Argonne NATIONAL LABORATORY

ANL-07/02 (Summary)

Summary Site Environmental Report

for Calendar Year 2006

Environment, Safety, and Health/Quality Assurance Oversight Division

About Argonne National Laboratory

Argonne is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC under contract DE-AC02-06CH11357. The Laboratory's main facility is outside Chicago, at 9700 South Cass Avenue, Argonne, Illinois 60439. For information about Argonne, see www.anl.gov.

Availability of This Report

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Introduction by Bridget O'Sullivan

This booklet is designed to inform the public about what Argonne National Laboratory is doing to monitor its environment and to protect its employees and neighbors from any adverse environmental impacts from Argonne research. The Downers Grove South Biology II class was selected to write this booklet, which summarizes Argonne's environmental monitoring programs for 2006. Writing this booklet also satisfies the Illinois State Education Standard, which requires that students need to know and apply scientific concepts to graduate from high school. This project not only provides information to the public, it will help students become better learners.

Biology II students at Downers Grove South High School:
In the front row, from left to right, are Emily Schimick, Caleb LaLonde, Kaitlin Hernandez, Fadi Mina and Mr. Scott Howard. In the back row, from left to right, Kevin Mak, Ashley Vizek, Bridget O'Sullivan, Oscar Parker, Ashleigh Pieniazek, and Christine Beuhler.

The Biology II class was assigned to condense Argonne's 300-page, highly technical Site Environmental Report into a 16-page plain-English booklet. The site assessment relates to the class because the primary focus of the Biology II class is ecology and the environment. Students developed better learning skills by working together cooperatively, writing and researching more effectively. Students used the Argonne Site Environmental Report, the Internet, text books and information from Argonne scientists to help with their research on their topics.

The topics covered in this booklet are the history of Argonne, groundwater, habitat management, air quality, Argonne research, Argonne's environmental non-radiological program, radiation, and compliance. The students first had to read and discuss the Site Environmental Report and then assign topics to focus on. Dr. Norbert Golchert and Mr. David Baurac, both from Argonne, came into the class to help teach the topics more in depth. The class then prepared drafts and wrote a final copy. Ashley Vizek, a student in the Biology class stated, "I reviewed my material and read it over and over. I then took time to plan my paper out and think about what I wanted to write about, put it into foundation questions and started to write my paper. I rewrote and revised so I think the amount of time that I put into the project will be worth it in the end because it is a cool thing to be a published writer."

While most students agree that putting the final paper together was the toughest part, the final result was worth the hard work. Christine Beuhler states, "The time and effort was worth it because I learned a lot about the Argonne facility. This project also improved my analyzing, reading, and writing skills." Emily Schimick and Kaitlin Hernandez agreed that the feeling of accomplishment when they finished the paper was their favorite part, while the reading of the Argonne Site Environmental Report was their least favorite because it was difficult to understand.

The Downers Grove South Biology II class would like to thank our teacher Mr. Scott Howard, as well as Dr. Golchert and Mr. Baurac for their investment in time and energy in helping with the project. Dr. Golchert and Mr. Baurac gave us valuable assistance in the preparation of this project, and we owe them our deepest gratitude. Their real-life experience at Argonne was inspirational. Mr. Howard set the goals and made the commitment to our class to complete this project. Without their kind support, this project would not have been possible.

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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 and layout by Sana Sandler.

What is Argonne? by Caleb LaLonde

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 located on a 1,500-acre wooded site in the southeastern corner of DuPage County, near the city of Darien, IL. Argonne is one of the largest federally funded research facilities in the nation. Scientists and engineers from around the world visit Argonne to conduct research that opens new possibilities for the future. Three of Argonne's physicists have won the Nobel Prize (Enrico Fermi, Maria Goeppert Mayer, and Alexei A. Abrikosov). Argonne's main missions are to support the U.S. Department of Energy in helping provide the nation with a secure energy supply, to advance the state of knowledge and to help solve the nation's leading problems in science and technology. The annual operating budget is around $530 million. The majority of the budget comes from the U.S. Department of Energy. There are 2,800 employees at Argonne. Out of these, about 750 have Ph.D.s in their respective fields. More than 90 different companies, including every major national pharmaceutical company in the nation, and all the nation's leading research universities conduct research at Argonne.

