4. The Y-12 National Security Complex

The Y-12 National Security Complex, a one-of-a-kind manufacturing facility, currently operated by Babcock & Wilcox Technical Services Y-12, LLC (formerly BWXT Y-12), was built during World War II as part of the Manhattan Project. Today, as part of the National Nuclear Security Administration Nuclear Security Enterprise, and with more than 60 years of experience to draw from, Y-12 is uniquely qualified as a premier manufacturing facility dedicated to making our nation and the world a safer place. While we are extremely proud of our past, our challenge today is to lay a firm foundation for the Y-12 of tomorrow—a streamlined, modern complex that is sized to meet future missions and to do so in a safe, secure, environmentally sound, energy-efficient, and sustainable manner. Infrastructure reduction activities since 2001, in which more than 1.2 million ft^2 (284 buildings) have been demolished, have already significantly changed the face of the Y-12 Complex. Recently constructed facilities such as the Jack Case and New Hope centers provide modern office space. Completion of the Highly Enriched Uranium Materials Facility in 2008 provides another transformation success.

The environmental programs at Y-12 continue to be managed and implemented in accordance with applicable environmental laws, regulations and permits. We seek to continually improve our environmental performance, reducing impact on the environment; improvements include increased use of environmentally friendly products and processes and reduced waste and emissions. Our environmental stewardship accomplishments have been recognized by our customer, our community, and other stakeholders. The compliance status and results of monitoring and measurements conducted by the Y-12 environmental programs during 2008 are presented in this chapter.

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 and is dedicated to making the nation and the world a safer place. With more than 60 years of experience to draw from, Y-12 is uniquely qualified to address the existing and emerging security challenges facing our nation and the world today. Today Y-12's roles include

- 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;
- providing technical support and know-how to National Nuclear Security Administration (NNSA) Defense Nuclear Nonproliferation Program;
- providing fuel for the nation's naval reactors program;
- transferring of technology to private industry;
- maintenance of DOE capabilities; and
- 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 g. Located within the town limits of Oak Ridge, Y-12 covers more than 328 ha in the Bear Creek Valley, stretching 2.5 miles down the valley and nearly 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 an analytical laboratory and a vehicle maintenance facility. 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 current 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 have already significantly changed the face of the Y-12 Complex. In FY 2008, an additional 149,000 ft^2 of floor space was demolished, bringing Y-12's total to more than 1.2 million ft^2 (284 buildings) demolished since the program was initiated in 2001. Infrastructure reduction also supports Y-12's waste reduction goals and recycling initiatives. Since 2002, through infrastructure reduction, more than 41 pollution prevention projects have been completed, including ongoing recycling projects that have resulted in the elimination of more than 9.4 million lb of waste with an estimated cost avoidance of more than $1.21 million. This does not include the significant cost avoidances and waste reduction amounts for the various ongoing Y-12 Complex recycling initiatives (e.g., lamps, batteries, ballasts, furniture) that are supported by infrastructure reduction.

4.1.2.2 New Construction

Two recently constructed buildings, the Jack Case Center and the New Hope Center, typify Y-12's rich history and bright future (Fig. 4.1). The Jack Case Center, which houses administrative, technical, and engineering functions, is named in honor of Jack M. Case, who rose through the ranks to become plant manager and who had the longest tenure—15 years. The New Hope Center is located at the east end of the complex, where the small community of New Hope once stood. The structure houses a visitor's center, a Y-12 History Exhibit (see Sect. 4.3.2.2), and other functions requiring frequent interaction with the public. Together, these new facilities replaced about 1 million ft^2 of obsolete workspace with about 540,000 ft^2 of modern office and laboratory space for about 1,500 employees. Both the Jack Case Center and the New Hope Center have incorporated many Leadership in Energy and Environmental Design (LEED®) guided sustainable building practices and techniques, with New Hope achieving LEED certification. The LEED program falls under the U.S. Green Building Council and is used to guide building design toward a holistic approach to sustainability. From establishing parking spaces for alternative-fuel vehicles to installing low-flow water fixtures in the restrooms and four aboveground 12,000-gal rainwater-harvesting tanks, LEED has inspired an impressive list of "green" features throughout both facilities.

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.

- **Highly Enriched Uranium Materials Facility (HEUMF)**—This new, state-of-the-art storage facility (Fig. 4.2) is our nation's central repository for highly enriched uranium and Y-12's first significant milestone in its quest for a modernized Uranium Center of Excellence. Special nuclear material that is housed in multiple aging facilities will be consolidated in it. On Sept. 29, 2008, the facility was officially introduced to the public and the Y-12 population in a celebration at the site. One month earlier (on August 27) the HEUMF project had accomplished its milestone of essentially completing construction on the facility.

Fig. 4.1. Jack Case Center (upper) and New Hope Center.

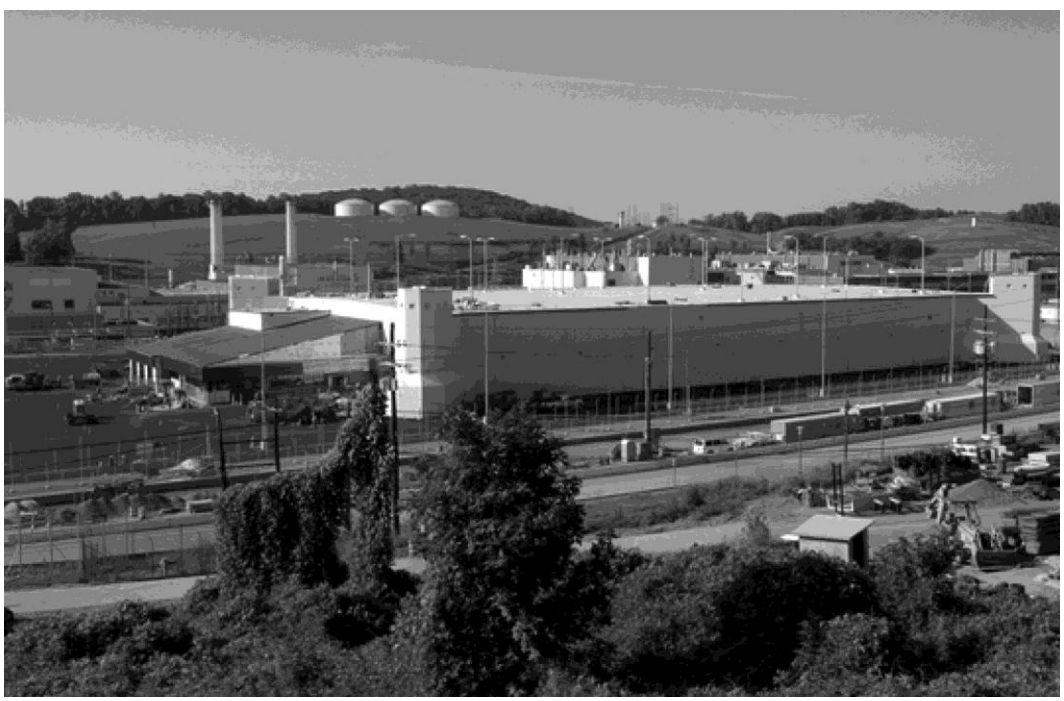

Fig. 4.2. Y-12's new state-of-the-art storage facility.

- **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, 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 9,000 ft of deteriorated original cast mains; and sprinkler system modifications.
- **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%, and particulate matter by 72%. In addition, the new plant will require less water and fewer chemicals because it uses reverse osmosis for water purification. Construction is ongoing and on track for completion by mid-January 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) project's Critical Decision-1 package was approved November 19, 2008, by NNSA. The 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.

4.2 Environmental Management System

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

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 Integrated Safety Management (ISM) for environmental compliance, pollution prevention, waste minimization, and resource conservation. B&W Y-12 has self-declared implementation based on the principles of the ISO 14001 standard after verifying and validating implementation based on a second-party independent assessment. The assessment concluded that "The EMS is fully integrated within ISMS and the required elements from ISO 14001 have been achieved."

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 such as the Environment, Safety, and Health Expo (see Sect. 4.2.4.2), and public documents such as this one. The B&W Y-12 ES&H policy contains environmental commitments required by ISO 14001 as 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 our work activities.

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. Y-12 environment, safety, and health policy.

4.2.3 Planning

The planning requirements of the ISO 14001 standard require B&W Y-12 to identify the environmental aspects and impacts of its activities, products, and services; to evaluate applicable legal and other requirements; to establish objectives and targets (goals); and to create action plans to achieve the objectives and targets. Selected accomplishments and continual improvement initiatives of 2008 are noted in the following sections.

4.2.3.1 Environmental Aspects

B&W Y-12 evaluates the operations, identifies the aspects that can impact the environment, and determines which of those impacts are significant. Environmental aspects are those elements of activities and services that can be controlled or influenced. They 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).

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 has established and maintains documented 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. The action plans may be amended to reflect new developments and new or modified activities as conditions change at the Y-12 Complex or as a result of management reviews. B&W Y-12 achieved 99% of planned environmental targets in 2008. Highlights included the following.

- Legacy low level waste—Dispositioned 50 of the 70 containers outside the barrier, which is a reduction of 71.4%, exceeding the goal of 30%.
- Mixed waste—Dispositioned 70.1% of the target inventory (1,500 of 2,139 items), which exceeded the goal of 50%.
- Building 9201-5 environmental liabilities—Finalized a project execution plan and schedule and made significant progress in disposing of hazardous materials.
- PrYde—All four of the Fiscal Year (FY) 2008 Clean Sweep areas have been verified acceptable by the YSO. Additionally, more than five customer-funded areas were completed during FY 2008.
- Outdoor low-level \waste areas – The number of outdoor areas was reduced 18%, which exceeds the 10% goal.

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 federal, state, and local environmental laws and regulations;

- in compliance with applicable DOE orders and standards related to protection of the environment; and
- consistent with our 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 is structured in sections to mirror 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.

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

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, the effects have been recognized by our customer, our community, and other stakeholders (see Sect. 4.2.4.2). Not only have pollution prevention efforts at Y-12 benefited the environment; they have also resulted in avoided costs (see Fig. 4.4).

During FY 2008, B&W Y-12 implemented 96 pollution prevention initiatives (see Fig. 4.5) with a reduction of more than 30.2 million kg of waste and a cost savings/avoidance of more than \$4.15 million. The completed projects include the activities described in the following sections.

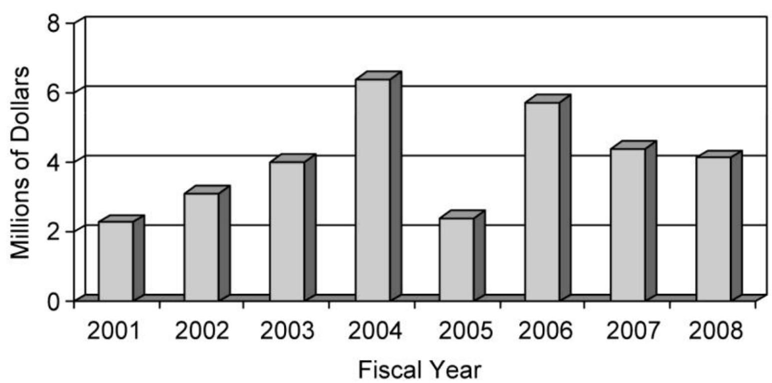

Fig. 4.4. Cost avoidance from Y-12 pollution prevention activities.

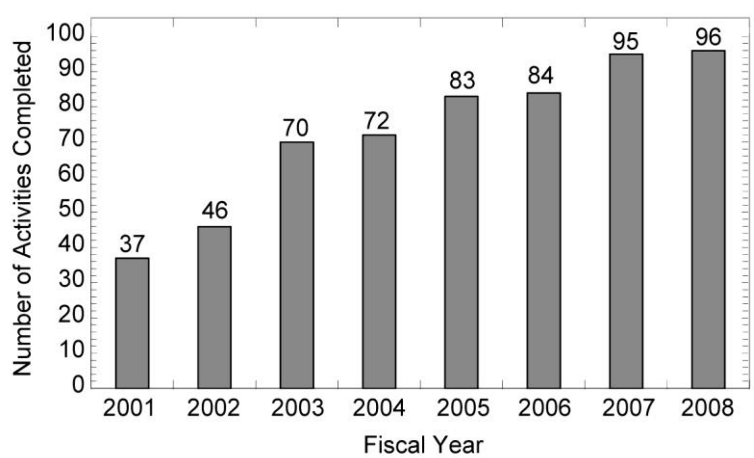

Fig. 4.5. Y-12 pollution prevention initiatives.

4.2.3.4.3.1 Sustainability Initiatives with Pollution Prevention Benefits

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, including the 2008 activities highlighted in this section.

Y-12 Clean Sweep Program. The Clean Sweep Program improves the environment and supports the prevention of pollution through site cleanup efforts. The FY 2008 goal was to identify, clean, and maintain four areas within the Y-12 Complex utilizing the appropriate mechanism such as recycling, excessing, Clean Sweep Program, and disposing of material as appropriate. This goal was achieved. In addition, a pilot program was initiated during 2008 that provides a sustainable process to ensure that a clean sweep area/building is maintained to promote a safe and clean environment. This process provides periodic support from organizations such as Radiological Control and Waste Management to ensure proper disposition (e.g., recycling, excessing, reuse, disposal) of materials in a timely manner. This pilot program has been extremely successful and will continue into 2009.

Additionally, the management at a Y-12 production facility provided the opportunity for a "Clean Up" Day, which ensured that, for the entire day, all of the resources needed to properly disposition materials were available. This provided a starting point of a safe and clean environment that will only have to be maintained in the future. During the event, more than 346 tons of materials were properly dispositioned. 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 2008, B&W Y-12 procured recycled-content materials valued at more than $4.67 million for use at the site.

4.2.3.4.3.2 Source Reduction Initiatives

B&W Y-12 continues to pursue source reduction initiatives across the site, thus reducing waste generation and reducing Y-12's impact on the environment. Many Y-12 source reduction activities have been implemented, including the 2008 activities highlighted in this section.

Invention of Innovative Negligible-Residue Tack Cloth. A research chemist at Y-12 invented a way to clean surfaces that leaves no sticky residue and won an R&D 100 award for his work. *R&D Magazine* issues the awards in recognition of the year's 100 most significant technological innovations.

The new invention, called the Negligible-Residue Tack Cloth (Fig. 4.6), traps dust, dirt, or other particles in the cloth as it is wiped over the surface of the material being cleaned. While the primary application for the tack cloth is removal of legacy beryllium contamination, it also has the potential for wide application in industry, including the semiconductor and electronics industries, where surface cleanliness is critical.

This invention will have wide spread application for decontamination of smooth surfaces across Y-12 as well as in industry nationwide, a true win for pollution prevention, DOE, and the nation.

4.2.3.4.3.3 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 the Y-12 recycling results graph (Fig. 4.7), thousands of metric tons of materials were diverted from landfills and into viable recycle processes. Currently, recycled materials range from office-oriented materials, such as paper (including phone books), aluminum cans, and toner cartridges, to operations-oriented materials, such as scrap metal, tires, and batteries. Many recycling activities have been implemented, including the 2008 activities highlighted in this section.

Excess Tanker Cars Transfer. NNSA donated two 1941-vintage tanker cars to the Southern Appalachia Railway Museum, an off-site non-profit organization operated by volunteers, avoiding the generation of low-level waste while preserving some historic tanker cars for future generations. The tanker cars were used to transport materials during World War II and will continue to have a place in history at the museum. The tanker cars are reportedly among only a handful of units of that particular type remaining in the United States. The donation of the tanker cars to the museum also complies with the National Historic Preservation Act and preserves and protects one of its historic resources while partnering with a local organization to convey the history of Y-12 to the community.

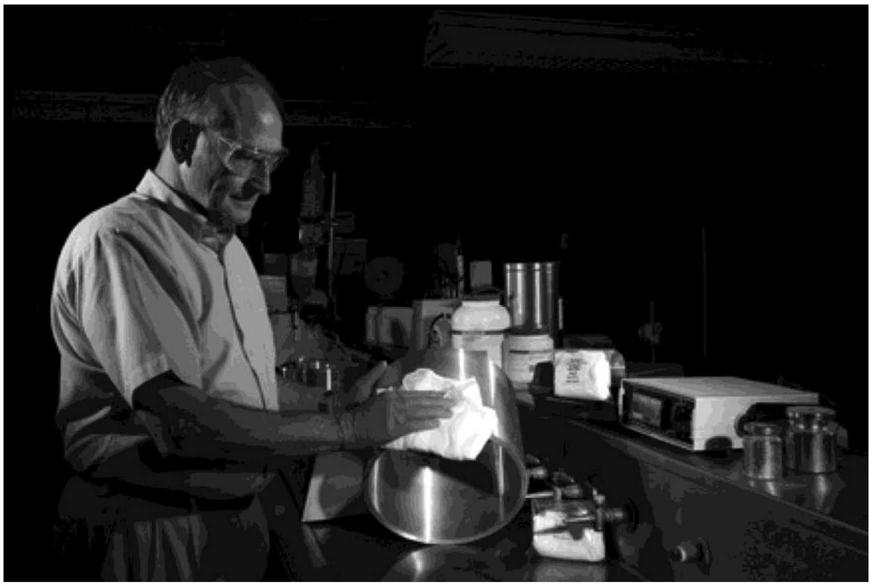

Fig. 4.6. Y-12's Ron Simandl with the negligible residue tack cloth.

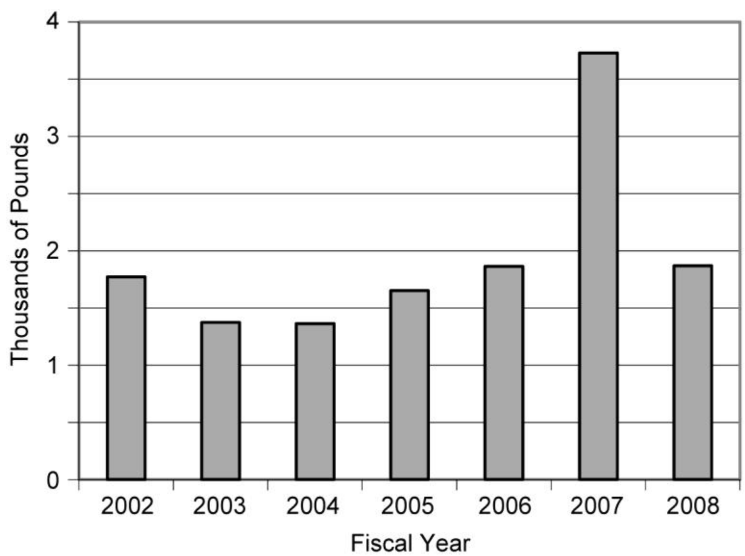

Fig. 4.7. Y-12 recycling results.

Through these joint efforts, approximately 94,600 lb of excess metal was transferred to the museum for reuse as tanker cars. The transfer of the tanker cars resulted in an overall cost avoidance of more than $40,790, while preserving historic items (see Fig. 4.8).

Expanded Recycling Program. B&W Y-12 expanded the Y-12 recycling initiatives to include the recycling of color toner cartridges, polychlorinated biphenyl (PCB) detectable oil (less than 50 ppm and more than 2 ppm PCB), and glass from New Hope and Jack Case Centers to an off-site recycling vendor. These recycling initiatives were fully-implemented during 2008.

Fig. 4.8. Preparing vintage railway tanker for donation to Southern Appalachia Museum.

4.2.3.4.4 Energy Management

In concert with Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management," DOE established the Transformational Energy Action Management initiative (TEAM) and TEAM goals intended to meet and exceed the goals of the new Executive Order 13423. The Y-12 Energy Management Plan addresses all aspects of the TEAM initiative as defined by DOE. Energy management is an ongoing and comprehensive effort that contains a key strategy of implementing guidelines to reduce the consumption of energy, water, and fuel (including gasoline, diesel fuel, electricity, and natural gas). Energy savings performance contracts (ESPCs) have been used at Y-12 and are integral to the future of Y-12 as a means of funding modernization of the complex with energy-saving equipment. With the advent of requirements of Executive Order 13423, ESPCs have been reinvigorated as a method for recapitalizing energy saving investments at Y-12. Johnson Controls, Inc., has been selected as Y-12's energy savings contractor (ESCO). The ESPC kickoff meeting was conducted in January 2008, initiating the project development phase.

