Argonne NATIONAL LABORATORY

ANL-08/05 (Summary)

Summary Site Environmental Report

for Calendar Year 2007

Environment, Safety, and Health/Quality Assurance Division

Introduction by Dylan Marciniak and Matt Morgan

This summary of Argonne National Laboratory's Site Environmental Report for calendar year 2007 was written by 20 students at Downers Grove South High School in Downers Grove, Ill. The student authors are classmates in Mr. Howard's Bio II course. Biology II is a research-based class that teaches students the process of research by showing them how the sciences apply to daily life.

For the past seven years, Argonne has worked with Biology II students to create a short document summarizing the Site Environmental Report to provide the public with an easy-to-read summary of the annual 300-page technical report on the results of Argonne's on-site environmental monitoring program. The summary is made available online and given to visitors to Argonne, researchers interested in collaborating with Argonne, future employees, and many others.

In addition to providing Argonne and the public with an easily understandable short summary of a large technical document, the participating students learn about professional environmental monitoring procedures, achieve a better understanding of the time and effort put forth into summarizing and publishing research, and gain confidence in their own abilities to express themselves in writing.

The Argonne Summary Site Environmental Report fits into the educational needs for 12th grade students. Illinois State Educational Goal 12 states that a student should understand the fundamental concepts, principles, and interconnections of the life, physical, and earth/space sciences. To create this summary booklet, the students had to read and understand the larger technical report, which discusses in-depth many activities and programs that have been established by Argonne to maintain a safe local environment. Creating this Summary Site Environmental Report also helps students fulfill Illinois State Learning Standard 12B5a, which requires that students be able to analyze and explain biodiversity issues, and the causes and effects of extinction. The same standard requires that Illinois students examine the impact of diminishing biodiversity due to human activity. An example of this would be the Argonne Restoration Prairie, which is discussed within the report. Because humans had to destroy part of a natural prairie in order to build, they must also plant an equivalent amount of prairie to make up for what was destroyed. The summary project perfectly meets Illinois State Learning Standard 13B section 5b, which requires students to be able to design and conduct an environmental impact study, analyze findings, and justify recommendations.

Students volunteered for the project for two main reasons: We would become published authors, and could include that fact on important documents, like college applications, and we felt we were doing a good deed for the public, considering that without our summary the public may have no real idea how Argonne complies with various environmental protection acts and programs within the state.

The summarization process was not easy, considering that we had never seen much of this kind of information before, especially in such detail. The project required a high level of commitment from all involved. This commitment ensured that the summary would be done on time and would be available to the public in the shortest time possible. Argonne representatives Norbert Golchert and Dave Baurac met with students and gave background information on Argonne and explained the importance of the research being done. In addition, they explained in-depth how the public benefits from the summarization. At the end of the presentation, students asked some questions, which were answered in specifics. The Site Environmental Report was divided into 10 sections, with groups of two students covering each section. The groups were eager to begin work on their assigned sections. After reading the complete report each group focused on a particular section. After much careful reading and analysis, we produced an outline. From the outline, partners divided work equally and began to carefully summarize. Groups' summaries were edited, not only within groups, but also by other groups, in order to acquire a different perspective. Finally, Mr. Howard, our Biology II instructor, took a final look at the products before sending them off for the final review by Argonne. The final project was a 16-page pamphlet.

The students reacted positively to the project. Asked if she was glad that she chose to work on the Argonne project, Katie Hanson said, "Yes. I have enjoyed having the opportunity to become a published author. Also, it is an honor to be able to work with a prestigious, nationally recognized laboratory such as Argonne." There were difficult aspects as well. Student Olga Zagariya said the hardest part of the project was "trying to choose which

information to put in the summary and which information to leave out, because it all seemed to be important." It seems that everyone was satisfied with his or her section. When Suse Lagory was asked how she felt about her section on groundwater, she said, "I was skeptical about my section at first. It seemed like it would be difficult. Even though it was, it taught me a lot about the different safety aspects regarding Argonne and groundwater."

We hope that through our studies and this Summary Site Environmental Report the public can gain a better understanding of what is going on around us in our own environment. The process was as rewarding for us as it was a challenge. Everyone involved has grown as a student, as well as a human being.

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For more information about Argonne's Site Environmental Report, contact Norbert Golchert at (630) 252-3912 or ngolchert@anl.gov. For more information about Argonne and its programs, visit the laboratory's World Wide Web site at www.anl.gov or contact Communications & Public Affairs at (630) 252-5575.

Photos by George Joch. The text was edited by David Baurac. Design by Sana Sandler. Layout by Cindi Andersen.

What is Argonne? by Katie Hanson and Megan Swieca

Aerial view of the Argonne site. Argonne is a federally funded research and development facility managed by UChicago Argonne, LLC for the U.S. Department of Energy's Office of Science.

Argonne National Laboratory is among the nation's leading federally funded research and development centers. Its mission is to carry out research and development to benefit the United States and the U.S. Department of Energy. Argonne conducts research to solve practical problems concerning energy, the environment, and national security. Within the community, Argonne offers several educational programs and meets with community leaders to discuss Argonne activities that may affect the surrounding areas. Argonne's annual operating budget is about $540 million, most of which is provided by the U.S. Department of Energy. Argonne has about 2,800 employees, including about 750 who hold Ph.D.s.

Argonne was established by the Atomic Energy Act of 1946 and was the first national laboratory. Today, Argonne is affiliated with University of Chicago. Argonne's research facilities are used by more than 100 companies and universities, including the University of Chicago, Harvard University, Intel, IBM and Amoco.

