



Technology development

Improvement through technical assistance, transfer of technology, and training

The Office of Surface Mining provides states, Indian tribes, federal agencies, and the coal industry with the technical information and tools they need to carry out their responsibilities under the Surface Mining Law. These activities include:

- providing direct *technical assistance* to address specific mining and reclamation problems;
- maintaining automated *systems and databases* used by others in making decisions under the Surface Mining Law; and
- transferring technical capability to others through *training, consultations, forums, and conferences*.

The goal is to help stakeholders develop the skills needed for solving problems on their own. In recent years, the Office of Surface Mining has been supplementing its traditional oversight presence with an increased emphasis on providing technical assistance and support to states and tribes.

While the focus of the Office of Surface Mining is to help state and tribal partners do their jobs, the ultimate goal is to improve the health, safety, and the environment for our primary customers—the people who live and work in coalfield communities. Using printed publications, website information, and videos, the Office of Surface Mining provides information to citizens to help them better understand their rights and responsibilities under the Surface Mining Law.

Photo to left: The first Office of Surface Mining/state abandoned mine land cooperative agreement project started under the Surface Mining Law was the abatement of the Peach Creek refuse fire in Logan County, West Virginia. The project contained 38 acres of burning refuse that was excavated and quenched using water from a ten-acre pond constructed on the project site. This photo taken 10 years after the reclamation was completed shows the area covered by a wide variety of vegetation and no traces of the burning coal refuse. Since 1977 approximately 1,700 acres of surface burning and 1,400 acres of underground mine fires have been extinguished and the land reclaimed

Technical Assistance

Computer Tools and Services

The Office of Surface Mining provides state regulators with a comprehensive set of analytical tools to aid in technical decision-making related to the Surface Mining Law. The services provided are centered on off-the-shelf scientific and engineering computer hardware and software supported by the Office of Surface Mining in partnership with the states and tribes. This technical assistance has grown from a few applications available on a specially-designed shared workstation, to a suite of software on each user's desktop computer. Costs are held low through shared licensing of the software via the Internet.

Currently, the assistance consists of Windows-based computers at state, tribal, and Office of Surface Mining offices with access to the licensed servers via the Internet and the Office of Surface Mining Wide Area Network. The 26 commercially available software applications cover a wide range of regulatory and abandoned mine land reclamation subjects. During 2004, on average, 122 customers used software provided by the Office of Surface Mining each workday. The customer base is comprised of over 700 desktop computers at 96 state, tribal, and Office of Surface Mining offices throughout the country. In 2004, two software updates were provided to each of the customer sites as part of a semiannual service to keep the software tools up to date.

Remote Sensing Technology

High resolution digital aerial photography and satellite imagery are increasingly being used by state and Office of Surface Mining offices throughout the country. In the western region, aerial and satellite imagery are an integral part of the regional geographic information system with quarterly updates acquired, processed, and provided to permitting and inspection staff. In 2004, the Office of Surface Mining provided imaging

and transfer

and mapping services for Alaska, and Indian and federal lands mines in the western U.S. The inspectors routinely use this imagery when planning field visits, during consultations with mine operators, and when preparing maps for inspection reports.

The Office of Surface Mining has acquired two thermal cameras (ThermaCAM™ E4) for use in locating acid materials and coal fires. The ThermaCAM is a hand held device that can also be used from aircraft. Thermal images and graphics are stored in the camera until downloaded to a personal computer where they can then be used as base layers in a Geographic Information System, or for inclusion in reports. Storage capacity is 50 digital images. The camera records temperatures in the range of -20°C to +250°C (-4°F to +482°F) with an accuracy of ± 2°C or ± 2% of absolute temperature in °C. Thermal imaging is best performed in the cool winter months when ambient air temperature is least likely to interfere with measurements.

The first training class in the use of the ThermaCAM occurred in November 2003 at the Western Regional Coordinating Center in Denver, Colorado. In 2004, the camera was used in the states of Colorado, Utah, and Washington to define underground coalbed fires. In December 2003, it was used to delineate burn zones at a coal stockpile in New Mexico. In April of 2004, the camera was used to locate a mine fire near Lonaconing, Maryland that was encroaching upon an underground natural gas pipeline. The camera was provided an accurate location of the fire so that the Maryland Bureau of Mines was able to construct a trench between the fire and the pipeline to put the fire out. In June it was used in Wilkes-Barre, Pennsylvania to successfully locate other underground mine fires for mitigation.

