4. The Y-12 National Security Complex

The Y-12 National Security Complex, a premier manufacturing facility operated by Babcock & Wilcox Technical Services Y-12 L.L.C. (B&W Y-12) for the National Nuclear Security Administration, plays a vital role in DOE’s Nuclear Security Enterprise. While drawing on more than 60 years of manufacturing excellence, Y-12 helps ensure a safe and reliable U.S. nuclear weapons deterrent.

The Complex also retrieves and stores nuclear materials, fuels the nation’s naval reactors, and performs complementary work for other government and private-sector entities.

Today’s environment requires a Y-12 that has a new level of flexibility and versatility. So while continuing its key role, Y-12 has evolved to become the complex that the nation looks to for support in protecting America's future by developing innovative solutions in manufacturing technologies, prototyping, safeguards and security, technical computing and environmental stewardship.

4.1 Description of Site and Operations

4.1.1 Mission

The Y-12 Complex is a one-of-a-kind manufacturing facility that plays an important role in U.S. national security. The roles of the Y-12 Complex include the following:

- receipt, storage, and protection of special nuclear materials;
- quality evaluation/enhanced surveillance of the nation’s nuclear weapon stockpile;
- safe and secure storage of nuclear materials;
- dismantlement of weapon secondaries and disposition of weapon components;
- provision of technical support to the National Nuclear Security Administration (NNSA) Defense Nuclear Nonproliferation Program;
- provision of fuel for the nation’s naval reactors program;
- transfer of technology to private industry;
- maintenance of DOE capabilities; and
- provision of support to DOE, other federal agencies, and other national priorities.

Babcock & Wilcox Technical Services Y-12, LLC (B&W Y-12) is the NNSA’s management and operating contractor responsible for operation the Y-12 National Security Complex. Located within the town limits of Oak Ridge, Y-12 covers more than 328 ha (810 acres) in the Bear Creek Valley, stretching 4.0 km (2.5 miles) down the valley and nearly 2.4 km (1.5 miles) wide. Approximately 6,000 people work on site, including employees of B&W Y-12, NNSA, Wackenhut Services (NNSA’s security services contractor), other DOE contractors, and subcontractors.

NNSA-related facilities located off the Y-12 Complex site but in Oak Ridge include the Office of Secure Transportation (OST) Agent Operations Eastern Command (AOEC) Secure Transportation Center and Training Facility and an analytical laboratory. The laboratory is a leased facility providing a wide range of routine and nonroutine analytical services for environmental and hazardous waste programs of NNSA, DOE, and other customers.

4.1.2 Transformation

Complex Transformation is NNSA’s vision for a smaller, safer, more secure, and less expensive nuclear weapons complex that leverages the scientific and technical capabilities of its workforce and meets national security requirements.

The complex is old; many of the facilities were required for the Cold War security environment but are no longer necessary to use or affordable to maintain. The Y-12 Complex's infrastructure reduction effort focuses on removing excess buildings and infrastructure to support reduction in maintenance and operating cost and to provide real estate for future modernization needs. The country's need to construct smarter, more environmentally friendly buildings is a focus of the new construction projects.

4.1.2.1 Infrastructure Reduction

Infrastructure activities continue to significantly change the face of the Y-12 Complex. In FY 2009, an additional 1425.5 m^2 (15,328 ft^2) of floor space was demolished, bringing Y-12's total to more than 0.1 million m^2 (1.2 million ft^2) or 284 buildings demolished since the program was initiated in 2001.

The Infrastructure Reduction project team completed the demolition of Buildings 9706-1 and 9706-1A. The Infrastructure Reduction project team completed planning efforts for FY 2009, which focused on the demolition of 13 facilities targeted to be funded under Transformation Disposition Program. Although the Transformation Disposition Program went unfunded in FY 2009, Facilities Infrastructure Recapitalization Program (FIRP) under-runs from FY 2008 were utilized to complete the planning effort for Buildings 9709 and 9766 including utility isolations on Building 9766. Both buildings were key demolitions needed to support the overall transformation efforts. The planning effort made the projects "shovel ready" in the event demolition funding could be obtained in FY 2010.

4.1.2.2 American Recovery and Reinvestment Act

In the spring of 2009, several projects were designated to receive funding under the American Recovery and Reinvestment Act (ARRA). The scope of these projects was based primarily on projects identified in the near-term baseline of the Integrated Facilities Disposition Project Critical Decision-1 schedule which was approved in November 2008. This work was deemed to meet ARRA criteria aimed at being ready to start work, expend available funding quickly to increase employment, accomplish needed cleanup work, and show visibly demonstrable achievement.

The projects initiated at Y-12 in May of 2009 are cleanout of legacy materials in Buildings 9201-5 and 9204-4; cleanout of a recovery furnace and demolition of a bag house in Building 9206; demolition of Buildings 9211, 9220, 9224, 9735, and 9769; removal and disposal of scrap metal on the surface of the Old Salvage Yard; and cleanout and repair of storm sewers in the West End Mercury Area (WEMA). Scrap metal remediation at the Old Salvage Yard and WEMA storm sewer remediation were previously authorized in Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Interim Records of Decision. The other projects are being conducted as CERCLA removal actions under Action Memoranda issued in May 2009.

By the end of 2009, legacy material removal was well under way, Building 9735 had been readied for demolition, containers of scrap metal were being shipped to disposal from the Old Salvage Yard, and inspection of accessible storm sewers was completed.

4.1.2.3 New Construction

A number of other projects to replace key facilities and to upgrade site infrastructure systems are planned or ongoing. In some cases new facilities will be constructed to maximize protection of sensitive materials and operations; in other cases the new facilities will replace worn-out obsolete buildings and systems. Examples include the following.

- **Potable Water System Upgrades**—A $62.5 million potable water system upgrades project broke ground in 2008. As a major utility upgrade, the new system will provide Y-12 with a more reliable and cost-effective source of potable water. The 2-year project includes new water tanks (Fig. 4.1), pumps, and distribution piping to provide a new primary and backup water supply to the Y-12 complex; underground pipe repairs and replacement of more than 2,745 m (9,000 ft) of deteriorated original cast mains; and sprinkler system modifications. As of the end of December 2009, the project was 92.9% complete.

- **The Steam Plant Life Extension Project**—The new plant will use natural-gas-fired package boilers with new burner technology instead of coal, creating much cleaner emissions. Sulfur dioxide will be reduced by 99.5%, nitrogen oxides by 94%, particulate matter by 72%, and greenhouse gas (GHG) carbon dioxide by 11%. In addition, the new plant will require less water and fewer chemicals because it uses reverse osmosis for water purification. As of the end of December 2009, the project was 95% complete and on track to turn over the new plant to Operations in the spring of 2010.
- **Complex Command Center—**Building on the success of the Jack Case and New Hope centers, Y-12 is moving forward with plans for an additional third-party-financed facility. The Complex Command Center (CCC) will consolidate Y-12's emergency services within Y-12's Property Protected Area. The proposed CCC will house the fire department, the plant shift superintendent's office, the technical support/emergency operations center, and emergency management support. These functions are now scattered throughout the site in aging, outmoded facilities. The project has registered with the United States Green Building Council (USGBC) and is working towards achieving a Leadership in Energy and Environmental Design (LEED) Silver rating, and quite possibly Gold, depending on how many points are ultimately accepted post-occupancy by USGBC.
- **Uranium Process Facility (UPF)—**The UPF (Fig. 4.2), cornerstone of Y-12's modernization strategy, is proposed to replace current enriched uranium and other processing operations. This involves a new, fully modernized manufacturing facility optimized for safety, security, and efficiency. It would be the only facility of its type in the United States.

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Fig. 4.1. Lifting the new 195,045 kg (215-ton) west tank for the potable water system into place.

4.2 Environmental Management System

As part of B&W Y-12's commitment to environmentally responsible operations, Y-12 has implemented an environmental management system (EMS) based on the rigorous requirements of the globally recognized International Organization for Standardization (ISO) 14001-2004 (ISO 2004).

4.2.1 Integration with Integrated Safety Management System

The Integrated Safety Management System (ISMS) is the DOE's umbrella of environment, safety, and health (ES&H) programs and systems that provides the necessary structure for any work activity that could potentially affect the public, a worker, or the environment. B&W Y-12's ISMS has incorporated the elements of the ISO 14001 EMS in the overall umbrella of ISMS for environmental compliance, pollution prevention, waste minimization, and resource conservation. The Y-12 NNSA Site Office self-declared implementation on June 29, 2009 based on the principles of the ISO 14001 standard after verifying and validating implementation through a third-party independent audit conducted in accordance with Executive Order (EO) 13423 (2007) requirements. The audit concluded that B&W Y-12's EMS is fully integrated within ISMS and the required elements from ISO 14001 and DOE orders have been achieved. In addition, the DOE Office of Health, Safety and Security (HSS) annual environmental progress reports on implementation of EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* (Executive Order 2007) and Office of Management and Budget's Environmental Stewardship Scorecard gave Y-12 an EMS scorecard rating for FY 2009 of green indicating full implementation of EO 13423 requirements.

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Fig. 4.2. Uranium Process Facility conceptual image.

4.2.2 Policy

The environmental policy of B&W Y-12 and its commitment to providing sound environmental stewardship practices through the implementation of an EMS have been defined and are endorsed by top management and have been made available to the public via company-sponsored forums and public documents such as this one. The B&W Y-12 ES&H policy is presented in Fig. 4.3.

This policy has been communicated to all employees; has been incorporated into General Employee Training (GET) for every employee, guest, and contractor; and made available for viewing on the internal Y-12 Web Site. Y-12 personnel are made aware of the commitments stated in the policies and how the commitments relate to Y-12 work activities.

4.2.3 Planning

4.2.3.1 Environmental Aspects

Environmental aspects may be thought of as potential environmental hazards associated with a facility operation, maintenance job, or work activity. Aspects and impacts are evaluated to ensure that the significant aspects and potential impacts continue to reflect stakeholder concerns and changes in regulatory requirements. The following aspects have been identified as potentially having significant environmental impact:

- waste generation,
- air emissions,
- liquid discharges,
- storage/use of chemicals and radioactive materials,
- legacy contamination,
- excess/surplus materials,
- historical and cultural resources,
- natural resource consumption (energy and water), and
- natural resource conservation (positive impacts).

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Y-12 Environment, Safety, and Health Policy

Policy: As we work to achieve the Y-12 mission and our vision of a modernized Y-12 Complex, we will do so by ensuring the safety and health of every worker, the public, and the environment. Every employee, contractor, and visitor is expected to take personal responsibility for their actions.

- Environmental Policy: We protect the environment, prevent pollution, comply with applicable requirements, and continually improve our environment.
- Safety and Health Policy: The safety and health of our workers and the protection of public health and safety are paramount in all that we do. We maintain a safe work place and plan and conduct our work to ensure hazard prevention and control methods are in place and effective.

In support of this policy, we are committed to:

- Integration of Environment, Safety and Health (ES&H) into our business processes for w ork planning, budgeting, authorization, execution, and change control in accordance with our Integrated Safety Management System.
- Continuously improving our processes and systems by establishing, tracking, and achieving goals that drive performance excellence.
- Direct, open, and truthful communication of this policy and our ES&H performance to our employees, contractors, customers, and stakeholders.
- Strive to minimize the impact of our operations on the environment in a safe, compliant, and cost-effective manner using sustainable practices for energy efficiency, fleet management, water consumption, pollution prevention, recycling/reuse, source reduction, resource conservation, and environmentally preferable purchasing.
- Incorporate sustainable design principles into the design and construction of facility upgrades, new facilities, and infrastructure considering life-cycle costs and savings.
- Incorporate the use of engineering controls to reduce or eliminate hazards whenever possible into the design and construction of facility upgrades, new facilities, and infrastructure.
- Strive to provide a clean and efficient workplace free of occupational injuries and illnesses (Target Zero).
- Foster and maintain a work environment of mutual respect and teamwork that encourages free and open expression of ES&H concerns.

Fig. 4.3. B&W Y-12 environment, safety, and health policy.

The EMS provides the system to ensure that environmental aspects are systematically identified, monitored, and controlled in order to mitigate or eliminate potential impacts to the environment.

4.2.3.2 Legal and Other Requirements

To implement the compliance commitments of the ES&H policy and to meet legal requirements, systems are in place to review changes in federal, state, or local environmental regulations and to communicate those changes to affected staff. The environmental compliance status is documented each year in the ASER (see Sect. 4.3).

4.2.3.3 Objectives, Targets, and Environmental Action Plans

B&W Y-12 continues to respond to change and pursue sustainability initiatives by establishing and maintaining environmental objectives, targets (goals), and action plans. Goals and commitments are established annually and are agreed to by the Y-12 NNSA Site Office (YSO) and B&W Y-12 and are consistent with mission, budget guidance, ES&H work scope, site incentive plans, and continuous improvement. The environmental action plans designate responsibility for achieving the goals and are amended as necessary to reflect new developments and changing conditions at the Y-12 Complex. Targets and action plans are established for broad objectives to pursue improvement in environmental performance in five areas: clean air, energy efficiency, hazardous materials, stewardship of land and water resources, and waste reduction/recycling/buy green. Highlights of the 2009 B&W Y-12 environmental targets achieved are presented in Sect. 4.2.6.1.

4.2.3.4 Programs

NNSA has developed and funded several important programs to integrate environmental stewardship into all facets of Y-12's missions. The programs also address the DOE order requirements for protecting various environmental media, reducing pollution, conserving resources, and helping to promote compliance with all applicable environmental regulatory requirements and permits.

4.2.3.4.1 Environmental Compliance

The B&W Y-12 Environmental Compliance Department (ECD) provides environmental technical support services and oversight for Y-12 Complex line organizations to ensure that site operations are conducted in a manner that is protective of workers, the public, and the environment; in compliance with applicable standards, DOE orders, environmental laws and regulations; and consistent with B&W Y-12's environmental policy and site procedures. The ECD serves as the B&W Y-12 interpretive authority for environmental compliance requirements and as the primary point of contact between B&W Y-12 and external environmental compliance regulatory agencies such as the city of Oak Ridge, the Tennessee Department of Environment and Conservation (TDEC), and the U.S. Environmental Protection Agency (EPA). The ECD administers compliance programs aligned with the major environmental legislation that affects Y-12 Complex activities. Compliance status and results of monitoring and measurements conducted by these compliance programs are presented in this document.

The ECD also maintains and ensures implementation of the Y-12 EMS and spearheads initiatives to proactively address environmental concerns in order to continually improve environmental performance and go "beyond compliance."

4.2.3.4.2 Waste Management

The B&W Y-12 Waste Management Department manages and supports the full life cycle of all waste streams within the Y-12 Complex. While ensuring compliance with federal and state regulations, DOE orders, waste acceptance criteria, and Y-12 procedures and policies, the Waste Management Department provides

- technical support to generators on waste management, pollution prevention, and recycling issues and
- waste certification in accordance with DOE orders and the Nevada Test Site (NTS) Waste Acceptance Criteria for waste to be shipped to NTS for disposition.

4.2.3.4.3 Sustainability and Stewardship

The Sustainability and Stewardship Program has two major missions. The first is to establish and maintain company-wide programs and services to support sustainable waste management operations. These sustainable operations include Pollution Prevention and Recycling Programs, Excess Materials, Burn House Operations, and Waste Generator Services. The second is the stewardship practices, the programs that manage the legacy issues and assist in the prevention of additional problematic areas being formed. Stewardship Programs include Clean Sweep, Unneeded Materials and Chemicals (UMC), and Legacy Waste.

This program establishes and maintains company-wide systems to ensure activities are conducted in a manner which ensures protection of employees from workplace hazards and promotes the well-being of the worker, protects the public and the environment, prevents pollution and conserves resources, promotes recycling/reuse and source reduction, supports environmentally preferable purchasing, complies with applicable regulations, and promotes sustainability principles in a safe and cost-effective manner.

4.2.3.4.4 Energy Management

Energy management is an ongoing and comprehensive effort containing key strategies to reduce consumption of energy, water, and fuel (electricity, coal, natural gas, and gasoline/diesel). The energy manager is responsible for developing energy and water reduction projects; performing facility energy surveys; communicating with Y-12 facility/building managers and plant population regarding energy use and reduction opportunities; maintaining the DOE energy database for Y-12; providing energy management input to capital project design; and interfacing with contractors regarding energy conservation measures.

4.2.4 Implementation and Operation

4.2.4.1 Roles, Responsibility, and Authority

The safe, secure, efficient, and environmentally responsible operation of Y-12 requires the commitment of all personnel. All personnel share the responsibility for successful day-to-day accomplishment of work and the environmentally responsible operation of Y-12. Environmental and Waste Management technical support personnel assist the line organizations with identifying and carrying out their environmental responsibilities. Additionally, an Environmental Officer Program is in place to facilitate communication of environmental regulatory requirements and to promote the EMS as a tool to drive continual environmental improvement at Y-12. Environmental Officers coordinate their organization’s efforts to maintain environmental regulatory compliance and promote other proactive improvement activities.

4.2.4.2 Communication and Community Involvement

Y-12 is committed to keeping the community informed in areas of operations, environmental concerns, safety, and emergency preparedness. The Community Relations Council, composed of 20 members from a cross section of the community, including environmental advocates, neighborhood residents, Y-12 retirees, and business and government leaders, serves to facilitate communication between Y-12 and the community. The council provides feedback to B&W regarding its operations and ways to enhance community and public communications. A few examples of Y-12’s community outreach activities are described in the following paragraphs.

B&W Y-12 sponsored and participated in community events in 2009 including WaterFest at the Ijams Nature Center in Knoxville and Oak Ridge Earth Day to provide highlights of Y-12’s environmental management, sustainability and stewardship, pollution prevention activities, and information about the Tennessee Pollution Prevention Partnership (TP3) to more than 2,000 members of the public. B&W also sponsored Oak Ridge Associated Universities Science Bowl, East Tennessee Fuels Coalition Run for Clean Air, and the Foothills Land Conservancy in 2009. In addition B&W Y-12 has promoted the history of Oak Ridge by partnering with The Oak Ridge Secret City Festival and the American Museum of Science and Energy to provide guided tours of the Y-12 Complex.

A “State of the Creek Address” was presented on April 16, 2009 (Fig. 4.4) to interested stakeholders and environmental regulators describing ecological changes that have occurred over the last 20 years in East Fork Poplar Creek (EFPC). The presentation was well attended by such groups as the ORR Local Oversight Committee, the Site Specific Advisory Board, City of Oak Ridge, TDEC, EPA, NNSA, and members of the public. The primary message of the presentation was that the health of EFPC has improved over the years; however, some legacy contaminants persist and require more work to reduce their presence in the environment.

B&W Y-12 held an Environment, Safety and Health Expo on June 10, 2009, with a theme of “It’s Easy Being Green” that was attended by approximately 8,000 employees and community members. The Expo included 115 booths and exhibits of information, equipment, supplies, and success stories to promote ES&H responsibilities at home and at work (Fig. 4.5).

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Fig. 4.4. “State of the Creek Address” presented in April to interested stakeholders.

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Fig. 4.5. NNSA Site Manager addresses the crowd at the 2009 ES&H Expo.

As part of Y-12 America Recycles Day activities, staff from the Y-12 Pollution Prevention Program visited five local charities to distribute $200 checks raised by Y-12 employee aluminum beverage can (ABC) recycling efforts. Since the ABC recycling program began in 1994, more than $76,000 has been donated to various charities.

B&W Y-12 actively promoted the TP3 program by mentoring and sharing information with interested organizations to encourage pollution prevention and involvement in TP3. In 2009, B&W Y-12 mentored the Oak Ridge National Laboratory (ORNL) and shared information with Denso Manufacturing

Tennessee, Inc., and the East Tennessee Technology Park (ETTP). Y-12 also hosted a TDEC East Tennessee TP3 Program Workshop (Fig. 4.6) on October 8, 2009, to offer guidance on the program, mentoring in sustainable practices, and a forum for networking and sharing various pollution prevention initiatives with other industries and organizations.

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Fig. 4.6. East Tennessee TP3 Program Workshop was held at Y-12's New Hope Center in October 2009.

4.2.4.3 Emergency Preparedness and Response

Local, state and federal emergency response organizations (EROs) are fully involved in the Y-12 emergency drill and exercise program. The annual drill and exercise schedule is coordinated with all organizations to ensure maximum possible participation. At a minimum, the Tennessee Emergency Management Agency (TEMA) Duty Office and the DOE Headquarters (HQ) Watch Office participate in all Y-12 emergency response exercises.

Y-12 conducted two full-scale and four functional exercises during FY 2009. The focus of FY 2009 exercises was on supporting site readiness activities. Three exercises were conducted in support of the readiness review for the recently constructed Highly Enriched Uranium Materials Facility (HEUMF), and one exercise was conducted in support of secure transportation readiness. In addition, one exercise was conducted involving a simulated active shooter in a Y-12 building and one exercise was conducted involving a fire and hazardous material release in a Y-12 building.

Y-12's expertise in emergency management is recognized within the Nuclear Weapons Complex. Y-12 Emergency Management Program Office (EMPO) staff performed an evaluation of the Savannah River Site annual exercise April 26–30, 2009. EMPO staff also participated in the DOE Emergency Management Issues Special Interest Group Conference held in San Francisco, California. Y-12 ERO members made presentations, participated in steering committee meetings, and distributed Y-12 Emergency Management Program information to other DOE facility emergency management professionals.

4.2.5 Checking

4.2.5.1 Monitoring and Measurement

Y-12 maintains procedures to monitor and measure key characteristics of its operations and activities that can have a significant environmental impact and to monitor overall environmental performance. Environmental effluent and surveillance monitoring programs are well established, and the results of the 2009 program activities are reported elsewhere in this document. Y-12 also maintains a process to monitor progress in achieving Y-12's environmental objectives and targets. The data are compiled in graphical format where possible, reported to management, and posted on the internal EMS web site. A monthly program review meeting with counterparts from the YSO includes discussions of these metrics as well as compliance information.

In 2009, Y-12 piloted a new Versatile Electronic Records Management System for improved indexing, retrieval, and long-term retention of electronic records and documents. The ECD implemented this system to digitize and electronically store environmental records, which contributed to streamlining the paper-based system and reducing the environmental impact of compliance activities.

4.2.5.2 EMS Assessments

To periodically verify that the EMS is operating as intended, assessments are conducted as part of Y-12's assessment program. The assessments are designed to ensure that nonconformities with the ISO 14001 standard are identified and addressed. Y-12's EMS assessment program consists of a three-prong approach that includes focused EMS assessments, routine surveillances, inspections and data reviews, and environmental multi-media assessments integrated with regularly scheduled facility evaluations lead by the Independent Assessment Organization.

Three EMS assessments and four facility evaluations employing an environmental multi-media approach were conducted in 2009. The EMS assessments included a review of Records Management and Document Control systems and an external third-party EMS audit to satisfy the DOE Order 450.1A (2008a) requirement for the site to make a formal declaration of conformance consistent with the requirements of DOE EO 13423 by June 30, 2009. The third-party audit determined that the Y-12 EMS was in conformance and met all requirements. The 2009 EMS assessments identified nine issues as continuous improvement opportunities which were subsequently corrected and implemented.

4.2.6 EMS Performance

B&W Y-12 prepared a plan for achieving compliance with DOE EO 13423, DOE Order 450.1A, *Environmental Protection Program* (DOE 2008a), and DOE O 430.2B, *Departmental Energy, Renewable Energy and Transportation Management* (DOE 2008b). The plan identified 16 actions in seven categories. Plans for improving the Environmental Management System, Training, Green Acquisition, Electronic stewardship, and Toxic/Hazardous Materials were completed. Progress has been made in the areas of High Performance Sustainable Buildings and Energy/Water conservation but more work is required to fully satisfy DOE EO 13423 requirements. The EMS objectives and targets and other plans, initiatives, and successes that work together to accomplish DOE EO 13423 goals and reduce environmental impacts are discussed in this section.

4.2.6.1 EMS Objectives and Targets

B&W Y-12 achieved 15 of 16 of the environmental targets on schedule in 2009. Highlights included the following with additional detail and success presented in other sections.

- Clean Air—A project continues to replace the existing coal-fired boiler steam plant by FY 2011. The project achieved a construction milestone by erecting and securing the new boiler stacks. As of the end of December the project was 95% complete overall. In addition, an estimate of GHG emissions for baseline year 2008 was developed (see Sect. 4.2.6.7).

- Energy Efficiency—Y-12 replaced 1,092, or 22%, of the older PC's and monitors at Y-12 that were not Energy Star or Electronic Product Environmental Assessment Tool (EPEAT) qualified with new energy-efficient equipment (achieving 146% of goal), and 43 virtual servers were deployed as part of a phased transition away from traditional data centers, exceeding the goal of 30 and reducing the number of physical servers required (which is expected to save more than 10.5 kW). Additional accomplishments are presented in Sect. 4.2.6.3.
- Hazardous Materials—Completed disposition of excess Chemicals Stage II (Stores), cleanup of the 9720-16 yard, shipment of 212 H-gears for off-site recycle, and the majority of the 9720-58 yard cleanup. Additional facility clean-out efforts resulted in removal of more than 1,451,496 kg (1,600 tons) of materials including some chemicals from 10 facilities, of which more than 570,619 kg (629 tons) of materials were recycled or reused rather than disposed (see Sect. 4.2.6.2).
- Land/Water Conservation—Completed an evaluation of options for reducing mercury loading in lower East Fork Poplar Creek. Pilot studies indicated that reduction of flow in certain areas of the creek is expected to reduce the amount of mercury in the water flow. A permit modification to reduce the amount of flow augmentation to EFPC by approximately 7.5 million liters (2 million gal) per day was issued by TDEC. Additional water conservation successes are presented in Sect. 4.2.6.4.
- Reduce/Reuse/Recycle/Buy Green—A pollution prevention opportunity assessment was completed on a key hazardous waste stream, the Y-12 Procurement Handbook was updated to incorporate requirements of Environmentally Preferable Procurement, and awareness training of new DOE Acquisition goals was conducted for Y-12 buyers. Section 4.2.6.2 presents additional successes that support this EMS target area.

4.2.6.2 Sustainability and Stewardship

Numerous efforts at Y-12 have reduced its impact on the environment. Efforts include increased use of environmentally friendly products and processes and reductions in waste and emissions. During the past few years, these efforts have been recognized by our customer, our community, and other stakeholders (see Sect. 4.2.7). Not only have the pollution prevention efforts at Y-12 benefited the environment, they have also resulted in avoided costs (Fig. 4.7).

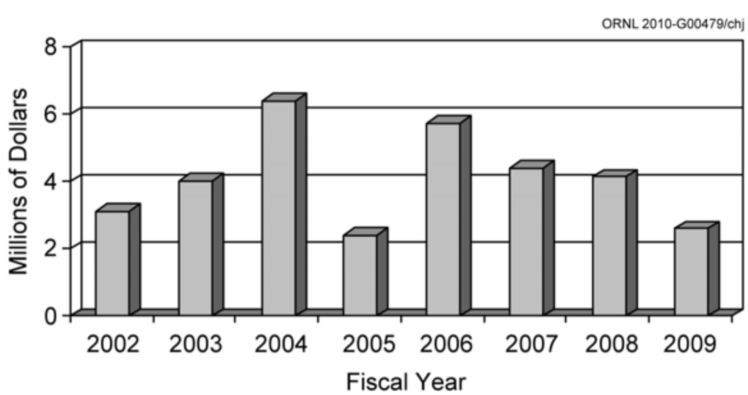


Fig. 4.7. Cost avoidance from Y-12 pollution prevention activities.

In FY 2009, Y-12 implemented 104 pollution prevention initiatives (Fig. 4.8), with a reduction of more than 16.25 million kilograms (36 million pounds) of waste and a cost savings/avoidance of more than $2.58 million. The completed projects include the activities presented below.

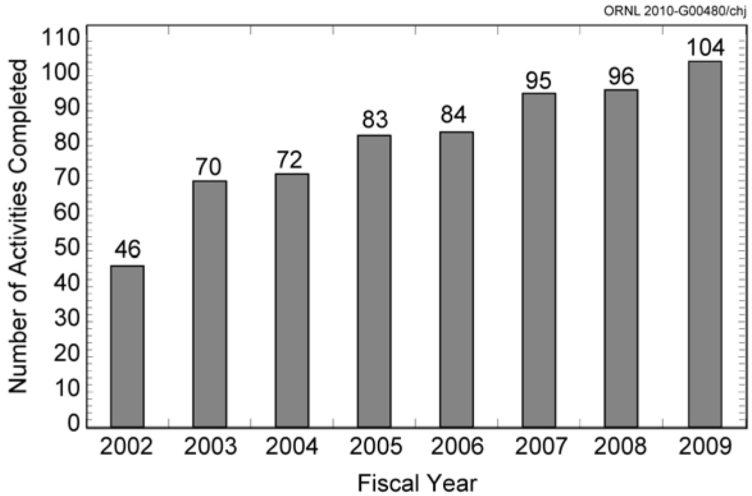


Fig. 4.8. Y-12 pollution prevention initiatives.

Initiatives with Pollution Prevention Benefits and Source Reduction. Sustainable initiatives have been embraced across the Y-12 Complex to reduce its impact on the environment and to increase operational efficiency. Many of Y-12's sustainable initiatives have pollution prevention benefits or targets eliminating the source of pollution, including the 2009 activities highlighted in this section.

Y-12 Clean Sweep Program. This program (Fig. 4.9) conducted cleanup events at key operating facilities in FY 2009 as part of a major initiative to improve the overall condition of the Y-12 Complex and support pollution prevention goals. Due to the complexity of these cleanups, Y-12 established a multi-organization team to ensure that the materials/chemicals are reused or recycled if at all possible and to plan these cleanups to ensure that all health and safety, security, operational, radiological, and environmental requirements are met. The cleanups resulted in the removal of more than 907,185 kg (1,000 tons) of materials and chemicals from more than six facilities, of which more than 317,515 kg (350 tons) of materials were recycled or reused. The effort resulted in an estimated cost avoidance of more than $15,770 due to reduced waste disposal costs; eliminated more than 108 m^2 (1,160 ft^2) of radiation management areas; and freed over 328.8 m^2 (3,535 ft^2) of valuable floor space that could be used for other mission critical tasks, with an associated estimated cost avoidance of $3,600,000 based on an estimated cost of $1,036 per 0.09 square meter (1 square foot) if such space had to be constructed. Finally, the overall cleanup efforts are implemented using the 7S process (sort, set in order, shine, standardize, safety, security, and sustain) to ensure that work spaces are maintained and the excess/recycle and disposal of materials can continue on an ongoing basis.

Environmentally Preferable Purchasing. Environmentally preferable products, including recycled-content materials, are procured for use across the Y-12 Complex. In 2009, B&W Y-12 procured recycled-content materials valued at more than $2.83 million for use at the site.

Y-12 Digital Radiography. The Y-12 Complex is implementing a high-energy digital radiography to automate part setup and alignment and digitize radiographs of products. The development of this high-resolution imaging system will make Y-12's digital capability equal to or better than film at all energy levels. The Y-12 technical team developed a mid-energy radiographic capability for operational use, which was followed by the development of a low-energy digital radiographic capability in 2009. Digital techniques provide additional capabilities such as image enhancements and feature extractions to support product analysis. Benefits include reducing setup time and the time associated with obtaining high-quality radiographs, eliminating the use of film and film processing chemicals, eliminating storage and archive costs associated with legacy radiographic films, enabling teleradiography collaboration and communications with Nuclear Weapons Complex partners, and implementing computed tomography. The implementation of digital radiography is a long-term process, and the progress made to date has reduced the chemical waste stream from film processing significantly and will continue to grow as the technology matures.

ORNL 2010-G00481/chj

Fig. 4.9. Y-12 Clean Sweep Program.

Recycling Initiatives. B&W Y-12 has a well-established recycling program and continues to identify new material streams and to expand the types of materials that can be recycled by finding new markets and outlets for the materials. As shown in Fig. 4.10, over 0.7 million kilograms (1.7 million pounds) of materials was diverted from landfills and into viable recycle processes. Currently, recycled materials range from office-related materials to operations-related materials such as scrap metal, tires, and batteries. Many recycling activities have been implemented, including the 2009 activities highlighted in this section.

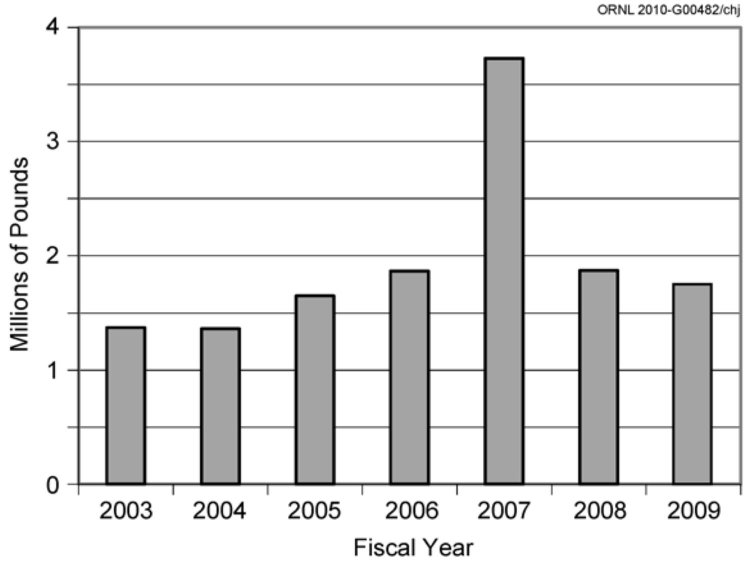


Fig. 4.10. Y-12 recycling results.

DOE-Wide Secure Electronics Recycling. Like all DOE facilities, Y-12 faced the challenge of managing electronic waste (items such as printed circuit boards and hard drives) in a manner that met cyber security and potential hazardous waste requirements. Based on past successes of collaborative efforts with DOE's Business Center for Precious Metals Sales and Recovery, Y-12 approached the center to establish a team to address electronic media waste. The team was able to select and establish a contract vehicle with a facility for the destruction of Y-12's electronic storage media followed by recovery of the resulting precious metals. The contract vehicle is being made available to the entire DOE Complex with the anticipation that other DOE sites will take advantage of this opportunity. All DOE NNSA sites and contractors that use this center see reduced waste generation and associated cost avoidance due to using these services. In 2009 alone, Y-12 reduced its generation of silver-bearing Resource Conservation and Recovery Act (RCRA) waste and electronic media waste by 9,532 kg (21,016 lb), resulting in a cost avoidance $82,848 from recycling via the DOE Business Center for Precious Metals Sales and Recovery.

Expanded Recycling Program. B&W Y-12 expanded recycling initiatives in 2009 to include the recycling of electronic media including circuit boards, used oil filters, and security sensitive paper to an off-site recycling vendor. These recycling initiatives were fully implemented during 2009.

4.2.6.3 Energy Management

Progress Meeting DOE EO 13423 Goals. The Y-12 Complex developed the *FY 2009 Y-12 National Security Complex Executable Plan Update and Annual Report on Energy Management for the National Nuclear Security Administration* (B&W Y-12 2009) reporting progress on Y-12 energy and water management activities established by DOE EO 13423 as defined by DOE Order 430.2B (DOE 2008b). The goals for energy and water management are summarized below along with current status (Table 4.1).