Short History of Argonne

Argonne is a descendant of the University of Chicago's Metallurgical Laboratory, part of the World War Two Manhattan Project, where in 1942, Enrico Fermi and about 50 colleagues created the world's first controlled nuclear chain reaction underneath the University of Chicago's Stagg Field. By February 1943, Fermi's reactor had been moved to the Argonne Forest section of the Cook County Forest Preserve. In 1946, Argonne became the nation's first national laboratory and was given the task of developing nuclear reactors for peaceful purposes. During the late 1940s, Argonne moved to its current location in DuPage County.

Argonne's Missions

Argonne has three main missions: basic science, applied science, and scientific user facilities. Basic science strives to find how nature works. Applied science is dedicated to finding solutions to important national problems in science and technology. Argonne designs, builds and operates scientific user facilities so researchers from companies, universities and government laboratories can use these one-of-a-kind facilities to conduct research they cannot conduct anywhere else. Some of these companies and universities include Texas Instruments, DOW, Northwestern University, and Harvard.

There are six major scientific user facilities at Argonne. These facilities are the Advanced Photon Source, the Center for Nanoscale Materials, the Intense Pulsed Neutron Source, the Argonne Tandem-Linac Accelerator System, the Electron Microscopy Center, and the Structural Biology Center. The most used facility at Argonne is the Advanced Photon Source (APS). This machine is the nation's largest scientific user facility and is used by 3,400 researchers a year. The APS provides the most brilliant X-ray beams for research in the Western Hemisphere. Some of the most remarkable research done with the APS includes studies that helped Abbott Labs develop one of the world's most prescribed drugs for treating AIDS.

Educational Programs

Another important Argonne mission is training the next generation of scientists and engineers. In 2007, about 3,800 students and teachers from kindergarten through university level participated in these programs. Argonne's educational program is the largest of any Department of Energy science laboratory.

One of Argonne's educational programs is Science Careers in Search of Women. This is an annual conference that has been held since 1986 to encourage high school girls to pursue careers in scientific and technical fields.

Argonne also sponsors an annual "Rube Goldberg Machine Contest." Held since 1996, this contest invites student teams from up to 12 Chicago-area high schools to solve science and engineering problems as they create a machine to perform a simple task in 20 or more steps.

Argonne also offers tours to the public. These tours are available by appointment only.

Argonne Research by Fadi Mina

Argonne National Laboratory is one of the country's leading federal research and development facilities. Argonne conducts basic research and helps develop new technologies for the nation. Scientists from all over the world visit Argonne to conduct research they can't do anywhere else. Argonne is a national leader in many areas of research and development, including advanced supercomputers, nanotechnology, and energy research. Argonne also helps train and educate the next generation of scientists and engineers.

Implemented Technology for the Future.

An excellent example of new technology that helps Argonne is the new IBM Blue Gene/P. This is Argonne's newest supercomputer. It is designed to do 111 trillion calculations per second, making it one of the world's fastest computers. This is important, because it provides researchers from many fields, such as chemistry, physics, transportation, and reactor engineering, with faster and more efficient calculations that will greatly advance their research. The flexibility and power of the Blue Gene/P will open up new opportunities for discovery in many fields. By making this supercomputer available to researchers around the nation, Argonne will help revolutionize the process of research and development. Many new advances in science will come all that much faster, and innovations in technology will flourish.

