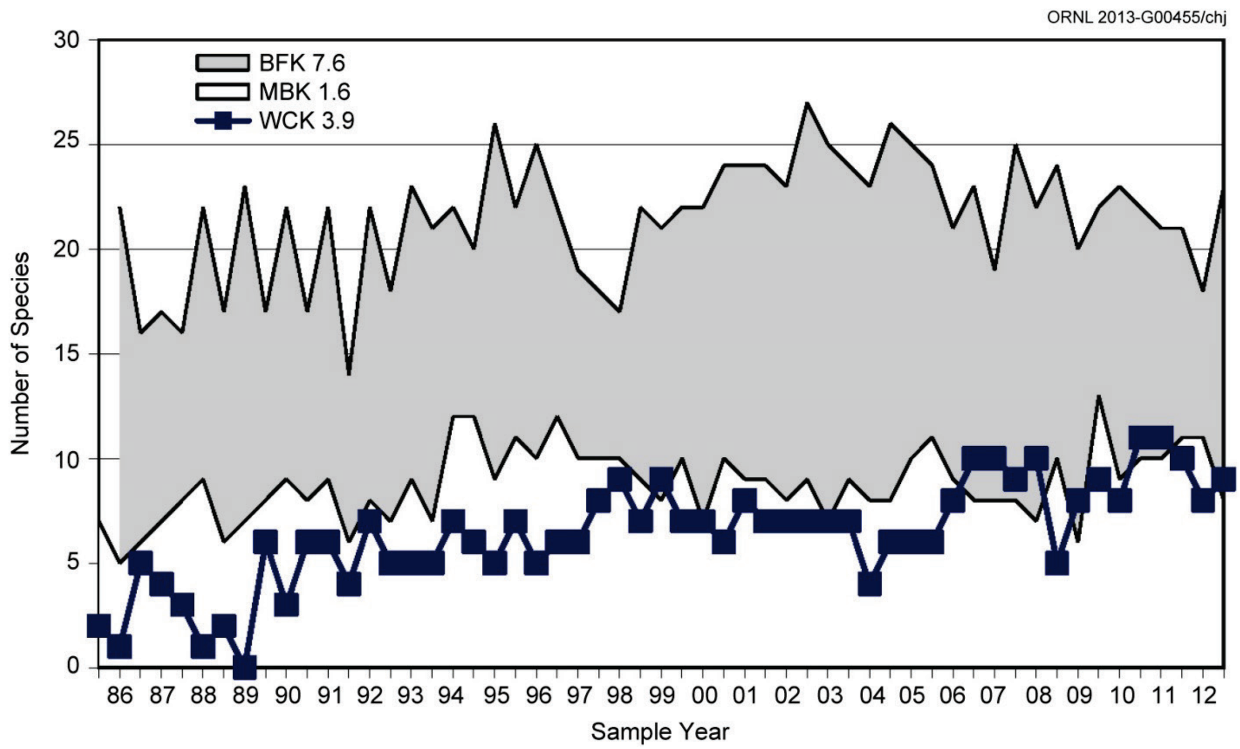

Fig. 5.36. Fish species richness (number of species) in upper White Oak Creek within the Oak Ridge National Laboratory campus compared with two reference streams.(BFK = Brushy Fork kilometer; MBK = Mill Branch kilometer; and WCK = White Oak Creek kilometer.)

5.5.9 Polychlorinated Biphenyls in the White Oak Creek Watershed

Past monitoring has shown that while PCBs are present in the watershed, they are not discharged from ORNL outfalls into the WOC watershed at levels detected by standard analytical methods. Largemouth bass collected from White Oak Lake continue to have tissue PCB concentrations higher than those recommended by TDEC and EPA for frequent consumption. While past monitoring efforts were instrumental in establishing a baseline for PCBs, the focus has historically been on relating PCB levels in fish to safe levels for consumption. These studies were not designed to identify specific stream reaches or sources contributing to PCB bioaccumulation.

The mobility of the fish populations used in traditional bioaccumulation monitoring studies precludes the possibility of source identification. Therefore, the source identification task involved the use of semipermeable membrane devices (SPMDs) to assess the chronic, low-level sources of PCBs at critical sites on the reservation. SPMDs are thin plastic sleeves filled with oil in which PCBs are soluble.

Because SPMDs remain submerged at a given site for 4 weeks and have a high affinity for PCBs, a time-integrated, semiquantitative index of the mean PCB concentration in the water column during the deployment period is provided. SPMDs also have advantages over “snapshot” water concentration analyses. The long deployment period enables distinction between the relative PCB inputs at sites whose aqueous PCB concentrations are below detection limits in water.

In 2012, ORNL’s PCB monitoring efforts continued focusing on the First Creek watershed, which has been identified previously as a source of PCBs. SPMDs and clams were deployed in First Creek. SPMDs were deployed in both wet- and dry-weather conditions in pipe networks for outfalls 250 and 341, contributing to First Creek, and in the outfall 001 pipe network contributing to lower WOC (Fig. 5.37). The results are summarized in Table 5.17.

The SPMD results in this study provide information on the relative contributions of outfall discharges along First Creek outfalls 250 and 341 and WOC outfall 001. The SPMD deployed at the reference site upstream of the ORNL campus, FCK 0.9, had background levels of PCBs. The PCB concentration for FCK 0.1 was greater than background levels at FCK 0.9, confirming that the First Creek watershed is a source of PCBs.

The results from this assessment confirm that outfall 250 is the pipe network of interest for PCB sources in First Creek. Outfalls 001 and 341 pipe network locations contained relatively lower PCB concentrations. The results also indicated that PCBs are likely distributed along the outfall 250 pipe network and likely not concentrated in the upper sections where the historic uses of PCBs were known to have occurred.

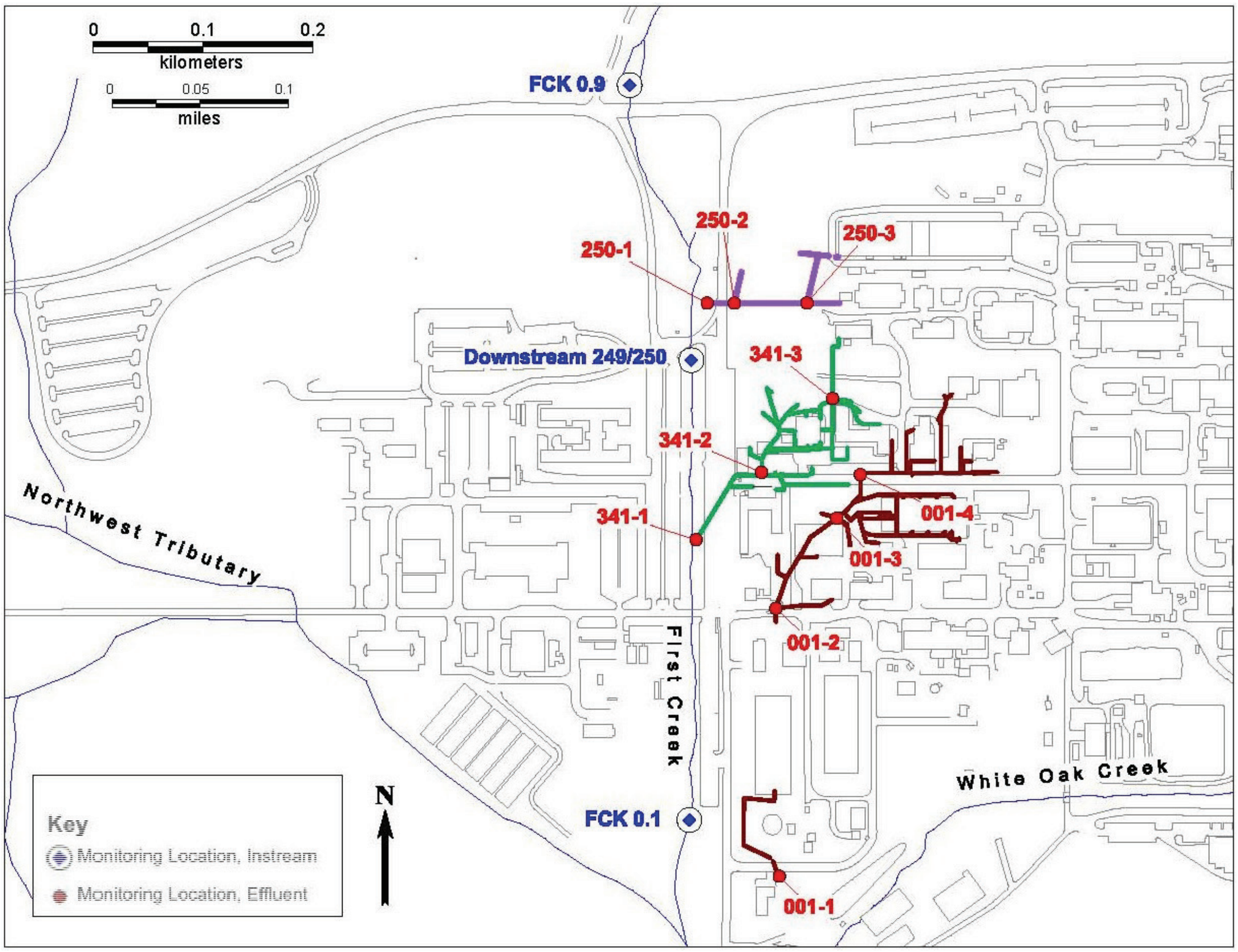

Fig. 5.37. Locations of monitoring points for First Creek source investigation. (FCK = First Creek kilometer)