Mobile Computing

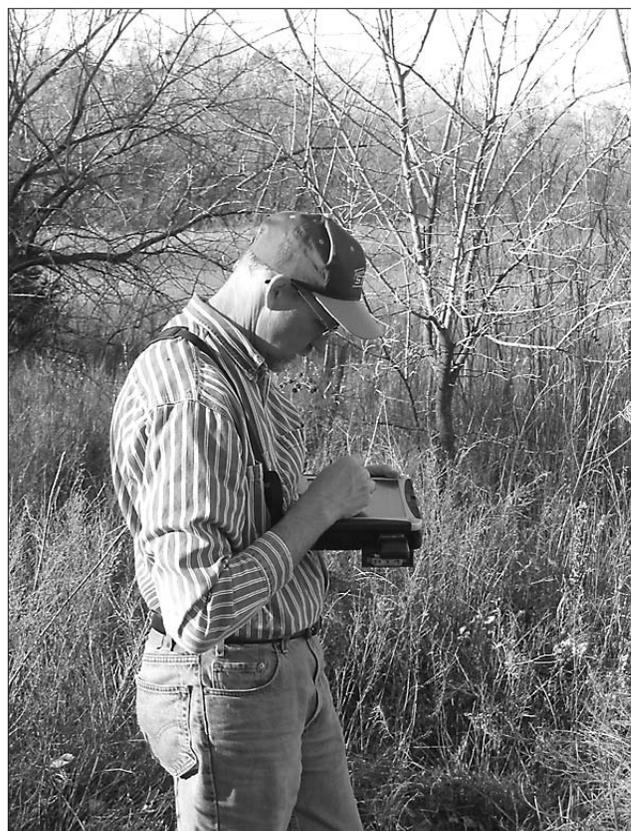
During 2004, Office of Surface Mining staff have used global positioning system-enabled tablet computers to conduct reconnaissance activities for bond release and bond forfeiture design. State reclamation experts are using mobile geographic information system technology in Alaska, Ohio, and Pennsylvania to map mine site features. Wyoming state inspectors and western Office of Surface Mining inspectors verify slope angle, topsoil depth, and placement of wildlife habitat features in the field through the use of company-supplied digital maps.

In the mid-continent, mapping efforts were initiated to aid in determining bond release areas and estimating

reclamation liability of multiple-permit bond forfeiture areas. Additional efforts were underway during 2004 in Alabama and Illinois to improve the quality and accuracy of water and soil data collection. During 2004, the Office of Surface Mining conducted a series of workshops, assistance efforts, and hands-on training sessions with state regulatory and abandoned mine reclamation programs to help introduce them to mobile geographic information systems and mobile computer-assisted drafting technologies. In 2005, Office of Surface Mining and state participants in the mobile computing effort will work with other Surface Mining Law programs to further perfect the technology applications.

Acid Drainage Technology Initiative

The Acid Drainage Technology Initiative is a partnership in which the Office of Surface Mining has joined with the coal industry, states, academia, other governmental agencies, and other interest groups to identify, evaluate, and develop “best science” based practices to prevent new acid mine drainage and eliminate existing sources. The Interstate Mining Compact Commission represents Eastern and Midwestern coal-



Using a tablet computer with built-in global positioning system and mobile geographic information system software, field personnel display existing contour maps over aerial photographs for mapping features that are important to abandoned mine land project design such as culvert locations, dangerous embankments, utility lines, and other features impacting the reclamation.



