Sandia National Laboratories Environmental Report 2001

Commitment to the Environment

environmental restoration

environmental technologies

waste management

pollution prevention

environmental monitoring

Sandia National Laboratories

A Department of Energy National Laboratory

Front Cover

Fire and Ice:

The cover photograph of an ice drop within the spines of a local cactus was made by Peter B. Davies, director of Sandia's Center for Geosciences and the Environment.

Walter Dickenman, at Sandia, was the principal photographer for this Project.

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INTRODUCTION

Sandia National Laboratories is committed to protecting the environment, to preserving the health and safety of the public and our employees, and to serving as a responsible corporate citizen in meeting the community's environmental goals.

Here in New Mexico, we are fortunate to live in a spectacularly beautiful setting that has a diversity of natural and human resources. In a survey conducted by the City of Albuquerque last year, great weather and our mountain setting were listed as the top-rated assets for our community. Sandia has grown and developed facilities alongside the growing Albuquerque community.

As Sandia's environmental programs have evolved over more than fifty years, the Laboratories has worked toward integrating environmental protection into all of its activities. These programs include environmental restoration, development of new technologies for environmental monitoring and renewal, state-of-the-art waste management processes, progressive pollution prevention efforts, energy and water conservation, and sustainable design and construction.

In addition, Sandia has established an elaborate system of environmental monitoring to ensure the protection of workers, the public and the environment.

The Department of Energy appraises Sandia's performance in a number of environmental areas each year. Results of the most recent appraisal are covered in this report.

Researchers have set up monitoring and surveillance programs for wastewater, stormwater, groundwater, soils, plants, animals, and air quality in and around the Labs. A number of commercial laboratories around the United States analyze our data, using Environmental Protection Agency-approved analytic methods. Our commitment to protecting the environment is reflected in the results of this monitoring program, as well as in our success in all areas of environmental protection.

We hope the following pages will give you a sense of Sandia's programs to date and our goals for the future. We understand that protecting our beautiful environment is Sandia's responsibility to future generations.

C. Paul Robinson

C. Paul Robinson,
President and Laboratories Director

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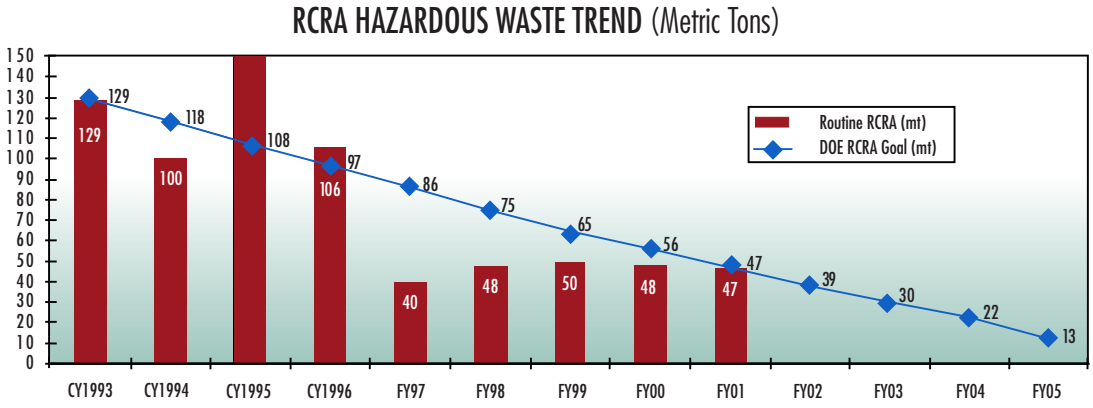
Waste Management: Waste/Recycling Trends

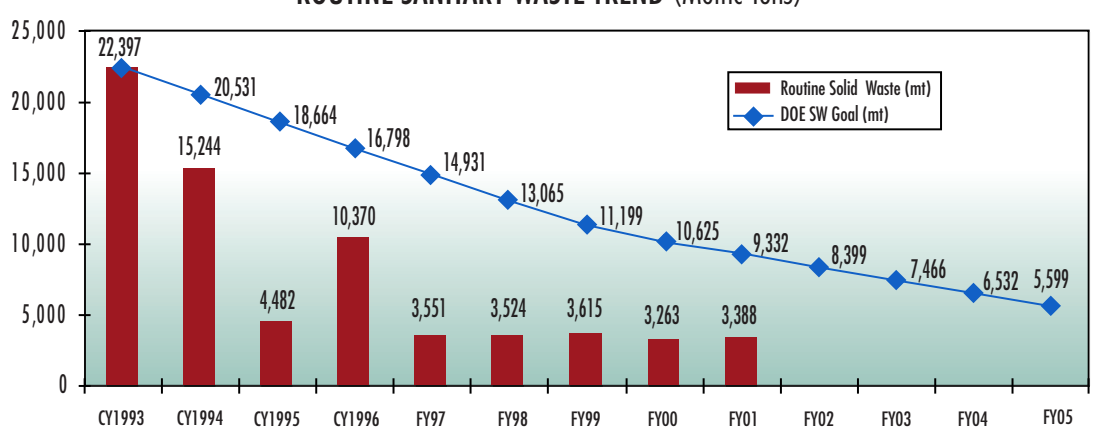
Sandia's waste management and facilities organizations continue to take steps toward reducing waste, recycling, and reuse in New Mexico. The Labs agreed during the nineties to address some difficult goals for waste reduction, conservation, and recycling. The goals, which are based on 1993 levels, call for major changes in waste practices and conservation efforts in order to achieve reductions by 2005. Some of the positive trends observed this year follow.

Hazardous Wastes



Quantities of hazardous wastes, as the term hazardous waste is defined by the Resource Conservation and Recovery Act (RCRA), are trending downward toward the Department of Energy (DOE) goal of 13 metric tons by Fiscal Year (FY) 2005. Achievement of this challenging goal will mean a 90 percent reduction from the volume of hazardous wastes handled at Sandia in 1993. The forty-seven metric tons of hazardous wastes handled in FY 2001 included spent solvents, adhesives, acid solutions, contaminated rags, general chemicals, and a diverse variety of other materials used in laboratories and testing facilities. RCRA requires that these materials be tracked and properly handled from manufacture or purchase through final disposal.

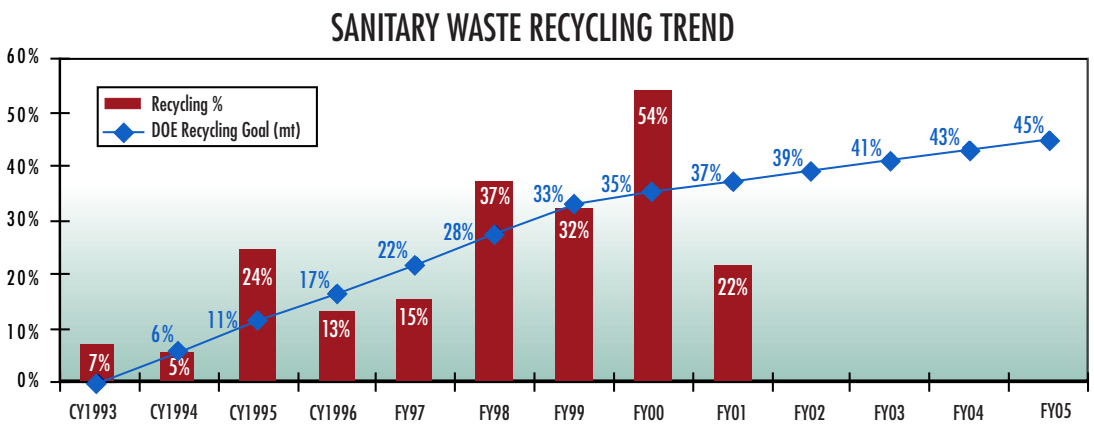
Routine Sanitary Wastes



Thanks to a state-of-the-art recycling and solid-waste transfer facility, Sandia has already achieved the DOE goal of limiting the generation of routine sanitary waste to 5600 metric tons by FY 2001. This goal further targets a 75 percent reduction between 1993 and FY 2005. Sandia's 2001 performance of less than 3400 metric tons is on track for an eventual 85 percent reduction. Sanitary wastes include office-generated wastes and packaging collected through a system of trash receptacles. Food wastes are handled separately, but are included as sanitary wastes.

Waste/Recycling Trends

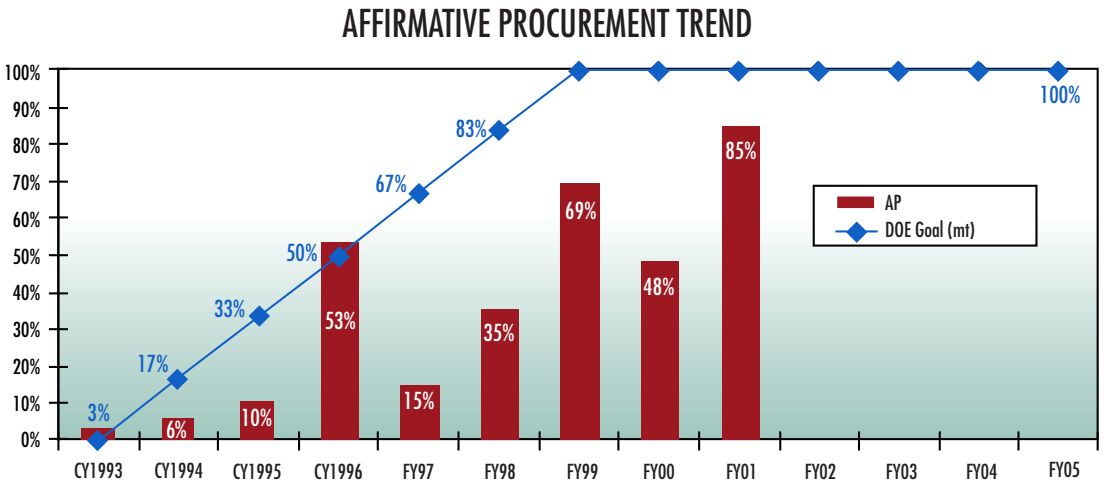
Recycling Progress



Recycling Trend. Significant fluctuations in success rates for recycling reflect Sandia's ability to recycle construction debris in any given year.

Sandia has nearly reached the halfway mark in programs to recycle and divert more waste, and, in so doing, has significantly reduced the amount of materials that must actually go to landfills or other authorized disposal sites. Both Sandia and the DOE are aiming for a goal of recycling 45 percent of sanitary waste by FY 2005. For 2001, the Labs has achieved a 22 percent recycling rate. Recycling includes paper, cardboard, aluminum cans, plastic bottles, construction debris (including concrete), and oil products.