Table 5.17. White Oak Creek and First Creek PCB source assessment, August 2012
[Total PCBs (parts per billion)]
[Total PCBs (parts per billion)]

Sample location	Location type	Watershed	Weather condition sampled	SPMD	Clams
FCK 0.9	Reference Site	First Creek	All	205	16.5
Outfall 250-3	Pipe Network	First Creek	Wet	23000	—
Outfall 250-2	Pipe Network	First Creek	Wet	11000	—
Outfall 250-1	End of Pipe	First Creek	Wet	41000	—
Downstream Outfall 249/250	Instream	First Creek	All	16000	2,490
Outfall 341-3	Pipe Network	First Creek	Wet	5900	—
Outfall 341-2	Pipe Network	First Creek	Wet	2320	—
Outfall 341-1	End of Pipe	First Creek	Wet	2500	—
FCK 0.1	Instream	First Creek	All	32000	1,344.5
Outfall 001-4	Pipe Network	White Oak Creek	Wet	2340	—
Outfall 001-3	Pipe Network	White Oak Creek	Wet	1580	—
Outfall 001-2	Pipe Network	White Oak Creek	Wet	2810	—
Outfall 001-1	End of Pipe	White Oak Creek	Wet	670	—

Abbreviations
FCK First Creek kilometer
PCB = polychlorinated biphenyl
SPMD semipermeable membrane device

5.5.10 Oil Pollution Prevention

CWA Section 311 regulates the discharge of oils or petroleum products to waters of the United States and requires the development and implementation of SPCC plans to minimize the potential for oil discharges. These requirements are provided in 40 CFR 112, *Oil Pollution Prevention*. Each ORR facility implements a site-specific SPCC plan. NTRC, which is located off ORR, also has an SPCC plan covering the oil inventory at its location. There were no regulatory or permitting actions related to oil pollution prevention at ORNL in 2012. The ORNL SPCC plan was revised in November 2011 to comply with regulatory requirements. An oil handler training program, which includes an initial training module and annual refreshers, has been implemented to comply with training requirements in 40 CFR 112.

5.5.11 Surface Water Surveillance Monitoring

The ORNL surface water monitoring program is conducted in conjunction with the ORR surface water monitoring activities discussed in Section 6.4 to enable assessing the impacts of ongoing DOE operations on the quality of local surface water. The sampling locations (Fig. 5.38) are used to monitor conditions upstream of ORNL main plant waste sources (WCK 6.8); within the ORNL campus (FFK 0.1); and downstream of ORNL discharge points (WCK 1.0).

Sampling frequencies and parameters vary by site and are shown in Table 5.18. Radiological monitoring at the discharge point downstream of ORNL, White Oak Lake at WOD, is conducted monthly under the ORNL WQPP (Section 5.5.4) and, therefore, is not duplicated by this program.

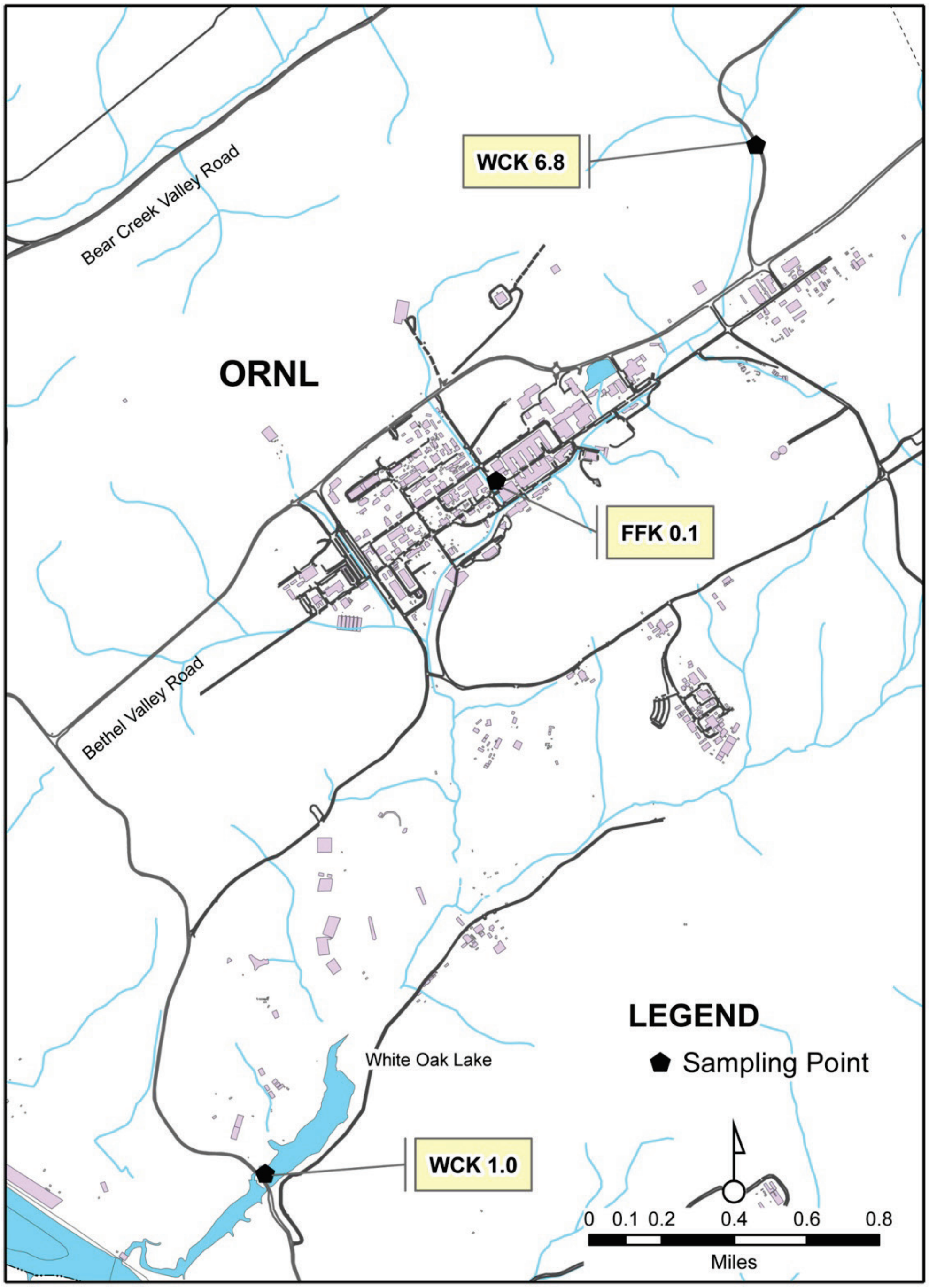

Fig. 5.38. Oak Ridge National Laboratory surface water sampling locations. (FFK = Fifth Creek kilometer; WCK = White Oak Creek kilometer.)

Samples are collected and analyzed for general water quality parameters and are screened for radioactivity at all locations (either under this program or under WQPP). Samples are further analyzed for specific radionuclides when general screening levels are exceeded. Samples from White Oak Lake at WOD are also checked for VOCs, PCBs, and mercury. WCK 6.8 and WCK 1.0 are classified by the State of Tennessee for freshwater fish and aquatic life. Tennessee WQCs associated with these classifications are used as references where applicable. The Tennessee WQCs do not include criteria for radionuclides. Four percent of the DOE DCS is used for radionuclide comparison because this value is roughly equivalent to the 4 mrem dose limit from ingestion of drinking water on which the EPA radionuclide drinking water standards are based.