Engineers installing the Blue Gene/P supercomputer

Technology Created at Argonne

Argonne works closely with industry researchers to help them create new products and technology beneficial for us today. Companies like IBM, Philips, Amoco, and Texas Instruments, companies whose products we use on a daily basis, have been conducting research at Argonne for years to create safe and useful new products. One especially notable project conducted at Argonne, was Abbott Laboratories' research that led to the anti-HIV drug Kaletra®. Abbott is one of many leading drug companies that conduct research at Argonne's Advanced Photon Source, the most powerful source of X-rays for research in the Western Hemisphere. More than 3,000 researchers from all over the world conduct experiments every year at the Advanced Photon Source. Abbott's research found a hole in the molecular structure of the HIV-virus and created a new drug to lock into the hole and block the last step in the virus's reproduction process, stopping the spread of this virus in the body. Today, Kaletra® is one of the world's most prescribed drugs to treat AIDS.

Argonne also conducts research to provide clean, efficient energy for the future. Two good examples are nuclear energy and transportation. Argonne designed, built, and tested the prototypes of most of today's commercial nuclear reactors. Nuclear energy is becoming more important around the world because it is the only large-scale electricity-generating technology that does not produce green-house gases, the major cause of global warming today. Today, Argonne is helping to develop the next generation of advanced nuclear reactors.

In the area of transportation research, the U.S. Department of Energy has designated Argonne the lead national laboratory in charge of testing and evaluating technologies for plug-in hybrid electric vehicles. These vehicles are not yet on the market, but experts believe they will get 100 mpg and will replace gasoline with electricity for the cost equivalent of about $1 per gallon. This will benefit the country's economy by reducing traveling expenses, as well as the air pollution problems we face today.

Scientists testing the new plug-in hybrid vehicles at Argonne

Technology that Will Be Used

Another area where scientists at Argonne are beginning to test and develop new ideas is nanotechnology, the use of materials measured in one-billionths of a meter. A billionth of a meter is about one-seventieth the diameter of a human hair. This technology is highly useful and important, research at Argonne's new Center for Nanoscale Materials will help find uses and implement them in new products and technologies for our society. One example of a practical product expected to come from nanotechnology is new, more efficient solar-energy panels.

NANOCENTER — The Center for Nanoscale Materials is connected to the Advanced Photon Source.

Another example is a medical device that can be inserted into the body to monitor blood sugar and inject insulin as needed. This would remove the hassle of diabetes patients having to check their own insulin levels, and having to poke themselves with a needle every day.

Argonne also helps train the next generation of scientists and engineers by operating the largest set of educational programs of any Department of Energy science laboratory. Last year, 3,800 students and faculty from kindergarten through university level participated in Argonne educational programs.

Argonne is truly one of our country's leading research laboratories. Argonne gives back to the community many times its value in innovations and new knowledge.

ENVIRONMENTAL COMPLIANCE by Christine Beuhler

Compliance, which is defined as conformity in fulfilling official requirements, affects every aspect of the Argonne facility. It affects the staff, funding, new technology, productivity, efficiency, and the surrounding environment. To be compliant, Argonne must adhere to environmental statutes and regulations administered by groups such as the U.S. Environmental Protection Agency, Illinois Environmental Protection Agency, U.S. Army Corps of Engineers, and the state Fire Marshal.

These regulations ensure clean air and water, safe disposal of hazardous wastes, and the conservation and protection of resources, wildlife, and the surrounding environment. In addition, Argonne has many programs dedicated to continually improving and correcting the laboratory's future impact on the environment.

The sources of most conventional air pollutants at Argonne are steam plants, gasoline and ethanol blend fuel-dispensing facilities, two alkali metal reaction booths, two dust collection systems, an engine test facility, diesel generators, and fire training activities. In order to keep the air safe from all of the emissions from these facilities Argonne must comply with the Clean Air Act. This federal statue sets airborne emission limits, in addition to requiring monitoring and record keeping of hazardous air pollutants emissions.