Underground coal mining during the early 1900s left over 900-acres of downtown Rock Springs, Wyoming with serious subsidence problems. Funding for this \$57 million project came from several sources. Mine subsidence abatement in Rock Springs was funded as an abandoned mine reclamation project. The water board paid for connecting utilities that were not damaged by subsidence. The city covered repair to gaps in deteriorated concrete not related to subsidence, plus other non-abandoned mine land eligible costs such as new street lights. Subsidence was stabilized by filling mine voids by injecting grout through more than 7,000 holes. With the project completed, over 1,600 homes and 50 businesses have been protected from mine subsidence. This project eliminated a long-term problem and helped bring economic stability to this Wyoming town.

producing states, and the National Mining Association represents the U.S. coal industry. The National Mine Land Reclamation Center at the West Virginia University serves as the central location for Acid Drainage Technology Initiative activities and related technology transfer. The Coal Mining Sector of the Initiative directs and coordinates activities of Initiative partners.

While the focus of the Initiative initially was on the coalfields of Appalachia, the scope was expanded when the Metal Mining Sector Work Group was formed in 1999 to include western and other hardrock mining.

The Office of Surface Mining has been funding this initiative at approximately \$200,000 per year. During 2004, this funding was used for field verification of acid mine drainage prediction; monitoring and follow-up evaluation of acid mine drainage passive treatment systems; the printing of additional copies of *Prediction of Water Quality at Surface Coal Mines*; continuation of work on standard Acid Drainage Technology Initiative kinetic testing protocols used in evaluating acid mine drainage potential; evaluating methods of identifying selenium in overburden materials; and evaluating methods to remove selenium from mine drainage water. A new project to assess the effects of changing precipitation amounts on the quality of water flow from underground mines and on the performance of passive treatment systems over time was initiated in 2004.

Slurry Impoundments

Since 1996, there have been four breakthroughs of coal slurry impoundments into underground mines. Slurry impoundments are created from the coal preparation process as coal is washed to remove impurities. A mixture of silt and sand-sized shale particles and water are pumped behind an embankment built of coarse coal waste to assure that offsite water pollution will not occur. The National Research Council of the National Academy of Science conducted a study on preventing coal waste impoundment failures and breakthroughs and released a report on that study in October 2001. The report included several recommendations for joint work by the Office of Surface Mining and the Labor Department's Mine Safety and Health Administration to minimize the potential for future breakthroughs. The Office of Surface Mining and Mine Safety and Health Administration established a joint technical committee to facilitate ongoing coordination. In addition, several ad hoc technical working groups were developed to prepare responses to the specific recommendations contained in the National Research Council report. These groups, which also involved representatives from state regulatory authorities, prepared a report to Congress, released on August 15, 2003 (See www.osmre.gov/pdf/coalwastereport081503.pdf for a copy of the report).