There are a number of radiological facilities at Argonne, such as the Advanced Photon Source, a superconducting heavy-ion linear accelerator, and several charged-particle accelerators. Argonne also operates chemical and metallurgical laboratories and several hot cells and laboratories designed to work with multicurie quantities of the actinide elements and with irradiated reactor fuel materials. The Department of Energy's New Brunswick Laboratory, a plutonium and uranium measurements and analytical chemistry laboratory, also occupies a building on the Argonne campus. The non-nuclear facilities that could have an impact on the environment around Argonne are a coal-fired boiler and two wastewater treatment plants.

Argonne occupies 1,500 acres in southeastern DuPage Country, Ill., less than 30 miles from downtown Chicago. The typical climate of this region consists of cold winters, warm summers, and short fluctuations in temperature, humidity, cloudiness and wind direction. Surrounding Argonne is Waterfall Glen Forest Preserve, which was once a part of Argonne but is now used for public recreation and a nature preserve. The land consists of woodland, prairie, and former farmland along with a number of small ponds and streams. Sawmill Creek, a tributary to the Des Plaines River, flows across the Argonne campus and is the primary pathway for land drainage. The Des Plaines River Valley contains the river and bluffs and is forested with mature deciduous trees. It also contains a network of ditches and culverts that transport surface runoff. Sawmill Creek and the Des Plaines River are little used for public recreation. Much of the farmland has been converted into housing, allowing for a significant increase in population in the surrounding areas.

Argonne is in the Prairie Peninsula of the Oak-Hickory Forest Region, which contains oak forest, oak openings, and tall-grass prairie. The forests mostly contain oak and hickory, and there are areas that are predominately prairie. The forests contain trees such as red oak, basswood, silver maple, elm, and cottonwood. Before Argonne was founded, about 75 percent of the land was crop rotated and 25 percent was pasture. Now dominated by either bluegrass or oak trees, Argonne has partnered with the Chicago Wilderness Coalition to restore and protect natural areas in the Chicago region.

Argonne contains five species of amphibians, seven of reptiles, 40 summer resident birds, and 25 mammals. During the migration period there can be up to 100 different bird species on the Argonne campus. A unique species that inhabits Argonne is the fallow deer, which was introduced to the area by a private landowner. White-tail deer also inhabit the area. The U.S. Fish and Wildlife service rated the Des Plaines River system, including the part that flows across Argonne, as "poor" in terms of the fish species present, due to industrial pollution and stream modification.

There are no federally listed threatened or endangered species at Argonne and no critical habitats of federally listed species on the site. However, within the Waterfall Glen

Forest Preserve, there are three known endangered species and one listed threatened species. The Hine's emerald dragonfly is an endangered species that live in wetland areas along the Des Plaines River floodplain. Leafy prairie clover is endangered and is associated with dolomite prairie remnants in the Des Plaines River Valley and in Waterfall Glen. The Indiana bat is an endangered species that may be present in the area. Lakeside daisy is a threatened species that has been planted in Waterfall Glen.

The geology at Argonne is mainly Niagaran and Alexandria dolomite, which is approximately 60 m (200ft) thick but has an irregular surface. There are also 46 archaeological sites at Argonne, including prehistoric chert quarries, special-purpose camps, base camps, and historical farmsteads. The range of human occupation spans several time periods, and four sites have been determined to be eligible for the *National Register of Historic Places*. There are also several buildings eligible to be recognized as historic districts or buildings.

Current Programs by Elise Murry and Cailee Madden

Current research and development programs at Argonne National Laboratory are hoping to advance technology, transportation, energy, and safety for our future. We can all benefit from the projects taking place at Argonne, and they are making progress day by day.

Transportation

Argonne is the U.S. Department of Energy's lead laboratory to evaluate technology needed for commercially successful plug-in hybrid-electric vehicles, which are like normal hybrid vehicles except that they can be recharged by plugging them into an ordinary household electrical outlet. Successful plug-in hybrid vehicles are predicted to get 100 miles per gallon at an estimated energy cost equivalent to $1 a gallon for gasoline. Many new advances in science will come all that much faster, and innovations in technology will flourish.

Argonne's Transportation Research and Analysis Computing Center uses computers to model complex car crash scenarios. This helps car manufacturers develop safer designs for cars without paying high prices to create car crashes with actual cars and dummies. Argonne researchers also use the computers to test the safety of bridges during bad weather. This helps improve the future structure of bridges.

Technology

Argonne is improving technology with the Advanced Photon Source, which creates the brightest X-ray beams in the Western Hemisphere. There are more than 40 beamlines in the facility, which allows a wide range of experiments to be conducted at the same time. For example, scientists use the machine to study cells that cause cancer and other harmful diseases. Scientists recently discovered a virus that can infect lung cancer cells. Each year, more than 3,000 researchers from companies like Abbot Laboratories, Intel, Texas Instruments, and scientists from the University of Chicago and Northwestern University visit Argonne to use the Advanced Photon Source.

At Argonne's Center for Nanoscale Materials, scientists and engineers study nanoscale materials, made from particles measured in billionths of a meter. The study of nanoscale materials is helping scientists to develop new applications and devices such as ultrastrong magnet nanocomposites and photo-induced energy conversion, as well as molecular conductors.

The Argonne Leadership Computing Facility researches new technologies with computers and computing applications. Argonne currently has a 163,000-processor IBM Blue Gene/P computer for systems and applications research. The computer runs so fast that it can complete 557 trillion calculations per second. With newer and faster computers, more research can be done on climate modeling, nanosciences, and nuclear physics. The advances that Argonne is making in the fields of communications, collaboration, and visualization technologies assist scientists in analyzing complex data.