Energy consumption over the past several years has continued a steady downward trend. In FY 2008, the Y-12 Complex achieved the following total site energy commodity usage reductions from the 2003 baseline (Fig. 4.9):

- 22.0% reduction in electricity,
- 50.6% reduction in natural gas, and
- 16.3% reduction in coal.

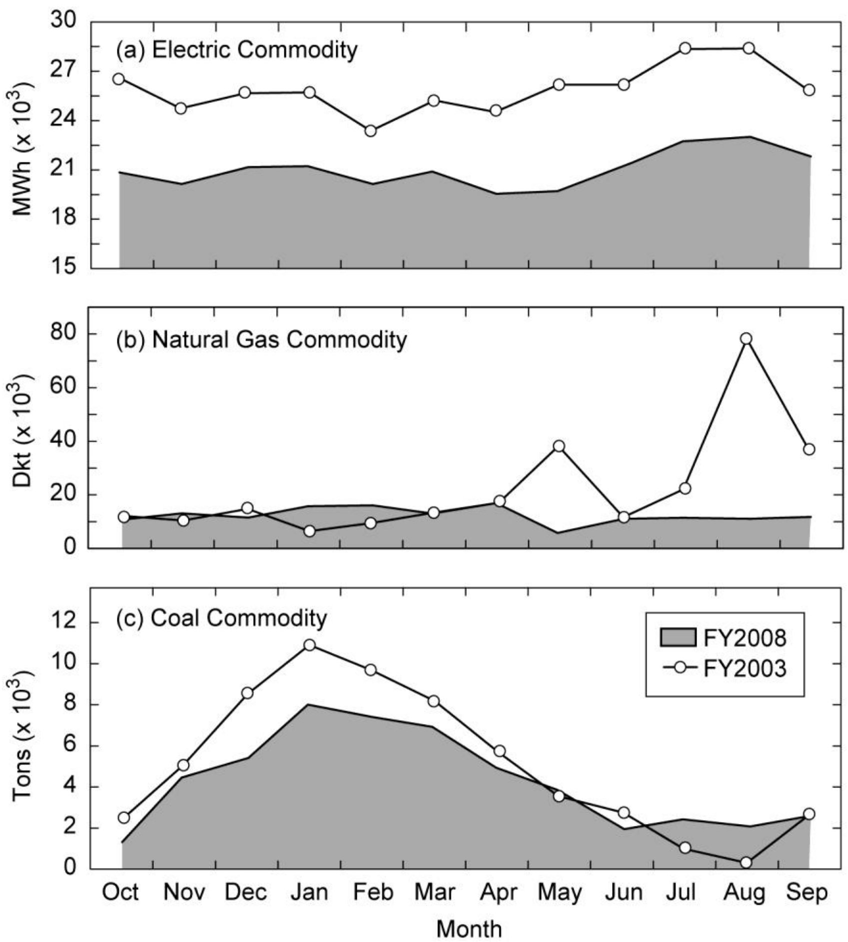

Fig. 4.9. Electrical (a), natural gas (b), and coal (c) consumption by month.

Based on reported facilities square footage, this reduction in commodity usage represents an overall 53.5% reduction in energy intensity (British thermal units per gross square foot) relative to the FY 2003 baseline. Figure 4.10 illustrates the current energy intensity reductions at Y-12 compared to the DOE TEAM goal.

The site is developing a phased approach to the implementation of the ESPC Phase I delivery commencing in FY 2009 and Phase II to begin in FY 2010. When coupled with the implementation of an energy management program at the site, NNSA anticipates achievement of the energy reduction goals.

The ESCO completed the development of the Initial Proposal (IP) for Delivery Order 1 and presented the five Y-12–supported projects to the NNSA Headquarters Review Board on July 27, 2008. The five projects supported are

- Chiller Plant Improvement,
- Condensate Return System Modification,

- Steam Trap Improvement,
- Cooling Tower Filtration, and
- Demineralized Water Production Facility Replacement.

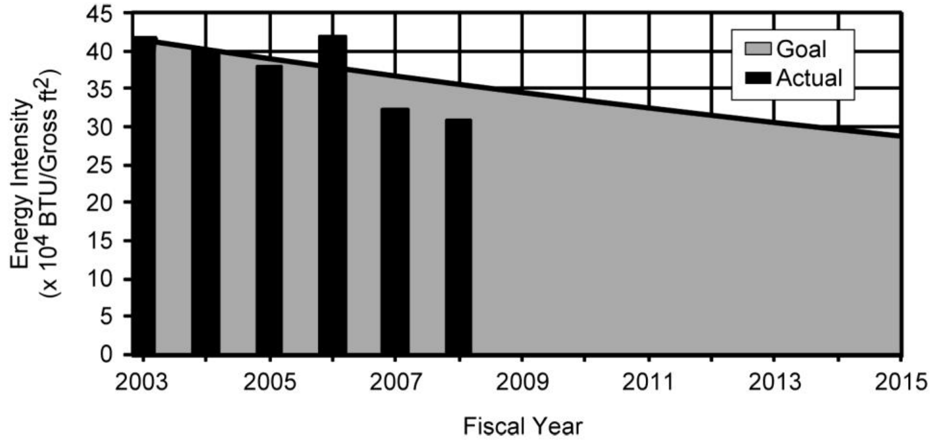

Fig. 4.10. Y-12 Energy intensity reductions compared to TEAM goal.

This IP implementation funding would be $21M and would provide annual energy, water, and Operations & Maintenance savings of $2.3M with a simple project payback of 8.99 years. NNSA approved the IP and issued the Notice of Intent to Award to the ESCO to initiate the Detailed Energy Survey. The survey kick-off was performed at Y-12 on August 14, 2008, and the ESCO began the system walkdowns and data gathering necessary to develop the project in October 2008.

The ESCO determined that the existing systems did not have existing metering capabilities to establish the baseline metering requirements. B&W worked with NNSA and the ESCO to identify the additional metering needs, and to develop a baseline metering installation plan. The baseline meters will be installed in early 2009.

4.2.3.4.5 Water Conservation

Potable water use has continued to decline (Fig. 4.11) due to the removal of excess buildings consisting of more than 1.2 million ft^2 of high-water-intensity facilities over the past 6 years. There are ongoing discussions between Y-12 and the potable water supplier, the city of Oak Ridge, regarding uncertainties with the accuracy of water supply metering. Therefore, the FY 2007 water intensity baseline, to be established per Executive Order 13423, is preliminary until the metering-accuracy questions are resolved. The city has agreed to install three new potable water supply meters. One new meter has been installed, and two additional meters were ordered in September 2008.

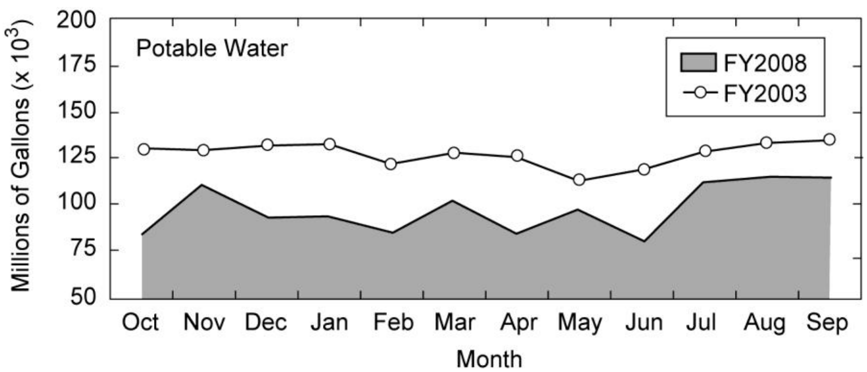

Fig. 4.11. Potable water consumption by month, FY 2003–2008.

4.2.3.4.6 Fleet Management

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.

Additional fleet highlights for FY 2008 are as follows.

- Compared with the 2005 baseline for fuel use, the site has reduced petroleum use by 22.2%.
- There has been a 233% increase in alternative fuel use since 2005.
- Of the current fleet at Y-12, 13% is alternative fuel vehicles.
- Use of biodiesel fuel has been ongoing since 2007.
- All flex fuel-capable vehicles were operated on E85 ethanol alternative fuel.

4.2.3.4.7 Electronic Stewardship

The Y-12 Complex completed the Federal Electronics Challenge (FEC) Facility Partner Registration form on March 31, 2008, on the FEC website. Registration involved the federal electronics challenge pledge, which included the ultimate goal to improve the management of electronic assets during all life-cycle phases: acquisition and procurement, operation and maintenance, and end-of-life management.

Additionally, Y-12 completed the FEC Baseline Survey of Current Practices form on May 7, 2008, on the FEC website. This Baseline Survey form was developed to assist Y-12 with identifying current electronics management practices and to recognize areas for improvements. Annual participation in the FEC Program will require completion of the Annual Reporting Form and Updated Goals. Finally, DOE plans to integrate all of the FEC reporting requirements into the annual pollution prevention reporting starting with FY 2008.

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 (EO) Program is in place to facilitate communication of federal- and state-mandated environmental regulatory requirements and to promote the EMS as a tool to drive continual environmental improvement at Y-12.

There are more than 30 EOs representing various organizations at Y-12. The EOs are appointed by managers of the various organizations located at Y-12. One of the primary responsibilities for EOs is to coordinate the organization’s efforts to seek, accomplish, and maintain environmental regulatory compliance and to promote the implementation of EMS activities in their area of responsibility.

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 serves to facilitate communication between Y-12 and the community. The council is composed of 20 members from a cross section of the community, including environmental advocates, neighborhood residents, Y-12 retirees, and business and government leaders. The council provides feedback to the company regarding its operations and ways to enhance communications and involvement with the community and public at large.

In addition, Y-12 has partnered with TDEC in a voluntary program designed to help all citizens do their part for the shared environment through the Tennessee Pollution Prevention Partnership. This network of Tennessee households, schools, government agencies, organizations, businesses, and industries demonstrates that pollution prevention protects the environment, saves money, and improves communities.

The Y-12 Pollution Prevention Program provided recycling and pollution prevention information to more than 150 local school-age children and teachers during FY 2008. Recycling, pollution prevention, and alternative fuel information was provided to the students by the use of an interactive pollution prevention activity. They were given items made with recycled content to reinforce the pollution prevention philosophy.

Y-12 employees and their families supported the East Tennessee Clean Fuels Coalition (ETCFC) and its initiative to improve the environment by participating in the "Run for Clean Air" on April 12, 2008. The event provided information to participants about ETCFC's mission, alternative fuels, and other clean air initiatives. As a participating sponsor, Y-12 provided posters noting its recent environmental accomplishments and environmental policy commitments. Several alternative-fuel vehicles were on display and were available for test driving. The 50-member Y-12 team (Fig. 4.12) was the largest and fastest in the fifth annual event, which is a fund raiser for ETCFC.

Fig. 4.12. The Run for Clean Air—2008 Y-12 team.

4.2.4.2.1 2008 Awards and Recognition

Tennessee Chamber of Commerce and Industry. Y-12 received a Tennessee Chamber of Commerce and Industry award for Environmental Excellence and certificates for outstanding environmental accomplishments at the Twenty-sixth Annual Environmental Awards Conference in October 2008 (see Fig. 4.13). 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 as follows:

- Solid Waste Management Award for Recycling Y-12 Transformers Reduces Solid Waste Generation,
- Water Quality Award for Y-12 Technology Exchange Results in Reduced Waste Water Generation through Implementation of Waste Coolant Evaporator,
- Comprehensive Environmental Excellence Achievement Certificate for Y-12's LEED Certification Process for New Hope Center, and
- Hazardous Waste Management Achievement Certificate for Y-12's EMS-Driven Green Online Auction and Product Exchange Reduces Hazardous Waste.

Fig. 4.13. Y-12 environmental accomplishments were recognized at the 2008 Tennessee Chamber of Commerce and Industry Awards.

NNSA Pollution Prevention Environmental Stewardship Award Certificates. The Y-12 Complex won five 2008 NNSA Pollution Prevention Environmental Stewardship Award Certificates:

- Y-12's Thinking Outside the Box Speeds Critical Quality Program, in the Waste/Pollution Prevention category;
- Y-12 Technology Exchange Results in Implementation of Waste Coolant Evaporator, in the Waste/Pollution Prevention category;
- Y-12 Recycling Transformers Reduces Unneeded Materials and Chemicals, in the Recycling category;
- Y-12 EMS-Driven Green Online Auction and Product Exchange, in the Environmental Management System category; and
- Y-12's LEED Certification Process for New Hope Center in the Sustainable Design/Green Building category.

The NNSA Pollution Prevention Environmental Stewardship Awards Program recognizes innovative and/or exemplary pollution prevention, recycling, environmental management systems, sustainable design/green buildings, and affirmative procurement projects and practices. This is the fifth consecutive year that the Y-12 Complex has received an NNSA award.

Tennessee Pollution Prevention Partnership. Y-12 was awarded a Tennessee Pollution Prevention Partnership Partner Membership certificate on March 15, 2007, for "making a commitment to positive environmental action through pollution prevention activities." On December 3, 2008, Y-12 was notified that the site had been awarded the Tennessee Pollution Prevention Partnership Performer level and will be receiving the green flag (Fig. 4.14) showing Y-12's commitment to pollution prevention in a ceremony planned for March 2009. Y-12 is 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. Notable results include reducing more than 436 metric tons of waste, including low-level and hazardous waste; reducing energy usage by more than 93 million kWh since FY 2004 through modernization activities; eliminated more than 5,000 lb or 70% as much trichlorofluoromethane (CFC-11) compared with 2005 levels; conserved more than 86,000 yd^3 of landfill space and established about 1.4 ha of native grasses; and reduced gasoline consumption in FY 2006 by 15,500 gal while increasing E-85 use by the flex fuel fleet to 100%.

Fig. 4.14. Y-12 has earned the honor to fly the "green flag" of the Tennessee Pollution Prevention Partnership.

4.2.4.3 Monitoring and Measurement

Y-12 maintains procedures that were established and implemented 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 have been established to monitor and measure liquid and gaseous effluents at the point of release to the environment and to take direct measurements of contaminants in air, water, groundwater, soil, foods, biota, and other media subsequent to effluent release. Results of the effluent and surveillance programs are reported elsewhere in the document.

In addition, Y-12 has implemented a process that includes the documenting of information 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. In addition, a monthly program review meeting with counterparts from the YSO includes discussions of environmental compliance performance as well as progress in achieving objectives and targets.

4.2.4.4 Emergency Preparedness and Response

The Y-12 Emergency Management Program Organization is compliant and/or adherent with federal, state, and local laws, regulations, and ordinances. The emergency management program incorporates all the planning, preparedness, response, recovery, and readiness assurance elements necessary to protect on-site personnel, the general public, the environment, and property in the event of an operational emergency involving Y-12 facilities, activities, or operations. Site-level procedures include procedures for assessing hazards, reporting releases, responding to environmental incidents, isolating contaminated areas, performing containment and cleanup activities, and notifying appropriate organizations. Emergency management exercises are scheduled periodically to test the emergency preparedness and response systems.

4.2.4.5 EMS Assessments

To periodically verify that the EMS is operating as intended, audits are conducted as part of Y-12's assessment program. The audits are designed to ensure that any nonconformance to the ISO 14001 standard is identified and addressed. In addition, compliance with regulatory requirements is verified through routine inspections, surveillances, and focused compliance audits.

Environmental assessment activities are conducted in accordance with the Y-12 Assessment and Corrective Action Program. EMS assessment can be incorporated into other assessments, such as independent assessments of site-wide ISM performance (e.g., training, document control, corrective action).

TDEC conducted a review of Y-12's EMS on June 24, 2008. The review was the final step in Y-12's 4-year pursuit of a Green Flag awarded by the TDEC Tennessee Pollution Prevention Partnership Program; it will be flown to signify Y-12's commitment to environmental stewardship. Y-12's EMS scored 417 of 420 possible points (99%) from the TDEC assessment.

Two EMS management assessments were conducted in November. Both focused on entities responsible for ensuring implementation of the EMS-related requirements of Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management"; DOE Order 430.2B, *Departmental Energy, Renewable Energy and Transportation Management;* and DOE Order 450.1A, *Environmental Protection Program*.

An EMS assessment of Information Technology and Procurement Operations was conducted November 10 through 13, 2008. An EMS assessment conducted on November 17 of organizations involved in fleet and transportation maintenance and management included

- business services, leased fleet, and facilities management;
- facility infrastructure and services, plant services, fleet maintenance, and transportation and material management; and
- the fleet maintenance facility.

The assessments served to increase awareness of EMS-related procurement, electronics stewardship, and transportation/fleet requirements and prepare the organizations for an external assessment planned for spring 2009. Opportunities for improvement were identified.

Per DOE Order 450.1A, the site EMS must make a formal declaration of conformance consistent with the requirements of the executive order by June 30, 2009. A formal assessment of the Y-12 EMS by a qualified party outside the control or scope of the EMS is planned for spring of 2009.

4.3 Compliance Status

Y-12 operations and activities are required to be in conformance with environmental standards established by a number of federal and state statutes and regulations, executive orders, DOE orders, contract-based standards, and compliance and settlement agreements. Many Y-12 processes and facilities operate under permits issued by regulatory agencies. Principal among the regulating agencies are the TDEC, the city of Oak Ridge, and EPA, which issue permits, review compliance reports, participate in joint monitoring programs, inspect facilities and operations, and oversee compliance with applicable regulations.

4.3.1 Environmental Permits

Table 4.1 notes environmental permits in force at Y-12 during 2008. 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 2008, environmental evaluations were completed for 34 proposed projects.

Table 4.1. 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	DOE	DOE	B&W Y-12
CAA	Chip Oxidizer Operating Permit	554594	10/21/2004	10/21/2009	DOE	DOE	B&W Y-12
CAA	Operating Permit (Title V)	554701	10/21/2004	10/21/2009	DOE	DOE	B&W Y-12
CAA	Purification Facility/ Construction Permit (Expiration date pending TDEC conversion to Operating Permit)	956248P	06/17/2003		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	04/01/2005	03/31/2010	DOE	DOE	B&W Y-12
CWA	Pump & Haul 9720-82	SOP 04018	11/30/2004	11/30/2009	B&W Y-12	B&W Y-12	B&W Y-12
CWA	National Pollutant Discharge Elimination System Permit	TN0002968	03/13/2006	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	02/06/2004		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	1/21/2009	1/31/2010	DOE	DOE	B&W Y-12

Table 4.1 (continued)

Regulatory Driver	Permit Title/Description	Permit Number	Issue Date	Expiration Date	Owner	Operator	Responsible Contractor
RCRA	Hazardous Waste Corrective Action Permit	TNHW-121	09/28/2004	09/28/2014	DOE	DOE, NNSA, and all ORR co-operators of hazardous waste permits	BJC
RCRA	Container Storage Units	TNHW-122	08/31/2005	08/31/2015	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 4.1 (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

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

The *Complex Transformation Draft Supplemental Programmatic Environmental Impact Statement* (SPEIS) Record of Decision (ROD) was signed December 2008. The SPEIS presents alternatives to support NNSA's proposal to continue transforming the Complex by consolidating and eliminating operations. NNSA is making the Complex smaller, more secure, more efficient, and better able to respond to future changes. Of particular importance are the alternatives presented in the SPEIS regarding the location of the new consolidated Uranium Production Facility, including the preferred alternative to locate it at Y-12.

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

The NEPA implementing procedures (10 CFR 1021 [1992]) requires a 5-year evaluation of the current Y-12 Complex sitewide 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 is pending approval from DOE Headquarters prior to public review.

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 2008 included completing an NHPA Section 106 review on 34 proposed projects, submitting the final machinery and equipment survey document to the Tennessee state historic preservation officer, conducting ongoing oral interviews, modifying the Y-12 History Exhibit Hall, and participating in various outreach projects with local organizations and schools.

Thirty-four 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 34 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.

A machinery and equipment survey was conducted and completed in 2006 per the programmatic agreement. The survey documented the remaining machinery and equipment associated with historic missions of the Y-12 Complex during World War II and the Cold War. The final report was approved by the state historic preservation officer in November 2008.

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 of day-to-day operations of the Y-12 Complex, the use and operation of significant 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 (Fig. 4.15), located in The New Hope Center, has an updated look and features more artifacts and new signs. The Exhibit Hall displays exhibits, photographs, artifacts, brochures, DVDs, and other information associated with the history of Y-12 and the New Hope Community. The Exhibit Hall 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 are available free to the public. Tours of the Exhibit Hall were conducted for organizations such as the Boys and Girls Club, Boy Scout Troops, local schools, and VIP visitors.