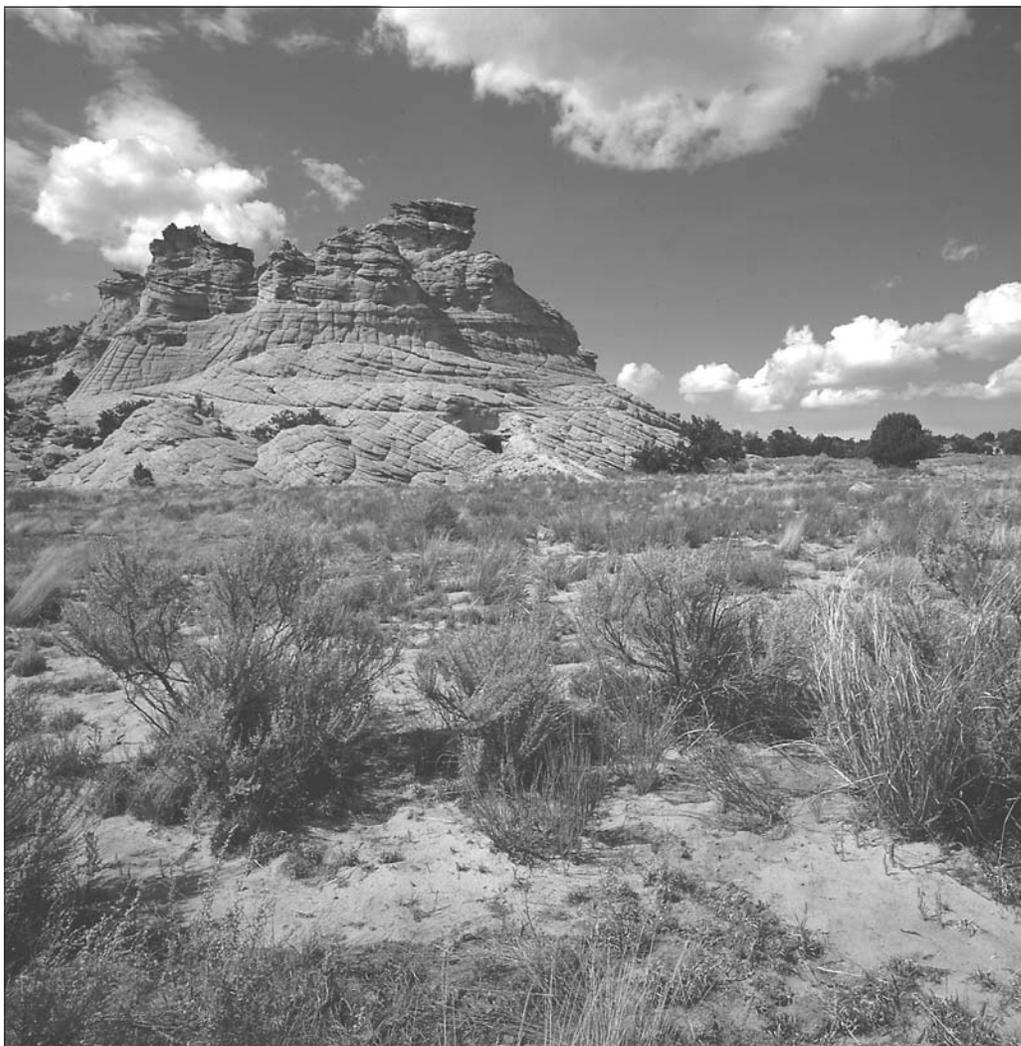
The report to Congress addresses a number of issues that warrant additional action. The Office of Surface Mining is currently analyzing the state regulatory authorities' impoundment review work load and staffing. The Mine Safety and Health Administration is also reviewing its work load and staffing, and is updating its *Engineering Design Manual for Coal Waste Disposal Facilities and Coal Mine Impoundment Inspection Procedures*. The Office of Surface Mining is currently conducting an oversight review of the state regulatory authorities' procedures for assessing breakthrough potential. This review includes an assessment of the reasonableness of states' decisions related to breakthrough potential. The Office of Surface Mining is also currently conducting a technical review of the flowability of slurry to determine its potential to flow into underground mines if an opening develops. The Office of Surface Mining and some states are in the process of scanning underground mine maps and making them available to the public. The Mine Safety and Health Administration and the states, under their regulations, are working together to improve underground mine mapping and have issued a contract for geophysical demonstration projects relating to the identification of unmapped underground mines. The

Department of Energy, the Commonwealth of Virginia, and the Office of Surface Mining conducted a test project on airborne and ground-based geophysical methods.

Revised Universal Soil Loss Equation

For the fourth consecutive year the Office of Surface Mining distributed compact disks with *Guidelines for the Use of the Revised Universal Soil Loss Equation (RUSLE) on Mined Lands, Construction Sites, and Reclaimed Lands*, for the public domain RUSLE Version 1.06, along with the upgraded software now operating in Windows 2000 and XP environments. Use of the guidelines maximizes the accuracy of soil-loss prediction estimates, recommending procedures for soil-loss estimate calculations that are generally reproducible, and by identifying critical areas for future research. In its outreach, the Office of Surface Mining has modified the guidelines to complement the new U.S. Department of Agriculture's RUSLE 1.06c software. In addition, two e-learning modules on the Revised Universal Loss Equation have been added to the compact disk and website information. Each module consists of a set of PowerPoint slides and a live narration. The first module provides information on creation of the Revised Universal Loss Equation model for mined lands, construction sites. The second module gives information on the use and misuse of the equation.

Located on Navajo land just east of the Grand Canyon, the Coppermine Abandoned Mine Project was completed by the in-house Navajo construction crew of the Tuba City, Arizona, Abandoned Mine Land Office. Historic mining left abandoned mine problems on 37 sites over 12-square miles including highwalls, vertical openings, and unstable portals. Today, with reclamation complete, sources of water pollution, soil erosion, and abandoned mine land hazards have been eliminated.