Argonne must ensure that its water is suitable to be used by humans and animals alike once the laboratory is through with it. The Clean Water Act, established in 1977 as an amendment to the Federal Water Pollution Control Act, does just that, providing for "the restoration and maintenance of water quality in all waters throughout the country." The Clean Water Act encompasses wastewater discharge, which consists of wastewater from restrooms, laboratory sinks, and storm water. At Argonne, the wastewater is treated in two different treatment systems. The first system, the sanitary system, is used for portions of the site that don't contain hazardous materials, such as office buildings; this wastewater is treated using different types of clarifiers and filters. The second system, the laboratory system, contains wastewater generated during research-related activities and uses more intensive methods to treat the water because it is more potentially dangerous. The Spill Prevention Control and Countermeasure Plan ensures that oil and oil products are not released into U.S. waters.

Argonne has a responsibility to safely dispose of hazardous wastes. These wastes can include solid radioactive waste, radioactively contaminated lead bricks, corrosive or toxic mixed waste, radiological liquid waste, or flammable waste. All of these are dangerous to humans and animals and must be disposed of very carefully. The main regulation that supervises waste management at Argonne is the Resource Conservation and Recovery Act (RCRA), which ensures that the generation, treatment, storage, and disposal of hazardous wastes is done so that it protects the environment and human health. The majority of wastes, once treated, are disposed of at approved off-site facilities. RCRA also regulates the management of underground storage tanks. Argonne currently has 13 underground storage tanks to store fuel oil (gasoline, diesel, etc.,) for emergency generators.

Argonne must ensure that its experiments and laboratory procedures do not disrupt or endanger the local environment and resources. To keep this from happening, Argonne complies with the National Environment Policy Act of 1969, which promotes consideration of environmental impacts in federal projects. Argonne also ensures that the pesticides and herbicides used on campus are Environmental Protection Agency approved and that any extra is removed from the site.

Argonne also upholds a "Protection of Wetlands" policy to reduce the negative impact certain activities may have on these areas. If impacts can't be avoided, Argonne must take action by doing one of two things. Argonne can either repair the damage done to the wetland or replace the wetland with one that is as similar to the original as possible. In addition, Argonne monitors woodland vegetation and the browsing effects of deer to determine overall forest health. It surveys woody vegetation in autumn and tree seedlings and herbaceous vegetation in spring in order to make deer and habitat-management decisions.

Argonne and its surroundings provide a home for many animals that rely on a stable environment. Argonne's compliance with the numerous regulations and statutes helps the environment to stay that way. Argonne has large populations of fallow and white-tailed deer, which is managed by DOE through an agreement with the U.S. Department of Agriculture. Too many deer can lead to ecological damage or to increased car accidents around Argonne. This agreement helps to avoid that and uses spotlight surveys to make informed deer management decisions.

Argonne's compliance helps to keep the facility a center of innovative technology that also takes into consideration safety, health, and the environment. Argonne's care in being environmentally accountable makes it a clear leader for the future.

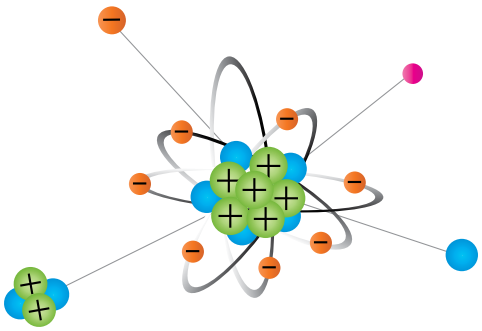
Radiation by Oscar Parker

Radiation has become a concern for human beings since the technological revolution. Radiation is always around us and is unavoidable. It is a good tool for medical use but can be hazardous to our bodies. Many medical treatments use radiation to kill tumors; however, too much radiation can cause cancer or even death.

What is Radiation?

All living things are made up of matter, which consists of atoms.

Elements may have different isotopes; of the same element that have different numbers of neutrons in their nuclei. Some isotopes are stable while other isotopes are unstable; these unstable isotopes emit radiation until they become stable.



