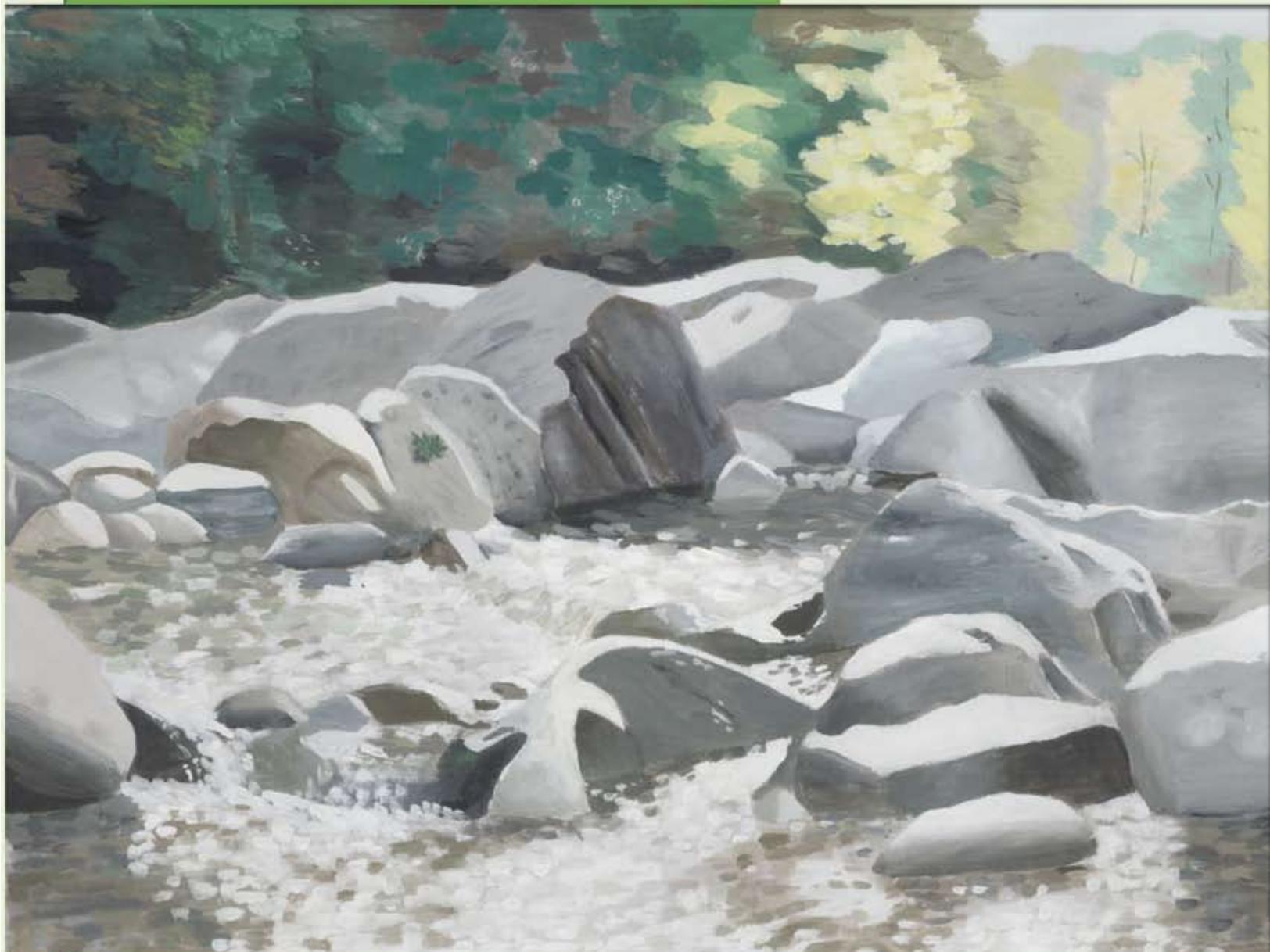


the Oak Ridge Reservation

ANNUAL SITE ENVIRONMENTAL REPORT Summary

2005

DOE/ORO/2219



"When you put your hand in a flowing stream, you touch the last that has gone before and the first of what is still to come."

- Leonardo da Vinci

What Working on this Project Meant to Me

from the Karns High School English II Honors Class 2006

<p>I like knowing what goes on in our community and seeing how the Department of Energy keeps things clean. This has been a great experience for me. - Brooke Mercer</p>	<p>I liked the fact that we got to understand what is going on in our community. The food was also a plus! - Hannah Holder</p>	<p>I liked learning about all the effort they put into keeping the environment and people safe. - Caroline Neal</p>	<p>This project has helped me learn about the past and present importance of the area where I now live. I had no idea how important Oak Ridge Reservation activities are. There are scientists from every background and country working and getting along together. That's great!! Even though many of the older facilities are being demolished, there are new buildings rising with the intent of making scientific and environmental progress which will have global applications. - Bee Willis</p>	
<p>It was neat to learn how unique and important Oak Ridge actually is. I also loved getting to miss school for the fieldtrip. - Erin Smith</p>	<p>I liked this project because our ORNL project leader was kind enough to fill our bellies with free sugar every week. We also got out of school for a day and they gave us lunch. - Bryon Morton</p>	<p>I think this project was TONS OF FUN! The writing we had to do helped us understand how to prepare an informational article. It also helped us learn about our history, why our state is important, and about new areas of science. FIELDTRIP + FOOD = BLAST!! - Kelsey Gheen</p>	<p>I enjoyed learning about and being able to visit the historical sites from World War II. It was very cold but I had fun. - Doug Baker</p>	<p>This was a rewarding and informative project. I had no idea how much work is put into keeping the environment clean! - Sarah Zerkel</p>
<p>I enjoyed this project because I learned a lot about the history of the Department of Energy's Oak Ridge Reservation. Plus our ORNL project leader bought us free food every Wednesday which is always a plus. It was great getting a day off from school to visit the facilities and learn even more. - Taylor Ridner</p>			<p>I've really enjoyed this project because I love to learn new things. It was very interesting learning about the history of Oak Ridge. - Rachel Rose</p>	
<p>I enjoyed the field trip to Oak Ridge. It was informative and entertaining. - Michael Vanden Henrel</p>		<p>I enjoyed this project immensely because of the free food and class time used. Doughnuts, cupcakes and cookies were brought to us as well as a field trip we missed school for. The actual work was cool too. - Joshua Branson</p>	<p>I liked the opportunity that was presented to us. We were able to help a government facility that is very important to the country, and I enjoyed the field trip to the Oak Ridge facilities. - Nick Reichert</p>	<p>I enjoyed working on this project with Oak Ridge. This was a great opportunity and the field trip and food were a great plus! - Katie Morrell</p>
<p>This project has been a blast! Loved getting food every Wednesday. I also learned some stuff about Oak Ridge. The field trip helped me learn a lot about how Oak Ridge came to be. I never knew there was so much out there. - Lauren White</p>	<p>This project has helped me understand what Oak Ridge does and how they want to keep the environment clean. - Aaron Martel</p>	<p>This project was one of the most exciting, fun, and interesting things that I have ever worked on. I never knew how important these places were and it has helped me decide on the kind of career path that I want to pursue. Because of this project I have realized that my dream is to become a nuclear engineer, working in the field of nuclear science. I enjoyed the field trip so much because it was a once-in-a-lifetime experience. I would like to thank everyone who made this opportunity possible. The food was the most delicious food that I ever had. Thank you very much. - Nadah Valadanouz</p>		<p>I enjoyed this Oak Ridge project for many different reasons. I thought it was interesting to learn about the history, present operations, and future plans at the Oak Ridge DOE facilities. Not only was it informative, but the entire project was very fun. - Lacey Cheverton</p>
<p>This project was helpful in learning things about Oak Ridge that otherwise I would never have known. - Julia Gunter</p>	<p>I second what Erin said. - Justin Baker</p>			
	<p>I really liked this project because I learned more of what Y-12, ORNL, and ETP's purposes are. I learned lots about uranium and the Manhattan Project. - Brittany Apking</p>	<p>I enjoyed working with the Oak Ridge National Laboratory personnel on this project - it was so much fun. I learned many things through this project including that Oak Ridge started as a key site of the Manhattan Project. It was great. - Bethany Clevenger</p>		

Handwritten signatures and names of participants, including: Lauren White, Hannah Holder, Sarah Zerkel, Rachel Rose, Lacey Cheverton, Brooke Mercer, Doug Baker, Taylor Ridner, Brittany Apking, Bethany Clevenger, Kelsey Gheen, Erin Smith, Hannah K. Willis, Julia Gunter, Justin Baker, Michael Vanden Henrel, Aaron Martel, Joshua Branson, Nick Reichert, Nadah Valadanouz, Bethany Clevenger, and others.

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Other Sources of Information About the Oak Ridge Reservation

Message from DOE and NNSA

In 2005, DOE once again conducted environmental monitoring of our three sites on the Oak Ridge Reservation – Oak Ridge National Laboratory, East Tennessee Technology Park, and Y-12 National Security Complex.

This summary report, the data volume, and the *Annual Site Environmental Report* are some of our most important reports because they explain our environmental-monitoring programs to you, our stakeholders. This monitoring also helps us to achieve our missions and to be successful in our DOE programs in science, national security, environmental management, and nuclear energy.

As you will see from the information in this report, it is safe to live and work here in Oak Ridge, a town which hosts some of the most technically complex work of DOE. We work each day to follow all environmental laws and regulations to ensure our operations protect our employees, plant neighbors, and the environment. You have our word that we take this commitment seriously, 24 hours a day, 365 days a year.

We hope that you enjoy reading the *2005 Annual Site Environmental Report Summary*, which we view as an important tool for educating the community on our environmental monitoring activities. Our thanks to the hardworking and talented students in the English II Honors Class at Karns High School; their teacher, Heather Bock; and Principal Clifford Davis Jr. Without their skills, enthusiasm, and support, this valuable summary document would not be possible.