Affirmative Procurement

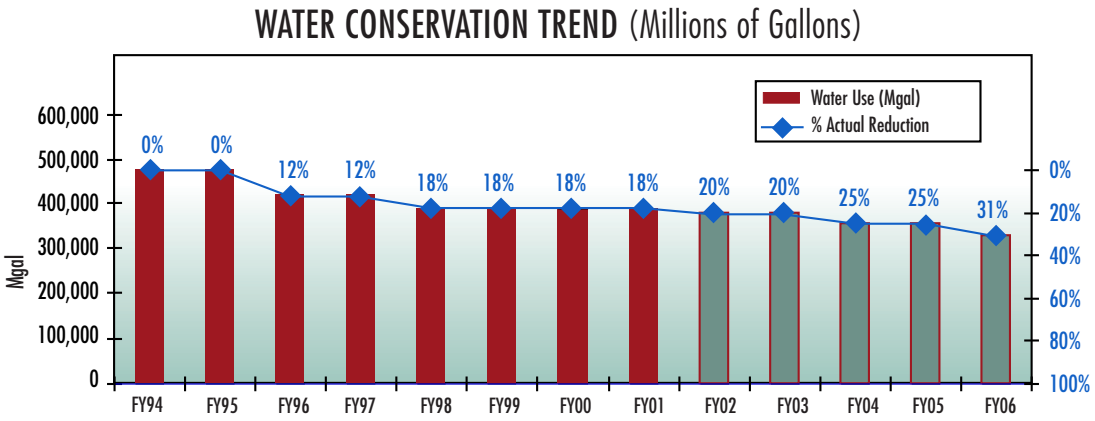


Yet another way of "thinking green" at Sandia involves reaching the DOE goal of 100 percent in the purchase of Environmental Protection Agency-(EPA) designated items containing recovered or recycled content. At Sandia this is known as the Affirmative Procurement program. EPA-designated items are recommended for use at the Labs unless they are not available at reasonable prices or do not meet Sandia's performance standards. From a designated items purchase rate of three percent in FY 1993, Sandia has gone on to achieve an 85 percent purchase rate in FY 2001—the best year yet for the purchasing program.

Items in the EPA-designated category include office supplies such as paper and plastic desktop accessories, cartridges for computer printers, rerefined oil, retreaded tires, and building materials such as concrete with fly ash, insulation, and carpet with recycled content. Much of the success of affirmative procurement at the Labs depends on the efforts of Sandia's secretarial and administrative assistant corps, which arranges many office purchases, and construction project managers, who influence the purchase of materials.

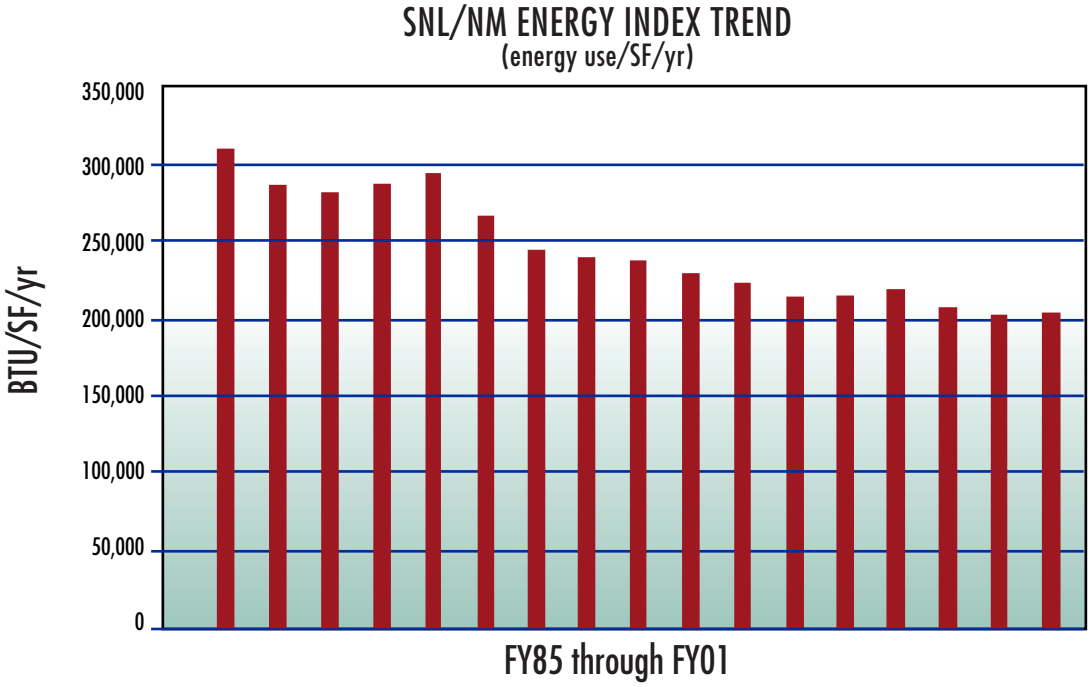
Waste/Recycling Trends

Water Conservation



To meet the Labs' own goal, Sandia must reduce 1995 levels of water use at its New Mexico facilities by 30 percent by FY 2004. Conservation measures during recent years helped achieve an 18.3 percent cut in usage, which, although significant, is only slightly more than half of the needed savings. Success in water conservation has involved a steady effort to convert many facilities to water-wise use, such as converting systems from once-through cooling to multiple-pass cooling loops, the reuse of process water, and a concerted effort to make cooling towers more efficient.

Energy Conservation Trends



By replacing some of its older buildings with new, energy efficient ones in the last 10 to15 years, Sandia has steadily reduced its energy use index, or energy use per square foot of building space. This chart shows the trend — the needed amount of energy, or energy intensity, per square foot of building space, has decreased in recent years. Improvements have been made to nearly all energy-using systems. These efficiency improvements have been complemented by expanding the extent of controls, using microprocessor and occupancy sensor technologies, to ensure that lighting, heating and cooling are shut off after hours. Significant retrofits have been made to Sandia's steam plant, to many chilled water plants, and to outdated lighting systems, for additional reductions. Sandia has goals to further reduce its energy use index by 35 percent in 2005 and by 40 percent in 2010, when compared to the 1985 baseline set by DOE.

Waste Management: Overview

Sandia collects office paper, sorts and bales it. Paper pictured here is recycled into tissue products.

As Sandia steadily reduces its volume of legacy wastes, the Labs continues to excel in managing both hazardous and radioactive waste operations in a complex laboratory setting where many toxic and radioactive materials must be handled routinely and safely, and disposed of properly.

Waste management is conducted at three primary facilities, where efforts focus on safe, efficient, and cost-effective waste management. These facilities are

- The Hazardous Waste Management Facility (toxic chemical wastes)
- The Radioactive and Mixed Waste Management Facility (radioactive low-level wastes, and wastes with radioactive and toxic components)
- The Solid Waste Transfer Facility (office wastes and a variety of recycling efforts).

Employees at Sandia's Hazardous Waste Management Facility are responsible for nonradioactive, nonexplosive hazardous chemical wastes. In 2000, the Facility collected, catalogued, and disposed of 12,233 individual chemical waste items—bottles and small bags of chemicals, lamp bulbs, asbestos, biohazardous wastes, and polychlorinated biphenyls (PCBs). Federal laws specify the handling of various hazardous chemicals. Typically, these laws call for a cradle-to-grave approach that dictates the procedures to be followed in production, handling, storage, recording, and disposal.

More than 3.1 million pounds of chemicals were characterized, packaged, and shipped from the Hazardous Waste Management Facility in FY 2001. The table below shows some of the main categories under which these chemicals were classified:

Category	Weight (pounds)
Hazardous waste	146,700
Asbestos	149,960
PCB	27,040
Biohazardous waste	698
Other recycled and chemical waste	2,786,020

The Solid Waste Transfer Facility accepts nonhazardous solid wastes from sources laboratory-wide. This waste is screened, compacted, baled, and stored for shipment to local area landfills. During the screening, workers pull many recyclable materials out of the waste stream. During 2000, the facility handled nearly 2.6 million pounds of solid waste and recycled more than 1.6 million pounds of paper and cardboard.

The Radioactive and Mixed Waste Management Facility handles low-level radioactive wastes, mixed waste, transuranic waste, and mixed waste with transuranic constituents. The table below shows wastes managed at the Facility in 2001:

Although most of the waste now being generated at the Labs is collected, categorized, packed, and shipped for disposal, this has not always been the practice. In the past, when disposal options did not exist, as was the case with some radioactive wastes, the wastes were stockpiled. Such wastes are called legacy wastes. Sandia currently is developing disposal paths or identifying treatment processes that will render the waste disposable. The Labs' goal is to complete disposal of all legacy wastes by 2004, which will meet a commitment Sandia made to the Department of Energy (DOE) in 1998. In 2000, Sandia's waste management organization exceeded goals and expectations for treatment and disposal of legacy waste for the fifth consecutive year. This achievement surpassed the DOE standard.

Category	Managed* (pounds)
Low Level Waste	1,304,141
Mixed Waste	217,921
Transuranic Waste	57,249

*Total inventory, including waste managed and stored.

Hazardous wastes from Sandia prepared for shipment to an offsite permitted disposal facility.

New Life for Old Brooms

Supervisors in Sandia Custodial Services had broom trouble. A pile of 200 broken push broom handles had accumulated, and they didn't feel comfortable about sending wood to a landfill when it could be used for something more productive. Sandia Manager Jim Kadlec met with Waste Management and Pollution Prevention personnel to help to find a way to extend the useful life of the brooms. The staff contacted an Albuquerque company, Soil-utions. Soil-lutions accepts wooden handles and grinds them into compost, mulch, and soil amendments. While batches of mop and broom handles go back to the earth, the Custodial Services supervisory team is looking into more durable alternatives.