Outreach activities in 2008 consisted of providing tours of the Y-12 Complex for the Secret City Festival and for the American Museum of Science and Energy. The Secret City Festival, held in June, is an annual event 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

1100 tourists from 49 states. Other outreach activities include visiting local schools and conducting presentations on the history of Y-12 and Oak Ridge.

Fig. 4.15. Y-12 History Exhibit Hall in New Hope Center.

4.3.3 Clean Air Act

Described in this section is a comprehensive review of the major elements of the Clean Air Program at the Y-12 Complex. There were several significant program highlights in 2008.

The Y-12 Complex was issued the Title V Major Source Operating Permits 554701 and 554594 in 2004, and required compliance implementation began April 1, 2005. More than 3,000 data points are collected and reported under the Title V operating permit every 6 months, and there are 5 continuous monitors for criteria pollutants as well as numerous continuous samplers for radiological emissions.

There were no noncompliances as a result of monitoring activities during 2008. A deviation from the requirement to conduct daily readings on a control device occurred and was reported. The deviation occurred as a result of a differential pressure recording device malfunction covering 6 days.

In 2008, three construction air permits were applied for and/or maintained. Under a permit issued in 2007, construction began in 2008 on the replacement steam plant (to be operational in about 2010). An existing construction permit was in place for a foundry operation for much of 2008 but was not renewed in October because construction was declared complete. A construction permit and compliance with its conditions are being maintained for a special materials facility until the permit conditions are combined into the Title V sitewide operating permit.

Construction began for a replacement steam plant project, which will ultimately result in the shutdown of the existing steam plant. More than 90% of the Y-12 Complex pollutant emissions to the atmosphere are 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 2008.

In 2008, TDEC personnel performed an inspection of the Y-12 Complex on February 6 and 7 to verify compliance with applicable regulations and permit conditions. There were no compliance issues 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. 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. The permit expired December 31, 2008, and Y-12 Complex discharges are continuing under the requirements of the present permit. 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 2008 the Y-12 Complex continued its excellent record for compliance to water discharge permits. More than 3,200 data points were obtained from sampling required by the NPDES permit; only one noncompliance was reported. Some of the requirements in the 2006 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 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 addition of 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);
- requirement for an annual storm water monitoring report, an annual report of the BMAP data;
- a requirement to manage the flow of East Fork Poplar Creek such that a minimum flow of 7 million gal/day is guaranteed by adding raw water from the Clinch River to the headwaters of East Fork Poplar Creek (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 the Comprehensive Environmental Response, Compensation, and Liability Act (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 2008 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 water lines), the Steam Plant Life Extension and Building 9720-82.

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 2008. Two were for exceeding the discharge limits (daily maximum and monthly average) for copper, and two 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 (February 19, 2008, and August 27, 2008). 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. An example is the plan developed for the Potable Water Systems Upgrades project, which covered repair and construction of underground water lines and also addressed protection of receiving streams during sanitizing of the new system. 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 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:

- total coliform,
- chlorine residuals,
- lead,
- copper,
- disinfectant by-product, and
- propylene glycol.

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.

In 2008, the Y-12 potable water system retained its approved status for potable water with 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 2008 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 2008 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; sampling was completed in August 2008. The results were below the TDEC and SDWA limits and meet the established requirements.

The 5 year inspection of the west emergency potable water storage tank was also completed.

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 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).

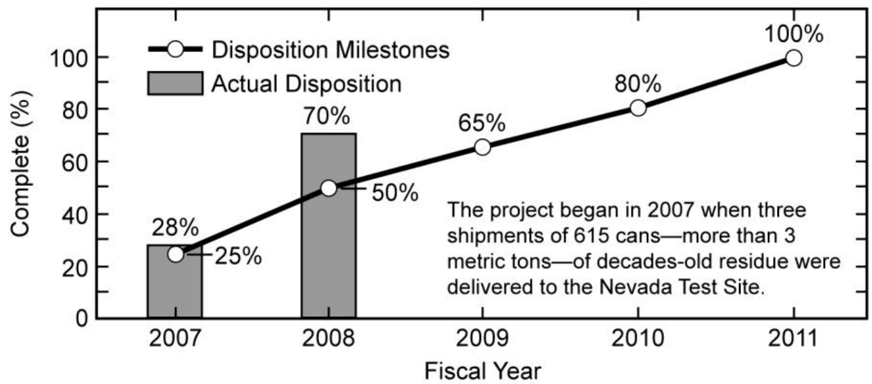

Fig. 4.16. Reducing inventory of legacy mixed waste as part of the *ORR Site Treatment Plan*.

The quantity of hazardous and mixed wastes generated by Y-12 increased in 2008 (Fig. 4.17). The increase was attributed to the treatment of more than 2,000,000 kg of additional contaminated groundwater. This directly correlates to 11 in. more rainfall in 2008 than in 2007. 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 *Oak Ridge Reservation Site Treatment Plan*. Progress on disposition of legacy mixed wastes exceeded established milestones for FY 2008. Of the amount of hazardous and mixed waste generated in 2008, 96% was generated as contaminated leachate from legacy operations. The Y-12 Complex currently reports waste on 129 active waste streams. In the 2008 RCRA report, 17 waste streams were closed due to inactivity (zero waste generation).

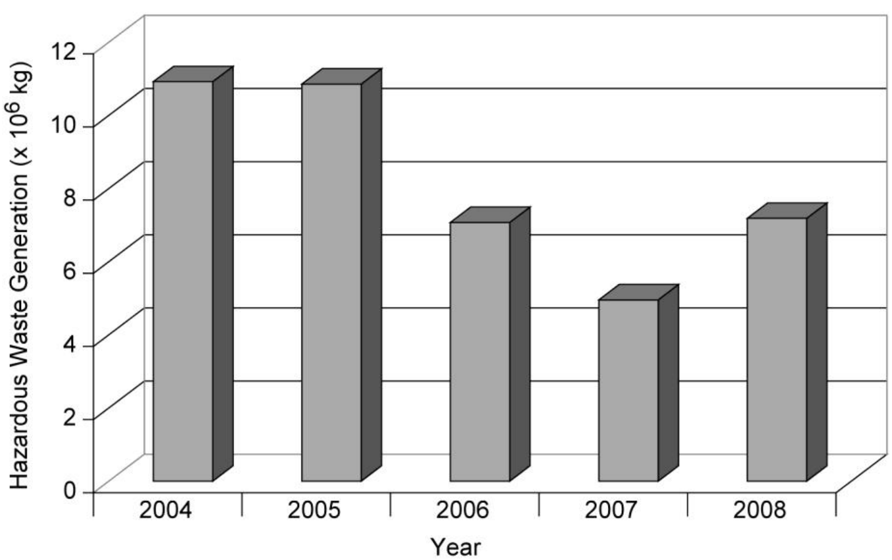

Fig. 4.17. Hazardous waste generation, 2004–2008.

Y-12 is a state-permitted treatment, storage, and disposal facility. Under its permits, Y-12 received 1,748 kg of hazardous and mixed waste from the off-site Union Valley analytical chemistry laboratory in 2008. In addition, 160,493 kg of hazardous and mixed waste was shipped to DOE-owned and commercial treatment, storage, and disposal facilities. Nearly 7 million kg 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 October 2008, including permitted storage facilities, satellite accumulation areas, and 90-day accumulation areas. No violations were noted during the inspection. TDEC stated in their final report, "B&W Y-12, its employees, contractors, and subcontractors, place a high priority on regulatory compliance and environmental stewardship."

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 certificates for the tanks are current, and certificates are posted at the UST locations, enabling fuel delivery until March 31, 2010. 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 June 2008. 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 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 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 4.1.

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 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 4.2). 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 will be reported yearly to TDEC and EPA in the annual CERCLA *Remediation Effectiveness Report* (DOE 2009) for the ORR.

Table 4.2. 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

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 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. All equipment containing PCBs must be inventoried, except for capacitors containing less than 3 lb of dielectric fluid or items with a concentration of PCB source material of less than 50 ppm. Certain PCB-containing articles or PCB containers must be labeled. The inventory is updated by July 1of each year.

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.

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 initiated in 2007 and was approved for issuance 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 2008 through the submittal of reports under EPCRA Sects. 302, 303, 311, and 312. In 2008 there were no releases of "extremely hazardous substances," which are reportable under Sect. 304.

The required Sect. 311 notifications were made in 2008 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 Sect. 312 requirements. Y-12 reported 69 chemicals in inventory during 2008.

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 2008 reportable toxic releases to air, water, and land and waste transferred off site for treatment, disposal, and recycling were 104,497 lb. Table 4.3 lists the reported chemicals for the Y-12 Complex and summarizes releases and off-site transfers for those chemicals exceeding reporting thresholds.

Table 4.3. Emergency Planning and Community Right-to-Know Act Sect. 313 toxic chemical release and off-site transfer summary for the Y-12 Complex, 2008

Chemical	Year	Quantity[a] (lb)[b]
Chromium	2007	*c*
	2008	*c*
Cobalt	2007	*c*
	2008	*d*
Copper	2007	*c*
	2008	*c*
Lead/lead compounds	2007	6,729
	2008	21,652
Manganese	2007	*c*
	2008	*d*
Mercury/mercury compounds	2007	32
	2008	31
Methanol	2007	48,478
	2008	33,814
Nickel	2007	*c*
	2008	*c*
Nitrate compounds	2007	*c*
	2008	*d*
Nitric acid	2007	2,060
	2008	4,000
Ozone	2007	*c*
	2008	*c*
Silver	2007	*c*
	2008	*c*
Sulfuric acid (aerosol)	2007	41,000
	2008	45,000
Total	2007	98,299
	2008	104,497

[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 5,000 lb, and hence a Form A was submitted.

[d]No reportable releases because the site did not exceed the applicable Toxic Release Inventory reporting thresholds.

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 were no releases of hazardous substances exceeding RQs and no fish kills at Y-12 during 2008. One observable oil sheen on upper East Fork Poplar Creek was reported due to a potable water line break (see Sect. 4.3.9.4).

4.3.9.4 Environmental Occurrences

A broken potable water line resulted in an occurrence report in the DOE Occurrence Reporting System (Y-12 National Security Complex, Building 9201-1 NA--YSO-BWXT-Y12NUCLEAR-2008-0029 - Water Main Break at Building 9201-1—[Significance Category 3]). On August 16, 2008, water was observed running out the front door of Building 9201-1. Approximately 6 to 12 in. of water and mud were observed in and around the shop area, and the entire first floor was covered to varying degrees with water and mud. The main potable water supply was isolated to the building to prevent further water damage. Possible environmental impacts and structural conditions were evaluated. Tenants were notified to evaluate their areas for damage, and the basement was pumped out.

Water from the ruptured line flowed into the basement of the facility and into East Fork Poplar Creek. The event created an oil sheen on East Fork Poplar Creek, and subsequently the National Response Center was notified. No apparent environmental impacts to aquatic life occurred. One immediate response was the pumping of water from the basement and elevator shaft to tankers and negotiating with the city of Oak Ridge to discharge the water to the sanitary system. This discharge had to meet discharge limits in the sanitary discharge permit. B&W Y-12 obtained approval from the city to discharge the water, set up an oil water separator to remove excess oil, and compliantly discharged more than 350,000 gal of water to the sanitary system. The water in the basement was removed with minimal impact on facility operations.

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 2008, spill response and waste services personnel conducted one removal and recovered an estimated 3.5 lb of mercury. Approximately 65 lb have been recovered since 2003; recovery of mercury is expected to continue in 2009.

4.3.10 Audits and Oversight

A number of federal, state, and local agencies oversee Y-12 activities. In 2008, Y-12 was inspected by federal, state, or local regulators on eight occasions. The TDEC Department of Energy Oversight Division maintained a part-time regulator on site who provided periodic oversight of Y-12 activities. In addition to external audits and oversight, Y-12 has a comprehensive self-assessment program. A summary of external regulatory audits and reviews for 2008 is provided in Table 4.4.

4.3.10.1 Enforcement Actions and Memos

No new consent orders were issued to Y-12 in 2008.

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 NESHAPs) 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.

Table 4.4. Summary of external regulatory audits and reviews, 2008

Date initiated	Date completed	Conducted by	Title of assessment	Total findings
1/10/2008	1/10/2008	EPA/TDEC	EPA/TDEC ORR PCB FFCA Site Visit	0
2/6/2008	2/7/2008	TDEC	TDEC Annual Clean Air Compliance Inspection	0
2/16/2008	2/19/2008	City of Oak Ridge	Semi-Annual Industrial Pretreatment Compliance Inspection	0
6/24/2008	6/24/2008	TDEC	EMS Evaluation for TP3 Performer Level Review	0
8/27/2008	8/27/2008	City of Oak Ridge	Semi-Annual Industrial Pretreatment Compliance Inspection	0
9/16/2008	9/17/2008	TDEC, Water Pollution Control	NPDES Compliance Evaluation Inspection	0
10/16/2008	10/16/2008	EPA/TDEC	EPA/TDEC ORR PCB FFCA Site Visit	0
10/27/2008	10/30/2008	TDEC	TDEC Annual RCRA Inspection	0

Abbreviations

EMS	Environmental Management System
EPA	Environmental Protection Agency, Region 4
FFCA	Federal Facilities Compliance Agreement
NPDES	National Pollutant Discharge Elimination System
ORR	Oak Ridge Reservation
PCB	Polychlorinated Biphenyl
RCRA	Resource Conservation and Recovery Act
TDEC	Tennessee Department of Environment and Conservation
TP3	Tennessee Pollution Prevention Partnership

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 assured 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 2008, three construction air permits were applied for and/or maintained. A construction permit for the replacement steam plant continued in 2008. An existing construction permit for a foundry operation was allowed to expire late in 2008 as construction was declared complete. A construction permit and compliance with its conditions were maintained for a special materials facility until the permit conditions are combined into the Title V site-wide operating permit.

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. During 2008, there were no modifications to theY-12 Complex Title V permit. Permit change requests still pending at the end of 2008 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 sitewide permit;
- a request to add the new steam plant to the operating permit;
- requests to cancel four shutdown sources from the permit (a machine shop, a paper incinerator, a metal forming operation, and Arc Melt operation);
- a request to remove the Steam Plant Maximum Achievable Control Technology conditions based on the standard being vacated; and
- a request to add Fuel Station Stage 1 emission control requirements to the permit.

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, 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. Control of asbestos, ozone-depleting substances, and fugitive particulate emissions are notable examples.

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. As part of the Infrastructure Reduction Program, more than 149,000 ft^2 of buildings were demolished in 2008 to bring the total square footage for the program to approximately 1,245,000 ft^2. Remediation and proper disposal of asbestos-containing materials in the buildings are precursors and major components of building demolition. No releases of RQs of asbestos were reported for the Y-12 Complex in 2008.

B&W Y-12 continues to investigate and implement actions to reduce the use of regulated ozone-depleting substances (ODSs), where possible, replacing them with materials that have less ozone-depleting potential. Since the ODS elimination program began in the early 1990s, more than 90% of its Class I ODSs used in heating, ventilation, and air-conditioning systems has been eliminated.

Past ODS phase-out and reduction efforts at the Y-12 Complex include

- retrofitting, replacing, or taking out of service chillers and air-conditioning systems;
- solvent substitutions for uses such as machining, cleaning, and cooling; and
- elimination or conversion of fixed fire protection systems that contained Halon 1301.

B&W Y-12 personnel continue to properly manage refrigerants via programs and actions such as

- certification of refrigerant recycling and recovery equipment,
- training and EPA certification of refrigerant technicians, and
- procedures for performance of leak checks and for response to equipment leaks.

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. If an ODS is no longer going to be used at the Y-12 Complex, it is dispositioned as follows:

- excessed to other DOE facilities;
- offered to other government agencies, such as the Defense Logistics Agency;
- sold to outside vendors for recycle; or
- properly disposed of.

Additionally, in 2008, Y-12 manufacturing eliminated the emission of more than 19,600 lb of Freon 113, which is both an ODS and a chlorofluorocarbon, through a recent change in a chip-cleaning manufacturing process. The reduction in Freon 113 emissions resulted in an estimated annual cost avoidance of approximately $277,000. In this project, Freon 113 was replaced with Vertrel XF, a more environmentally friendly and safer product.

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.

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 2008, emissions categorized as actual emissions totaled 2,497.9 tons, and emissions calculated by the allowable methodology totaled 808.2 tons.

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,
- processes or operations exhausting through laboratory hoods also involving Appendix D calculations, and
- processes from room exhausts monitored by radiation control equipment.

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 2008, 42 process exhaust stacks were continuously monitored, 35 of which were major sources; the remaining 7 were minor sources. (Stack US-011 did not run during 2008.) The sampling systems on these stacks have been approved by EPA Region 4.

During 2008, unmonitored uranium emissions at the Y-12 Complex occurred from 43 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. 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 2008 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. Three emission points from room ventilation exhausts were identified in 2008 where emissions exceeded 10% of the DAC. Each of the emission points fed to monitored stacks, and any radiological emissions are accounted for monitored emission points.

A construction permit was issued by the state in November 1998 for Y-9998-F-143, a new 3,500-ton press in Building 9998. The source was designed and equipped with a stack monitor prior to the effective date of the September 9, 2002, final amendment to 40 CFR Part 61, Subpart H, which incorporated the use of the American National Standards Institute (ANSI) Standard ANSI/HPS N13.1-1999.

The Y-12 Complex was issued the Title V Major Source Operating Permits 554701 and 554594 in 2004. The permits required compliance implementation beginning April 1, 2005. Contained in the permits was a site-wide, streamlined alternate emission limit for enriched and depleted uranium process emission units. A limit of 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 NESHAPs compliance. An estimated 0.0071 Ci (0.6 kg) of uranium was released into the atmosphere in 2008 as a result of Y-12 activities (Figs. 4.18 and 4.19).

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 (NESHAPs) for Radionuclide Emission Measurements* (Y-12 2005). The plan satisfies the quality assurance (QA) requirements in 40 CFR Part 61, Method 114, 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.

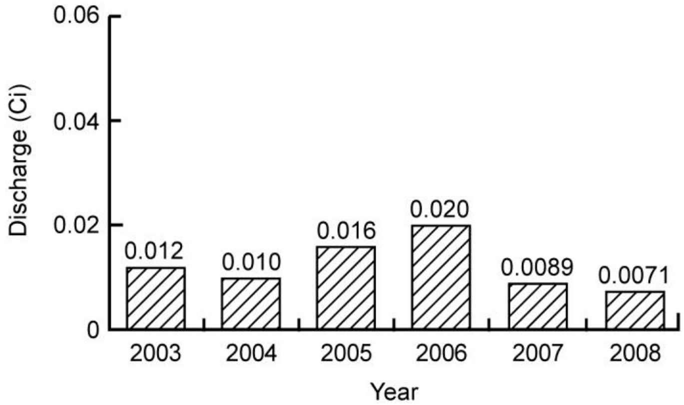

Fig. 4.18. Total curies of uranium discharged from the Y-12 Complex to the atmosphere, 2004–2008

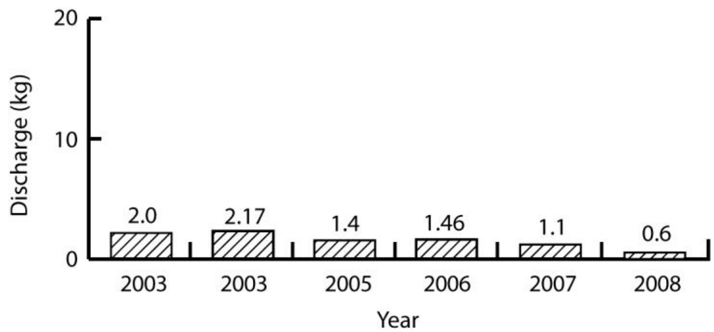

Fig. 4.19. Total kilograms of uranium discharged from the Y-12 Complex to the atmosphere, 2003–2007.

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 4.5. 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 2008, the opacity monitoring systems were operational for more than 95% of the operational time of the monitored units during each month. During 2008, nine 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 4.6 is a record of excess emissions and inoperative conditions for the east and west stack opacity monitors for 2008. 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 2008 ozone season were 123 tons of NO_x; the limit is 232 tons (Fig. 4.20).

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.