FACTS: DOE in Oak Ridge

- 13,000 employees
- \$2.7 billion budget
- 33,725 acres
- 1,456 buildings

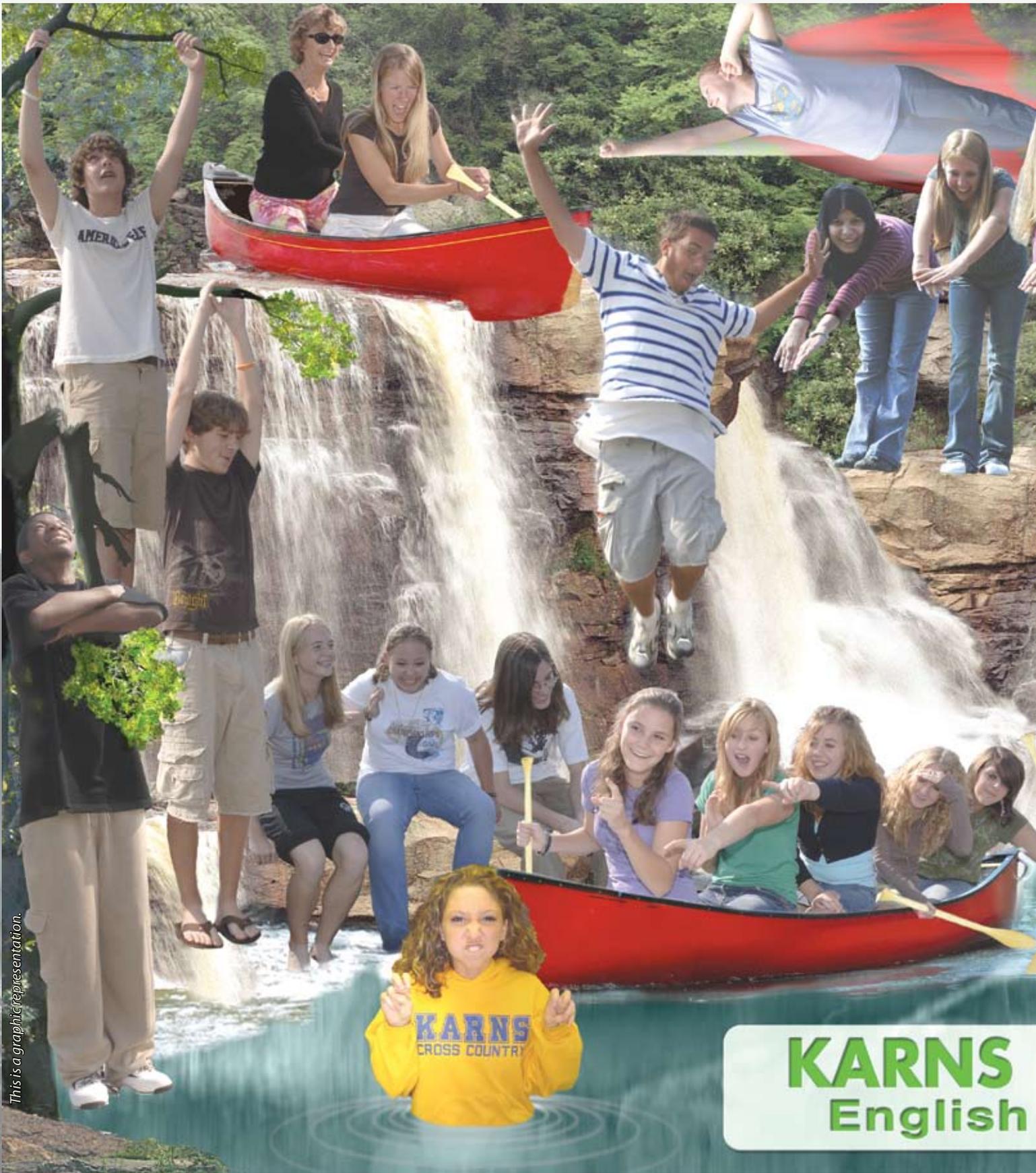


Gerald G. Boyd

Theodore Sherry



Credits



This is a graphic representation.

KARNS
English

The Oak Ridge Reservation Annual Site Environmental Report Summary 2005 is on the world wide web.

2 • When you put your hand in a flowing stream . . .

The Oak Ridge Reservation ANNUAL SITE ENVIRONMENTAL REPORT SUMMARY

Date published: February 2007

About the Cover:

Each year the Department of Energy's Oak Ridge Office sponsors the Annual Site Environmental Report Cover Design Contest, and invites students from nearby Karns High School to submit original artwork emphasizing East Tennessee's beauty and abundance of natural resources. This year's contest was judged by Robert A. Tino, one of the most gifted and celebrated artists in the Southeast.

The winning painting featured on this year's cover was submitted by Michelle Wayne, a senior at Karns High School. In addition to being an accomplished artist, Michelle loves the scenery and recreational opportunities the region offers, and hikes and camps frequently. Her painting was inspired by one of her favorite places on a mountain stream near the Oak Ridge Reservation.

The Department of Energy would like to thank the twenty student artists who participated in the cover design contest and to express appreciation to Robert A. Tino, who served as the judge for this year's contest.

Pictured Contributors:

Holding on to branches, from top to bottom:

Bryon Morton, Joshua Branson, Demetrik Booker

In canoes from left to right:

Joan Hughes, Heather Bock, Kelsey Gheem,
Sarah Zerkel, Julia Gunter, Caroline Neal, Brooke Mercer, Hannah
Holder, Brittany Apking, Rachel Rose, Aaron Martel

Flying: Hannah Willis

Jumping from cliff, from left to right:

Nick Reichert, Nadah Valadzouz, Bethany Clevenger, Katie Morrell,
Sean Bataille, Erin Smith, Justin Baker

Standing: Doug Baker

Sitting, from left to right:

Lauren White, Taylor Ridner, Michael Vanden Keuvel

In the water: Lacey Cheverton

Production Team:

Fall 2006 English II Honors Students

Karns High School

Heather Bock

Instructor, Karns High School

Joan Hughes

Project Director, Oak Ridge National Laboratory

David Page

Project Manager, Department of Energy Oak Ridge Office

Michelle Wayne

Front Cover Artwork, Karns High School Student Artist

Corey Smith

Back Cover Artwork, Karns High School Student Artist

Andy Sproles, LeJean Hardin, and Colby Earles

Design, Illustration, and Layouts

Creative Media, Oak Ridge National Laboratory

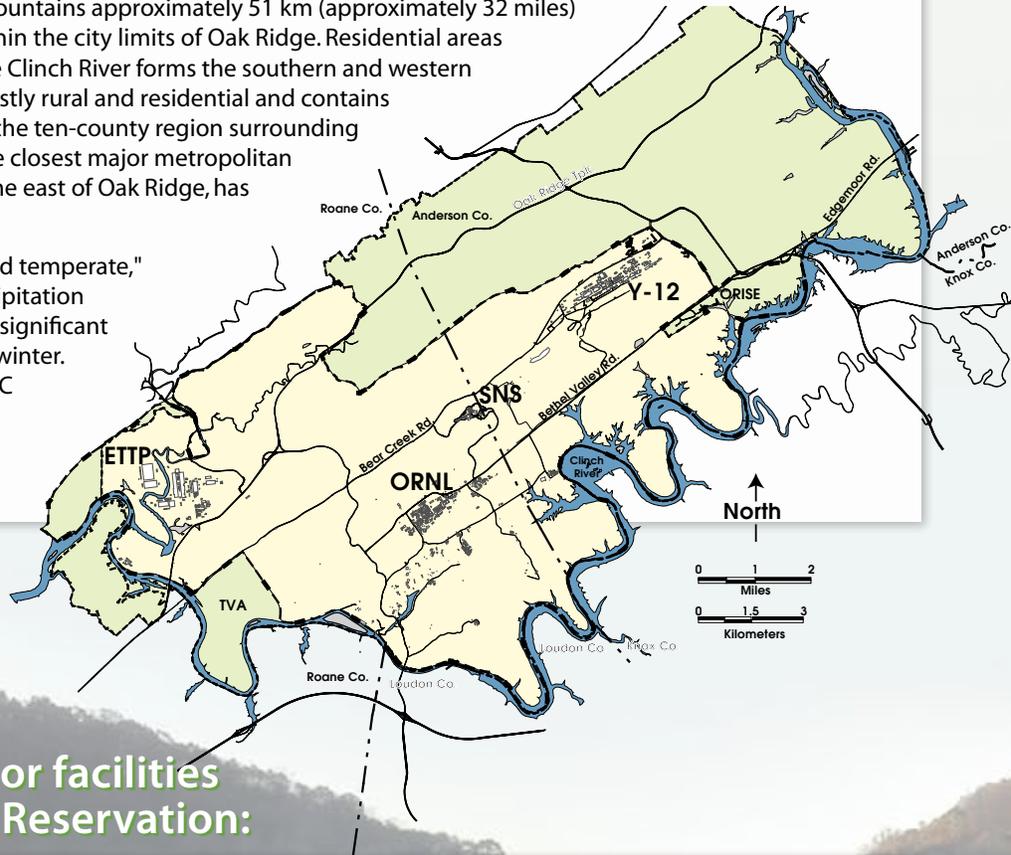


HIGH SCHOOL II Honors 2006

Setting and Site Overview

The Oak Ridge Reservation (ORR) is a government-owned, contractor operated facility with three major operating sites: the Y-12 National Security Complex, Oak Ridge National Laboratory, and the East Tennessee Technology Park. The Reservation spans approximately 13,401 hectares (approximately 33,000 acres) in Anderson and Roane counties in East Tennessee and lies within the great valley of eastern Tennessee between the Cumberland Mountains, approximately 16 km (approximately 10 miles) to the northwest, and Great Smoky Mountains approximately 51 km (approximately 32 miles) to the southeast. Most of the reservation is within the city limits of Oak Ridge. Residential areas of the city form the northern boundary, and the Clinch River forms the southern and western boundaries. The area near the reservation is mostly rural and residential and contains homes, farms, and pastures. The population of the ten-county region surrounding the ORR is approximately 884,960. Knoxville, the closest major metropolitan area, located about 40 km (about 25 miles) to the east of Oak Ridge, has a population of about 176,790.