Radiation comes in three different forms: alpha, beta, and gamma. Alpha and beta radiation are subatomic particles. Alpha particles are essentially helium nuclei, consisting of two protons and two neutrons. Because they are relatively large, alpha particles are easy to block. They are so big they are unable to penetrate through a piece of paper. However, if they enter the human body, they perform the greatest amount of damage. Beta radiation consists of energetic electrons. Beta radiation is generally less harmful to the body than alpha radiation but can still be lethal at high doses. Gamma rays are the most common form of radiation, consisting of electromagnetic radiation, like visible light or X-rays. Gamma rays are used in medical treatments and are generally the least harmful. However, just like beta radiation, gamma rays can be hazardous at large doses.

Radiation is measured in several ways. The measurment unit of radiation is called becquerels (bq); this is the rate at which a nucleus decays. The amount of energy deposited in living tissue is called a "dose". The amount of radiation absorbed in tissue is called "absorbed dose" and is measured in rads or grays (Gy). To give the relative difference in damage, an alpha particle's impact on tissue is 20 times greater than a beta particle's. Other more common units of radiation are millirem (mrem) and millisievert (mSv).

Radiation and Technology

There are two broad sources of radiation present around us: natural radiation and artificial or man-made radiation. Natural radiation has been around forever. Humans on average receive 363 mrems of radiation a year, 300 of which is from natural sources. The remaining 63 mrems of human radiation exposure comes from man-made technologies, such as television sets, computers, tobacco, and especially medical equipment. Researchers in industry, academia, and government are continually searching for ways to reduce this radiation exposure due to the unhealthy effects that come from radiation.

Natural radiation comes from many sources, including cosmic rays, soil, rock, radon gas, and naturally radioactive minerals in our own bodies. Radon accounts for nearly 67 percent of human exposure to natural radiation. The amount of radiation from cosmic rays depends on elevation. At higher elevations, the amount of radiation is greater because the extraterrestrial source is closer and because there is less air to filter the radiation. So the amount of cosmic radiation at the peaks of Colorado is much higher than in the valleys of Arizona.

The man-made radiation comes mostly from medical X-rays and other treatments. A small portion of man-made radiation comes from consumer products, such as televisions and smoke detectors. The effect of radiation from these sources varies among people by how much they are exposed and their body weight.

Argonne and the Study of Radiation

Argonne complies with DOE Order 5400.5, which establishes radiation standards for Argonne. This order requires that the Argonne campus be environmentally monitored to measure of radiation in the air, water and soil. During 2006, Argonne did not release any property containing radioactive material for recycle or reuse. All of the property that contained residual radioactivity was properly disposed of in an off-site low-level radioactive disposal facility.

Environmental Nonradiological Program by Kevin Mak

The Environmental Nonradiological Program at Argonne monitors "point sources," – facilities that can potentially release hazardous chemicals into the water or air. Argonne uses a wide range of chemicals in its research and operations, which is why this program is especially concerned with monitoring metals and limiting possible releases into the environment. Argonne endeavors to comply fully with agencies and laws that restrict the discharge of chemicals. Point sources within Argonne are monitored and reported on a frequent basis depending on their regulations. In addition, statistics are used to identify patterns to prevent predicted exceedances.

The majority of hazardous air pollutants from Argonne are released in such small quantities that they do not have an impact on the environment. One of the gases, sulfur dioxide, is released at Boiler No. 5. This facility burns natural gas and coal to provide heating for Argonne's buildings, offices, and laboratories. Its operations are monitored 24/7 and did not exceed emission limits in 2006.

Another area monitored at Argonne is the 800-area landfill, where solid wastes are buried underground. The materials decompose over time and naturally release methane gas, a contributor to the greenhouse effect. Four wells within the landfill and ten surrounding the area are checked for concentrations of methane. The wells outside the landfill are used as references to determine the spread of methane. In 2006, instruments in two outer wells detected methane, but the concentration was less than one percent of that in the landfill.