Table 5.18. Oak Ridge National Laboratory surface water sampling locations, frequencies, and parameters, 2012

Location[a]	Description	Frequency and type	Parameters[b]
WCK 1.0	White Oak Lake at WOD	Quarterly, Grab	Volatiles, mercury, PCBs, field measurements
WCK 6.8	WOC upstream from ORNL	Quarterly, Grab	Gross alpha, gross beta, total radioactive strontium, gamma scan, tritium, field measurements
FFK 0.1	Fifth Creek just upstream of WOC (ORNL)	Semiannually, Grab	Gross alpha, gross beta, total radioactive strontium, gamma scan, tritium, field measurements

[a]Locations identify bodies of water and locations on them (e.g., WCK 1.0 is 1 km upstream from the confluence of White Oak Lake and the Clinch River).

[b]Field measurements consist of dissolved oxygen, pH, and temperature.

Abbreviations

FFK = Fifth Creek kilometer
ORNL = Oak Ridge National Laboratory
WCK = WOC kilometer
WOC = White Oak Creek
WOD = White Oak Dam

The ORR upstream reference site (CRK 66) may be compared with results from this program as applicable to evaluate potential impacts to area surface water as a result of DOE activities at ORNL (Section 6.4.1). Overall radionuclide results from 2012 surveillance monitoring efforts are consistent with historical data.

No radionuclides were detected in surface water at WCK 6.8. Radionuclides were detected at the Fifth Creek location; however, none were above 4% of the DOE DCS. Radionuclide results before WOC empties into the Clinch River (at WOD) are discussed in Section 5.5.4.

PCB-1254 and PCB-1260 were detected at estimated levels once during 2012 at WOC at WOD. Only PCB-1254 was detected last year; before that, PCBs had not been detected since 2001 at WOC at WOD.

5.6 Groundwater Protection Program

As in years past, groundwater monitoring at ORNL was conducted under two sampling programs in 2012: EM monitoring and DOE Office of Science surveillance monitoring. The EM groundwater monitoring program was performed by UCOR in 2012. The Office of Science groundwater monitoring surveillance program was conducted by UT-Battelle.

Radiological and metal contaminant concentrations observed in groundwater exit pathway discharge areas were generally consistent with observations reported in past ASERs. One VOC was identified at low estimated concentrations in samples collected from a WOC discharge area sampling location. Based on the results of the 2012 monitoring effort, there is no indication that current Office of Science operations are significantly impacting groundwater at ORNL.

5.6.1 DOE Office of Environmental Management Groundwater Monitoring

Monitoring was performed as part of an ongoing comprehensive CERCLA cleanup effort in Bethel and Melton Valleys at ORNL, the two administrative watersheds at the ORNL site. Groundwater monitoring for baseline and trend evaluation in addition to measuring effectiveness of completed CERCLA remedial actions is conducted as part of WRRP. WRRP is managed by UCOR for the DOE EM program. The results of CERCLA monitoring for ORR for fiscal year 2012, including monitoring at ORNL, are evaluated and reported in the *2013 Remediation Effectiveness Report for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee* (DOE 2013) as required by the ORR FFA. The monitoring results and remedial effectiveness evaluations for Bethel and Melton Valley are reported in Sections 2 and 3, respectively, in this report.

WRRP also conducts groundwater monitoring at SWSA 6 and submits the required annual groundwater monitoring report to TDEC in response to the RCRA Permit.

Groundwater monitoring conducted as part of the EM program at ORNL includes routine sampling and analysis of groundwater in Bethel Valley to measure performance of several remedial actions and to continue contaminant and groundwater quality trend monitoring. In Melton Valley, where CERCLA remedial actions were completed in 2006 for the extensive waste management areas, the groundwater monitoring program includes monitoring groundwater levels to evaluate the effectiveness of hydrologic isolation of buried waste units. Additionally, groundwater is sampled and analyzed for a wide range of general chemical and contaminant parameters in 46 wells within the interior portion of the closed waste management area.

In FY 2010 DOE initiated activities on a groundwater treatability study at the Bethel Valley 7000 Services Area VOC plume. This plume contains TCE and its transformation products cis-1,2-DCE and vinyl chloride, all at concentrations greater than EPA primary drinking water standards. The treatability study is a laboratory and field demonstration that microbes inherent to the existing subsurface microbial population can fully degrade the VOCs to nontoxic end products.

During FY 2012 post-remediation monitoring was started at SWSA 3 following completion of hydrologic isolation of the area by construction of a multilayer cap and upgradient stormflow/shallow groundwater diversion drain. Remedial actions and monitoring were specified in a CERCLA remedial action work plan that was developed by DOE and was approved by EPA and TDEC before the project was started.

During FY 2012 the EM monitoring program continued sampling and analysis in the off-site groundwater monitoring well array west of the Clinch River adjacent to Melton Valley. In addition to off-site groundwater quality monitoring near Melton Valley, exit pathway groundwater monitoring in Melton Valley is conducted as part of the EM program, including sampling at six multiport monitoring wells in western Melton Valley (wells 4537, 4538, 4539, 4540, 4541, 4542).

5.6.1.1 Summary of DOE Office of Environmental Management Groundwater Monitoring

5.6.1.1.1 Bethel Valley

During FY 2011 construction was completed for remedial actions at two former waste storage sites, SWSA 1 and SWSA 3, which were used for disposal of radioactively contaminated solid wastes between 1944 and 1950. Wastes disposed at SWSA 1 originated from the earliest operations of ORNL while those at SWSA 3 originated from ORNL, Y-12, the K-25 Site (ETTP), and off-site sources. Although most of the disposed waste was solid waste, some containerized liquid wastes were disposed at SWSA 3. Some wastes were encapsulated in concrete after placement in burial trenches while most of the waste was soil-covered. The Bethel Valley ROD (DOE 2002) selected hydrologic isolation using multilayer caps and groundwater diversion trenches as the remedial action for the waste burial grounds and construction of soil covers over the former contractor's landfill and contaminated soil areas near SWSA 3. The baseline monitoring conducted during FY 2010 included measurement of groundwater levels to obtain baseline data to allow evaluation of post-remediation groundwater-level suppression. Sampling and analysis of groundwater quality and contaminants were also conducted. Post-remediation monitoring was specified for SWSA 3 in the *Phased Construction Completion Report for the Bethel Valley Burial Grounds at the Oak Ridge National Laboratory, Oak Ridge, Tennessee* (DOE 2012). Required monitoring includes quarterly groundwater-level monitoring in 42 wells with continuous water-level monitoring in 8 wells to confirm cap performance. Groundwater samples are collected semiannually at 13 wells for laboratory analyses to evaluate groundwater contaminant concentration trends. During FY 2012 monitoring results showed that the cap was effective although target groundwater elevations were exceeded at three of eight wells. Comparison of pre-remediation to post-remediation groundwater contaminant concentrations showed that evaluated contaminant levels decreased at four locations, were stable at three locations, and exhibited no trend at two locations.

During FY 2012 the DOE EM program monitored three groundwater monitoring wells in Bethel Valley to the west of Tennessee Highway 95 to detect and monitor contamination from the SWSA 3 area. These three wells supplement data being collected from a multiport well (4579) near SWSA 3 for exit pathway groundwater monitoring in western Bethel Valley. Groundwater monitoring near SWSA 3, along with the exit pathway, and groundwater monitoring and surface water monitoring at the northwest tributary of WOC and in the headwaters of Raccoon Creek allow integration of data concerning SWSA 3 contaminant releases as presented in the 2013 remediation effectiveness report (DOE 2013).

During FY 2012 groundwater monitoring continued at the ORNL 7000 Area to evaluate treatability of the VOC plume at that site. Site characterization testing of the endemic microbial community showed that microbes were present that are capable of fully degrading TCE and its degradation products if sufficient electron donor compounds were present in the subsurface environment. During FY 2011 a mixture of emulsified vegetable oil and a hydrogen releasing compound was injected into four existing monitoring wells in the 7000 area. Monitoring of the stimulation of the endemic microbial community along with concentrations of chlorinated VOCs continued through FY 2012. Results of the monitoring show that the microbial community responded well to the addition of the carbon electron donor, and the VOC concentrations in the treated area have decreased significantly.

The other principal element of the Bethel Valley ROD (DOE 2002) remedy that requires groundwater monitoring is the containment pumping to control and treat discharges from the ORNL Central Campus core hole 8 plume. The original action for this plume was a CERCLA removal action that was implemented in 1995. The remedy had performed well until the latter portion of FY 2008 when conditions changed and ^{90}Sr and $^{233/234}$U concentrations in monitoring wells and the groundwater collection system began increasing. Leaking utility waterlines near the source area are suspected to have increased the mass of contaminants feeding the plume. Increased infiltration of plume water into storm drains has allowed increased contaminant flux to First Creek, a tributary of WOC. During FY 2009 the remedy did not meet its performance goal, which is a reduction of ^{90}Sr in WOC. In March 2012 DOE completed refurbishment and enhancement of the groundwater collection system to increase the plume containment effectiveness. During FY 2012 the remedy met its performance goal of reducing ^{90}Sr levels in WOC as measured at the 7500 Bridge.