Energy

Energy is a big concern for society and Argonne is looking for ways to provide safe, clean, and efficient energy technologies that address global energy issues. Solar energy, advanced batteries, and advanced nuclear energy are being researched to reduce the amount of greenhouse gas and decrease the impact of global warming. Scientists are also researching issues like acid rain and the greenhouse effect.

Education and Funding

Argonne offers many one- to two-hour classes for kids fourth grade and older. These classes teach kids about light, color, and the scientific method. Each class focuses on a different aspect of science so that most kids can be accommodated. Argonne sponsors the Rube Goldberg design contest, which challenges kids to make complicated machines to perform simple, everyday tasks, while an annual conference is specifically designed to interest young women in careers in science, engineering, and technology. About $540 million supports research at Argonne, and part of this amount goes towards their education programs. About 2,800 workers are employed at Argonne National Laboratory, and their incomes total more than $200 million. This goes to show how well suited they really are to provide education and do research.

Argonne's Impact on Our Community

by Armand Haddad and Olga Zagariya

Argonne has been operating near Chicago for decades and has impacted us in ways that protect our environment and improve our lives.

Argonne actively works to inform the public of its activities. One example is the annual Site Environmental Report, which is available to the public. This report details Argonne's monitoring of air, water, and soil on and around the Argonne campus and reports in detail any environmental impacts on and off campus. The report also documents any violations of environmental standards and explains activities to improve areas that failed to meet the standards.

Argonne's environmental monitoring and waste management programs protect employees and the public from potentially hazardous materials which Argonne uses in small amounts. Argonne contains many sources of potential air pollutants, such as a coal-fired steam plant that heats buildings, fuel facilities that dispense gasoline and gasoline-ethanol blends, and engine test facilities. Asbestos is found in some older Argonne buildings and is gradually being removed and disposed of safely.

Argonne's Waste Management Department is responsible for the storage and disposal of all regular waste generated at Argonne, including hazardous waste, special waste, and mixed waste. The department is also responsible for seeing that Argonne complies with the Resource Conservation and Recovery Act Part B permit, which regulates the management of Argonne's hazardous wastes. Argonne also has a Pollution Prevention Program, which actively looks for opportunities to reduce or eliminate pollution at Argonne.

The Safe Drinking Water Act of 1974 ensures that public drinking water is free of potential harmful materials. This act covers maximum contaminant levels and monitoring requirements, treatment standards, and regulation of underground injection activities. Argonne's drinking water is safe because, like most of the Chicago area, Argonne uses Lake Michigan water.

Argonne also impacts our lives by supporting many projects to preserve our natural surroundings, such as the Illinois prairie, which is unique to our part of the world. Argonne has created and currently maintains native Illinois prairies on its 1,500-acre campus. Argonne also works to eliminate invasive species that threaten natural wildlife. Whether it's a plant or an insect, every organism has some impact on our natural surroundings. The Endangered Species Act of 1972 protects endangered and threatened species. Argonne complies with this act, but no federally listed endangered or threatened species is known to occur on the Argonne site, and no habitat there is threatened.

Argonne also helps develop new technology to make our lives better. For example, researchers from Abbott Laboratories used the Advanced Photon Source at Argonne to determine the precise structure of a key component of the HIV virus. Armed with this knowledge, Abbott scientists developed a drug that prevents the HIV virus from replicating. Today, that drug, Kaletra®, is one of the world's most prescribed anti-HIV drugs. Argonne also developed the Anti-Jet-Lag Diet, which has helped millions of travelers, including President Ronald Reagan, reduce or eliminate the effects of jet lag. Argonne's energy research programs help decrease the country's dependency on foreign oil in a number of ways. Argonne is also developing effective green technology transportation vehicles. These vehicles include improved technology for hybrid and electric cars. Argonne's programs in advanced nuclear technology are developing safe, efficient ways for our nation to acquire energy with minimal waste and without producing greenhouse gases.

In conclusion Argonne has affected our lives in many ways through pollution prevention, preservation of natural surroundings, and the development of new technology. The positives of Argonne's presence have outweighed the negatives and overall have helped our community.

Environmental Compliance by Becky Fenske and Theresa Kolodziej

Argonne has to comply with several laws to keep the environment, including animals and people, safe from harm. Argonne is subject to regulations set by the U.S. Environmental Protection Agency, the Illinois Environmental Protection Agency, the U.S. Army Corps of Engineers and the State Fire Marshal, whose goals are to protect public health and the environment from potential biological, chemical, and radiological risks associated with Argonne research projects. Argonne is committed to following required environmental regulations. Argonne policy states that Argonne "is committed to leadership in environmental management by integrating environmental accountability into day-to-day activities and long-term planning processes."

Clean Air Act

The Clean Air Act is a federal law that sets emission limits for air pollutants and determines emission limits for equipment and operations that may release hazardous air pollutants, such as asbestos, which has been known to cause cancer, and certain radionuclides known to harm living tissue. Several buildings on the Argonne site contain large amounts of asbestos-containing materials, such as floor tiles and thermal insulation around pipes and tanks. However, the airborne asbestos levels near these potential asbestos sources are within the regulations. Asbestos-containing materials are removed using EPA-approved procedures.

Clean Water Act

The Clean Water Act (CWA) provides for the restoration and maintenance of water quality in all waters throughout the country, with the ultimate goal of achieving and maintaining "fishable and swimmable" water quality. Argonne has previously exceeded the limits stated in the act. Argonne received a Notice of Violations in May 2006 for exceeding the limits of total dissolved solids (chemicals, such as salt, dissolved in water) and chloride allowed by the CWA 12 times, along with seven other exceedances. Argonne worked with the Illinois Environmental Protection Agency to develop a solution that calls for rerouting cooling-tower discharges, repairing faulty equipment, and improving the snow management at Argonne.