Wastewater discharged from Argonne is treated at two facilities: the Sanitary Wastewater Treatment Plant (SWTP) and the Laboratory Wastewater Treatment Plant (LWTP). The SWTP receives water from non-research-related facilities, such as bathrooms and cafeterias. Polluted water from laboratories that conduct experiments is treated at the LWTP. There are several parameters that must comply with regulatory standards, including pH levels, concentrations of metals, volatile organic compounds, primary pollutants, and the flow rate of the water. Discharges from the SWTP and the LWTP are analyzed separately, then combined and monitored again before being released into Sawmill Creek, a small stream that flows across the Argonne campus. Although sampling for discharged wastewater compliance ends at this point, water quality is also measured in Sawmill Creek and farther downstream. Argonne feels the need to ensure the safety of nearby communities. One study, for example, measures changes in chemical concentrations as the stream flows away from Argonne's boundary.

In 2006, Argonne had a few instances when discharged pollutants exceeded regulatory limits, although these pollutants only slightly exceeded limits and were influenced by outside, uncontrollable factors. In spite of this, Argonne has shown its determination to address wastewater discharges. For example, in June, water discharged at one outfall had low levels of copper, lead, and zinc compounds, but by December levels were so low they could no longer be detected.

From January to February, water discharged at another outfall contained high levels of total dissolved solids (TDS), but in March levels fell back to normal and stayed there for the rest of the year. High TDS concentrations have been a recurring issue for several consecutive winters. The source is road salt used to de-ice roads on the Argonne campus; melting snow and ice carry the salt into surface water and result in temporarily high TDS levels.

Air Quality by Ashley Vizek

We are surrounded by air everyday, but we only give air attention for negative reasons. We notice when it smells like car exhaust or is too polluted to even see through. Fortunately, regulations exist in order to keep air healthy. Argonne meets all the expectations of these standards. Argonne conducts a wide range of research that uses many different chemicals, and the laboratory is required to comply with the standards set by such laws such as the Clean Air Act.

The Clean Air Act was established in 1963 and amended in the 1970s. It is the major regulation that governs air quality at Argonne. Under Title V of the Clean Air Act, large stationary sources of pollution are granted permits to operate only after submission of a permit application that addresses all requirements of the Clean Air Act. Argonne created an acceptable plan and received its current permit in 2001. Title V requires that all air pollutants be reported, not just those that are harmful or come from major sources.

Argonne meets clean air standards by monitoring the potential sources of hazardous and conventional pollutants on its campus, including the steam plant with a coal-fired boiler, an engine test facility, and diesel generators. Argonne also complies with the National Emission Standards for Hazardous Air Pollutants (NESHAP), which sets standards for asbestos and radionuclides. Asbestos is a soft, fibrous mineral with good heat-resistant and insulating properties. Unfortunately, the inhalation of asbestos can result in serious lung illnesses, including cancer.

Argonne has started work to reduce the amount of asbestos-containing material. Asbestos exists at Argonne in thermal insulation around pipes and tanks, as well as in surfacing material and floor tiles. Argonne is working with the Illinois Department of Public Health. The removal plan is in accordance with the NESHAP.

Radionuclides are atoms that have an unstable nucleus, which makes them radioactive. If the radionuclides get inside the body they can cause serious damage and illness. A few locations at Argonne conduct research that could emit radionuclides. Air from these facilities is monitored as it exits ventilation systems. Argonne releases a very

small amount of radioactive material into the atmosphere. While Argonne complies with the federal standards regulating air quality, the laboratory is not satisfied to merely maintain the status quo. Argonne researchers are striving to find new and innovative ways to improve air quality. One such research project is sponsored by the U.S. Department of Energy. Together they are working to help develop the plug-in hybrid electric vehicle. This car is similar to the hybrid vehicles that are currently on the road today, but its battery can be charged by both the gasoline engine and by a standard electrical outlet. While several years from being commercially available, this new form of technology will improve the air quality by cutting gasoline use and producing lower carbon dioxide emissions.