The climate of the ORR region is called "humid temperate," which means there is an annual surplus of precipitation compared to evapotranspiration, and there are significant changes in temperatures between summer and winter. The average temperature in Oak Ridge is 14.4°C (58°F) with the coldest temperatures in January (average 2.3°C (36°F)) and the warmest temperatures in July (25.3°C (77.5°F) average).



Today there are three major facilities located on the Oak Ridge Reservation:

Oak Ridge Y-12 National Security Complex



The Y-12 National Security Complex (Y-12) is a one-of-a-kind manufacturing facility that plays an important role in the United States' national security. Y-12 is dedicated to making our nation and the world a better and safer place to live. The Y-12 Complex is operated by BWXT Y-12, LLC, for the National Nuclear Security Administration. The current mission of Y-12 includes

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

East Tennessee Technology Park

The East Tennessee Technology Park (ETTP, formerly the K-25 site) is currently undergoing environmental remediation. The Department of Energy's long-term goal for the East Tennessee Technology Park is to convert the site into a private industrial park. The plant was permanently shut down in 1987, and in 1996, reindustrialization went into effect with efforts focusing on restoration of the environment, decontamination and decommissioning of the facilities, and management of legacy wastes. Bechtel Jacobs



Company LLC, DOE's environmental management contractor, is responsible for this cleanup work. The goals are to property transfer a portion of the buildings to the Community Reuse Organization of East Tennessee, retain some areas as a museum, and remediate the remainder of the site.



Oak Ridge National Laboratory

The Oak Ridge National Laboratory (ORNL), the Department of Energy's largest science and energy laboratory, is a multiprogram science and technology laboratory managed for the U.S. Department of Energy by UT-Battelle, LLC. Scientists and engineers at ORNL conduct basic and applied research and development to create scientific knowledge and technological solutions that strengthen the nation's leadership in key areas of science; increase the availability of clean, abundant energy; restore and protect the environment; and contribute to national security. ORNL's mission focuses on six broad scientific areas: neutron science, energy, biological systems, high-performance computing, advanced materials, and national security.



In late 1942 and early 1943, scientists, engineers, and workers came from all around the world to build and operate three huge facilities in East Tennessee. These facilities were part of the secret Manhattan project, a scientific endeavor to build an atomic bomb. The ultimate goal of the work in Oak Ridge was to end World War II. This area was chosen because abundant supplies of water were available from the Clinch River, nearby Knoxville was a good source of labor, the Tennessee Valley Authority could supply vast amounts of electricity, and the valleys and ridges surrounding the area could provide secrecy and contain any accidental explosions. In order to obtain the land needed, about three thousand residents were forced to leave their homes. In time, the worker's city, named Oak Ridge, grew to 75,000 residents and used one-seventh of the electrical power generated in the country. Oak Ridge quickly became the fifth largest city in Tennessee, but due to the secrecy of

the Manhattan Project, it did not appear on any map, and no visitors were admitted without special approval. Each of the three major facilities had a different mission to help achieve the development of an atomic bomb.

The Y-12 Plant (now the Y-12 National Security Complex), built on the northern edge of the reservation, used an electromagnetic method to separate fissionable isotopes of uranium from natural uranium. This plant alone had 22,000 workers and was built at a cost of \$427 million. The U.S. Treasury loaned Y-12 approximately 14,000 tons of silver for use in the calutrons.

The main purpose of the K-25 Site (now East Tennessee Technology Park) was to separate the uranium-235, an isotope that could achieve nuclear fission, from uranium-238 using a technique called gaseous diffusion. This plant hired 12,000 workers and was built on the reservation's western edge for \$500 million. The K-25 facility included a multistory process building covering more area than any other structure ever built up to that time.

The X-10 Site (now ORNL), located near the reservation's southwestern corner, was also known during the war years as Clinton Laboratories. X-10 was much smaller than the K-25 and Y-12 sites. It was built between February and November 1943 for \$12 million and employed only 1513 people. The Graphite Reactor, the world's first fully operational nuclear reactor, was constructed at the X-10 site. The Graphite Reactor was built in only 11 months. The reactor has been registered as a National Historic Landmark, and the control room and reactor face are accessible to visitors today.

Environmental Compliance on the Oak Ridge Reservation during 2005



artist: *Kelsey Rust*

All Department of Energy activities are required to be in conformance with applicable environmental standards established by federal, state, and local statutes and regulations. The Environmental Protection Agency and the Tennessee Department of Environment and Conservation (TDEC) are the primary regulatory agencies ensuring that all requirements are met.

Throughout the history of the Department of Energy's Oak Ridge operations, the use of hazardous and radioactive materials has been required, thus creating the possibility of releases of these materials to the environment. Today's activities also have the potential to release small amounts of hazardous chemicals and radionuclides to the environment. UT-Battelle, BWXT Y-12, and Bechtel Jacobs Company are all committed to conducting environmentally responsible operations and employ Environmental Management Systems (EMS's) to identify, control, and monitor environmental impacts. An EMS also provides mechanisms for responding to changing environmental conditions and requirements, reporting on environmental performance, and reinforcing continual improvement. Each of the three major contractors has implemented a high-level policy that integrates principles of environmental protection into all facets of operations and expresses a commitment to conducting activities in a manner which protects the public and the environment, prevents pollution, complies with applicable regulations, and continually improves performance.

Oak Ridge National Laboratory's EMS was designed to meet the rigorous requirements of the globally recognized International Organization for Standardization (ISO) 14001 environmental management standard, with additional emphasis on compliance, pollution prevention, and community involvement. UT-Battelle was registered to ISO 14001 by third-party registrar in 2004. The ORNL EMS is implemented through the work-control process, which requires identification of potential environmental impacts during planning phases to ensure that appropriate controls are in place to protect workers and the environment.

The BWXT Y-12 EMS is based on the principles of ISO 14001. An independent assessment conducted in 2005 found that BWXT-Y12 has successfully implemented the EMS in accordance with the ISO 14001 standard. The BWXT Y-12 EMS is also implemented through work-control processes that identify environmental impacts and concerns before work is performed and ensure that protective controls are in place.

Bechtel Jacobs Company integrates EMS considerations into work activities and has developed procedures for identifying environmental protection controls, impacts, and concerns prior to performing a scope of work, during work activities, and after work is completed.



artist: *Susanna Grove*

Applicable Environmental Statutes

The three major facilities that occupy the Oak Ridge Reservation manage activities to comply with federal, state, and local environmental protection laws. There are numerous environmental regulations that are pertinent to the Oak Ridge facilities, including:

Clean Air Act – This act provides the principal framework for national, state, and local efforts to protect air and improve air quality. The radiological off-site dose limit for protection of the public is 10 millirem per year for air emissions. Oak Ridge levels were way below this dose limit at 0.9 millirem in 2005. There was one Clean Air Act noncompliance in 2005 on the Oak Ridge Reservation, which is discussed below. The Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAPs) establishes an airborne emission dose limit for radionuclides of 10 millirem per year from DOE operations.

Federal Facilities Compliance Act – This act removed the government's sovereign immunity from solid and hazardous waste laws.

Safe Drinking Water Act – This act ensures the quality of American's drinking water by setting standards that make sure all drinking water is safe and nontoxic. There were no violations or concerns with any of the drinking water sample results from the three major Oak Ridge Reservation facilities in 2005.

Clean Water Act – This act is the cornerstone of surface water quality protection in the United States. It established the National Pollutant Discharge Elimination System (NPDES) permit program, which controls water pollution by regulating sources that discharge pollutants into waters of the United States. The three major facilities on the Oak Ridge Reservation all achieved an NPDES permit compliance rate greater than 99.9% in 2005. Permit noncompliances are discussed below.

Comprehensive Environmental Response, Compensation, and Liability Act – This act was established to provide a systematic approach for locating, investigating, and cleaning up uncontrolled or abandoned hazardous waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. There was one release of asbestos above required reporting levels on the Oak Ridge Reservation during 2005.

Endangered Species Act – This act includes legislation to ensure the conservation of threatened and endangered plants, animals, and habitats. When operations or new projects are planned, the effects on animals and plants are taken into consideration. There are many plant and animal species of concern on the Oak Ridge Reservation protected under this act.

Toxic Substances Control Act – This law regulates the manufacture, use, and disposal of certain toxic chemical substances, notably polychlorinated biphenyls (PCBs).

National Historic Preservation Act – This act establishes a program to protect and preserve agreed-upon historic properties.

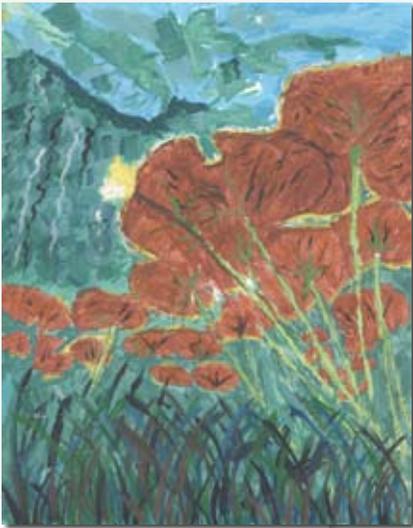
Federal Insecticide, Fungicide, and Rodenticide Act – This act establishes controls for pesticide distribution, sale, and use. There are no restricted-use pesticide products used at ORNL, the Y-12 Complex, or ETTP.

Resource Conservation and Recovery Act (RCRA) – This act was passed to address management of the country's huge volume of solid waste. It provides a system for controlling hazardous wastes from origin to disposal. There were three notices of violation issued on the Reservation during 2005. Detail is provided below.