Coal Combustion By-Products

The Office of Surface Mining continues to be involved in coal combustion by-product related activities, including: technology transfer, rulemaking efforts by the Environmental Protection Agency, assistance to the Interstate Mining Compact Commission efforts to develop a state consensus of issues related to coal combustion by-product placement at mines, and research efforts by the Department of Energy - National Energy Technology Laboratory.

During 2004, the Office of Surface Mining conducted the fourth in a series of technical interactive forums, *State Regulation of CCB placement at Mine Sites* that evaluate the use and disposal of coal combustion by-products at mines in the United States. This forum focused on issues related to fluidized bed combustion materials in reclamation. State regulation of mines, environmental damage cases, and a response to public concerns about placement at mines. As a member of the combined American Coal Ash Association/

University of Kentucky national steering committee for the World of Coal Ash Conference in 2005, the Office of Surface Mining is planning a joint forum on *Regulation, Risk, and Reclamation with CCBs at Mines*.

In support of Environmental Protection Agency rulemaking efforts, the Office of Surface Mining participated in four open meetings to gather public opinion in Pennsylvania, Indiana, and Texas. The Office of Surface Mining participates on the advisory panels of the "C2P2" study that will evaluate the Texas coal combustion by-products program as a model for other states and on the recently funded study by the National Academy of Science to look into potential environmental impacts of coal combustion by-product placement at mines.

In support of coal combustion by-product research activities, the Office of Surface Mining is an active participant on the Department of Energy's Combustion By-Products Recycling Consortium National Steering Committee, which evaluates and makes recommendations for funding of the Energy Department's coal combustion by-product research. For additional information on coal combustion by-product placement at mine sites see www.mcrcc.osmre.gov/ccb.

Bat Conservation and Mining

The Office of Surface Mining has worked to protect the populations and habitats of bats associated with mining since 1998, when a Memorandum of Understanding was signed with Bat Conservation International. During 2004, the Office of Surface Mining began planning for its third technical forum, *Indiana Bat and Coal Mining*. The forum will focus on: Indiana Bat biology and life history, field techniques for biological assessment, the endangered species consultation process, case studies, and guidance development for mine permitting.

The Office of Surface Mining published its proceedings on *Bat Gate Design*, which is now being used by Bat Conservation International and other professional organizations as a model for the construction of devices to protect the entrances to underground bat habitats. The proceedings include 41 presentations on why bats and their habitats need protection, how to plan for a mine or cave closure project, how to design specific bat-friendly closures, how to manage the construction of a bat-friendly closure, and how to maintain a closure structure and monitor the effects of

that closure on bat populations. Additional information on bat conservation and abandoned mines is at www.osmre.gov/bats.htm.

Prime Farmland Reclamation

The Office of Surface Mining has partnered with the Indiana Regulatory Authority, the U.S. Department of Agriculture - Natural Resources Conservation Service, coal mining companies, consultants, and farming representatives to publicize the latest technology in reclamation of prime farmlands. The partnership has developed and distributed the popular brochure entitled *Citizen's Guide to Land Reclamation* (see www.mcrcc.osmre.gov/CitizenSoilsGuideWeb.pdf), and is currently developing a guidance brochure on management of reclaimed prime farmlands. In addition, the group sponsored a biannual tour of coal mines with exemplary prime farmland reclamation.

Reforestation

The Office of Surface Mining has been extensively involved with efforts to encourage reforestation of coal mined lands since 1998. During 2004, the Office of Surface Mining published the proceedings of the technical interactive forum "Market-Based Approaches to Reclamation and Reforestation of Mined Land." The proceedings include 17 presentations on market-based approaches to land reclamation, market-based economic and management considerations related to reforestation of mined lands, and reforestation success stories.

Established in 2004, the Appalachian Regional Reforestation Initiative is a cooperative effort among the states of Kentucky, Maryland, Ohio, Pennsylvania, Virginia, and West Virginia; the Office of Surface Mining, including the Tennessee federal program; their partners in industry; environmental organizations; academia; local, state, and federal government agencies; and local citizenry. The goals of the initiative are to plant more high-value hardwood trees on reclaimed coal mined lands in Appalachia and to increase the survival and growth rates of the planted trees. Forestry research has proven that these goals can be accomplished by reclaiming coal mines using the following 5-step forestry reclamation approach.