During 2007, an informational monitoring program revealed that no radionuclides or volatile organic compounds (typically, industrial cleaning solvents) were detected in Argonne's water.

National Historic Preservation Act

The National Historic Preservation Act requires federal agencies to assess the impact of proposed projects on historic or culturally important sites, structures, or objects. In 2001, Argonne completed evaluations of all structures built prior to 1989 for potential listing on the National Register of Historic Places, which is the official list of the nation's historic places worthy of preservation. Argonne's early work related to the first development of fuels for nuclear reactors, along with development of reactor technology, was deemed historically significant, and the buildings where this research took place are eligible to be listed on the National Register of Historic Places.

Endangered Species Act

The Endangered Species Act is federal legislation designed to protect plant and animal resources from the adverse effects of human activities. Argonne follows the regulations set by the National Environmental Policy Act (NEPA) to assess any potential impact of Argonne activities on endangered species. Under NEPA, Argonne must assess land to determine if it is a habitat of an endangered species or a critical habitat, meaning a threatened habitat. At Argonne, any project proposal must contain a statement detailing what impact it will have on any endangered species. No federally listed endangered or threatened species is known to inhabit the Argonne campus, however there are state-listed endangered and threatened species on the site. Some state endangered species include the yellow-crowned night heron, prairie bush clover, and the spotted turtle. Threatened species include the buffalo clover, white lady's slipper orchid, and the Blanding's clover. These species have been found on or near the Argonne site. Three federally listed endangered species and one federally listed threatened species are known to inhabit the Waterfall Glen Forest Preserve that surrounds Argonne. Argonne is working to improve the natural habitats to support the goals of the Endangered Species Act.

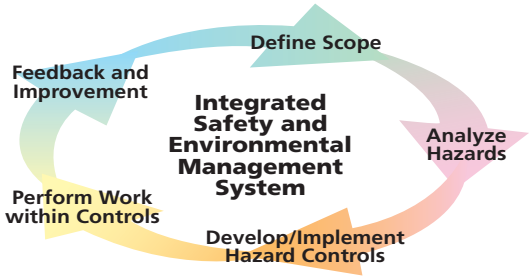
Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act is a federal law that regulates the handling, storage, treatment, and disposal of hazardous waste. This regulation ensures that Argonne handles, stores, treats and disposes of its hazardous waste in a safe way that doesn't endanger employees, the environment, or the public. Argonne generates waste from its research activities including ignitable, corrosive, toxic, solid hazardous, and radioactive wastes. These dangerous

by-products are stored and treated at different locations around Argonne in tanks and other treatment units.

Summary

Readers may think that these regulations limit Argonne scientists in conducting research, but they don't. In order for researchers and employees at Argonne to meet expectations and comply with these laws, Argonne follows the Integrated Safety Management System (ISM), a process that includes a detailed analysis of what chemicals and materials are needed and their possible impacts on the environment. ISM requires that the researchers take necessary precautions. In planning their research projects, scientists and employees analyze the tasks and potential risks associated with achieving their goals. Once the risks are identified, proper care is exercised to minimize them, including the use of lower-risk alternative procedures, chemicals, and materials. For example, the use of methyl ethyl ketone, a well known solvent and carcinogen, has been replaced by alternative solvents such as acetone.



Nonradiological Monitoring

by Kevin Badon and Leslie Hiquiana

The environmental effects of experiments and other activities at Argonne National Laboratory are managed to ensure they do not exceed the regulatory limits that ensure a safe environment. In order to prevent negative effects and to better understand its emissions, Argonne regularly monitors nonradiological emissions on its campus. Argonne has been working to reduce pollutants in its air and surface water from its inception in the early 1950s.

The main source of air pollutants at Argonne is a coal-fired boiler plant used primarily to heat Argonne buildings in the winter. In 2007, chemicals emitted from the boiler did not exceed any limits set by the Clean Air Act. Another nonradioactive air pollutant that Argonne monitors is methane gas emitted from a former landfill in the northwest corner of the Argonne campus. Argonne closed this landfill several years ago, but monitors it regularly. In 2007, gas from the landfill did not exceed permit regulations. Volatile organic compounds are also monitored in groundwater regularly and have been found not to exceed regulatory limits. Argonne minimizes its use of those chemicals to help limit any threat to the surrounding communities and wildlife.

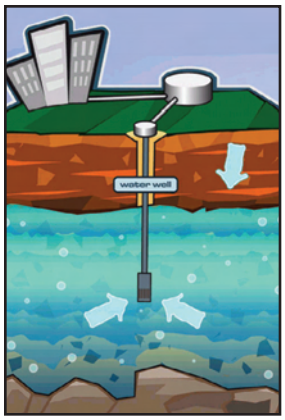
Argonne monitors surface water by testing samples taken throughout its campus and at several locations off site to ensure there is no contamination occurring to this valuable resource. Samples are tested for temperature, pH, chloride, mercury, sulfate, oil, grease, total dissolved solids, total organic halogen, volatile organics, and metals. Some chemicals found in the water, such as bromoform and dibromochloromethne, come from the chlorination process conducted by the Chicago Water Department. Trace amounts of other chemicals, such as 1-Propanol, ethanol, acetone, and ethyl ether, come from cooling towers, cooling water, condensate, and footing drain system on the Argonne campus.