Left to Right: Jim Kadlec, Lavone Cobb, Charles Hollis, Mary Wolf, and Ron Maes

Innovation: The Key to Success

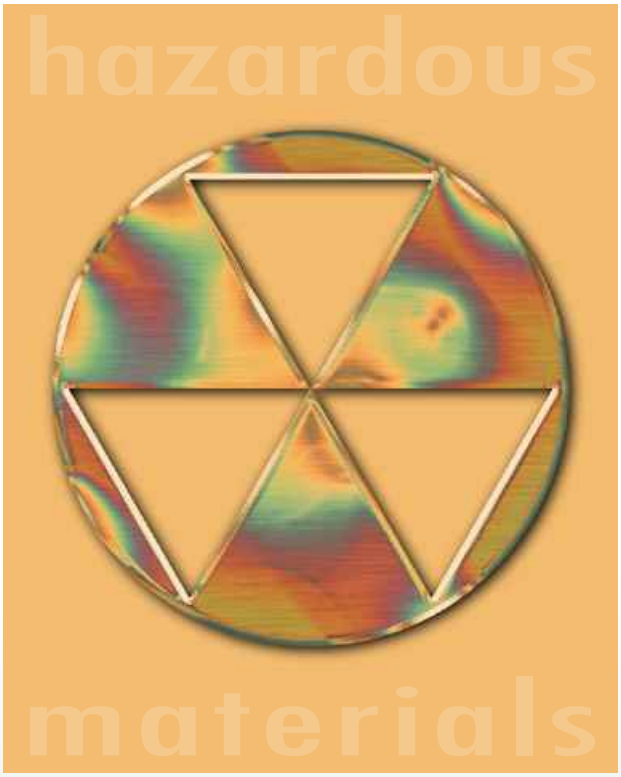
In Sandia's Waste Management Program, innovation is often the key to success. During the past year, Sandia's Waste Management group applied creative measures in dealing with one waste stream and, as a result, reduced the Labs' historic or "legacy" waste accumulations dramatically.

Legacy wastes at Sandia originated during a time in the Labs' history when waste was stockpiled or put into landfills or other onsite repositories. By the early nineties, Sandia was beginning to address waste problems as they arose, and was developing a state-of-the-art system for dealing with all operational wastes. The Waste Management group also began to work toward a solution to the problem of its legacy wastes.

Like day-to-day wastes from present operations, legacy wastes include radioactive and hazardous wastes from many different laboratories and tests, solid wastes from offices, and other wastes in a variety of combinations. In earlier days, no known treatment plan existed for some of the wastes. So, waste management was not only a matter of safely handling, storing, packaging, and shipping wastes for authorized disposal, but also a research operation to determine possible treatments for unusual kinds of waste.

One of the largest waste streams in Sandia's history is 250 barrels of septage recovered from septic tanks in remote areas across Kirtland Air Force Base. In the early nineties, these areas were either connected to the city sewer system or shut down. But the remaining tanks still needed to be cleaned up. Sandia's Environmental Restoration (ER) Project investigated the sites, performed interviews with knowledgeable employees, and sampled the septic waste to determine its contents. At several sites, the ER group found that hazardous materials and radioactive materials had been poured down drains. The materials' presence was detected during testing.

These hazardous material combinations, which typically consist of spent solvents and low-level radioactive materials, resulted in a category called *mixed wastes*. In 1994 and



1995, the ER group pumped the contents of these septic tanks into drums and rinsed out the tanks with water, which they also put into drums. All drums were then transferred to Sandia's Waste Management group, and stored in a 4000-square-foot building pending final disposition. But storage became problematic, recalled Phyllis Peterson, a Sandian who helped treat the wastes. Some of the barrels generated hydrogen sulfide, odors, and explosive methane gas. Despite a ventilation system in the storage building, concerns were raised regarding potential health hazards to nearby workers.

During the latter part of the nineties, waste management staff investigated several disposal options, but each proved unsuitable for the septage. Then, in 2000, an innovative solution was found in the Labs' Radioactive and Mixed Waste Management facility by Sandian Jeff Jarry. Jeff negotiated an unusual arrangement with an Environmental Protection Agency-approved commercial energy recovery boiler facility near Kingston, Tennessee. The Kingston facility wanted liquids to use in place of water during their sludge treatment process. Sandia needed to dispose of hazardous wastes. So, Sandia strained the septage through a mesh and transported the liquids, as well as the dissolved solids that remained in the liquids, to Tennessee in a tanker.

Phyllis Peterson developed the plan for straining the septage barrels, with assistance from industrial hygiene, site safety personnel and radiation control technicians. The team accomplished their difficult task without safety or health hazards.

In Tennessee the Sandia septage was combined with the Kingston facility's radioactive wastes, to get an appropriate slurry consistency, required for boiler treatment. In this way, the Sandia staff was able to reduce the volume of its sludge inventory to twenty-five barrels. The shipments freed the New Mexico storage site for other wastes. Sandia reduced its inventory of legacy mixed-waste inventory by 45 cubic meters with the shipments.

The remaining twenty-five drums of sludge are now being tested to see if they meet the treatment standards of a disposal facility in Oak Ridge, Tennessee. If they are in compliance, Sandia's waste management team anticipates shipping the barrels for disposal during 2002, bringing to an end a troublesome waste stream.

Environmental Restoration: Overview of Success

Environmental Restoration worker gathers a soil sample.

Sandia's Environmental Restoration (ER) Project has completed another successful year, including progress on two major excavation projects, several dozen smaller site cleanups, and a first step toward a long-term environmental stewardship plan.

Sandia has cleaned up or progressed toward the closure of more than 90 percent of the 203 environmental sites identified in the eighties, said project manager Fran Nimick. Major efforts are under way to complete most of the remaining work on two large landfills and other projects, and cleanup of the last of the sites is expected within the next few years. As a result, the ER staff, which at the height of the project numbered 150, is beginning to shrink in size.

"The ultimate measure is when these sites move off our state permit, that is, when the decision-makers tell us no further actions are needed," said Dick Fate, ER manager for project closure and environmental stewardship. "If you look across the DOE complex, you'll find few sites at this advanced stage."

Sandia, Department of Energy (DOE), and Environmental Protection Agency (EPA) officials first defined the ER Project in 1988, and the road has been long.

"In its early stage, the cleanup process was, as is prescribed by regulations, heavy on study and planning," explained former project manager Warren Cox. "The result was a large amount of paper but little cleanup."

By 1994, Sandia and other DOE sites were being chastised by Congress for spending money but not cleaning up, Warren said.

Sandia responded to concerns by working with the New Mexico Environment Department (NMED), EPA regulators, and the DOE to streamline the clean-up process. This liaison enabled cleanup work to progress more quickly without sacrificing the ultimate authority of the regulators. "We took a cue from those jogging shoe ads," said Dick. "'Just do it.'"

The new process developed by the ER Project staff proved to have a number of benefits: It cut projected costs in half, shortened the schedule, and made the project more flexible. The streamlined process also involved the regulators more closely in the joint working relationship.

Groundwater Threat

Cause for environmental concern emerged early in the project when groundwater contamination was discovered at three Sandia sites. After Sandia reported the discovery, local groups expressed concern that the contamination might threaten the city's principal drinking water source.

"We found TCE (a common solvent and suspected cancer-causing agent) in groundwater at our chemical waste landfill in Technical Area 3 and, later, in a monitoring well in Technical Area 5," said David Miller, manager for landfills and test areas. Low levels of TCE also were discovered in monitoring wells near Technical Area 2. The project has tackled this challenge aggressively, drilling several dozen monitoring wells, including twenty-three wells around Technical Areas 1 and 2, the Tijeras Arroyo Groundwater area.

At the chemical waste landfill, a vapor extraction project vacuumed toxic vapors out of the soil above the water table, and captured them. "The result proved that the transport mechanism for the solvent was clearly vapor, not liquid," said David. The recently completed excavation of all debris

Sandia's chemical waste landfill as it looked in the 1960s.

from the landfill has removed any significant remaining source of TCE and is expected to prevent a recurrence of the problem, he added. Long-term site monitoring under the Environmental Stewardship Program will confirm that the groundwater remains uncontaminated.

Investigators at the Technical Area 5 site have determined the likely source of the solvents, and work is under way to evaluate remedies. Tijeras Arroyo investigators are watching monitoring data closely. Very low levels of solvent appear to be captured in a shallow zone about three hundred feet below the surface and not in the deeper drinking-water zone. Sandia continues to work with city, county, and Air Force investigators on this problem. "We have to consider the possibility of multiple sources of solvent, including some that are not Sandia sources," David said.

Moving Ahead

With the development of a streamlined negotiation process with regulators and the cleanup of a number of locations, including past test sites with scattered debris, spill sites, and landfills, the ER Project leaped ahead of schedule in the late nineties. After project staff completed excavation of a radioactive waste landfill in 1996, they turned to a nearby classified waste landfill the following year. A multi-year excavation, the classified landfill project encompasses the spectrum of ER activities, including security, reapplication, waste minimization, and waste disposal. Although excavation was completed early in 2000, sorting and disposal of recovered items is likely to continue for some time, said task leader Bob Galloway.

This summer, Sandia completed a two-and-a-half-year excavation of the chemical waste landfill to a depth of twelve feet. "We put in 150,000 staff hours on this project without a serious injury," task leader Sharissa Young reported.

Excavated from Sandia's classified waste landfill in 1998, this bomb casing is now housed in an Air Force museum.

The excavation of the 1.9-acre site began carefully, and took a labor-intensive approach. "We let the guys in the field suggest a lot of process improvements, and that allowed us to take a much faster, safer approach," Sharissa explained.

The landfill was Sandia's main disposal location for laboratory-generated wastes from 1962 until 1985. Excavating the landfill involved the recovery of two thousand intact chemical containers, many with unknown contents; 350 corroded, banged-up compressed-gas cylinders; nine hundred thermal batteries; aging munitions components; hundreds of cubic yards of scrap metal, wood, paper, concrete, and plastics; and nearly one thousand cubic yards of rocks. Some of the 43,000 cubic yards of soil recovered and all of the rocks will go back into the landfill, Sharissa explained. Sandia will treat and dispose of about 25,000 cubic yards of soil that has been stained with chemicals and other contaminants.

All chemical waste landfill workers were specially trained and were equipped with Level B protective equipment, which includes synthetic coveralls, hardhats, safety glasses, and self-contained breathing systems, as well as other safety equipment. Chemical monitoring and radiation-detecting instruments were part of the safety array.

"Since the ER Project's first remediation activity in 1994, several hundred thousand staff hours have been spent dealing with radioactive, explosive, and other hazardous materials," said Paul Freshour, deputy project manager. "The health and safety of site workers is always our top priority. Our safety record to date is exemplary. We have not had a single significant injury in more than eight years of work."

A nearby monitored storage, treatment, and containment facility for wastes derived from the chemical waste landfill is another example of ER innovation. The facility, which is called a corrective action management unit (CAMU), is expected to reduce waste disposal costs by as much as $10 million, depending on final volumes.

Aerial view of Sandia's CAMU facility, for storage, treatment, and permanent containment of wastes from Sandia's Chemical Waste Landfill.

Small-Scale Efforts

While these important projects continue, other staff members are also busy addressing some of the smaller ER sites. These include firing sites in the Coyote Test Field south of Technical Area-3; testing sites in the Canyons area of the Manzanita Mountains on the eastern side of Kirtland Air Force Base; and a wide-spread variety of sites used as dumps, staging areas, or for experiments. Firing sites encompass a variety of locales where objects were detonated or impacted to help Sandia researchers understand weapons-related safety issues or to better understand material properties. Typical contaminants at these sites can include explosives residues, depleted uranium fragments, metals, oils, solvents, and unexploded ordnance.