5.6.1.1.2 Melton Valley

The Melton Valley ROD (DOE 2000) established goals for a reduction of contaminant levels in surface water, groundwater-level fluctuation reduction goals within hydrologically isolated areas, and minimization of the spread of groundwater contamination. Remedy effectiveness groundwater monitoring in Melton Valley includes groundwater-level monitoring in wells within and adjacent to hydrologically isolated shallow waste burial areas and groundwater quality monitoring in selected wells adjacent to buried waste areas.

Groundwater-level monitoring shows that the hydrologic isolation component of the Melton Valley remedy is effectively minimizing the amount of percolation water contacting buried waste and is reducing contaminated leachate formation. During FY 2012 greater than average annual rainfall occurred for the fourth consecutive year since the remedy was completed in 2006. In a few areas groundwater levels within capped areas continue to respond to groundwater fluctuations imposed from areas outside the caps, but contact of groundwater with buried waste is minimal. Overall the hydrologic isolation systems are performing as designed; however, groundwater-level control at the SWSA 4 downgradient collection trench was challenged following large rain events. Near the end of FY 2012, EM initiated a project to redevelop the groundwater extraction wells in the SWSA 4 downgradient collection trench. The effectiveness of that maintenance activity on collection trench performance will be evaluated in the 2014 remediation effectiveness report.

Groundwater quality monitoring in the interior of Melton Valley shows that in general groundwater contaminant concentrations are declining or are stable following remedial actions.

During the past 8 years of groundwater monitoring in the Melton Valley exit pathway, several site-related contaminants have been detected in groundwater near the Clinch River. Low concentrations of ^{90}Sr, ^{3}H, uranium, and VOCs have been detected intermittently in a number of the multizone sampling locations. Groundwater in the exit pathway wells has high alkalinity and sodium and exhibits elevated pH. During FY 2012 the EM program monitored an off-site groundwater monitoring well array west of the Clinch River adjacent to Melton Valley. Monitoring included groundwater-level monitoring to evaluate potential flowpaths near the river and sampling and analysis for a wide array of metals, anions, radionuclides, and VOCs. Groundwater-level monitoring showed that natural head gradient conditions cause groundwater seepage to converge toward the Clinch River from both the DOE (eastern) and off-site (western) sides of the river. Groundwater quality monitoring showed that aggressive off-site well pumping related to well construction may have drawn chlorinated VOCs associated with DOE beneath the river. Those compounds were detected only during the first of five sampling events. DOE provided funding for installation of utility water supplies to residents near the Clinch River opposite the Melton Valley area in response to the potential vulnerability of off-site well pumping drawing contaminants off ORR. Monitoring results are summarized in the 2013 remediation effectiveness report (DOE 2013).

5.6.2 DOE Office of Science Groundwater Monitoring

DOE O 458.1 (DOE 2011c) is the primary requirement for a sitewide groundwater protection program at ORNL. As part of the groundwater protection program, and to be consistent with UT-Battelle management objectives, groundwater surveillance monitoring was performed to monitor ORNL groundwater exit pathways and UT-Battelle facilities (“active sites”) potentially posing a risk to groundwater resources at ORNL. Results of the DOE Office of Science groundwater surveillance monitoring program are reported in the following sections.

Exit pathway and active-sites groundwater surveillance monitoring points sampled during 2012 included seep/spring and surface-water monitoring locations in addition to groundwater surveillance monitoring wells. Seep/spring and surface-water monitoring locations were used in the absence of monitoring wells located in appropriate groundwater discharge areas.

Groundwater monitoring performed under the exit pathway groundwater surveillance and active-sites monitoring programs is not regulated by federal or state regulations. Consequently, no permit or standards exist for evaluating sampling results. To provide a basis for evaluating analytical results and for assessment of groundwater quality at locations monitored by UT-Battelle for the Office of Science, federal drinking water standards and Tennessee WQCs for domestic water supplies (TDEC 2012) were used as reference standards in the following discussions. Four percent of the DCSs established by DOE O 458.1 were used if no federal or state standards had been established for a particular radionuclide. Although drinking water standards and DOE DCSs are used for comparative purposes, it is important to note that no members of the public consume groundwater from ORNL wells, nor do any groundwater wells furnish drinking water to personnel at ORNL.

5.6.2.1 Exit Pathway Monitoring

During 2012, exit pathway groundwater surveillance monitoring was performed in accordance with the exit pathway sampling and analysis plan (SAP) (Bonine 2012). Groundwater exit pathways at ORNL include areas from watersheds or subwatersheds where groundwater discharges to the Clinch River–Melton Hill Reservoir to the west, south, and east of the ORNL main campus. The exit pathway monitoring points were chosen based on hydrologic features, screened interval depths (for wells), and locations relative to discharge areas proximate to DOE facilities operated by, or under the control of, UT-Battelle. The groundwater exit pathways at ORNL include four discharge zones identified by a data quality objectives process. One of the original exit pathway zones was split into two zones for geographic expediency. The Southern Discharge Area Exit Pathway was carved from the East End Discharge Area Exit Pathway.

The five zones are as follows:

- the WOC Discharge Area Exit Pathway,
- the 7000–Bearden Creek Watershed Discharge Area Exit Pathway,
- the East End Discharge Area Exit Pathway,
- the Northwestern Discharge Area Exit Pathway, and
- the Southern Discharge Area Exit Pathway.

Figure 5.39 shows the locations of the exit pathway monitoring points sampled in 2012.

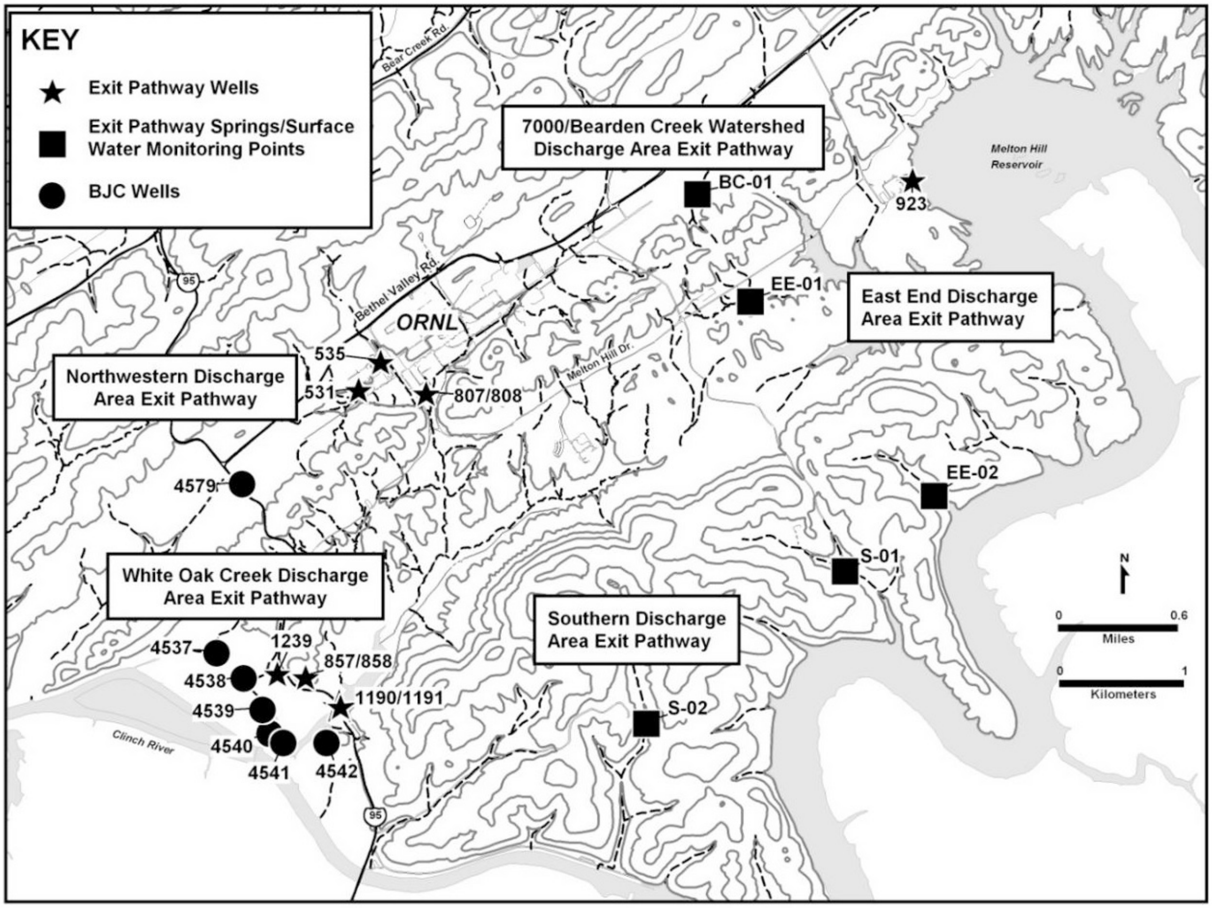

Fig. 5.39. UT-Battelle exit pathway groundwater monitoring locations at Oak Ridge National Laboratory, 2012.