Argonne has three main outfalls that discharge treated sanitary wastewater into Sawmill Creek to be carried off campus. Outfall A01 discharges wastewater treated at Argonne's Sanitary Wastewater treatment plant. Outfall B01 discharges wastewater treated at Argonne's Laboratory Wastewater Treatment Plant. Outfall 001 discharges combined wastewater from both treatment plants. Each outfall is tested monthly or semiannually. In 2007, only three exceedances were found, all from Outfall B01. All were caused by Total Suspended Solids (TSS) on the same day. After investigating, Argonne determined that the cause of this exceedance was a temporary process upset at the Laboratory Wastewater Treatment Plant, which released more TSS than normal. The fact that Argonne has such a good method of monitoring and sampling the water around Argonne resulted in few limited violations in the past year.

Storm water runoff at Argonne is monitored to ensure that it doesn't contaminate anything. During the winter, roads are salted, and once that salt dissolves, rain can wash it away and contaminate surrounding water. Some contaminations found in water sources in Argonne are caused from storm water contaminations. Argonne collects storm water samples during the first half-hour of the peak of big storms. In 2007, Argonne was only able to retrieve one sample. There was no exceedance found in this sample.

Groundwater by Suse LaGory and Shelby O'Brien

Why is Groundwater Important?



Would you have guessed that about one-half of America's supply of drinking water comes from groundwater? This fact in itself shows the importance of maintaining clean groundwater to keep the public safe. Groundwater is water that is stored underground in a saturated layer of porous rock, sand, gravel, or soil.

Groundwater is a necessary component in many ecosystems, but if too much of the wrong chemicals, such as arsenic, chloride, or lead, become dissolved into groundwater it can become harmful. The contamination could have damaging effects on humans and wildlife living in the area who may be exposed to or consume the groundwater.

Groundwater is present underneath the Argonne campus in several different geologic units. It may be present in layers of glacial drift with high proportions of sand and gravel. Dolomite bedrock contains cracks, fissures, and solution cavities that allow groundwater to migrate through the stone. This zone contains the uppermost aquifer used near Argonne as a source of drinking water for low-capacity wells. Argonne monitors this groundwater by collecting and analyzing water samples from strategically placed wells on and off the Argonne campus.

Argonne's groundwater mainly comes from precipitation, such as rain, hail, snow, and sleet, that is absorbed into the ground. While these underground stores, or aquifers, do not supply drinking water directly to the public, their water quality can have an effect on the aquifers that do provide drinking water. Groundwater, like surface water, does travel and its movement can carry contaminants from a polluted aquifer into an otherwise clean one. Because the aquifers underneath the Argonne site have the potential to integrate with others that supply drinking water to surrounding communities, it is important to eliminate what contamination may be present.

What is Groundwater Like at Argonne?

As of 2007, the overall groundwater quality at Argonne is considered to be Class I, which is the highest quality. Although the overall quality is of the highest standard, not all areas at Argonne meet the requirements for groundwater quality. The two main areas that do not meet standards are Area 317 and Area 319, both located at the southeast corner of the Argonne campus; Area 317 contains a waste management area, and Area 319 contains a former on-site landfill. In these areas, the levels of hydrogen-3 and volatile organic compounds were above regulatory standards. Because this contamination could affect groundwater quality in an isolated area of the Waterfall Glen Forest Preserve, Argonne has taken several actions to reduce contamination in these areas. One action is to plant a small stand of special fast-growing poplar trees between the source of contamination and the Argonne boundary. The tree roots grow down into the aquifers, where they absorb and remove contamination. Argonne has also installed shallow wells throughout the site to monitor contaminant movement. In 1996, a series of groundwater seeps was discovered in a network of steeply eroded ravines in the Waterfall Glen Forest Preserve southeast of the 317 and 319 Areas. Shallow monitoring wells were then placed in three locations where the seeps were visible at the surface. Because shallow wells collect groundwater samples from the uppermost saturated zones underlying the landfill, they would quickly show evidence of migration of hazardous materials from the landfill if such migration was occurring.

How is Groundwater at Argonne Monitored?

Argonne is required to protect and track the quality of the groundwater on its campus. Argonne uses equipment, such as underground wells, to monitor water quality; each well is sampled quarterly. Wells are scattered throughout the Argonne campus. These wells are used to collect water samples, which are then used to monitor water quality. Various components of water quality are measured, such as metals, organic components, and radioactive contaminants. This sampling process is completed by Argonne employees who regularly test the groundwater to ensure that its quality meets standards. Argonne also uses extraction wells to eliminate contaminated groundwater from the system and prevent the spread of contamination off site. Contaminated water is removed and transferred to the wastewater treatment plant, where it is processed and treated to remove contaminants. There is a higher concentration of extraction wells in problematic areas of the site, such as Areas 317 and 319, where contaminant extraction is required more often.

Radiation in General

Radiation can be really harmful to people and our environment, which gives us the motivation to monitor it. At the same time, radiation provides many important benefits that help protect and maintain human health and safety. Nuclear medicine procedures are common in today's hospitals, providing diagnostic procedures that quickly and safely identity and treat diseases like cancer. Modern radiology centers rely on X-rays, magnetic resonance imaging, and CAT scans. The food industry uses radiation to kill germs to make foods safer to eat and last longer before spoiling.

What is radiation?

Radiation, also known as radiant energy, is the spontaneous emission of electromagnetic rays or particles from nuclear decay. The three types of radiation are alpha, beta, and gamma rays. Gamma rays are the most penetrating and are capable of altering atoms, molecules, and disrupting the chemical activity in cells. Beta rays are the second most penetrating, and alpha rays are the form of radiation most easily blocked. A simple piece of tissue paper is enough shielding to stop alpha rays.

How radiation is measured

Radiation is measured in units of becquerels (Bq) or in curies (Ci). When radiation is measured in terms of damage to the human body, it's measured in units called rem. One rem of radiation is a fairly large dose equivalent, so radiation dose is often expressed in millirem (mrem), which is 1/1000 of a rem.