During 2001, the project presented thirty sites for the "No Further Action" designation, which removes them from the list of active ER sites. The list, which is part of Sandia's permit with the NMED, is the official scorecard for the project, spelling out the environmental sites identified and the number needing no additional cleanup.

A group of citizens and several representatives from local and state government took the lead in commenting on these sites for the community. Several of the citizens were past members of the DOE/Sandia Citizens Advisory Board. They served as advisers to the ER Project from 1994 to 2000.

"We looked at the proposals site by site, and addressed all the questions, concerns, and input," said Craig Richards, who served as chair of the Sites Review group. "We challenged each other on issues and got help from Sandia's staff on our questions. We learned a lot about the sites we tracked."

The citizens established one clear goal in recommending that the thirty sites be removed from the active list: Build an adequate long-term environmental stewardship program capable of protecting the community far into the future. "Our expectation is that the Long-Term Environmental Stewardship Program will be an enduring process that ensures current and projected land uses occur as planned," the citizens group wrote in its action recommendation letter.

Giving Old Tools to Schools

Jaci Hernandez

When Sandia's Radiological Protection and Laboratory Services Department upgraded its equipment, an expensive but outdated liquid scintillation counter was declared excess. Sandian Jaci Hernandez realized this equipment could serve as a valuable teaching tool. Finding her way through a maze of regulations, she arranged for the equipment to be donated to the Technical Vocational Institute's Radiological Control Technician Program.

Long-Term Environmental Stewardship

Sandia's Franz Lauffer makes a point to Paul Catacosinos, interested citizen, at a meeting on Long Term Environmental Stewardship.

What happens to Sandia's environmental sites after they are closed? Will they be safe? Will someone be around to maintain the covers or other barriers that may have been put in place? Will the sites be posted, fenced, and monitored for possible contaminants? What if Kirtland Air Force Base is transferred to the private sector—who will know where the sites are, or what dangers they may hold for future generations?

These are the kinds of questions dozens of Albuquerque citizens, representatives of local and state government, tribal authorities, federal agency personnel, and other stakeholders have been discussing with Sandia for more than two years. These issues of long-term environmental stewardship present challenges for planners and interested citizens.

Three volunteer task groups studied various aspects of environmental stewardship during an eighteen-month period that ended in 2001. Each of the groups wrote recommendations to the Department of Energy (DOE) and Sandia on important aspects of a long-term plan. Based on these recommendations, the DOE and Sandia created the first draft of a plan in late 2001.

"The plan is just a first step," said Dick Fate, manager of Sandia's closure and environmental stewardship department. "Our approach is to continue to improve on the plan, and to answer the questions that come up as we move toward project closure," he said.

Sandia and the DOE welcome public comment and public involvement in the development of the plan, Dick said. Copies of the document are available at the DOE's Community Resources and Information Office, 8338B Comanche Road NE, Albuquerque, (505) 294-5514.

Green Zia Award: Commitment to Environmental Excellence

Workers at a Sandia environmental site wearing washable protective clothing.

The State of New Mexico has awarded a Green Zia to Sandia for its efforts to recycle and reuse materials, and to reduce the impact of Labs' operations on the environment through the Environmental Restoration (ER) Project. The Green Zia Award was made to Sandia for 2001 by Governor Gary Johnson, who praised the ER Project for its commitment to environmental excellence.

Since 1997, Sandia's Pollution Prevention and ER staffs have conducted assessments to identify pollution prevention opportunities. The staffs also are investigating ways to minimize the generation of all pollutants, including contaminants in soil, air, and water, and to cut consumption of raw materials, water, and energy. To date, Sandia has identified waste reduction opportunities in more than twenty areas. The total potential savings is six hundred cubic meters and more than a million dollars. Among the projects Sandia identified were

- Application of segmented gate system (SGS) technology to soil separation for radioactively contaminated soils. SGS is a commercial technology that uses detectors to separate clean and contaminated soils and material on conveyors. The new technology potentially reduces contaminated soil volume by 95 percent.
- Substitution of washable coveralls and reusable boots for disposable items. This method has eliminated about 5900 pounds of waste, and is saving Sandia more than $30,000 annually in disposal costs.
- Various recycling activities, including:
  - Segregation and screening in the field for radiological contamination of metals. Clean metals are sold either to a smelter or to a metal recycler.
  - Selling cleaned circuit boards to recyclers.
  - Segregating clean concrete in the field for use by Kirtland Air Force Base as landfill stabilization or crushed road-base material.
  - Recycling nickel/cadmium and lead/acid batteries from routine operations or from excavations, through Sandia's Hazardous Waste Management Facility.

Sandia's Classified Waste Landfill remediation provides an example of the ER project's recycling accomplishments. All recovered objects were inspected to determine their security status. Objects of special historical significance were transferred to museums. Other items were recycled after being rendered useless for military applications. As this remediation work approaches completion, estimates indicate Sandia has achieved waste reductions of up to 80 percent.

The ER Project has reduced the overall mass of waste generated by more than 30 percent, far exceeding the Department of Energy's current goal of 10 percent.

Environmental Technologies: Subsurface Reactive Barriers

Brian Dwyer points out a feature of the high pressure reactive barrier injection tool he designed.

Groundwater contamination at old, unlined hazardous waste sites is a familiar story around the United States. But now, Sandian Brian Dwyer has a solution. Brian, who has an extensive knowledge about subsurface barriers, has found an innovative way to create zones in the ground that function as natural passive reactors to clean up solvents, metals, and radioactive compounds.

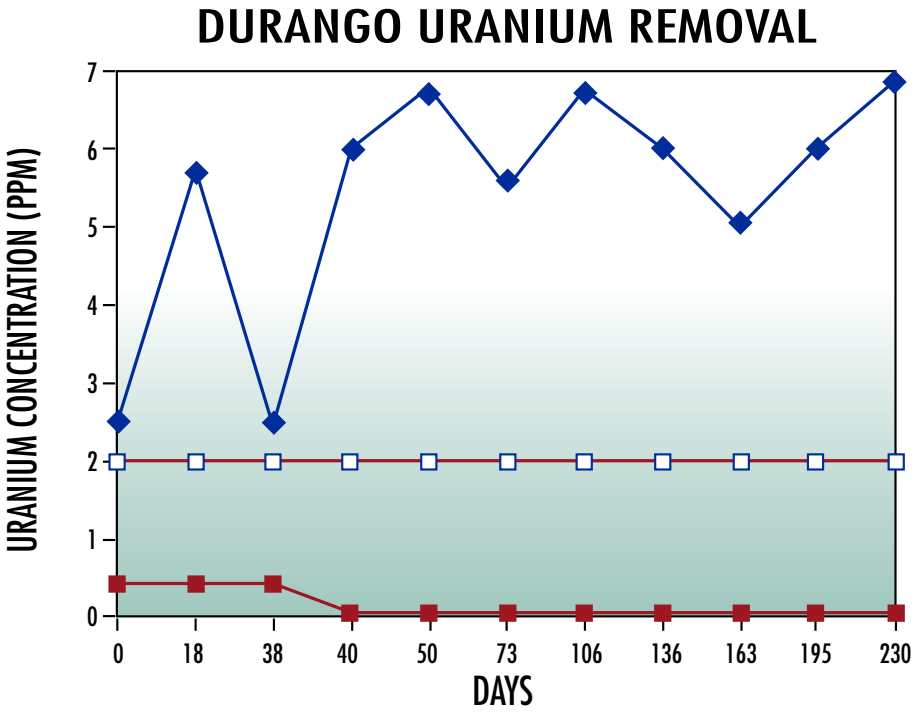
With the help of others within the Department of Energy (DOE), Brian already has demonstrated two subsurface passive reactors in Colorado. He also has completed pilot laboratory studies of how various media might work inside those reactors. Now, he is ready to go deeper—as much as 250 feet deeper—with a new drill bit arrangement designed to use jet grouting techniques at depths never before thought possible.

Brian first applied the passive in situ concept in 1996 to remediate drainage water at a uranium mill tailings repository near Durango, Colorado. When workers created a treatment pond below the site to capture water seeping through the tailings, Brian proposed a project to test four passive treatment approaches. He envisioned that if he designed the plumbing carefully, the site could be organized so that clean water could be released into a nearby dry arroyo. Water not adequately treated by the reactors could be returned to the treatment pond.

"A system based on this design is now operational," Brian said.

Site operators and regulators are pleased with the way the passive reactors clean up the seepage. The system removes a number of contaminants, including uranium, selenium, and molybdenum, and conditions the water so that it meets strict Colorado Public Health and Environment Department standards and can be returned to the natural stream system.

Brian's design for the passive treatment system involves several layers that control the flow of the runoff through the unit. One layer includes a reactive medium that chemically alters the drainage, capturing contaminants. Brian tested zero-valent iron, rolls of steel wool, and other materials as the reactive matrix for the four reactive zones at the Durango site. The design allowed the contaminated runoff to flow through the structures and react with the permeable media. The runoff was then tested for remaining contamination.



The red line at the right shows how actual concentrations of uranium dropped to near zero parts per million (PPM) after 40 days of treatment at a project near Durango, Colorado. Blue line shows original concentrations, all above Colorado standard (white and red line.)

At the DOE's Rocky Flats plant outside of Denver, Brian found a variation on the problem that exists at Durango. An old, contaminated site was leaching uranium, plutonium, and americium into nearby Walnut Creek. After lab-scale testing with iron filings, iron-silica foam, and other media to determine the reaction times needed, Brian suggested installing a subsurface reactor.

The Rocky Flats treatment system, which is completely passive in nature, is composed of a subsurface dam of interlocking high-density polyethylene that captures the runoff in a gravel layer and transfers it via gravity flow into a subsurface reactor. Early data showed the treatment successfully brought contaminant levels to concentrations deemed safe by regulators. Rocky Flats environmental personnel have since installed two additional systems modeled after the Walnut Creek design.

Several other successful treatment installations have followed the Colorado projects. At most sites, however, problems can only be solved by moving the passive reactor deeper into the subsurface. Among the remaining technical issues are determination of the most effective media from both cost and operations perspectives, and methods for placing barriers dry reactive media deeper into the subsurface.

Brian has designed a high-pressure reactive barrier injection tool that can be used to create the barrier walls for the subsurface reactors. The tool utilizes jet grouting technology, a percussion hammer, and an innovative method using air to deliver dry reactive media deeper into the subsurface. Brian already has tested the new tool above ground and is preparing now to check its subsurface performance.

Aerial photograph of Sandia's Alternative Landfill Cover Design Project south of Albuquerque, NM. Thousands interested in landfill design have toured the site.