Table 4.1. DOE Order 430.2B goals and summary status

Goal	Status and Plans
30% energy intensity reduction by FY 2015 from a FY 2003 baseline	Y-12 has achieved a 12% reduction in energy intensity from the 2003 baseline. Implementation of the ESPC is projected to provide an additional 11.6% reduction in energy intensity.
16% water intensity reduction by FY 2015 from a FY 2007 baseline	Y-12 has achieved a 9% water intensity reduction from a FY 2007 baseline, despite metering problems with the utility. ESPC implementation will further assist with water conservation at Y-12.
7.5% of a site's annual electricity consumption from on-site renewable sources by FY 2010	The purchase and installation of a renewable energy source are being evaluated in a solar photovoltaic study and a fuel cell feasibility study.
Every site to have at least one on-site renewable energy generating system	The purchase and installation of a renewable energy source are being evaluated.
10% annual increase in fleet alternative fuel consumption relative to a FY 2005 baseline	Y-12 has already exceeded the alternative fuel goal with a 193% increase within 4 years.
2% annual reduction in fleet petroleum consumption relative to a FY 2005 baseline	Y-12 has already achieved the petroleum reduction goal with a 43% reduction within 4 years
75% of light duty vehicle purchases must consist of alternative fuel vehicles	Plans and budget requests for light duty vehicle purchases comprise 100% alternative fuel vehicles.
All new construction and major renovations greater than $5 million to be LEED® Gold certified	Existing plans for any new construction or leased facilities are being developed with the LEED certification criteria.
15% of existing buildings to be compliant with the five guiding principles of HPSB design	Building assessments are under way and a schedule for inspecting the building inventory before 2012 was established and specific buildings have been targeted for upgrade.
Advanced metering to the maximum extent practicable	Advanced electrical and water meters were installed to establish baseline data for the ESPC estimates and additional advanced metering is projected and budgeted in the Utilities Migration Plan.

Energy Performance. Energy consumption has continued a downward trend by continued modernization efforts and energy conservation measures. In FY 2009, the Y-12 Complex achieved a 20%

reduction in electricity usage (Fig. 4.11) and a 29% reduction in natural gas usage from the FY 2003 baseline. This was the final year of coal consumption due to the replacement of the old coal-fired steam plant with the new natural-gas-fired steam plant.

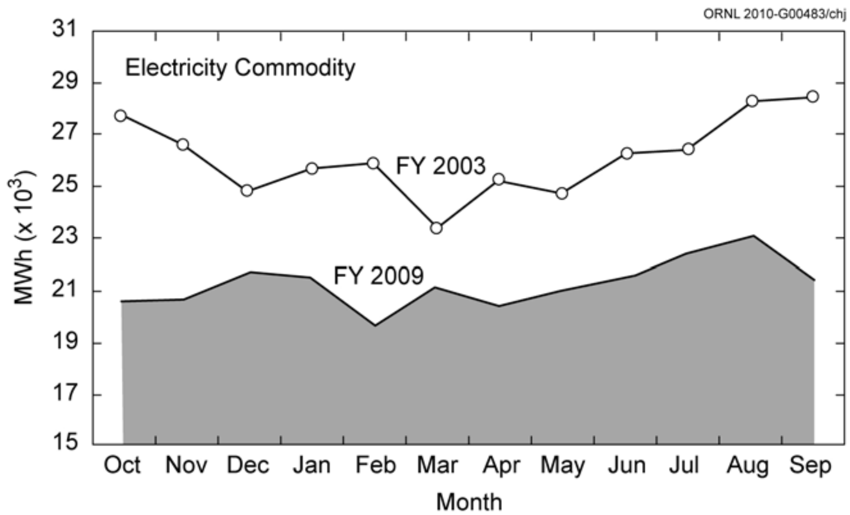


Fig. 4.11. Y-12 electrical consumption by month.

The following energy improvement and sustainable building activity highlights were completed in FY 2009.

- A Y-12 Energy Steering Team was established which has conducted benchmarking and has engendered ideas for energy and water upgrades, as well as potential renewable projects.
- Significant work was completed on the $61.5 million natural gas-fired steam plant (brought online in April 2010) which will eliminate coal burning and reduce emissions of sulfur dioxide by 99.5%, nitrogen oxides by 94%, and the GHG carbon dioxide by 11%.
- A $62.5 million potable water upgrade replaces a World War II–era piping system, saving $25 million in deferred maintenance costs.
- A $22.5 million Energy Savings Performance Contract (ESPC) was signed in September 2009 that will reduce energy intensity by 4%, potable water use by 5%, and save over $2 million annually in electricity, natural gas, water, sewer, and annual maintenance costs. Construction on the projects begins in FY 2010.
- Y-12 submitted several proposals to NNSA and Energy Efficiency Renewable Energy/Federal Energy Management Program (EERE/FEMP), which include measures for building metering, setback systems, renewable energy projects, smart grid systems, retro-commissioning, cooling tower replacement, and site-wide energy and water audits.
- The Facility Infrastructure Recapitalization Program (FIRP) Roof Asset Management Program replaced over 60,450 m^2 (650,000 ft^2) of deteriorated and leaking roof structures with energy-efficient and environmentally friendly white roof installations that support facility High-Performance Sustainable Building (HPSB) standards (Fig. 4.12).
- The development team for the third-party financed Complex Command Center has included a preference of LEED Goal–certified structure in lease agreement documents, including pervious concrete, waste recycling, rainwater collection, high-performance HVAC systems, building commissioning, and LEED-related design and processing fees.

4.2.6.4 Water Conservation

Potable water use has continued to decline due to the removal of excess buildings which include 0.1 million m^2 (1.2 million ft^2) of high-water-intensity facilities over the past 7 years. ESPC projects will reduce potable water consumption by 185 million liters (49 million gal) per year. In 2009 three new potable water supply meters were installed to ensure accurate measurement and better control of water usage, and significant progress was made on a Potable Water Upgrade Project (FY 2010 project completion) to replace piping that is over 60 years old to eliminate potential underground piping leaks and resolve low system pressure and backflow preventer isolation issues. A total of 21 meters have been installed at 8 building and cooling tower locations, and 16 of these meters were connected to the Utilities Management System for performance monitoring and automated baseline metering data collection and report generation.

Fig. 4.12. Replacement of deteriorated roof on Building 9113 with a sustainable white roof.

4.2.6.5 Fleet Management

The Y-12 site has already achieved the petroleum reduction goal with respect to the 2005 baseline. The site achieved a 55.6 % reduction within 4 years, which surpasses the requirement for the reduction of 2% per year. These three initiatives have helped spur that significant reduction.

- Vehicle pools were established at facilities with large concentrations of workers.
- Shuttle buses are provided throughout areas of the plant site.
- Vehicles not meeting site-use goals have been removed or reassigned on the basis of site needs.

Furthermore, the site has been very successful in achieving the goals for alternative fuel usage, as summarized in chart below (Table 4.2). A 192.6% increase in alternative fuels has been achieved from the 2005 baseline (surpassing the goal of 100%), with 11% of the current Y-12 fleet being alternative fuel vehicles. (Of Y-12's 527 vehicles, 56 are now flexible fuel vehicles and 73 were converted to ultralow sulfur diesel fuel.) All flexible fuel–capable vehicles have been operated on E85 ethanol alternative fuel since 2008.

In order to track the continued success of the fuel-saving measures, the fleet manager monitors gasoline, E-85 ethanol, and B20 biodiesel fuel consumption by both Y-12 and General Services Administration vehicle fleets and maintains monthly reporting metrics. Future fleet management energy savings will be achieved by continued strict monitoring of vehicle use. Increasing the use of alternative fuels and replacing gasoline-fueled vehicles with E-85-fueled vehicles will occur as funding permits.

Table 4.2. Summary of petroleum and alternative fuel usage over a 4-year period

	2005 Baseline	2009 Data	% Increase/ decrease	EO 13423 goal	Actual
Petroleum (Non-fleet)	54,426 L (14,378 gal)	24,181 L (6,388 gal)	55.6% decrease	2% per year decrease	14% per year decrease
Petroleum (Fleet)	606,141 L (160,126 gal)	348,802 L (92,144 gal)	42.5% decrease	2% per year decrease	11% per year decrease
E-85 fuel + biodiesel	18,174 L (4,801 gal)	53,132 L (14,036 gal)	192.6% increase	10% per year increase	48% per year increase

4.2.6.6 Electronic Stewardship

The Y-12 Complex is committed to the Federal Electronics Challenge (FEC) pledge in 2008 to improve the management of electronic assets during all life-cycle phases: acquisition and procurement, operation and maintenance, and end-of-life management. In 2009, as an FEC Partner, B&W Y-12 completed all FEC annual reporting to account for procurement of energy-efficient electronics and implementation of other practices to maximize Y-12 energy efficiency, reduce electronic-related wastes, and improve end-of-life management. B&W Y-12 received a 2009 FEC Bronze Level Award in June 2009 (see Sect. 4.2.7).

4.2.6.7 Greenhouse Gas

Y-12 began a GHG management initiative in FY 2009, recognizing that minimizing GHG emissions is a growing component to ensuring sustainable long-term operations. Y-12's environmental management planners and the Executive Steering Group established an EMS target to "initiate planning and data collection to develop a Y-12 Complex GHG Inventory." The target included actions to establish a GHG team, benchmark GHG inventories from similar facilities, and initiate development of a GHG Inventory Management Plan. Y-12 GHG team members included representatives from Energy Management, Utilities, Environmental Compliance, Air Quality, Pollution Prevention, Fleet Management, and Business Travel.

The GHG Team benchmarked other GHG inventories to help define the scope of Y-12's GHG inventory, participated in Y-12's ES&H Expo to present GHG educational materials, and gather data on GHG emissions from employee commuting, identify GHG emission data sources, and created a preliminary Y-12 GHG Inventory Management Plan and GHG emission inventory. The preliminary estimate indicates more than 320,000 metric tons of GHG emissions (carbon dioxide equivalents per year) in 2008. Results presented in Fig. 4.13 indicate that the majority (54%) of Y-12's GHG emissions are from indirect (scope 2) emission from purchased electricity. The largest direct (scope 1) emission was from combustion of coal to produce steam (35%), and estimated GHG emissions from employees commuting to work accounted for approximately 6% of the preliminary site-wide GHG emissions included in this inventory. Additional scopes to be evaluated include business travel, process emissions, and waste disposal.

4.2.7 Awards and Recognition

The Y-12 commitment to environmentally responsible operations has been recognized by more than 45 external environmental awards since November 2000 from local, state, and national agencies. The awards received in 2009 are summarized below.

White House Closing the Circle Award. "Y-12 Manufacturing Makes High-Tech P2 Look Easy" submitted in the Waste/Pollution Prevention category was selected as one of 15 activities to receive a 2009 White House Closing the Circle Award (Fig. 4.14) for outstanding Federal environmental stewardship from the Office of the Federal Environmental Executive (OFEE). The White House Closing the Circle Award recognizes Federal facilities and employees for innovative practices and programs that have improved environmental performance and conditions at Federal facilities. Y-12 was selected to receive this prestigious award signed by the President of the United States of America from more than 150 nominations and was the only DOE activity recipient.

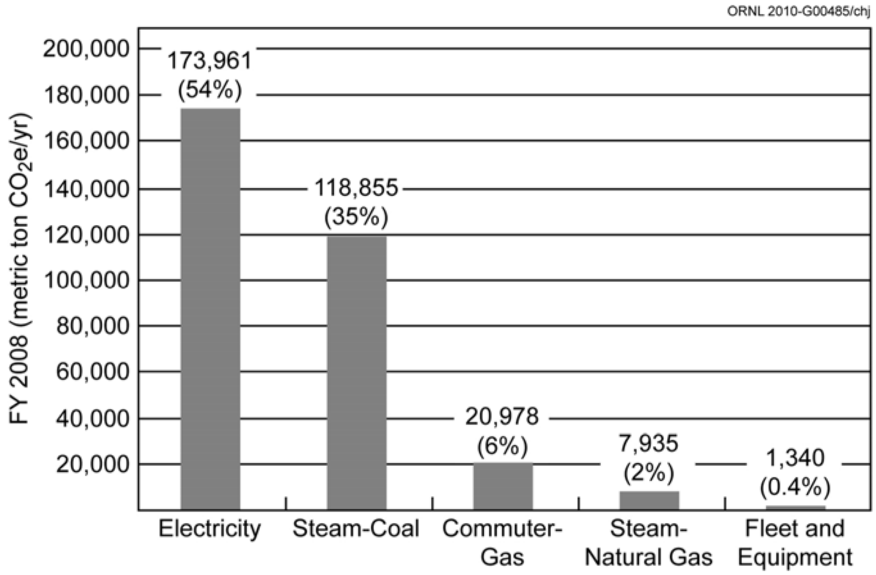


Fig. 4.13. Preliminary B&W Y-12 greenhouse gas inventory by source.

Fig. 4.14. Y-12 was recognized for outstanding environmental stewardship with a White House Closing the Circle award in 2009.

Tennessee Chamber of Commerce and Industry (TCC&I). Y-12 received two TCC&I Awards for environmental excellence and three achievement certificates for outstanding environmental accomplishments at the Twenty-seventh Annual Environmental Awards Conference in October 2009. Award winners were selected by a panel of state officials who reviewed the nominations, accomplishments, and compliance records of the respective environmental programs. Award and achievement certificates were for the following projects (and award/certificate categories):

- "Complex-Wide Precious Metals Recovery Shines" (Hazardous Waste Management)
- "Y-12 UMC Reuse Efforts Right on Track" (Solid Waste Management)
- "Y-12 Cleaning Its Way to a Greener More Sustainable Facility"(Solid Waste Management)
- "Y-12's "Go Green" Transportation Movement Just Keeps Going, Growing, and Greening" (Air Quality)
- "Y-12 Manufacturing Makes High-Tech P2 Look Easy" (Environmental Excellence)

DOE/NNSA Awards. The Y-12 Complex also received three 2009 NNSA Pollution Prevention Best in Class Awards, one NNSA Environmental Stewardship Award Certificate, and three DOE E-Star Awards for the projects honored by the TCC&I. This is the sixth consecutive year that the Y-12 Complex has been recognized by NNSA for award-winning activities. These awards recognize innovation and/or excellence in pollution prevention and environmental sustainability stewardship efforts within the NNSA and DOE and are selected by an independent panel.

Tennessee Pollution Prevention Partnership. Y-12 was awarded a TP3 Performer green flag by TDEC Commissioner Jim Fyke on March 17, 2009 (Fig. 4.15), showing Y-12's commitment to positive environmental action through pollution prevention activities. Y-12 is thus far only the second government facility in the state to be awarded this honor. Y-12 documented five environmental success stories to achieve Performer status, demonstrating measurable results in pollution prevention.

Federal Electronics Challenge (FEC). B&W Y-12 received a 2009 FEC Bronze Level Award in June 2009 which recognizes the achievements of FEC partners and their leadership in federal electronics stewardship. Y-12 was one of 16 Bronze Level Award winners. This FEC Bronze Award was specifically received for Y-12's accomplishments in end-of-life management activities of electronics.

4.3 Compliance Status

4.3.1 Environmental Permits

Table 4.3 notes environmental permits in force at Y-12 during 2009. More detailed information can be found within the following sections.

4.3.2 NEPA/NHPA Assessments

NNSA adheres to the National Environmental Policy Act (NEPA) regulations, which require federal agencies to evaluate the effects of proposed major federal activities on the environment. The prescribed evaluation process ensures that the proper level of environmental review is performed before an irreversible commitment of resources is made.

During 2009, environmental evaluations were completed for 28 proposed actions, all of which were determined to be covered by a categorical exclusion (CX).

4.3.2.1 Site-Wide Environmental Impact Statement (SWEIS) for Y-12 Complex

The NEPA implementing procedures, 10 CFR 1021 (DOE 1996), require a 5-year evaluation of the current Y-12 Complex site-wide environmental impact statement (SWEIS). A new SWEIS is being prepared to evaluate the new modernization proposals and to update the analyses presented in the original Y-12 SWEIS (issued in November 2001). The notice of intent was published in the *Federal Register* on November 28, 2006, and a public scoping meeting was held December 15, 2006, in Oak Ridge.

The draft SWEIS was issued in October 2009 (NNSA 2009) and a notice of availability was published in the *Federal Register* on October 30, 2009. Two public hearings for the draft SWEIS were held on November 17 and 18, 2009. These hearings allowed members of the public to provide comments on the draft SWEIS. The meetings were attended by approximately 350 members of the public. The public comment period for the draft SWEIS ends on January 29, 2010. Once all comments are received the final SWEIS will be published and the SWEIS ROD will be issued.

ORNL 2010-G00487/chj

Fig. 4.15. Y-12 was presented with a Tennessee Pollution Prevention Partnership Performer flag on March 17, 2009.

4.3.2.2 Preserving Y-12's History for Future Generations

In accordance with the National Historic Preservation Act (NHPA), NNSA is committed to identifying, preserving, enhancing, and protecting its cultural resources. The compliance activities in 2009 included completing an NHPA Section 106 review on 28 proposed projects, and participating in various outreach projects with local organizations and schools.

Twenty-eight proposed projects were evaluated to determine whether any historic properties eligible for inclusion in the *National Register of Historic Places* would be adversely impacted. Of the 28 proposed projects, it was determined that there were no adverse effects on historic properties eligible for listing in the *National Register* and that no further Section 106 documentation was required.

The Y-12 Oral History Program and Knowledge Preservation Program continue with ongoing efforts to conduct oral interviews of current and former employees to document the knowledge and experience of those who worked at the Y-12 Complex during World War II and the Cold War era. The interviews provided information on day-to-day operations of the Y-12 Complex, the use and operation of significant

Table 4.3. Y-12 Complex environmental permits

Regulatory driver	Permit title/description	Permit number	Issue date	Expiration date	Owner	Operator	Responsible contractor
CAA	New Steam Plant Package Boilers (Construction)	960947	9/06/2007	2/01/2009[a]	DOE	DOE	B&W Y-12
CAA	Chip Oxidizer Operating Permit	554594	10/21/2004	10/21/2009[b]	DOE	DOE	B&W Y-12
CAA	Operating Permit (Title V)	554701	10/21/2004	10/21/2009[b]	DOE	DOE	B&W Y-12
CAA	Steam Plant (existing) Clean Air Interstate Rule NO_x Permit	861316	6/9/2008	Upon renewal of Title V permit (554701)	DOE	DOE	B&W Y-12
CWA	Industrial & Commercial User Wastewater Discharge (Sanitary Sewer Permit)	No. 1-91	4/1/2005	3/31/2010	DOE	DOE	B&W Y-12
CWA	National Pollutant Discharge Elimination System Permit	TN0002968	3/13/2006	12/31/2008 Application for reissuance submitted 7/1/2008	DOE	DOE	B&W Y-12
CWA	General Stormwater Permit (Expires on approval of NOT)	TNR130714	2/6/2004	The Notice of Termination was sent to TDEC in December 2009.	B&W Y-12	B&W Y-12	B&W Y-12
CWA	General Stormwater Permit Potable Water System Upgrade	TNR 132628	6/29/2007	5/30/2010	B&W Y-12	B&W Y-12	B&W Y-12
CWA	General Stormwater Permit Potable Water System Upgrade	TNR 132975	6/29/2007	5/30/2010	DOE	Washington Group	Washington Group
CWA	General Stormwater Permit Steam Plant Replacement Project	TNR 133198	7/2/2008	5/30/2010	DOE	G&S Construction	G&S Construction
RCRA	Hazardous Waste Transporter Permit	TN3890090001	1/11/2010	1/31/2011	DOE	DOE	B&W Y-12

Table 4.3 (continued)

Regulatory driver	Permit title/description	Permit number	Issue date	Expiration date	Owner	Operator	Responsible contractor
RCRA	Hazardous Waste Corrective Action Permit	TNHW-121	9/28/2004	9/28/2014	DOE	DOE, NNSA, and all ORR co-operators of hazardous waste permits	BJC
RCRA	Container Storage Units	TNHW-122	8/31/2005	8/31/2015	DOE	DOE/B&W Y-12	B&W Y-12/ Navarro-GEM JV, co-operator
RCRA	Hazardous Waste Container Storage and Treatment Units	TNHW-127	10/06/2005	10/06/2015	DOE	DOE/B&W Y-12	B&W Y-12 co-operator
RCRA	RCRA Post-Closure Permit for the Chestnut Ridge Hydrogeologic Regime	TNHW-128	9/29/2006	9/29/2016	DOE	DOE/BJC	BJC
RCRA	RCRA Post-Closure Permit for the Bear Creek Hydrogeologic Regime	TNHW-116	12/10/2003	12/10/2013	DOE	DOE/BJC	BJC
RCRA	RCRA Post-Closure Permit for The Upper East Fork Poplar Creek Hydrogeologic Regime	TNHW-113	9/23/2003	9/23/2013	DOE	DOE/BJC	BJC
Solid Waste	Industrial Landfill IV (Operating, Class II)	IDL-01-103-0075	Permitted in 1988—most recent modification approved 1/13/1994	N/A	DOE	DOE/BJC	BJC
Solid Waste	Industrial Landfill V (Operating, Class II)	IDL-01-103-0083	Initial permit 4/26/1993	N/A	DOE	DOE/BJC	BJC
Solid Waste	Construction and Demolition Landfill (Overfilled, Class IV Subject to CERCLA ROD)	DML-01-103-0012	Initial permit 1/15/1986	N/A	DOE	DOE/BJC	BJC
Solid Waste	Construction and Demolition Landfill VI (Postclosure care and maintenance)	DML-01-103-0036	Permit terminated by TDEC 3/15/2007	N/A	DOE	DOE/BJC	BJC

Table 4.3 (continued)

Regulatory driver	Permit title/description	Permit number	Issue date	Expiration date	Owner	Operator	Responsible contractor
Solid Waste	Construction and Demolition Landfill VII (Operating, Class IV)	DML-01-103-0045	Initial permit 12/13/1993	N/A	DOE	DOE/BJC	BJC
Solid Waste	Centralized Industrial Landfill II (Postclosure care and maintenance)	IDL-01-103-0189	Most recent modification approved 5/8/1992	N/A	DOE	DOE/BJC	BJC

[a] A request for extension was submitted to TDEC on January 7, 2009. This permit is addressed in the Title V renewal application.

[b] The Y-12 Title V Operating Air Permit Renewal Application was submitted to TDEC on April, 23, 2009. As part of the permit application renewal, it was requested that TDEC combine Air Permit 554594 into Air Permit 554701 followed by cancellation of Air Permit 554594.

Abbreviations

BJC	Bechtel Jacobs Company
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWA	Clean Water Act
DOE	U.S. Department of Energy
GEM-JV	GEM Technologies, Inc. Joint venture
NNSA	National Nuclear Security Administration
NOT	Notice of termination
ORR	Oak Ridge Reservation
RCRA	Resource Conservation and Recovery Act
ROD	record of decision
TDEC	Tennessee Department of Environment and Conservation

components and machinery, and how technological innovations occurred over time. Some of the information collected from the interviews may be used in various media to include DVDs shown in the Y-12 History Exhibit Hall.

The Exhibit Hall, located in The New Hope Center, continues to be a work in progress featuring new artifacts, photographs, and pop-up signs. The Exhibit Hall, renamed "The Y-12 History Center," displays exhibits, photographs, artifacts, brochures, DVDs, and other information associated with the history of Y-12 and the New Hope Community. The Center is open to the public Monday through Thursday from 8:00 a.m. to 5:00 p.m. and on Fridays by special request. A selection of materials, including DVDs, books, pamphlets, and fact sheets, is available free to the public. Tours of the Center were conducted for various organizations, local schools, and VIP visitors.

Outreach activities in 2009 consisted of providing tours of the Y-12 Complex for the Secret City Festival and for the American Museum of Science and Energy. Twenty thousand people attended the annual Secret City Festival, held in June, sponsored by the city of Oak Ridge, the Convention and Visitor's Bureau, and the Arts Council of Oak Ridge. B&W Y-12 partnered with The Secret City Festival to promote the history of Oak Ridge by providing guided tours of the Y-12 Complex. B&W Y-12 also partnered with the American Museum of Science and Energy by providing guided public tours from June through September for over 1545 tourists from 42 states. Other outreach activities include visiting local schools and conducting presentations on the history of Y-12 and Oak Ridge.

4.3.3 Clean Air Act

This section contains a review of the major elements of the Clean Air Program at the Y-12 Complex Including program highlights for 2009.

The DOE was issued the Title V Major Source Operating Permits 554701 and 554594 in 2004 for the Y-12 Complex and required compliance implementation began April 1, 2005. More than 3,000 data points are obtained and reported under the Title V operating permit every 6 months, and there are five continuous monitors for criteria pollutants as well as numerous continuous samplers for radiological emissions.

There was no noncompliance as a result of monitoring activities during 2009.

In 2009, only one construction air permit was in effect at the Y-12 Complex. Under a permit issued in 2007, construction began in 2008 on the replacement steam plant. The new steam plant is planned to be transitioned to management and the operating contractor in April 2010. Completion of the new steam plant will ultimately result in the shutdown of the existing steam plant.

More than 90% of the Y-12 Complex pollutant emissions to the atmosphere is attributed to the operation of the existing coal-fired and natural gas–fired steam plant. Emissions from the new steam plant will be significantly lower than those from the existing steam plant, resulting in an overall air quality improvement. The new steam plant will burn primarily natural gas and will have a fuel oil backup. The Clean Air construction permit for this project included a Best Available Control Technology analysis for certain criteria pollutants and a case-by-case Maximum Achievable Control Technology (MACT) analysis for hazardous air pollutants.

Prior-year efforts to increase usage of E-85 (i.e., a mixture of 85% ethanol and 15% gasoline) in flexible fuel vehicles continued to reap motor vehicle emission reductions in 2009.

In 2009, TDEC personnel performed an inspection of the Y-12 Complex on January 21 and 22 to verify compliance with applicable regulations and permit conditions. No compliance issues were identified.

4.3.4 Clean Water Act and Aquatic Resources Protection

The Y-12 NPDES permit (TN0002968) was issued on March 13, 2006, and became effective on May 1, 2006. An application for reissuance of the NPDES permit was submitted to TDEC, Division of Water Pollution Control, on July 1, 2008.

In 2008 an evaluation of options for reducing mercury loading in lower East Fork Poplar Creek was completed. The pilot studies indicated that a reduction of flow in certain areas of the creek would reduce the amount of mercury in the water flow. To implement this improvement effort, a permit modification was required. The request to reduce flow was embraced by both state and EPA regulators. The request to modify flow was in part a result of activities associated with a team of NNSA, DOE-EM, and contractor employees formed to study proposed state requirements for a mercury Total Maximum Daily Load (TMDL) in EFPC. On December 30, 2008, the permit was modified to change the required minimum flow in East Fork Poplar Creek at Station 17 to 5 million gal/day from 7 million gal/day.. The permit expired December 31, 2008, and Y-12 Complex discharges are continuing under the requirements of this permit pending TDEC action on the renewal application submitted on July 1, 2008. The effluent limitations contained in the permit are based on the protection of water quality in the receiving streams. The permit emphasizes storm water runoff and biological, toxicological, and radiological monitoring.

During 2009 the Y-12 Complex continued its excellent record for compliance with the National Pollutant Discharge Elimination System (NPDES) water discharge permit. More than 6,000 data points were obtained from sampling required by the NPDES permit; only one noncompliance was reported. Some of the key requirements in the permit are summarized below (additional details are provided in Sect. 4.5, Surface Water Program):

- chlorine limitations based on water quality criteria at three outfalls located near the headwaters of East Fork Poplar Creek and a construction schedule for new dechlorinators (construction of new dechlorination systems was completed in 2007);
- reduction of the measurement frequency for pH and chlorine at East Fork Poplar Creek outfalls with the additional requirement for measurements in stream at the Station 17 location;
- a radiological monitoring plan requiring monitoring and reporting of uranium and other isotopes at pertinent locations (see Sect. 4.5.2);
- implementation of a storm water pollution prevention plan requiring sampling and characterization of storm water (see Sect. 4.5.3);
- stormwater sampling of stream baseload sediment at four instream East Fork Poplar Creek locations (see Sect. 4.5.3);
- a requirement for an annual storm water monitoring report, an annual report of the Biological Monitoring and Abatement Plan (BMAP) data;
- a requirement to manage the flow of East Fork Poplar Creek such that a minimum flow of 26 million L/day (7 million gal/day) is guaranteed by adding raw water from the Clinch River to the headwaters of East Fork Poplar Creek [note: the permit was modified in 2008 to require a minimum flow of 19 million L/day (5 million gal/day; see Sect. 4.5.4)]; and
- whole effluent toxicity testing limitation for the three outfalls of East Fork Poplar Creek (see Sect. 4.5.8).

A notice of appeal of certain permit terms and limits for legacy constituents of mercury and PCBs was filed by NNSA in April 2006. The permit limits for toxicity at three outfalls were appealed because legacy contamination may adversely affect toxicity and their cleanup is addressed under CERCLA. Chlorine limits at the headwaters of the creek were also appealed. Issues associated with the appeal were not resolved prior to expiration of the permit.

An application for renewal of the NPDES permit was completed in June 2008 and was submitted to TDEC on July 1, 2008. This work effort included special sampling needed to fully characterize effluents and to properly complete permit application forms. During 2009 permits for storm water associated with construction activity were in effect for three projects located in the Y-12 Complex. The projects are the Potable Water System (storage tanks and waterlines), the Steam Plant Life Extension, and Building 9720-82. Construction of Building 9720-82 was completed and the storm water permitted in 2009. Y-12 Environmental Compliance staff continue to keep TDEC apprised of site developments, and as of January 2010 TDEC had not yet issued a draft of the new permit.

The Industrial and Commercial User Wastewater Discharge Permit (1-91) was issued by the City of Oak Ridge to Y-12 on April 1, 2005. The permit, which expires on March 31, 2010, provides requirements for the discharge of wastewaters to the sanitary sewer system as well as prohibitions for certain types of wastewaters. There were four permit exceedances of the permit in 2009. One was for exceeding the discharge limit (monthly average) for nickel, and three were for exceeding the maximum daily allowable flow limit. During the year the city of Oak Ridge conducted two inspections under the Industrial Pretreatment Program (January 14, 2009, and September 14, 2009). The City of Oak Ridge requested, and Y-12 has delivered, an action plan to address inflow/infiltration into the sanitary sewer system. Members of the Clean Water Program continued to work on surface water programs such as the Storm Water Pollution Prevention, including storm water sampling and site inspections, BMAP, and development of best management practices plans for projects and site activities. Work continued on streamlining data management for compliance reporting, review, approval, and tracking of water discharges and connections to the storm and sanitary sewer systems.

4.3.5 Safe Drinking Water Act

The City of Oak Ridge supplies potable water to the Y-12 Complex that meets all federal, state, and local standards for drinking water. The water treatment plant, located north of the Y-12 Complex, is owned and operated by the City of Oak Ridge.

The Tennessee Regulations for Public Water Systems and Drinking Water Quality, Chap.1200-5-1, sets limits for biological contaminants and for chemical activities and chemical contaminants. Sampling for the following is conducted by the Y-12 Utilities Management Organization:

- Total coliform
- Chlorine residuals
- Lead
- Copper
- Disinfectant by-product
- Propylene glycol

In 2009, the Y-12 potable water system retained its approved status for potable water with the TDEC. Y-12 continued sampling the potable water system for propylene glycol. TDEC instituted a requirement for sampling the site potable water system for propylene glycol in 2007 after learning that an unapproved cross connection exists between the Y-12 potable water system and the antifreeze fire sprinkler systems containing propylene glycol. All of the samples collected during 2009 resulted in laboratory results below the detection limits. A potable water system upgrade project is scheduled for the installation of approved backflow prevention devices, conversion to dry pipe, and/or disconnection of the antifreeze fire sprinkler systems by 2010.

All total coliform samples collected during 2009 were analyzed by the state of Tennessee lab, and the results were negative. Analytical results for disinfectant by-products (total trihalomethanes and haloacetic acids) for the Y-12 water systems were below the TDEC and Safe Drinking Water Act (SDWA) limits. The Y-12 potable water system is currently sampled triennially for lead and copper, and the system sampling was last completed in August 2008. These results were below the TDEC and SDWA limits and meet the established requirements.

Major improvements to the potable water system were performed during 2009 including:

- Construction of two 7.5 million liters (2 million gal) elevated water tanks that are scheduled for completion in 2010 to replace legacy ground storage tanks
- Replacement of 702 m (2,300 ft) of potable water lines
- Cleaned and lined 645 m (2,115 ft) of potable water lines
- Excavated and inspected 317 m (1,040 ft) of existing potable water lines
- Installed 52 new backflow assemblies
- Isolation and conversion of 152 anti-freeze loop fire sprinkler systems

4.3.6 The Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) regulates hazardous wastes that, if mismanaged, could present risks to human health or the environment. The regulations are designed to ensure that hazardous wastes are managed from the point of generation to final disposal. In Tennessee, EPA delegates the RCRA program to TDEC; EPA retains an oversight role. Y-12 is considered a "large-quantity generator" because it may generate more than 1,000 kg (2,205 lb) of hazardous waste in a month and because it has RCRA permits to store hazardous wastes for up to 1 year before shipping off site to licensed treatment and disposal facilities. Y-12 also has a number of satellite accumulation areas and 90-day waste storage areas.

Mixed wastes are materials that are both hazardous (under RCRA guidelines) and radioactive. The Federal Facilities Compliance Act (1992) requires that DOE work with local regulators to develop a site treatment plan to manage mixed waste. Development of the plan has two purposes: to identify available treatment technologies and disposal facilities (federal or commercial) that are able to manage mixed waste produced at federal facilities and to develop a schedule for treating and disposing of the waste streams.

The ORR Site Treatment Plan (TDEC 2008) is updated annually and submitted to TDEC for review. The updated plan documents the current mixed-waste inventory and describes efforts undertaken to seek new commercial treatment and disposal outlets for various waste streams. NNSA has developed a disposition schedule for the mixed waste in storage and will continue to maintain and update the plan as a reporting mechanism, as progress is made. Y-12 is reducing inventory of legacy mixed waste as part of the plan (see Fig. 4.16).

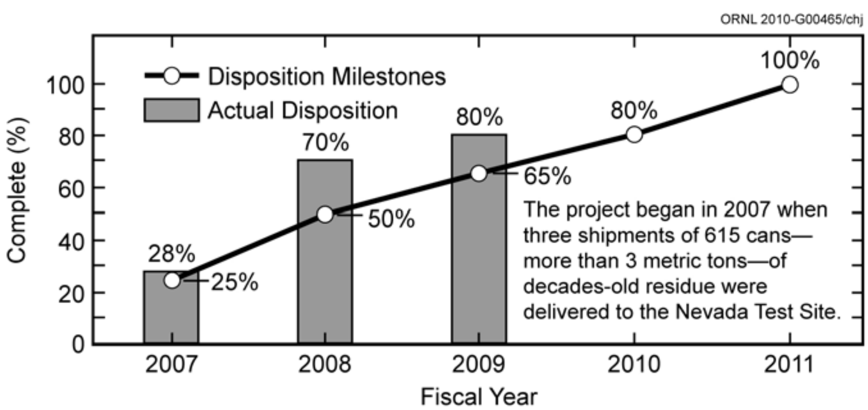


Fig. 4.16. Reducing inventory of legacy mixed waste as part of the ORR Site Treatment Plan.