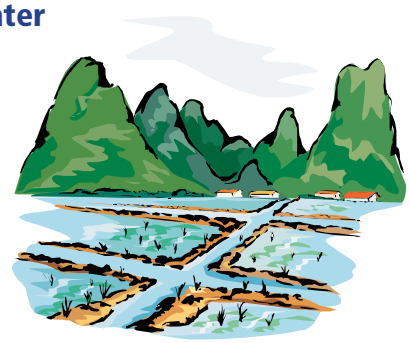
All human beings need clean air to survive. If the quality of the air was not regulated then our oxygen would become contaminated with harmful chemicals and pollutants. Due to federal standards such as the Clean Air Act, the harmful pollutants that are emitted by various facilities are limited. Argonne is a vital scientific resource for the progress of our nation, but Argonne also emits small amounts of harmful pollutants. Argonne complies with the standards set for air quality, thus providing a safe and healthy environment for the surrounding areas.

Groundwater by Kaitlin Hernandez and Emily Schimick

What is Groundwater?

When most people think of our planet's water supply, they only consider surface water such as oceans, lakes and streams. However, there is about a hundred times more water in the ground than in all of the lakes and rivers in the world. This abundance of groundwater exists because water is constantly being absorbed into the ground as a result of rainwater, snowmelt, crop irrigation, and pipeline leakage. While some of this water moves towards lakes or streams, a considerable portion of it seeps into the ground. Gravity carries the water downward, and it travels through spaces in the gravel, sand, sandstone, and rock that form the Earth's soil. As water continues to move lower, it eventually reaches a layer of soil that is too dense for the water to pass through. When the water reaches this level, it is unable to move further into the ground and begins to pool. It then becomes stored in the spaces between the rocks and other soil particles. Since a useable amount of water is stored in these spaces, this area of rock and soil is known as an aquifer. The groundwater in this aquifer is replenished when more water seeps down from the surface after a rainfall or snowmelt.

Uses of Groundwater



The groundwater beneath the earth's surface has many important uses. In the United States, the main use of groundwater is for irrigation. This is important to farmers and those living in rural areas. There are many other uses for groundwater, including drinking water, water for firefighting, and water for delivery to homes and businesses. Industries and mining facilities also use groundwater. In the United States about 30 percent of fresh water comes from groundwater sources. Groundwater is a great natural resource for areas that do not have enough surface water.

Quality/Contaminants

Water is an excellent solvent, meaning it easily dissolves other materials. This can be a problem when it comes to the quality of groundwater because water can easily dissolve chemicals that contaminate groundwater. Since water often moves slowly through soil as it seeps into the ground, chemicals are given plenty of time to dissolve into the groundwater. The physical properties of aquifers can affect groundwater quality. For example, groundwater can be contaminated by chemicals that occur naturally within an aquifer. The thickness of an aquifer can also determine the amount of contaminants in the groundwater. If an aquifer is extremely thick, chemicals will have more difficulty reaching the groundwater. Another important factor is the location of the aquifer. If an aquifer is closer to the Earth's surface, it has a much greater risk of becoming contaminated than a deeper aquifer. This is because more contaminants are located closer to the Earth's surface, so groundwater is more exposed to them when it is located in an aquifer near the surface.

Although some groundwater contaminants occur naturally, many enter the ground as a result of industrial, domestic, and agricultural chemical uses. For example, when farmers and homeowners use pesticides and herbicides to fertilize their crops and lawns, the chemicals can seep into the ground and contaminate the groundwater. However, Argonne puts a lot of time and effort into testing its groundwater to ensure that the quality is high.

Testing the Quality of Groundwater

Testing the quality of groundwater is very essential at Argonne National Laboratory. In order to test the groundwater, Argonne draws water samples from wells that are deep enough to reach the groundwater. Argonne draws water samples from several wells at different locations throughout the campus. The samples are then analyzed to determine whether certain harmful chemicals are present. Some of these chemicals include nitrate, mercury, manganese, and lead. Argonne also tests for radioactive materials such as, cesium-137, hydrogen-3, and strontium-90.