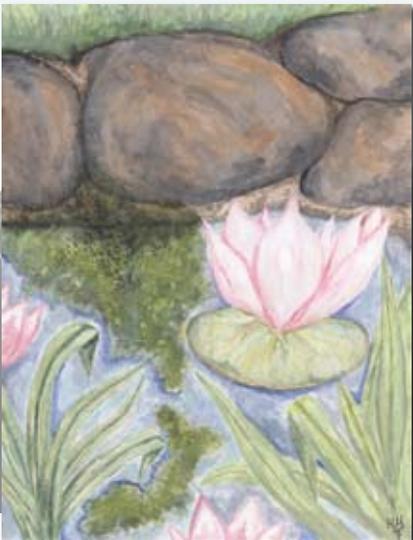
National Environmental Policy Act – This act requires evaluation of the environmental impacts of proposed federally funded projects and the examination of alternatives.

Environmental Occurrences, Noncompliances, Notices of Violations, and Releases in 2005

- ♦ Toxicity test results at the Y-12 East Fork Poplar Creek monitoring point 201 on January 6 – 13, 2005, were above National Pollutant Discharge Elimination System (NPDES) allowable limits. The cause for this exceedance was not identified; no toxicity was detected downstream nor in a follow-up test at this location.
- ♦ A mercury sample obtained on July 7, 2005, at Y-12 outfall 55 had results above permit daily maximum levels. Heavy rain on the sample date may have caused some movement of legacy mercury contamination, but no definitive cause was identified.
- ♦ A methanol-water solution from a leak at a utility system at the Y-12 Complex was carried into a waste water treatment facility and affected the ability of the facility to treat mercury. As a result, noncompliances to the daily maximum mercury permit limit



artist: *Joanna Duane*



artist: *Mikaela Minihan*



artist: *Glenn Palmer*

occurred on October 25, November 30, December 7, and December 14, 2005, and the monthly average limit for mercury was exceeded in November and December 2005. Actions to correct the problem included shutdown of the treatment facility, cleaning lines and equipment, replacement of carbon and water in storage tanks, and investigations to improve treatment efficiency.

- ◆ A water line break at ETPP resulted in total residual chlorine above the NPDES permit limit at outfall 100 on January 24, 2005. The section of the water line was immediately valved off, and repairs were made.
- ◆ At ORNL untreated sewage backed up in a collection line, overflowed onto grass and nearby streets, and was discharged to First Creek through outfalls 001 and 014. The blockage was cleared and cleanup efforts were completed at all affected areas.
- ◆ A lawn mower hit an aboveground hose that conveys water from a faucet and through a dechlorinator to mix dechlorination chemical with source streams at ORNL. The faucet was mistakenly turned off to stop the leak, which stopped the dechlorination at outfall 81. Repairs were made, and the faucet was tagged to indicate that it cannot be turned off.
- ◆ Four instream temperature change limits were exceeded during the annual temperature sampling events at ORNL's High Flux Isotope Reactor. To prevent future occurrences of temperature-change exceedances, flow was diverted to a new path, which provides more aeration and additional cooling time before discharging into Melton Branch.
- ◆ There was a reportable asbestos release at the ETPP near the K-1400 building on July 14, 2005. Approximately two pounds of asbestos insulation fell from utility steam lines. The National Response Center and the Tennessee Emergency Management Agency were notified as required. The spill was cleaned up, and the asbestos was properly disposed of.
- ◆ The Y-12 Complex reported a release of hazardous material to the environment on April 4, 2005, when a small pool of mercury was found to have drained from a broken monometer that had been sent off-site to excess property sales. The spill was cleaned, and there was no environmental insult. Further evaluation determined that the quantity of mercury spilled was less than a reportable quantity.
- ◆ On September 9, 2005, a fuel spill occurred at the Y-12 gas station when a fuel delivery truck driver dispensed unleaded gasoline from a tanker truck and overfilled the underground fuel storage tank. Spill response personnel estimated approximately 5 gallons of fuel was spilled.
- ◆ ORNL received one notice of violation from TDEC in 2005 for a RCRA nonconformance involving violation of the Low-Level Waste Management Agreement and violation of the conditions of the waste analysis plan for permit TNHW-010A. Corrective actions are ongoing.
- ◆ ORNL received a notices of violation from TDEC in 2005 for an accidental release of an herbicide-and-dye mixture to an ORNL site storm water drain in December 2004.
- ◆ TDEC issued a notice of violation on March 17, 2005, for ETPP RCRA operations. The state of Tennessee cited four alleged issues related to hazardous waste management requirements.
- ◆ Y-12 received a notice of violation in late 2005 for RCRA violations related to lack of access to communication devices in 90-day accumulation areas, mischaracterization of stored hazardous waste, and storing waste for longer than one year.

Radiation Facts

What is it?

Radiation is a kind of energy that is given off from atoms that spontaneously emit energy as rays or particles. There are two main kinds of radiation: ionizing and non-ionizing. Ionizing radiation is radiation that is powerful enough to break molecular bonds or remove electrons from atoms, thus forming ions. This is the type of radiation that people usually think of as "radiation." Nonionizing radiation is not powerful enough to change the structure of atoms. Examples of this kind of radiation are sound waves, visible light, and microwaves.

There are three major kinds of ionizing radiation: alpha, beta, and gamma radiation. Alpha particles do not present an external hazard because they can be blocked by thin materials such as the outer layer of skin or a piece of paper but can present an internal hazard when inhaled or ingested. Beta radiation is more penetrating than alpha, but like alpha radiation the main risk is inhalation or ingestion of particles. Beta radiation can pass through 1 to 2 centimeters (0.39 to 0.79 inches) of water or flesh but can be shielded by a thin piece of aluminum. Gamma radiation or X rays are able to travel many feet in air and many inches in human tissue. They readily penetrate most materials and are sometimes called "penetrating" radiation. Only dense materials such as lead or concrete provide shielding from gamma radiation.

Alpha
Beta
Gamma

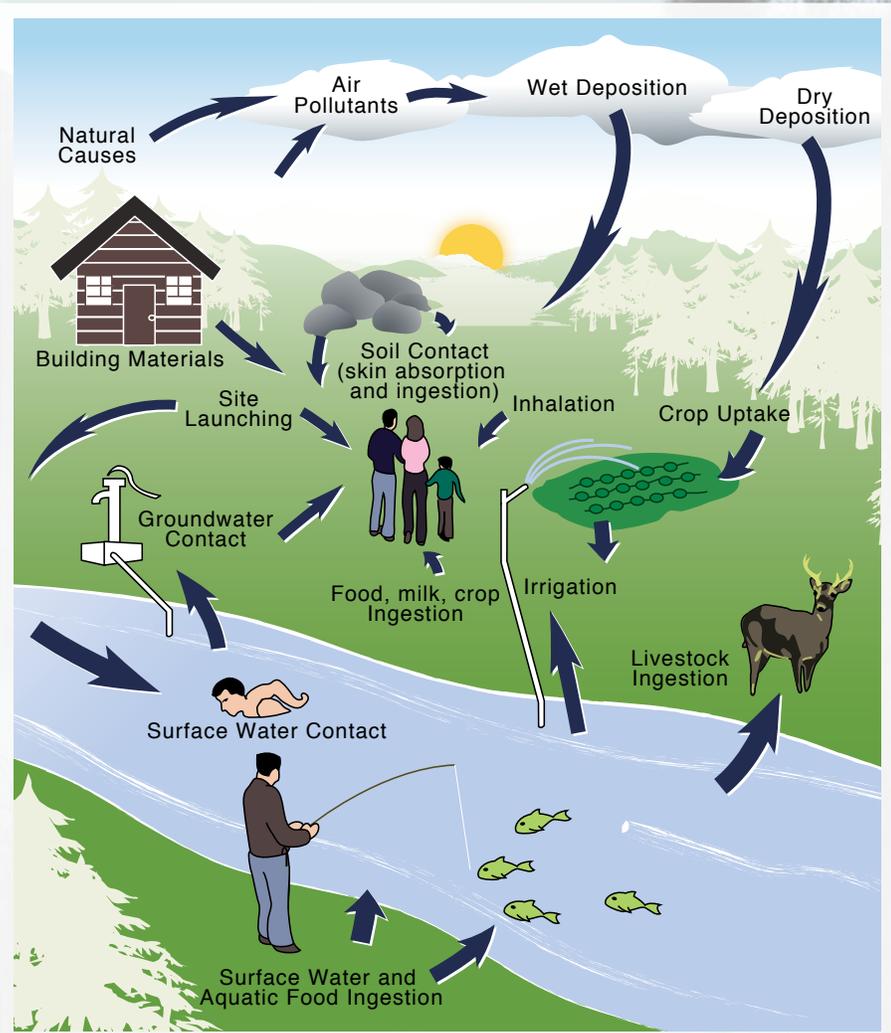


Where does it come from?

Radiation comes from natural and human-made sources. People are constantly exposed to radiation. Even as you read this report, you are being exposed to radiation from your surroundings. Naturally occurring radiation includes cosmic radiation from outer space and terrestrial radiation. Terrestrial radiation refers to radiation emitted from radioactive materials in the earth's rocks and soils. Most terrestrial radiation comes from uranium, radon, potassium, and carbon. Human-made sources of radiation exposure include medical tests and X rays, building materials such as concrete, air travel, smoking cigarettes, fallout from past nuclear testing, emission of materials from nuclear facilities, and consumer products such as smoke detectors.

What are the pathways of exposure?

People can be exposed to radionuclides in many ways. The potential routes of exposure are called "pathways." An example of a pathway for human exposure to radiation is when airborne contamination falls onto grass in a field. Cows eat the grass, taking in radionuclides. In turn, humans may drink milk from the cows or eat meat from the cows, thus taking in radionuclides.



Dose Facts

What is it?

Dose is a general term that describes the amount and types of radiation a person receives. In radiation protection, "dose" has a specific meaning—it is the energy of ionizing radiation absorbed per unit mass of any material. In many situations, the energy of radiation absorbed per unit mass of material can be related directly to radiation effects. It is measured in units called "rems" – a thousandth of a rem is called a millirem. The average person in the United States receives approximately 300 millirems every year from natural sources; including rocks in the earth, the sun, and food. An additional 60 millirems come from consumer and medical products such as X rays, natural gas for heating, CT scans, and road construction materials.