The quantity of hazardous and mixed wastes generated by Y-12 increased in 2009 (Fig. 4.17). The increase was attributed to the treatment of more than 6,000,000 kg of additional contaminated groundwater. This directly correlates to 43 cm (17 in.) more rainfall in 2009 than in 2008. Waste resulting from repackaging and disposal of legacy mixed waste also increased. Legacy mixed wastes are being repackaged and disposed of in accordance with milestones in the ORR Site Treatment Plan. Progress on disposition of legacy mixed wastes exceeded established milestones for FY 2009. Ninety-seven percent of the total hazardous and mixed waste generated in 2009 was generated as contaminated leachate from legacy operations. The Y-12 Complex currently reports waste on 126 active waste streams. Y-12 is a state-permitted treatment, storage, and disposal facility. Under its permits, Y-12 received 1,535 kg (3,385 lb) of hazardous and mixed waste from the off-site Union Valley analytical chemistry laboratory in 2009. In addition, 218,035 kg (480,767 lb) of hazardous and mixed waste was shipped to DOE-owned and commercial treatment, storage, and disposal facilities. More than 12 million kg (26 million lb) of hazardous and mixed wastewater was treated at on-site wastewater treatment facilities.

TDEC conducted a comprehensive inspection of Y-12's hazardous waste program in November 2009, including permitted storage facilities, satellite accumulation areas, and 90-day accumulation areas. No violations were noted during the inspection.

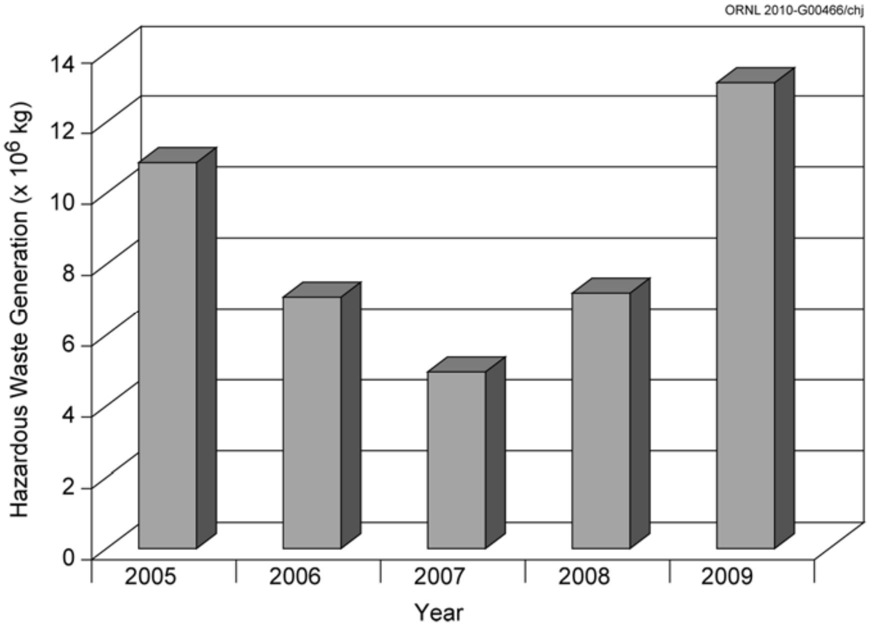


Fig. 4.17. Hazardous waste generation, 2005–2009.

4.3.6.1 RCRA Underground Storage Tanks

TDEC regulates the active petroleum underground storage tanks (USTs) at Y-12. Existing UST systems that are to remain in service at the Y-12 Complex must comply with performance requirements described in TDEC underground storage tank regulations (TN 1200-1-15). Three specific requirements are considered:

- release detection for both the tank and piping,
- corrosion protection for both the tank and piping, and
- spill/overfill prevention equipment.

The Y-12 UST Program includes two active petroleum USTs that meet all current regulatory compliance requirements. The UST registration fees for the tanks are current, enabling fuel delivery until March 31, 2011. All legacy petroleum UST sites at Y-12 have either been granted final closure by TDEC or have been deferred to the CERCLA process for further investigation and remediation. TDEC conducted a comprehensive inspection of Y-12's petroleum USTs in August 2009. No violations were found during that inspection.

4.3.6.2 RCRA Subtitle D Solid Waste

Located within the boundary of the Y-12 Complex are the Oak Ridge Reservation landfills operated by the DOE-EM (Office of Environmental Management) program. The facilities include two Class II operating industrial solid waste disposal landfills and one operating Class IV construction demolition landfill. The facilities are permitted by TDEC and accept solid waste from DOE operations on the ORR. In addition, one Class IV facility (Spoil Area 1) is overfilled by 8,945 m^3 (11,700 yd^3) and has been the subject of a CERCLA remedial investigation/feasibility study. A CERCLA ROD for Spoil Area 1 was signed in 1997. One Class II facility (Landfill II) has been closed and is subject to postclosure care and maintenance. Associated TDEC permit numbers are noted in Table 4.3.

Landfill V, a Class II landfill, is used for disposal of sanitary, industrial, construction, and demolition waste. This landfill is being expanded with ARRA funding. Expansion of the landfill will increase capacity by 294,354 m^3 (385,000 yd^3) to provide more capacity for the increased cleanup work on the Reservation. The expansion also includes upgrading and refurbishing support facilities.

A “Notice of Violation (NOV) for maximum contaminant limit (MCL) Exceedance in Ground Water Monitoring Well GW-305 at Industrial Landfill IV” was issued by TDEC in November 2009 (see Sect. 2.5).

4.3.7 RCRA/CERCLA Coordination

The ORR Federal Facility Agreement is intended to coordinate the corrective action processes of RCRA required under the Hazardous Waste Corrective Action permit (formerly known as the Hazardous and Solid Waste Amendments permit), with CERCLA response actions.

Three RCRA postclosure permits, one for each of the three hydrogeologic regimes at Y-12, have been issued to address the eight major closed waste disposal areas at Y-12. Because it falls under the jurisdiction of two postclosure permits, the S-3 Pond Site is described as having two parts, eastern and former S-3 (see Table 4.4). Postclosure care and monitoring of East Chestnut Ridge Waste Pile was incorporated into permit TNHW-128. Groundwater corrective actions required under the postclosure permits have been deferred to CERCLA. RCRA groundwater monitoring data were reported yearly to TDEC and EPA in the annual CERCLA Remediation Effectiveness Report (DOE 2010) for the ORR.

Periodic updates of proposed construction and demolition activities at the Y-12 Complex (including alternative financing projects) 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 that warrant CERCLA oversight. The goal is to ensure that modernization efforts do not impact the effectiveness of previously completed CERCLA environmental remedial actions and that they do not adversely impact future CERCLA environmental remedial actions.

4.3.8 Toxic Substances Control Act

The storage, handling, and use of PCBs are regulated under the Toxic Substances Control Act (TSCA). Capacitors manufactured before 1970 that are believed to be oil filled are handled as if they contain PCBs, even when that cannot be verified from the manufacturer’s records. Certain equipment containing PCBs and PCB waste containers must be inventoried and labeled. The inventory is updated by July 1of each year. The 2009 (PCB) annual inventory was submitted June 16, 2009.

Given the widespread historical uses of PCBs at Y-12, along with fissionable material requirements that must be maintained, an agreement between EPA and DOE was negotiated to assist the ORR facilities in becoming compliant with TSCA regulations. This agreement, known as the *Oak Ridge Reservation Polychlorinated Biphenyl Federal Facilities Compliance Agreement* (ORR PCB FFCA), which came into effect in 1996, provides a forum with which to address PCB compliance issues that are truly unique to these facilities. Y-12 operations involving TSCA-regulated materials were conducted in accordance with TSCA regulations and the ORR-PCB-FFCA.

4.3.9 Preventing Spills and Reporting Spills/Releases

4.3.9.1 Preventing Oil Pollution and Spills

Y-12 maintains its *Spill Prevention, Control, and Countermeasures Plan* (SPCC Plan) to prevent spills of oil and hazardous constituents as well as the countermeasures to be invoked should a spill occur. A major revision to the SPCC Plan was last issued in 2008. In general, the first response of an individual discovering a spill is to call the plant shift superintendent. Spill response materials and equipment are stored near tanks and drum storage areas and other strategic areas of the Y-12 Complex to facilitate spill response. All Y-12 personnel and subcontractors are required to have initial spill and emergency response training before they can work on site. This training is received as part of the GET Program.

4.3.9.2 Emergency Reporting Requirements

The Emergency Planning and Community Right-to-Know Act (EPCRA) and Title III of the Superfund Amendments and Reauthorization Act (SARA) require that facilities report inventories (i.e., Tier II Report sent to the local emergency planning committees and the state emergency response commission) and releases (i.e., Tier III Report submitted to state and federal environmental agencies) of certain chemicals that exceed specific release thresholds. Y-12 complied with those requirements in 2009 through the submittal of reports under EPCRA Sections 302, 303, 311, and 312. Y-12 had no releases of extremely hazardous substances as defined by EPCRA in 2009.

Table 4.4. RCRA postclosure status for former treatment, storage, and disposal units on the ORR

Unit	Major components of closure	Major postclosure requirements
Upper East Fork Poplar Creek Hydrogeologic Regime (RCRA Postclosure Permit No. TNHW-113)		
New Hope Pond	Engineered cap, Upper East Fork Poplar Creek distribution channel	Cap inspection and maintenance. No current groundwater monitoring requirements in lieu of ongoing CERCLA actions in the eastern portion of Y-12
Eastern S-3 Ponds Groundwater Plume	None for groundwater plume, see former S-3 Ponds (S-3 Site) for source area closure	Postclosure corrective action monitoring. Inspection and maintenance of monitoring network
Chestnut Ridge Hydrogeologic Regime (RCRA Postclosure Permit No. TNHW-128)		
Chestnut Ridge Security Pits	Engineered cap	Cap inspection and maintenance. Postclosure corrective action monitoring. Inspection and maintenance of monitoring network and survey benchmarks
Kerr Hollow Quarry	Waste removal, access controls	Access controls inspection and maintenance. Postclosure detection monitoring. Inspection and maintenance of monitoring network and survey benchmarks
Chestnut Ridge Sediment Disposal Basin	Engineered cap	Cap inspection and maintenance. Postclosure detection monitoring. Inspection and maintenance of monitoring network and survey benchmarks
East Chestnut Ridge Waste Pile	Engineered cap	Cap inspection and maintenance. Postclosure detection monitoring. Inspection and maintenance of monitoring network, leachate collection sump and survey benchmarks. Management of leachate
Bear Creek Hydrogeologic Regime (RCRA Postclosure Permit No. TNHW-116)		
Former S-3 Ponds (S-3 Site)	Neutralization and stabilization of wastes, engineered cap, asphalt cover	Cap inspection and maintenance. Postclosure corrective action monitoring. Inspection and maintenance of monitoring network and survey benchmarks
Oil Landfarm	Engineered cap	Cap inspection and maintenance. Postclosure corrective action monitoring. Inspection and maintenance of monitoring network and survey benchmarks
Bear Creek Burial Grounds A-North, A-South and C-West, and the Walk-In Pits	Engineered cap, leachate collection system specific to the burial grounds	Cap inspection and maintenance. Post-closure corrective action monitoring. Inspection and maintenance of monitoring network and survey benchmarks

Abbreviations

RCRA Resource Conservation and Recovery Act

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act

The required Section 311 notifications were made in 2009 because hazardous materials were determined to be over the threshold for the first time. 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 Section 312 requirements. Y-12 reported 70 chemicals that were in inventory over threshold during the 2009 reporting year.

Each ORR facility evaluates its respective operations to determine applicability for submittal of 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 as well as 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 are compared with regulatory thresholds to determine which chemicals exceed the reporting thresholds based on amounts manufactured, processed, or otherwise used at each facility. After threshold determinations are made, releases and off-site transfers are calculated for each chemical that exceeded one or more of the thresholds.

Total 2009 reportable toxic releases to air, water, and land, and waste transferred off site for treatment, disposal, and recycling were 73,111 kg (161,180 lb). Table 4.5 lists the reported chemicals for the Y-12 Complex and summarizes releases and off-site transfers for those chemicals exceeding reporting thresholds.

Table 4.5. Emergency Planning and Community Right-to-Know Act Section 313 toxic chemical release and off-site transfer summary for the Y-12 Complex, 2008, 2009

Chemical	Year	Quantity[a] (lb)[b]
Chromium	2008	c
	2009	6,106
Copper	2008	c
	2009	c
Lead Compounds	2008	21,652
	2009	12,859
Mercury Compounds	2008	31
	2009	125
Methanol	2008	33,814
	2009	92,020
Nickel	2008	c
	2009	c
Nitric Acid	2008	4,000
	2009	3,320
Ozone	2008	c
	2009	c
Sulfuric Acid	2008	45,000
	2009	46,000
Total	2008	104,497
	2009	161,180

[a] Represents total releases to air, land, and water and includes off-site waste transfers. Also includes quantities released to the environment as a result of remedial actions, catastrophic events, or one-time events not associated with production processes.

[b] 1 lb = 0.45359237 kg.

[c] Not applicable because releases were less than 500 lb, hence a Form A was submitted.

4.3.9.3 Spills and Releases

Y-12 has procedures for notifying off-site authorities for categorized events at the Y-12 National Security Complex. Off-site notifications are required for specified events according to federal statutes, DOE orders, and the Tennessee Oversight Agreement. As an example, any observable oil sheen on East Fork Poplar Creek and any release impacting surface water must be reported to the EPA National Response Center in addition to other reporting requirements. Spills of CERCLA reportable quantity (RQ) limits must be reported to the EPA National Response Center, DOE, the Tennessee Emergency Management Agency, and the Anderson County Local Emergency Planning Committee.

There was one release of a hazardous substance (asbestos) exceeding an RQ. There were no fish kills at Y-12 in 2009. There was one release of hydraulic fluid that resulted in an observed oil sheen on upper East Fork Poplar Creek (see Sect. 4.3.9.4).

4.3.9.4 Environmental Occurrences

The Y-12 Occurrence Reporting program provides timely notification to the DOE Complex of Y-12 events and site conditions that could adversely affect the public or worker health and safety, the environment, national security, DOE's safeguards and security interests, functioning of DOE facilities, or the department's reputation.

Y-12 occurrences are categorized and reported through the Occurrence Reporting and Processing System (ORPS). ORPS provides NNSA and the DOE community with a readily accessible database of information about occurrences at DOE facilities, causes of those occurrences, and corrective actions to prevent recurrence of the events. DOE analyzes aggregate occurrence information for generic implications and operational improvements.

On June 22, 2009, a hydraulic line on a construction crane failed, resulting in a leak of approximately 370 L (98 gal) of hydraulic fluid (Occurrence Report N/A--YSO-BWXT-Y12CM-2009-0002). Efforts were made to capture and absorb the material; however, some hydraulic fluid reached a storm drain system inlet to East Fork Poplar Creek, resulting in an oil sheen and prompting reporting to the National Response Center, the Tennessee Emergency Management Agency, and the Local Emergency Planning Committee. This event was the result of mechanical failure (hydraulic hose rupture), and all personnel involved followed the proper protocol that mitigated the release. There were no observed effects to fish and aquatic conditions as result of this event. After notification, a TDEC inspector visited the site to review the spill and the subsequent actions of the Y-12 personnel involved in the spill event. The TDEC representative concluded that response to the spill and cleanup efforts had been dealt with effectively and efficiently and had no negative remarks (concerns) relating to the cleanup effort.

On September 2, 2009, while performing cleanup activities and operating heavy equipment at the 9720-58 yard, a pressurized acetylene cylinder was inadvertently punctured resulting in a release of asbestos material on the ground that exceeded the reportable quantity (Occurrence Report NA--YSO-BWXT-Y12SITE-2009-0026). The work site was inspected by hand prior to restart of activities. This activity included hand removal of bulky items, wearing the proper personal protective equipment, as well as clearing and combing through overgrown areas in an attempt to reveal any items which may have been hidden. Thorough training on the identification of various types of anomalous waste likely to be encountered and instructions on how to respond to the discovery was provided to all employees working in the area.

A Notice of Violation (NOV) for maximum contaminant limit (MCL) exceedance in groundwater monitoring well GW-305 at Industrial Landfill IV was issued by TDEC in November 2009 to Bechtel Jacobs, the DOE-EM contractor at Y-12 (see Sect. 2.5). Such notifications are also reported in the DOE Occurrence Reporting system (Occurrence Report EM-ORO--BJC-Y12WASTE-2009-0001).

4.3.9.5 Mercury Removal from Storm Drain Catch Basins

In May 2003, metallic mercury was observed in two storm drain catch basins located in the west end of the Y-12 Complex. The storm drain line on which the catch basins are located flows into East Fork Poplar Creek at Outfall 200. Mercury tends to collect at those low spots in the drain system following heavy rains. During 2009, spill response and waste services personnel conducted one removal and recovered an estimated 0.5 kg (1.0 lb) of mercury. Approximately 30 kg (66 lb) have been recovered since 2003.

4.3.10 Audits and Oversight

A number of federal, state, and local agencies oversee Y-12 activities. In 2000, Y-12 was inspected by federal, state, or local regulators on five occasions. The TDEC Department of Energy Oversight Division maintained a part-time regulator on site who provided periodic oversight of Y-12 activities. Except for work completed under the Federal Facilities Agreement (FFA), TDEC DOE Oversight work is non-regulatory. This clarification should be made to avoid a misunderstanding of TDEC DOE Oversight's role at Y-12. Most other matters such as CAA, CWA, and RCRA are regulated by TDEC's Knoxville Basin Office, not TDEC DOE Oversight. The Environmental Restoration Section at TDEC DOE-O handles CERCLA matters at Y-12. In addition to external audits and oversight, Y-12 has a comprehensive self-assessment program. A summary of external regulatory audits and reviews for 2009 is provided in Table 4.6.

Table 4.6. Summary of external regulatory audits and reviews, 2009

Date initiated	Date completed	Conducted by	Title of assessment	Total findings
1/14/2009	1/14/2009	City of Oak Ridge	Semi-Annual Industrial Pretreatment Compliance Inspection	1[a]
1/21/2009	1/22/2009	TDEC	TDEC Annual Clean Air Compliance Inspection	0
8/4/2009	8/4/2009	TDEC	Underground Storage Tank Compliance Inspection	0
9/14/2008	9/14/2009	City of Oak Ridge	Semi-Annual Industrial Pretreatment Compliance Inspection	0
11/2/2009	11/5/2009	TDEC	TDEC Annual RCRA Inspection	0

[a] The City of Oak Ridge requested an action plan to address inflow/infiltration into the sanitary sewer system.

Abbreviations:

RCRA—Resource Conservation and Recovery Act

TDEC—Tennessee Department of Environment and Conservation

4.3.10.1 Enforcement Actions and Memos

There was no consent orders issued to Y-12 in 2009. The DOE-EM contractor for the Oak Ridge Reservation construction demolition landfill at Y-12 received a NOV for MCL exceedance in groundwater monitoring well GW-305 at Industrial Landfill IV from TDEC in November 2009. There was no impact to the operation of Industrial Landfill IV. Due to the remote location of this groundwater monitoring well from public property and/or drinking water sources, there is negligible impact at this point from a health and safety viewpoint. Environmental impacts will be determined as part of the required Phase III Assessment Monitoring Program Plan as required by the TDEC Solid Waste Regulations.

4.4 Air Quality Program

Permits issued by the state of Tennessee are the primary vehicle used to convey the clean air requirements that are applicable to the Y-12 Complex. New projects are governed by construction permits, and eventually, the requirements are incorporated into the site-wide Title V operating permit. Sections of the Title V permit contain requirements that are generally applicable to most industrial sites. Examples include requirements associated with asbestos controls, control of stratospheric ozone-depleting chemicals, and control of fugitive emissions as well as the general administration of the permit. The Title V permit also contains a section of specific requirements directly applicable to individual sources of air emissions at Y-12. Major requirements included in that section include the National Emission Standards for Hazardous Air Pollutants for Radionuclides (Rad NESHAP, 40 CFR 61) requirements and the numerous requirements associated with emissions of criteria pollutants and other hazardous air pollutants (nonradiological). In addition, a number of sources that are exempt from permitting requirements under state rules but subject to listing on Title V permit application are documented, and information about them is available upon request from the state.

Ambient air monitoring, while not specifically required by any permit condition, is conducted at Y-12 to satisfy DOE order requirements, as a best management practice and/or to provide evidence of sufficient programmatic control of certain emissions. Ambient air monitoring conducted specifically for Y-12 (i.e., mercury monitoring) is supplemented by additional monitoring conducted for the ORR and by both on-site and off-site monitoring conducted by TDEC. In addition, the overall effectiveness of the Clean Air

Act compliance program is ensured by internal audits and external audits, such as the annual inspection conducted by state of Tennessee personnel.

4.4.1 Construction and Operating Permits

In 2009, Y-12 Complex had only one construction air permit. A construction permit for the replacement steam plant continued in 2009.

The DOE/NNSA and Y-12 Title V permits, currently two permits with an outstanding request to combine them into one permit, include 37 air emission sources and more than 100 air emission points. All remaining emission sources are categorized as insignificant and exempt from permitting. The Tennessee Air Pollution Control Board issued a minor modification to the Title V Major Source Operating Permit 554701 on April 5, 2009. The minor modification was to align permit conditions with site transformation activities. Permit change requests still pending at the end of 2009 include

- a request to convert one construction permit to an operating permit;
- a request to combine permit 554594 (which only has one emission source) into the existing Y-12 site-wide permit;
- a request to add the new steam plant to the operating permit; and
- a request to add Fuel Station Stage 1 emission control requirements to the permit.

The Y-12 Complex major source (Title V) operating air permit renewal application was prepared and hand-delivered to the TDEC personnel in April 2009. As part of the permit application renewal, it was requested that TDEC combine Air Permit 554594 into Air Permit 554701 followed by cancellation of Air Permit 554594. The complete permit application consists of four volumes. The complete, unedited application consists of Volumes 1, 2, 3.2, and 4.3. Volumes 3.1, 4.1, and 4.2, which are edited for classification reasons, were provided to the TDEC for their review and approval. Any classified information is held on site at the Y-12 National Security Complex for the appropriately Q-cleared TDEC personnel to review as needed.

Permit administration fees in excess of $100,000 per year are paid to TDEC in support of the Title V program. Y-12 has chosen to pay the fees based on a combination of actual emissions [steam plant, methanol, solvent 140 volatile organic compound (VOC)] and allowable emissions (balance of plant). In years when a detailed air emission inventory is not required to be compiled for Y-12 operations, the emissions ledger compiled to support the annual fee payment is the most comprehensive presentation of total site emissions. In 2009, emissions categorized as actual emissions totaled 2,697,704 kg (2,973.71 tons), and emissions calculated by the allowable methodology totaled 756,365 kg (833.75 tons). The total emissions fee paid was $139,736.57.

Demonstrating compliance with the conditions of air permits is a significant effort at the Y-12 Complex. Key elements of maintaining compliance are maintenance and operation of control devices, monitoring, record-keeping, and reporting. High-efficiency particulate air (HEPA) filters, baghouses, and scrubbers are control devices used at the Y-12 Complex. HEPA filters are found throughout the complex, and in-place testing of HEPA filters to verify the integrity of the filters is routinely performed. Baghouses and scrubbers are operated and maintained in accordance with source-specific procedures. Monitoring consists of tasks such as continuous stack sampling, one-time stack sampling, and monitoring the operation of control devices. Examples of continuous stack sampling are the radiological stack monitoring systems on numerous sources throughout the complex, continuous NO_x monitors on the steam plant, and continuous opacity monitors on the steam plant. The Y-12 Complex site-wide permit requires quarterly and semiannual reports. In addition, two major annual reports are required. One report is the overall ORR radiological NESHAP report (CFR 2009a), which includes specific information regarding Y-12 Complex emissions; the second is an annual Title V compliance certification report indicating compliance status with all conditions of the permit.

4.4.1.1 Generally Applicable Permit Requirements

The Y-12 Complex, like many industrial sites, has a number of generally applicable requirements that require management and control. Asbestos, ozone-depleting substances, and fugitive particulate emissions are notable examples.

4.4.1.1.1 Control of Asbestos

The Y-12 Complex has numerous buildings and equipment that contain asbestos-containing materials. The compliance program for management of removal and disposal of asbestos-containing materials includes demolition and renovation notifications to TDEC and inspections, monitoring, and prescribed work practices for abatement and disposal of asbestos materials. There was one reportable release of asbestos in 2009, when an acetylene cylinder was inadvertently punctured while performing site cleanup activities and operating heavy equipment at the 9720-58 yard (see Sect. 4.3.9.4). Corrective actions were implemented, and the area cleared of asbestos with approval from the Supervisor of the Asbestos Abatement Activity for resumption of normal activities. There was no impact to the environment.

4.4.1.1.2 Stratospheric Ozone Protection

Y/TS-1880, *Y-12 Complex Ozone Depleting Substances (ODS) Phase-Out and Management Plan* (B&W Y-12 2009a), provides a complete discussion of requirements and compliance activities at the Y-12 Complex. ODS reductions are based on the DOE Order 450.1A (DOE 2008a) objective to phase out as equipment reaches life expectance, equipment repairs are no longer cost-effective, or viable solvent replacements are identified. Past ODS reduction initiatives began in the early 1980s and focused on Class I ODS usage in refrigerants and solvent cleaning operations. Only one small chiller remains at the Y-12 Complex which contains Class I ODS. This system has a 181-kg (400-lb) charge of refrigerant and was manufactured in 1992. If it is determined to be economically practicable, this system will be retrofitted in accordance with the DOE 2010 implementation goal.

Y-12 Complex initiatives in support of the DOE objectives have also involved elimination of solvents in cleaning processes. Operations personnel developed and implemented changes in one process which reduced the amount of ODS solvent emissions by up to 8,891 kg (19,600 lb) each year. Evaluation of ODS reduction opportunities continue for another solvent cleaning operation. Future actions related to this process will be dependent on ongoing efforts to identify a safe and viable replacement chemical or to identify practical and cost-effective modifications to process equipment.

Any Class I and Class II substitutions are made in accordance with EPA’s Significant New Alternatives Program (SNAP). Y-12 Complex personnel are notified as EPA issues regulations detailing SNAP replacement chemicals which may be applicable to plant operations. In order to prevent ODS from coming on-site, procurement documents are written to ensure that no additional equipment or processes using Class I ODS are brought onsite, and Class II ODS usage is limited wherever possible.

Infrastructure reduction activities also led to the reduction of ODS materials on site. All refrigerants and solvents must be removed from equipment prior to disposal. Recovered ODS are typically recycled/reused in other equipment in the Y-12 Complex. However, Class I ODS deemed excess must be transferred to Defense Logistics Agency as needed. Remaining ODS are offered to other DOE sites or government agencies, sold, or properly disposed if not useable.

The calculated radiation dose to the maximally exposed off-site individual from airborne radiological release points at Y-12 during 2009 was 0.1 mrem. This dose is well below the NESHAP standard of 10 mrem and is less than 0.04 % of the 300 mrem that the average individual receives from natural sources of radiation. (See Sect. 7.1.2. for an explanation of how the airborne radionuclide dose was determined.)

4.4.1.1.3 Fugitive Particulate Emissions

As Modernization and Infrastructure Reduction efforts increase at the Y-12 Complex, the need also increases for good work practices and controls to minimize fugitive dust emissions from construction and demolition activities. Y-12 Complex personnel continue to use a mature project planning process to review, recommend, and implement appropriate work practices and controls to minimize fugitive dust emissions.

4.4.1.2 Radiological National Emission Standard for Hazardous Air Pollutants

The release of radiological contaminants, primarily uranium, into the atmosphere at the Y-12 Complex occurs almost exclusively as a result of plant production, maintenance, and waste management activities. The major radionuclide emissions contributing to the dose from the Y-12 Complex are the nuclides ^{234}U, ^{235}U, ^{236}U, and ^{238}U, which are emitted as particulates. The particle size and solubility class of the emissions are determined based on review of the operations and processes served by the exhaust systems to determine the quantity of uranium handled in the operation or process, the physical form of the uranium, and the nature of the operation or process. The four categories of processes or operations that are considered in the total of uranium emissions are

- those that exhaust through monitored stacks,
- unmonitored processes for which calculations are performed per Appendix D of 40 CFR 61 (CFR 2009b),
- processes or operations exhausting through laboratory hoods also involving Appendix D calculations, and
- emissions from room ventilation exhausts using radiological control monitoring data from the work area.

Continuous sampling systems are used to monitor emissions from a number of process exhaust stacks at the Y-12 Complex. In addition, a probe-cleaning program is in place, and the results from the probe cleaning at each source are incorporated into the respective emission point source term. In 2009, 41 process exhaust stacks were continuously monitored, 34 of which were major sources; the remaining 7 were minor sources. (Stack US-143 began operation in 2009, and Stack US-011 did not run during 2009.) The sampling systems on these stacks have been approved by EPA Region 4.

During 2009, unmonitored uranium emissions at the Y-12 Complex occurred from 40 emission points associated with on-site, unmonitored processes and laboratories operated by B&W Y-12. Emission estimates for the unmonitored process and laboratory stacks were made using inventory data with emission factors provided in 40 CFR Part 61, Appendix D (CFR 2009b). The Y-12 Complex source term includes an estimate of those unmonitored emissions.

The Analytical Chemistry Organization laboratory, operated by B&W Y-12, is located in a leased facility on Union Valley Road, approximately 0.3 miles east of the Y-12 Complex, and is not within the ORR boundary. In 2009 there were no emission points (or sources) in the laboratory facility.

Additionally, estimates from room ventilation systems are considered using radiological control data on airborne radioactivity concentrations in the work areas. Where applicable, exhausts from any area where the monthly concentration average exceeds 10% of the derived air concentration (DAC), as defined in the Compliance Plan (DOE 2005), are included in the annual source term. Annual average concentrations and design ventilation rates are used to arrive at the annual emission estimate for those areas. Seven emission points from room ventilation exhausts were identified in 2009 where emissions exceeded 10% of the DAC. These emission points feed to monitored stacks and any radionuclide emissions are accounted for as noted for monitored emission points.

The Y-12 Complex Title V Major Source Operating Permits contain a site-wide, streamlined alternate emission limit for enriched and depleted uranium process emission units. A limit of 907 kg (2,000 lb) per year of particulate was set for the sources for the purposes of paying fees. The compliance method defined for Permit 554701, Condition E3, and Permit 554594, Condition E4, requires the annual actual mass emission particulate emissions to be generated using the same monitoring methodologies required for Rad NESHAP compliance. An estimated 0.0081 Ci (0.7 kg) of uranium was released into the atmosphere in 2009 as a result of Y-12 activities (Figs. 4.18 and 4.19).

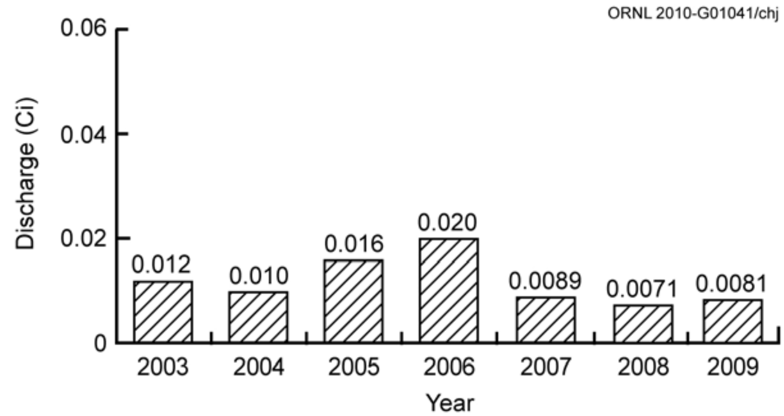


Fig. 4.18. Total curies of uranium discharged from the Y-12 Complex to the atmosphere, 2003–2009 (2009: 8.12E-3 Ci).

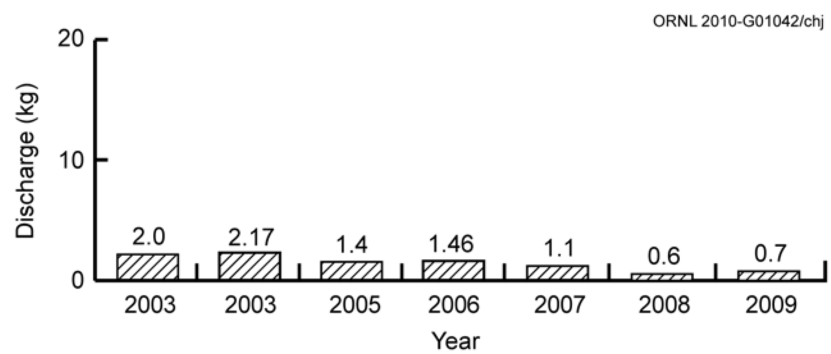


Fig. 4.19. Total kilograms of uranium discharged from the Y-12 Complex to the atmosphere, 2003–2009 (2009: 700 g or 0.7 kg).

4.4.1.3 Quality Assurance

Quality assurance activities for the Rad NESHAP program are documented in Y-12 National Security Complex Quality Assurance Project Plan for National Emission Standards for Hazardous Air Pollutants (NESHAP) for Radionuclide Emission Measurements (Y-12 2005). The plan satisfies the quality assurance (QA) requirements in 40 CFR Part 61, Method 114 (CFR 2007), for ensuring that the radionuclide air emission measurements from the Y-12 Complex are representative to known levels of precision and accuracy and that administrative controls are in place to ensure prompt response when emission measurements indicate an increase over normal radionuclide emissions. The requirements are also referenced in TDEC regulation 1200-3-11-.08. The plan ensures the quality of the Y-12 radionuclide emission measurements data from the continuous samplers, breakthrough monitors, and minor radionuclide release points. It specifies the procedures for the management of the activities affecting the quality of the data. The QA objectives for completeness, sensitivity, accuracy, and precision are discussed. Major programmatic elements addressed in the QA plan are the sampling and monitoring program, emission characterization, the analytical program, and minor source emission estimates.

4.4.1.4 Source-Specific Criteria Pollutants

Proper maintenance and operation of a number of control devices (e.g., HEPA filters, baghouses, and scrubbers) are key to controlling emissions of criteria pollutants. The primary source of criteria pollutants at the Y-12 Complex is the steam plant, where coal and natural gas are burned. Information regarding actual vs. allowable emissions from the steam plant is provided in Table 4.7. The Y-12 Title V operating air permit for the Y-12 Steam Plant requires the opacity monitoring systems to be fully operational 95% of the operational time of the monitored units during each month of the calendar quarter. During 2009, the opacity monitoring systems were operational for more than 95% of the operational time of the monitored units during each month. During 2009, 26, 6-min periods of excess emissions occurred. Quarterly reports of the status of the Y-12 Steam Plant opacity monitors are submitted to TDEC personnel. Table 4.8 is a record of excess emissions and inoperative conditions for the east and west stack opacity monitors for 2009. Visible emission evaluations are also conducted at the steam plant semiannually to demonstrate compliance. The Y-12 Title V operating air permit also requires continuous monitoring of NO_x mass emissions during the ozone season (May 1 through September 30). The cumulative NO_x mass emissions measured from the steam plant for the 2009 ozone season was 114,396 kg (126.1 tons) of NO_x, the limit being 157,850 kg (174 tons), as shown in Fig. 4.20. Boiler 3 was shutdown and its tonnage was removed from the total NO_x limit for the steam plant.