The efficacy of the exit pathway monitoring program was reviewed in late 2011. As a result, the groundwater monitoring program was modified through an optimization approach that included frequency analysis of parameters and their concentrations based on an exhaustive review of historical groundwater sampling data. The modification resulted in a 10-year staggered groundwater monitoring schedule and analytical suite selection. This approach was initiated in 2012. Groundwater samples scheduled to be collected from the monitoring points and analyzed for the parameter suites in 2012 are outlined in Table 5.19.

Table 5.19. Scheduled 2012 exit pathway groundwater monitoring

Discharge area	Monitoring point	Wet season	Dry season
White Oak Creek	857	Radiological	Radiological
	858	Radiological, organic, and metals	Radiological
	1190	Radiological, organic, and metals	Radiological, organic, and metals
	1191	Radiological, organic, and metals	Radiological, organic, and metals
	1239	Radiological	Radiological
Northwestern	531	Radiological	Radiological
	535	Radiological	Radiological
	807	Radiological, organic, and metals	Radiological
	808	Radiological	Radiological
7000-Bearden Creek	BC-01	Radiological, organic, and metals	Radiological
East End	923	Radiological	Radiological
	EE-01	Radiological, organic, and metals	Radiological
	EE-02	Radiological	Radiological
Southern	S-01	Radiological	Radiological
	S-02	Radiological	Radiological

Unfiltered samples were collected from the exit pathway groundwater surveillance monitoring points in 2012. The organic suite was composed of VOCs and semivolatile organic compounds (SVOCs); the metallic suite included metals (e.g., mercury); and the radionuclide suite was composed of gross alpha/gross beta activity, gamma emitters, total radioactive strontium, and ^{3}H. Under the monitoring strategy outlined in the exit pathway SAP, samples were collected semiannually during the wet (March) and dry (August) seasons.

5.6.2.1.1 Exit Pathway Monitoring Results

Statistical trend analyses were performed on 2012 exit pathway monitoring data sets containing data exceeding reference standards. The bases used for the trend analyses were the historical data collected from the late 1980s through 2012. Trend analyses were not performed on data sets where minimum detection limits exceeded reference standards (e.g., the SVOCs atrazine, benzo(a)pyrene, hexachlorobenzene, and pentachlorophenol) and were not performed on parameters for which there are no reference standards or where data densities were insufficient. Parameters that exhibited statistically significant (80% to 99% confidence levels) upward or downward trends are reported. Trend analysis results are summarized in Table 5.20.

Samples were not collected at BC-01, EE-01, EE-02 or S-01 during the dry season due to a lack of water flow at these locations. Samples were collected at all other monitoring points during both the wet and dry seasons. Monitoring results are available in OREIS. Access to this system can be requested via email (oreis@ettp.doe.gov) or by telephone (865-574-3257).

Table 5.21 provides a summary of radiological parameters detected in samples collected from exit pathway monitoring points during 2012. Table 5.22 summarizes organics parameters detected in samples collected from exit pathway monitoring points. Given that metal parameters are ubiquitously detected in exit pathway groundwater monitoring points, they are not likewise summarized. Parameters (including metals) exceeding reference standards during 2012 are summarized in Table 5.20.

Table 5.20. 2012 exit pathway groundwater monitoring—results of statistical trend analyses for parameters exceeding reference standards

Discharge area	Monitoring point	Parameter	Trend
White Oak Creek	1190	Iron	None
		Manganese	Down
		Tritium	Down
	1191	Iron	None
		Manganese	Up
		Gross beta	Down
		Total radioactive strontium	None
		Tritium	Down
Northwest	807	Iron	Up
		Manganese	None
7000 Area–Bearden Creek	BC-01	Aluminum	None
		Iron	None
Eastern	EE-01	Aluminum	None

Table 5.21. 2012 exit pathway groundwater monitoring results—detected radiological parameters[a]

Discharge area	Monitoring point	Radiological parameter	Wet season	Dry season
White Oak Creek	857	Bismuth-214	32	11
		Lead-214	31	17
		Thallium-208	3.4	[b]
		Tritium	470	[b]
	858	Tritium	240	[b]
	1190	Gross beta	3.5	2.9
		Bismuth-214	26	[b]
		Lead-214	26	11
		Tritium	25000	27000
	1191	Gross beta	300	350
		Bismuth-214	14	19
		Lead-214	[b]	17
		Total radioactive strontium	140	220
		Tritium	33000	24000
	1239	Gross beta	2.6	[b]
Northwestern	535	Gross beta	7.2	[b]
		Bismuth-214	24	[b]
		Lead-214	23	[b]
	807	Gross beta	6.7	3.5
		Bismuth-214	24	[b]
		Lead-214	26	[b]
		Total radioactive strontium	1.8	[b]
		Tritium	350	480
	808	Gross beta	2.5	2.8
East End	923	Gross beta	3.2	[b]

Table 5.21. (continued)

Discharge area	Monitoring point	Radiological parameter	Wet season	Dry season
7000 Area–Bearden Creek	BC-01	Gross alpha	2.1	[b]
Southern	S-01	Gross beta	3.2	[b]
		Bismuth-214	7.1	[b]
	S-02	Thallium-208	2.4	[b]

[a]Radiological units—pCi/L
[b]None detected

Table 5.22. 2012 exit pathway groundwater monitoring results—detected organic parameters[a]

Discharge area	Monitoring point	Radiological parameter	Wet season	Dry season
White Oak Creek	1191	Benzoic acid	[b]	*J14*

[a]Organic units—µg/L
[b]None detected

Radiological and metal contaminant concentrations observed in groundwater exit pathway discharge areas were generally consistent with observations reported in past ASERs. Most of the radiological contaminants detected in groundwater in 2012 occurred during the wet season at the WOC and Northwestern discharge areas. Tritium, total radioactive strontium, and gross beta activity were the only radiological contaminants exceeding reference standards at any of the discharge areas and these three contaminants were found at the WOC discharge area in 2012. Statistical trend analyses show that radiological contaminant trends at exit pathway monitoring locations continue downward. The downward trend in radiological contaminants in the WOC discharge area is very likely attributable to EM remediation activities in Melton Valley. No other radiological contaminants exceed reference standards at other discharge areas. Metals were detected in groundwater monitoring locations in all of the exit pathway discharge areas. Only three metals (iron, manganese, and aluminum) were detected at concentrations exceeding reference standards. These metals are commonly found in groundwater at ORNL. One VOC (benzoic acid) was identified at low estimated concentrations in samples collected from a WOC discharge area sampling location. Its source is unknown. Based on the results of the 2012 monitoring effort, there is no indication that current Office of Science operations are significantly impacting groundwater at ORNL.

5.6.2.2 Active Sites Monitoring

5.6.2.2.1 Active Sites Monitoring—High Flux Isotope Reactor

Groundwater monitoring conducted by the Research Reactors Division ceased in 2007 based on declining ^{3}H concentrations observed since the repair of the subsurface leak site discovered in late 2000. Since then, outfall pipelines intercepting groundwater have been monitored for ^{3}H routinely under the ORNL NPDES permit. (See Section 5.5.4 for a discussion of results.)

5.6.2.2.2 Active Sites Monitoring—Spallation Neutron Source

Active sites groundwater surveillance monitoring was performed in 2012 at the SNS site. The site was monitored based on the potential for adverse impact on groundwater resources at ORNL should a release occur. Monitoring at the SNS site was performed in 2012 under the SNS operational monitoring plan (Bonine, Ketelle, and Trotter 2007). Operational monitoring was initiated following a 2-year (2004–2006) baseline monitoring program and will continue throughout the duration of SNS operations.

The SNS site is located atop Chestnut Ridge, northeast of the main ORNL facilities. The site slopes to the north and south, and small stream valleys, populated by springs and seeps, lie on the ridge flanks. Surface water drainage from the site flows into Bear Creek to the north and WOC to the south.

The SNS site is a hydrologic recharge area underlain by geologic formations that form karst geologic features. Groundwater flow directions at the site are based on the generally observed tendency for groundwater to flow parallel to geologic strike (parallel to the orientation of the rock beds) and via karst conduits that break out at the surface in springs and seeps located down gradient of the SNS site. A sizable fraction of infiltrating precipitation (groundwater recharge) flows to springs and seeps via the karst conduits.