How much do the Oak Ridge facilities contribute to dose?

The Department of Energy has established a 100-millirem dose limit to members of the public from any DOE activities. National Emission Standards for Hazardous Air Pollutants (NESHAP) specifies a 10-millirem dose limit from the airborne emissions component. The maximum estimated dose that any member of the public could have received from activities on the Oak Ridge Reservation in 2005 was 8 millirem. This includes eating deer, turkey, fish, and geese harvested on or near the reservation; drinking the most contaminated water; and breathing the most contaminated air. It is very unlikely any one person could have actually received this dose.

Maximum potential radiation dose equivalents

Pathway	Dose to maximally exposed individual										
	mrem	Airborne effluents (All pathways)	Liquid effluents:	- Drinking water	- Eating fish	- Other activities	Eating deer	Eating geese	Eating turkey	Direct radiation	All pathways
mSv	0.009	0.9	0.0005	0.0005	0.003	0.00004	0.046 ^a	0.002 ^b	0.002 ^c	0.013 ^d	0.08

^a The maximum estimated EDE from consumption of a deer harvested on the ORR in 2005.

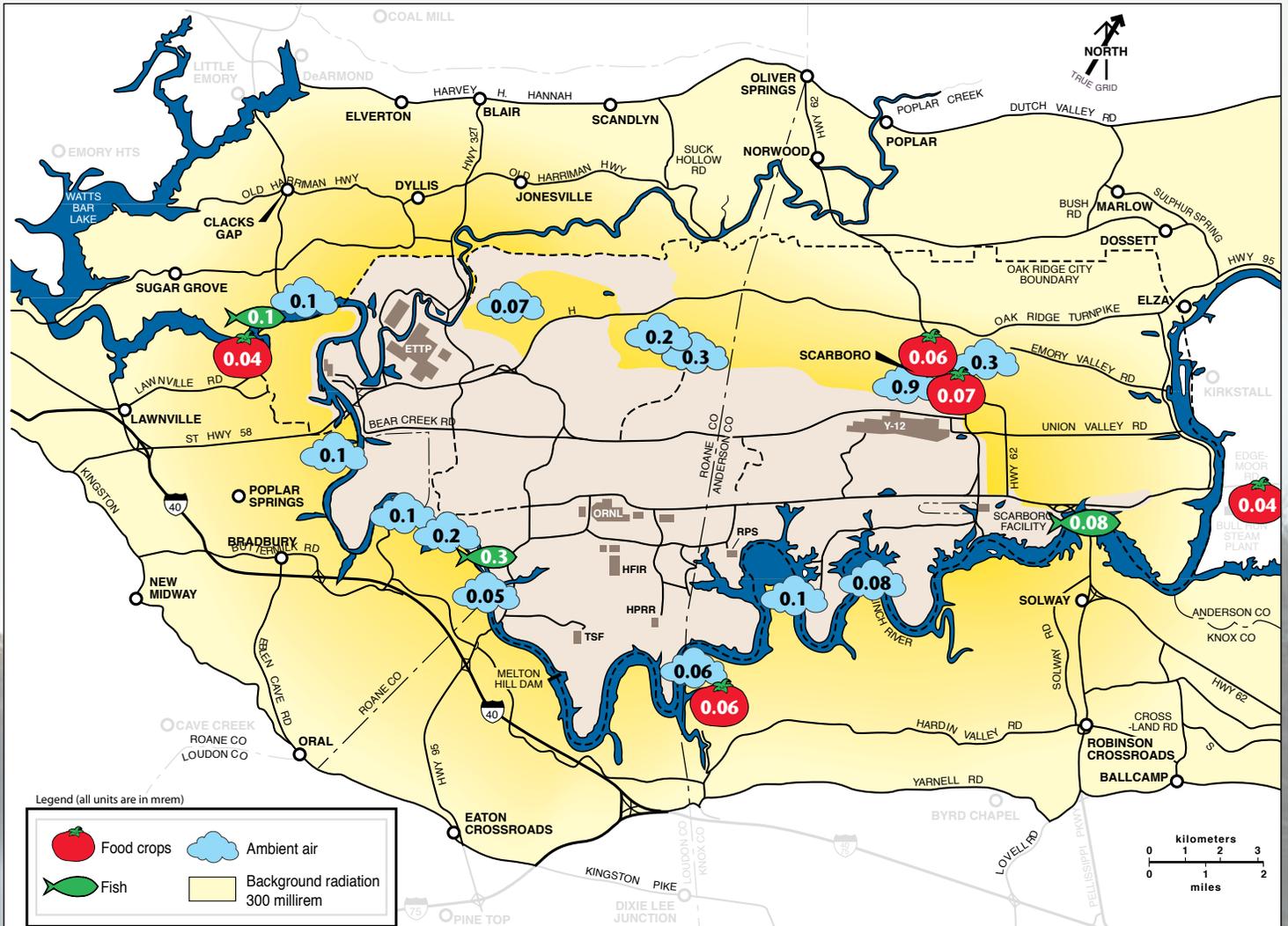
^b Maximum estimated dose from consuming two hypothetical worst-case geese harvested on the ORR in 2005.

^c Maximum estimated dose from consuming two hypothetical worst-case turkeys harvested on the ORR in 2005.

^d Direct radiation dose estimate based on exposure to a fisherman on Poplar Creek.

1 mSv = 100 mrem

Possible radiation doses on or near the Oak Ridge Reservation



artist: Shayne Knehans



artist: Tyler Blazer

Environmental Monitoring

Environmental monitoring is performed across the Oak Ridge Reservation to confirm that no member of the public is exposed to hazardous substances or radionuclides above regulatory levels from Department of Energy activities. There are two primary types of environmental monitoring and sampling. Effluent monitoring involves collecting and analyzing liquid or gaseous samples at the point of emission. This could be a pipe discharging water from a facility or a stack emitting air discharges from an operation or activity. Surveillance monitoring involves collecting and analyzing samples of air, water, soil, vegetation, wildlife, biota, and other media from the reservation and the nearby areas. Each major facility conducts site-specific monitoring programs and participates in a reservation-wide surveillance monitoring program that measures radiological and nonradiological parameters directly in environmental media adjacent to the facilities.

Y-12 National Security Complex

The Y-12 environmental protection program focuses on water, air, soil, and biota. Surface streams and wastewater discharges are regulated by the Tennessee Department of Environment and Conservation under a site-wide NPDES permit that requires approximately 9500 chemical and radiological analyses and thousands of field measurements and observations. This permit covers more than 90 discharge points and storm water events. During 2005 the Y-12 NPDES compliance rate was greater than 99.9% with eight NPDES permit violations. Details on these violations are discussed in the Environmental Compliance Section (page 7). Additionally, there was one Y-12 exceedance of the Industrial and Commercial Users Wastewater Permit for discharge of sanitary wastewater to the city of Oak Ridge publicly owned treatment works.

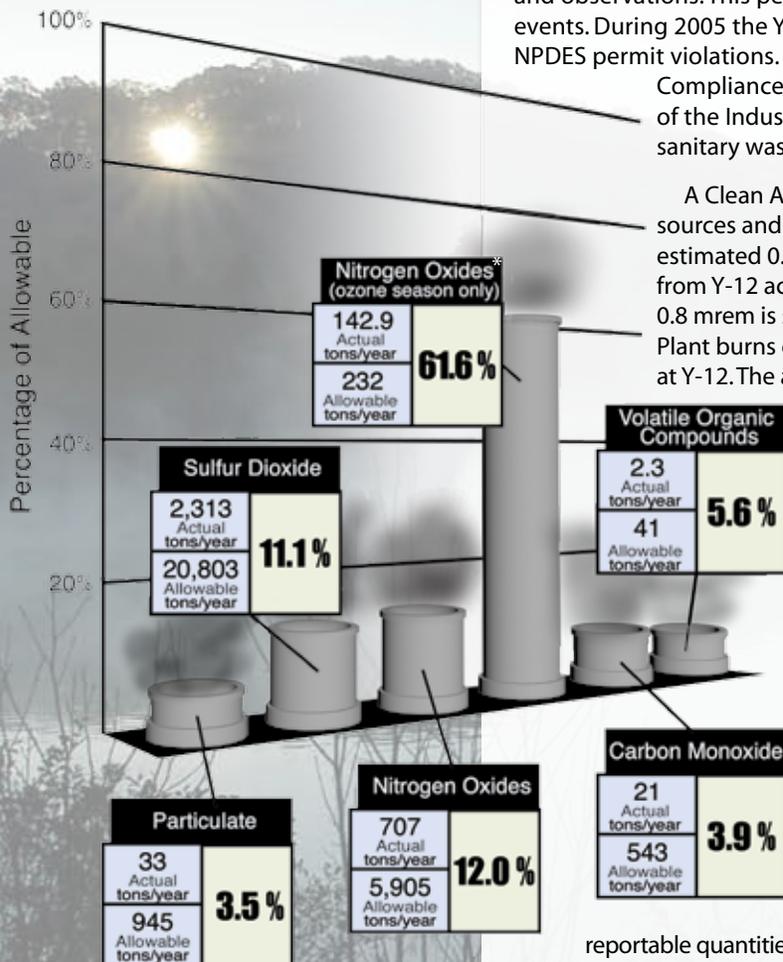
A Clean Air Act Title V permit regulates air emissions from 35 emission sources and more than 100 air emission points at the Y-12 Complex. An estimated 0.016 Ci (1.4 kg) of uranium was released into the atmosphere from Y-12 activities in 2005. The resulting total effective dose equivalent of 0.8 mrem is significantly less than the DOE limit of 10 mrem. The Y-12 Steam Plant burns coal and natural gas and is a primary source of criteria pollutants at Y-12. The actual vs allowable air emissions from the Y-12 steam plants are shown in the accompanying chart.