Table 4.7. Actual vs. allowable air emissions from the Oak Ridge Y-12 Steam Plant, 2009

Pollutant	Emissions (tons/year)[a]		Percentage of allowable
	Actual	Allowable	
Particulate	38	945	4.0
Sulfur dioxide	2,337	20,803	11.2
Nitrogen oxides[b]	584.9	5,905	9.9
Nitrogen oxides (ozone season only)	126.1[c]	174	72.5
Volatile organic compounds[b]	3	41	7.3
Carbon monoxide[b]	25	543	4.6

[a] 1 ton = 907.2 kg.

[b] When there is no applicable standard or enforceable permit condition for some pollutants, the allowable emissions are based on the maximum actual emissions calculation as defined in Tennessee Department of Environment and Conservation Rule 1200-3-26-.02(2)(d)3 (maximum design capacity for 8760 h/year). The emissions for both the actual and allowable emissions were calculated based on the latest EPA compilation of air pollutant emission factors. (EPA 1995 and 1998. *Compilation of Air Pollutant Emission Factors AP-42, Fifth Edition, Volume 1: Stationary Point and Area Sources.* Environmental Protection Agency, Research Triangle Park, N.C. January 1995 and September 1998.)

[c] Monitored emissions.

Particulate emissions from point sources result from many operations throughout Y-12. Compliance demonstration is achieved via several activities, including monitoring the operations of control devices, limiting process input materials, and using certified readers to conduct stack-visible emission evaluations.

Emissions of SO_2 are primarily from the combustion of coal at the steam plant. Sulfur in coal is analyzed, and calculations are performed to ensure that emissions remain below permit limits.

Use of Solvent 140 and methanol throughout the complex along with use of acetonitrile at a single source are primary sources of VOC emissions. Material mass balances and engineering calculations are used to determine annual emissions.

The results of monitoring a number of process parameters along with stack-monitoring results are provided in reports to TDEC quarterly, semiannually, and annually. All monitored results, including stack-monitoring results, were provided in reports in 2009 and were in compliance with the Title V permit.

Table 4.8. Periods of excess emissions and out-of-service conditions for Y-12 Steam Plant east and west opacity monitors, 2009

Date	Stack	Condition	Comments
January 26	East	One 6-min period of excess emissions	Due to bad/damaged bags in Compartment 7 of Baghouse 4
July 14	East	One 6-min period of excess emissions	Due to maintenance personnel checking the Boiler 4 ID fan damper system while the fan was running which caused an upset condition of the ductwork system that created the excess emission (opacity)
October 22	East	One 6-min period of excess emissions	Due to initial start-up of the fans on Boiler 4 after an overhaul
October 5	West	One 6-min period of excess emissions	Due to damaged/deteriorated bags in Baghouse 1
October 7	West	One 6-min period of excess emissions	Due to damaged/deteriorated bags in Baghouse 1
October 8	West	Eight 6-min periods of excess emissions	Due to damaged/deteriorated bags in Baghouse 1
October 9	West	Four 6-min periods of excess emissions	Due to damaged/deteriorated bags in Baghouse 1
October 19	West	One 6-min period of excess emissions	Due to damaged/deteriorated bags in Baghouse 1
November 4	West	Five 6-min periods of excess emissions	Due to damaged/deteriorated bags in Baghouse 1
November 5	West	Three 6-min periods of excess emissions	Due to damaged/deteriorated bags in Baghouse 1

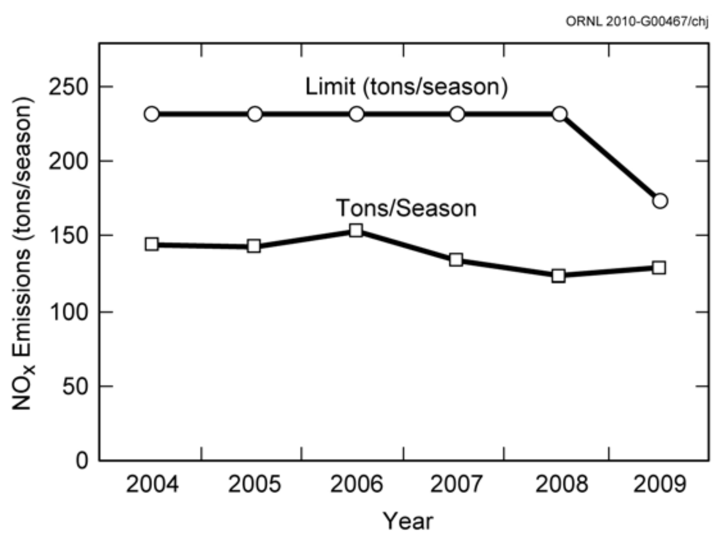


Fig. 4.20. Y-12 steam plant NO_x emissions per ozone season.

4.4.1.5 Quality Control

Calibration error tests of the opacity monitoring systems are performed on a semiannual basis as required by the permit. The calibration error tests for the steam plant opacity monitors were performed two times for both the west and east stack opacity monitors. The first semiannual calibration error tests were conducted on April 11 and 12, 2009, for the west and east opacity monitors, respectively. The second semiannual calibration error tests were conducted on December 12 and 17, 2009, for the west and east opacity monitors, respectively. Both monitors passed the test. The tests were submitted to TDEC staff as proof of the continuous operation of the opacity monitoring systems within acceptable accuracy limits.

The NO_x continuous emissions monitoring systems are operated in conformance with the requirements of 40 CFR 75 (CFR 2010). Requirements include a periodic relative accuracy test audit (RATA) for continuous nitrogen oxides emissions monitoring systems as part of the NO_x Budget Trading Program. A periodic RATA is required once annually, provided that the RATA is conducted after January 1. The periodic RATA for the NO_x analyzers was completed in February and March 2009 for all three boilers. The reports were submitted on April 15, 2009, to TDEC and EPA.

In addition, the NO_x analyzers are calibrated daily under the control of a data logger at a specified time during normal operation (as recorded by the data logger internal clock). On a weekly basis, the subcontractor personnel review the continuous emission monitoring system (CEMS) data reports that are generated on a daily basis by the data acquisition and handling system, including calibration error reports and data summary reports. On a daily basis, subcontractor personnel monitor the CEMS performance via telephone modem. Linearity checks on the NO_x analyzers are conducted on a quarterly basis. The linearity checks are conducted while the unit is combusting fuel at typical duct temperature and pressure. The linearity checks for NO_x analyzers were conducted in April and August 2009, in accordance with 40 CFR 75. The linearity tests were submitted with the NO_x electronic reports.

4.4.1.6 Hazardous Air Pollutants (Nonradiological)

Beryllium emissions from machine shops are regulated under a state-issued permit and are subject to a limit of 10 g per 24 h. Compliance is demonstrated through a one-time stack test and through monitoring of control device operations. Hydrogen fluoride is used at one emission source, and emissions are controlled through the use of scrubber systems. The beryllium control devices and the scrubber systems were monitored during 2009 and found to be operating properly.

Methanol is released as fugitive emissions (e.g., pump and valve leaks) as part of the brine/methanol system. Methanol is subject to state air permit requirements; however, due to the nature of its release (fugitive emissions only), there are no specific emission limits or mandated controls. Mercury is a significant legacy contaminant at the Y-12 Complex, and cleanup is being addressed under the environmental remediation program. Like methanol emissions, mercury air emissions from legacy sources are fugitive in nature and therefore are not subject to specific air emission limits or controls. On-site monitoring of mercury is conducted and is discussed under Sect. 4.4.2, Ambient Air.

Y-12 Steam Plant emissions, due to the combustion of coal, contain hazardous air pollutants such as mercury, hydrogen chloride, and other metals and gaseous hazardous air pollutants. In 2007 the EPA vacated a proposed MACT, which was intended to minimize hazardous air pollution emissions. The Y-12 Steam Plant would have become subject to certain elements of the new rule effective in 2007 had the rule not been vacated. It is anticipated at this time that the new natural-gas-fired steam plant will be on-line in 2010 and that coal will no longer be combusted, prior to the rule becoming effective. In 2007, a case-by-case MACT review was conducted as part of the construction permitting process for the Y-12 replacement steam plant. Specific conditions aimed at minimizing hazardous air pollutant emission from the new steam plant will be incorporated into the operating permit for the new source.

Unplanned releases of hazardous air pollutants are regulated through the Risk Management Planning regulations. Y-12 Complex personnel have determined that there are no processes or facilities containing inventories of chemicals in quantities exceeding thresholds specified in rules pursuant to Clean Air Act, Title III, Sect.112(r), “Prevention of Accidental Releases.” Therefore, the Y-12 Complex is not subject to that rule. Procedures are in place to continually review new processes and/or process changes against the rule thresholds.

4.4.2 Ambient Air

To understand the complete picture of ambient air monitoring in and around the Y-12 Complex, data from monitoring conducted on and off site specifically for Y-12, DOE reservation-wide monitoring, and on-site and off-site monitoring conducted by TDEC personnel must be considered. There are no federal regulations, state regulations, or DOE orders that require ambient air monitoring within the Y-12 Complex boundary; however, on-site ambient air monitoring for mercury and radionuclides is conducted as a best management practice. With the reduction of plant operations and improved emission and administrative controls, levels of measured pollutants have decreased significantly during the past several years. In addition, major processes that result in emission of enriched and depleted uranium are equipped with stack samplers that have been reviewed and approved by EPA to meet requirements of the NESHAP regulations.

4.4.2.1 Mercury

The Y-12 Complex ambient air monitoring program for mercury was established in 1986 as a best management practice. The objectives of the program have been to maintain a database of mercury concentrations in ambient air, to track long-term spatial and temporal trends in ambient mercury vapor, and to demonstrate protection of the environment and human health from releases of mercury to the atmosphere at Y-12. Originally, four monitoring stations were operated at Y-12, including two within the former mercury-use area near the west end of Y-12. The two atmospheric mercury monitoring stations currently operating at Y-12, Ambient Air Station No. 2 (AAS2) and Ambient Air Station No. 8 (AAS8), are located near the east and west boundaries of Y-12, respectively (Fig. 4.21). Since their establishment in 1986, AAS2 and AAS8 have monitored mercury in ambient air continuously with the exception of short intervals of downtime because of electrical or equipment outages. In addition to the monitoring stations located at Y-12, a control or reference site (Rain Gauge No. 2) was operated on Chestnut Ridge in the Walker Branch Watershed for a 20-month period in 1988 and 1989 to establish a reference concentration.

In order to determine mercury concentrations in ambient air, airborne mercury vapor is collected by pulling ambient air through a sampling train consisting of a Teflon filter and an iodated-charcoal sampling trap. A flow-limiting orifice upstream of the sampling trap restricts airflow through the sampling train to ~1 L/min. Actual flows are measured weekly with a calibrated Gilmont flowmeter in conjunction with the weekly change-out of the sampling trap. The charcoal in each trap is analyzed for total mercury using cold vapor atomic fluorescence spectrometry after acid digestion. The average concentration of mercury vapor in ambient air for each 7-day sampling period is calculated by dividing the total mercury per trap by the volume of air pulled through the charcoal trap during the corresponding sampling period.

As reported previously, the average mercury concentration at the ambient air monitoring sites has declined significantly since the late 1980s. Recent average annual concentrations at the two boundary stations are comparable to concentrations measured in 1988 and 1989 at the Chestnut Ridge reference site (Table 4.9). The average mercury concentration at the AAS2 site for 2009 was 0.0030 µg/m^3 (N = 50; S.E. = ±0.0002), comparable to the previous year of 0.0029 µg/m^3. After noting a gradual increase in average annual concentration at AAS8 for the period 2005 through 2007 (thought to be perhaps due to increased excavation and decontamination and decommissioning work on the west end during this period), the average concentration at AAS8 for 2009 was 0.0041 µg/m^3 (N = 49; SE = 0.0002) or similar to levels recorded in 2008 and prior to 2005.

Table 4.9 summarizes the 2009 mercury results and results from the 1986 through 1988 period for comparison. Figure 4.22 illustrates temporal trends in mercury concentration for the two active mercury monitoring sites since the inception of the program in 1986 through 2009 (plots 1, 2) and seasonal trends at AAS8 from 1993 through 2009 (plot 3). The dashed line superimposed on plots 1 and 2 is the EPA reference concentration (RfC) of 0.3 µg/m^3 for chronic inhalation exposure. The large increase in Hg concentration at AAS8 observed in the late 1980s (plot 2) was thought to be related to disturbances of Hg-contaminated soils and sediments during the Perimeter Intrusion Detection Assessment System and utility restoration projects under way then. In plot 3, a monthly moving average has been superimposed over the AAS8 data to highlight seasonal trends in mercury at AAS8 from January 1993 through 2008.

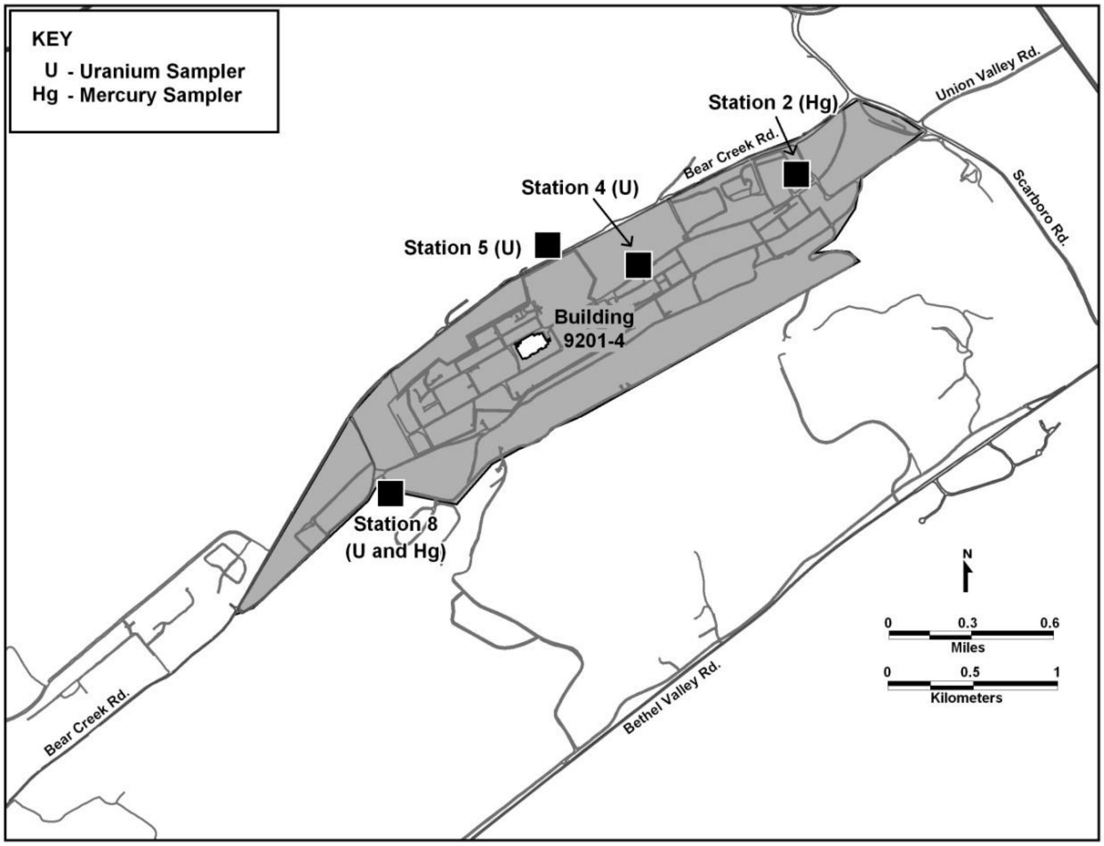


Fig. 4.21. Locations of ambient air monitoring stations at the Y-12 Complex.

Table 4.9. Summary of data for the Oak Ridge Y-12 National Security Complex mercury in ambient air monitoring program, 2009

Ambient air monitoring stations	Mercury vapor concentration (µg/m^3)			
	2009 average	2009 maximum	2009 minimum	1986–1988[a] average
AAS2 (east end of the Y-12 Complex)	0.0030	0.0058	0.0011	0.010
AAS8 (west end of the Y-12 Complex)	0.0041	0.0099	0.0017	0.033
Reference Site, Rain Gauge No.2 (1988[b])	N/A	N/A	N/A	0.006
Reference Site, Rain Gauge No.2 (1989[c])	N/A	N/A	N/A	0.005

[a] Period in late 1980s with elevated ambient air Hg levels.
[b] Data for period from February 9 through December 31, 1988.
[c] Data for period from January 1 through October 31, 1989.

In conclusion, 2009 average mercury concentrations at the two mercury monitoring sites are comparable to reference levels measured for the Chestnut Ridge reference site in 1988 and 1989. Measured concentrations continue to be well below current environmental and occupational health standards for inhalation exposure to mercury vapor, that is, the National Institute for Occupational Safety and Health recommended exposure limit of 50 µg/m^3 (time-weighted average or TWA for up to a 10-h workday, 40-h workweek), the American Conference of Governmental Industrial Hygienists workplace threshold limit value of 25 µg/m^3 as a TWA for a normal 8-h workday and 40-h workweek, and the current EPA reference concentration (RfC = 0.3 μg/m^3) for elemental mercury for daily inhalation exposure without appreciable risk of harmful effects during a lifetime.

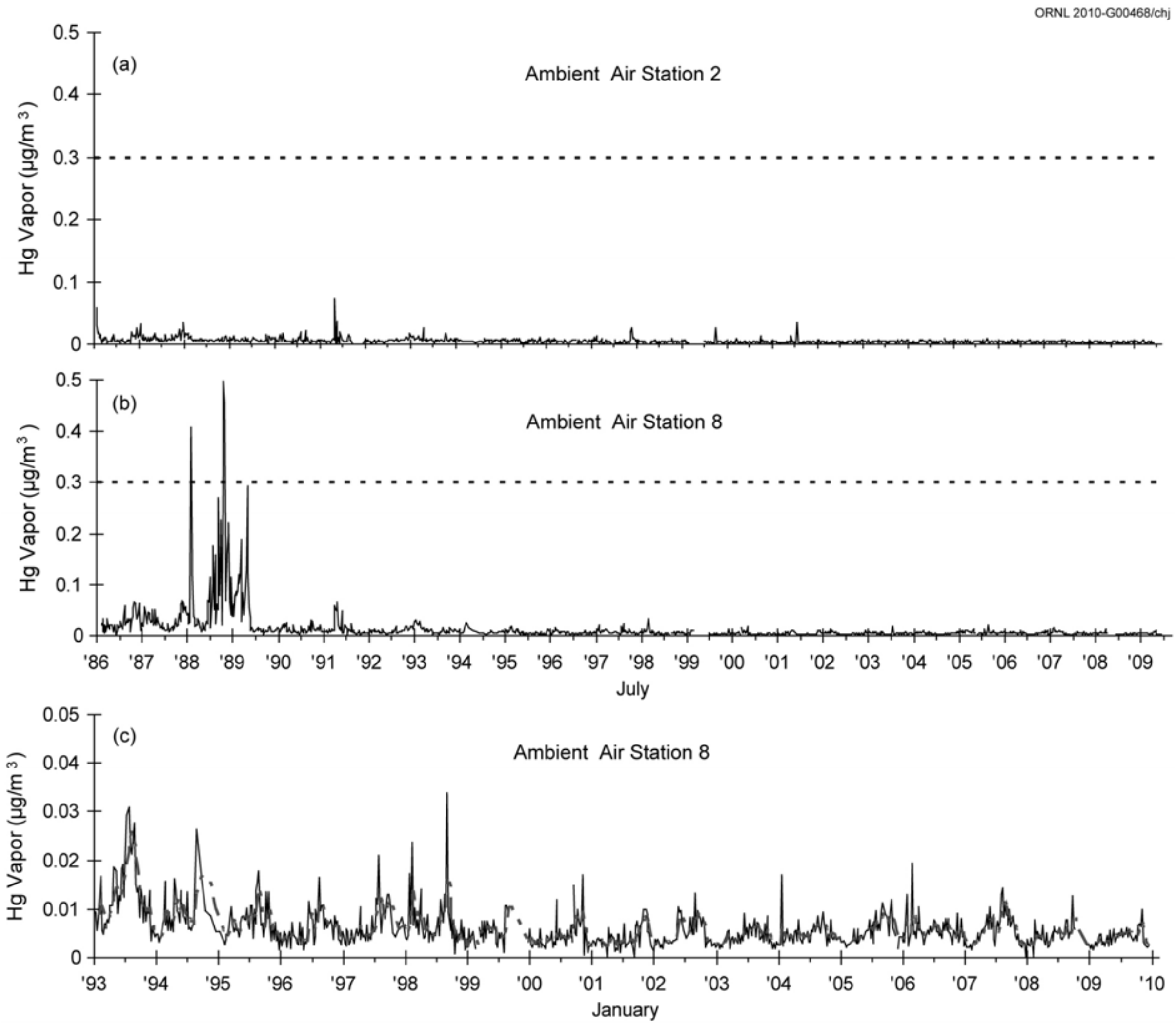


Fig. 4.22. Temporal trends in mercury vapor concentration for the boundary monitoring stations at the Y-12 National Security Complex, July 1986 to January 2010 (plots 1 and 2) and January 1993 to January 2010 for AAS8 (plot 3).

4.4.2.2 Quality Control

A number of QA/QC steps are taken to ensure the quality of the data for the Y-12 mercury in ambient air monitoring program.

An hour meter records the actual operating hours between sample changes. This allows for correction of total flow in the event of power outages during the weekly sampling interval.

The Gilmont correlated flowmeter used for measuring flows through the sampling train is shipped back to the manufacturer annually for calibration traceable to the National Institute of Standards and Technology.

A minimum of 5% of the samples in each batch submitted to the analytical laboratory are blank samples. The blank sample traps are submitted "blind" to verify trap blank values and to serve as a field blank for diffusion of mercury vapor into used sample traps during storage prior to analysis.

In order to verify the absence of mercury breakthrough, 5 to 10% of the field samples have the front (upstream) and back segments of the charcoal sample trap analyzed separately. The absence of mercury above blank values on the back segment confirms the absence of breakthrough.

Chain-of-custody forms track the transfer of sample traps from the field technicians all the way to the analytical laboratory.

A field performance evaluation is conducted annually by the project manager to ensure that proper procedures are followed by the sampling technicians. No issues were identified in the last evaluation conducted March 25, 2009.

Analytical QA/QC requirements include

- use of prescreened and/or laboratory purified reagents,
- analysis of at least two method blanks per batch,
- analysis of standard reference materials,
- analysis of laboratory duplicates (one per 10 samples; any laboratory duplicates differing by more than 10% at five or more times the detection limit are to be rerun [third duplicate] to resolve the discrepancy), and
- archival of all primary laboratory records for at least 1 year.

4.4.2.3 Ambient Air Monitoring Complementary to the Y-12 Ambient Air Monitoring

Ambient air monitoring is conducted at multiple locations near the ORR to measure radiological and other selected parameters directly in the ambient air. These monitors are operated in accordance with DOE orders. Their locations were selected so that areas of potentially high exposure to the public are monitored continuously for parameters of concern. This monitoring provides direct measurement of airborne concentrations of radionuclides and other hazardous air pollutants, allows facility personnel to determine the relative level of contaminants at the monitoring locations during an emergency, verifies that the contributions of fugitive and diffuse sources are insignificant, and serves as a check on dose-modeling calculations. As part of the ORR network, an ambient air monitoring station located in the Scarboro Community of Oak Ridge (Station 46) measures off-site impacts of the Y-12 operations. This station is located near the theoretical area of maximum public pollutant concentrations as calculated by air-quality modeling. ORR network stations are also located at the east end of the Y-12 Complex (Station 40) and just south of the Country Club Estates neighborhood (Station 37).

The state of Tennessee is primarily responsible for ambient air monitoring to characterize the region in general and to characterize and monitor DOE operations specifically. This is accomplished in numerous ways. Specific to Y-12 operations, there are three uranium ambient air monitors within the Y-12 Complex boundary that, since 1999, have been utilized by TDEC personnel in their environmental monitoring program. Each of the monitors uses 47-mm borosilicate glass-fiber filters to collect particulates as air is pulled through the units. The monitors control airflow with a pump and rotometer set to average approximately 2 standard cubic feet per minute.

In addition, TDEC DOE Oversight Division air quality monitoring includes several other types of monitoring on the ORR, for example,

- RADNet air monitoring,
- fugitive radioactive air emission monitoring,
- ambient VOC air monitoring,
- perimeter air monitoring,
- real-time monitoring of gamma radiation,
- ambient gamma radiation monitoring using external dosimetry, and
- program-specific monitoring associated with infrastructure-reduction activities.

Results of these activities are summarized in annual status reports, which are issued by the TDEC DOE Oversight Division.

The state of Tennessee also operates a number of regional monitors to assess ambient concentrations of criteria pollutants such as sulfur dioxide, particulate (various forms), and ozone, for comparison against ambient standards. The results are summarized and available through EPA and state reporting mechanisms.

4.5 Surface Water Program

4.5.1 NPDES Permit and Compliance Monitoring

The current Y-12 NPDES permit (TN0002968) requires sampling, analysis, and reporting for approximately 65 outfalls. Major outfalls are noted in Fig. 4.23. The number is subject to change as outfalls are eliminated or consolidated or if permitted discharges are added. Currently, the Y-12 Complex has outfalls and monitoring points in the following water drainage areas: East Fork Poplar Creek, Bear Creek, and several tributaries on the south side of Chestnut Ridge, all of which eventually drain to the Clinch River.

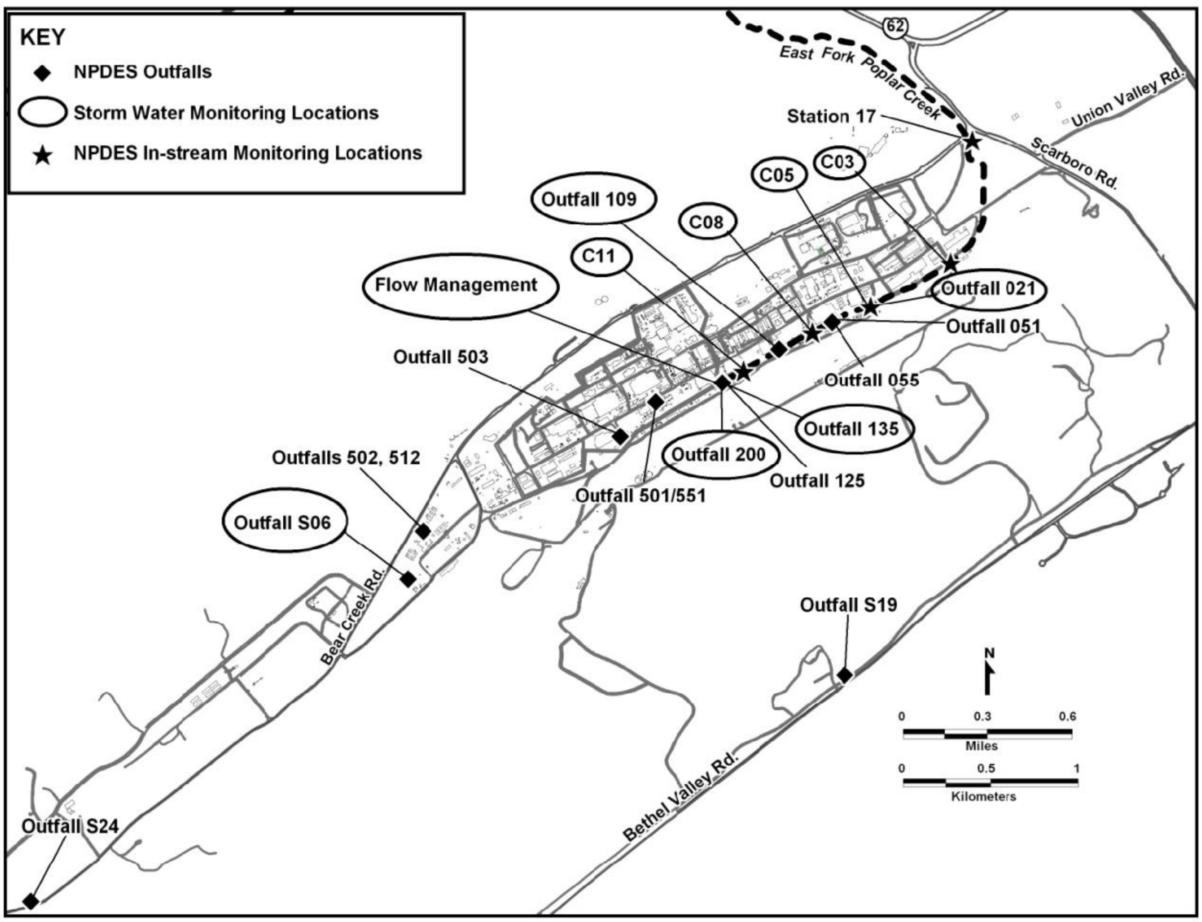


Fig. 4.23. Major Y-12 Complex National Pollutant Discharge Elimination System (NPDES) outfalls and storm water monitoring locations.

Discharges to surface water allowed under the permit include storm drainage, cooling water, cooling tower blowdown, steam condensate, and treated process wastewaters, including effluents from wastewater treatment facilities. Groundwater inflow into sumps in building basements and infiltration to the storm drain system are also permitted for discharge to the creek. The monitoring data collected by the sampling and analysis of permitted discharges are compared with NPDES limits where applicable for each parameter. Some parameters, defined as “monitor only,” have no specified limits.

The water quality of surface streams in the vicinity of the Y-12 Complex is affected by current and legacy operations. Discharges from the Y-12 Complex processes flow into East Fork Poplar Creek before the water exits the Y-12 Complex. East Fork Poplar Creek eventually flows through the City of Oak Ridge to Poplar Creek and into the Clinch River. Bear Creek water quality is affected by area source runoff and groundwater discharges. The NPDES permit requires regular monitoring and storm water characterization in Bear Creek and several of its tributaries.

Requirements of the NPDES permit for 2009 were satisfied and monitoring of outfalls and instream locations indicated excellent compliance. Data obtained as part of the NPDES program are provided in a monthly report to the TDEC. The percentage of compliance to the permit for 2009 was >99.9%. The only 2009 NPDES permit excursion occurred when the measured cadmium monthly average at Outfall 200, 0.00162 mg/L, exceeded the permit limit of 0.001 mg/L on April 4, 2009. At the time of the reading, there were no observed adverse effects on the receiving stream.

Dechlorination treatment in the upper reach of EFPC provided excellent control of chlorinated discharges, and toxicity testing results of three outfalls in the upper reach have shown no toxicity. Table 4.10 lists the NPDES compliance monitoring requirements and the 2009 compliance record.

4.5.2 Radiological Monitoring Plan and Results

A radiological monitoring plan is in place at the Y-12 Complex to address compliance with DOE orders and NPDES Permit TN002968. The permit requires the Y-12 Complex to submit results from the radiological monitoring plan quarterly as an addendum to the NPDES discharge monitoring report. There were no discharge limits set by the NPDES permit for radionuclides; the requirement is to monitor and report. The radiological monitoring plan was developed based on an analysis of operational history, expected chemical and physical relationships, and historical monitoring results. Under the existing plan, effluent monitoring is conducted at three types of locations: (1) treatment facilities, (2) other point-source and area-source discharges, and (3) instream locations. Operational history and past monitoring results provide a basis for parameters routinely monitored under the plan (Table 4.11). The current *Radiological Monitoring Plan for Y-12 Complex* (Y-12 2006) was last revised and reissued in June 2006.

Radiological monitoring during storm water events is accomplished as part of the storm water monitoring program. Uranium is monitored at three major East Fork Poplar Creek storm water outfalls, four instream monitoring locations as well as raw water flow, and at an instream outfall on Bear Creek. Results of storm event monitoring during 2009 were reported in *Annual Storm Water Report for the Y-12 National Security Complex* (B&W Y-12 2010), which was issued in January 2010. In addition, the monthly 7-day composite sample for radiological parameters taken at Station 17 on East Fork Poplar Creek likely includes rain events.

Radiological monitoring plan locations sampled in 2009 are noted in Fig. 4.24. Table 4.12 identifies the monitored locations, the frequency of monitoring, and the sum of the percentages of the derived concentration guidelines (DCGs) for radionuclides measured in 2009. Radiological data were well below the allowable DCGs.

In 2009, the total mass of uranium and associated curies released from the Y-12 Complex at the easternmost monitoring station, Station 17 on Upper East Fork Poplar Creek, was 187 kg or 0.067 Ci (Table 4.13). Figure 4.25 illustrates a 5-year trend of these releases. The total release is calculated by multiplying the average concentration (grams per liter) by the average flow (million gallons per day). Converting units and multiplying by 365 days per year yields the calculated discharge. The increase in uranium quantity in 2009 may be the result of higher rainfall and subsequent movement of sediment and runoff from surfaces such as rooftops.

The Y-12 Complex is permitted to discharge domestic wastewater to the City of Oak Ridge's publicly owned treatment works. Radiological monitoring of the sanitary sewer system discharge is conducted and reported to the City of Oak Ridge, although there are no city-established radiological limits. Potential sources of radionuclides discharging to the sanitary sewer have been identified in previous studies at the Y-12 Complex as part of an initiative to meet the "as low as reasonably achievable" goals. Results of radiological monitoring are reported to the City of Oak Ridge in a quarterly monitoring report.