Environmental Technologies:

Alternative Landfill Cover Demonstration

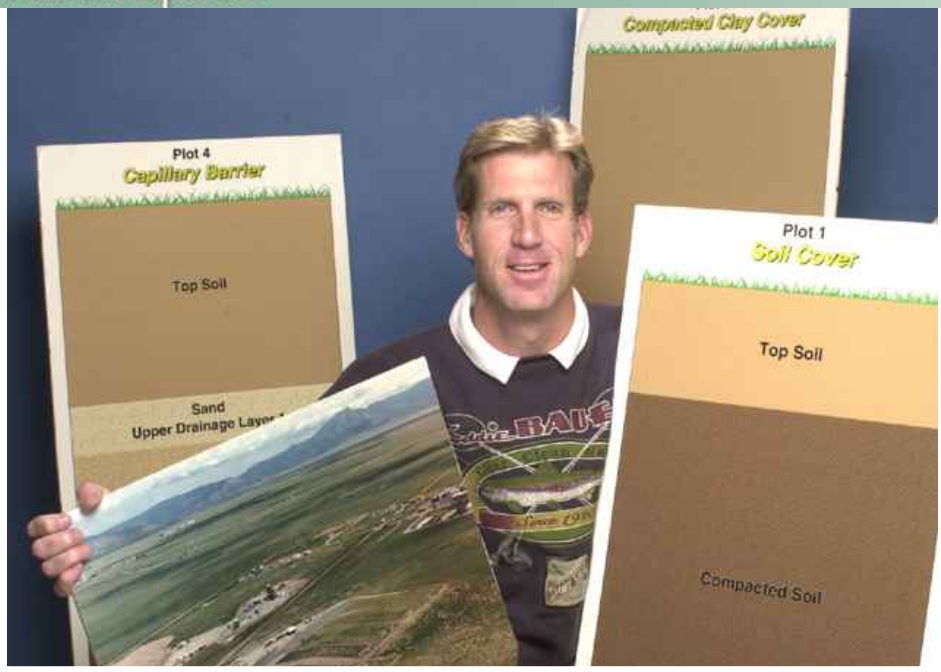
Real-world design and testing of landfill covers, a large-scale Sandia project that has started the United States down a path toward new cover regulations, has moved into its final phase at Kirtland Air Force Base south of Albuquerque.

The research project also is providing valuable data for engineers in many other nations, and attracting a steady stream of visitors to the Labs. "I've probably given one thousand tours at the demonstration site, to visitors from Israel, Australia, Argentina, Canada, Mexico, Russia, and several European nations," said principal investigator Stephen Dwyer.

Results of an EPA study conducted prior to the demonstration identified problems at 146 of 163 randomly selected covers. Sandia's demonstration project, which is officially called the Alternative Landfill Cover Demonstration Project, addressed the problem of improving current landfill cover technologies by providing useful engineering data that could be applied to accomplish needed improvements.

Sandia's project first began to draw widespread attention six years ago, after it received an endorsement from the U.S. Western Governor's Association. Regulators from every state, Environmental Protection Agency (EPA) officials from all nine regions, representatives of the Navajo Nation and other Southwest pueblos, and many city and state engineers, researchers, and designers began coming to Sandia's Technical Area 3 on Kirtland Air Force Base to see the state-of-the-art landfill covers.

The demonstration involves the side-by-side construction of two conventional and four alternative cover designs, all of uniform size. The project was designed to evaluate the various cover designs for water balance performance, ease and reliability of construction, and cost. "We were not trying to showcase



Steve Dwyer among several columns illustrating the materials make-up of some of the landfill covers currently under investigation at Sandia's Alternative Landfill Cover Design Project.

a single technology," Steve said.

Seen from the air, the demonstration plot looks like a series of stripes on the high desert. The plots are monitored with sensors and other sophisticated instrumentation, and have now yielded four years of comparative data. Sprinklers cover half of each of the six cover types, helping to create a slightly more humid environment, so researchers also can understand performance in both arid and semiarid climates.

The numbers show that the new cover technologies, particularly the simpler ones, are often the most cost-effective. Failures drive up costs because of the need for expensive cleanup efforts. Information gathered on the project is helping designers of both municipal-type landfills and landfills containing hazardous materials.

"The key is that we have real field data that design engineers can use when they apply to regulators for permission to construct an alternative cover. Regulators are accepting our data," Steve said.

Covers based on the demonstration site are already being deployed nationally and internationally. The information has also led the EPA to revise guidance documentation on landfill covers. Steve was one of four authors of the new documentation.

"Technologies that we tested, and the data on them, are included in the guidance," he said. "The research has shown that significantly less expensive cover designs can perform as well as more expensive ones in arid and semi-arid environments. In some cases, this can mean a reduction in cover installation costs from $15 per square foot to about $8 per square foot -- representing a potential savings of $5 - $15 billion in the DOE complex alone."

One of the features that led to the widespread success of the demonstration was the early involvement of regulators, engineers, politicians, and environmental activists. The demonstration's conceptual design, individual cover profile designs, construction, and data collection were made available to these stakeholders, Steve said.

"The public is very accepting of this project because they feel it is not biased and is technically sound," Steve said. Reviews by organizations like the National Academy of Sciences, American Society of Mechanical Engineers, and the Department of Energy further support this viewpoint.

WasteWise 2001 Award

The Environmental Protection Agency (EPA) has named Sandia "WasteWise Federal Government Partner of the Year" for 2001. Al West, director of Sandia's Integrated Safety and Security Center, accepted the award on behalf of Sandia in ceremonies held in Washington, D.C. Mike Shapiro, principal deputy assistant administrator of the EPA's Office of Solid Wastes, presented the award.

WasteWise is a voluntary EPA program aimed at reducing costly solid waste streams. Any organization or business in the United States may join. WasteWise encompasses a number of categories for different types of organizations. The EPA makes one award in each category.

Sandia's award submission highlighted the Labs' efforts in sustainable design, construction, and demolition waste recycling, as well as in other waste reduction activities. "The objective is to save an organization money through reduced purchasing and waste disposal costs," Shapiro explained.

Al West,(right) accepting "WasteWise 2001" award from Mike Shapiro in Washington D.C.

Pollution Prevention: Build Green

Sandia architects, engineers, and construction personnel are working to integrate an initiative known as sustainable design into new and renovated facilities. Four new projects at Sandia (one completed, one under construction, and two in planning phases) illustrate the Labs' commitment to "building green."

These efforts incorporate the many values of sustainable design, including renewable resources, energy efficiency, water conservation, reduced environmental impact, and indoor environmental quality. The ultimate goal is healthful, productive work environments that use building resources wisely and serve as models for other Department of Energy (DOE) sites.

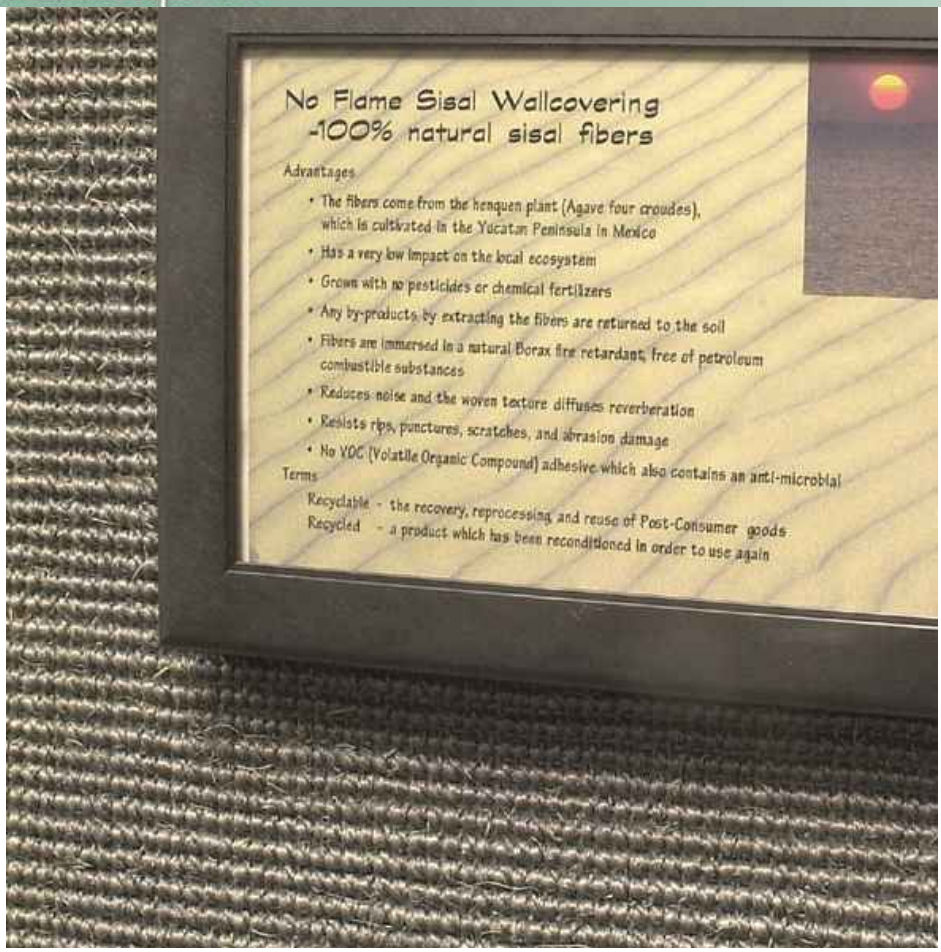
Sandia is using a team approach to achieve sustainable design. The approach addresses the needs of the building occupants, and involves a collaborative effort between a number of programs including energy management, water conservation, pollution prevention, project management, systems engineering, architecture, and inspections. The team is focusing on a whole-building design process, to ensure that the individuals involved in the design, construction, use, and operation of the building all have a voice in assessing and understanding the issues and needs of all parties. Design team members are looking at materials, components, and systems from different perspectives, and working together to find the best solution. Decisions are based on criteria such as workplace quality, costs, future flexibility, efficiency, environmental impact, productivity, and creativity.

As part of this approach, Sandia has already incorporated sustainable design in

- The creation of a "green" conference room
- The renovation of the Model Validation Building
- The establishment of design criteria for the Joint Computational Engineering Laboratory (JCEL), the Microsystems and Engineering Sciences Applications (MESA) complex, and other facilities.

To ensure that sustainable design is routinely included in future construction efforts, Sandia has begun to revise its Construction Specifications and Design Manual to reflect these principles.

David Humble (right), Sandia architect, and Matthew Brito, a graduate student and staff member, used this "green" conference room to demonstrate the effective use of recycled and natural materials.



These natural fiber coverings were used on the conference room walls.