Approximately 300 groundwater wells and springs were sampled in 2005. Results were consistent with past sampling data, and primary contaminants in groundwater are nitrates, volatile organic compounds, metals, and radionuclides. Overall trends are stable or decreasing.

Six environmental audits/inspections by outside regulatory agencies (TDEC and the city of Oak Ridge) were conducted at the Y-12 National Security Complex during 2005. A notice of violation was issued to Bechtel Jacobs Company for RCRA violations found during the November 2005 inspection, including lack of access to communication devices, and mixed-waste storage issues at Y-12. The city of Oak Ridge identified one issue during the August 2005 sanitary sewer pretreatment inspection.

There were no releases of hazardous substances exceeding reportable quantities, no reportable oil sheens, and no fish kills at Y-12 during 2005.

Actual vs allowable air emissions from Y-12 steam plant, 2005



1 ton = 907.2 kg

*Ozone season is defined as May 1 through September 30.

Oak Ridge National Laboratory

The Oak Ridge National Laboratory demonstrates compliance with environmental requirements and a commitment to achieve environmental excellence through the employment of an Environmental Management System (EMS) modeled after ISO 14001, an international environmental management standard.

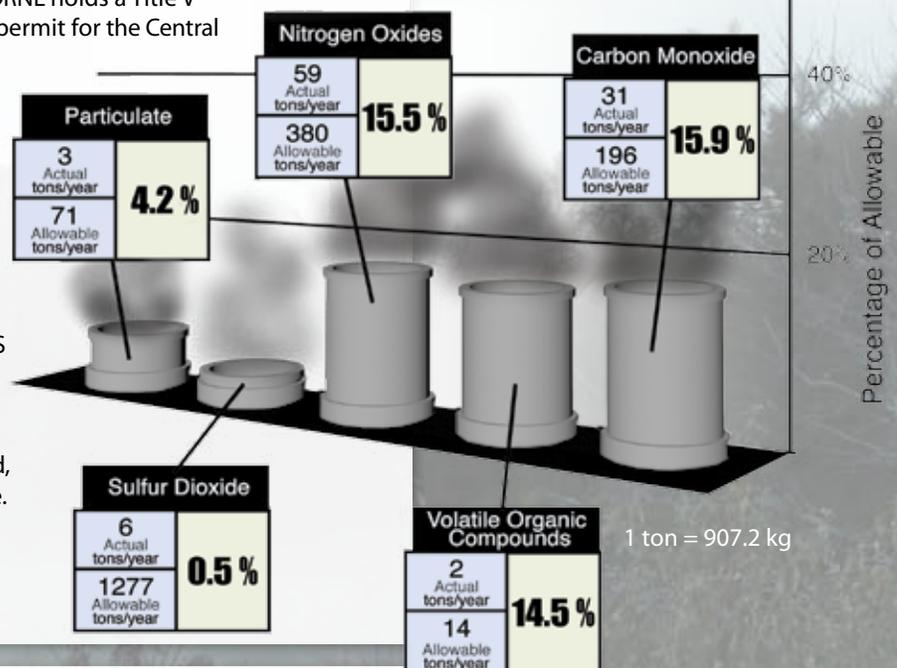
The NPDES permit for the Oak Ridge National Laboratory involves approximately 7500 annual samples, measurements, and observations from 169 locations. The 2005 NPDES compliance rate was greater than 99.9%, with only three permit at Y-12 noncompliances (discussed above in the Environmental Compliance Section [page 8]). Several surface water monitoring points and 49 groundwater wells were also sampled at ORNL during 2005, and all data were consistent with historical monitoring results.

Airborne discharges from ORNL, both radioactive and nonradioactive are subject to regulation by the Environmental Protection Agency and the Tennessee Department of Environment and Conservation Division of Air Pollution Control. Radioactive airborne discharges at ORNL consist primarily of ventilation air from radioactively contaminated or potentially contaminated areas, vents from tanks and processes, and ventilation for hot cell operations and reactor facilities. The calculated dose to the maximally exposed off-site individual from all radiological airborne release points at ORNL during 2005 was 0.1 mrem, which is well below the NESHAP standard of 10 mrem. ORNL holds a Title V permit for ten emission sources and one construction permit for the Central Exhaust Facility at the Spallation Neutron Source. During 2005 TDEC inspected all permitted emission sources and found all to be in compliance. Actual and allowable emissions of nonradiological parameters are compared in the accompanying chart.

Seven environmental audits/inspections were conducted at ORNL by TDEC and DOE Headquarters during 2005. The Bechtel Jacobs Company received one notice of violation for RCRA issues found during the May 2005 RCRA inspection. In addition, two NPDES notices of violation were issued to ORNL by TDEC for an accidental release of an herbicide-dye mixture to a storm water drain and for exceedance of stream temperature criteria. Both situations were investigated, and corrective actions were taken to prevent recurrence.

There were no releases of hazardous substances exceeding reportable quantities, no reportable oil sheens, and no fish kills at ORNL during 2005.

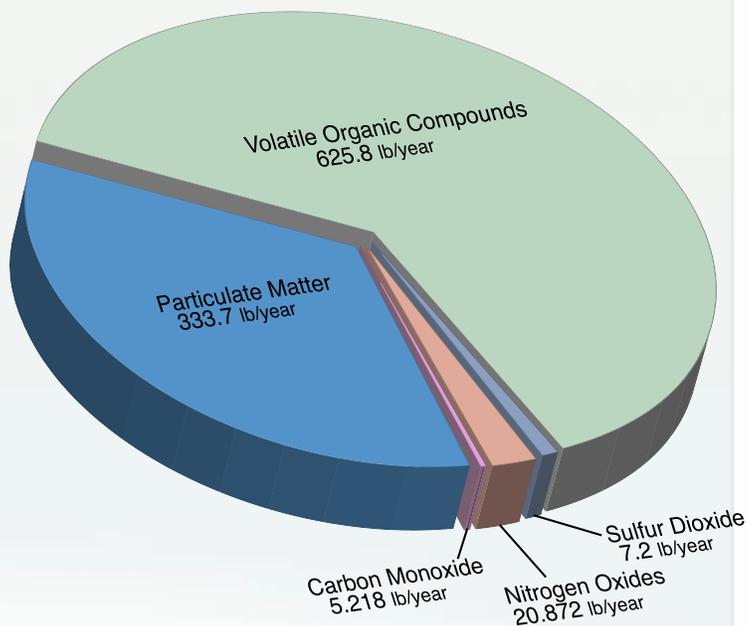
Actual vs allowable air emissions from ORNL steam production, 2005



East Tennessee Technology Park

During 2005, thousands of data points were collected from surface water locations at the East Tennessee Technology Park, as required by NPDES permits regulating discharges from the site. NPDES compliance rates with ETPP permits were greater than 99.9%, with only one permit exceedance during 2005. The permit exceedance was a total residual chlorine reading that exceeded the NPDES permit limit for stormwater outfall 100. ETPP also conducts sampling of surface water, soil, and sediment from various areas around the site. These results are then compared to guidelines and standards from both DOE and TDEC. With very few exceptions, the results are always well within the applicable standards. In 2005 there were three exceptions, all of them low dissolved-oxygen readings that were caused by natural conditions (high summer temperatures and very low water flow) in

Actual emissions of criteria pollutants
from permitted ETPP sources in 2005
(1 lb = 2.205 kg)



two of the site streams. The streams are regularly inspected to be sure that the aquatic organisms are not harmed; no sign of undue stress was noted during these periods.

Dose estimates from radiological air emissions from the East Tennessee Technology Park in 2005 demonstrate levels well below the NEHSAP standard of 10 mrem per year. A maximally exposed individual was estimated to have received a total effective dose equivalent of 0.04 mrem from ETPP emissions. No direct monitoring of nonradiological airborne contaminants is required at ETPP. Instead, monitoring of key processes and air pollution control device parameters is performed to ensure compliance with permitted emission limits. The following chart demonstrates actual emissions from permitted ETPP sources during 2005.

Two environmental audits/inspections by an outside regulatory agency (TDEC) were conducted at ETPP during 2005. A notice of violation was issued to Bechtel Jacobs Company by TDEC on March 17, 2005, for ETPP RCRA operations following the February 2005 inspection. The state cited four issues related to hazardous waste management requirements. One violation was rescinded by TDEC; the other three were corrected with a response was sent to TDEC in April 2005.

In 2005 there was a reportable release of asbestos at the ETPP near the K-1400 building when approximately 2 pounds of asbestos fell from utility steam lines. The material remaining on the pipes was stabilized, and the National Response Center and the Tennessee Emergency Management Agency were notified as required.

Oak Ridge Reservation Surveillance Monitoring



Meteorological Monitoring

There are nine meteorological towers that collect atmospheric data on the Oak Ridge Reservation. Data collected from these towers are used in routine dispersion modeling to predict impacts from facility operations and as input to emergency-response atmospheric models, which are used in the event of accidental releases.

Ambient Air

In addition to the exhaust stack monitoring discussed above, ambient air samples are collected at nine monitoring stations near the Oak Ridge Reservation and at an unaffected background location to measure airborne concentrations of radiological parameters at locations that could be affected by Department of Energy activities. All radionuclide concentrations measured at the reservation ambient air stations during 2005 were less than 1% of Department of Energy Derived Concentration Guides, which are reference values established to ensure no member of the public receives a radiological dose above acceptable limits from DOE activities. The total estimated dose from atmospheric releases on the ORR during 2005 was approximately 0.9 mrem, which is significantly below the 10-mrem NESHAP standard.

Surface Water

The reservation surface water surveillance program includes sample collection from three points on the Clinch River. This effort is conducted in addition to surface water monitoring activities carried by each major facility. The purpose of this monitoring program is to assess the impacts of past and current DOE activities on the quality of local surface water. Locations include a reference location upstream from any Department of Energy influence, a location below all ORNL inputs, and a location downstream from all DOE activities. Grab samples are screened for general water quality parameters and are analyzed for radionuclides, metals, volatile organic compounds, and PCBs. Comparisons of upstream and downstream locations show that there are no statistically significant differences in any of the parameters of interest.