Table 4.10. NPDES compliance monitoring requirements and record for the Y-12 Complex, January through December 2009

Discharge point	Effluent parameter	Daily avg (lb/d)	Daily max (lb/d)	Daily avg (mg/L)	Daily max (mg/L)	Percentage of compliance	Number of samples
Outfall 501 (Central Pollution Control)	pH, standard units			*a*	9.0	*b*	0
	Total suspended solids			31.0	40.0	*b*	0
	Total toxic organic				2.13	*b*	0
	Hexane extractables			10	15	*b*	0
	Cadmium	0.16	0.4	0.075	0.15	*b*	0
	Chromium	1.0	1.7	0.5	1.0	*b*	0
	Copper	1.2	2.0	0.5	1.0	*b*	0
	Lead	0.26	0.4	0.1	0.2	*b*	0
	Nickel	1.4	2.4	2.38	3.98	*b*	0
	Nitrate/Nitrite				100	*b*	0
	Silver	0.14	0.26	0.05	0.05	*b*	0
	Zinc	0.9	1.6	1.48	2.0	*b*	0
	Cyanide	0.4	0.72	0.65	1.20	*b*	0
	PCB				0.001	*b*	0
Outfall 502 (West End Treatment Facility)	pH, standard units			*a*	9.0	100	4
	Total suspended solids	19	36.0	31.0	40.0	100	4
	Total toxic organic				2.13	100	1
	Hexane extractables			10	15	100	4
	Cadmium	0.16	0.4	0.075	0.15	100	4
	Chromium	1.0	1.7	0.5	1.0	100	4
	Copper	1.2	2.0	0.5	1.0	100	4
	Lead	0.26	0.4	0.10	0.20	100	4
	Nickel	1.4	2.4	2.38	3.98	100	4
	Nitrate/Nitrite				100	100	4
	Silver	0.14	0.26	0.05	0.05	100	4
	Zinc	0.9	1.6	1.48	2.0	100	4
	Cyanide	0.4	0.72	0.65	1.20	100	4
	PCB				0.001	100	1
Outfall 503 (West End Treatment Facility)	pH, standard units			*a*	9.0	*b*	0
	Total suspended solids	125	417	30.0	40.0	*b*	0
	Hexane extractables	63	83.4	10	15	*b*	0
	Iron	20.8	20.8	5.0	5.0	*b*	0
	Cadmium	0.16		0.075	0.15	*b*	0
	Chromium	0.8	0.8	0.20	0.20	*b*	0
	Copper	4.17	4.17	0.20	0.40	*b*	0
	Lead			0.10	0.20	*b*	0
	Zinc	4.17	4.17	1.0	1.0	*b*	0

Table 4.10 (continued)

Discharge point	Effluent parameter	Daily avg (lb/d)	Daily max (lb/d)	Daily avg (mg/L)	Daily max (mg/L)	Percentage of compliance	Number of samples
Outfall 512 (Groundwater Treatment Facility)	pH, standard units			*a*	9.0	100	12
	PCB				0.001	100	4
Outfall 520	pH, standard units			*a*	9.0	b	0
Outfall 200 (North/South pipes)	pH, standard units			*a*	9.0	100	55
	Hexane extractables			10	15	100	53
	Cadmium			0.001	0.025	92	12
	Lead			0.041	1.190	100	12
	PCB			0.002	0.002	100	4
Outfall 550	pH, standard units			*a*	9.0	*b*	0
	Mercury			0.002	0.004	*b*	0
Outfall 551	pH, standard units			*a*	9.0	100	52
	Mercury			0.002	0.004	100	52
Outfall 051	pH, standard units			*a*	9.0	100	12
Outfall 135	pH, standard units			*a*	9.0	100	14
	Lead			0.04	1.190	100	12
	PCB			0.002	0.002	100	4
Outfall 125	pH, standard units			*a*	9.0	100	12
	Cadmium			0.001	0.025	100	12
	Lead			0.04	1.190	100	12
	PCB			0.002	0.002	100	4
Outfall 055	pH, standard units			*a*	9.0	100	14
	Mercury				0.004	100	52
	Total Residual Chlorine				0.5	100	8
Outfall 109	pH, standard units			*a*	9.0	100	7
	Total Residual Chlorine				0.5	100	6
Outfall 021	pH, standard units			*a*	9.0	100	5
	Total Residual Chlorine				0.188	100	4
Outfall 077	pH, standard units			*a*	9.0	b	0
Outfall EFP	pH, standard units			*a*	9.0	100	210

Table 4.10 (continued)

Discharge point	Effluent parameter	Daily avg (lb/d)	Daily max (lb/d)	Daily avg (mg/L)	Daily max (mg/L)	Percentage of compliance	Number of samples
Outfall C11	pH, standard units			*a*	9.0	100	27
	Total residual chlorine				0.019	100	26
	Temperature (°C)				30.5	100	27
Outfall S06	pH, standard units			*a*	9.0	100	2
Outfall S19	pH, standard units			*a*	9.0	100	1
Outfall S24	pH, standard units			*a*	9.0	100	5
Category I outfalls	pH, standard units			*a*	9.0	100	20
Category II outfalls	pH, standard units			*a*	9.0	100	29
	Total Residual Chlorine				0.5	100	28
Category III outfalls	pH, standard units			*a*	9.0	100	10
	Total residual chlorine				0.5	100	10

[a] Not applicable.
[b] No discharge.

Table 4.11. Radiological parameters monitored at the Y-12 Complex, 2009

Parameters	Specific isotopes	Rationale for monitoring
Uranium isotopes	^{238}U, ^{235}U, ^{234}U, total U, weight % ^{235}U	These parameters reflect the major activity, uranium processing, throughout the history of Y-12 and are the dominant detectable radiological parameters in surface water
Fission and activation products	^{90}Sr, ^{3}H, ^{99}Tc, ^{137}Cs	These parameters reflect a minor activity at Y-12, processing recycled uranium from reactor fuel elements, from the early 1960s to the late 1980s, and will continue to be monitored as tracers for beta and gamma radionuclides, although their concentrations in surface water are low
Transuranium isotopes	^{241}Am, ^{237}Np, ^{238}Pu,$^{239/240}$Pu	These parameters are related to recycle uranium processing. Monitoring has continued because of their half-lives and presence in groundwater
Other isotopes of interest	^{232}Th, ^{230}Th, ^{228}Th, ^{226}Ra, ^{228}Ra	These parameters reflect historical thorium processing and natural radionuclides necessary to characterize background radioisotopes

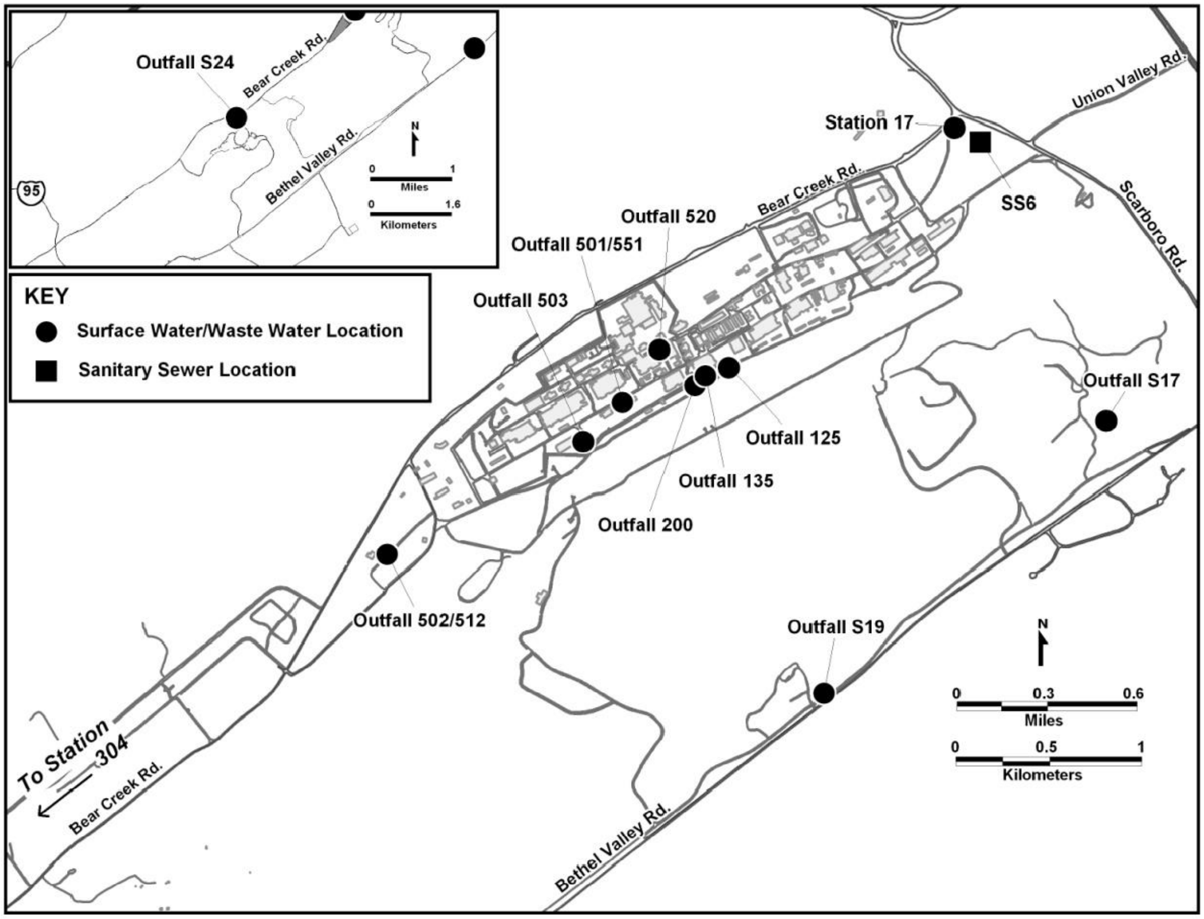


Fig. 4.24. Surface water and sanitary sewer radiological sampling locations at the Y-12 Complex.

4.5.3 Storm Water Pollution Prevention

The development and implementation of a storm water pollution prevention plan at the Y-12 Complex is designed to minimize the discharge of pollutants in storm water runoff. The plan identifies areas that can reasonably be expected to contribute contaminants to surface water bodies via storm water runoff and describes the development and implementation of storm water management controls to reduce or eliminate the discharge of such pollutants. This plan requires (1) characterization of storm water by sampling during storm events, (2) implementation of measures to reduce storm water pollution, (3) facility inspections, and (4) employee training.

The NPDES permit defines the primary function of the Y-12 Complex to be a fabricated metal products industry. However, it also requires that storm water monitoring be conducted for three additional sectors: scrap/waste recycling activities; landfill and land application activities; and discharges associated with treatment, storage and disposal facilities as they are defined in the Tennessee Storm Water Multi Sector General Permit for Industrial Activities (TNR050000). Each sector has prescribed cut-off concentration values and some have defined sector mean values. The “rationale” portion of the NPDES permit for the Y-12 Complex states “cut-off concentrations were developed by the EPA and the state of Tennessee and are based on data submitted by similar industries for the development of the multi-sector general storm water permit. The cut-off concentrations are target values and should not be construed to represent permit limits.” Similarly, sector mean values are defined as “a pollutant concentration calculated from all sampling results provided from facilities classified in this sector during the previous term limit.”

Table 4.12. Summary of Y-12 Complex Radiological Monitoring Plan sample requirements[a] and 2009 results

Outfall no.	Location	Sample frequency	Sample type	Sum of DCG percentage
	Y-12 Complex wastewater treatment facilities			
501	Central Pollution Control Facility	1/month	Composite during batch operation	No flow
502	West End Treatment Facility	1/batch	24-h composite	1.4
503	Steam Plant Wastewater Treatment Facility	4/year	24-h composite	No flow
512	Groundwater Treatment Facility	4/year	24-h composite	4.2
520	Steam condensate	1/year	Grab	No flow
551	Central Mercury Treatment Facility	4/year	24-h composite	0
	Other Y-12 Complex point and area source discharges			
125	Outfall 125	4/year	24-h composite	5.8
135	Outfall 135	4/year	24-h composite	0
S17	Kerr Hollow Quarry	1/year	24-h composite	0
S19	Rogers Quarry	1/year	24-h composite	1.1
	Y-12 Complex instream locations			
S24	Outfall S24	4/year	7-day composite	5.7
Station 17	East Fork Poplar Creek, complex exit (east)	1/month	7-day composite	0
200	North/south pipes	1/month	24-h composite	4.0
	Y-12 Complex Sanitary Sewer			
SS6	East End Sanitary Sewer Monitoring Station	1/week	7-day composite	8

[a] The *Radiological Monitoring Plan* was last updated in June 2006.

Table 4.13. Release of uranium from the Y-12 Complex to the off-site environment as a liquid effluent, 2005–2009

Year	Quantity released	
	Ci[a]	kg
	Station 17	
2005	0.043	93
2006	0.050	131
2007	0.036	70
2008	0.046	75
2009	0.067	187

[a] 1 Ci = 3.7E+10 Bq.

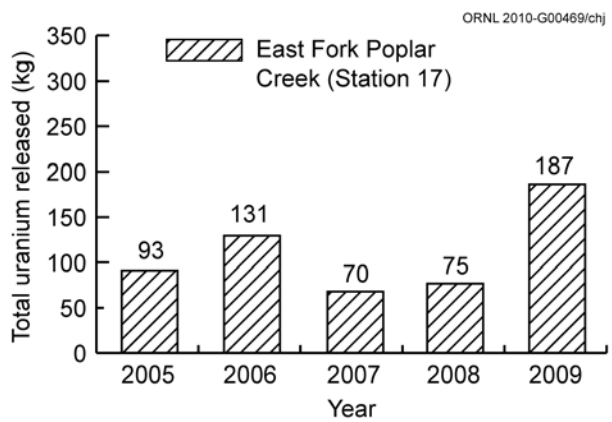


Fig. 4.25. Five-year trend of Y-12 Complex release of uranium to East Fork Poplar Creek.

Storm water sampling was conducted for 2009 during rain events that occurred in August, September, and October. Results were published in the *Annual Storm Water Report for the Y-12 National Security Complex* (B&W Y-12 2010), which was submitted to the Division of Water Pollution Control in January 2010. Per the NPDES permit, storm water monitoring is performed each year for sector outfalls, three major outfalls that drain large areas of the Y-12 Complex, raw water flow, and four instream monitoring locations on East Fork Poplar Creek (Fig. 4.23). The permit also calls for sampling of stream baseload sediment that is being transported due to the heavy flow. Sediment sampling is performed at the four instream locations.

In general, results of storm water monitoring in 2009 indicated improvement in the quality of storm water exiting the Y-12 Complex. Results of sediment sampling, while inconclusive, did indicate reduction of levels of PCBs at all instream sampling locations.

4.5.4 Flow Management (or Raw Water)

Because of concern about maintaining water quality and stable flow in the upper reaches of East Fork Poplar Creek, the NPDES permit requires the addition of Clinch River water to the headwaters of East Fork Poplar Creek (North/South Pipe–Outfall 200 area) so that a minimum flow of 26 million liters (7 million gal) per day is maintained at the point where East Fork Poplar Creek leaves the reservation (Station 17). With the completion of the project, instream water temperatures decreased by approximately 5°C (from approximately 26°C at the headwaters).

A request to modify the NPDES permit to allow the minimum flow, measured at Station 17, to be reduced to 19 million liters (5 million gal) per day was made, and on December 30, 2008, TDEC modified the permit. The modified permit requires 19 million liters (5 million gal) rather than 26 million liters (7 million gal) minimum daily flow as measured at the Station 17 location. In addition to water conservation, this action offers the potential benefit of reducing the transport of mercury from a contaminated section of the streambed.

During 2009 DOE and B&W Y-12 personnel were in discussion with City of Oak Ridge water system management regarding modification of the raw water supply system for EFPC. A design proposal for modification has been prepared. The proposed new control system will allow Y-12 to reduce total flow to the 19 million liters (5 million gal) per day, maintain a more consistent flow during rain events, and provide more flexibility.

4.5.5 Y-12 Complex Ambient Surface Water Quality

To monitor key indicators of water quality, a network of real-time monitors located at three instream locations along Upper East Fork Poplar Creek is used. The Surface Water Hydrological Information Support System (SWHISS) is available for real-time water quality measurements, such as pH, temperature, dissolved oxygen, conductivity, and chlorine. The locations are noted in Fig. 4.26. The primary function of the SWHISS is to provide an indication of potential adverse conditions that could be causing an impact on the quality of water in Upper East Fork Poplar Creek. It is operated as a best management practice.

Additional sampling of springs and tributaries is conducted in accordance with the Y-12 Groundwater Protection Program to monitor trends throughout the three hydrogeologic regimes (see Sect. 4.6).

4.5.6 Industrial Wastewater Discharge Permit

The Industrial and Commercial User Wastewater Discharge Permit No. 1-91 provides requirements for the discharge of wastewaters to the sanitary sewer system as well as prohibitions for certain types of wastewaters. It prescribes requirements for monitoring certain parameters at the East End Sanitary Sewer Monitoring Station. Limitations are set in the permit for most parameters. Samples for gross alpha, gross beta, and uranium are taken by a weekly 24-h composite sample. The sample is analyzed for uranium if the alpha and beta values exceed certain levels. Other parameters (including metals, oil and grease, solids, and biological oxygen demand) are monitored on a monthly basis. Organic parameters are monitored once per quarter. Results of compliance sampling are reported quarterly. Flow is measured 24 h per day at the monitoring station.

As part of the City of Oak Ridge’s pretreatment program, city personnel use the monitoring station to conduct compliance monitoring as required by the pretreatment regulations. City personnel also conduct twice yearly compliance inspections. Monitoring results during 2009 (Table 4.14) indicated four exceedances of permit limits. One was for exceedance of permit limits (monthly average) for nickel. The other three were for exceedance of the permit limit for maximum daily flow.

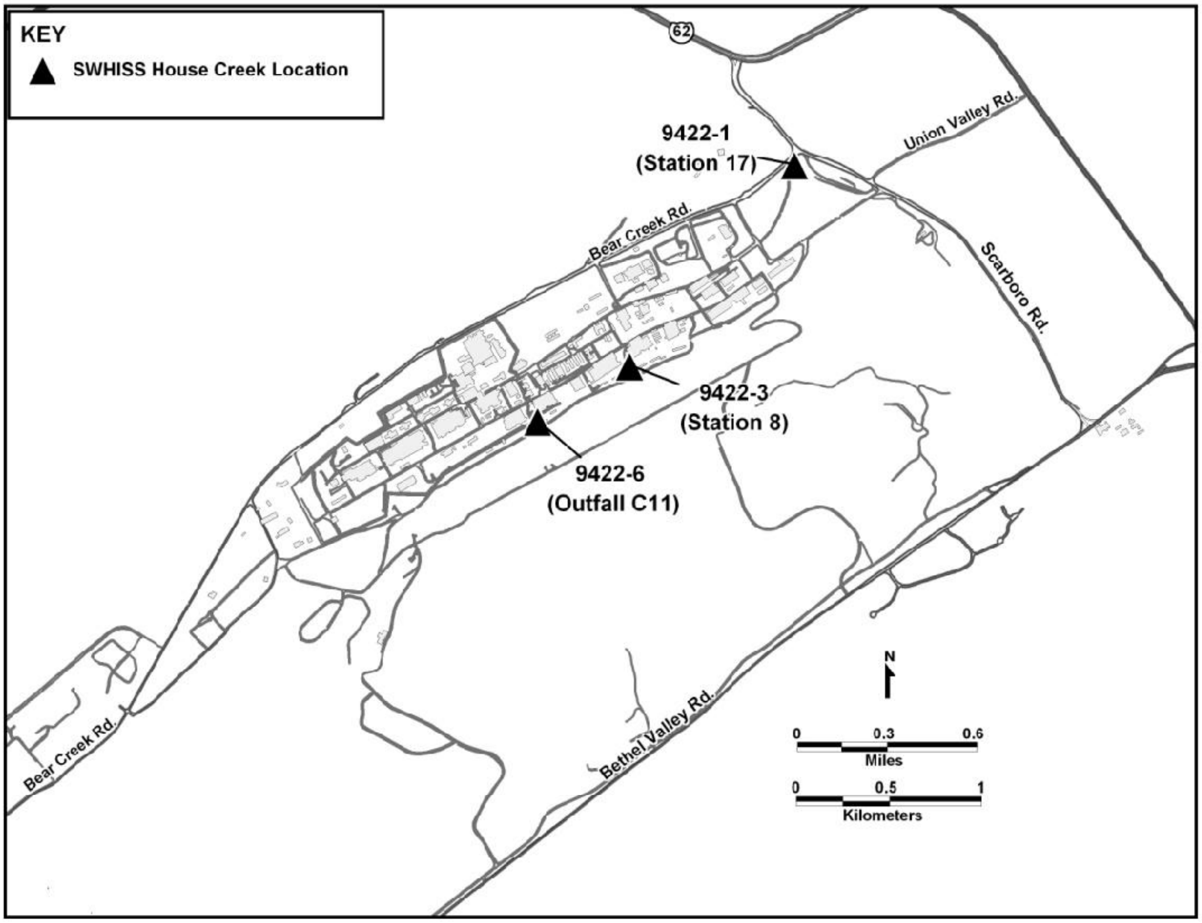


Fig. 4.26. Surface Water Hydrological Information Support System (SWHISS) monitoring locations.

Over the last several years Y-12 personnel have conducted flow monitoring at key locations of the sanitary sewer system during wet and dry weather conditions. This effort has enabled a determination to be made of the general areas of the system most likely to contribute the greatest volume of infiltration or inflow of extraneous water into the lines. Examination of the data in 2009 led to the conclusion that inflow of surface water was the major contributor, and in November 2009, a plan was developed to conduct smoke tests of the lines to locate specific inflow problems. This work will be initiated in 2010.

4.5.7 Quality Assurance/Quality Control

The Environmental Monitoring Management Information System (EMMIS) is used to manage surface water monitoring data. EMMIS uses standard sample definitions to ensure that samples are taken at the correct location at a specified frequency using the correct sampling protocol.

Field sampling QA encompasses many practices that minimize error and evaluate sampling performance. Some key quality practices include the following:

- use of standard operating procedures for sample collection and analysis;
- use of chain-of-custody and sample identification, customized chain-of-custody documents, and sample labels provided by EMMIS;
- instrument standardization, calibration, and verification;
- sample technician training;

- sample preservation, handling, and decontamination; and
- use of QC samples, such as field and trip blanks, duplicates, and equipment rinses.

Table 4.14. Y-12 Complex Discharge Point SS6, Sanitary Sewer Station 6, January through December 2009 compliance status

Effluent parameter	Number of samples	Daily average value (effluent limit)[a]	Daily maximum value (effluent limit)[b]	Percentage of compliance
Flow, mgd	366	NA	1.4	99
pH, standard units	12	NA	9/6[c]	100
Silver	12	0.05	0.1	100
Arsenic	12	0.01	0.015	100
Biochemical oxygen demand	13	200	300	100
Cadmium	12	0.0033	0.005	100
Chromium	12	0.05	0.075	100
Copper	12	0.14	0.21	100
Cyanide	12	0.041	0.062	100
Iron	12	10	15	100
Mercury	12	0.023	0.035	100
Kjeldahl nitrogen	12	45	90	100
Nickel	12	0.021	0.032	99
Oil and grease	12	25	50	100
Lead	12	0.049	0.074	100
Phenols—total recoverable	12	0.3	0.5	100
Suspended solids	12	200	300	100
Zinc	12	0.35	0.75	100

[a] Units in milligrams per liter unless otherwise indicated.
[b] Industrial and Commercial Users Wastewater Permit limits.
[c] Maximum value/minimum value.

Surface water data are entered directly by the analytical laboratory into the Laboratory Information Management System (LIMS) on the day of approval. EMMIS routinely accesses LIMS electronically to capture pertinent data. Generally, the system will store the data in the form of concentrations.

A number of electronic data management tools enable automatic flagging of data points and allow for monitoring and trending data over time. Field information on all routine samples taken for surface water monitoring is entered in EMMIS, which also retrieves data nightly from the analytical laboratory. The system then performs numerous checks on the data, including comparisons of the individual results against any applicable screening criteria, regulatory thresholds, compliance limits, best management standards, or other water quality indicators, and produces required reports.

4.5.8 Biomonitoring Program

In accordance with the requirements of the 2006 NPDES permit (Part III-E, p. 9), a biomonitoring program is in place that evaluates three outfalls that discharge to the headwaters of East Fork Poplar Creek (Outfalls 200, 135, and 125). Water from each outfall was tested once in 2009 using fathead minnow larvae and *Ceriodaphnia dubia*. Table 4.15 summarizes the inhibition concentration (IC_{25}) results of biomonitoring tests conducted during 2009 at Outfalls 200, 135, and 125. The IC_{25} is the concentration of effluent that causes a 25% reduction in *Ceriodaphnia* survival or reproduction or fathead minnow survival or growth. Thus, the lower the value, the more toxic the effluent. The IC_{25} was greater than the highest tested concentration of each effluent (100% for outfall 200, 20% for outfall 135, and 36% for outfall 125) for each test conducted during 2009.

Table 4.15. Y-12 Complex Biomonitoring Program summary information[a] for Outfalls 200, 135, and 125 in 2009

Site	Test date	Species	IC_{25}[b] (%)
Outfall 200	12/10/09	*Ceriodaphnia*	>100
Outfall 200	12/10/09	Fathead minnow	>100
Outfall 135	12/11/09	*Ceriodaphnia*	>20
Outfall 135	12/11/09	Fathead minnow	>20
Outfall 125	12/10/09	*Ceriodaphnia*	>36
Outfall 125	12/10/09	Fathead minnow	>36

[a] The inhibition concentrations (IC_{25}) are summarized for the discharge monitoring locations, Outfalls 200, 135, and 125.

[b] IC_{25} as a percentage of full-strength effluent from outfalls 200, 135, and 125 diluted with laboratory control water. The IC_{25} is the concentration that causes a 25% reduction in *Ceriodaphnia* survival or reproduction or fathead minnow survival or growth.

4.5.9 Biological Monitoring and Abatement Programs

The NPDES permit issued for the Y-12 Complex in 2006 mandates a Biological Monitoring and Abatement Program (BMAP) with the objective of demonstrating that the effluent limitations established for the facility protect the classified uses of the receiving stream, East Fork Poplar Creek. The BMAP, which has been monitoring the ecological health of East Fork Poplar Creek since 1985, currently consists of three major tasks that reflect complementary approaches to evaluating the effects of the Y-12 Complex discharges on the aquatic integrity of East Fork Poplar Creek. These tasks include (1) bioaccumulation monitoring, (2) benthic macroinvertebrate community monitoring, and (3) fish community monitoring. Data collected on contaminant bioaccumulation and the composition and abundance of communities of aquatic organisms provide a direct evaluation of the effectiveness of abatement and remedial measures in improving ecological conditions in the stream.

Monitoring is presently being conducted at five primary East Fork Poplar Creek sites, although sites may be excluded or added, depending upon the specific objectives of the various tasks. The primary sampling sites include upper East Fork Poplar Creek at East Fork Poplar Creek kilometer (EFK) 24.4 and 23.4 (upstream and downstream of Lake Reality, respectively); EFK 18.7 (also EFK 18.2), located off the ORR and below an area of intensive commercial and light industrial development; EFK 13.8, located upstream from the Oak Ridge Wastewater Treatment Facility; and EFK 6.3, located approximately 1.4 km below the ORR boundary (Fig. 4.27). Brushy Fork at Brushy Fork kilometer (BFK) 7.6 is used as a reference stream in two tasks of the BMAP. Additional sites off the ORR are also occasionally used for reference, including Beaver Creek, Bull Run, Cox Creek, Hinds Creek, Paint Rock Creek, and the Emory River in Watts Bar Reservoir (Fig. 4.28).

Significant increases in species richness and diversity in East Fork Poplar Creek over the last two decades demonstrate that the overall ecological health of the stream continues to improve. However, the pace of improvement in the upper reaches of East Fork Poplar Creek near the Y-12 Complex has slowed in recent years, and fish and invertebrate communities continue to be less diverse than the corresponding communities in reference streams.

4.5.9.1 Bioaccumulation Studies

Mercury and PCB levels in fish from East Fork Poplar Creek (EFPC) have been historically elevated relative to fish in uncontaminated reference streams. Fish in EFPC are monitored regularly for mercury and PCBs to assess spatial and temporal trends in bioaccumulation associated with ongoing remedial activities and Y-12 Complex operations.

As part of this monitoring effort, redbreast sunfish (*Lepomis auritus*) and rock bass (*Ambloplites rupestris*) are collected twice a year from five sites throughout the length of EFPC and are analyzed for tissue concentrations of mercury (twice yearly) and PCBs (annually). Mercury concentrations remained much higher during 2009 in fish from East Fork Poplar Creek than in fish from reference streams. Elevated mercury concentrations in fish from the upper reaches of EFPC indicate that the Y-12 Complex remains a continuing source of mercury to fish in the stream. Although waterborne mercury concentrations in the upper reaches of EFPC decreased substantially following the 2005 start-up of a treatment system on a mercury-contaminated spring (Fig. 4.29), mercury concentrations in fish have not yet decreased in response and were significantly higher in 2009 than in recent years. Mean concentrations of PCBs in fish at EFK 23.4 (the site where PCBs in fish are highest) continued to be much lower in 2009 than peak concentrations observed in the mid 1990s (Fig. 4.30).

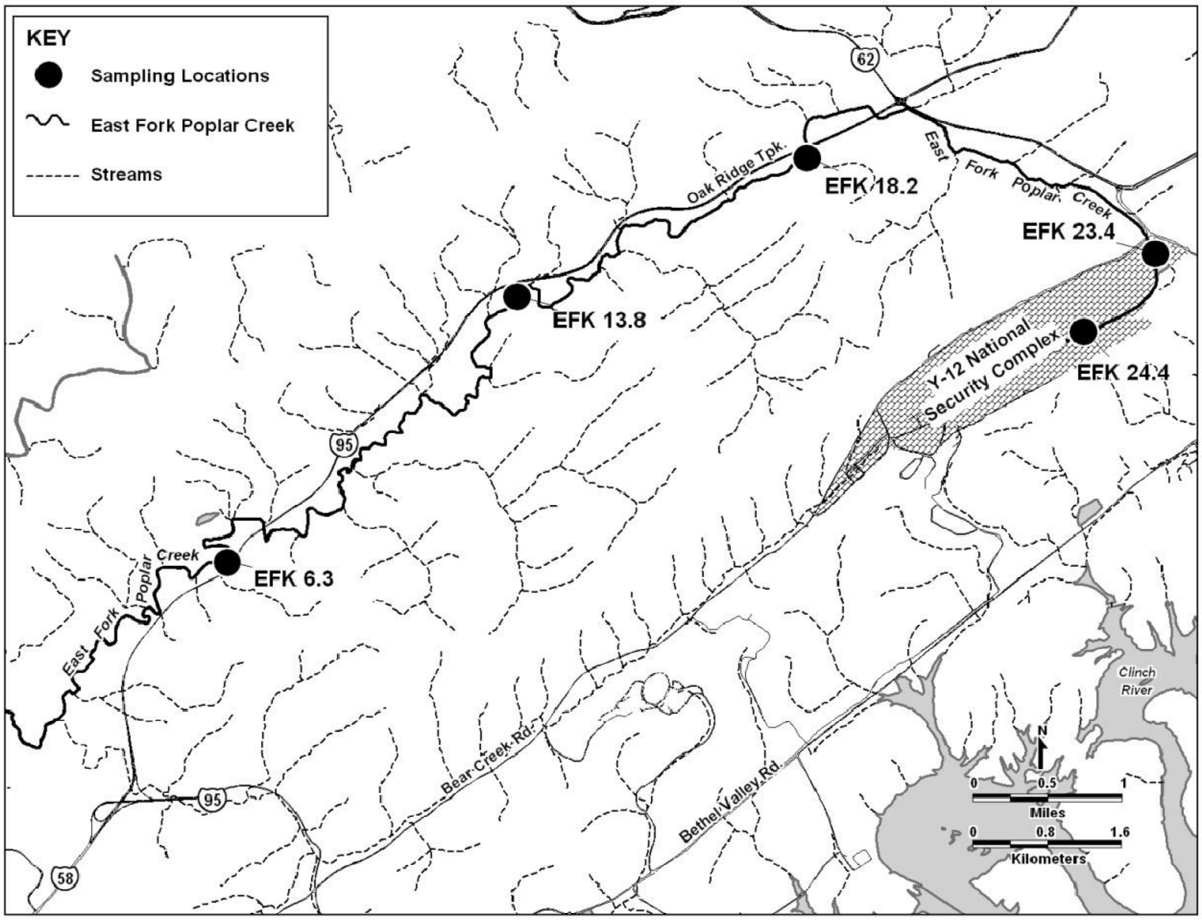


Fig. 4.27. Locations of biological monitoring sites on East Fork Poplar Creek in relation to the Oak Ridge Y-12 National Security Complex.

4.5.9.2 Benthic Invertebrate Surveys

Benthic macroinvertebrate communities were monitored at three sites in East Fork Poplar Creek and at two reference streams in the spring of 2009. The macroinvertebrate communities at EFK 23.4 and EFK 24.4 remained degraded as compared with reference communities, especially in the richness of pollution-sensitive taxa (i.e., EPT taxa richness; Fig. 4.31). Of note is a similar recent trend of reductions in total taxa richness and EPT taxa richness at EFK 13.8 and the BFK 7.6 reference site. Although empirical evidence is not available, the trends at these sites may be related to weather changes, specifically precipitation. Heavy rains in spring 2009 may have affected these sites, although it is not clear why the HCK 20.6 site was not similarly affected unless precipitation patterns in that watershed were different. The upstream sites in EFPC, on the other hand, are dominated by species that are tolerant of a wide range of both natural and human-caused disturbances. While the benthic macroinvertebrate community at EFK 24.4 appears to have stabilized in recent years, there appears to have been a small increase in both total taxa richness and EPT taxa richness at EFK 23.4.

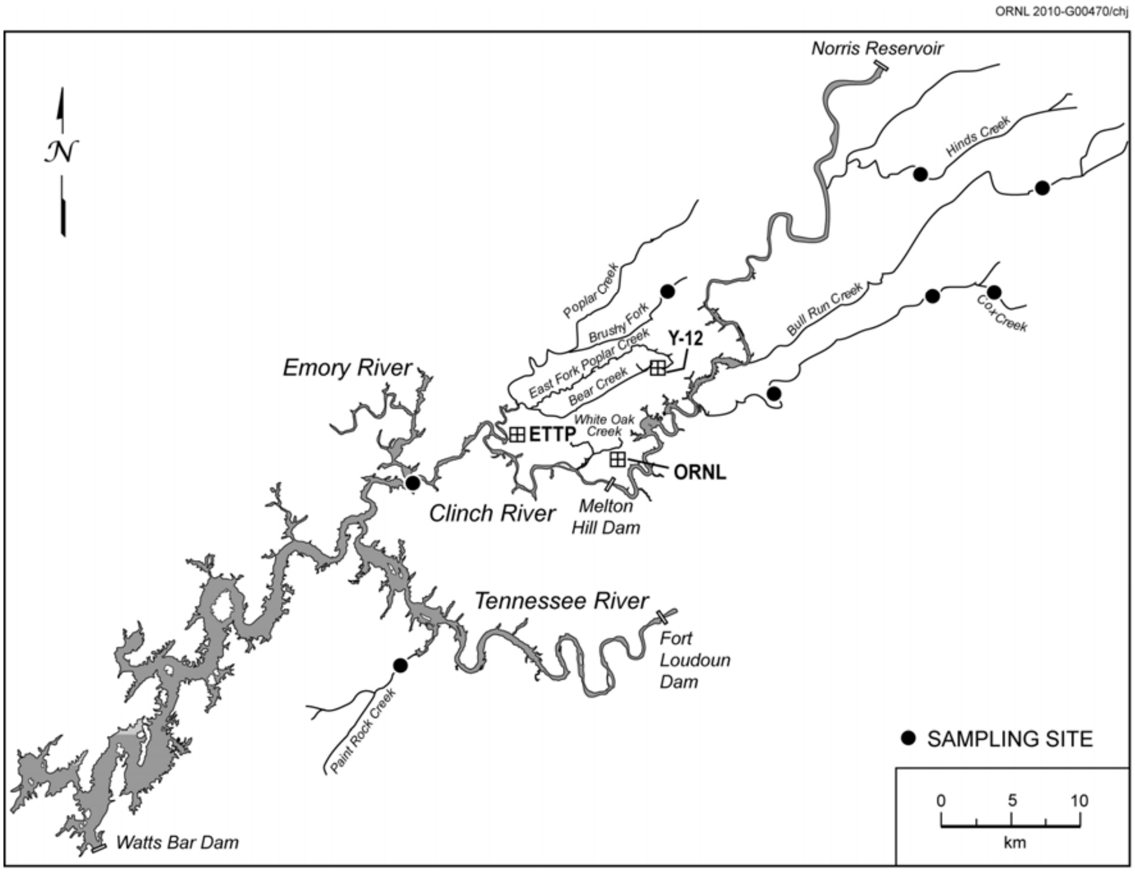


Fig. 4.28. Locations of biological monitoring reference sites in relation to the Oak Ridge Y-12 National Security Complex.