- Create a suitable rooting medium for good tree growth that is no less than four feet deep and is comprised of topsoil, weathered sandstone and/or the best available material;
- Loosely grade the topsoil or topsoil substitutes established in step one to create a non-compacted growth medium;
- Use native and noncompetitive ground covers that are compatible with growing trees;
- Plant two types of trees -- early succession species for wildlife and soil stability, and commercially valuable crop trees; and
- Use proper tree planting techniques.

The 5-step technology is currently being used to promote reclamation of active and abandoned mine sites in the Appalachian Region. This ongoing initiative will promote reforestation through training, information sharing, and research.

For additional information on the Office of Surface Mining's Reforestation Initiatives, see www.mcrc.org/osmre/tree.

International Activities

International technical assistance activities by the Office of Surface Mining and its state partners continued in 2004, by working with the Indonesian Ministry of Energy and Mineral Resources and expanding to include cooperation with the Indonesian agency responsible for environmental protection. Both agencies are in the process of decentralizing their activities to comply with the broad mandates for program decentralization that were established as part of Indonesia's transition to democratic governance.

The United States Agency for International Development continued to provide the Office of Surface Mining with one hundred percent funding for its activities in support of technical assistance in Indonesia. The model of cooperative federalism in the Surface Mining Law continues to be of interest to agencies in the Indonesian government. The principle of consultation and coordination among agencies of the central and local governments appears to mesh well with the broad movement to decentralization that is occurring in Indonesia. In its assistance, the Office of Surface Mining continues to rely on personnel from



Mining in Utah's American Fork Canyon during the 1870s left open shafts and portals throughout the area. Today, this spectacular scenic area has become an important regional recreation area. In Utah, bats represent 15 percent of the mammal species and the open portals and shafts are a critical winter habitat so steel grates were used to close openings where bat habitats were found. Portals contaminated with heavy metals were both backfilled and closed with concrete block walls. However, because the mountainous terrain and sensitive high-altitude vegetation prevented the use of mechanized equipment, most of this reclamation work was completed by hand. The result -- a natural area that's safe for both bats and people. On September 30, 2004, there were more than 1,000 open abandoned mine portals that need reclamation in Utah.

state regulatory authorities to provide personnel and technical capacity to train and otherwise assist Indonesian agency staffs in implementing their new responsibilities.

In October, 2003, the project was augmented by the establishment of a position of Senior Environmental Specialist in Jakarta that was filled by a professional staff member from the State of Colorado's Division of Geology and Minerals. The assignment was accomplished under the provisions of the Intergovernmental Personnel Act, which provides for temporary assignments of personnel from one level of government to another level. The presence of a state regulatory authority professional adds significantly to the project's capabilities in Indonesia.

Specific training activities undertaken by the Office of Surface Mining and its state partners during 2004 include:

- A workshop on Mineral Recovery and Environmental Protection for Small-Scale Mining for the provincial government of North Sulawesi and the county government of North Minahasa, the local government of Tatelu, and small-scale miners.

- A workshop on small-scale mining for members of the Ministry's technical training Staff.
- A workshop on Principles of Reclamation held for the provincial government of South Sumatra, county government of Muara Enim, and PT Bukit Asam, a state-managed coal company.
- An Office of Surface Mining instructor and a water quality specialist from the Pennsylvania Department of Environmental Quality traveled to Indonesia and conducted a series of seminars on the protection of water quality.
- An environmental assessment course for provincial and local governments. The course was developed by a joint team of Office of Surface Mining, State

Regulatory Authority and Indonesian officials from both the Ministry of Energy and Mineral Resources and the Indonesian Environmental Protection Agency. The course was team-taught and marked the first time that an environmental assessment course was taught by instructors from the Ministry of Energy and Mineral Resources and the Indonesian Environmental Protection Agency.