One common instrument that measures radiation is a Geiger counter. It is used to check materials and the environment for radioactivity.

Sources and acceptable dose

Radiation comes from both man-made and natural sources. For most people, natural radiation accounts for the great majority of their radiation exposure. Natural radiation comes from cosmic rays, natural minerals in the earth, internal radiation from natural minerals in our bodies, and radon. Radon is a radioactive gas formed from the decay of natural radium. Figure 1 shows the most typical sources of radiation exposure for the average person. The main sources of man-made radiation are medical X-rays, nuclear medicine, and consumer products.

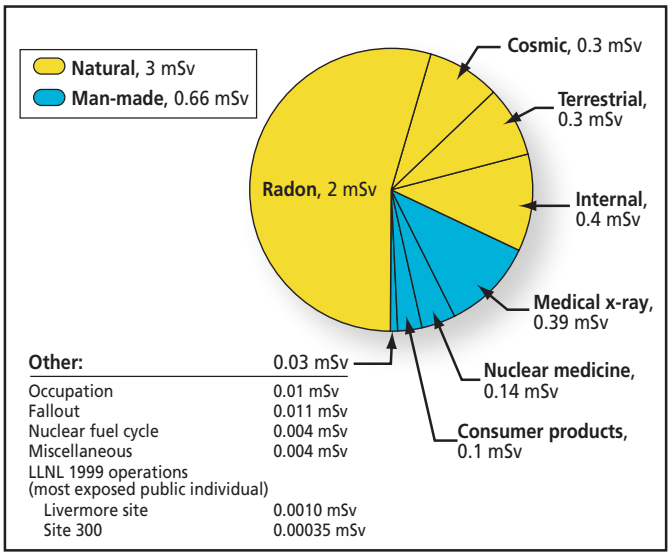


Figure 1. Typical annual radiation doses from natural and man-made sources (National Council on Radiation Protection 1987b).

The exposure of man to radiation can be by many routes or pathways. A number of pathways are illustrated in Figure 2.

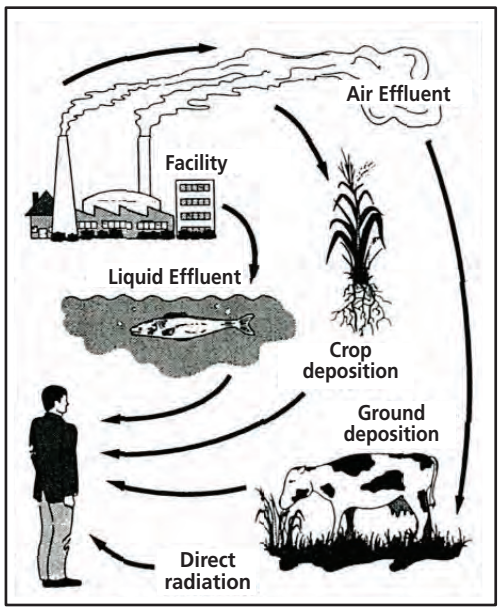


Figure 2. Examples of radiation pathways.

Argonne Radiological Program

by Ashley Carpenter and Alex Uzarowicz

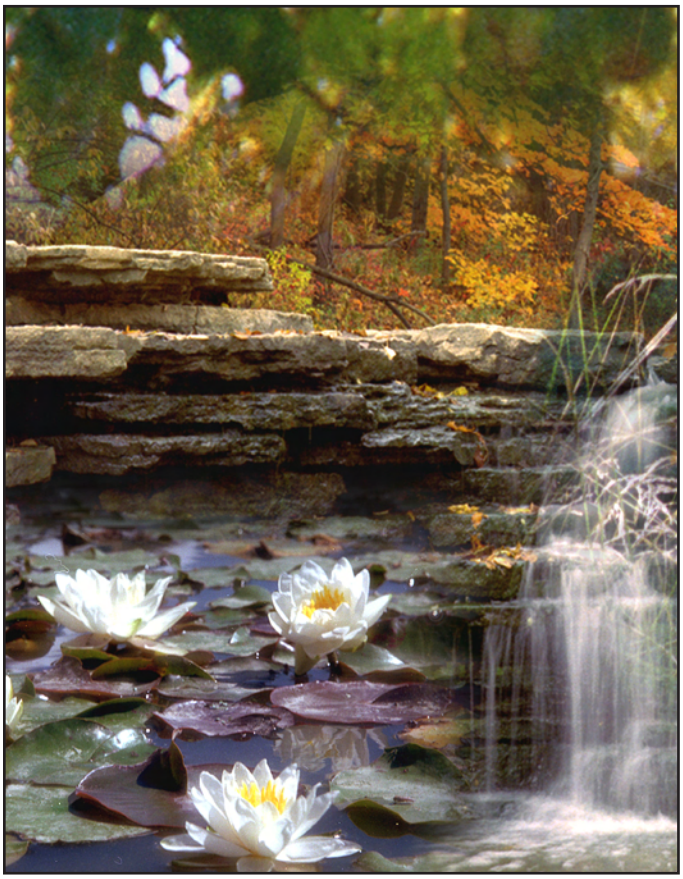
Knowing about the place you live is important, especially the different factors that could affect your family's health. However, one does not have to worry when it comes to Argonne's levels of radioactive emissions because there are hardly any. Argonne's closest neighbor lives 2.7 km (1.7 miles) away. From living close to Argonne, he or she receives a hypothetical radiation dose of only 0.045 mrem/yr — less than one-hundredth the dose from a standard medical X-ray — and to get this amount of exposure he or she would have to stay outdoors 24/7 during the entire year. This dose is harmless. Argonne is doing a spectacular job in keeping the levels of radioactivity down.