4.5.9.3 Fish Community Monitoring

Fish communities were monitored in the spring and fall of 2009 at five sites along East Fork Poplar Creek and at a reference stream. Over the past two decades, overall species richness, density, and the number of pollution-sensitive fish species (Fig. 4.32) have increased at all sampling locations below Lake Reality. However, the East Fork Poplar Creek fish community continues to lag behind reference stream communities in most important metrics of fish diversity and community structure, especially at the monitoring site closest to the Y-12 Complex.

4.6 Groundwater at the Y-12 Complex

Groundwater monitoring at Y-12 is performed to determine what impacts to the environment from legacy and current operations are occurring. More than 200 sites have been identified at the Y-12 Complex that represent known or potential sources of contamination to the environment as a result of past operational and waste management practices. Monitoring provides information on the nature and extent of contamination of groundwater which is then used to determine what actions must be taken to protect the worker, public, and the environment in compliance with regulations and DOE orders. Figure 4.33 depicts the major facilities or areas for which groundwater monitoring was performed during CY 2009.

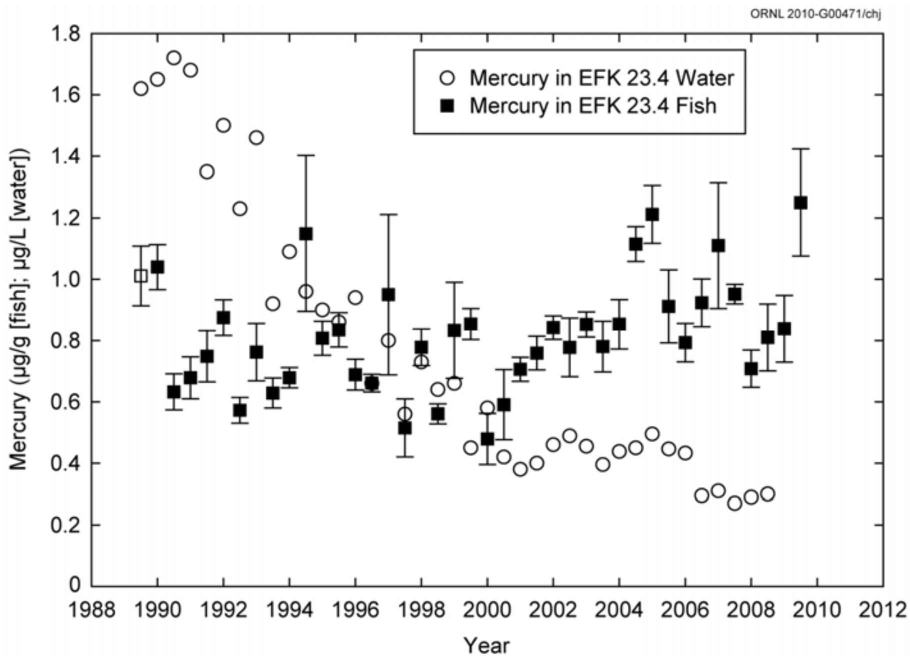


Fig. 4.29. Semiannual average mercury concentration in water and muscle fillets of redbreast sunfish and rock bass in East Fork Poplar Creek at EFK 23.4 through spring 2009.

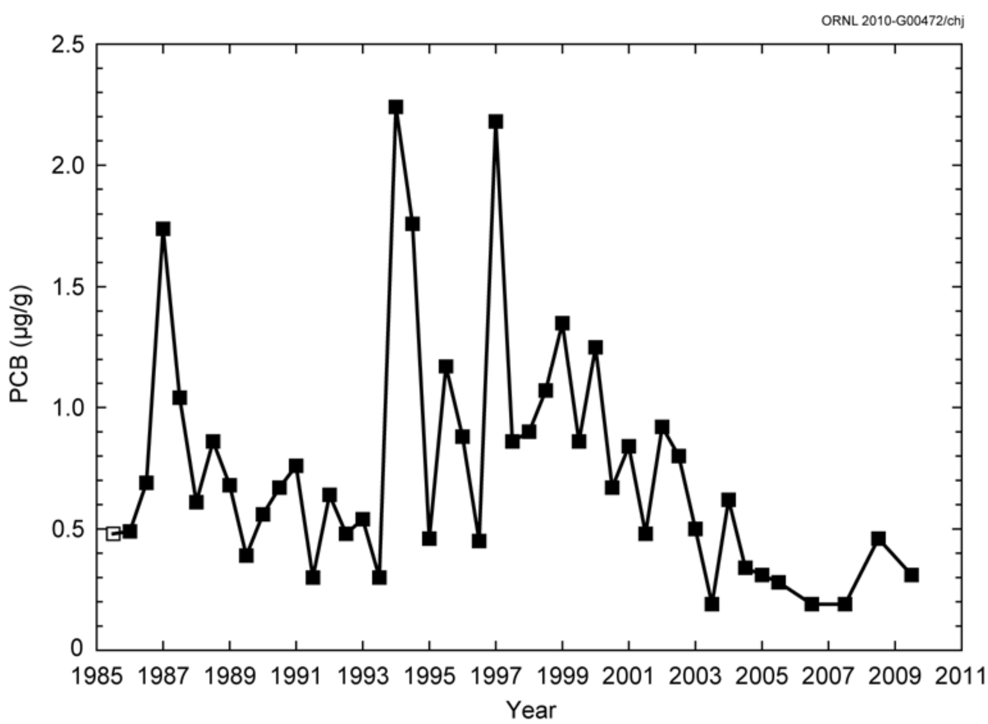


Fig. 4.30. Mean concentrations of PCBs in redbreast sunfish and rock bass muscle fillets in East Fork Poplar Creek at EFK 23.4 through spring 2009 (EFK = East Fork Poplar Creek kilometer).

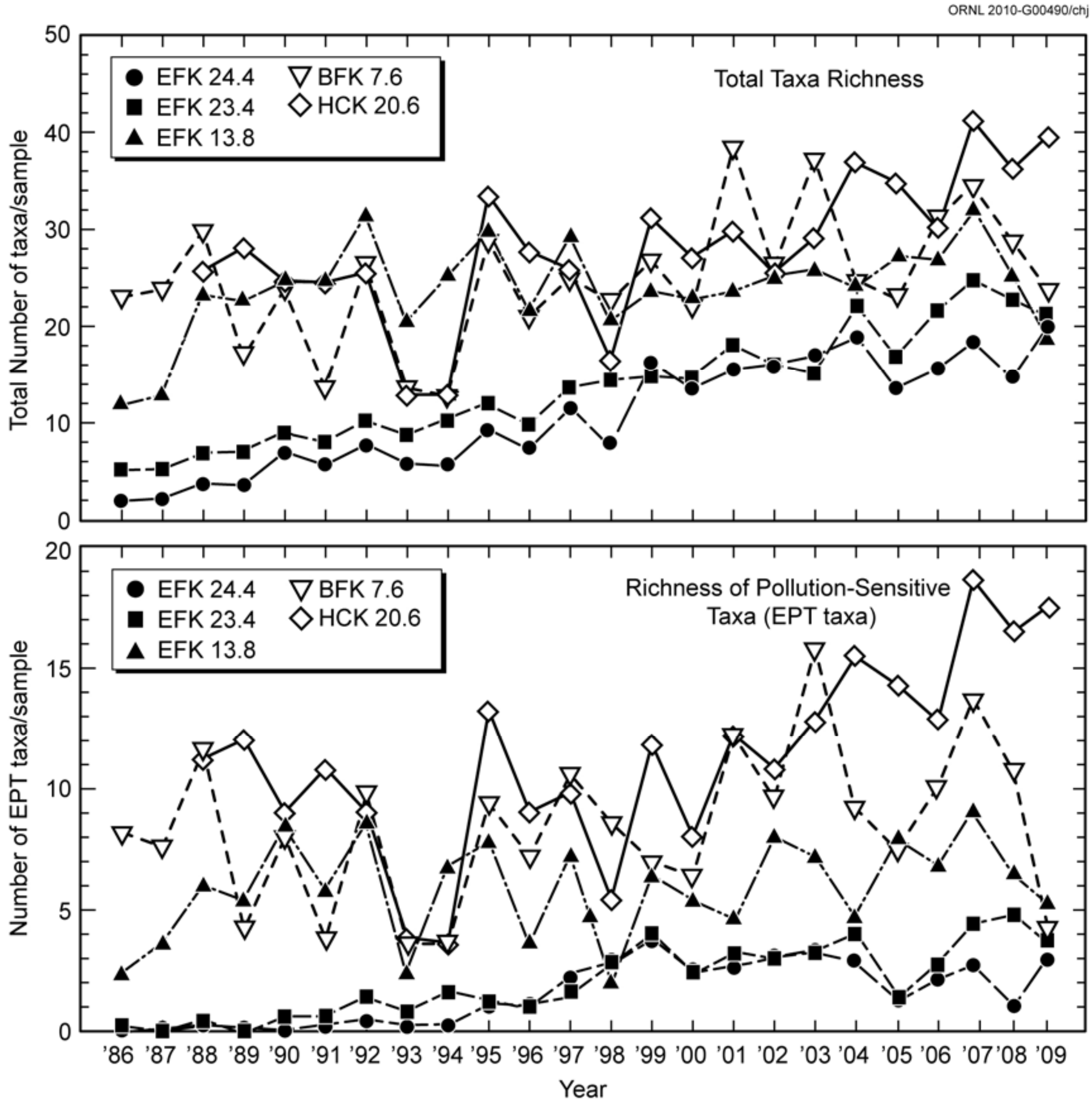


Fig. 4.31. Total taxonomic richness (mean number of taxa/sample) and total taxonomic richness of the *Ephemeroptera*, *Plecoptera*, and *Trichoptera* (EPT) (mean number of EPT taxa/sample) of the benthic macroinvertebrate communities sampled in spring from East Fork Poplar Creek and references sites on nearby Brushy Fork (BFK 7.6) and Hinds Creek (HCK 20.6).

4.6.1 Hydrogeologic Setting

The Y-12 Complex is divided into three hydrogeologic regimes (i.e., Bear Creek, Upper East Fork Poplar Creek, and Chestnut Ridge), which are delineated by surface water drainage patterns, topography, and groundwater flow characteristics (Fig. 4.34). Most of the Bear Creek and Upper East Fork Poplar Creek regimes are underlain by fractured noncarbonate rock. The southern portion of the two regimes is underlain by the Maynardville Limestone, which is part of the Knox Aquifer. The entire Chestnut Ridge regime is underlain by the Knox Aquifer. In general, groundwater flow in the water table interval follows the topography. Shallow groundwater flow in the Bear Creek and the Upper East Fork regimes is divergent from the topographic and groundwater divide located near the western end of the Y-12 Complex that defines the boundary between the two. In addition, flow converges on the primary surface streams (Bear Creek and Upper East Fork Poplar Creek) from Pine Ridge and Chestnut Ridge. In the Chestnut Ridge regime, a groundwater divide exists that approximately coincides with the crest of the ridge. Shallow groundwater flow tends to be toward either flank of the ridge, with discharge primarily to surface streams and springs located in Bethel Valley to the south and Bear Creek Valley to the north.

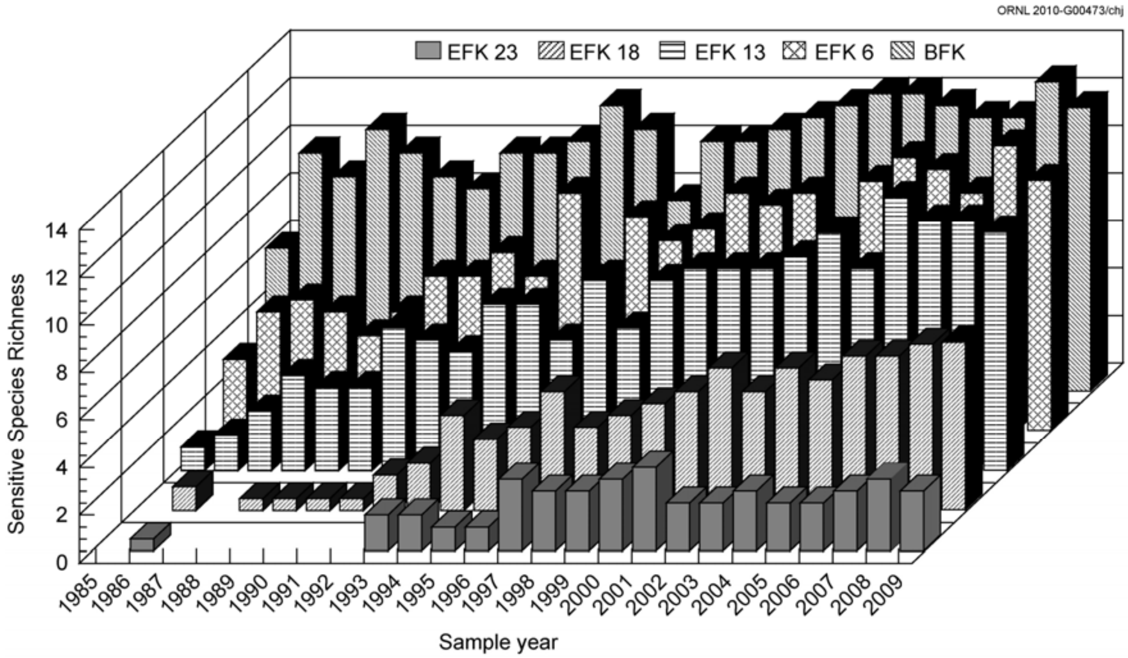


Fig. 4.32. Comparison of mean sensitive species richness (number of species) collected each year from 1985 through 2009 from four sites in East Fork Poplar Creek and a reference site (Brushy Fork).

In Bear Creek Valley, groundwater in the intermediate and deep intervals moves predominantly through fractures in the noncarbonate rock, converging on and then moving through fractures and solution conduits in the Maynardville Limestone. Karst development in the Maynardville Limestone has a significant impact on groundwater flow paths in the water table and intermediate intervals. In general, groundwater flow parallels the valley and geologic strike. Groundwater flow rates in Bear Creek Valley vary widely; they are very slow within the deep interval of the fractured noncarbonate rock (<1 ft/year) but can be quite rapid within solution conduits in the Maynardville Limestone (tens to thousands of feet per day). The rate of groundwater flow perpendicular to geologic strike from the fractured noncarbonate rock to the Maynardville Limestone is also very slow below.

Contaminant migration is primarily advective (contaminants are transported along with flowing groundwater through the pore spaces, fractures, or conduits of the hydrogeologic system). Strike-parallel transport of some contaminants can occur within the fractured noncarbonate rock for significant distances, where they discharge to surface water tributaries or underground utility and stormwater distribution systems in industrial areas. Continuous elevated levels of nitrate (a groundwater contaminant from legacy waste disposals) within the fractured noncarbonate rock are known to extend east and west from the S-3 Site for thousands of feet. Volatile organic compounds (e.g., petroleum products, coolants, and solvents) at source units in the fractured noncarbonate rock, however, can remain close to source areas because they tend to adsorb to the bedrock matrix, diffuse into pore spaces within the matrix, and degrade prior to migrating to exit pathways, where more rapid transport occurs for longer distances. Regardless, extensive volatile organic compound contamination occurs throughout the groundwater system in both the Bear Creek and Upper East Fork regimes.

Groundwater flow in the Chestnut Ridge regime is through fractures and solution conduits in the Knox Group. Discharge points for intermediate and deep flow are not well known. Groundwater is currently presumed to flow toward Bear Creek Valley to the north and Bethel Valley to the south. Groundwater from intermediate and deep zones may discharge at certain spring locations along the flanks of Chestnut Ridge. Following the crest of the ridge, water table elevations decrease from west to east, demonstrating an overall easterly trend in groundwater flow.

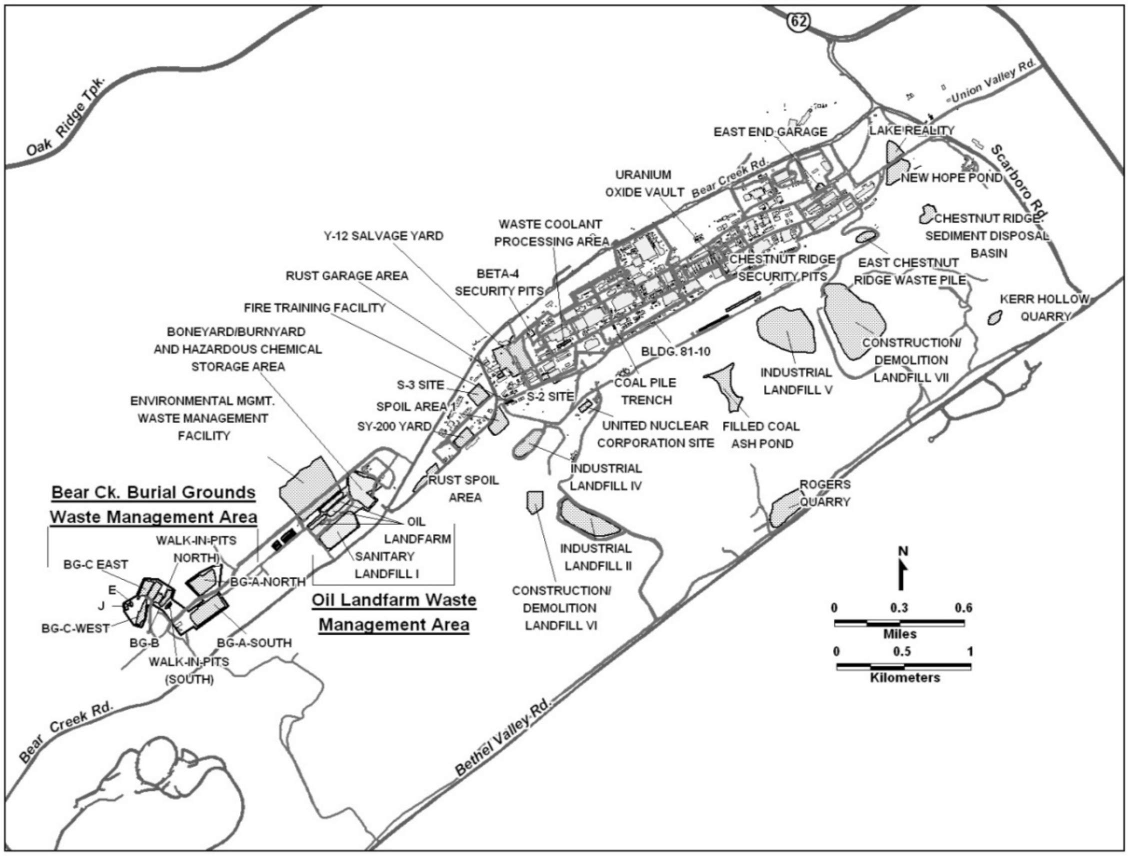


Fig. 4.33. Known or potential contaminant sources for which groundwater monitoring was performed at the Y-12 Complex during CY 2009.

4.6.2 Well Installation and Plugging and Abandonment Activities

A number of monitoring devices are routinely used for groundwater data collection at the Y-12 Complex. Monitoring wells are permanent devices used for the collection of groundwater samples; they are installed according to established regulatory and industry standards. Figure 4.35 shows a cross section of a typical groundwater monitoring well. Piezometers are similar in construction to monitoring wells but are primarily temporary devices used to measure groundwater levels. Other devices or techniques are sometimes employed to gather groundwater data, including drive points and push probes.

In CY 2009, 17 monitoring wells and two piezometers were installed at Y-12. One new well and two piezometers were installed at the Environmental Management Waste Management Facility (EMWMF) to support monitoring requirements of a newly constructed disposal cell, and four surveillance monitoring wells were installed north of Bear Creek Road to replace wells previously removed to make way for construction activities. Twelve wells were installed in support of research activities by the Environmental Remediation Sciences Oak Ridge Field Research Center. The purpose of the Field Research Center is to investigate the interactions and processes within a contaminated groundwater system to assist in the development of remediation strategies and tools for groundwater cleanup.

No monitoring wells were plugged and abandoned during the year, but six piezometers at the EMWMF were removed in support of the newly constructed disposal cell.

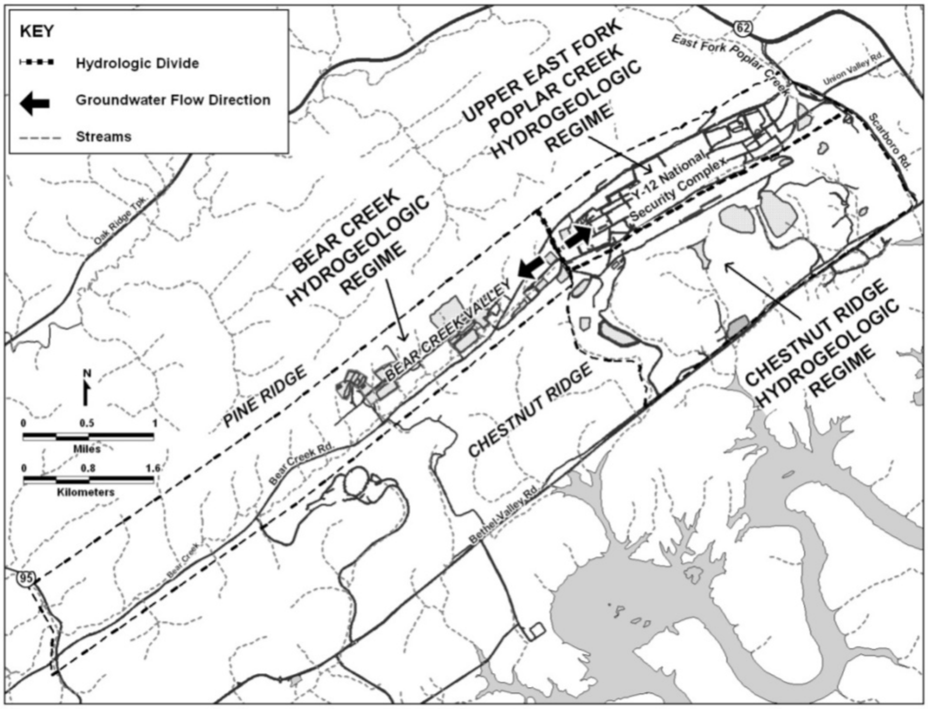


Fig. 4.34. Hydrogeologic regimes at the Y-12 Complex.

4.6.3 CY 2009 Groundwater Monitoring

Groundwater monitoring in CY 2009 was performed to comply with DOE orders and regulations by the Y-12 Groundwater Protection Program, the Water Resources Restoration Program, and other projects. Compliance requirements were met by monitoring 223 wells and 50 surface water locations and springs (Table 4.16). Figure 4.36 shows the locations of Y-12 Complex perimeter/exit pathway groundwater monitoring stations.

In an attempt to gain efficiencies in sampling activities, the Y-12 Groundwater Protection Program initiated the use of passive diffusion bag samplers (Fig. 4.37). The passive diffusion bag sampling method is suitable only for monitoring for the presence and concentration of selected volatile organic compounds in groundwater. This method involves suspending a polyethylene bag (semipermeable membrane) filled with deionized water at a selected depth within the monitored interval of the well and leaving the passive diffusion bag in place for a prescribed period (at least 2 weeks). The chemical concentration gradient between the uncontaminated deionized water in the passive diffusion bag and the surrounding contaminated groundwater induces volatile organic compounds in the groundwater to diffuse through the bag into the deionized water until equilibrium conditions are achieved. When retrieved, the water in the passive diffusion bag is decanted into volatile organic compound sample bottles and analyzed using standard procedures.

Comprehensive water quality results of groundwater monitoring activities at Y-12 in CY 2009 are presented in the annual *Calendar Year 2009 Groundwater Monitoring Report* (B&W Y-12 2010a).

Details of monitoring efforts performed specifically for CERCLA baseline and remediation evaluation are published in the FY 2009 and FY 2010 Water Resources Restoration Program sampling and analysis plans (Bechtel Jacobs Company 2008; Bechtel Jacobs Company 2009), and the 2010 *Remediation Effectiveness Report* (DOE 2010).

Groundwater monitoring compliance reporting to meet RCRA postclosure permit requirements can be found in the annual RCRA *Groundwater Monitoring Report* (Bechtel Jacobs Company 2010).

4.6.4 Y-12 Groundwater Quality

Historical monitoring efforts have shown that there are four primary contaminants that have impacted groundwater quality at the Y-12 Complex: nitrate, volatile organic compounds, metals, and radionuclides. Of those, volatile organic compounds are the most widespread due to their common use and disposal. In groundwater, uranium and technetium-99 are the radionuclides of greatest concern. Trace metals, the least extensive groundwater contaminants, generally occur close to source areas. Historical data have shown that plumes from multiple-source units have mixed with one another and that contaminants (other than nitrate and technetium-99) are no longer easily associated with a single source.

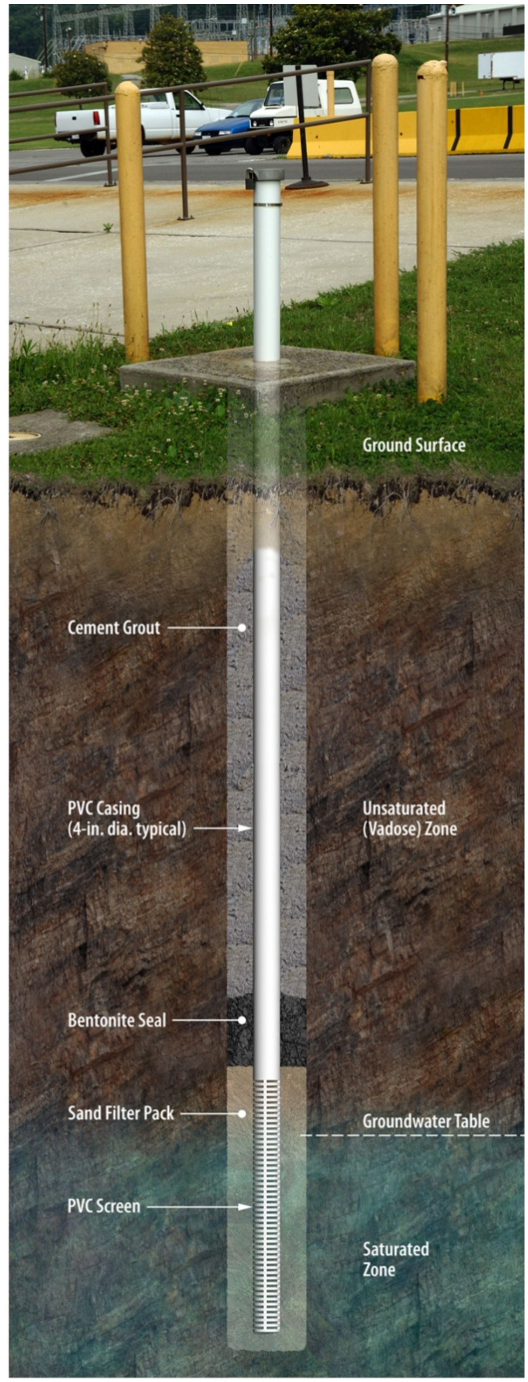


Fig. 4.35. Cross section of a typical groundwater monitoring well.

4.6.4.1 Upper East Fork Poplar Creek Hydrogeologic Regime

Among the three hydrogeologic regimes on the Y-12 Complex, the Upper East Fork regime encompasses most of the known and potential sources of surface water and groundwater contamination. A brief description of waste management sites is given in Table 4.17. Chemical constituents from the S-3 Site (primarily nitrate and technetium-99) and volatile organic compounds from multiple source areas are observed in the groundwater in the western portion of the Upper East Fork regime; groundwater in the eastern portion, including Union Valley, is predominantly contaminated with volatile organic compounds.

4.6.4.1.1 Plume Delineation

Sources of groundwater contaminants monitored during CY 2009 include the S-2 Site, the Fire Training Facility, the S-3 Site, the Waste Coolant Processing Facility, petroleum USTs, New Hope Pond, the Beta-4 Security Pits, the Y-12 Salvage Yard, and process/production buildings throughout the Y-12 Complex. Although the S-3 Site, now closed under RCRA, is located west of the current hydrologic divide that separates the Upper East Fork regime from the Bear Creek regime, it has contributed to groundwater contamination in the western part of the Upper East Fork regime. As previously mentioned, contaminant plumes in the East Fork regime are elongated in shape due to the result of preferential transport of the contaminants parallel to strike (parallel to the valley axis) in both the Knox Aquifer and the fractured noncarbonate rock.

Table 4.16. Summary groundwater monitoring at the Y-12 Complex, 2009

	Purpose for which monitoring was performed				
	Restoration[a]	Waste management[b]	Surveillance[c]	Other[d]	Total
Number of active wells	60	32	114	131	337
Number of other monitoring stations (e.g., springs, seeps, surface water)	29	6	15	5	55
Number of samples taken[e]	159	40 *	145	2,815	3,159
Number of analyses performed	9,456	3,556 *	10,561	3,8000	61,580
Percentage of analyses that are non-detects	75.6	86.1	80.6	40.8	55.6
Ranges of results for positive detections, VOCs (μg/L)[f]					
Chloroethenes	0.3–2,730	0.045–15	1–180,000	NA[g]	
Chloroethanes	1–373	0.12–40	1–11,000	NA	
Chloromethanes	1–1,340	0.045-0.13	1–690	NA	
Petroleum hydrocarbons	0.4–8,110	0.027-0.11	1–2,100	NA	
Uranium (mg/L)	0.0044–0.6	0.004-0.004	0.0006–1.33	0.0054-64.93	
Nitrates (mg/L)	0.01–8,030	0.5–2.8	0.059–10,400	0-25,778	
Ranges of results for positive detections, radiological parameters (pCi/L)[h]					
Gross alpha activity	2.44–433	0.83–4.39	3.5–400	NA	
Gross beta activity	3.18–16,200	3.12–16.7	1.7–11,000	NA	

[a] Monitoring to comply with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements and with Resource Conservation and Recovery Act post closure detection and corrective action monitoring.

[b] Solid waste landfill detection monitoring and CERCLA landfill detection monitoring; * = excludes EMWMF

[c] DOE Order 450.1 surveillance monitoring

[d] Research-related groundwater monitoring associated with activities of the DOE Natural and Accelerated Bioremediation Research Field Research Center.

[e] The number of unfiltered samples, excluding duplicates, determined for unique location/date combinations.

[f] These ranges reflect concentrations of individual contaminants (not summed VOC concentrations):
Chloroethenes—includes tetrachloroethene, trichloroethene, 1,2-dichloroethene (*cis* and *trans*) 1,1-dichloroethene, and vinyl chloride
Chloroethanes—includes 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichloroethane
Chloromethanes—includes carbon tetrachloride, chloroform, and methylene chloride
Petroleum hydrocarbon—includes benzene, toluene, ethylbenzene, and xylene

[g] NA – not analyzed.

[h] 1 pCi = 3.7×10^2 Bq.

4.6.4.1.2 Nitrate

Nitrate concentrations in groundwater at the Y-12 Complex exceed the 10-mg/L drinking water standard in a large part of the western portion of the Upper East Fork regime (a complete list of national drinking water standards is presented in Appendix D). The two primary sources of nitrate contamination are the S-2 and S-3 sites. The extent of the nitrate plume is essentially defined in the unconsolidated and shallow bedrock zones. In CY 2009, groundwater containing nitrate concentrations as high as 8,960 mg/L (Well GW-275) occurred in the shallow bedrock just east of the S-3 Site (Fig. 4.38). These results are consistent with results from previous years.

4.6.4.1.3 Trace Metals

Concentrations of arsenic, barium, beryllium, cadmium, chromium, lead, nickel, and uranium exceeded drinking water standards during CY 2009 in samples collected from various monitoring wells and surface water locations downgradient of the S-2 Site, the S-3 Site, the Salvage Yard, and throughout the complex. Elevated concentrations of those metals in groundwater were most commonly observed from monitoring wells in the unconsolidated zone. Trace metal concentrations above standards tend to occur only adjacent to the source areas due to their low solubility in natural water systems.

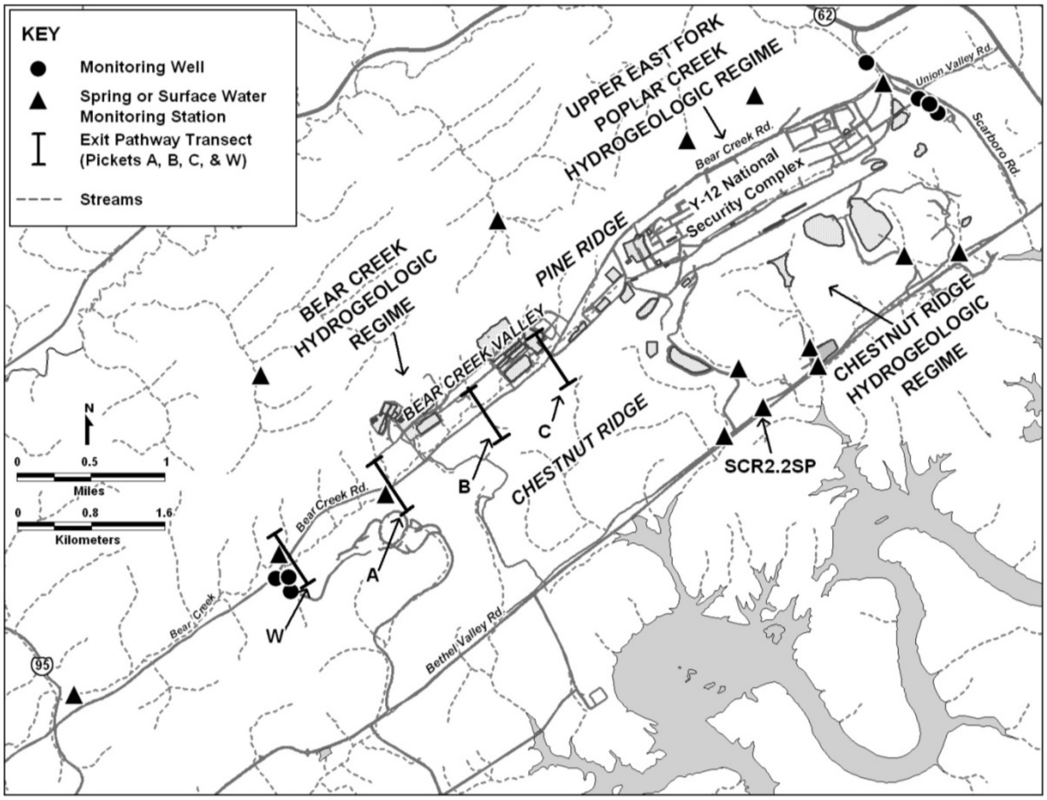


Fig. 4.36. Locations of Y-12 Complex perimeter/exit pathway well, spring, and surface water monitoring stations.

Concentrations of uranium exceed the standard (0.03 mg/L) in a number of source areas (e.g., S-3 Site, production areas and the Former Oil Skimmer Basin) and contribute to the uranium concentration in Upper East Fork Poplar Creek.

One trace metal absent from the list of those that exceed drinking water standards in CY 2009 is mercury. Mercury has a very high affinity for clay-rich soils such as those on the ORR, and hence exhibits little tendency for extensive transport in diffuse groundwater plumes. Additionally, the hydrogeologic complexities of the fracture/conduit flow system underlying Y-12 make it challenging to delineate the vertical and horizontal extents of any groundwater contamination. Elevated mercury concentrations (above analytical detection limits) in groundwater have been consistently observed only near known source areas (Fig. 4.39). In the past, mercury concentrations above the drinking water standard (0.002 mg/L) have been observed in groundwater monitoring wells at the identified source areas presented in Fig. 4.39.