A "Green" Conference Room

Sandia's Weapon System Engineering Building houses a good example of a functioning "green" conference room that was designed and remodeled according to sustainable design principles: The materials selections were based on highly sustainable manufacturing processes, lifecycle costs and durability, recyclability, and impact on human health and the environment.

- The carpet is made from 25 percent reclaimed nylon, and has 100 percent recycled backing. The wear-resistant carpet fibers will reduce waste disposal and replacement costs. The adhesives used to install the carpet use nontoxic chemicals that do not emit harmful vapors.
- Wall covering is 100 percent natural. It is made from organically farmed agave plants that are completely recyclable. The wall covering also provides sufficient noise reduction, and is manufactured in a process which produces compostable by-products.
- Ceiling tiles contain 70 percent recycled materials, and are completely recyclable. They offer excellent acoustical performance and light reflectivity. During the tile manufacturing process, most of the water is reused. Ninety percent of the scrap is recyclable.

The final costs for both the carpet and the recycled wall covering were below those of the standard, less environmentally friendly materials, dispelling the myth that the costs of goods made from recycled materials is higher. The carpet cost 30 to 40 percent less and the wall covering cost 50 percent less than nonrecycled alternatives.

The conference room's energy-efficient lighting system will reduce Sandia's utility costs and contribute toward the Labs' goal of reduced energy consumption. Also in keeping with the lifecycle concept of sustainable design, the old ceiling tiles, light fixtures, and surplus electronic equipment removed during the remodeling are being reused at Sandia or other government facilities.

Model Validation Building

The Model Validation Building is an 18,600-square-foot renovation project currently under construction in the high desert on the edge of Sandia's Technical Area 3. The Sandia "Green Team" was able to include contract requirements for both designers and builders in this project. Consultants and a cross section of project stakeholders brainstormed early in the planning process during a two-day design charrette (a rigorous planning and innovation meeting) that proved invaluable to the sustainable design approach.

The successes achieved through this approach have been substantial. Seventy percent of the basic structure of the original building is being reused in the new building. Sandia is limiting site disturbance in order to preserve more existing vegetation, and will restore vegetation damaged by construction activities. Drought-tolerant native landscaping will further reduce water consumption. Outside lighting will consist of minimum wattage lamps on articulating arms that help direct the lighting at the building, reducing night sky pollution. Other features include:

• Staff amenities. For the convenience of the building's future occupants, carpool and bicycle spaces are being integrated into parking areas and showers will be installed for employees who ride bicycles to work or exercise during the workday.

• Day lighting and energy-efficient lighting. Supplying natural light is known to improve worker morale and productivity. Sensors will dim lights when sufficient daylight is available. The energy efficient lighting system requires no more than one watt per square foot, helping to reduce cooling needs. Other sensors will automatically turn off lights when spaces are unoccupied for a given period.

• Variable frequency drives. The facility's various heating, ventilating and air conditioning (HVAC) system motors will adjust fan and pump speeds to deliver just the amounts needed. In a large office HVAC system, this can reduce motor operating costs by 30 to 60 percent annually.

Energy efficiency measures will provide an estimated 30 percent energy reduction over a conventionally designed building.

Metering will be installed to measure and confirm the projections.

Construction activities in the Model Validation Building are focusing not only on recycling and reusing building materials, but also on utilizing products manufactured in accordance with sustainable practices. Sandia has recycled more than 65 percent (656 tons) of all construction debris including land-clearing debris, fluorescent lamps, concrete masonry block, copper wire, and scrap metals (steel, ferrous, and brass). Additionally, Sandia workers removed more than 200 items such as sinks and hardware from the building, and sent them out for reuse. New construction materials were selected for local availability, ease of renewability, and recyclability. Twenty to 50 percent of the material recovered during renovation will be reused in construction. The facility will have a centrally located recycling center.

Sandia's Facilities Group designed this Model Validation Building with sustainability in mind.

JCEL & MESA

Two large new projects, the 60,000-square-foot Joint Computational Engineering Laboratory (JCEL), and the 377,000-square-foot Microsystems and Engineering Sciences Applications (MESA) complex, both currently in the design stage, are slated to be built in the southeast corner of Sandia's Technical Area 1. Both of these projects relate to Sandia's efforts to develop advanced tools for a science-based weapons stockpile stewardship program, and also have applications in the microelectronics industry.

JCEL activities will focus on high-performance computing techniques for critical weapons surety work. The project will provide space for approximately 175 computer scientists, designers, and analysts, and associated laboratory facilities. As with the Model Validation Project, a charrette was held at the beginning of the design phase. The design team is following an approach that includes whole-building design and lifecycle cost analysis. As the project nears completion, a sustainable design

The 18,600-square-foot Model Validation Building is nearing completion, with a focus on recycling and re-use of building materials.

This artist's conceptual drawing of the MESA project illustrates the broad scope of the effort.

report is tracking the progress of design efforts and decisions.

The JCEL project incorporates sustainable design elements similar to those being used in the Model Validation Building. These include roof rainwater harvesting, retaining storm-water on site for landscape needs, maximizing day-lighting opportunities, and integrating high-efficiency lighting. Builders also are selecting environmentally friendly building materials, and meeting high levels of efficiency for the structure's heating and cooling systems.

The MESA project is a mammoth, multibuilding complex with the primary mission of integrating a variety of microsystems for industrial and weapons applications. The integration will result in higher reliability, lower cost multifunctional components that replace single-function components and provide other efficiencies. This huge complex, which is still in the design phase, is projected to have a $1.9 million annual energy cost and consume up to 220 million gallons of water annually without water conservation measures. Advanced efficiency requirements in the design criteria are expected to reduce energy and water consumption by as much as 30 percent compared to existing Sandia facilities. "Water is scarce in many areas. It's a precious commodity," said Don Cook, director of the MESA Project. "If we can save it here, it can be saved in other microelectronics fabrication plants, which are notorious for high water use. We will not only be good neighbors to the people of Albuquerque, we will contribute to the preservation of the ecology in any areas where a microfabrication plant exists."

The MESA complex is scheduled for construction between 2003 and 2007. Sandia is working to reduce the environmental impact of the construction process. In carrying out these requirements, Sandia is a leader in implementing sustainable designs that lessen the environmental impact of buildings and set an example for other community development projects.

Each of these Sandia projects will be submitted for certification as a "Green Building" by the U.S. Green Building Council.

Waste to Warmth

Sandia was a major sponsor for "Waste to Warmth," an Albuquerque community program sponsored by KOB-TV. In support of the program, Sandia supplied six large recycling containers around the city so that local residents could donate old newspapers for conversion into residential dwelling insulation for more than twenty homes, many of which are entirely uninsulated. Sandia also collected the containers, baled and stored the newspaper, and sent it offsite for processing. In all, 200,000 pounds of newsprint were processed.

Build Green: Thermal Energy Storage

The construction of a thermal energy storage system for Sandia's new Processing and Environmental Technology Laboratory (PETL) in Albuquerque has resulted in significant operational improvements and two energy management awards for the Labs—the 2001 Federal Energy Management Program's "Innovation Award," and the New Mexico Association of Energy Engineers' "Energy Project of the Year Award."

The energy-saving effort involved the integration of a thermal energy storage (TES) system into an existing chilled water plant, which enabled Sandia to avoid the purchase of a new chiller plant, said Ralph Wrons, Sandia facilities energy manager. The system also prompted several modifications to improve the efficiency of the existing chiller. These changes are saving Sandia about $200,000 in annual energy costs, lower peak energy demands, and maintenance.

TES systems are more often associated with shifting energy use from high-peak costs to off-peak costs than with actual energy savings. In Sandia's situation, however, adding a system to an existing chilled water plant obligated Labs' engineers to make numerous efficiency improvements in the plant.

Sandia's Thermal Energy Storage System means chillers at the Microelectronics Development Lab (MDL) work at night and are off during peak times of the day. Ralph Wrons (from left to right); Carl Peterson, Mike Rymarz; and John Garcia are pictured in front of one of the MDL chillers.

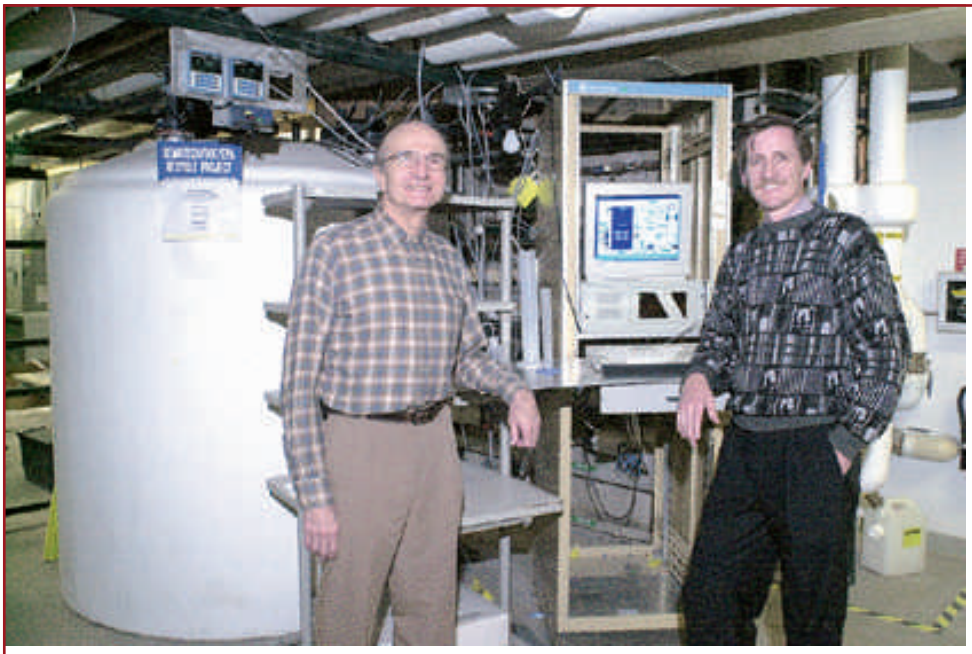
"It was a great opportunity to make advances toward plant optimization and increase energy savings," Ralph explained. "Just as importantly, one improvement that saves about $25,000 each year also restored about 500 tons of chilled water capacity to the plant."

The energy cost savings are earned by producing chilled water at night when electricity rates are low, and also by turning off the chillers during the day, especially during peak hours when rates are higher. Sandia achieves further energy savings by charging the TES system at night when the 1000-horsepower chillers are operating at peak efficiency, rather than during the day. During the summer peak period (1 to 5 p.m. daily), demand is reduced by as much as 1.7 megawatts. In the winter, demand is reduced by as much as 1.2 megawatts—equivalent to the summer and winter peak demands of a 300,000-square-foot office building.