SNS operations have the potential for introducing radioactivity (via neutron activation) in the shielding berm surrounding the SNS linac, accumulator ring, and/or beam transport lines. A principal concern is the potential for water infiltrating the berm soils to transport radionuclide contamination generated by neutron activation to saturated groundwater zones. The ability to accurately model the fate and transport of neutron activation products generated by beam interactions with the engineered soil berm is complicated by multiple uncertainties resulting from a variety of factors, including hydraulic conductivity differences in earth materials found at depth, the distribution of water-bearing zones, the fate and transport characteristics of neutron activation products produced, diffusion and advection, and the presence of karst geomorphic features found on the SNS site. These uncertainties led to the initiation of the groundwater surveillance monitoring program at the SNS site. Objectives of the groundwater monitoring program outlined by the operational monitoring plan include the following: (1) maintain compliance with applicable environmental quality standards and (2) provide uninterrupted monitoring of the SNS site.

A total of seven seeps/springs and surface water sampling points (seeps/springs S-1, S-2, S-3, S-4, S-5, and SP-1 and surface-water point SW-1) were routinely monitored as analogues to, and in lieu of, groundwater monitoring wells. Locations were chosen based on hydrogeological factors and proximity to the beam line. Figure 5.40 shows the locations of the specific monitoring points sampled during 2012.

Because of the presence of karst geomorphic features at the SNS site (and the lack of groundwater wells at the SNS site), sampling of the seeps/springs was performed quarterly to characterize the radionuclide content of the water throughout the expected range of flow at each monitoring location. Three grab samples were collected from each seep/spring: one sample to represent base flow (collected during dry periods between rainfall events) and two samples collected during rainfall events representing higher stage/flow rates [i.e., one representing the rising limb of the storm hydrograph (water flow induced by the initial pulse of rainfall percolating through the system) and one representing the falling limb of the storm hydrograph (water flowing in the system after peak flow induced by rainfall has occurred)], as shown in Fig. 5.41. Given their fate and transport characteristics, ^{3}H and ^{14}C are the principal groundwater constituents of concern at the SNS site. In 2012, samples were collected on a quarterly basis for ^{3}H and ^{14}C analyses. Additionally, samples were collected during wet-season base flow conditions for gross activity (alpha and beta) and for selected gamma spectroscopic parameters.

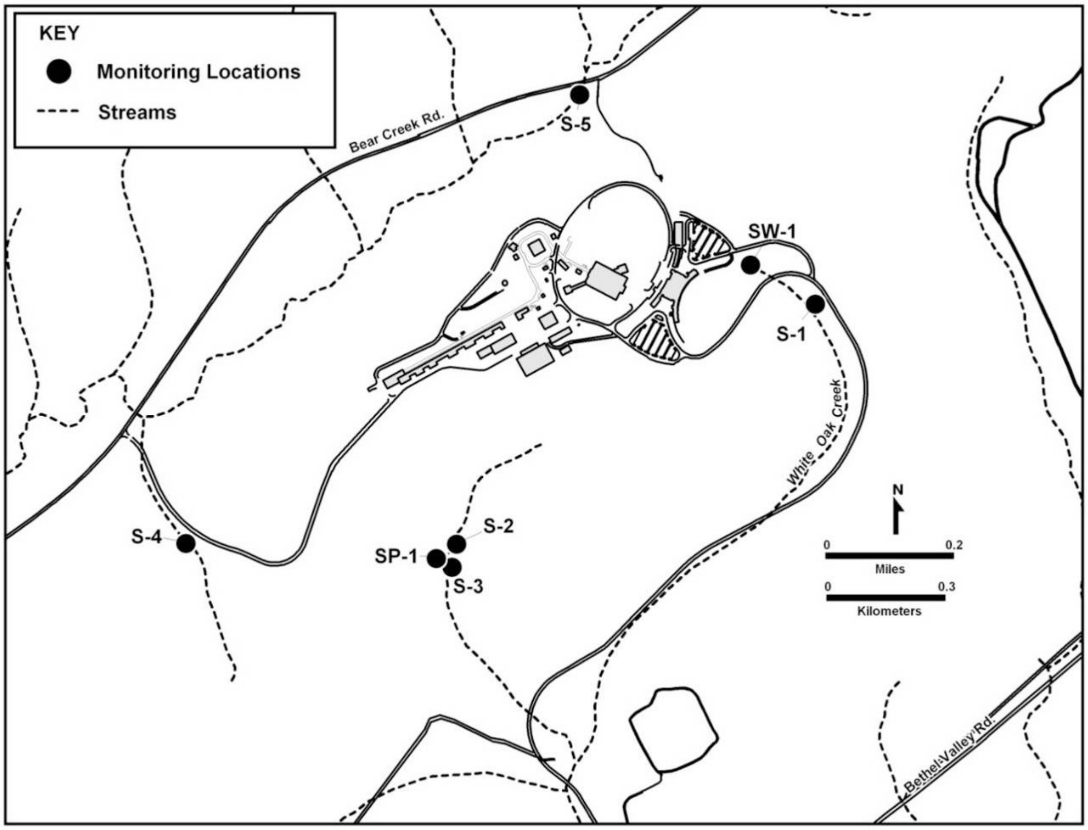

Fig. 5.40. Groundwater monitoring locations at the Spallation Neutron Source, 2012.

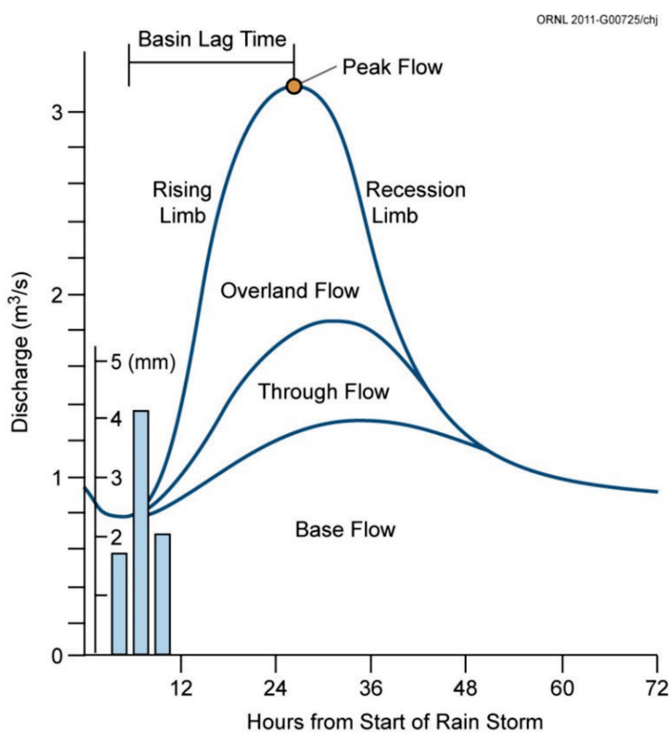

Fig. 5.41. Simple hydrograph of spring discharge vs time after initiation of rainfall.

Spallation Neutron Source Site Results

Sampling at the SNS site occurred during March, June, August, September, and November 2012. No SNS sample results exceeded reference standard thresholds in 2012. Carbon-14, gross beta activity, and gamma-emitting radionuclides were not detected in samples collected at the SNS site during 2012. Low concentrations of gross alpha activity were detected in samples collected from S-3 and S-5 during base flow conditions in March. Low concentrations of ^{3}H were detected numerous times at very low concentrations during 2012. Table 5.23 provides a summary of the locations, flow conditions, and sampling events for ^{3}H detections observed during 2012.

Table 5.23. Spallation Neutron Source groundwater monitoring results—^{3}H detections in 2012

Monitoring point	Flow condition		
	Base flow	Rising limb	Falling limb
S-1	March, June, August, and November	March	March, September, and November
S-2	March, August, and November	March, September, and November	September and November
S-3	March	March	March and September
S-4	March and August	March and September	March and September
S-5	March	March	None
SP-1	None	None	None
SW-1	March, June, August, and November	March, June, and November	March, June, September, and November

5.7 Quality Assurance Program

UT-Battelle implements the requirements of DOE O 414.1D, *Quality Assurance,* (DOE. 2011e) for all programs, projects, and activities and 10 CFR 830 Subpart A, *Quality Assurance Requirements,* for nuclear facilities, radiological areas, and programs and activities that have the potential to impact nuclear or radiological safety. ORNL has adopted ISO 9001:2008 as the laboratory consensus standard and has been registered to the standard by a third party registrar. Adoption of ISO 9001:2008 provides the level of rigor and flexibility necessary for the wide range of activities UT-Battelle conducts at ORNL. Additional QA requirements or guidance documents are used on a project- or process-specific basis based on potential risk factors and customer requirements. The application of QA/QC programs specifically focused on environmental monitoring activities on ORR is essential for generating data of known and defensible quality. Each aspect of an environmental monitoring program from sample collection to data management and record keeping must address and meet applicable quality standards. The activities associated with administration, sampling, data management, and reporting for ORNL environmental programs are performed by the UT-Battelle Environmental Protection and Waste Services Division (EP&WSD).