Groundwater Quality Compliance

According to the Illinois Environmental Protection Agency's Groundwater Quality Standards, Argonne's groundwater is classified as Class I groundwater, which is the highest quality possible. However, some areas of the Argonne site, such as landfill areas, contain a fairly high concentration of contaminants. An area on the Argonne site known as the 317/319 Area, for example, contains several units that were used in the past for the disposal of waste. Several decades ago, a portion of the 317 Area called the French drain was used as a dumping ground for liquid chemical wastes, causing the groundwater beneath the area to become contaminated with chemicals. This happens because some of the waste in the landfill areas seeps into the ground and dissolves into the groundwater. Even though the groundwater in the 317/319 Area is not used as a source for drinking water, Argonne has continued to clean this area up since the late 1980s. With the exception of the 317/319 Area, Argonne's groundwater generally complies with groundwater regulations, and the quality of its groundwater meets or exceeds environmental standards.

Habitat Management by Ashleigh Pieniazek

When you walk onto the Argonne site and see four amazing habitats, it is so interesting to see how similar yet unique they all are. Argonne is not only managing its habitats but assisting its neighbors in managing their own backyards. Habitat management is the way in which we help to maintain or increase population numbers. Habitats provide food, space, and other needs of the animals. Management of native and invasive plant species is also necessary for all habitats. Argonne manages and restores four habitats: tall grass prairie, wetland, oak forest, and the oak savanna. Argonne manages the invasive exotic species and replants species that are necessary in the habitats.

Argonne also makes sure natural cycles are occurring and that biodiversity is high. Argonne established a land management and habitat restoration program to help restore and manage the four habitats. Argonne's goals are to reintroduce native species and to preserve high quality non-developed areas. The reintroduction of native species will help lower maintenance costs, reduce air pollution, and increase biodiversity.

Over the years, Argonne's environmental stewardship program has set many goals for itself and is continuing to meet them, calling on many techniques in the process. Argonne uses controlled burns and hand-clearing of invasive shrubs to restore vegetation in woodland and savannas and has transformed a six-acre area into a native prairie. Native forbs and grasses are planted to restore areas excavated for utility lines.

No threatened or endangered species are known to inhabit the Argonne campus, yet some can be found at the neighboring Waterfall Glen Forest Preserve. Some of these endangered species are the Hine's emerald dragonfly, leafy prairie clover, Indiana bat, and the lakeside daisy. While no endangered species inhabit Argonne, one rare species does, the white deer. About 35 white deer and 35 whitetail deer inhabit Argonne's site. The white deer are native to North Africa, Europe, and parts of Asia. These deer are descended from eight or nine purchased early in the 20th century by Gustav Freund from Chicago clothier, Maurice L. Rothchild. In the late 1930s, Freund had the white deer captured and shipped off site, but two does escaped capture. One of the does gave birth to a buck, and that is how the herd began once again. Except during mating season the bucks and does stay in their separate groups. Sometimes groups of the white deer can be seen early in the morning.

The deer roam freely and are able to leave Argonne site if they want. Some have been found as far away as Lockport but most stay within Argonne's confines. Even though the deer are present on the property, Argonne neither owns nor feeds them.

Argonne continuously monitors and tracks environmental contaminants on site. The laboratory also tracks, collects, and properly disposes of the small amounts of chemical and radioactive wastes that Argonne research generates. The habitats at Argonne are not significantly altered by the materials in the laboratories due to the small amounts that are used. The habitats at Argonne also serve educational purposes. Schools are able to visit the campus to observe and study the habitats. Argonne also offers scheduled tours, newsletters, and an annual chamber music series held on the campus.

Argonne's environmental stewardship goals are to enhance the ecological quality of the campus and to improve compliance with the environmental mandates. To advance these goals, Argonne is considering returning oak trees to the savanna. The presence of oak trees offers several advantages, such as eliminating mowing costs, expanding native habitats, and reducing flooding. Planting oak trees might be expensive today, but would reduce future costs to control storm water, flooding, and erosion.

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