Because workers do not have to maintain the new chillers and towers that otherwise would have been built for PETL, the new procedures also have resulted in slightly reduced maintenance costs. The original payback analysis for the project estimated a four-year recovery time for the extra TES costs ($1.1 million), which was compared with building an additional chiller plant ($900,000). The TES system and related improvements are saving Sandia $200,000 annually, which amounts to payback in the first year of operation.

TES also provided a successful case study for the Department of Energy (DOE). According to a recent national survey, only about one percent of all TES systems in operation are located in federal facilities. "The success of Sandia's system may encourage other DOE sites to use TES systems," Ralph said.

Build Green: Water Efficiency



Sandia's Darell Rogers (right) and Bob Donovan (L&M Technologies) at the control panel for Sandia's Microelectronics Development Lab (MDL) water recycling project.

Using silicon wafer technology, micromachines conserve natural resources because they require less material, power, and lubrication than large machines. But replacing macro parts with micro parts means more water will be needed to carry off fabrication debris created by the increased processing of silicon and other materials.

Sandia's Microsystems and Engineering Sciences Applications (MESA) complex, which is now in the planning phase, will one day soon help an entire industry to conserve valuable freshwater resources by serving as a showcase and leader for water-efficiency technologies.

Sandia's project engineers are incorporating technologies that will give MESA a water consumption rate for its silicon wafer fabrication processes that is 50 percent lower than the current industry standard. Sandian Darell Rogers, a systems project engineer and water conservation officer for MESA, says a variety of possibilities for additional conservation also are under evaluation, such as using reclaimed water for irrigation and other low-end needs.

"It is the dream of Sandia's MESA conservation team to find a way to consume all the water we take in for the industrial processes, resulting in near-zero discharge to the sanitary sewer system," he said.

Recycling, reclaiming, and increasing reverse osmosis (R/O) efficiency techniques are among the technologies expected to keep MESA's water consumption low. Other facilities have applied a variety of these methods, which are defined and described below, but never before have all of them been integrated into one industrial complex.

- Recycling means cleaning water for use on successive wafer runs. Sandia's pilot test plant allows MESA engineers to research methods for recycling selected spent rinse water. The results are promising. Recycling on the MESA project is expected to save thirty to sixty million gallons annually.

- Reclaiming refers to using wastewater rather than fresh water for such purposes as air scrubbers and cooling towers. Sandia began reclaiming wastewater for use in cooling towers at its Microelectronics Development Laboratory in 1998, and has reduced freshwater consumption by twenty million gallons annually through reclamation. MESA's cooling towers will use reclaimed water, saving an estimated twenty million gallons a year.

- Increasing reverse osmosis recovery efficiency can have a huge impact on water use. R/O is the process used to restore water to a highly pure form. In 1996, a separate Sandia project boosted R/O efficiency to 65 percent, which amounted to an annual savings for Sandia of approximately thirty million gallons. At this recovery rate, 1.5 gallons of wellwater produce one gallon of R/O water. MESA planners are aiming to

increase the recovery rate to 90 percent by using a new commercial process. If the new process is successful, the savings at the MESA facility alone could amount to an additional forty million gallons per year.

Some domestic and international chip manufacturers already have experimented with these various common-sense approaches. But widespread adoption of these techniques within industry has been thwarted by anecdotal resistance—bad-luck stories that move swiftly throughout the manufacturing community and give a process a bad name, sometimes unfairly.

One company may decide against recycled water because of fears that it could lead to a higher product failure rate. Another company may have no reluctance about recycling, but will oppose the use of wastewater in cooling towers. In other cases, water is so inexpensive that little incentive exists to recycle for cost reasons alone. Many plants that recycle do so only because local utilities will not allow them an increase in water consumption.

"For someone who has used an automated car wash where the water used on the first car of the day is saved for reuse on the second, third, and maybe even the fourth cars, recycled water can have an unpleasant association. Why would anyone want to use dirty water on their car when well water is available and cheap?" Darell said.

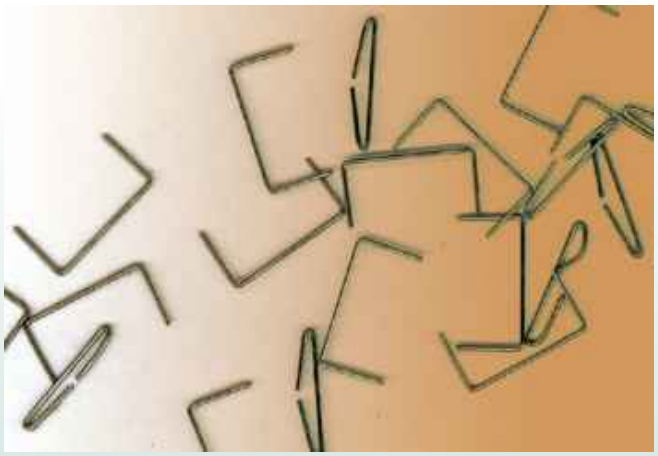
Kraig Kirby (right), Sandia water treatment mechanic, shakes hands with Darell Rogers, Sandia water conservation program manager. Microelectronic cooling tower (background) reclaims 20 million gallons of water annually.

But industry is finding answers to that question as it applies to wafer fabrication facilities. Microchip fabricators are already recycling, and they have discovered that recycling is actually preferable to freshwater consumption because recycled water is, after treatment, better suited to their industrial needs than well water or surface water.

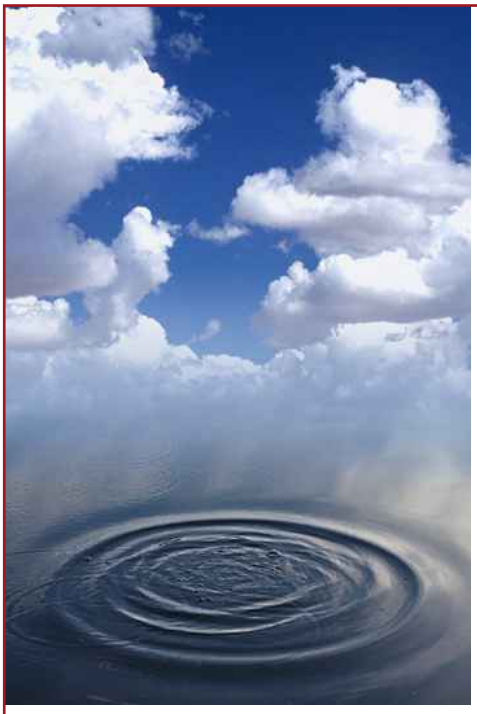
What Sandia aims to demonstrate in the MESA project is that recycling, reclaiming, and high-efficiency recovery all can work together to reduce water use by 50 percent or more. Not only is Sandia going to save water in the New Mexico desert, MESA production processes will demonstrate to fabricators in other states that they can save a substantial amount of fresh water by adopting these methods.

Even Staples Get Recycled

Facility staff member Sandi Manes recycles aluminum cans, all regular copying paper, and file folders. If file folders have writing on them, she turns them inside out for reuse. She also has found a way to recycle used staples: because they are aluminum, she puts them inside the aluminum cans that she donates to her church's recycling program.



Environmental Monitoring: Overview



Albuquerque: Pleasant weather, scenic mountain setting. In a recent survey conducted by the City of Albuquerque, residents cited these two aspects of Albuquerque's natural environment as the things they like most about their city.

As Sandia continues to pursue its mission in the national interest, environmental monitoring and surveillance programs are being put in place to monitor and measure air, water, soil and other aspects of environmental quality. Environmental professionals are studying potential pathways by which contaminants may escape from Sandia operations and impact workers, the community, or the environment. Then, they are putting monitoring and testing stations in place to verify that Labs' activities are not causing harm.

Radiological Emissions

Sandia uses a variety of radioactive materials in association with its weapons work and in other areas. The Labs conducts experiments at a research reactor, and generates radioactivity as a result of other processes, including work with a number of large pulsed power machines. The radiation dose to the community is determined annually through a combination of measurements and calculations.

The average annual radiation dose to any individual anywhere in the United States—caused mostly by natural sources but also coming from some manmade sources—is about 360 millirems. Sandia's most recent determination, as reported in the Labs' Annual Site Environmental Report for 2000, shows that Sandia's operations contribute about one thousandth of a millirem. Sandia's emissions continue to be well below the annual Environmental Protection Agency (EPA) limit of ten millirems.

Nonradiological Air Quality

Five air-monitoring stations are used to measure general air quality around Sandia facilities. They are testing for the existence of a number of chemicals specified by the EPA as harmful. The most recent data, as reported in Sandia's most recent environmental report, show all values to be within the guidelines set by the City of Albuquerque and the EPA.

Weather measurements

Sandia maintains eight fully instrumented meteorological towers on Kirtland Air Force Base. These towers, several of which are as high as sixty meters, measure temperature, wind, humidity, barometric pressure, and rainfall. Sandia's meteorologists use this information to provide data for outdoor testing activities, such as burn tests. They also use the information in models for a better understanding of how a hazardous release might spread from the base in an emergency. These models are tested regularly in simulated emergencies.

Wastewater effluent

Wastewater from Sandia is monitored at four stations before it flows into city sewer lines. An additional station monitors wastewater from the Microelectronics Development Laboratory. All stations monitor acidity level and flow rate twenty-four hours a day. Samples are also taken on a quarterly basis for the city. The city chooses which chemicals or isotopes to test for in these samples. Possibilities include metals, radioactive compounds, and a variety of other inorganic and organic chemicals.

Sandia discharges approximately 800,000 gallons per day to the city sewer. In 2001, the City of Albuquerque presented Sandia with four Gold Awards for the Labs' 100 percent compliance with city requirements. Gold Awards are given for achievements such as source reduction and pollution prevention, and compliance with discharge limits.

In Sandia's Technical Area 5, research reactors have the potential to produce radiologically activated process water. Reactor effluent is channeled to holding tanks that are part of Sandia's liquid effluent control system (LECS) before any of the contents are released to the public sewer system. The LECS is monitored before any discharge to the city, in compliance with regulations.

Stormwater and Surface Runoff

Storm water at Sandia drains from paved streets and parking lots, dirt roads, landscaped areas, and buildings into culverts, channels, arroyos, and some impoundments. These waters may collect vehicle exhaust residues, engine oils, deposits from air pollutants, metals, pesticides, fertilizers, and other potentially harmful components. Sandia controls these discharges by limiting their contact in areas where chemicals, wastes, and oils are stored or handled.

Runoff from a summer thunderstorm is measured and sampled at this station.

Aerial view of the "baffle chute" on Kirtland Air Force Base, where storm water from Sandia and Kirtland flows into the Tijeras Arroyo.

Runoff at all waste-handling facilities is diverted to lined basins, where water can be tested before disposal.