Table 4.5. Actual vs. allowable air emissions from the Oak Ridge Y-12 Steam Plant, 2008

Pollutant	Emissions (tons/year)[a] Actual	Emissions (tons/year)[a] Allowable	Percentage of allowable
Particulate	32	945	3.4
Sulfur dioxide	1,994	20,803	9.6
Nitrogen oxides[b]	469	5,905	7.9
Nitrogen oxides (ozone season only)	123[c]	232	53.0
Volatile organic compounds[b]	2	41	4.9
Carbon monoxide[b]	20	543	3.7

[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, NC. January 1995 and September 1998.)

[c]Monitored emissions.

Table 4.6. Periods of excess emissions and out-of-service conditions for Y-12 Steam Plant east and west opacity monitors, 2008

Date	Stack	Condition	Comments
March 14	West	One 6-min period of excess emissions	Due bad/damaged bags in Baghouse 1
March 24	East	Two 6-min periods of excess emissions	Due to Boiler 4 ID fan damper actuator/controller failure which caused an upset condition that created the opacity malfunction
August 17	East	Three 6-min periods of excess emissions	Baghouse 4 bypass dampers opened due to a high temperature interlock. The high temperature was caused by a bearing failure on Preheater 4 which prevented the preheater from rotating
October 25	West	One 6-min period of excess emissions	Due to lose bags in Baghouse 1
December 21	West	One 6-min period of excess emissions	Due to lose bags in Compartment 5 of Baghouse 1
December 30	West	One 6-min period of excess emissions	Due to bag blown off in Compartment 3 of Baghouse 1

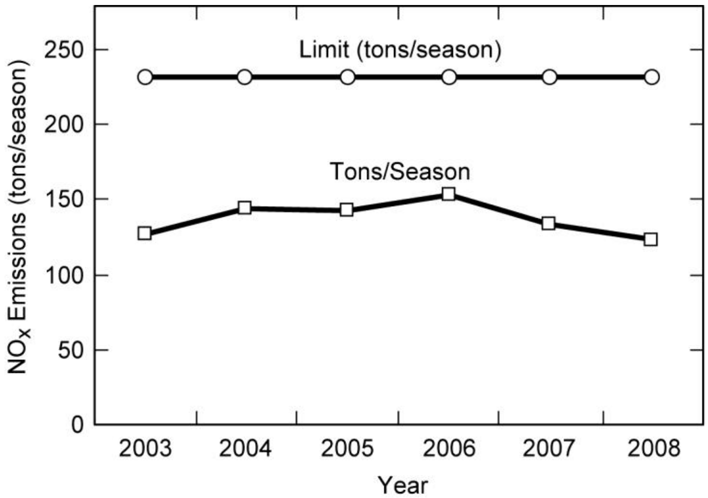

Fig. 4.20. Y-12 Steam plant NO_x emissions per ozone season.

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 were in compliance with the Title V permit in 2008.

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 reports were submitted to the TDEC technical secretary for the Division of Air Pollution Control for his approval and records.

The NO_x continuous emissions monitoring systems are operated in conformance with the requirements of 40 CFR 75. 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 on February 2008 for all three boilers. The reports were submitted on March 31, 2008, 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 tests for NO_x pre-RATA test were conducted in February 2007. Tests were also conducted in June 2007 (second quarter). During the third quarter, the test was conducted in September 2007. The linearity tests are 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. 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. 5.5.2, “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 existing steam plant will be replaced 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 Hydrogen Fluoride

State of Tennessee regulation 1200-3-3-.01 does not define primary standards (affecting public health) for hydrogen fluoride. However, secondary standards (affecting public welfare, i.e., vegetation, aesthetics) are defined in 1200-3-3-.02 for gaseous fluorides expressed as HF. In anticipation of the start-up of the HF system during CY 2005, arrangements were made to monitor the community adjacent to the Y-12 Complex for the presence of fluorides. The monitoring was initiated in November 2004. The monitoring methodology chosen for use was in accordance with the American Society for Testing and Materials (ASTM) Standard D3266, which designates the use of a dual-tape sampler, which is scheduled for calibration and maintenance activities once per quarter. The time period over which the monitoring occurs was 7 days and resulted in a total of 56 samples being generated per week (3 h per sample, 8 samples per day; 7 days per week). The samples were submitted for analysis, along with six additional QA samples, via chain of custody, to the Y-12 Complex analytical chemistry laboratory, which uses industry-accepted analytical techniques and protocol. The results represent a composite (7-day average) and serve to provide background information on the presence of fluorides in the surrounding area. The regulatory secondary standard for the 7-day average is 1.6 $\mu g/m^3$.

Actual monitoring data collected from November 2004 through September 2008 were well below the 1.6 $\mu g/m^3$ secondary standard. The maximum of 0.114 $\mu g/m^3$ was detected during the first sample period reported November 9, 2004. Review of the ambient HF data collected during more representative Oxide Conversion Facility operations (between September 2006 and August 2008) also concluded that the ambient HF data collections were well below the regulatory secondary standards. Therefore, ambient HF air monitoring for Y-12 was discontinued on September 30, 2008.

4.4.2.2 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 (see 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.

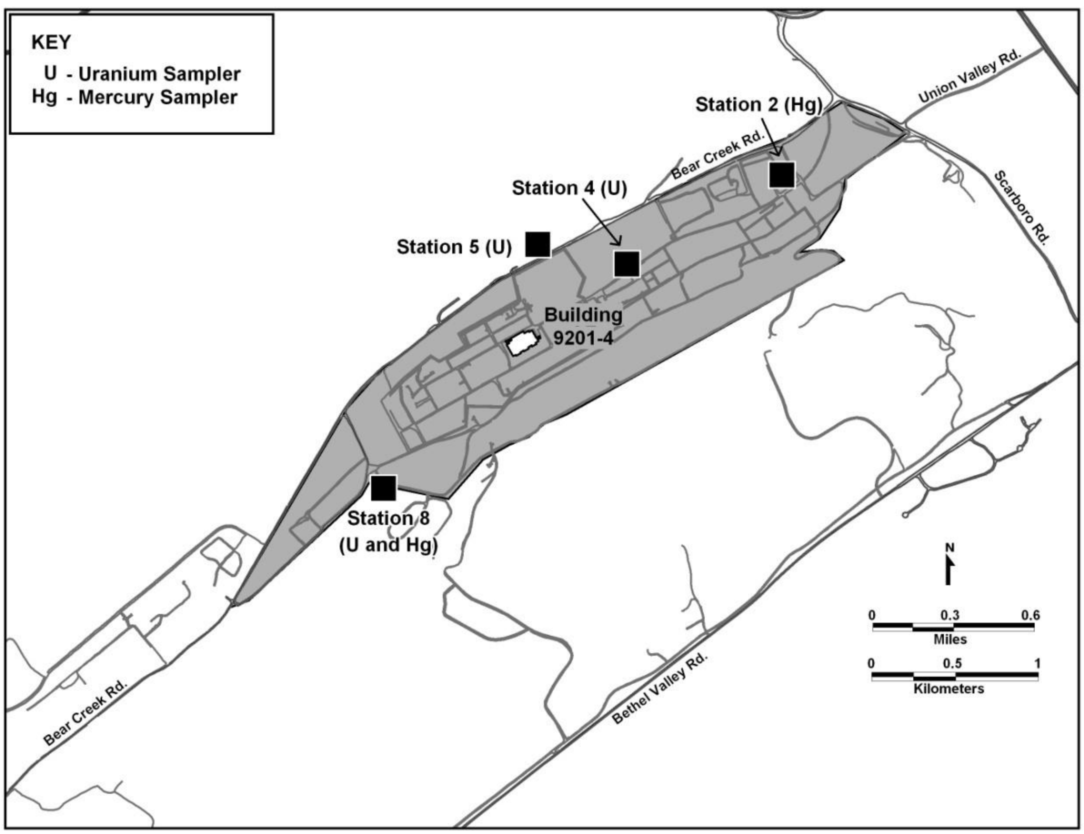

Fig. 4.21. Location of ambient air monitoring stations at the Y-12 Complex.

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, 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 4.7). Average mercury concentration at the AAS2 site for 2008 is 0.0029 μg/m^3 (N = 49; S.E. = ±0.0001), a slight drop from the previous year of 0.0036 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 2008 was 0.0048 μg/m^3 (N = 39; SE = 0.0003) or similar to levels recorded prior to 2005. Utility work during November and December in the area of AAS8 resulted in an approximately 2-month power outage at the monitoring site, thus the reduced number of samples for 2008 at AAS8 (N = 39).

Table 4.7. Summary of data for the Oak Ridge Y-12 National Security Complex mercury in ambient air monitoring program, 2008

Ambient air monitoring stations	Mercury vapor concentration (μg/m^3)			
	2008 average	2008 maximum	2008 minimum	1986–1988[a] average
AAS2 (east end of the Y-12 Complex)	0.0029	0.0054	0.0013	0.010
AAS8 (west end of the Y-12 Complex)	0.0048	0.0127	0.0020	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

Table 4.7 summarizes the 2008 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 2008 (plots 1, 2) and seasonal trends at AAS8 from 1993 through 2008 (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.

In conclusion, 2008 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, i.e., 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.

4.4.2.3 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.

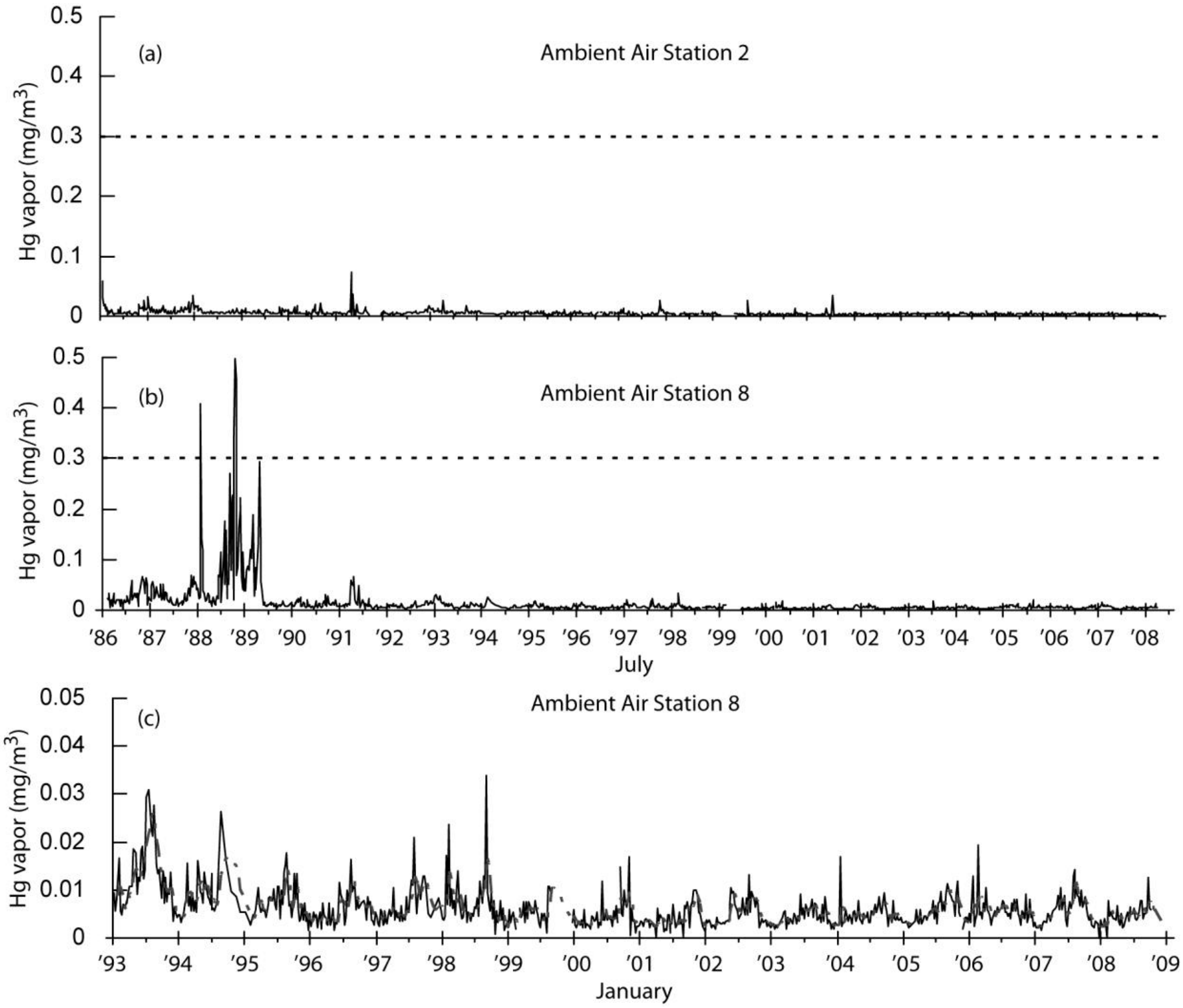

Fig. 4.22. Temporal trends in mercury vapor concentration for the boundary mercury monitoring stations at the Y-12 National Security Complex, July 1986 to January 2008 (Plots 1 and 2) and January 1993 to January 2008 for AAS8 (plot 3).

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 techs all the way to the analytical lab.

Semiannually, a field performance evaluation is conducted to ensure that proper procedures are followed by the sampling technicians.

Analytical QA/QC requirements include

- use of prescreened and/or laboratory purified reagents,
- analysis of at least 2 method blanks per batch,
- analysis of standard reference materials,

- analysis of laboratory duplicates (1 per 10 samples; any laboratory duplicates differing by more than 10% at 5 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.

4.4.2.4 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 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

This section provides a review of major components of the Y-12 Clean Water Compliance Program and activities associated with surface water monitoring at the Y-12 Complex. There were several significant highlights related to water compliance in 2008.

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.

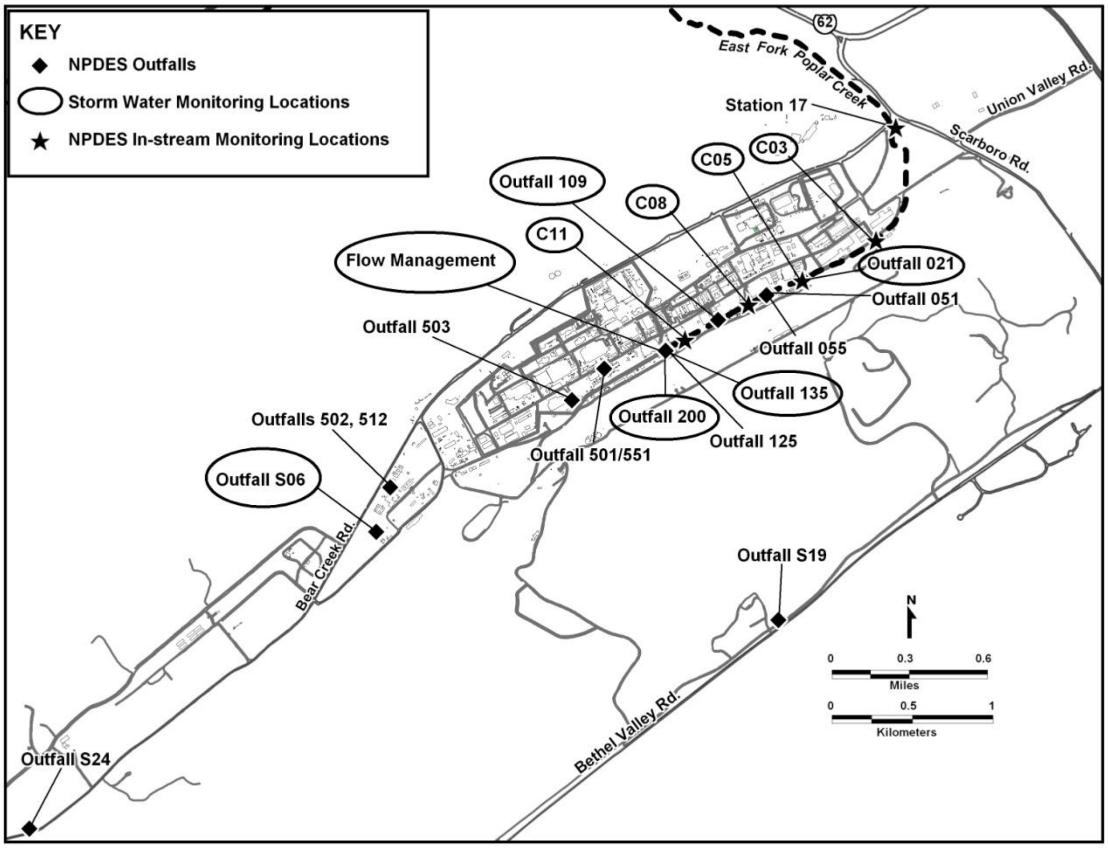

Fig. 4.23. Major Y-12 Complex National Pollutant Discharge Elimination System (NPDES) outfalls and storm water monitoring locations.

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 2008 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 2008 was >99.9%. The only 2008 NPDES permit excursion this year occurred as a result of a January 9 field reading of 0.68 mg/L for total residual chlorine made at one outfall. This exceeds the allowable daily maximum concentration of 0.50 mg/L. At the time of the reading there were no observed adverse effects on the receiving stream.

Action was taken by checking operation of the tablet-type dechlorination units located upstream. All units were found to be in working order. Table 4.8 lists the NPDES compliance monitoring requirements and the 2008 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 4.9). 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 2008 were reported in *Annual Storm Water Report for the Y-12 National Security Complex* (B&W Y-12 2009a), which was issued in January 2009. 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 2008 are noted in Fig. 4.24. Table 4.10 identifies the monitored locations, the frequency of monitoring, and the sum of the percentages of the derived concentration guidelines (DCGs) for radionuclides measured in 2008. Radiological data were well below the allowable DCGs.

In 2008, 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 75kg or 0.046Ci (Table 4.11). 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 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.

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

Table 4.8. NPDES compliance monitoring requirements and record for the Y-12 Complex, January through December 2008

Discharge point	Effluent parameter	Daily avg (lb/d)	Daily max (lb/d)	Daily avg (mg/L)	Daily max (mg/L)	Percentage of compliance	No. 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	*b*	0
	Total suspended solids	19	36.0	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	0.10	0.20	*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 503 (Steam Plant Waste Water 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 4.8 (continued)

Discharge point	Effluent parameter	Daily avg (lb/d)	Daily max (lb/d)	Daily avg (mg/L)	Daily max (mg/L)	Percentage of compliance	No. 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	100	13
Outfall 200 (North/South pipes)	pH, standard units			*a*	9.0	100	54
	Hexane extractables			10	15	100	54
	Cadmium			0.001	0.025	100	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	53
	Mercury			0.002	0.004	100	53
Outfall 051	pH, standard units			*a*	9.0	100	12
Outfall 135	pH, standard units			*a*	9.0	100	13
	Lead			0.04	1.190	100	14
	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	12
	Mercury				0.004	100	42
	Total residual chlorine				0.5	100	2
Outfall 109	pH, standard units			*a*	9.0	100	5
	Total residual chlorine				0.5	100	16
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	100	2
Outfall EFP	pH, standard units			*a*	9.0	100	262

Table 4.8 (continued)

Discharge point	Effluent parameter	Daily avg (lb/d)	Daily max (lb/d)	Daily avg (mg/L)	Daily max (mg/L)	Percentage of compliance	No. of samples
Outfall C11	pH, standard units			*a*	9.0	100	25
	Total residual chlorine				0.019	100	26
	Temperature (°C)				30.5	100	24
Outfall S06	pH, standard units			*a*	9.0	100	3
Outfall S19	pH, standard units			*a*	9.0	100	3
Outfall S24	pH, standard units			*a*	9.0	100	5
Category I outfalls	pH, standard units			*a*	9.0	100	41
Category II outfalls	pH, standard units			*a*	9.0	100	39
	Total residual chlorine				0.5	97	36
Category III outfalls	pH, standard units			*a*	9.0	100	12
	Total residual chlorine				0.5	100	11

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

Table 4.9. Radiological parameters monitored at the Y-12 Complex, 2008

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

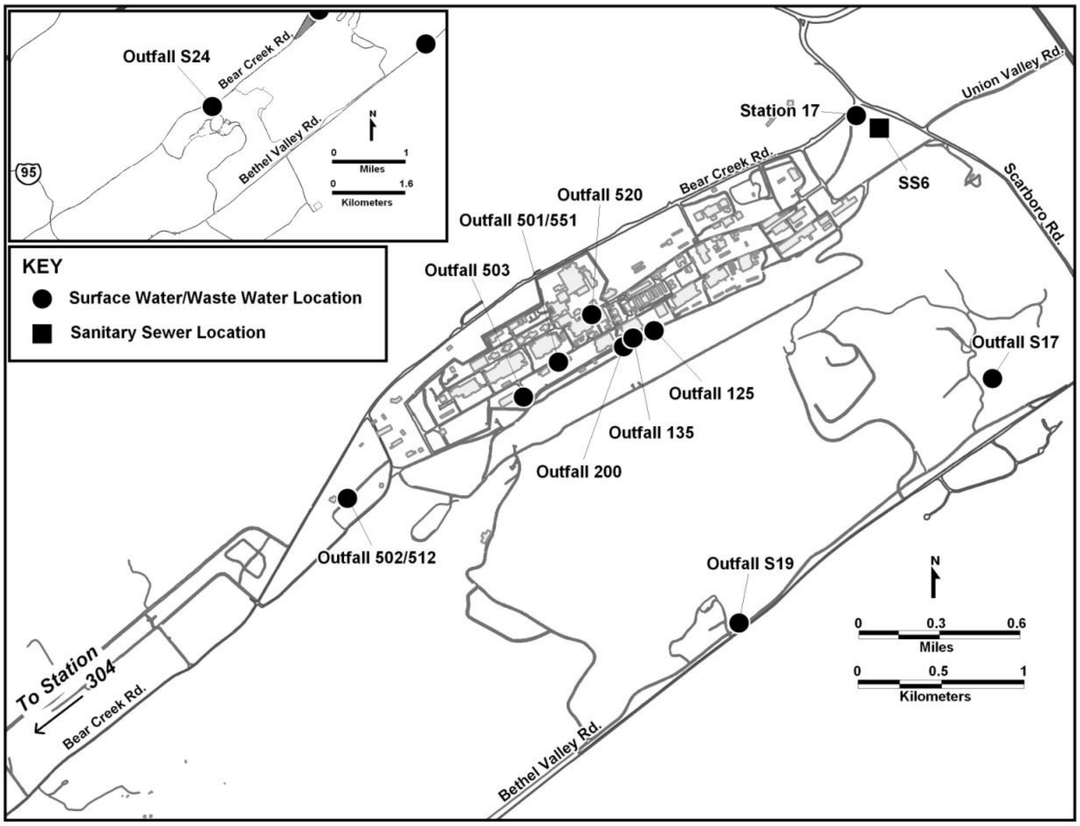

Fig. 4.24. Surface water and sanitary sewer radiological sampling locations at the Y-12 Complex.