Everyone wants to be informed about their surroundings, and the different areas around them. Argonne is keeping people safe. The concern that many citizens have with Argonne is the fear of being exposed to radioactivity. Argonne met the 2007 regulations set by the Environmental Protection Agency (EPA), and the Department of Energy (DOE) to prevent individual citizens from getting exposed to radioactivity. Both agencies set environmental standards and inspect Argonne to determine if Argonne meets these standards.

Argonne measures radioactivity levels in air, surface water, sub-surface water, and sediment on its site. The media of greatest concern are air and water. These are obviously most important because they affect all of us. Hence, radioactivity levels in air and water must be constantly monitored by environmental agencies, and radioactivity levels in air and water on the Argonne campus must be at or below the 100 mrem/yr level.

Radioactive materials can be found everywhere. In order to monitor radioactive content of particles in the air, Argonne staff collect and analyze filter samples. Air quality is measured by taking the totals of alpha, beta, and gamma-ray emitters at different locations on and around the Argonne campus. Argonne releases some small amounts of radioactive material into the air despite the laboratory's efforts to closely monitor and prevent releases.

Radioactive waste in water is significant since many of DuPage's citizens acquire their water from surface water. This is significant for Argonne because Sawmill Creek flows across the Argonne campus before it empties into the Des Plaines River. Radiation measurements in Sawmill Creek water are lower when the water leaves Argonne than when it arrives, which means Argonne actually cleans the water as it passes across the campus.



In conclusion, Argonne released radionuclides such as radon-220 and hydrogen-3, as well as several other fission products in millicurie or smaller amounts. None of these releases had any significant impact on public health.

Land Management and Habitat Restoration

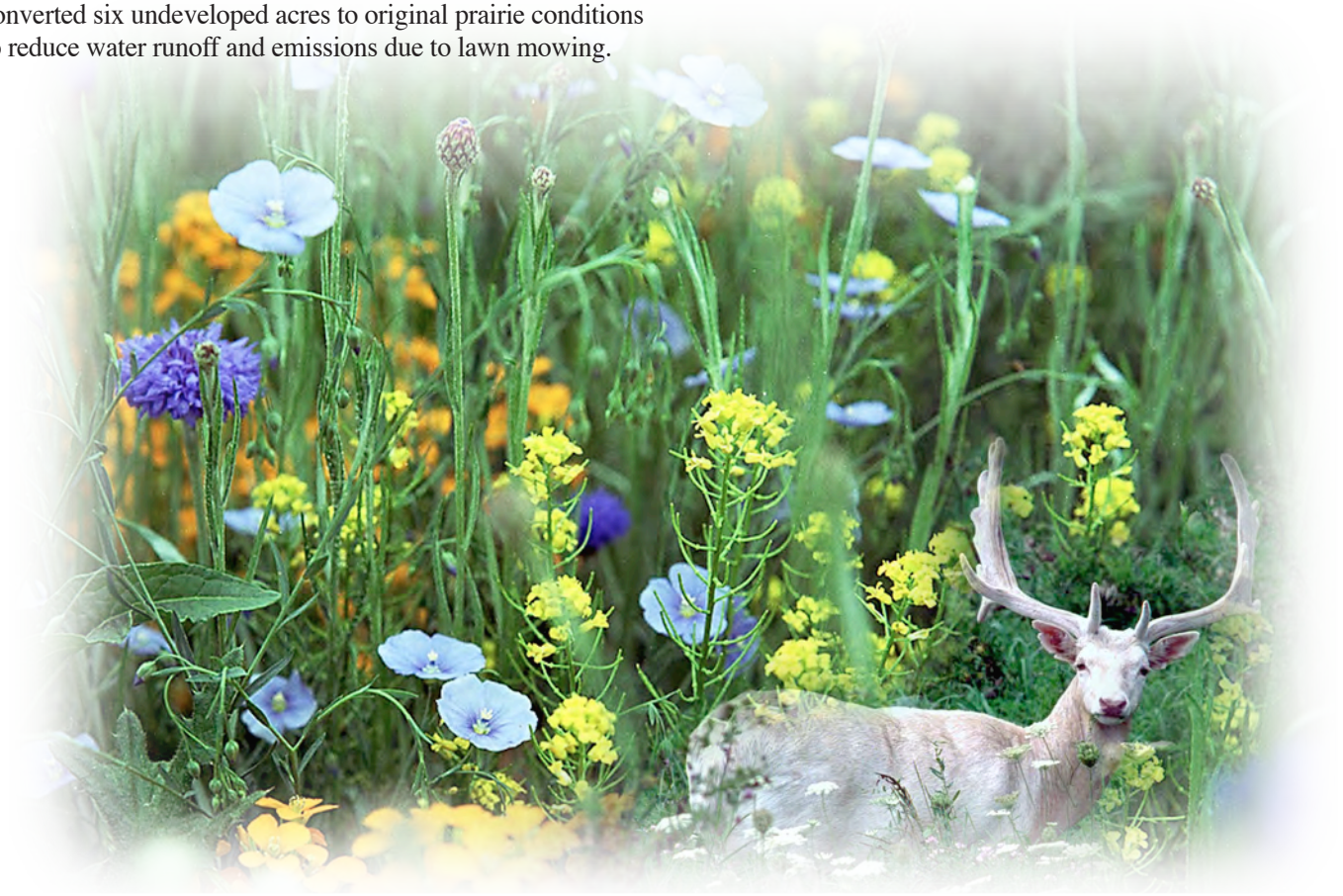
by Scott Pavletic and Katie Kech

Argonne National Laboratory is unlike many other science research facilities. In addition to focusing on being first to discover new science and technology, Argonne has active programs in land management and restoration that maintain the four distinct ecosystems — the oak forest, tall grass prairie, wetland, and oak savanna — found on the Argonne campus.