- A blasting and inspection class taught for the Jamaican government in Kingston, Jamaica. The class focused on blasting practices with minor emphasis on sediment and erosion control from quarries. The class was funded by the Agency for International Development as part of its Ridge to Reef Watershed Project.



Near the town of Eureka, Utah, the Tintic project closed 41 underground mine openings. Early 1900s hardrock mining in Utah left hundreds of abandoned mine openings. Shafts and portals were a safety hazard at the Tintic site due to its popularity with hikers and mountain bikers. Some of the openings were closed by backfilling; however, many were covered by steel grates. Due to limited fill, and the need of landowners to have future access to the mines, vandal-proof grates were designed. The grates used one-inch re-bar on 8-inch centers, with welded intersections. Reinforced concrete beams were poured around the opening to anchor the structure and complete the closure. The grates provide a low-cost method of protecting the public from very dangerous abandoned shafts that otherwise would be impossible to close. On September 30, 2004, there were more than 800 abandoned vertical shafts that needed reclamation in Utah.

The Office of Surface Mining and its state partners also hosted several delegations of visitors from countries that had regulatory programs for surface coal mining. These included delegations from the Ministry of Land and Resources of the People's Republic of China and the Republic of Vietnam.

Systems and Databases

Applicant/Violator System

One of the underlying principles in the Surface Mining Law is that those who conduct mining are responsible for returning the land and water to productive use. Section 510(c) of the Law prohibits the issuance of new permits to applicants who own or control operations with unabated or uncorrected violations.

The primary purpose of the Applicant/Violator System is to provide state regulatory authorities with a central database of application, permit, ownership and control, and violation information. Federal and state officials review Applicant/Violator System data when evaluating the applicant's eligibility for new permits. The system is also used to determine the eligibility of potential recipients of Abandoned Mine Land reclamation contracts and for inspection and oversight purposes.

Access to the system is available to the public, coalfield citizens, coal companies, and industry representatives through the use of customized communications software distributed free of charge. Upon request, the Office of Surface Mining provides system users with demonstrations and training, often tailored to meet the specific needs of the target audience, on how to access and interpret system information.

During 2004, the Office of Surface Mining responded with quality reviews for 3,655 requests for Applicant/Violator System data evaluations from state and federal regulatory authorities and state abandoned mine land program officials. The Office of Surface Mining collected or settled payments of civil penalties and reclamation fees in the amount of \$5,306,461 in part because of violation information in the system.

During 2004, the Office of Surface Mining also published a proposed rulemaking in the *Federal Register* in settlement of the lawsuit brought by the

National Mining Association concerning certain provisions adopted in the 2000 ownership and control rule.

During 2004, the Applicant/Violator System Office began what is anticipated to be a yearlong process to dramatically improve the usability of the Applicant/Violator System. The redesign involves not only the transformation of the current system to a more user-friendly, web-based system, but also a rewrite of the business processes and change in language allowing for ease in future development and modification.

The Office of Surface Mining began a joint project assisting the West Virginia Department of Environmental Protection, Division of Mining and Reclamation and Office of Legal Services in pursuing additional types of alternative enforcement actions in cases where primary enforcement has failed to achieve abatement or correction of a violation or complete reclamation. To date, the project has established alternative enforcement processes and procedures within the Division of Mining and Reclamation; determined that tracking these cases can be accomplished by using current systems with some enhancements, which are currently underway; and identified two candidates for individual civil penalties from the ten cases investigated by the Office of Surface Mining.

During 2004, the Applicant/Violator System Office received a customer satisfaction rating of 98 percent for services provided. This is the fifth consecutive year that the office has received extremely high customer satisfaction ratings. The combined average customer satisfaction rating for the past five years is 97 percent.

General information about the system, including access and user information can be found at www.av.s.osmre.gov.

Geographic Information Systems and Geologic Modeling

The Wyoming Geographic Information System for Bond Release Pilot Project, a cooperative effort between the Office of Surface Mining, the Wyoming Land Quality Division, and Powder River Coal Company, continued in 2004. The geodatabase bond tracking and verification geographic information system was developed for both the North Antelope/Rochelle and Caballo Mines.

Electronic data was received from both mines and processed into the system database. In addition, a global positioning component was developed, tested, and procedures for data verification were developed.