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."

Storm water sampling for 2008 was conducted during September and October rain events. Results were provided in the Annual Storm Water Report, which was submitted to the Tennessee Division of Water Pollution Control in January 2009. 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 (see Fig. 4.23). In general, results of storm water 2008 monitoring indicated some improvement in the quality of storm water exiting the Y-12 Complex.

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 7 million gal/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).

Table 4.10. Summary of Y-12 Complex Radiological Monitoring Plan sample requirements[a]

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-hour composite	No flow
503	Steam Plant Wastewater Treatment Facility	4/year	24-hour composite	No flow
512	Groundwater Treatment Facility	4/year	24-hour composite	2.5
520	Steam condensate	1/year	Grab	0
551	Central Mercury Treatment Facility	4/year	24-hour composite	1.8
	Other Y-12 Complex point and area source discharges			
055	Outfall 055	4/year	24-hour composite	b
125	Outfall 125	4/year	24-hour composite	12.4
135	Outfall 135	4/year	24-hour composite	0
S17	Kerr Hollow Quarry	1/year	24-hour composite	1.8
S19	Rogers Quarry	1/year	24-hour composite	1.7
	Y-12 Complex instream locations			
S24	Outfall S24	4/year	7-day composite	12.2
Station 17	East Fork Poplar Creek, complex exit (east)	1/month	7-day composite	3.4
200	North/south pipes	1/month	24-hour composite	3.4
	Y-12 Complex Sanitary Sewer			
SS6	East End Sanitary Sewer Monitoring Station	1/week	7-day composite	0

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

During a two week period in August 2008, the flow augmentation water was reduced in the uppermost reach of the stream by approximately 2 million gal/day. The minimum flow requirement was met by diverting 2 million gal/day of the raw water input to a downstream location (outfall 002) near Station 17. Mercury concentrations in EFPC were measured for two weeks prior, during, and after the diversion. This study demonstrated a reduction in the transport of mercury from a contaminated section of streambed could be expected by reducing flow through this stream section.

Table 4.11. Release of uranium from the Y-12 Complex to the off-site environment as a liquid effluent, 2004–2008

Year	Quantity released	
	Ci[a]	kg
	Station 17	
2004	0.067	161
2005	0.043	93
2006	0.050	131
2007	0.036	70
2008	0.046	75

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

A request to modify the NPDES permit to allow the minimum flow, measured at Station 17, to be reduced to 5 million gal/day was made, and on December 30, 2008, TDEC modified the permit. The modified permit requires 5 million gal rather than 7 million gal minimum daily flow as measured at the Station 17 location. In addition to water conservation, this action offers the additional benefit of reducing Y-12's water cost by $272K annually.

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 are 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.

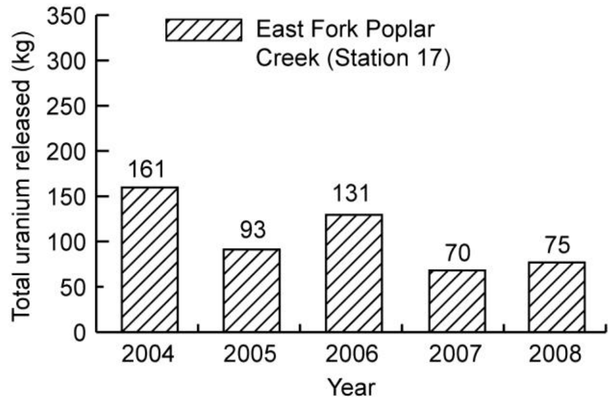

Fig. 4.25. Five-year trend of Y-12 Complex release of uranium to East Fork Poplar Creek.

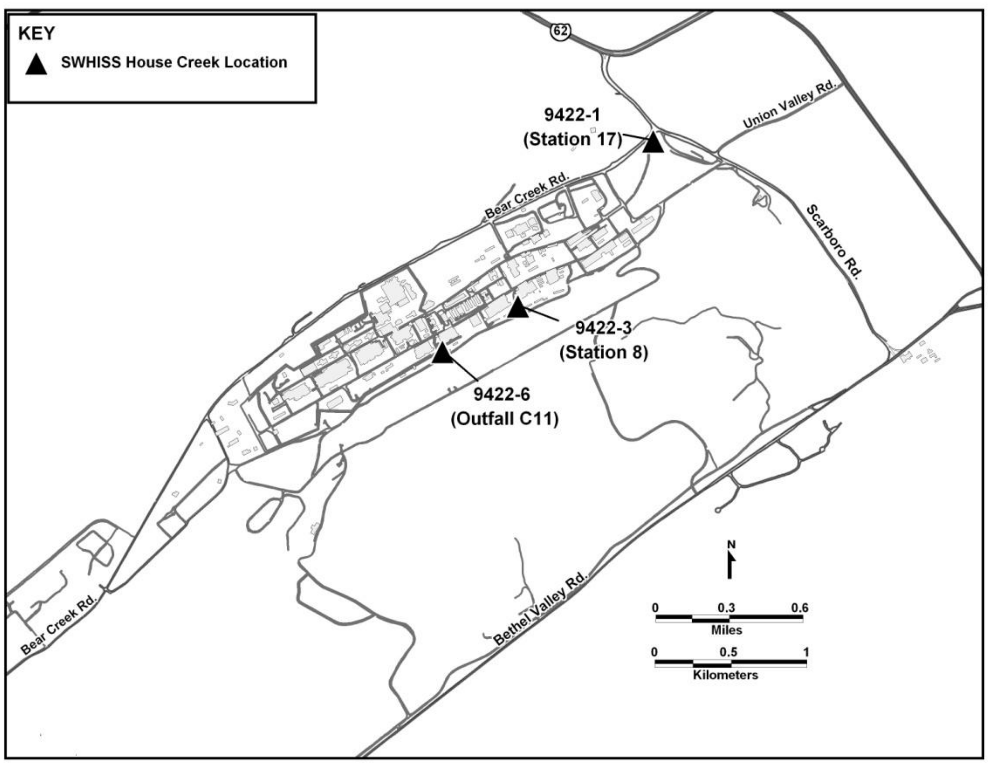

Fig. 4.26. Surface Water Hydrological Information Support System (SWHISS) monitoring locations.

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 hour 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 hours 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 2008 (Table 4.12) indicated four exceedances of permit limits. Two were for exceedance of permit limits (daily maximum and monthly average) for copper. The other two were for exceedance of the permit limit for maximum daily flow.

Table 4.12. Y-12 Complex Discharge Point SS6, Sanitary Sewer Station 6, January through December 2008

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	14	NA	9/6[c]	100
Silver	14	0.05	0.1	100
Arsenic	14	0.01	0.015	100
Biochemical oxygen demand	14	200	300	100
Cadmium	14	0.0033	0.005	100
Chromium	14	0.05	0.075	100
Copper	14	0.14	0.21	93
Cyanide	15	0.041	0.062	100
Iron	14	10	15	100
Mercury	14	0.023	0.035	100
Kjeldahl nitrogen	14	45	90	100
Nickel	14	0.021	0.032	100
Oil and grease	15	25	50	100
Lead	14	0.049	0.074	100
Phenols—total recoverable	14	0.3	0.5	100
Suspended solids	14	200	300	100
Zinc	14	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.

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.

Surface water data are 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 2008 using fathead minnow larvae and *Ceriodaphnia dubia*. Table 4.13 summarizes the inhibition concentration (IC_{25}) results of biomonitoring tests conducted during 2008 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 2008.

Table 4.13. Y-12 Complex Biomonitoring Program summary information[a] for outfalls 200, 135, and 125 in 2008

Site	Test date	Species	IC_{25}[b] (%)
Outfall 200	12/16/08	*Ceriodaphnia*	>100
Outfall 200	12/16/08	Fathead minnow	>100
Outfall 135	12/16/08	*Ceriodaphnia*	>20
Outfall 135	12/16/08	Fathead minnow	>20
Outfall 125	12/16/08	*Ceriodaphnia*	>36
Outfall 125	12/16/08	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 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).

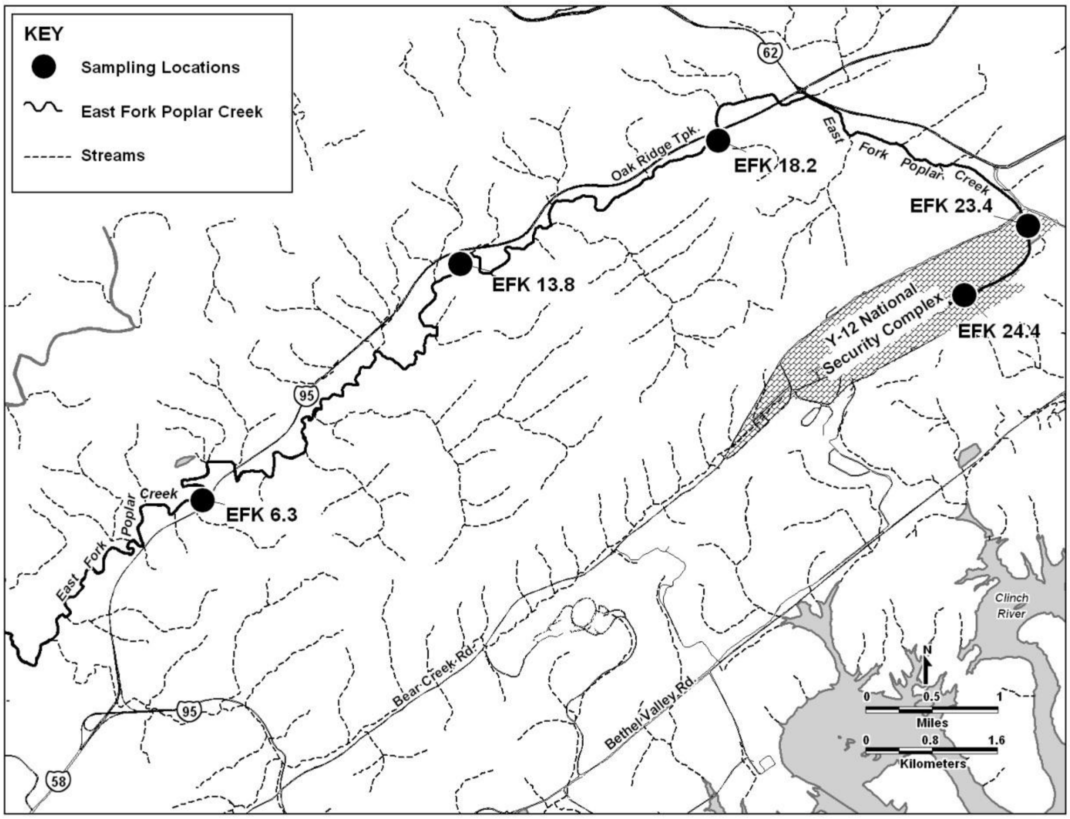

Fig. 4.27. Locations of biological monitoring sites on East Fork Poplar Creek in relation to the Oak Ridge Y-12 National Security Complex.

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 degraded in comparison with similar communities in reference streams.

4.5.9.1 Bioaccumulation Studies

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

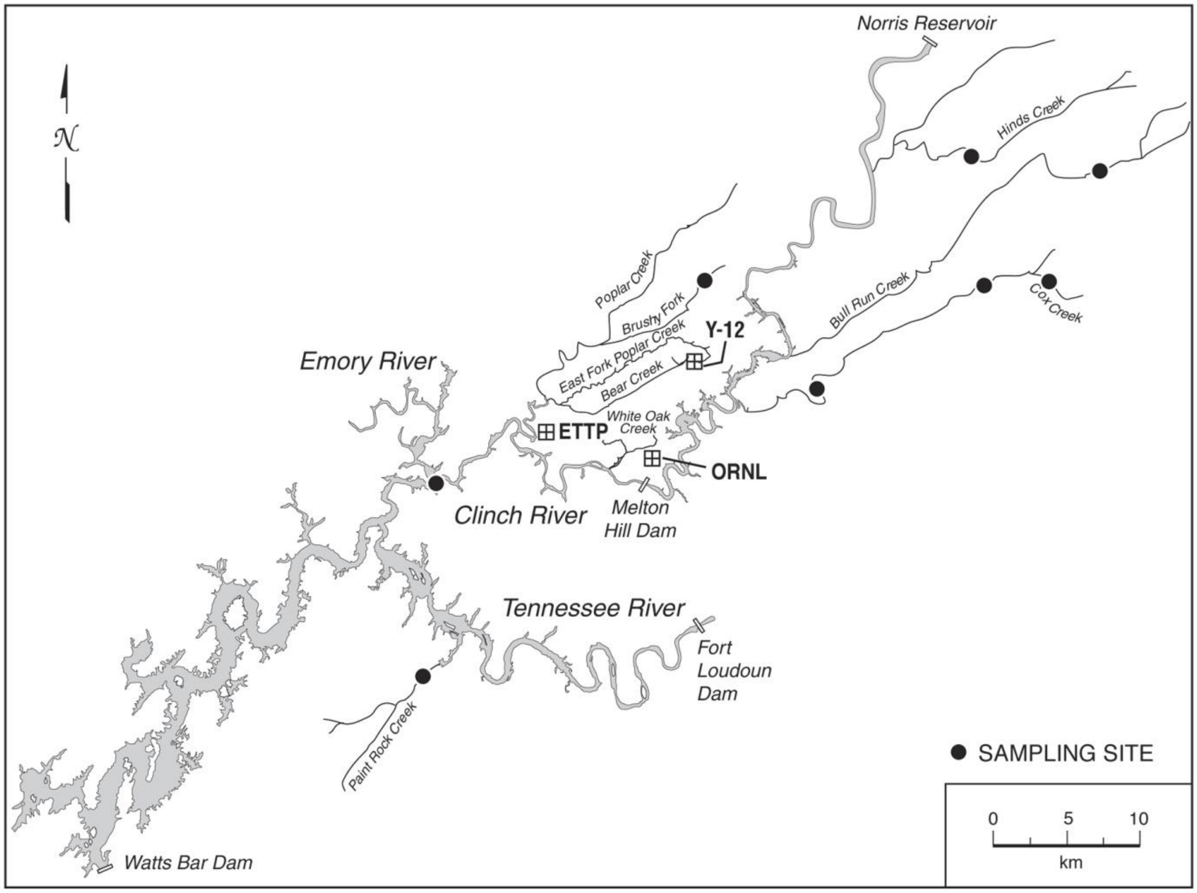

Fig. 4.28. Locations of biological monitoring reference sites in relation to the Oak Ridge Y-12 National Security Complex.

As part of this monitoring effort, redbreast sunfish (*Lepomis auritus*) and rock bass (*Ambloplites rupestris*) are collected twice yearly from five sites throughout the length of East Fork Poplar Creek and are analyzed for tissue concentrations of mercury (twice yearly) and PCBs (annually). Mercury concentrations remained much higher during 2008 in fish from East Fork Poplar Creek than in fish from reference streams. Elevated mercury concentrations in fish from the upper reaches of East Fork Poplar Creek 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 East Fork Poplar Creek 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. Mean concentrations of PCBs in fish at EFK 23.4 (the site where PCBs in fish are highest) continued to be much lower in 2008 than peak concentrations observed in the mid 1990s, although PCBs did rise in 2008 relative to recent years (Fig. 4.30).

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 2008. 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 (Fig. 4.31). The benthic macroinvertebrate community at the upstream-most sites in East Fork Poplar Creek appears to have stabilized in recent years, with the magnitude of changes between years being comparable to those at the reference sites, including the decreases in both metrics at EFK 24.4.

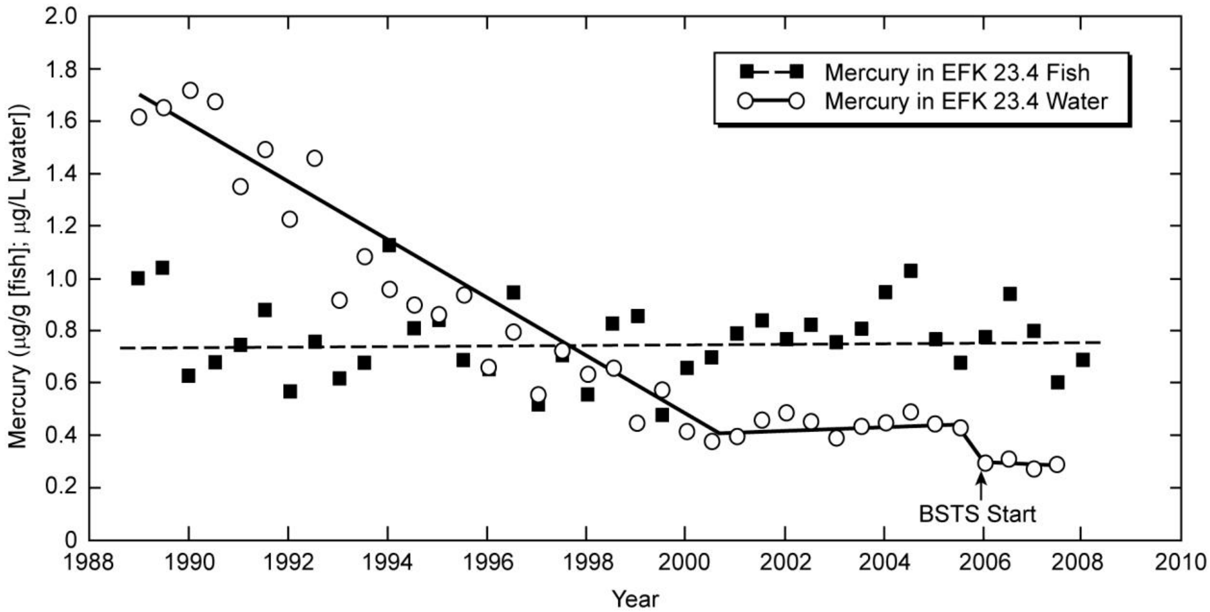

Fig. 4.29. Semiannual average mercury concentration in water and muscle fillets of redbreast sunfish and rock bass in East Fork Poplar Creek at EFK 23.4 through spring 2008. (BSTS = Big Spring Treatment System.)