Argonne and the U.S. Department of Energy belong to Chicago Wilderness, a partnership of more than 100 private and public organizations, having the common goal of restoring, protecting, and managing natural resources in and around the Chicago area. These groups work to reintroduce native plant and animal species to help control erosion and pollution while cutting down maintenance costs due to flooding. Hand-clearing and controlled burns of specific areas help to restore and preserve undeveloped wetlands, woodlands, prairies, and savannas. Argonne's vision and current focus in land restoration is to integrate native species into the developed and non-developed areas at Argonne while meeting all regulatory and policy obligations, as well as following sound ecological management. Argonne recently converted six undeveloped acres to original prairie conditions to reduce water runoff and emissions due to lawn mowing.

Argonne has some unusual animal species roaming its campus, including a herd of about 40 fallow deer. The deer's white color is striking but natural. Native to southern Europe and northern Africa, the current herd has descended from a small herd that roamed the country estate of Gustav Freund before the government acquired the property in the late 1940s to build Argonne. There is also a population of about 60 white tail deer, which are brown in color and native to Illinois. The white-tail and fallow deer tolerate one another and do not compete for food. The white tail deer mainly eat leaves and fallen brush while the fallow deer graze on the mown grasses. These two species cannot interbreed.

In addition to reducing erosion and flooding, habitat restoration will make Argonne's campus a more beautiful place to visit. The cost of restoration can be recouped over the years due to the lowered cost of maintenance to the campus.



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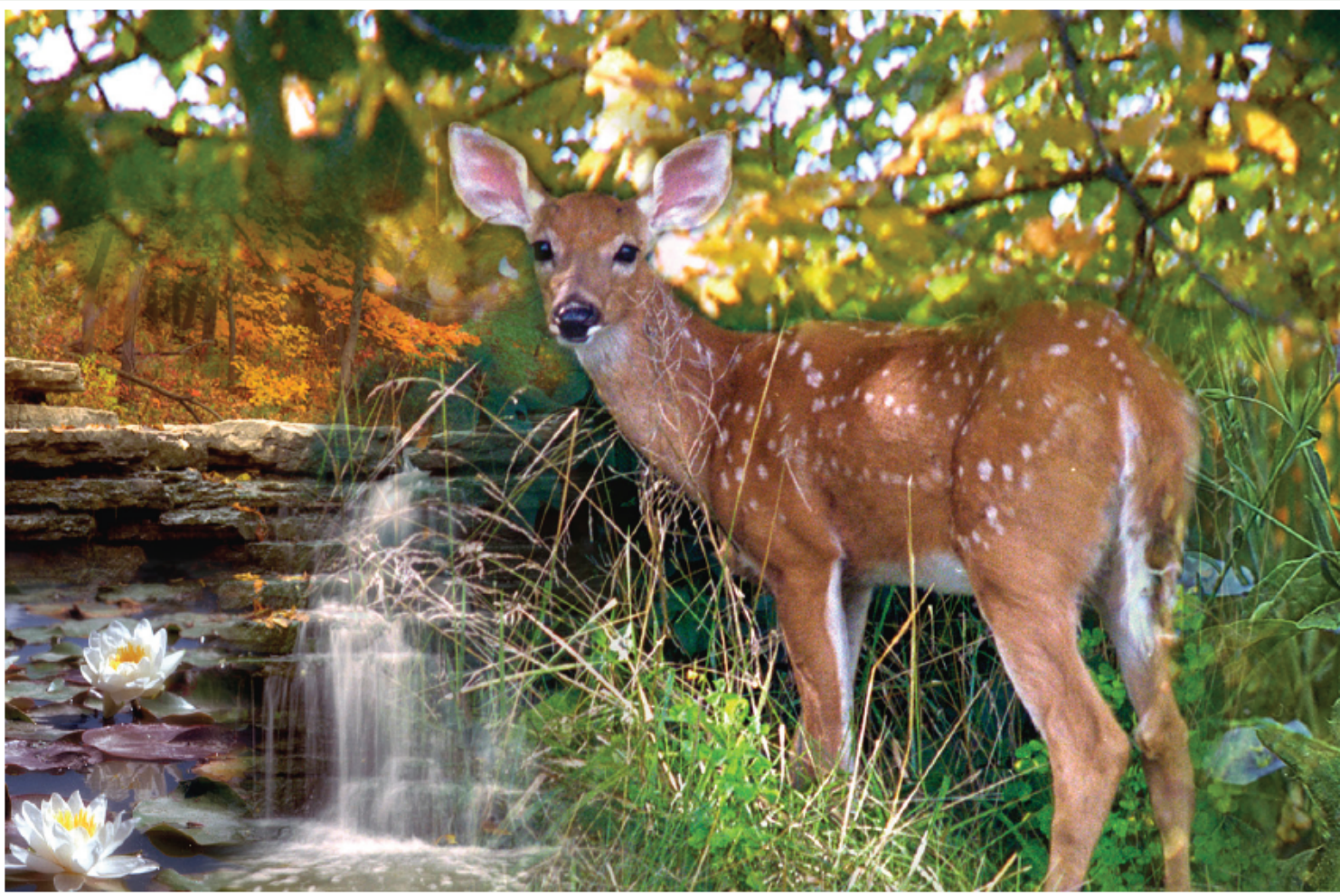

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