Food Crops

Samples of foodcrops and vegetation are collect from areas that could be influenced by DOE's Oak Ridge activities to evaluate potential radiation doses received by consumers of locally grown produce; to predict possible concentrations in meat, eggs, and milk from animals consuming hay; and to monitor trends in environmental contamination. During 2005 samples of hay, lettuce, tomatoes, and turnips were collected and analyzed for gross alpha, gross beta, gamma-emitting radionuclides, and isotopic uranium. All analytical results were consistent with historical values and were at background levels indicating that DOE activities in the Oak Ridge area do not significantly impact the radionuclide concentrations of locally grown produce.

Milk

Radionuclides can be transferred from the environment to people via food chains such as the grass-cow-milk pathway. The 2005 milk sampling program consisted of grab samples collected bimonthly from three locations. Milk samples were analyzed for gamma emitters, tritium, and total radioactive strontium. All measured results were consistent with background reference values.

Fish

Members of the public could be exposed to contaminants originating from the Oak Ridge Reservation through the consumption of fish caught in area waters. In 2005 sunfish and catfish were collected from three locations on the Clinch River, and edible flesh was analyzed to monitor this exposure pathway. The locations consisted of an upstream location above any potential influence from Department of Energy activities, a location downstream from ORNL inputs, and a location downstream from all reservation influences. There is a "do not consume" advisory for catfish in all of Melton Hill Reservoir because of PCB contamination and a precautionary fish advisory for catfish in the Clinch River arm of the Watts Bar Reservoir because of PCB contamination. These advisories extend to areas not impacted by DOE activities and are the result of activities by private industry, various utilities, and Department of Energy. In 2005, mercury, radionuclides, pesticides, and PBCs were detected in both sunfish and catfish at all locations, without statistically significant differences in upstream and downstream concentrations.

White-Tailed Deer

In November and December 2005, the Department of Energy and the Tennessee Wildlife Resources Agency managed the twentieth annual deer hunt on the Oak Ridge Reservation. There were about 500 shotgun/muzzleloader-permitted hunters and 525 archery-permitted hunters. The year's harvest was 350 deer, including 153 bucks and 197 does. Of the 350, three were retained for exceeding release limits for beta activity in bone. Since 1985 there have been 9,215 deer harvested on the reservation and 183 (2.0%) have been retained as a result of potential radiological contamination.



artist: Emily Collins



artist: Suzanne Adkins



artist: *Meghan Guinn*

Canada Geese

The consumption of Canada geese is a potential pathway for exposure of members of the public to radionuclides released from Oak Ridge operations because open hunts for Canada geese are held annually in counties adjacent to the ORR. Geese that feed and live on the ORR are rounded up each summer and are subjected to noninvasive whole body gross radiological surveys. The 2005 roundup included geese from ETP, ORNL, Y-12, and Clark Center Park. A total of 167 geese were screened during the roundup and none were retained due to radiological contamination.

Turkey

Two wild turkey hunts managed by DOE and TWRA were held on the reservation in April 2005. Thirty-eight birds were harvested during the shotgun and archery hunts, and one was retained for exceeding administrative release limits. Since 1997, 458 turkeys have been harvested on the Oak Ridge Reservation. Of these, only three have been retained due to potential radiological contamination.



Amanda Carpenter, Age Group 9–11
Winner of the ORNL Earthday Competition
Best in Show – *Brown Paper Bag Art*

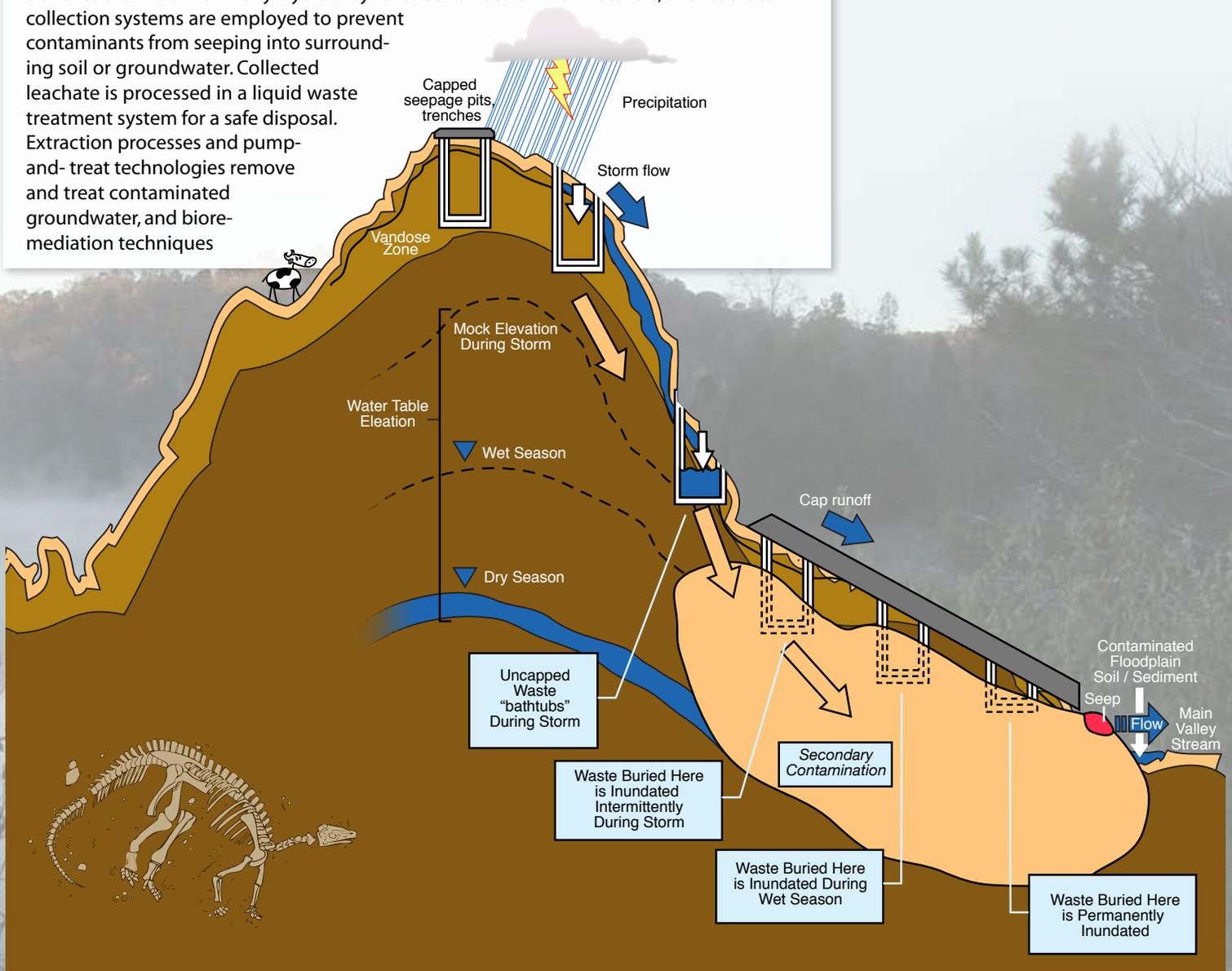


Environmental Management & Restoration

Since the 1940s the programmatic missions of the Department of Energy's Oak Ridge activities have produced hazardous and radioactive waste and have resulted in contamination of facilities, structures, and environmental media. The DOE Environmental Management Program is responsible for cleaning up contaminated areas or for taking measures to ensure that the public and the environment are protected from areas that contain contamination and cannot be cleaned up. In the 1940s and 1950s wastes were often stored or disposed of in ponds, ditches, and subterranean pipes and tanks on the ORR. Once it became apparent that these practices were harming the environment, remediation activities were initiated, primarily under the requirements of the Federal Facility Compliance Act and the Comprehensive Environmental Response, Compensation, and Liability Act.

Remediation

The process of remediation includes a variety of techniques that help protect and restore the environment. Now instead of using unlined ditches to hold contaminated waste, trenches are lined with many layers of synthetic and natural liner materials, and leachate collection systems are employed to prevent contaminants from seeping into surrounding soil or groundwater. Collected leachate is processed in a liquid waste treatment system for a safe disposal. Extraction processes and pump-and-treat technologies remove and treat contaminated groundwater, and bioremediation techniques



use biological agents to treat contaminated water. The Environmental Management Waste Management Facility is used for disposal of refuse and scrap metals from facilities undergoing demolition or refurbishment.

All three sites (Y-12, ORNL, and ETPP) have long histories of cutting-edge operations in which a wide variety of materials were used. Inevitably, these operations have produced waste by-products. Now, a major effort is under way at all three sites to deal with this waste. DOE and its contractors are working with the EPA and the state of Tennessee to make sure that these waste streams are correctly addressed and that the environment is properly protected. This is the largest single program on the Oak Ridge Reservation. At ETPP almost all current activities are concerned with either cleaning up waste or cleaning up facilities and demolishing buildings that are no longer needed. The program has adopted an accelerated cleanup approach that puts an emphasis on safely and quickly cleaning up the environment. Most of the effort has centered on ETPP, but all three sites are involved to some extent.