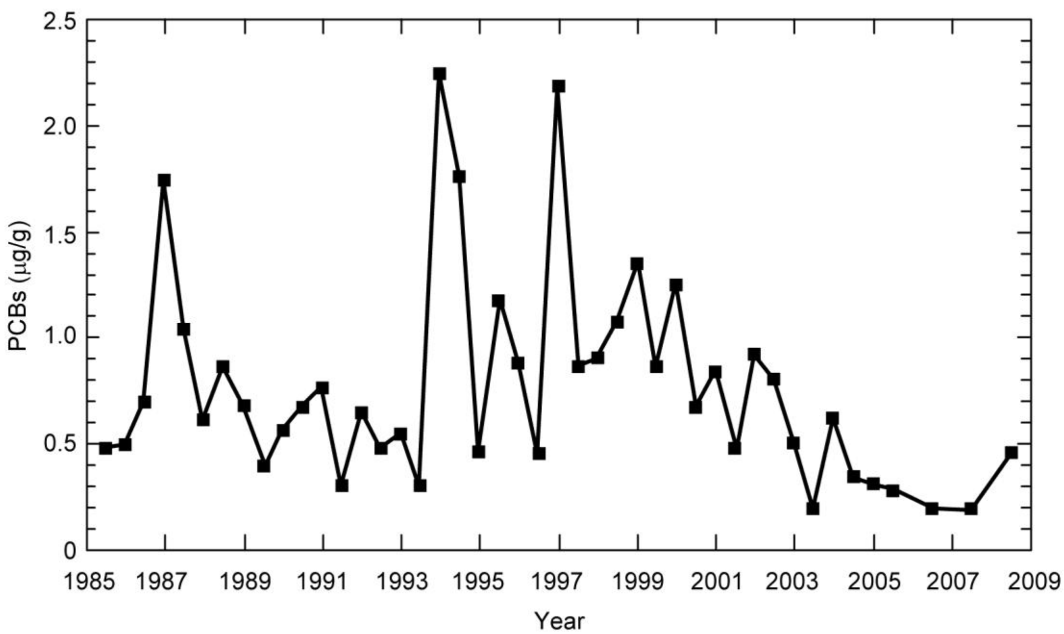

Fig. 4.30. Mean concentrations of PCBs in redbreast sunfish and rock bass muscle fillets in East Fork Poplar Creek at EFK 23.4 through 2008. (EFK = East Fork Poplar Creek kilometer.)

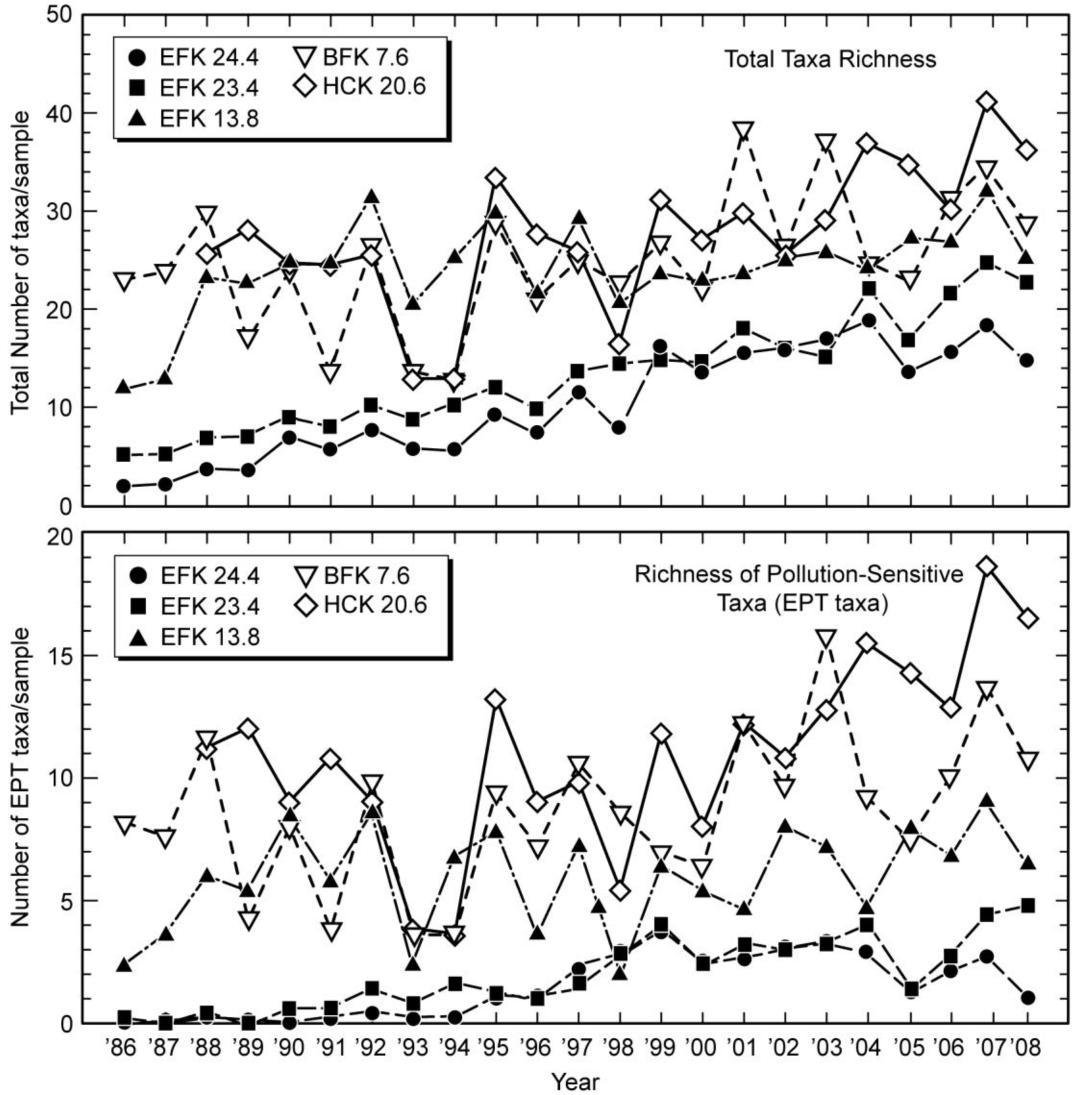

Fig. 4.31. Total taxonomic richness (mean number of taxa/sample) and total taxonomic richness of the Ephemeroptera, Plecoptera, and Trichoptera (EPT) (mean number of EPT taxa/sample) of the benthic macroinvertebrate communities sampled in spring from East Fork Poplar Creek and references sites on nearby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

4.5.9.3 Fish Community Monitoring

Fish communities were monitored in the spring and fall of 2008 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 is water that occurs and moves below the surface of the earth in pore spaces of soil, sediment, and rock formations. These formations, when saturated and permeable enough to be used as a water source, are referred to as aquifers, and are everywhere beneath our feet. Groundwater is an

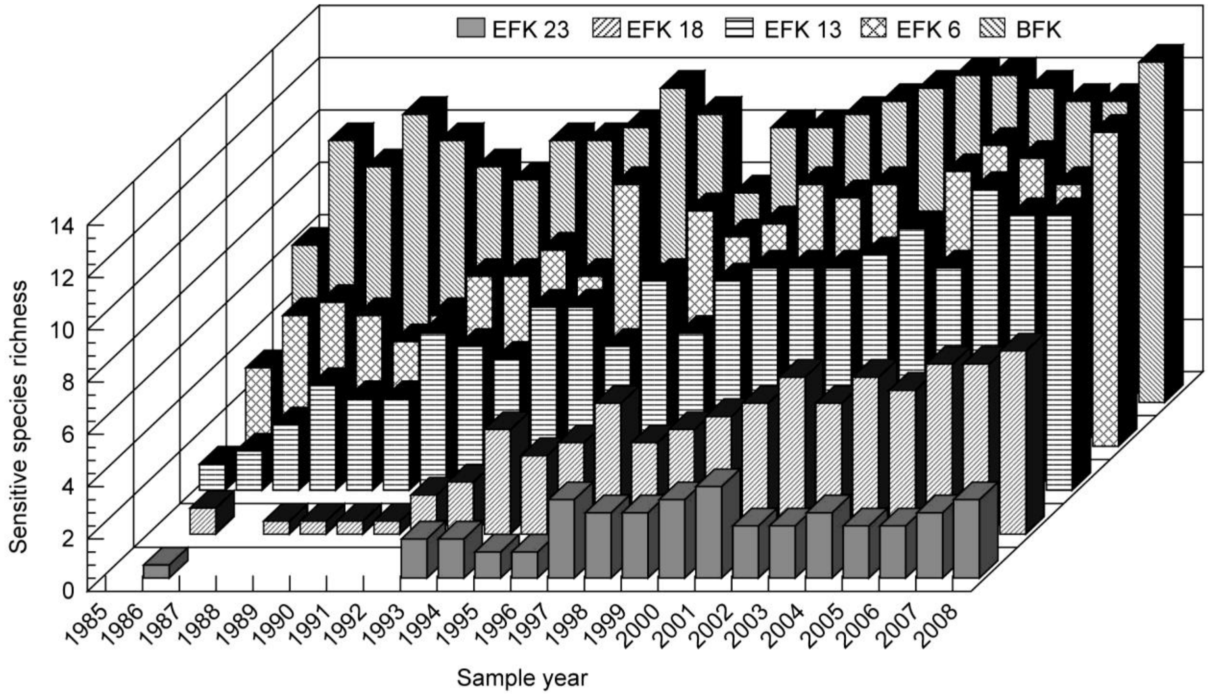

Fig. 4.32. Comparison of mean sensitive species richness (number of species) collected each year from 1985 through 2008 from four sites in East Fork Poplar Creek and a reference site (Brushy Fork).

important natural resource, especially in those parts of the country without ample surface-water sources, such as the arid West. More than 50% of the people in the United States, including almost everyone who lives in rural areas, use groundwater for drinking and other household uses. Groundwater is also used in some way by about 75% of cities and by many industries. The largest use of groundwater is crop irrigation.

Groundwater is an active and complex part of the Earth's hydrologic cycle. Recharging (or contributing to) aquifers is accomplished when rainfall seeps into the ground and percolates through soil and rock to the water table (the top of the saturated zone within the subsurface), or when surface waters contribute directly to groundwater. Discharges from groundwater are naturally occurring and commonly observed at natural springs and seeps but can also occur directly to streams, rivers, lakes, or oceans. Groundwater is not a stagnant underground lake, but instead is usually moving, allowing subsequent contributions from rainfall, runoff, and surface water. Groundwater is a renewable resource that has been used for thousands of years.

Operations at the Y-12 Complex reflect the growing awareness of the need to protect the environment, including groundwater systems. 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. Because of that contamination, groundwater monitoring is performed to comply with regulations and DOE orders. Figure 4.33 depicts the major facilities or areas for which groundwater monitoring was performed during CY 2008.

4.6.1 Hydrogeologic Setting

The Y-12 Complex is divided into three hydrogeologic regimes, which are delineated by surface water drainage patterns, topography, and groundwater flow characteristics. The regimes are further defined by the waste sites located within the area. These regimes include the Bear Creek Hydrogeologic, the Upper East Fork Poplar Creek Hydrogeologic, and the Chestnut Ridge Hydrogeologic Regimes

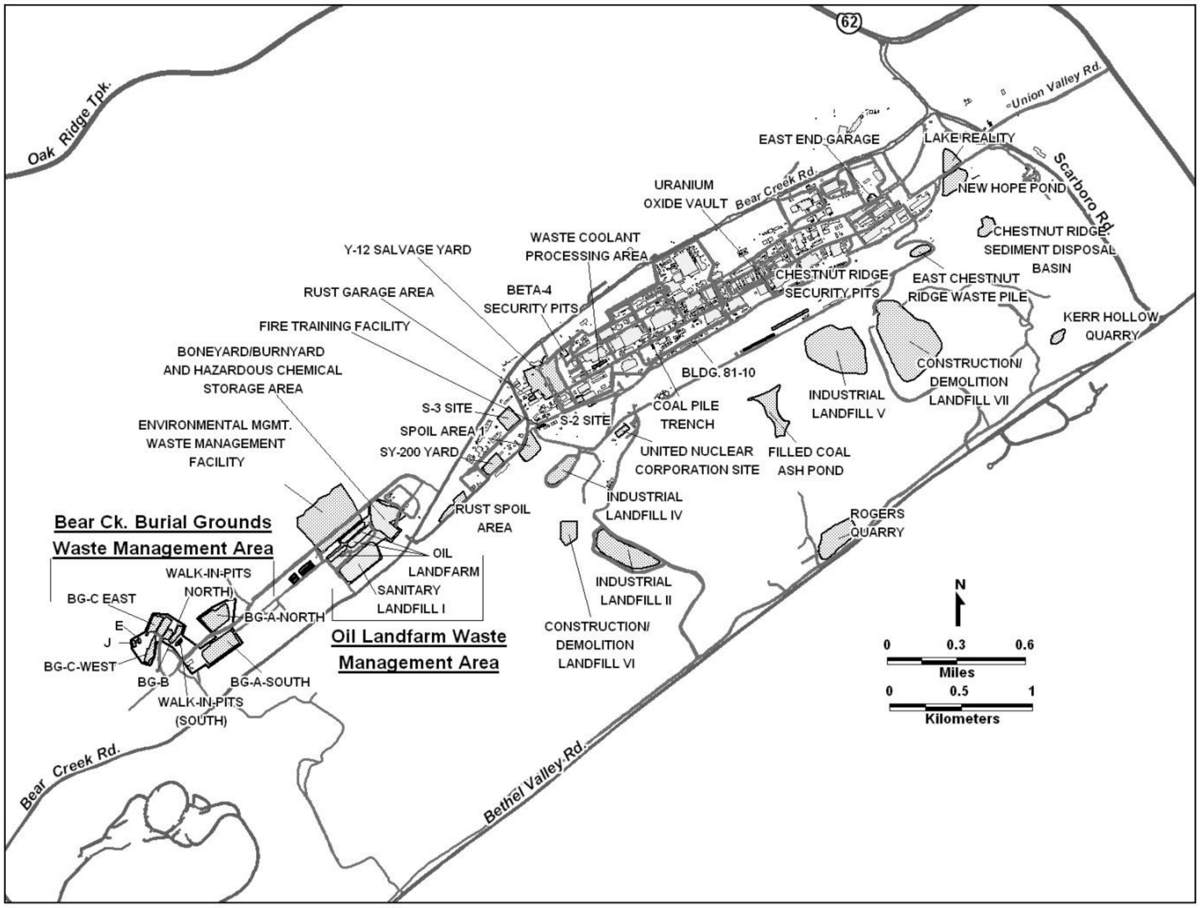

Fig. 4.33. Known or potential contaminant sources for which groundwater monitoring was performed at the Y-12 Complex during CY 2008.

(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 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.

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).

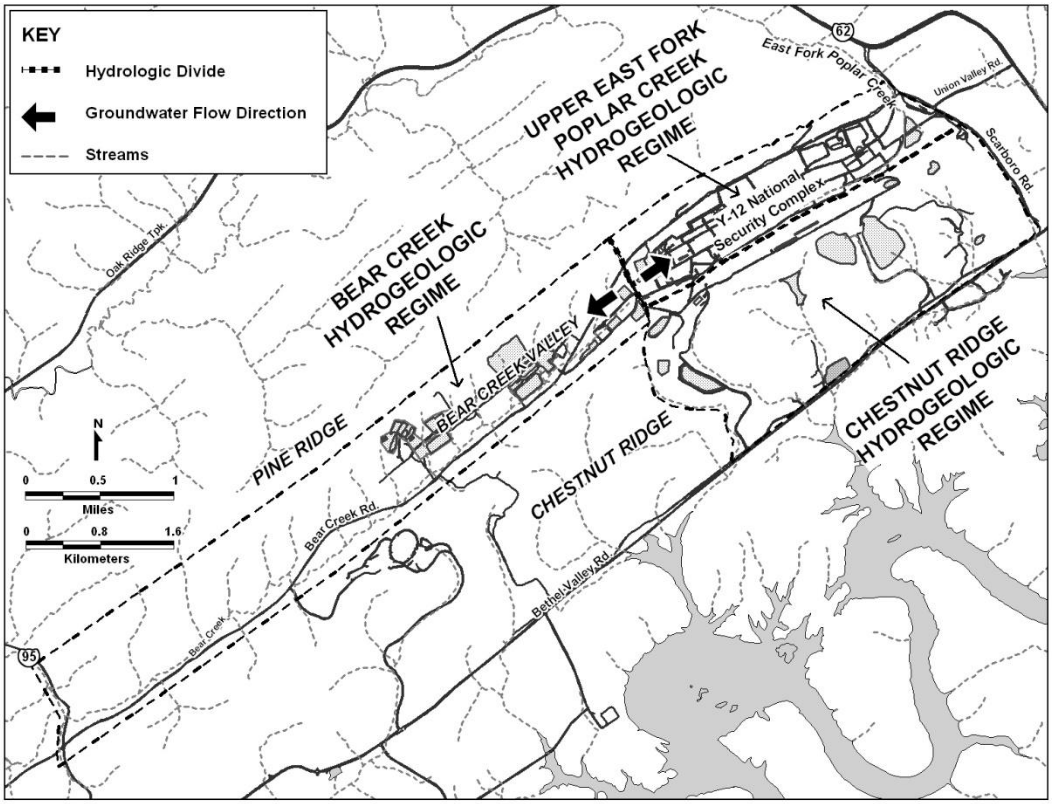

Fig. 4.34. Hydrogeologic regimes at the Y-12 Complex.

The rate of groundwater flow perpendicular to geologic strike from the fractured noncarbonate rock to the Maynardville Limestone has been estimated to be very slow below the water table interval. Most contaminant migration appears to be via surface tributaries to Bear Creek or along underground utility traces and buried tributaries in the Upper East Fork regime. Strike-parallel transport of some contaminants can occur within the fractured noncarbonate rock for significant distances. Continuous elevated levels of nitrate within the fractured noncarbonate rock are known to extend east and west from the S-3 Site for thousands of feet. Volatile organic compounds at source units in the fractured noncarbonate rock, however, tend to 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 rapid transport occurs for long 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.

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 primarily temporary devices used to measure groundwater table levels. Other devices or techniques are sometimes employed to gather data,

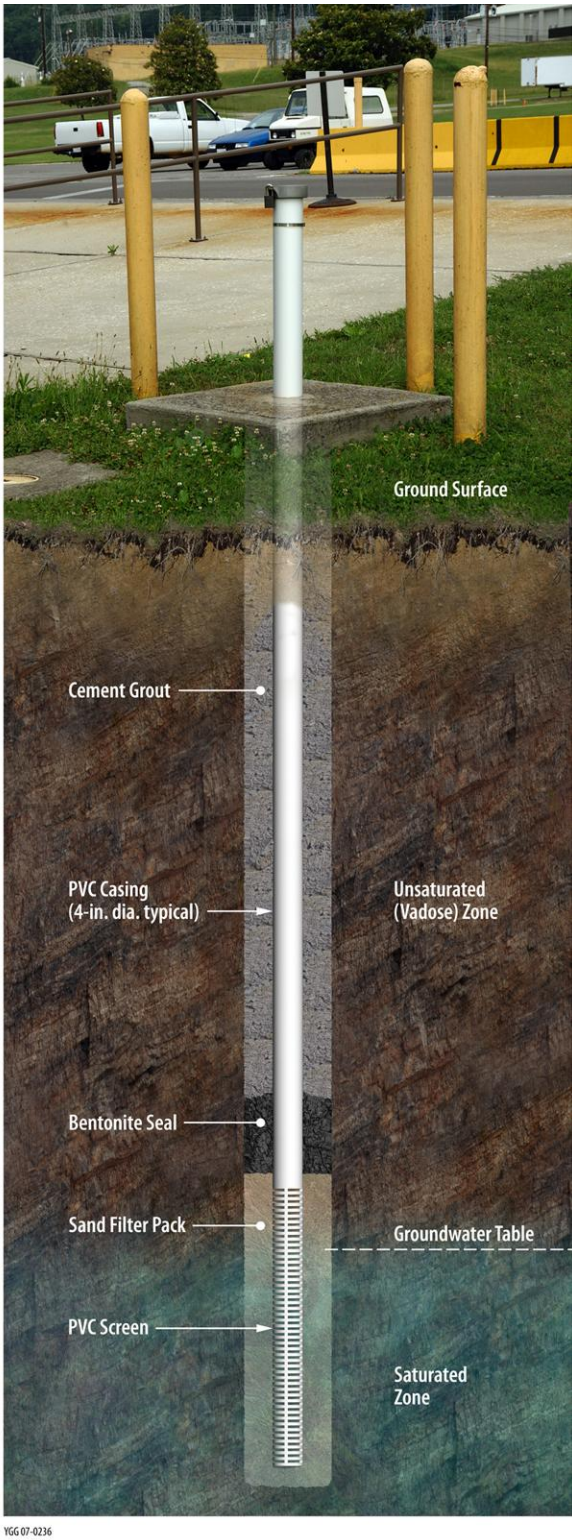

Fig. 4.35. Cross-section of a typical groundwater monitoring well.

including well points and push probes. In CY 2008, no compliance or surveillance monitoring wells were installed or plugged; however, ten 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 research the interactions and processes within a contaminated groundwater system to assist in the development of remediation strategies and tools for groundwater cleanup.