UT-Battelle uses SBMS to provide a systematic approach for integrating QA, environmental, and safety considerations into every aspect of ORNL environmental monitoring. SBMS is a web-based system that provides a single point of access to all the requirements necessary for staff to safely and effectively perform work. SBMS translates laws, orders, directives, policies, and best-management practices into laboratory-wide subject areas and procedures.

5.7.1 Work/Project Planning and Control

UT-Battelle's work/project planning and control directives establish the processes and requirements for executing work activities at ORNL. All environmental sampling tasks are performed following the four steps required in the work control subject areas:

- define scope of work;
- perform work planning—analyze hazards and define controls;
- execute work; and
- provide feedback.

In addition, EP&WSD has approved project-specific standard operating procedures for all activities controlled and maintained through the Integrated Document Management System.

Environmental sampling standard operating procedures developed for UT-Battelle environmental sampling programs provide detailed instructions on maintaining chain of custody, sample identification, sample collection and handling, sample preservation, equipment decontamination, and collection of quality control samples such as field and trip blanks, duplicates, and equipment rinses.

5.7.2 Personnel Training and Qualifications

The UT-Battelle Training and Qualification Management System provides employees and nonemployee staff of UT-Battelle with the knowledge and skills necessary to perform their jobs safely, effectively, and efficiently with minimal supervision. This capability is accomplished by establishing site-level procedures and guidance for training program implementation with an infrastructure of supporting systems, services, and processes.

Likewise, the WAI Training and Qualification program provides employees with the knowledge and skills necessary to perform their jobs safely, effectively, and efficiently with minimal supervision. This capability is accomplished by establishing site-level procedures and guidance for training program implementation with an infrastructure of supporting systems, services, and processes.

5.7.3 Equipment and Instrumentation

5.7.3.1 Calibration

The UT-Battelle Quality Management System includes subject area directives that require all UT-Battelle staff to use equipment of known accuracy based on appropriate calibration requirements that are traceable to an authority standard. UT-Battelle Facilities and Operations Instrumentation and Control Technical Support tracks all equipment used in the environmental monitoring programs conducted by UT-Battelle for the ORNL site and ORR through a maintenance recall program to ensure that equipment is functioning properly and within defined tolerance ranges. The determination of calibration schedules and frequencies is based on a graded approach at the activity planning level. EP&WSD environmental monitoring programs follow rigorous calibration schedules to eliminate gross drift and the need for data adjustments. Instrument tolerances, functions, ranges, and calibration frequencies are established based on manufacturer specifications, program requirements, actual operating environment and conditions, and budget considerations.

In addition, continuous monitors used for CAA compliance monitoring at specific ORNL boilers are subjected to rigorous quality assurance protocols as specified by EPA methods. A relative accuracy test audit (RATA) is performed annually to certify the Predictive Emissions Monitoring System (PEMS) for nitrogen oxides and oxygen. The purpose of RATA is to provide a rigorous QA assessment in accordance with EPA 40 CFR, Performance Specification 16. Three out of four quarters a relative accuracy audit is performed on PEMS using a second, calibrated system to verify the accuracy of the on-stack system. A calibration error opacity audit is performed quarterly on continuous opacity monitoring systems. This audit is performed at low-, mid-, and high-ranges. Automated zero and span checks are performed daily. The results of these QA tests are provided to TDEC quarterly and annually as applicable.

5.7.3.2 Standardization

The UT-Battelle Integrated Document Management System (IDMS) provides the necessary functionality and controls to ensure controlled documents are managed, distributed, revised, and maintained in accordance with ORNL document control requirements. EP&WSD sampling procedures are maintained in IDMS and include requirements and instructions for the proper standardization and use of monitoring equipment. Requirements include the use of traceable standards and measurements; performance of routine, before-use equipment standardizations; and actions to follow when standardization steps do not produce required values. Standard operating procedures for sampling also include instructions for designating nonconforming instruments as "out-of-service" and initiating requests for maintenance.

5.7.3.3 Visual Inspection, Housekeeping, and Grounds Maintenance

EP&WSD environmental sampling personnel conduct routine visual inspections of all sampling instrumentation and sampling locations. These inspections identify and address any safety, grounds keeping, general maintenance, and housekeeping issues or needs.

5.7.4 Assessment

Independent audits, surveillance, and internal management assessments are performed to verify that requirements have been accurately specified and activities that have been performed conform to expectations and requirements. External assessments are scheduled based on requests from auditing agencies. Table 2.1 presents a list of environmental audits and assessments performed at ORNL in 2012 and information on the number of findings identified, if any. EP&WSD also conducts internal management assessments of UT-Battelle environmental monitoring procedural compliance, safety performance, and work planning and control. Surveillance results, recommendations, and completion of corrective actions, if required, are also documented and tracked in the ORNL Assessment and Commitment Tracking System.

WAI and Isotek perform independent audits, surveillances, and internal management assessments to verify that requirements have been accurately specified and activities that have been performed conform to expectations and requirements. Corrective actions, if required, are documented and tracked in the WAI Issues Management Database and the Isotek Assessment and Commitment Tracking System, respectively.

5.7.5 Analytical Quality Assurance

The contract laboratories that perform analyses of environmental samples from the UT-Battelle environmental monitoring programs at ORNL and on ORR are required to have documented QA/QC programs, trained and qualified staff, appropriately maintained equipment and facilities, and applicable certifications. Several laboratories are contracted under basic ordering agreements to perform analytical work to characterize UT-Battelle environmental samples. The DOE Environmental Management Consolidated Audit Program performs oversight of subcontracted commercial laboratories. This program, administered by DOE and subcontractors from across the DOE complex, establishes required internal and external laboratory control and performance evaluation programs and conducts on-site laboratory reviews that monitor the performance of all subcontracted laboratories and verify that all quality requirements are met.

A statement of work for each project specifies any additional QA/QC requirements and includes detailed information on data deliverables, turnaround times, and required methods and detection limits. Blank and duplicate samples are routinely submitted along with ORR environmental samples to provide an additional check on analytical laboratory performance.

5.7.6 Data Management and Reporting

Management of data collected by UT-Battelle in conjunction with ORR and ORNL environmental surveillance programs and with CWA activities at ORNL is accomplished using the Environmental Surveillance System (ESS), a web interface data management tool. A software QA plan for ESS has been developed to document ESS user access rules; verification and validation methods; configuration and change management rules; release history; software registration information; and the employed methods, standards, practices, and tools.

Field measurements and sample information are entered into ESS, and an independent verification is performed on all records to ensure accurate data entry. Sample results and associated information are loaded into ESS from electronic files provided by analytical laboratories. An automated screening is performed to ensure that all required analyses were performed, appropriate analytical methods were used, holding times were met, and specified detection levels were achieved.

Following the screening, a series of checks is performed to determine whether results are consistent with expected outcomes and historical data. QC sample results (i.e., blanks and duplicates) are reviewed to check for potential sample contamination and to confirm repeatability of analytical methods within required limits. More in-depth investigations are conducted to explain results that are questionable or problematic.

ORNL radiological airborne effluent monitoring data are managed using the Rad-NESHAPs Inventory Web Application and the Rad NESHAPs Source Data Application. Field measurements and analytical data inputs along with emission calculations results are independently verified.

5.7.7 Records Management

The UT-Battelle Records Management System provides the requirements for managing all UT-Battelle records. Requirements include creating and identifying record material; scheduling, protecting, and record storage in office areas and the UT-Battelle Inactive Records Center; and destroying records.

WAI and Isotek maintain all records specific to their projects at ORNL, and associated records management programs include the requirements for creating and identifying record material, protecting and storing records in applicable areas, and destroying records.

5.8 Environmental Management and Waste Management Activities at Oak Ridge National Laboratory

Because of past waste disposal practices and unintentional releases, portions of land and facilities on ORR are contaminated with radioactive elements, mercury, asbestos, polychlorinated biphenyls, and industrial wastes. EM conducts cleanup programs across the reservation to correct the contamination remaining from years of energy research and weapons production (Fig. 5.42).

ORNL 2012-P00352

Fig. 5.42. Removal of Tank W-1A eliminated the main source of groundwater contamination at Oak Ridge National Laboratory.