Due to past processes and disposal practices, mercury is a legacy contaminant at Y-12. It is commonly found in the soils near specific areas where it was used in processes in the 1950s and 1960s. This metal is a contaminant of concern in surface waters discharging from these areas. It appears that high mercury concentrations in water within the storm drain network in those areas arise from the oxidation and dissolution of mercury from metallic mercury deposits in close proximity to flowing water that produces high localized concentrations of dissolved mercury that infiltrate the storm drain system. A similar process occurs in reaches of the open stream where mercury metal is buried under gravel sediments. When dissolved mercury is discharged from the storm drain system into the open creek channel, it is rapidly sequestered by particulate materials, and fluvial sediment/particle transport becomes the primary mechanism of mobility.

Fig. 4.37. Groundwater sampling at Y-12. Technicians use a passive diffusion bag to sample for volatile organic compounds in groundwater.

In tightly fractured shale and other noncarbonate bedrock, the natural flow paths are such that significant transport of mercury is not likely. In industrialized areas of Y-12 where the shallow subsurface has been reworked extensively, some preferential transport along building foundations and underground utilities is occurring. This is evident from elevated surface water concentrations of mercury.

Interconnection between the surface water and groundwater systems have been demonstrated by tracer investigations (DOE 2001) and the discharge of elevated concentrations of mercury from a buried spring (i.e., OF-51) adjacent to East Fork Poplar Creek. This discharge is presently captured and treated to remove the mercury at the Big Springs Water Treatment System. It has been proposed that dissolved mercury in the spring discharge arises from metallic mercury that has infiltrated into the solution cavities and conduits of the karstic Maynardville Limestone Formation below the water table. Although the subsurface inventory of metallic mercury in the limestone bedrock has not been determined, it could account for a part of the quantities lost during operational use. Subsurface storage may also minimize mobility of mercury due to decreased surface area (i.e., immobilized in filled seams, fractured, and conduits, in contrast to the surface exposure of mercury as particles) (Rothschild et al. 1984).

4.6.4.1.4 Volatile Organic Compounds

Because of the many legacy source areas, volatile organic compounds are the most widespread groundwater contaminants in the East Fork regime. Dissolved volatile organic compounds in the regime primarily consist of chlorinated solvents and petroleum hydrocarbons. In CY 2009, the highest summed concentration of dissolved chlorinated solvents (59,767 µg/L) was again found in groundwater at Well 55-3B in the western portion of the Y-12 Complex adjacent to manufacturing facilities. The highest dissolved concentration of petroleum hydrocarbons (14,780 µg/L) was obtained from Well GW-658 at the closed East End Garage.

The CY 2009 monitoring results generally confirm findings from the previous years of monitoring. A continuous dissolved plume of volatile organic compounds in groundwater in the bedrock zone extends eastward from the S-3 Site over the entire length of the regime (Fig. 4.40). The primary sources are the Waste Coolant Processing Facility, fuel facilities (Rust Garage and East End), Y-12 Salvage Yard, and other waste-disposal and production areas throughout the Y-12 Complex. Chloroethene compounds (tetrachloroethene, trichloroethene, dichloroethene, and vinyl chloride) tend to dominate the volatile organic plume composition in the western and central portions of the Y-12 Complex. However, tetrachloroethene and isomers of dichloroethene are almost ubiquitous throughout the extent of the plume, indicating many source areas. Chloromethane compounds (carbon tetrachloride, chloroform, and methylene chloride) are the predominant volatile organic compounds in the eastern portion of the Complex.

Table 4.17. History of waste management units and underground storage tanks included in groundwater monitoring activities, Upper East Fork Poplar Creek Hydrogeologic Regime, 2009

Site	Historical data
New Hope Pond	Built in 1963. Regulated flow of water in Upper East Fork Poplar Creek before exiting the Y-12 Complex grounds. Sediments include PCBs, mercury, and uranium but not hazardous according to toxicity characteristic leaching procedure. An oil skimmer basin was built as part of the pond when constructed. This basin collected oil and floating debris from Upper East Fork Poplar Creek prior to discharge into the pond. Closed under RCRA in 1990
Salvage Yard Scrap Metal Storage Area	Used from 1950 to present for scrap metal storage. Some metals contaminated with low levels of depleted or enriched uranium. Runoff and infiltration are the principal release mechanisms to groundwater
Salvage Yard Oil/Solvent Drum Storage Area	Primary wastes included waste oils, solvents, uranium, and beryllium. Both closed under RCRA. Leaks and spills represent the primary contamination mechanisms for groundwater
Salvage Yard Oil Storage Tanks	Used from 1978 to 1986. Two tanks used to store PCB-contaminated oils, both within a diked area
Salvage Yard Drum Deheader	Used from 1959 to 1989. Sump tanks 2063-U, 2328-U, and 2329-U received residual drum contents. Sump leakage is a likely release mechanism to groundwater
Building 81-10 Area	Mercury recovery facility operated from 1957 to 1962. Potential historical releases to groundwater from leaks and spills of liquid wastes or mercury. The building structure was demolished in 1995
Rust Garage Area	Former vehicle and equipment maintenance area, including four former petroleum USTs. Petroleum product releases to groundwater are documented
9418-3 Uranium Oxide Vault	Originally contained an oil storage tank. Used from 1960 to 1964 to dispose of nonenriched uranium oxide. Leakage from the vault to groundwater is the likely release mechanism
Fire Training Facility	Used for hands-on firefighting training. Sources of contamination to soil include flammable liquids and chlorinated solvents. Infiltration is the primary release mechanism to groundwater
Beta-4 Security Pits	Used from 1968 to 1972 for disposal of classified materials, scrap metals, and liquid wastes. Site is closed and capped. Primary release mechanism to groundwater is infiltration
S-2 Site	Used from 1945 to 1951. An unlined reservoir received liquid wastes. Infiltration is the primary release mechanism to groundwater
Waste Coolant Processing Area	Used from 1977 to 1985. Former biodegradation facility used to treat waste coolants from various machining processes. Closed under RCRA in 1988
East End Garage	Used from 1945 to 1989 as a vehicle fueling station. Five USTs used for petroleum fuel storage were excavated, 1989 to 1993. Petroleum releases to the groundwater are documented
Coal Pile Trench	Located beneath the current steam plant coal pile. Disposals included solid materials (primarily alloys). Trench leachate is a potential release mechanism to groundwater

Abbreviations
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
UST = underground storage tank

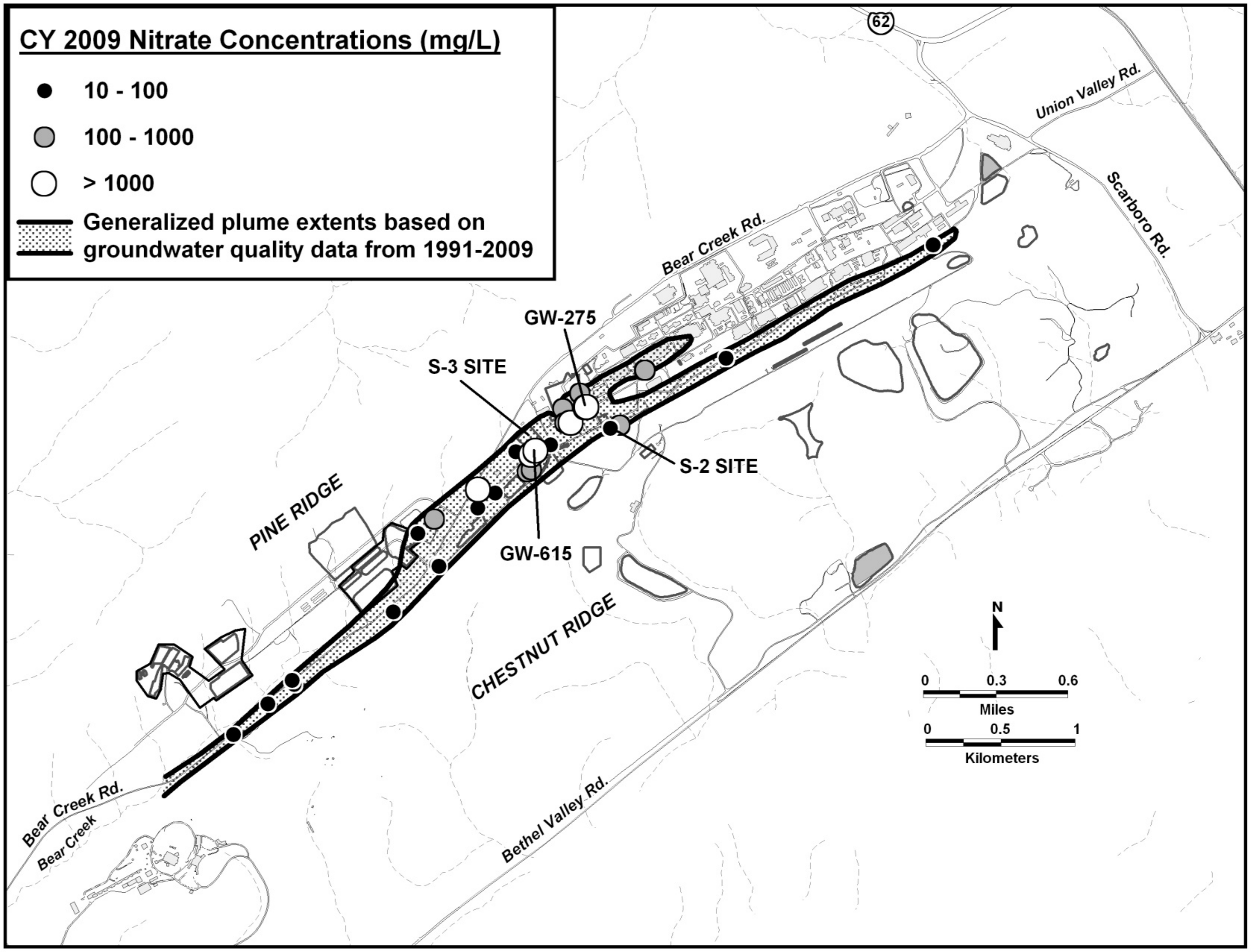


Fig. 4.38. Nitrate observed in groundwater at the Y-12 Complex, 2009.

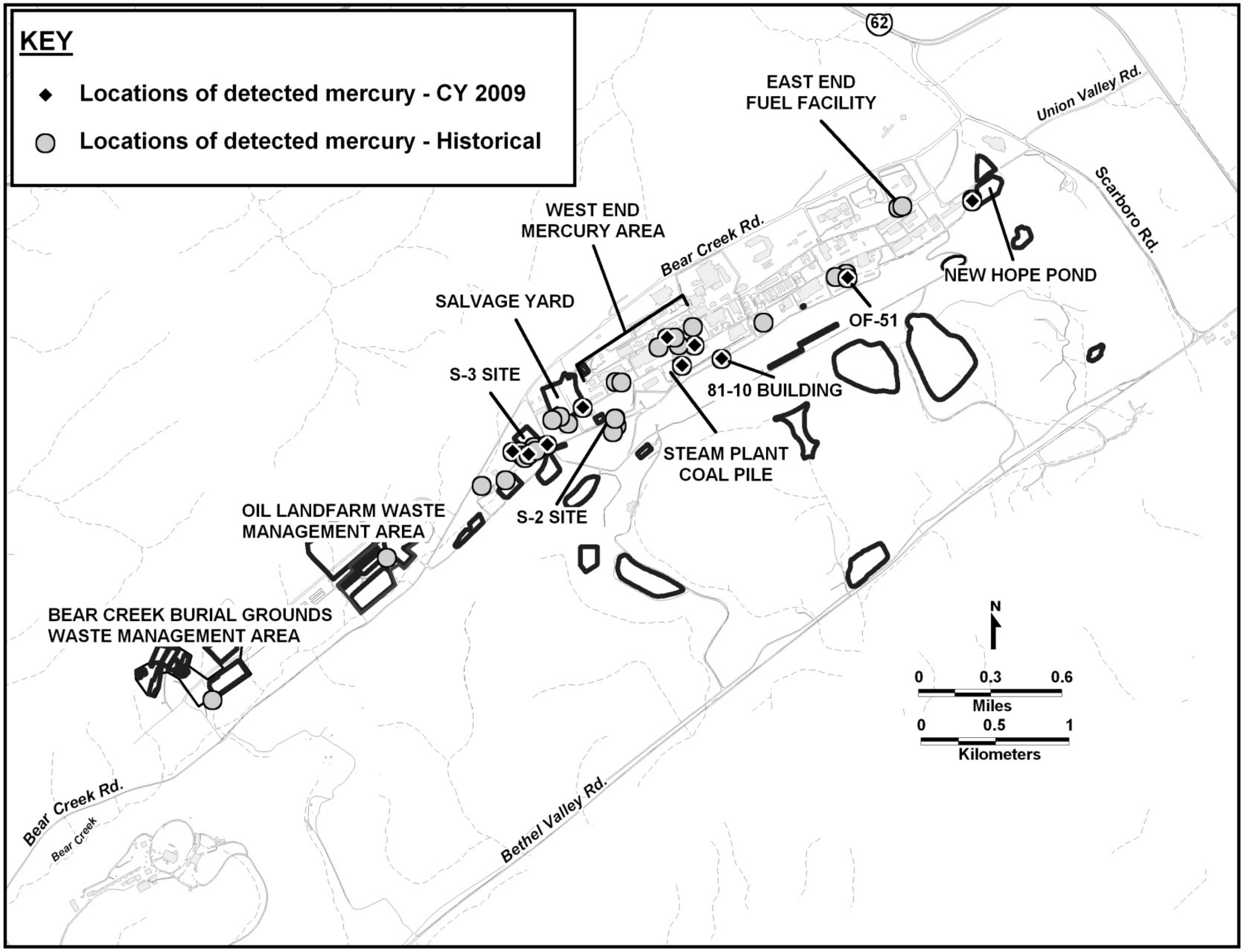


Fig. 4.39. Y-12 groundwater monitoring stations where mercury has been detected.

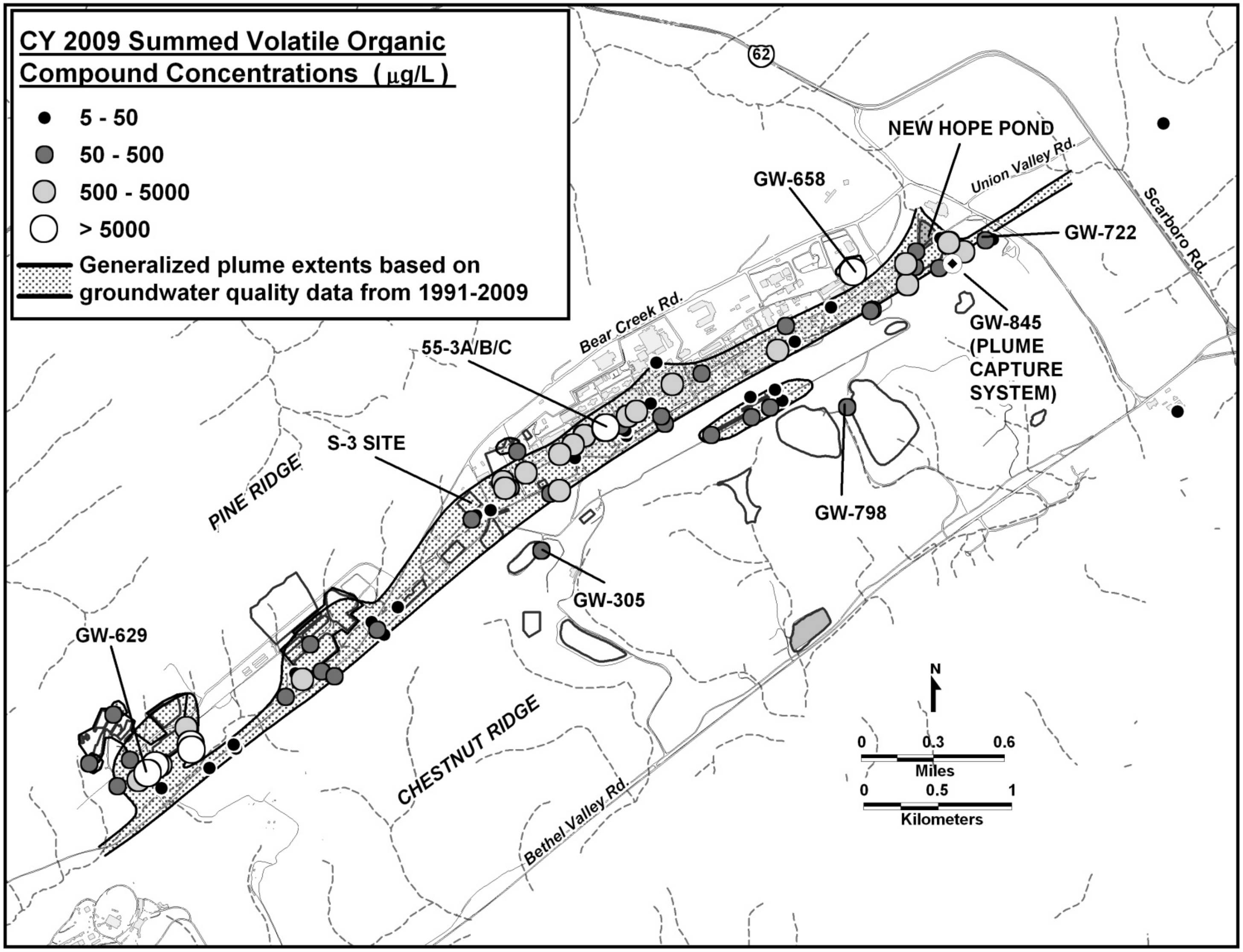


Fig. 4.40. Summed volatile organic compounds observed in groundwater at the Y-12 complex, 2009.

Variability in concentration trends of chlorinated volatile organic compounds near source areas is seen within the Upper East Fork regime. As seen in previous years, data from most of the monitoring wells have remained relatively constant (i.e., stable) or have decreased since 1988. Increasing trends are observed in monitoring wells associated with the Rust Garage and S-3 site in western Y-12, some production/process facilities in central areas, and the chloroethene component of the East End volatile organic compound plume, indicating that some portions of the plume are still showing activity.

Within the exit pathway the general trends are also stable or decreasing. The trends west of New Hope Pond are indicators that the contaminants from source areas are attenuating due to factors such as (1) dilution by surrounding uncontaminated groundwater, (2) dispersion through a complex network of fractures and conduits, (3) degradation by chemical or biological means, or (4) adsorption by surrounding bedrock and soil media. Wells to the southwest to southeast of New Hope Pond are displaying the effects of the pumping well (GW-845) operated to capture the plume prior to migration off of the ORR into Union Valley. Wells east of the New Hope Pond and north of Well GW-845 exhibit an increasing trend in volatile organic compound concentrations, indicating that little impact or attenuation from the plume capture system is apparent across lithologic units (perpendicular to strike). However, no subsequent downgradient detection of these compounds is apparent, so either migration is limited or some downgradient across-strike influence by the plume capture system is occurring.

4.6.4.1.5 Radionuclides

The primary alpha-emitting radionuclides found in the East Fork regime during CY 2009 are isotopes of uranium. Historical data show that gross alpha activity consistently exceeds the drinking water standard (15 pCi/L) and that it is most extensive in groundwater in the unconsolidated zone in the western portion of the Y-12 Complex near source areas such as the S-3 Site, the S-2 Site, and the Y-12 Salvage Yard. However, the highest gross alpha activity (433 pCi/L) in groundwater continues to be observed on the east end of the Y-12 Complex in Well GW-154, east of the Former Oil Skimmer Basin (Fig. 4.41).

The primary beta-emitting radionuclides observed in the Upper East Fork regime during CY 2009 are technetium-99, isotopes of uranium, and associated daughter products. Elevated gross beta activity in groundwater in the Upper East Fork regime shows a pattern similar to that observed for gross alpha activity, where technetium-99 is the primary contaminant exceeding the screening level of 50 pCi/L in groundwater in the western portion of the regime, with the primary source being the S-3 Site (Fig. 4.42). The highest gross beta activity in groundwater was observed during CY 2009 from well GW-108 (16,200 pCi/L), east of the S-3 site.

4.6.4.1.6 Exit Pathway and Perimeter Monitoring

Data collected to date indicate that volatile organic compounds are the primary class of contaminants that are migrating through the exit pathways in the Upper East Fork regime. Historically, the compounds have been observed at depths of almost 500 ft in the Maynardville Limestone, the primary exit pathway on the east end of the Y-12 Complex. The deep fractures and solution channels that constitute flow paths within the Maynardville Limestone appear to be well connected, resulting in contaminant migration for substantial distances off the ORR into Union Valley to the east of the complex.

In addition to the intermediate to deep pathways within the Maynardville Limestone, shallow groundwater within the water table interval of that geologic unit near New Hope Pond, Lake Reality, and Upper East Fork Poplar Creek is also monitored. Historically, volatile organic compounds have been observed near Lake Reality from wells, a dewatering sump, and the New Hope Pond distribution channel underdrain. In that area, shallow groundwater flows north-northeast through the water table interval east of New Hope Pond and Lake Reality, following the path of the distribution channel for Upper East Fork Poplar Creek.

During CY 2009, the observed concentrations of volatile organic compounds at the New Hope Pond distribution channel underdrain continue to remain low. This may be because the continued operation of the groundwater plume–capture system in Well GW-845 southeast of New Hope Pond is effectively

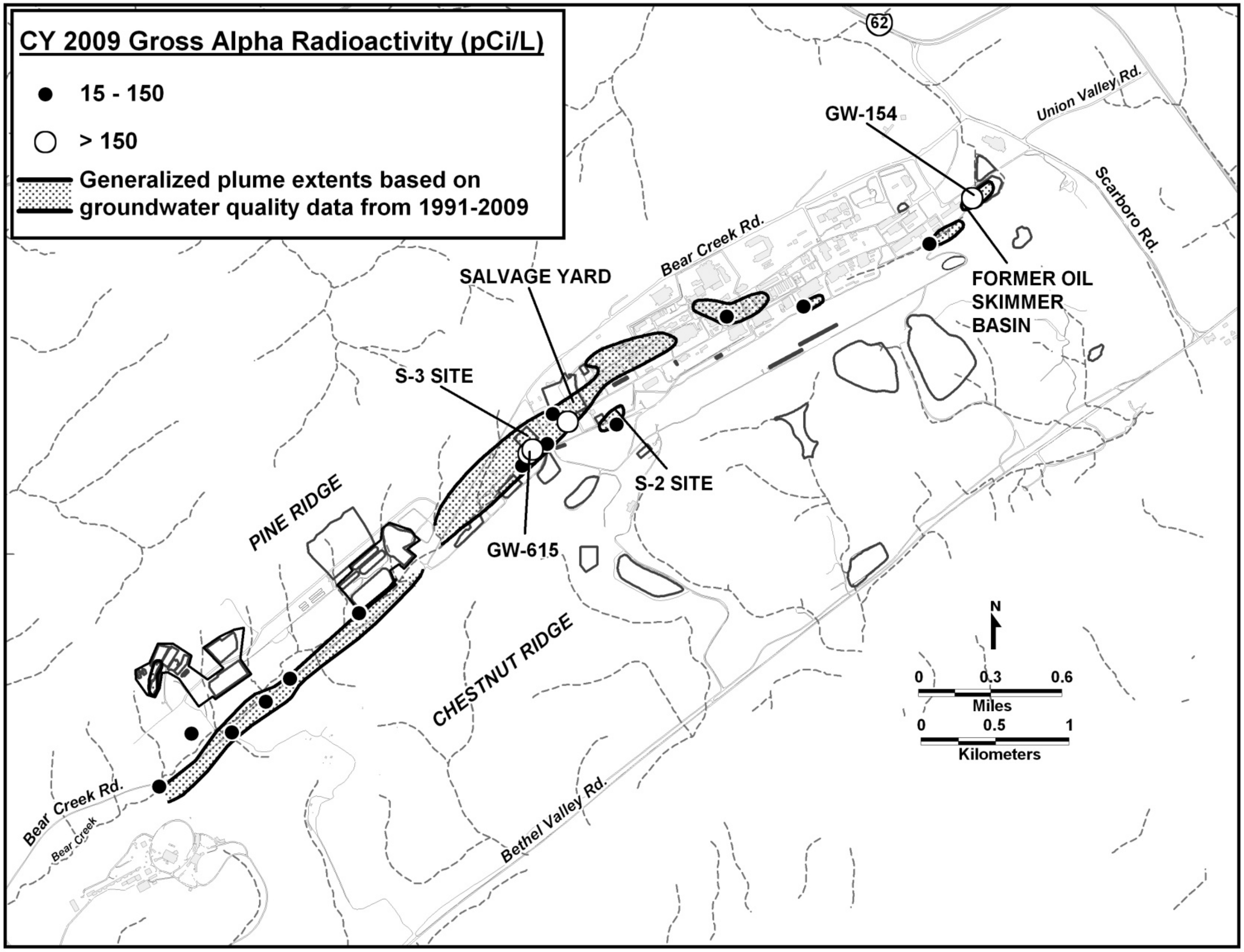


Fig. 4.41. Gross alpha radioactivity observed in groundwater at the Y-12 complex, 2009.

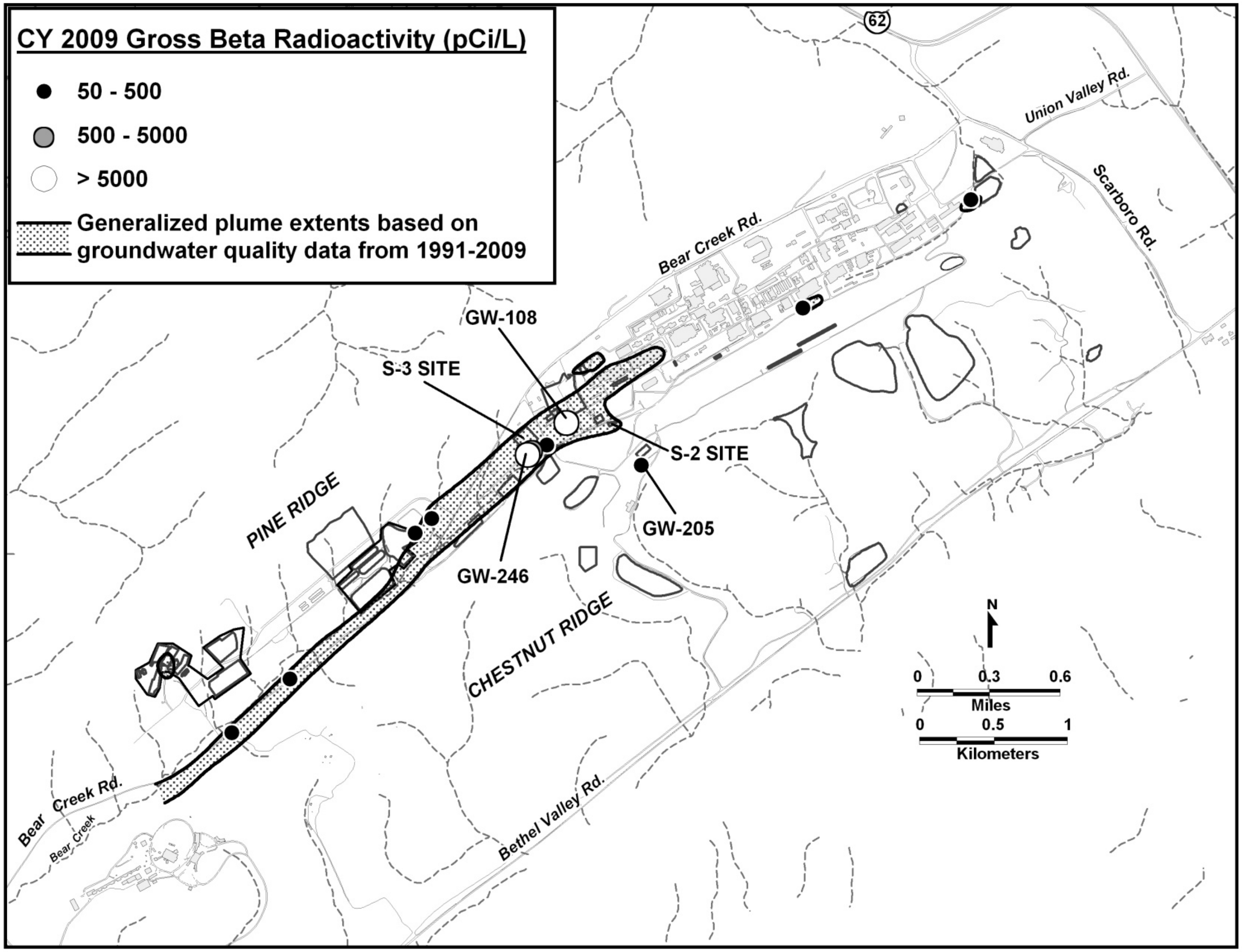


Fig. 4.42. Gross beta radioactivity observed in groundwater at the Y-12 complex, 2009.

reducing the levels of volatile organic compounds in the area. The installation of the plume capture system was completed in June 2000. This system pumps groundwater from the intermediate bedrock depth to mitigate off-site migration of volatile organic compounds. Groundwater is continuously pumped from the Maynardville Limestone at about 95 L/min (25 gal/min), passes through a treatment system to remove the volatile organic compounds, and then discharges to Upper East Fork Poplar Creek.

Monitoring wells near Well GW-845 continue to show an encouraging response to the pumping activities. The multiport system installed in Well GW-722, approximately 153 m (500 ft) east and downgradient of Well GW-845, permits sampling of vertically discrete zones within the Maynardville Limestone between 27 and 130 m (87 and 425 ft) below ground surface. This well has been instrumental in characterizing the vertical extent of the east-end plume of volatile organic compounds and is critical in the evaluation of the effectiveness of the plume capture system. Monitoring results from the sampled zones in Well GW-722 indicate reductions in volatile organic compounds due to groundwater pumping upgradient at Well GW-845 (Fig. 4.43). Other wells also show decreases that may be attributable to the plume capture system operation. These indicators show that operation of the plume capture system is decreasing volatile organic compounds upgradient and downgradient of Well GW-845.

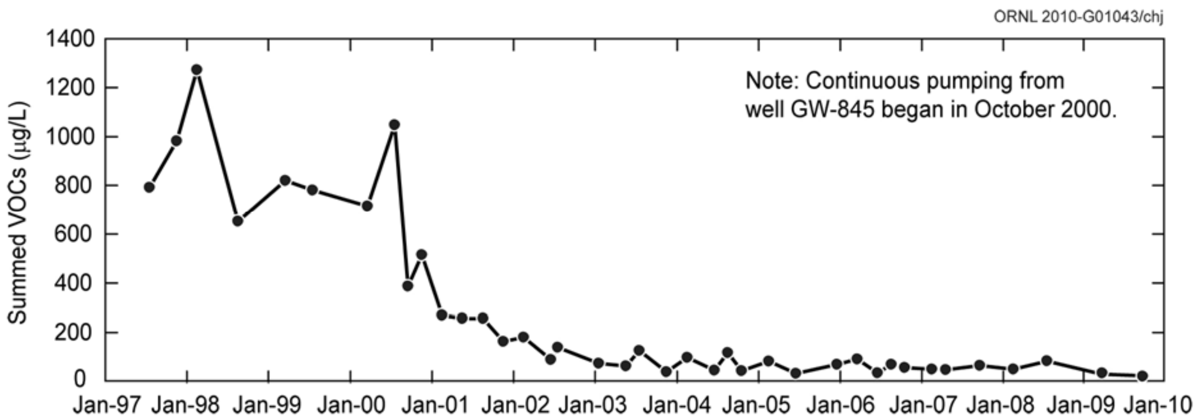


Fig. 4.43. Decreasing summed volatile organic compounds observed in exit pathway Well GW-722-17 near the New Hope Pond, 2009.

Upper East Fork Poplar Creek flows north from the Y-12 Complex through a large gap in Pine Ridge. Shallow groundwater moves through the exit pathway, and very strong upward vertical flow gradients exist. Continued monitoring of the wells since about 1990 has shown no indication of any contaminants moving via that exit pathway (Fig. 4.36). Only one shallow well was monitored in CY 2009, and no groundwater contaminants were observed.

Three sampling locations continue to be monitored north and northwest of the Y-12 Complex to evaluate possible contaminant transport from the ORR. Those locations are considered unlikely groundwater or surface water contaminant exit pathways; however, monitoring was performed due to previous public concerns regarding potential health impacts from Y-12 operations to nearby residences. One of the stations monitored a tributary that drains the north slope of Pine Ridge on the ORR and discharges into the adjacent Scarboro Community. One location monitors an upper reach of Mill Branch, which discharges into the residential areas along Wiltshire Drive. The remaining location monitors Gum Hollow Branch as it discharges from the ORR and flows adjacent to the Country Club Estates community. Samples were obtained and analyzed for metals, inorganic parameters, volatile organic compounds, and gross alpha and gross beta activities. No results exceeded a drinking water standard, nor were there any indications that contaminants were being discharged from the ORR into those communities.

4.6.4.1.7 Union Valley Monitoring

Groundwater monitoring data obtained in 1993 provided the first strong indication that volatile organic compounds were being transported off the ORR through the deep Maynardville Limestone exit pathway. The Upper East Fork Poplar Creek remedial investigation (DOE 1998) provided a discussion of the nature and extent of the volatile organic compounds.

In CY 2009, monitoring of locations in Union Valley continued, showing an overall decreasing trend in the concentrations of contaminants forming the groundwater contaminant plume in Union Valley.

Under the terms of an interim Record of Decision (ROD), administrative controls, such as restrictions on potential future groundwater use, have been established and maintained. Additionally, the previously discussed plume capture system (Well GW-845) was installed and initiated to mitigate the migration of groundwater contaminated with volatile organic compounds into Union Valley (DOE 2010).

In July 2006, the Agency for Toxic Substances and Diseases Registry, the principal federal public health agency charged with evaluating the human health effects of exposure to hazardous substances in the environment, published a report in which they evaluated groundwater contamination across the ORR (ATSDR 2006). In the report, it was acknowledged that extensive groundwater contamination exists throughout the ORR, but the authors concluded that there is no public health hazard from exposure to contaminated groundwater originating from the ORR. The Y-12 Complex east end volatile organic compound groundwater contaminant plume was acknowledged as the only confirmed off-site contaminant plume migrating across the ORR boundary. The report recognized that the institutional and administrative controls established in the ROD do not provide for reduction in toxicity, mobility, or volume of contaminants of concern, but they conclude that the controls are protective of public health to the extent that they limit or prevent community exposure to contaminated groundwater in Union Valley.

4.6.4.2 Bear Creek Hydrogeologic Regime

Located west of the Y-12 Complex in Bear Creek Valley, the Bear Creek regime is bounded to the north by Pine Ridge and to the south by Chestnut Ridge. The regime encompasses the portion of Bear Creek Valley extending from the west end of the Y-12 Complex to State Highway 95. Table 4.18 describes each of the waste management sites within the Bear Creek regime.