4.6.3 CY 2008 Groundwater Monitoring

Groundwater monitoring in CY 2008 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 213 wells and 32 surface water locations and springs (Table 4.14, Fig. 4.36). Figure 4.37 shows the locations of Y-12 Complex perimeter/exit pathway groundwater monitoring stations.

Comprehensive water quality results of groundwater monitoring activities at Y-12 in CY 2008 are presented in the annual *Groundwater Monitoring Report* (B&W Y-12 2009b).

Details of monitoring efforts performed specifically for CERCLA baseline and remediation evaluation are published in the FY 2008 and FY 2009 Water Resources Restoration Program sampling and analysis plans (BJC 2007 and BJC 2008), and the 2009 *Remediation Effectiveness Report* (DOE 2009).

Groundwater monitoring compliance reporting to meet RCRA postclosure permit requirements can be found in the annual RCRA *Groundwater Monitoring Report* (BJC 2009).

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. 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.

Table 4.14. Summary of groundwater monitoring at the Y-12 Complex, 2008

	Purpose for which monitoring was performed				
	Restoration[a]	**Waste management**[b]	**Surveillance**[c]	**Other**[d]	**Total**
Number of active wells	60	30	123	59	272
Number of other monitoring stations (e.g., springs, seeps, surface water)	12	6	14	5	37
Number of samples taken[e]	123	36 *	172	400	731
Number of analyses performed	6,662	3,688 *	16,624	6,557	33,531
Percentage of analyses that are non-detects	70.2	86.8	77.5	33	68.4
Ranges of results for positive detections, VOCs (µg/L)[f]					
Chloroethenes	0.1–3,500	0.14–8.9	0.9–50,000	NA	
Chloroethanes	0.1–470	0.27–25	1–3,000	NA	
Chloromethanes	0.2–1,300	ND	1–1,400	NA	
Petroleum hydrocarbons	0.1–8,300	ND	1–2,300	NA	
Uranium (mg/L)	0.0042–0.54	ND	0.0005–1.53	0.0031–77.96	
Nitrates (mg/L)	0.028–7,440	0.59–3.0	0.029–11,100	0.36–54,540.2	
Ranges of results for positive detections, radiological parameters (pCi/L)[g]					
Gross alpha activity	1.72–431	2–4.6	2.6–1,100	NA	
Gross beta activity	3.0–21,300	1.18–13.4	4.5–9,600	NA	

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

[b]Solid waste landfill detection monitoring; *=excludes CERCLA landfill (Environmental Monitoring Waste Management Facility) detection monitoring.

[c]DOE Order 450.1A surveillance monitoring.

[d]Research-related groundwater monitoring associated with activities of the DOE ORR Field Research Center.

[e]The number of samples, excluding duplicates, determined for unique location/date combinations. Samples are unfiltered except for those reported for "Other."

[f]These ranges reflect concentrations of individual contaminants (not summed volatile organic compound concentrations):

Chloroethene—includes tetrachloroethene, trichloroethene, 1,2-dichloroethene (*cis* and *trans*), 1,1-dichloroethene, and vinyl chloride.

Chloroethanes—include 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichloroethane.

Chloromethanes—include carbon tetrachloride, chloroform, and methylene chloride.

Petroleum hydrocarbon—includes benzene, toluene, ethylbenzene, and xylene.

[g]1 pCi = 3.7×10^{-2} Bq.

Abbreviations

NA = Not applicable

ND = Not detected

Fig. 4.36. Groundwater sampling at Y-12.

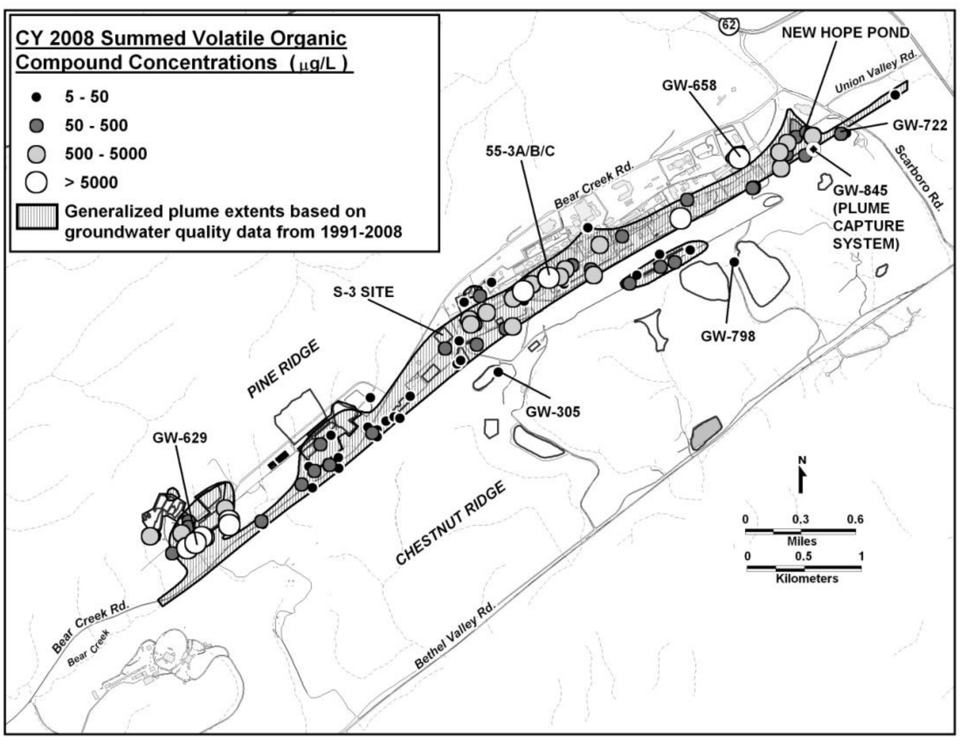

Fig. 4.37. Locations of Y-12 Complex perimeter/exit pathway well, spring, and surface water monitoring stations.

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 4.15. 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.

Table 4.15. History of waste management units and underground storage tanks included in groundwater monitoring activities, Upper East Fork Poplar Creek Hydrogeologic Regime, 2008

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 fire-fighting 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

4.6.4.1.1 Plume Delineation

Sources of groundwater contaminants monitored during CY 2008 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 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.

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 2008, groundwater containing nitrate concentrations as high as 11,200 mg/L (Well GW-109) occurred in the shallow bedrock just east of the S-3 Site (Fig. 4.38). These results are consistent with results from previous years.

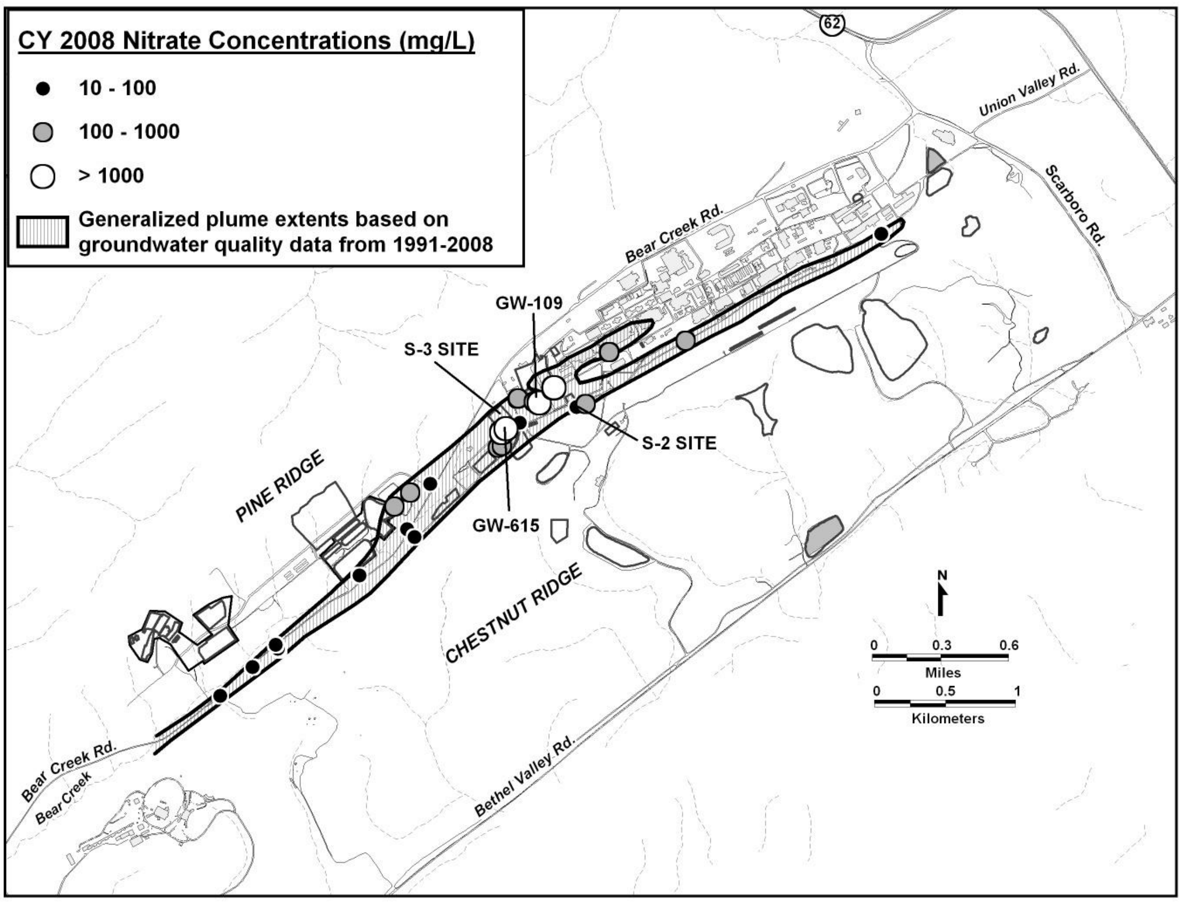

Fig. 4.38. Nitrate observed in groundwater at the Y-12 Complex, 2008.

4.6.4.1.3 Trace Metals

Concentrations of barium, beryllium, cadmium, chromium, lead, mercury, nickel, and uranium exceeded drinking water standards during CY 2008 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. Concentrations of uranium exceed the standard (0.03 mg/L) in a number of source areas (e.g., production areas and the Former Oil Skimmer Basin) and contribute to the uranium concentration in Upper East Fork Poplar Creek.

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 2008, the highest summed concentration of dissolved chlorinated solvents (54,895 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 (20,100 µg/L) was obtained from Well GW-658 at the closed East End Garage.

The CY 2008 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 . 4.39). 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.

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 Waste Coolant Processing Facility, some production/process facilities, and the chloroethene component of the East End volatile organic compound plume, indicating that some portions of the plume are still mobile. Additionally, concentrations are influenced by precipitation with dilution or flushing effects dominating in wells depending upon the permeability of the surrounding rock and proximity to sources and migration pathways. For example, Well 55-3B has an observable inverse correlation between annual rainfall rates and concentrations of chlorinated volatile organic compounds indicating that dilution effects dominate in the vicinity of this well within the noncarbonated fractured rock.

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 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.

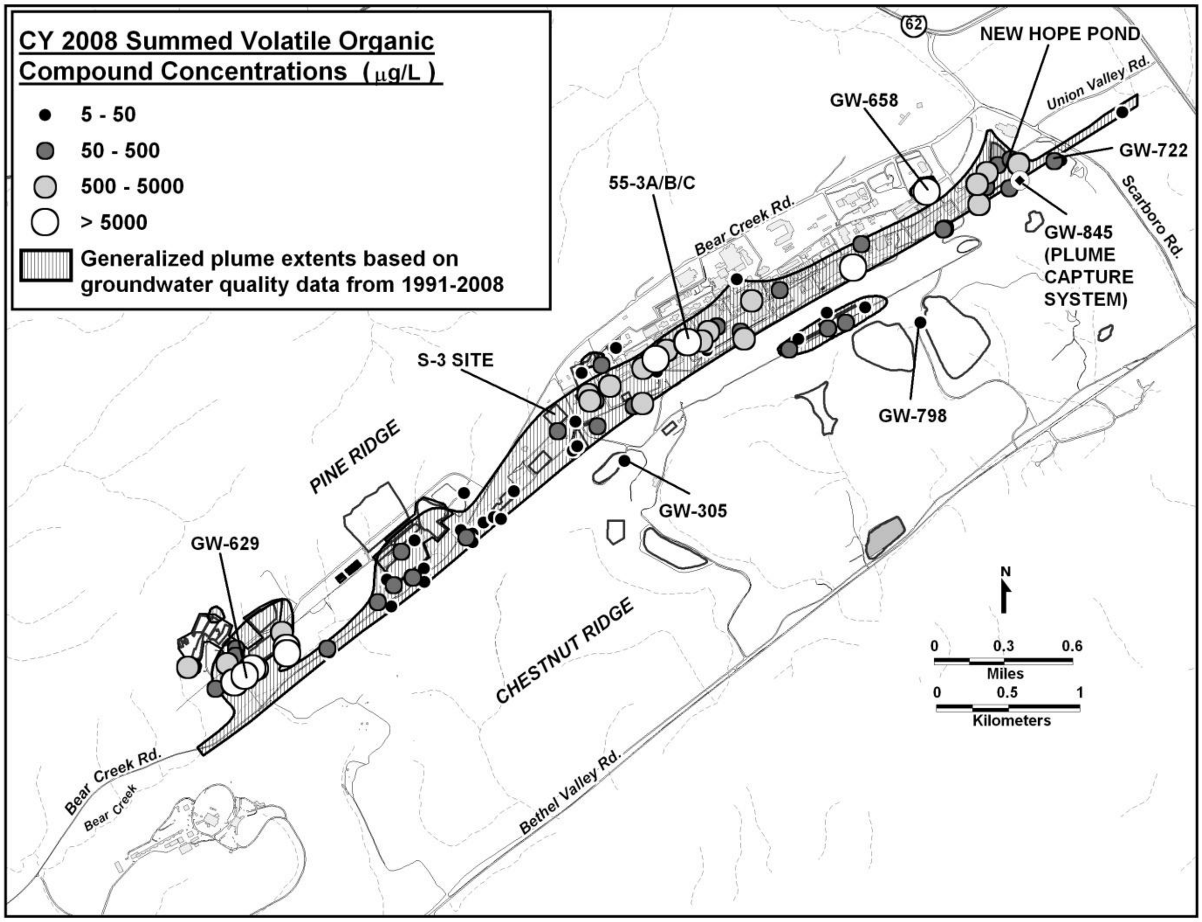

Fig. 4.39. Summed volatile organic compounds observed in groundwater at the Y-12 Complex, 2008.

4.6.4.1.5 Radionuclides

The primary alpha-emitting radionuclides found in the East Fork regime during CY 2008 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 (431 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. 4.40).

The primary beta-emitting radionuclides observed in the Upper East Fork regime during CY 2008 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. 4.41). The highest gross beta activity in groundwater was observed during CY 2008 from well GW-108 (21,300 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. The compounds are migrating at depths of almost 500 ft in the Maynardville Limestone, the primary exit pathway on the east

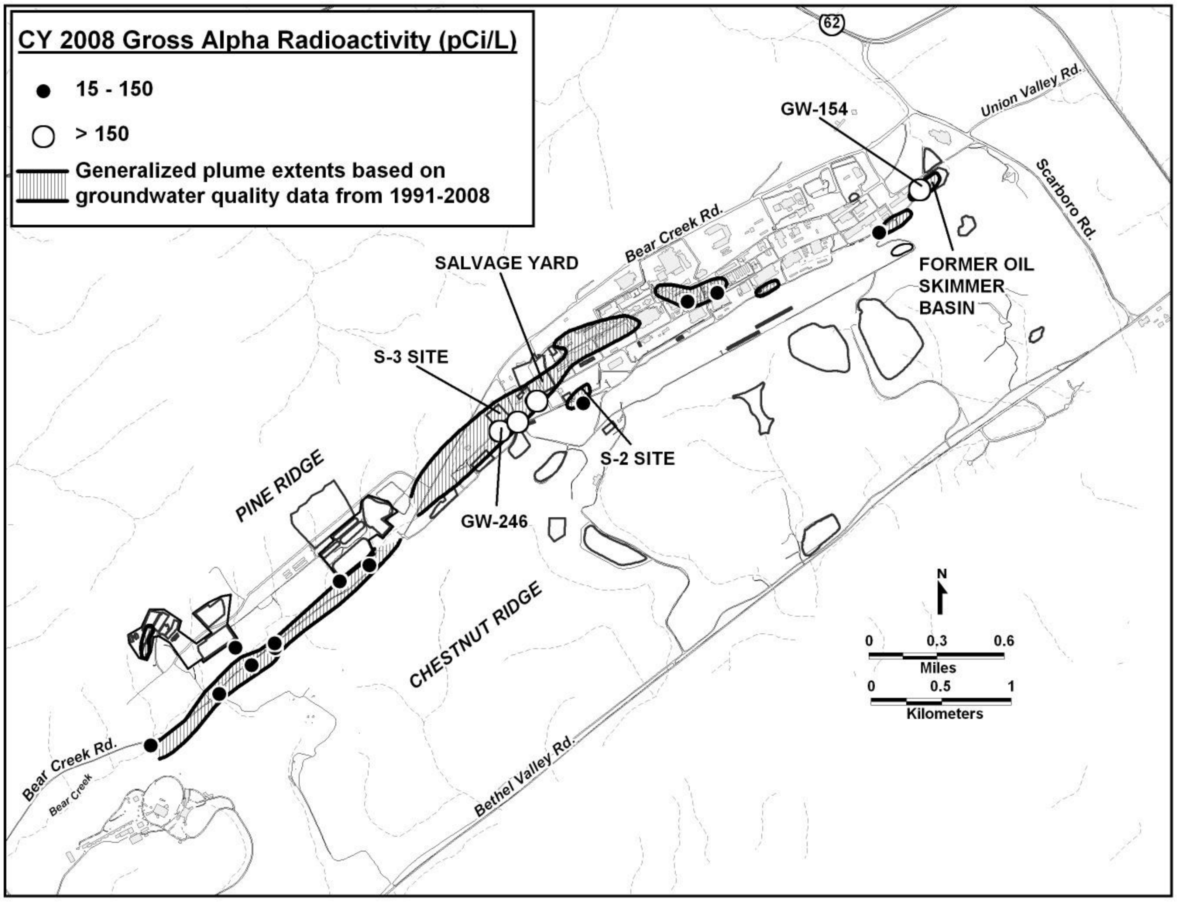

Fig. 4.40. Gross alpha radioactivity observed in groundwater at the Y-12 Complex, 2008.