EM has divided ORNL into two major cleanup areas: Bethel Valley and Melton Valley. The Bethel Valley area was used for reactors and the principal research facilities, and the Melton Valley area was used for reactors and waste management. The following sections summarize some of the 2012 EM activities undertaken at ORNL. More detailed information is available in the 2012 cleanup progress report to the Oak Ridge community (DOE 2011a)

5.8.1 Contaminated Tank W-1A and Soil Removal

Removal and disposal of a 15,142 L (4,000 gal) contaminated tank at ORNL was completed in FY 2012. Tank W-1A and its pipelines were the largest source of groundwater contamination at the site. The contaminated soil surrounding the vessel was also disposed.

5.8.2 Isotope Row Material Removed

In FY 2012 work was completed on the removal of legacy materials from the Isotope Row area in the central portion of ORNL.

Historically, Isotope Row facilities served as radioisotope production laboratories and support facilities. Work completed in FY 2012 included the removal, packaging, and off-site disposal of lead shielding from the exterior of the hot cells in Buildings 3030 and 3031 and the packaging and disposal of shielded casks, carriers, and miscellaneous materials staged to the west of Building 3028. A completion report documenting the work performed was prepared, submitted, and approved in FY 2012.

5.8.3 Uranium-233 Disposition Planning

A significant inventory of uranium-233 (^{233}U) is stored in ORNL Building 3019A. Uranium-233 is an SNM that requires strict safeguards and security controls to protect against access. The U-233 Project was initiated to address safeguards and security requirements, eliminate safety and nuclear criticality concerns, and ship the material to an approved disposal site. Treating the ^{233}U inventory as expeditiously as possible will reduce the substantial annual costs associated with safeguards and security requirements, eliminate the risk of a nuclear criticality event, and avoid the need for future facility upgrades to Building 3019A to ensure safe storage of the inventory. DOE commissioned a review of alternatives for dispositioning the ^{233}U inventory.

Phase I of the Alternatives Analysis, which screened and identified potential alternatives, was completed in January 2011. The Deputy Secretary of Energy endorsed the review recommendations in April 2011, and the team began executing the two-part direct disposition campaign on January 1, 2012. By October 2012, 126 items had been dispositioned to NNSS, and 10 items were safely and securely transferred to UT-Battelle for programmatic reuse.

Phase II of the Alternatives Analysis, which provided a more detailed evaluation of processing options for the inventory unable to be directly dispositioned was approved by the DOE Offices of Environmental Management and Science and endorsed by the Secretary of Energy in July 2012.

5.8.4 Upgrade of 4500 Waste System

The objective of the 4500 Area Gaseous Waste System Upgrades Project is to deactivate one of the five Cell Ventilation System branches and remove several facilities from the central hot off-gas system.

The ventilation system branches and off-gas system are part of the Central Gaseous Waste System at ORNL that vents through the 3039 central stack. The project will provide localized ventilation systems to the 4501, 4505, 4500N, and 4507 facilities; stabilize the hot cells in Building 4507; clean out filter pits 3106 and 4556; and stabilize hundreds of feet of deactivated underground ductwork.

Demolition and removal of existing equipment and fabrication and installation of the replacement ventilation system for the 4501, 4505, and 4500N facilities began in FY 2012 and will be completed during FY 2013. During FY 2012 the local ventilation system for Building 4507 was designed, fabricated, installed, and commissioned and stabilization of the 4507 hot cells was completed. Characterization of the underground ductwork was completed and planning initiated for cleanout of the 3106 filter pit. Cleanout of the 4556 filter pit was initiated in FY 2012 and will be completed in FY 2013 along with cleanout of the 3106 filter pit and stabilization of the underground ductwork once the remaining facilities are removed from the central systems.

5.8.5 Remediation of Slab Areas

During FY 2012, remedial actions were completed for 18 slabs and the associated concrete structures, associated inactive process waste drains, and underlying soil following building demolition in the Bethel Valley area of ORNL.

The slabs that were removed and disposed covered an area of about 1 ha (2.4 acres), and these sites were restored to either open grassed areas or gravel lots—depending on the planned use of the area—to support ongoing ORNL research and operations. Waste from the removal of the slabs and associated structures was packaged and disposed. The inactive process waste pipelines were removed and disposed or backfilled in place, depending on the depth of the piping below ground. A completion report documenting the work performed was prepared, submitted, and approved in FY 2012.

5.8.6 Hot Cell Structure Demolition

Building 3026 C&D, one of the original buildings constructed in the 1940s to support the war effort, has been inactive since the 1990s. Entries into the highly contaminated hot cells have been minimal.

A waste handling plan for the 3026 hot cells demolition and waste disposition was approved by EPA and TDEC in FY 2011. The six structures associated with Building 3026 C&D were in various stages of characterization, planning, decontamination, and demolition in FY 2012. Two structures (3026C Counting Room and 3026C Tritium Lab) were decontaminated in FY 2011. Three additional structures (3026C Cell Bank 1, 3026C Cell Bank 2, and 3026D Storage/Sorting Cell) were decontaminated in FY 2012. This work included removal of internal equipment, the final step to make these structures ready for demolition.

The four 3026C structures were also demolished and disposed of in FY 2012. Preparation for demolition of the two remaining structures (3026D Storage/Sorting Cell and 3026D Cell A and B) is under way. In March 2011, higher levels of contamination than anticipated were found in the 3026D structures while performing initial characterization.

The project’s revised technical approach for hot cell cleanout was approved in FY 2012; the operational readiness review was completed in July 2012, and demolition will be completed in FY 2013.

5.8.7 Bethel Valley Groundwater

Several activities were initiated in FY 2012 to address Bethel Valley groundwater, including the following:

- 7000 Area groundwater treatability study,
- core hole 8 intercept extraction system, and
- SWSA 3 exit pathway monitoring.

5.8.8 Demolition of Unneeded Facilities

Legacy material removal and demolition activities were completed in FY 2012 at several ORNL facilities. These contaminated nonreactor facilities were surplus buildings, some dating from the original Manhattan Project, that were no longer needed.

As part of the 34 Buildings D&D Project, legacy material was removed from more than 2,976 m^2 (32,000 ft^2) of facility space, and a total of 10,751 m^2 (115,600 ft^2) of building space was demolished and the demolition debris disposed. The 34 buildings, located in the busy central campus portion of ORNL, were safely and successfully demolished without impacting adjacent laboratory facilities. This project has eliminated the risk associated with these unused facilities and will allow reuse of the area to support ORNL’s ongoing and future research activities.

5.8.9 Oak Ridge National Laboratory Waste Management

5.8.9.1 Oak Ridge National Laboratory Wastewater Treatment

At ORNL, EM operates PWTC and the Liquid Low-Level Waste Treatment Facility. In 2012 447 million L (118 million gal) of wastewater was treated and released at PWTC in 2012. In addition, the liquid LLW evaporator at ORNL treated 721,121 L (190,500 gal) of waste. The waste treatment activities of these facilities support both EM and Office of Science mission activities, ensuring that wastewaters from activities associated with projects of both offices are managed in a safe and compliant manner.

5.8.9.2 Oak Ridge National Laboratory Newly Generated Waste Management

ORNL is the largest, most diverse Office of Science laboratory in the DOE complex. Although much effort is expended to prevent pollution and eliminate waste generation, some waste streams are generated as a by-product of performing research and operational activities and must be managed to ensure that the environment is protected from associated hazards. UT-Battelle, as the prime contractor for the management of ORNL, is responsible for management of most of the wastes generated from R&D activities and wastes generated from operation of the R&D facilities. TRU wastes and waste streams that can be treated by on-site liquid and/or gaseous waste treatment facilities operated by EM are treated via these systems. Other R&D waste streams are generally packaged by UT-Battelle in appropriate shipping containers for off-site transport to commercial waste processing facilities. No accidents, incidents, or other compliance problems associated with the management of ORNL waste materials were experienced in CY 2012.

5.8.9.3 Transuranic Waste Processing Center

TRU waste-processing activities carried out for DOE in 2012 by WAI addressed CH solids/debris and RH solids/debris and involved processing, treating, repackaging, and off-site transportation and disposal at NNSS, WIPP, and other approved off-site facilities. Planning for treating RH sludge continued this year.

During CY 2012, 132.4 m^3 (173.2 yd^3) of CH waste and 91.0 m^3 (119.0 yd^3) of RH waste were processed. In CY 2012, 75.4 m^3 (98.6 yd^3) of CH waste and 15.0 m^3 (19.6 yd^3) of RH waste were shipped off-site.

5.8.10 SEC Federal Services Corporation Waste

In 2012 SEC shipped 750.52 m^3 (981.64 yd^3) of material from SEC hot cells, which includes Building 3026 and Building 3038. SEC also shipped 3,093.3 m^3 (4,045.92 yd^3) of material from the Miscellaneous Facilities Project, which concluded in June 2012.

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