4.6.4.2.1 Plume Delineation

The primary groundwater contaminants in the Bear Creek regime are nitrate, trace metals, volatile organic compounds, and radionuclides. The S-3 Site is a source of all four contaminants. The Bear Creek Burial Grounds and the Oil Landfarm waste management areas are significant sources of uranium and other trace metals and volatile organic compounds. Volatile organic compounds such as tetrachloroethene, trichloroethene, 1,1-dichloroethene, 1,2-dichloroethene, and high concentrations of PCBs have been observed as deep as 82 m (270 ft) below the Bear Creek Burial Grounds.

Contaminant plume boundaries are essentially defined in the bedrock formations that directly underlie many waste disposal areas in the Bear Creek regime, particularly the Nolichucky Shale. This fractured noncarbonate rock unit is positioned north of and adjacent to the exit pathway unit, the Maynardville Limestone. The elongated shape of the contaminant plumes in the Bear Creek regime is the result of preferential transport of the contaminants parallel to strike (parallel to the valley axis) in both the Knox Aquifer and the fractured noncarbonate rock.

4.6.4.2.2 Nitrate

Unlike many groundwater contaminants, nitrate is highly soluble and moves easily with groundwater. The limits of the nitrate plume probably define the maximum extent of subsurface contamination in the Bear Creek regime. The horizontal extent of the nitrate plume is essentially defined in groundwater in the upper to intermediate part of the aquitard and aquifer [less than 92 m (300 ft) below the ground surface].

Data obtained during CY 2009 indicate that nitrate concentrations in groundwater exceed the drinking water standard in an area that extends west from the source area at the S-3 Site. The highest nitrate concentration (10,400 mg/L) was observed at Well GW-615 adjacent to the S-3 Site at a depth of 68 m (223 ft) below ground surface (Fig. 4.38), indicating that high concentrations persist deeper in the subsurface groundwater system. In previous years, elevated concentrations of nitrate have been observed as deep as 226 m (740 ft) below ground surface.

Table 4.18. History of waste management units included in CY 2009 groundwater monitoring activities, Bear Creek Hydrogeologic Regime

Site	Historical data
S-3 Site	Four unlined surface impoundments constructed in 1951. Received liquid nitric acid/uranium–bearing wastes via the Nitric Acid Pipeline until 1983. Closed and capped under RCRA in 1988. Infiltration was the primary release mechanism to groundwater
Oil Landfarm	Operated from 1973 to 1982. Received waste oils and coolants tainted with metals and PCBs. Closed and capped under RCRA in 1989. Infiltration was the primary release mechanism to groundwater
Boneyard	Used from 1943 to 1970. Unlined shallow trenches used to dispose of construction debris and to burn magnesium chips and wood. Excavated and restored in 2002–2003 as part of Boneyard/Burnyard remedial activities
Burnyard	Used from 1943 to 1968. Wastes, metal shavings, solvents, oils, and laboratory chemicals were burned in two unlined trenches. Excavated and restored in 2002–2003
Hazardous Chemical Disposal Area	Used from 1975 to 1981. Built over the Burnyard. Handled compressed gas cylinders and reactive chemicals. Residues placed in a small, unlined pit. The northwest portion was excavated and restored in 2002–2003 as part of Boneyard/Burnyard remedial activities
Sanitary Landfill I	Used from 1968 to 1982. TDEC-permitted, nonhazardous industrial landfill. May be a source of certain contaminants to groundwater. Closed and capped under TDEC requirements in 1985
Bear Creek Burial Grounds: A, C, and Walk-in Pits	A and C received waste oils, coolants, beryllium and uranium, various metallic wastes, and asbestos into unlined trenches and standpipes. Walk-in Pits received chemical wastes, shock-sensitive reagents, and uranium saw fines. Activities ceased in 1981. Final closure certified for A (1989), C (1993), and the Walk-in Pits (1995). Infiltration is the primary release mechanism to groundwater
Bear Creek Burial Grounds: B, D, E, J, and Oil Retention Ponds 1 and 2	Burial Grounds B, D, E, and J, unlined trenches, received depleted uranium metal and oxides and minor amounts of debris and inorganic salts. Ponds 1 and 2, built in 1971 and 1972, respectively, captured waste oils seeping into two Bear Creek tributaries. The ponds were closed and capped under RCRA in 1989. Certification of closure and capping of Burial Grounds B and part of C was granted February 1995
Rust Spoil Area	Used from 1975 to 1983 for disposal of construction debris, but may have included materials bearing solvents, asbestos, mercury, and uranium. Closed under RCRA in 1984. Site is a source of volatile organic compounds to shallow groundwater according to CERCLA remedial investigation.
Spoil Area I	Used from 1980 to 1988 for disposal of construction debris and other stable, nonradioactive wastes. Permitted under TDEC solid waste management regulations in 1986; closure began shortly thereafter. Soil contamination is of primary concern. CERCLA record of decision issued in 1996
SY-200 Yard	Used from 1950 to 1986 for equipment and materials storage. No documented waste disposal at the site occurred. Leaks, spills, and soil contamination are concerns. CERCLA ROD issued in 1996
Above-Grade LLW Storage Facility	Constructed in 1993. Consists of six above-grade storage pads used to store inert, low-level radioactive debris and solid wastes packaged in steel containers

Abbreviations

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
LLW = low-level radioactive waste
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
TDEC = Tennessee Department of Environment and Conservation

4.6.4.2.3 Trace Metals

During CY 2009, uranium, barium, cadmium, lead, beryllium, and nickel were identified from groundwater monitoring as the trace metal contaminants in the Bear Creek regime that exceeded drinking water standards. Historically, elevated concentrations of many of the trace metals were observed at shallow depths near the S-3 Site. In the Bear Creek regime, where natural geochemical conditions prevail, the trace metals may occur sporadically and in close association with source areas because conditions are typically not favorable for dissolution and migration. Disposal of acidic liquid wastes at the S-3 Site reduced the pH of the groundwater, which allows the metals to remain in solution longer and migrate further from the source area.

The most prevalent trace metal contaminant observed within the Bear Creek regime is uranium, indicating that geochemical conditions are favorable for its migration. Early characterization indicated that the Boneyard/Burnyard site was the primary source of uranium contamination of surface water and groundwater. Historically, uranium has been observed at concentrations exceeding the drinking water standard of 0.03 mg/L in shallow monitoring wells, springs, and surface water locations downgradient from all of the waste areas. In 2003, the final remedial actions at the Boneyard/Burnyard were performed with the objective of removing materials contributing to surface water and groundwater contamination to meet existing ROD goals. Approximately 65,752 m^3 (86,000 yd^3) of waste materials was excavated and placed in the EMWMF (DOE 2007). There has been a significant decrease in uranium in the surface water tributary immediately downstream of the Boneyard/Burnyard, which indicates that the remedial actions performed from 2002 to 2003 were successful in removing much of a primary source of uranium in Bear Creek Valley. In 2009, a corresponding continuing decrease in uranium concentrations was observed downstream in Bear Creek (Table 4.19). Other trace metal contaminants that have been observed in the Bear Creek regime are arsenic, boron, chromium, cobalt, copper, lithium, manganese, mercury, strontium, thallium, and zinc. Concentrations have commonly exceeded background values in groundwater near contaminant source areas.

4.6.4.2.4 Volatile Organic Compounds

Volatile organic compounds are widespread in groundwater in the Bear Creek regime. The primary compounds are tetrachloroethene, trichloroethene, 1,2-dichloroethene, 1,1-dichloroethane, and vinyl chloride. In most areas, they are dissolved in the groundwater and can occur in bedrock at depths up to 92 m (300 ft) below ground surface. Groundwater in the fractured noncarbonate rock that contains detectable levels of volatile organic compounds occurs primarily within about 305 m (1,000 ft) of the source areas. The highest concentrations observed in CY 2009 in the Bear Creek regime occurred in the intermediate bedrock zone at the Bear Creek Burial Ground waste management area, with a maximum summed volatile organic compound concentration of 219,070 µg/L in Well GW-629 (Fig. 4.40). This result is an order of magnitude higher than concentrations seen in all previous years.

Table 4.19. Nitrate and uranium concentrations in Bear Creek[a]

Bear Creek Monitoring Station (distance from S-3 site)	Contaminant	Four-Year Average Concentration (mg/L)				
		1990–1993	1994–1997	1998–2001	2002–2005	2006–2009
BCK[b]-11.84 to 11.97	Nitrate	119	80	80	79.5	33.4
(~0.5 miles downstream)	Uranium	0.196	0.134	0.139	0.133	0.122
BCK-09.20 to 09.47	Nitrate	16.4	9.6	10.6	11.3	9.1
(~2 miles downstream)	Uranium	0.091	0.094	0.171	0.092	0.067
BCK-04.55	Nitrate	4.6	3.6	2.6	2.9	1.1
(~5 miles downstream)	Uranium	0.034	0.031	0.036	0.026	0.022

[a] Excludes results that do not meet data quality objectives.
[b] BCK = Bear Creek kilometer

When this monitoring well was sampled using the passive diffusion bag sampler, the bag was hung about 88 m (290 ft) below ground surface. When the sampler was removed from the well, it was coated with an oily substance. This discovery initiated an additional sampling event with a standard Teflon bailer to capture this substance. The bailer sample consisted of a heavy free phase oil and water. The analysis of the oil showed high concentrations of volatile organic compounds (primarily tetrachloroethene), semivolatile organic compounds, and PCBs. The compounds detected in the water sample were consistent with the oil sample, but at much lower concentrations. These results are consistent with oil and water samples taken during the installation of this and other nearby wells in 1990 (MMES 1990). These results, coupled with increasing trends observed downgradient of the Bear Creek Burial Ground waste management area in the fractured noncarbonate rock (Fig. 4.44), indicate that a considerable mass of dense non-aqueous phase organic compounds is still present at depth below the Bear Creek Burial Grounds, providing a source for dissolved phase migration of volatile organic compounds. This migration through the fractured noncarbonate rock parallel to the valley axis and toward the exit pathway (Maynardville Limestone) is occurring in both the unconsolidated and bedrock intervals.

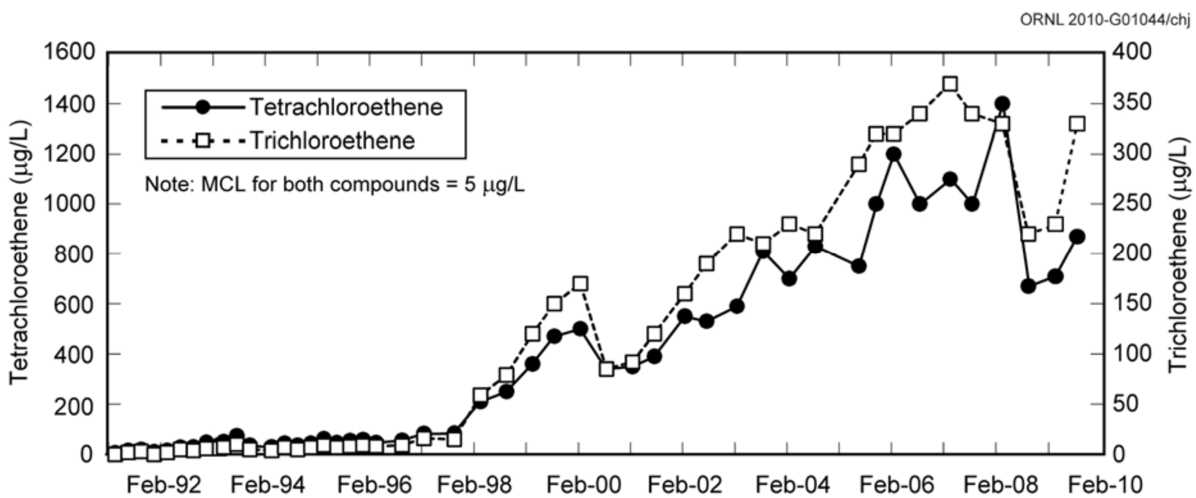


Fig. 4.44. Increasing volatile organic compounds observed in groundwater at Well GW-627 west and downgradient of the Bear Creek Burial Grounds, 2009.

Significant transport of volatile organic compounds has occurred in the Maynardville Limestone. Data obtained from exit pathway monitoring locations show that in the shallow groundwater interval, an apparently continuous dissolved plume extends at least 2,440 m (8,000 ft) westward from the S-3 Site to just southeast of the Bear Creek Burial Ground waste management area.

4.6.4.2.5 Radionuclides

The primary radionuclides identified in the Bear Creek regime are isotopes of uranium and technetium-99. Neptunium, americium, radium, strontium, thorium, plutonium, and tritium are secondary and less widespread radionuclides, primarily present in groundwater near the S-3 Site. Evaluations of their extent in groundwater in the Bear Creek regime during CY 2009 were based primarily on measurements of gross alpha activity and gross beta activity. If the annual average gross alpha activity in groundwater samples from a well exceeded 15 pCi/L (the drinking water standard for gross alpha activity), then one (or more) of the alpha-emitting radionuclides (e.g., uranium) was assumed to be present at elevated levels in the groundwater monitored by the well. A similar rationale was used for annual average gross beta activity that exceeded 50 pCi/L. Technetium-99, a more volatile radionuclide, is qualitatively screened by gross beta activity analysis and, at certain monitoring locations, is evaluated isotopically.

Groundwater with elevated levels of gross alpha activity occurs near the S-3 Site and the Oil Landfarm and Bear Creek Burial Grounds waste management areas. In the bedrock interval, gross alpha activity exceeds 15 pCi/L in groundwater in the fractured noncarbonate rock only near source areas (Fig. 4.41). Data obtained from exit pathway monitoring stations show that gross alpha activity in groundwater in the Maynardville Limestone and in the surface waters of Bear Creek exceeds the drinking water standard for over 3,355 m (11,000 ft) west of the S-3 Site. The highest gross alpha activity observed in CY 2009 was 400 pCi/L in Well GW-615 located adjacent to the S-3 Site.

The distribution of gross beta radioactivity in groundwater is similar to that of gross alpha radioactivity. During CY 2009, it appears that the lateral extent of gross beta activity within the exit pathway groundwater interval and surface water above the drinking water standard has not changed from those observed in recent years. Gross beta activities exceeded 50 pCi/L within the Maynardville Limestone exit pathway for 2,440 to 3,050 m (8,000 to 10,000 ft) from the S-3 Site (Fig. 4.42). The highest gross beta activity in groundwater in the Bear Creek Regime in 2009 was 11,000 pCi/L at Well GW-246 located adjacent to the S-3 Site.

4.6.4.2.6 Exit Pathway and Perimeter Monitoring

Exit pathway monitoring began in 1990 to provide data on the quality of groundwater and surface water exiting the Bear Creek regime. The Maynardville Limestone is the primary exit pathway for groundwater. Bear Creek, which flows across the Maynardville Limestone in much of the Bear Creek regime, is the principal exit pathway for surface water. Various studies have shown that the surface water in Bear Creek, the springs along the valley floor, and the groundwater in the Maynardville Limestone are hydraulically connected. Surveys have been performed that identify gaining (groundwater discharging into surface waters) and losing (surface water discharging into a groundwater system) reaches of Bear Creek. The western exit pathway well transect (Picket W) serves as the perimeter well location for the Bear Creek regime (Fig. 4.36).

Exit pathway monitoring consists of continued monitoring at four well transects (pickets) and selected springs and surface water stations. Groundwater quality data obtained during CY 2009 from the exit pathway monitoring wells indicate that groundwater is contaminated above drinking water standards in the Maynardville Limestone as far west as Picket A and trends are generally decreasing (Fig. 4.45).

Surface water samples collected during CY 2009 indicate that water in Bear Creek contains many of the compounds found in the groundwater. Additionally, nitrate and uranium concentrations and gross beta activities exceeding their respective drinking water standards have been observed in surface water west of the burial grounds as far as Picket A. The concentrations in the creek decrease with distance downstream of the waste disposal sites (Table 4.19). Individual monitoring locations along Bear Creek also show a decrease in concentration with respect to time, reflecting the positive steps toward remediation of legacy wastes and active mitigating practices of pollution prevention.

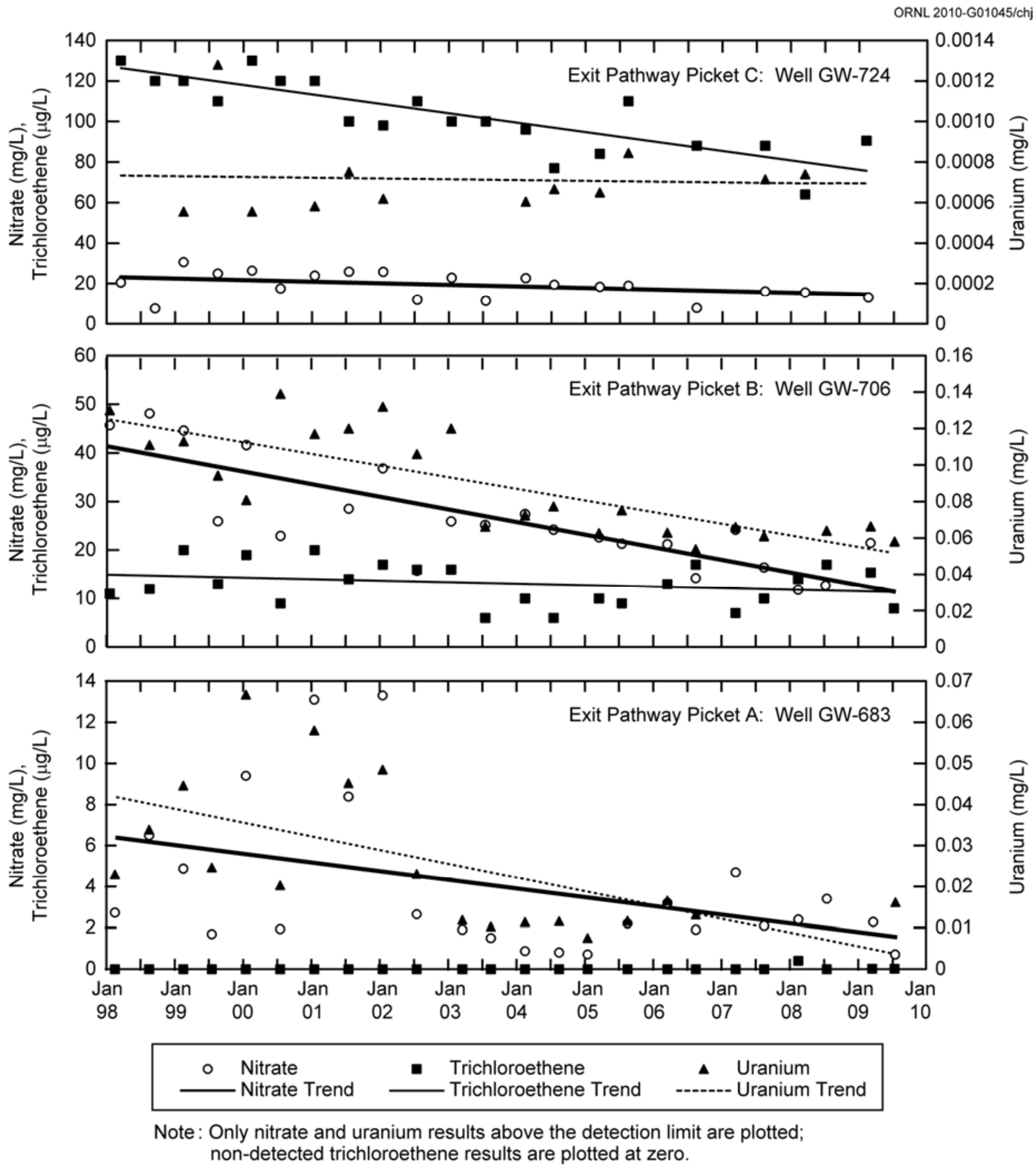
4.6.4.3 Chestnut Ridge Hydrogeologic Regime

The Chestnut Ridge Hydrogeologic Regime is flanked to the north by Bear Creek Valley and to the south by Bethel Valley Road (Fig. 4.34). The regime encompasses the portion of Chestnut Ridge extending from Scarboro Road, east of the complex, to Dunaway Branch, located just west of Industrial Landfill II.

The Chestnut Ridge Security Pits area is the only documented source of groundwater contamination in the regime. Contamination from the Security Pits is distinct and does not mingle with plumes from other sources. Table 4.20 summarizes the operational history of waste management units in the regime.

4.6.4.3.1 Plume Delineation

Through extensive monitoring of the wells on Chestnut Ridge, the horizontal extent of the volatile organic compound plume at the Chestnut Ridge Security Pits seems to be reasonably well defined in the water table and shallow bedrock zones. With two possible exceptions, historical monitoring indicates that the volatile organic compound plume from the Chestnut Ridge Security Pits has not migrated very far in any direction [305 m (<1,000 ft)]. Groundwater quality data obtained during CY 2009 indicate that the western lateral extent of the plume of volatile organic compounds at the site has not changed significantly from previous years. The continued observation of volatile organic compound contaminants over the past several years at a well approximately 458 m (1,500 ft) southeast of the Chestnut Ridge Security Pits shows that some migration of the eastern plume is apparent. Additionally, dye tracer test results and the intermittent detection of volatile organic compounds (similar to those found in wells adjacent to the Chestnut Ridge Security Pits) at a natural spring approximately 2745 m (9,000 ft) to the east and along geologic strike may indicate that Chestnut Ridge Security Pits groundwater contaminants have migrated much further than the monitoring well network indicates.



Note: Only nitrate and uranium results above the detection limit are plotted; non-detected trichloroethene results are plotted at zero.

Fig. 4.45. CY 2009 concentrations of selected contaminants in exit pathway monitoring wells GW-724, GW-706, and GW-683 in the Bear Creek Hydrogeologic Regime.

Table 4.20. History of waste management units included in groundwater monitoring activities, Chestnut Ridge Hydrogeologic Regime, 2009

Site	Historical data
Chestnut Ridge Sediment Disposal Basin	Operated from 1973 to 1989. Received soil and sediment from New Hope Pond and mercury-contaminated soils from the Y-12 Complex. Site was closed under RCRA in 1989. Not a documented source of groundwater contamination
Kerr Hollow Quarry	Operated from 1940s to 1988. Used for the disposal of reactive materials, compressed gas cylinders, and various debris. RCRA closure (waste removal) was conducted between 1990 and 1993. Certification of closure with some wastes remaining in place was approved by TDEC February 1995
Chestnut Ridge Security Pits	Operated from 1973 to 1988. Series of trenches for disposal of classified materials, liquid wastes, thorium, uranium, heavy metals, and various debris. Closed under RCRA in 1989. Infiltration is the primary release mechanism to groundwater
United Nuclear Corporation Site	Received about 29,000 drums of cement-fixed sludges and soils demolition materials and low-level radioactive contaminated soils. Closed in 1992; CERCLA record of decision has been issued
Industrial Landfill II	Operated from 1983–1995. Central sanitary landfill for the Oak Ridge Reservation. Detection monitoring under postclosure plan has been ongoing since 1996
Industrial Landfill IV	Opened for operations in 1989. Permitted to receive only nonhazardous industrial solid wastes. Detection monitoring under TDEC solid-waste-management regulations has been ongoing since 1988
Industrial Landfill V	Facility completed and initiated operations April 1994. Baseline groundwater monitoring began May 1993 and was completed January 1995. Currently under TDEC solid-waste-management detection monitoring
Construction/Demolition Landfill VI	Facility operated from December 1993 to November 2003. The postclosure period ended and the permit was terminated March 2007
Construction/Demolition Landfill VII	Facility construction completed in December 1994. TDEC granted approval to operate January 1995. Baseline groundwater quality monitoring began in May 1993 and was completed in January 1995. Permit-required detection monitoring per TDEC was temporarily suspended October 1997 pending closure of construction/demolition Landfill VI. Reopened and began waste disposal operations in April 2001
Filled Coal Ash Pond	Site received Y-12 Steam Plant coal ash slurries. A CERCLA record of decision has been issued. Remedial action complete
East Chestnut Ridge Waste Pile	Operated from 1987 to 1989 to store contaminated soil and spoil material generated from environmental restoration activities at Y-12. Closed under RCRA in 2005 and incorporated into RCRA Postclosure Plan issued by TDEC in 2006

Abbreviations

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

RCRA = Resource Conservation and Recovery Act

TDEC = Tennessee Department of Environment and Conservation

4.6.4.3.2 Nitrate

Nitrate concentrations were below the drinking water standard at all monitoring stations in the Chestnut Ridge Hydrogeologic Regime.

4.6.4.3.3 Trace Metals

A chromium result exceeding the drinking water standard (0.1 mg/L) was observed in a groundwater sample from one well (GW-305) at the Industrial Landfill IV (Fig. 4.33) with a maximum concentration of 0.13 mg/L. The presence of this trace metal in groundwater at the Y-12 Complex, with the exception of the S-3 Site, is not due to historical waste disposal but to corrosion of well casings. Nickel is a primary component of stainless steel, and its presence indicates the occurrence of corrosion and subsequent dissolution of stainless steel well casing and screen materials due to chemical or biochemical processes (LMES 1999).

4.6.4.3.4 Volatile Organic Compounds

Monitoring of volatile organic compounds in groundwater attributable to the Chestnut Ridge Security Pits has been in progress since 1987. A review of historical data indicates that concentrations of volatile organic compounds in groundwater at the site have generally decreased since 1988. However, a shallow increasing trend in volatile organic compounds in groundwater samples from monitoring well GW-798 to the southeast and downgradient of the Chestnut Ridge Security Pits has been developing since CY 2000 (Fig. 4.40). Elevated concentrations observed in GW-798 appear to fluctuate with changing precipitation conditions. The volatile organic compounds detected in CY 2009 in Well GW-798 continue to be characteristic of the Chestnut Ridge Security Pits plume.

At Industrial Landfill IV, a number of volatile organic compounds have been observed since 1992. Monitoring well GW-305, located immediately to the southeast of the facility, has historically displayed concentrations of compounds below applicable drinking water standards, but the concentrations have exhibited a shallow increasing trend. In CY 2009, samples slightly exceeded the standard for 1,1-dichloroethene, resulting in the issuance of a regulatory notice of violation by the Tennessee Department of Environment and Conservation (see Section 2.5 for more details).

4.6.4.3.5 Radionuclides

In CY 2009, no gross alpha activity above the drinking water standard of 15 pCi/L was observed in any groundwater samples collected in the Chestnut Ridge Hydrogeologic Regime. Gross beta activities exceeded the screening level of 50 pCi/L at monitoring well GW-205 (Fig. 4.42) at the United Nuclear Corporation site (the maximum detected activity was 64.3 pCi/L). This location has consistently exceeded the screening level since August 1999. Isotopic analyses show a correlative increase in the beta-emitting radionuclide potassium-40, which is not a known contaminant of concern at the United Nuclear Corporation Site. The source of the radioisotope is not known.

4.6.4.3.6 Exit Pathway and Perimeter Monitoring

Contaminant and groundwater flow paths in the karst bedrock underlying the Chestnut Ridge regime have not been well characterized by conventional monitoring techniques. A number of tracer studies have been conducted that show groundwater from Chestnut Ridge discharging into Scarboro Creek and other tributaries that feed into Melton Hill Lake. However, no springs or surface streams that represent discharge points for groundwater have been conclusively correlated to a waste management unit at Y-12 that is a known or potential groundwater contaminant source. Water quality from a spring along Scarboro Creek is monitored quarterly by the TDEC DOE Oversight Office, and trace concentrations of volatile organic compounds are intermittently detected. The detected volatile organic compounds are suspected to originate from the Chestnut Ridge Security Pits; however, this has not been confirmed.

Monitoring of natural groundwater exit pathways is a basic monitoring strategy in a karst regime such as that of Chestnut Ridge. Perimeter springs and surface water tributaries were monitored to determine whether contaminants are exiting the downgradient (southern) side of the regime. Five springs and three surface water monitoring locations were sampled during CY 2009. No contaminants were detected in any of these natural discharge points above drinking water standards.

4.6.5 Quality Assurance

All groundwater monitoring is performed under quality controls to ensure that representative samples and analytical results are obtained. Since there are a number of organizations responsible for performing groundwater sampling and analysis activities to meet separate requirements, there may be some minor differences in sampling and analysis procedures and methodology, but ultimately the final results are comparable for use by all projects and programs. This permits the integrated use of groundwater quality data obtained at the Y-12 Complex.

A number of quality assurance measures are performed to ensure accurate, consistent, and comparable groundwater results. These measures are described in sampling and analysis plans and include the following:

- Groundwater sampling is performed across the Y-12 Complex using a number of sampling methods and procedures. The predominant method of sampling is by using a low-flow minimum drawdown method. Under this method, a sample is obtained from a discrete depth interval without introducing stagnant water from the well casing. Groundwater is pumped from the well at a flow rate low enough to minimize drawdown of the water level in the well; field readings are also taken to ensure that the sample is representative of the groundwater system and not the well casing itself. All sampling methods follow industry-/regulatory-recognized protocols to ensure that consistent and repeatable samples are obtained.
- Quality controls such as field blank, trip blank, duplicate, and equipment rinsate samples are collected.
- All groundwater samples are controlled under chain of custody from their collection in the field through the analytical laboratory that performed the analyses.
- Laboratory analyses are performed using standard methodologies and protocols within established holding times.

During 2009 all groundwater monitoring and related analytical activities were performed in accordance with the established protocols.

4.7 Remedial Action and Waste Management

4.7.1 Upper East Fork Poplar Creek Remediation

Remediation of the Upper East Fork Poplar Creek (UEFPC) Watershed is being conducted in stages under Records of Decision using a phased approach. Phase 1 addresses remediation of mercury-contaminated soil, sediment, and groundwater discharges that contribute contamination to surface water.

The initial project of the Phase 1 ROD, construction of the Big Springs Water Treatment System, was completed in 2006. The system has been fully operational since September 2006, removing mercury from local spring and sump waters that discharge to UEFPC.

With ARRA funding, cleanup and repair of storm sewers in the West End Mercury Area (historic mercury use area) was initiated in FY 2009. The initial phase, videotaping the storm sewer system, has been completed and the videotape has been evaluated. An Engineering Study Report that documents the results has been completed and submitted to the regulatory agencies for their comment. Future phases of this action will include the removal of contaminated sediments from the storm sewers and relining or replacement of leaking sewer sections. This action is part of three actions identified in the Phase 1 ROD to limit mercury migration by hydraulically isolating the West End Mercury Area. A Characterization Plan for the 81-10 Area, the site of a historic mercury recovery process, has been prepared and submitted to the regulatory agencies for comment.

The focus of the second phase is remediation of the balance of contaminated soil, scrap, and buried materials within the Y-12 Complex. Decisions regarding final land use and final goals for surface water, groundwater, and soils will be addressed in future decision documents. The Phase 2 ROD was approved by all FFA parties in April 2006. ARRA funding is being used to remove scrap metal from the Old Salvage Yard, one of the remedies authorized in the Phase II ROD.

The initial project of the Phase 2 ROD is remediation of the Y-12 Old Salvage Yard. The Y-12 Old Salvage Yard Project started in 2009 using ARRA funding. In addition, a Remedial Action Work Plan for remediation of all contaminated soils at the Y-12 Complex has been submitted to the regulatory agencies for comment and approval.

4.7.2 Time-Critical Removal Actions Planned

ARRA funding was received in FY 2009 to expedite removal of legacy wastes and building demolition at the Y-12 National Security Complex. Two CERCLA Time-Critical Removal Actions were initiated to remove legacy wastes from the Alpha 5 and Beta 4 buildings , demolish some of the Biology Complex Buildings (9211, 9220, 9224, and 9769), and demolish 9735 and clean and remove some uranium recovery system components in 9206.

A Waste Handling Plan has been prepared for submission to the regulators to allow disposition of Alpha 5 wastes at EMWMF. Some wastes are being packaged for shipment to the Nevada Test Site, and some will be disposed at EMWMF, while wastes meeting the Y-12 Landfill waste acceptance criteria are being disposed at that facility.

4.7.3 Waste Management

The Environmental Management Waste Management Facility (EMWMF), located in east Bear Creek Valley near the Y-12 Complex, was selected as the remedy for disposal of waste resulting from CERCLA cleanup actions on the Oak Ridge Reservation. This remedy called for the detailed design, construction, operation, and closure of a 1.3 million m^3 (1.7 million yd^3) disposal facility. The facility currently consists of four disposal cells with a fifth cell under construction at the end of FY September 2009. To ensure the continuity of disposal capacity for ORR cleanup waste, Cell 5 was redesigned to enable a sixth cell to be added if appropriate regulatory approvals are secured. Construction of Cell 5 began in May 2009.

EMWMF is an engineered landfill that accepts low-level radioactive and hazardous wastes that meet specific waste acceptance criteria developed in accordance with agreements with state and federal regulators. Waste types that qualify for disposal include soil, dried sludge and sediment, solidified wastes, stabilized waste, building debris, scrap equipment, and secondary waste such as personal protective equipment.

During FY 2009, EMWMF operations collected, analyzed, and dispositioned approximately 12.8 million liters (3.4 million gal) of leachate at the ORNL Liquids and Gases Treatment Facility. An additional 34 million liters (8.9 million gal) of contact water was collected and analyzed. After determining that it met the release criteria, the water was released to the sediment basin. Operating practices also effectively controlled site erosion and sediments.

EMWMF received approximately 14,700 truckloads of waste accounting for approximately 157 million kilograms (173,600 tons) during FY 2009. Projects that have disposed of waste at EMWMF during the fiscal year include the following:

- David Witherspoon, Inc. 1630 Site Remedial Action Project;
- K-25/K-27 Project, including hazardous material abatement, excess materials removal, and K-25 Building (west wing) demolition debris and equipment; and
- ETTP Decontamination and Decommissioning Project, including K-1401, K-1066-G Scrapyard, K-1070-B Burial Ground, and K-1035 demolition debris.

Concurrent with the activities at EMWMF, DOE also operates the solid waste disposal facilities called the Oak Ridge Reservation Landfills (ORRL), which are located near the Y-12 Complex (see

Sect. 4.3.6.2). The ORRL are engineered facilities permitted by the State Division of Solid Waste for the disposal of sanitary, industrial, construction, and demolition waste that meet the waste acceptance criteria for each landfill. In FY 2009, more than 110,860 m^3 (145,000 yd^3) of industrial, construction/demolition, classified, and spoil material waste were disposed.

Operation of the ORRL generated more than 6 million liters (1.6 million gal) of leachate that was collected, monitored, and discharged to the Oak Ridge sewer system.

EMWMF and ORRL are serving the disposal needs of the Oak Ridge Reservation cleanup program as well as the active missions of ORNL and the Y-12 Complex.

4.7.4 Wastewater Treatment

The National Nuclear Security Administration (NNSA) at the Y-12 Complex treated 513 million liters (135.5 million gal) of contaminated ground/sump water at the Groundwater Treatment Facility, the Central Mercury Treatment System, Big Springs Water Treatment System, and the East End Volatile Organic Compounds Treatment System.

The Big Springs Water Treatment System treated 436 million liters (115.3 million gal) of mercury-contaminated groundwater and realized an annual savings of $10,000 by optimizing the treatment system to reduce filter change-out and disposal.

The East End Volatile Organic Compound Treatment System treated 57 million liters (15.1 million gal) of contaminated groundwater. The West End Treatment Facility and the Central Pollution Control Facility at the Y-12 Complex processed 3,205,895 liters (847,000 gal) of wastewater primarily in support of NNSA operational activities.

The Central Pollution Control Facility also downblended more than 113,460 liters (30,000 gal) of enriched wastewaters using legacy and newly generated uranium oxides from on-site storage.

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