Groundwater Surveillance

Groundwater is found in pore spaces and cracks within rocks and sediments below the surface. Kirtland Air Force Base and the City of Albuquerque use this important resource for drinking water. The water is pumped from deep wells located throughout the Albuquerque Basin. To protect this resource, Sandia collects samples from a network of surveillance wells on the base. These wells, in addition to more than ninety-seven monitoring wells from the Environmental Restoration (ER) Project, Kirtland Air Force Base production and monitoring wells, and others, form a protective system for checking water quality and demonstrating compliance with all regulations.

Groundwater Quality Analyses

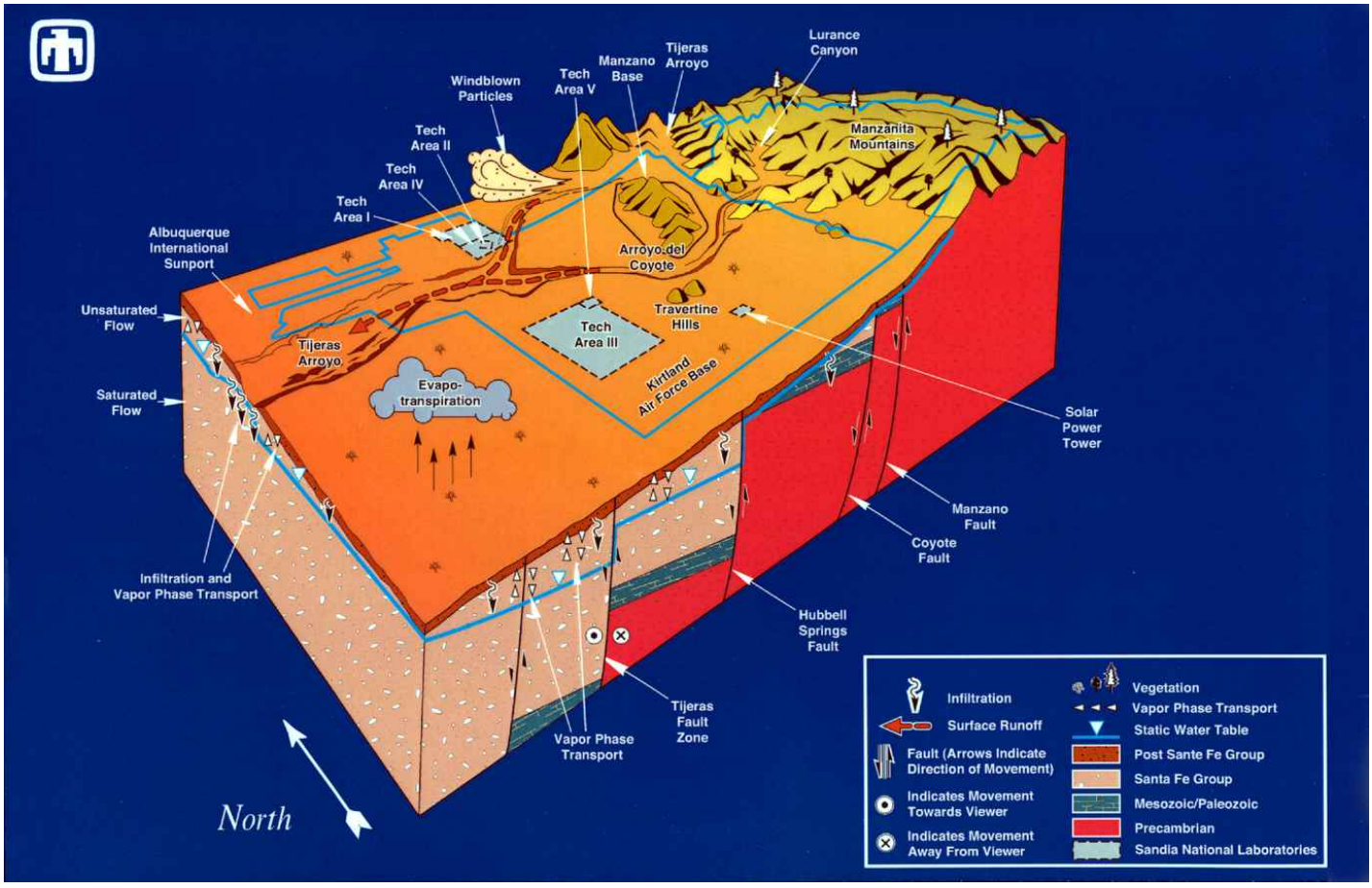
Groundwater quality analyses published in March 2001 in the Annual Groundwater Monitoring Report, showed EPA maximums have not been exceeded for volatile organics, such as solvents and cleaning fluids, or for nonmetallic inorganic compounds. Fluoride and chloride levels in water samples collected at a natural spring in the foothills exceeded EPA-allowable levels; however, these are attributed to natural sources. Cadmium was the only metal detected in the sampling in excess of regulatory limits. Slightly elevated levels of uranium-234 were also detected in groundwater east of the Tijeras Fault complex, where groundwater contacts bedrock that is naturally high in uranium.

Terrestrial Surveillance

Sandia collects samples and surveys plant and animal distributions at sites both on the base and far-removed from Labs' operations. These locations serve as a basis for comparing onsite and perimeter results. Currently, the terrestrial surveillance team samples soils, sediments from arroyos, and vegetation. Information on population and distribution of key animals in the various base ecosystems, including small mammals and birds, is also recorded.

To date, soil data continue to show some areas where values for metals are higher than offsite values. When such areas occur, they tend to be at environmental restoration sites. The sites with elevated values that are not ER sites are well below established regulatory action levels.

Among the animals monitored by Sandia is the burrowing owl, which lives in some prairie dog towns on Kirtland Air Force Base. Data indicate that Kirtland may host more burrowing owls than any other New Mexico site. Although the birds are not currently threatened with extinction, they have been listed as a species of concern and, as a result, prairie dog towns with resident owls receive special consideration when construction activities occur nearby.



This illustrative model of a section of the eastern Rio Grande Valley shows how surface water and groundwater are related. Environmental monitoring is conducted regularly at Sandia to protect the environment and the public.

Performance Assesment: Outstanding

In the annual Department of Energy National Nuclear Security Administration multi-program appraisal for FY2001, Sandia was judged "outstanding" in the overall assessment. Environmental performance accounted in a key way for this high mark. Sandia receives an overall grade and additional grades for specific functional areas in the appraisal.

With a possible score of 100, the performance measure grades are:

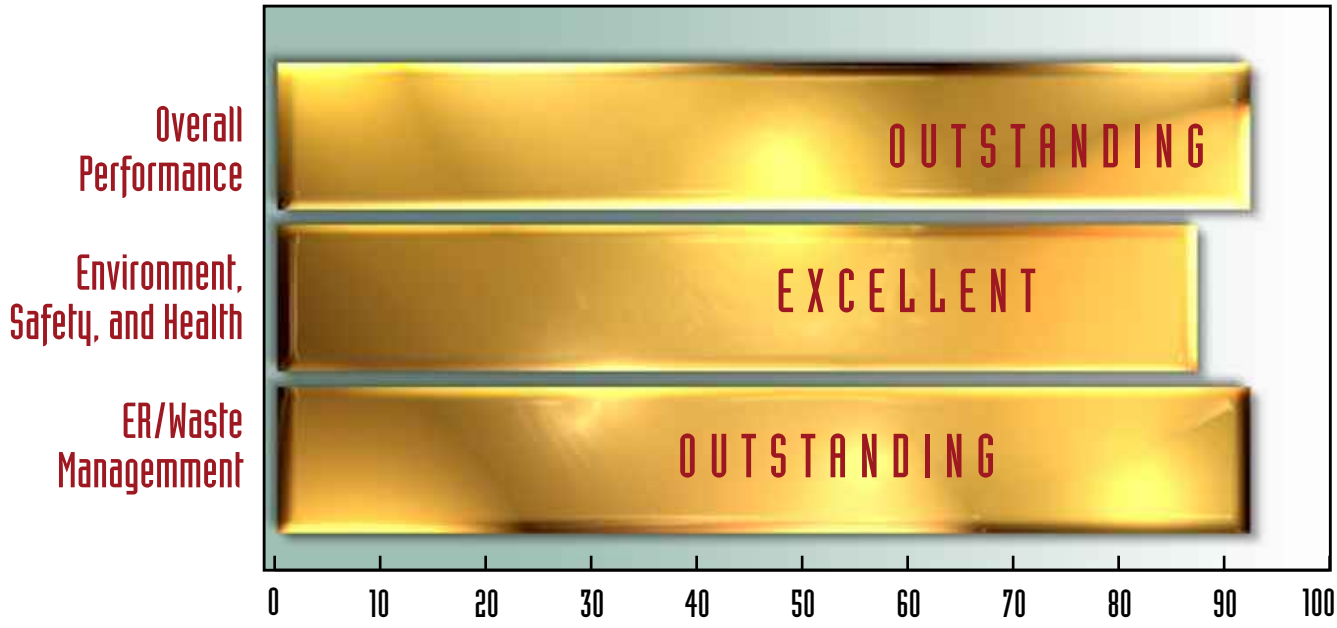
Outstanding, 90 to 100, demonstrating performance significantly exceeding the standard
Excellent, 80 to 90, exceeding the standard of performance
Good, 70 to 80, meeting the standard in an acceptable manner
Marginal, 60 to 70, below the standard with management attention required
Unsatisfactory, 59 or below, significantly below performance standard with prompt corrective action required

Sandia's Environmental Restoration (ER)/Waste Management performance was rated "outstanding." During the year, the Environmental Protection Agency (EPA) Region 6 and the New Mexico Environment Department (NMED) inspected the Labs. The weeklong, multi-media Compliance Audit resulted in no Resource Conservation and Recovery Act (RCRA) compliance findings. The inspectors commended Sandia for managing an effective waste management operation. They also commended Sandia's performance at the Classified Waste Landfill project.

Among the noteworthy actions cited:

- Sandia has taken the initiative to provide innovative and alternative mixed waste treatment capabilities at considerable savings to the taxpayers.
- Sandia interacted extensively with citizens, representatives of local, state and federal government offices, and the media on several subjects, particularly Long-Term Environmental Stewardship and the Mixed Waste Landfill.
- Sandia teamed with DOE and regulators to increase the number of Environmental Restoration sites proposed for removal from the Labs' permit with the NMED.

In the area of Environmental Compliance, Sandia also showed "excellent" performance. The Labs reported two Notices of Violation (NOVs) and four releases to the environment at Sandia's New Mexico site. To score "outstanding," in this category the goal of no NOVs must be attained. The assessment also noted there were no Clean Air Act issues during FY2001.



Sandia
National
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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000

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