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 2008, the observed concentrations of volatile organic compounds at the New Hope Pond distribution channel underdrain continue to remain low (Fig. 4.42). This may be because the continued operation of the groundwater plume-capture system in Well GW-845 southeast of New Hope Pond is effectively 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 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 500 ft east and downgradient of Well GW-845, permits sampling of ten discrete zones within the Maynardville Limestone between 87 and

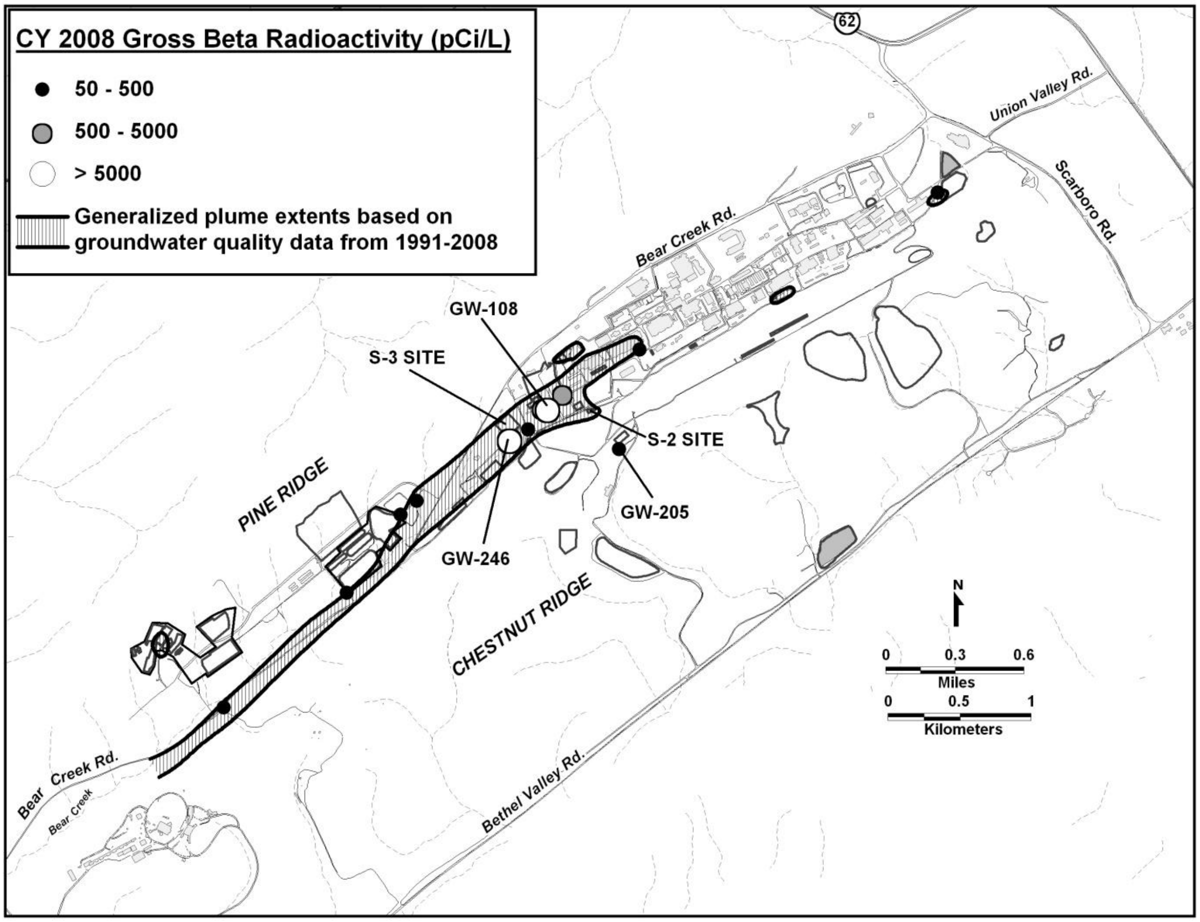

Fig. 4.41. Gross beta radioactivity observed in groundwater at the Y-12 Complex, 2008.

560 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 4.42). 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.

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. 4.37). Only one shallow well was monitored in CY 2008, 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.

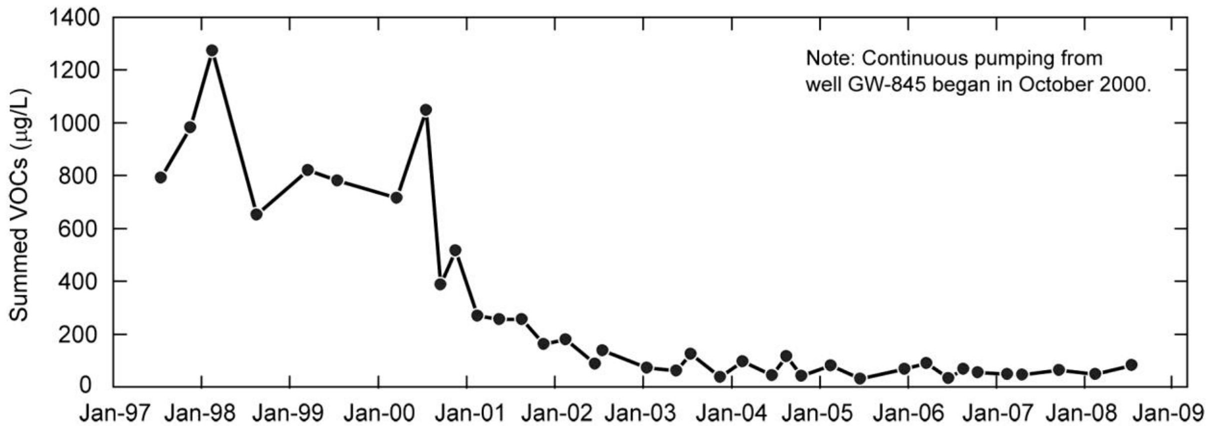

Fig. 4.42. Decreasing summed volatile organic compounds observed in exit pathway Well GW-722-17 near the New Hope Pond, 2008.

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 2008, 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 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 2009).

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 4.16 describes each of the waste management sites within the Bear Creek regime.

Table 4.16. History of waste management units included in CY 2008 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 a mounts 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 record of decision 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

4.6.4.2.1 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 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 300 ft below the ground surface).

Data obtained during CY 2008 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 (11,100 mg/L) was observed at Well GW-615 adjacent to the S-3 Site at a depth of 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 740 ft below ground surface.

4.6.4.2.3 Trace Metals

During CY 2008, uranium, barium, cadmium, lead, beryllium, nickel, and arsenic 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, Bechtel Jacobs Company performed the final remedial actions at the Boneyard/Burnyard with the objective of removing materials contributing to surface water and groundwater contamination to meet existing record-of-decision goals. Approximately 86,000 yd^3 of waste materials were excavated and placed in the EMWMF (DOE 2009). 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 the primary source of uranium in Bear Creek Valley. In CY 2008, a corresponding decrease in uranium concentrations is continuing to be observed downstream in Bear Creek (Table 4.17). Other trace metal contaminants that have been observed in the Bear Creek regime are boron, cobalt, copper, lithium, manganese, strontium, mercury, and zinc. Concentrations have commonly exceeded background values in groundwater near contaminant source areas.

Table 4.17. Nitrate and uranium concentrations in Bear Creek[a]

Bear Creek Monitoring Station (distance from S-3 site)	Contaminant	Average concentration (mg/L)				
		1990–1993	1994–1997	1998–2001	2002–2005	2006–2008
BCK[b] 11.84 to 11.97	Nitrate	119	80	80	79.5	37.0
(~0.5 miles downstream)	Uranium	0.196	0.134	0.139	0.133	0.123
BCK 09.20 to 09.47	Nitrate	16.4	9.6	10.6	11.3	9.9
(~2 miles downstream)	Uranium	0.091	0.094	0.171	0.092	0.069
BCK 04.55	Nitrate	4.6	3.6	2.6	2.9	1.0
(~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

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 greater than 300 ft. Groundwater in the fractured noncarbonate rock that contains detectable levels of volatile organic compounds occurs primarily within about 1,000 ft of the source areas. The highest concentrations observed in CY 2008 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 28,631 µg/L in Well GW-629 (Fig. 4.39). This result is much higher than concentrations seen prior to 2006. This, coupled with increasing trends observed downgradient of the Bear Creek Burial Ground waste management area in the fractured noncarbonate rock (Fig. 4.43), indicates that some

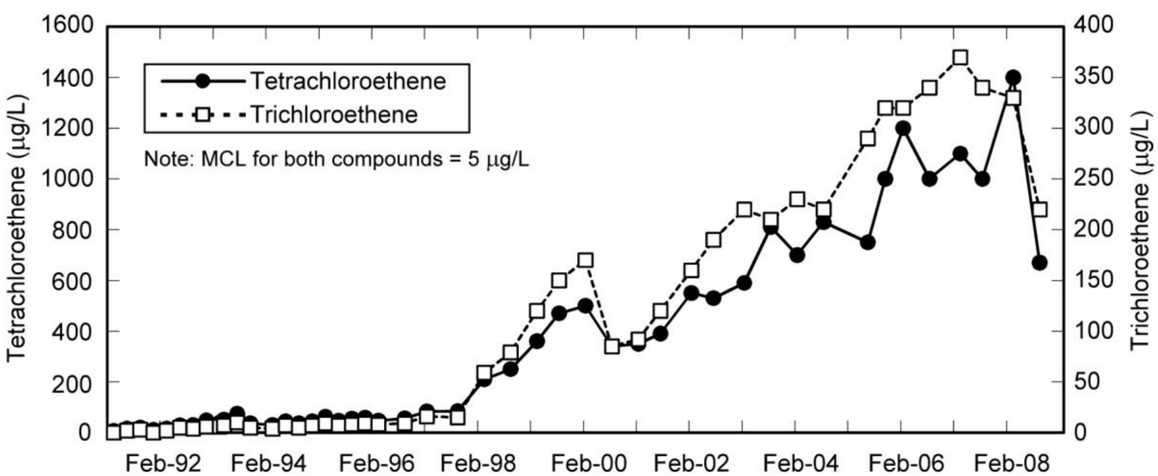

Fig. 4.43. Increasing volatile organic compounds observed in groundwater at Well GW-627 west and downgradient of the Bear Creek Burial Grounds, 2008. MCL = maximum contaminant limit.

migration of volatile organic compounds is occurring. 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.

Significant transport of volatile organic compounds has occurred in the Maynardville Limestone. Data obtained from exit pathway monitoring locations show that in the vicinity of the water table, an apparently continuous dissolved plume extends at least 7,400 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 2008 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 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. 4.40). 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 9,000 ft west of the S-3 Site. The highest gross alpha activity observed in CY 2008 was 420 pCi/L in Well GW-246 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 2008, 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 8,000 to 10,000 ft from the S-3 Site (Fig. 4.41). The highest gross beta activity in groundwater in the Bear Creek Regime in 2008 was 21,300 pCi/L at Well GW-108 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. 4.37).

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 2008 from the exit pathway monitoring wells indicate that groundwater is contaminated above drinking water standards in the Maynardville Limestone as far west as Picket B and trends are generally decreasing (Fig. 4.44).

Surface water samples collected during CY 2008 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 (B&W Y-12 2009). The concentrations in the creek decrease with distance downstream of the waste disposal sites (Table 4.17). 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.

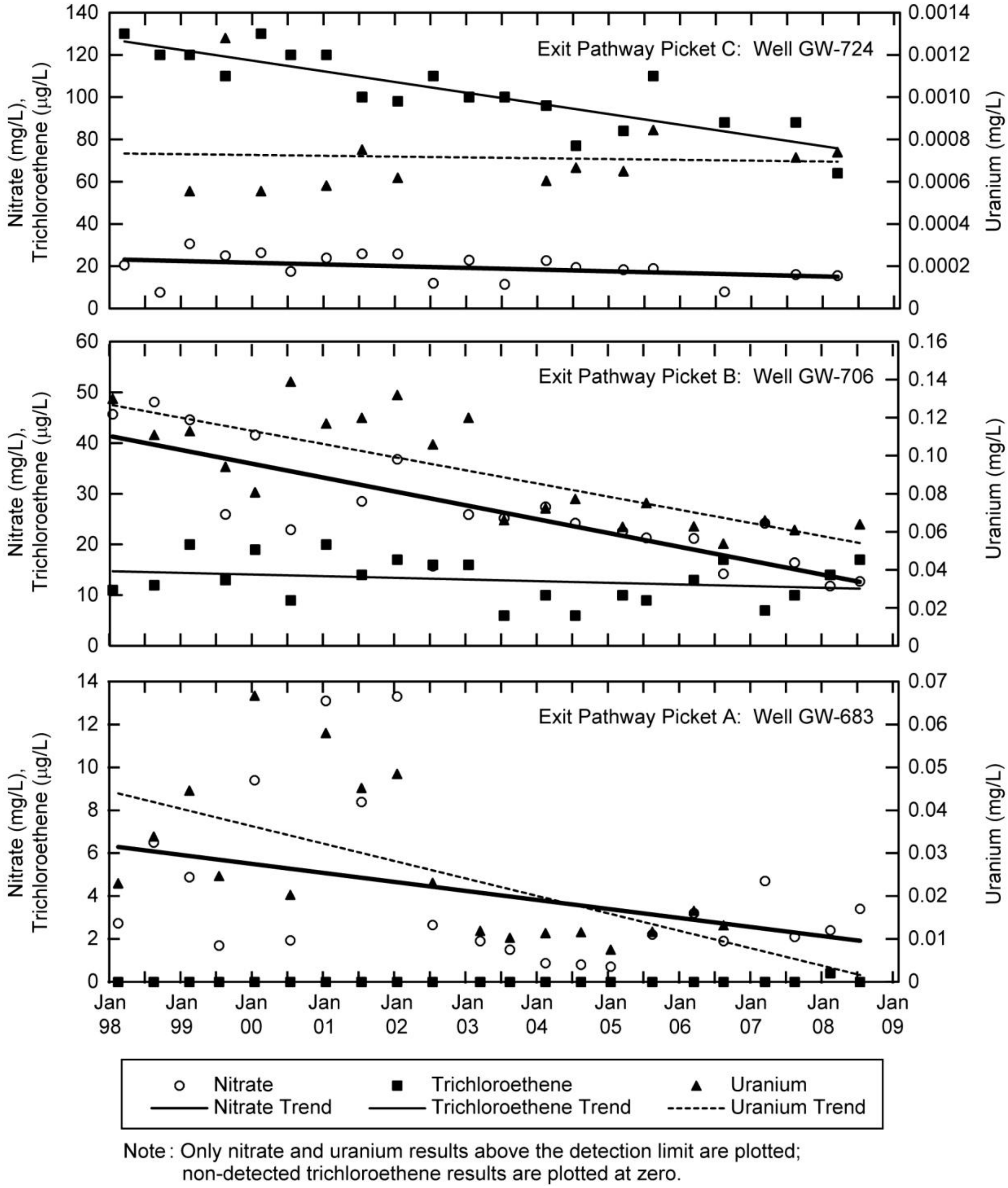

Fig. 4.44. Concentrations of selected contaminants in exit pathway monitoring wells GW-724, GW-706, and GW-683 in the Bear Creek Hydrogeologic Regime, 2008.

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 4.18 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 (<1,000 ft). Groundwater quality data obtained during CY 2008 indicate that the western lateral extent of the plume of volatile organic compounds at the site has not changed significantly from previous years. However, a slight increase in the summed volatile organic compound concentrations may be due to an increase in degradation products due to chemical and biological attenuation of the contaminants. The continued observation of volatile organic compound contaminants over the past several years at a well approximately 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 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.

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

Nickel concentrations above the drinking water standard (0.1 mg/L) were observed in the groundwater sample from one well (GW-305) at the Industrial Landfill IV (Fig. 4.33) with a maximum concentration of 0.11 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 is suspected to be due 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. 4.39). Elevated concentrations observed in GW-798 appear to fluctuate with changing precipitation conditions. The volatile organic compounds detected in CY 2008 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 been on a shallow increase. In CY 2008, results from this well continue to show trace levels of volatile organic compounds; however, no exceedance of drinking water standards was observed.

Table 4.18. History of waste management units included in groundwater monitoring activities, Chestnut Ridge Hydrogeologic Regime, 2008

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

4.6.4.3.5 Radionuclides

In CY 2008, 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. 4.41) at the United Nuclear Corporation site (the maximum detected activity was 68.2 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 2008. No contaminants were detected in any of these natural discharge points above drinking water standards. The volatile organic compound 1,1,2-trichloro-1,2,2-trifluoroethane, also known as Freon-113, was qualitatively detected at Spring SCR2.1SP at a very low concentration of 2 µg/L. This is the first detection at this perimeter monitoring station. This compound has been observed in groundwater samples from wells adjacent to the Chestnut Ridge Security Pits. However, due to the low mobility of Freon-113, it is unlikely that this compound would be the first to be detected. The detection is inconsistent with historical results for the spring and may be an outlier or analytical/sampling artifact. Future monitoring results will confirm or negate the presence of this contaminant in the groundwater from the spring.

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 were collected.
- All groundwater samples were controlled under chain of custody from their collection in the field through the analytical laboratory that performed the analyses.

- Laboratory analyses were performed using standard methodologies and protocols within established holding times.

4.7 Remedial Action and Waste Management

4.7.1 Upper East Fork Poplar Creek Remediation

Remediation of the Upper East Fork Poplar Creek Watershed is being conducted in stages using a phased approach. Phase 1 addresses interim actions for 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 Upper East Fork Poplar Creek.

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 parties in April 2006. The initial project of the Phase 2 ROD is remediation of the Y-12 Old Salvage Yard.

Approximately 14,446 tons of scrap metal at the Y-12 Complex Old Salvage Yard require removal and disposal in an approved location. The scrap is generally contaminated with depleted uranium. Before 1995, the Old Salvage Yard received scrap into open piles. Since 1995, and prior to shutdown, procedures required that all scrap metal be placed inside containers.

In 2008, the Remedial Design Report/Remedial Action Work Plan and the Waste Handling Plan, which are Federal Facility Agreement milestone documents needed to plan the remediation, were submitted by DOE to TDEC and EPA for approval. Procurement planning was also initiated by DOE in 2008 to support establishment of a remediation contract. The remedial action contractor will be required to develop a comprehensive schedule for the overall effort, including all activities required to accomplish the scrap removal.

4.7.2 Waste Management

The CERCLA Waste Facility, located in Bear Creek Valley near the Y-12 Complex, is an ORR waste facility used for disposal of waste resulting from CERCLA cleanup actions on the ORR. It is an engineered landfill that accepts both low-level radioactive and hazardous wastes in accordance with specific waste acceptance criteria under agreement with state and federal regulators.

The CERCLA Waste Facility received approximately 6,500 truckloads of waste accounting for approximately 89,000 tons during FY 2008. Projects that have disposed of waste at the CERCLA Waste Facility during the fiscal year include the following:

- David Witherspoon, Inc., 1630 Site Remedial Action Project;
- K-25/K-27 Project, including hazardous materials abatement, excess materials removal, and K-1030 demolition debris;
- ETTP Decontamination and Decommissioning Project, including K-1401, K-1420, and K-413 demolition debris, Balance of Site Laboratory soils and debris, and K-1070-B Burial Ground waste;
- Upper East Fork Poplar Creek Project, including the Jack Case Center Force Main debris; and
- Melton Valley Project, including Molten Salt Reactor Experiment secondary waste.

Concurrent with the activities at the CERCLA Waste Facility, DOE also operates solid waste disposal facilities called the Oak Ridge Reservation Landfills (ORRL), which are located near the Y-12 Complex. The ORRL are engineered facilities permitted by the TDEC 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 2008, more than 129,000 yd^3 of industrial, construction/demolition, classified, and spoil material waste were disposed of.

Operation of the ORRL generated more than 817,000 gal of leachate that was collected, monitored, and discharged to the Oak Ridge sewer system.

The CERCLA Waste Facility and the ORRL are serving the disposal needs of the ORR cleanup program as well as the active missions of the Y-12 Complex and ORNL.

4.7.3 Wastewater Treatment

Liquid waste management services are located in various locations throughout the Y-12 Complex. Examples include:

- the Big Spring Water Treatment System,
- the Central Mercury Treatment Facility,
- the Central Pollution Control Facility,
- the East End Volatile Organic Compound Plume Facility
- the Groundwater Treatment Facility,
- the West End Treatment Facility, and
- the West Tank Farm.

The NNSA program at the Y-12 Complex treated 122.5 million gal of ground/sump water at the Groundwater Treatment Facility, Central Mercury Treatment System, and East End Volatile Organic Compound System.

At the Big Spring Water Treatment System, 108.7 million gal of ground/sump water was processed. The West End Treatment Facility and the Central Pollution Control Facility at the Y-12 Complex processed 416,000 gal of wastewater, primarily in support of NNSA operational activities. This wastewater included hazardous materials such as cyanide, mercury, cadmium, chromium, and uranium. The hazardous materials end up in the sludge generated from wastewater treatment. The sludge is disposed off-site.

4.8 References

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