Important activities that occurred in 2005 include removing large quantities of contaminated scrap metal, removal of many asbestos-containing panels from the K-25 Building, the shipment of most of the uranium cylinders to a conversion plant in Ohio, and the demolition of many unneeded and contaminated buildings. Some burial grounds where waste has been stored were covered with caps to prevent rainfall from leaking into the burial pits and leaching waste out into the surface water and groundwater. In Melton Valley (ORNL) and at Blair Quarry (ETPP) cleanup efforts to remove soils and sediment contaminated by past waste disposal operations are nearly complete. The Bethel Valley Groundwater Engineering Study drilled and installed wells at many locations in order to collect data from soils and groundwater. Data from this effort will be used to determine ways to protect the groundwater in this area. Upper East Fork Poplar Creek is being actively studied to determine the extent of contamination from past releases of mercury. This effort is being carried out in concert with regulatory agencies to ensure that the watershed is properly remediated. In addition, there are several treatment facilities that treat not only the waste from local operations but also waste from other sites in the DOE complex. One such facility is the Toxic Substances Control Act Incinerator, the only treatment facility in the United States that is designed to treat waste contaminated with hazardous materials, radioactivity, and PCBs.



artist: *Hannah Henegar*



artist: *Hannah Armes*

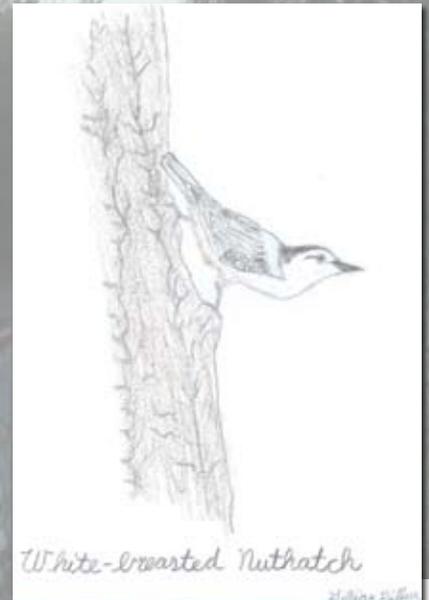
Public Involvement

The DOE actively seeks public involvement in many decisions affecting cleanup of the ORR. Public meetings are held, and there are many organizations through which interested or affected stakeholders can participate or obtain information.

- ◆ The Oak Ridge Site Specific Advisory Board is an independent, federally appointed citizens' panel that provides advice and recommendations to the DOE on its Environmental Management Program in Oak Ridge. Members are appointed by DOE and serve on a voluntary basis. All meetings are open to the public. Information is also available at <http://www.oakridge.doe.gov/em/ssab/> or by calling (865) 241-4583.
- ◆ The Oak Ridge Reservation Local Oversight Committee (LOC) represents counties and communities affected most directly by DOE activities in Oak Ridge. The LOC is funded by a grant from the Tennessee Department of Environment and Conservation's DOE-Oversight Division. LOC board members are concerned with human health and the environment as well as with their communities' economic and social well-being. The board of directors meets six times a year, and the LOC Citizen's Advisory Panel meets once a month. Each year, the LOC publishes the Tennessee Department of Environment and Conservation DOE Oversight Division's Status Report to the public, which presents an independent view of the safety and quality of the Oak Ridge environment. The web site is www.local-oversight.org, the phone number is (865) 483-1333.
- ◆ The City of Oak Ridge Environmental Quality Advisory Board (EQAB) is an appointed advisory board of the Oak Ridge City Council. EQAB meets on the first Thursday of each month. Information is available at <http://orserv01.ci.oak-ridge.tn.us/eqab/oakridge.htm>.
- ◆ The Roane County Environmental Review Board was established to enable qualified individuals to review matters that are brought before the Roane County Commission concerning nuclear energy, hazardous waste, and/or the environment.
- ◆ The Tennessee Department of Environment and Conservation Department of Energy Oversight Office provides independent state oversight of DOE's Oak Ridge activities. Information is available at <http://www.state.tn.us/environment>.
- ◆ Advocates for the Oak Ridge Reservation is a nongovernmental organization that focuses on land use issues and has participated in initiatives regarding use of undeveloped lands on the ORR.



artist: Rachel Littleton



artist: Gillian Giffen

Other Sources of Information

About the Oak Ridge Reservation



artist: *Chris Loveday*



artist: *Keith Giles*



artist: *Suzanne Adkins*

The DOE Oak Ridge Office Public Affairs Office, which may be reached at (865) 576-0885, covers programs in science, environmental management and nuclear fuel supply at Oak Ridge National Laboratory, the East Tennessee Technology Park and the Oak Ridge Institute of Science and Education. For national security programs, the National Nuclear Security Administration's Y-12 National Security Complex Public Affairs Office may be reached at (865) 576-9918.

- ◆ The Department of Energy Information Center is the central location for public information about all DOE programs in Oak Ridge. The center located at 475 Oak Ridge Turnpike in Oak Ridge, the center may be reached at (865) 241-4583 or 1-800-382-6938, option 6. A website is also available at <http://www.oakridge.doe.gov/external/PublicActivities/InfoCenter/tabid/126/Default.aspx>.
- ◆ Public activities are highlighted on the web at <http://www.oakridge.doe.gov> under the Public Activities section, including a monthly calendar of public meetings and announcements.
- ◆ The Oak Ridge Site Specific Advisory Board has a video lending library at the DOE Information Center that provides the community with a valuable educational resource regarding environmental management program issues. Information on these library resources is available by calling (865) 241-4583 or by viewing the website, <http://www.oakridge.doe.gov/em/ssab>.
- ◆ The Public Involvement Plan for CERCLA Activities at the U.S. Department of Energy Oak Ridge Reservation (DOE/OR/01/2163&D2), available at the DOE Information Center, highlights opportunities for public participation in environmental cleanup activities at DOE sites in Oak Ridge.
- ◆ The American Museum of Science and Energy, located at 300 S. Tulane Avenue in Oak Ridge, contains many exhibits highlighting the history of DOE in Oak Ridge along with educational displays on science, nuclear energy, national security, and environmental management. Public bus tours of the ORR are offered May through September. The museum may be reached at (865) 576-3200 or through the website, <http://www.amse.org>.



*Come and listen to me and I'll tell you a tale
About Sigmund, the humpback whale*



*He lived far away
Down deep in the sea
The fisherman came for him
And he ceased to be*

*He provided food and light
For many to enjoy
So the people were thankful
Every girl and boy*

*Later, more cousins and brothers died
Not for food, but for sport
His gifts of meat and oil
Were not tasted, but wasted*

*All at once, Siggy's group became small
If all are gone from the sea
Earth and beyond
It would never be the same*

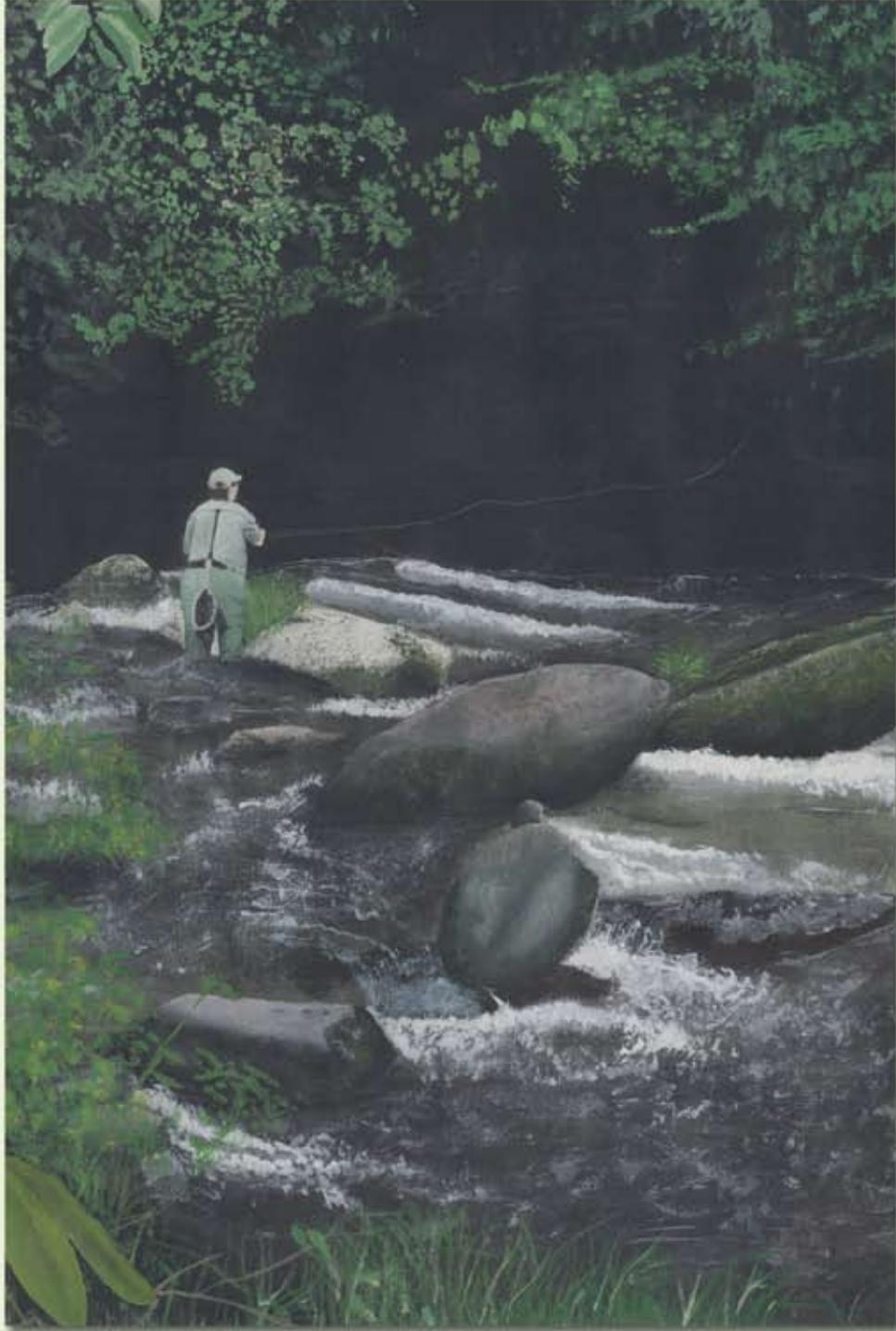
*So save my brothers and sisters and cousins
So you can have what you need
And let us live in harmony*



Zachary Carpenter, Age Group 9-11
Winner of the ORNL Earthday Competition
Best in Show – Poetry

Disclaimer

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ORR ASER 2005 Summary