Enterprise Geographic Information Management Work group

Geographic Information System professionals from the Office of Surface Mining are part of the Interior

Department's Enterprise Geographic Information Management Work group. This is a group composed of experts from all bureaus with the purpose of providing leadership for geographic information systems in the Interior Department. Team members determine needs for standardization of geographic information systems and provide direction on policy, programs, initiatives, funding priorities, and organizational needs. On July 14-15, 2004, the work group hosted the Interior



A landslide above this Kentucky house required emergency work to prevent further damage. Surface and subsurface drains at the top of the hill divert water around the house. The concrete wall will provide a solid base at the bottom of the hill and prevent future sliding. The large pipe covered with gravel behind the wall will prevent water buildup and keep added pressure off the wall. As the last step in the reclamation process, the entire site will be graded and revegetated. On September 30, 2004, there were more than 1,500 acres of dangerous slides that needed reclamation in Kentucky.

Department's Executive Workshop on Enterprise Geospatial Systems at the Denver Federal Center. This workshop focused on developing an integrated, department-wide approach to the management of spatial information systems. Approximately 120 participants attended the workshop.

Internet Mapping Services Project

The Office of Surface Mining has formed an Internet Mapping Services Team to investigate the application of Internet mapping technology to coal mining operations. The purpose of the team is to find practical methods of implementing Internet mapping services technology for surface mining applications, share information with other team members in implementing this technology, provide technical support to team members when necessary, and to find a unified approach in delivering Internet mapping services to our customers. Internet Mapping Services use geospatial data sets to produce maps on a server which can be delivered through the Internet to a standard browser as an image for interactive use at a remote workstation. The user can view, pan, zoom, query, select themes, download, and print the interactive map. An internal prototype map service has been established and can be viewed by Office of Surface Mining staff. The Internet mapping services initiative is intended to meet the Interior Department's E-Government Strategy, Objective 5.6 (Geospatial Information Management) by sharing geospatial information inside and outside the department, modifying information technology systems to enable them to use geospatial data, and improving the capability to access geospatial information on-line.

Integrated Geographic Information Systems for Regulatory Programs

A cooperative project between the Office of Surface Mining, the Pennsylvania Geographic Information System Consortium, and Wilkes College is projecting use of several geospatial applications for regulatory (and bonding) oversight and management at an ongoing mining operation in western Pennsylvania. This project includes the integrated use of a geographic information system, carrier phase (real-time kinematic) Global Positioning System, and satellite imagery (e.g., Digital Globe's Quick Bird data at 2' pixel resolution) to provide geospatial and geophysical data/analysis needed for engineering mapping and operations monitoring consistent with existing management procedures of the Office of Surface Mining and Pennsylvania Department of Environmental Protection.

This geographic information system-based system tracks and verifies mining operations, related on-site reclamation, and bond release status to test the use of geographic information systems, global positioning systems, and remote sensing technologies. The project objective is to serve as a national model to support and enhance environmental and regulatory oversight of active mining operations and related site reclamation efforts. Training and technology transfer to the Pennsylvania Department of Environmental Protection staff are key components of this project.

Geologic Modeling for Forest Fire Ignited by a Colorado Underground Mine Fire

In the summer of 2002, the city of Glenwood Springs, Colorado was threatened by a forest fire ignited by an underground coal fire. The subsequent investigation by the state of Colorado is being assisted by the Office of Surface Mining in 2004 through construction of a



The Richmond Shafts Project, near Richmond, Virginia, closed abandoned mine shafts left from some of the nation's earliest coal mining. The project closed 10 shafts that were adjacent to a suburban neighborhood and to "Aetna Hill," an historic home built by the mine's original owner in the late eighteenth century. The procedure for sealing the mine shafts consisted of removing loose material and debris, then backfilling with coarse aggregate stone. However, there was still the potential that total back fill of the shaft was hindered by false bottoms. So concrete slabs were installed in shafts where false bottoms were expected. Approximately six feet of soil was placed over the concrete slab, compacted, and seeded. As a precautionary measure, vent pipes were installed to prevent any potential gas buildups. Today, local residents use the area for recreation without the dangers of falling into vertical underground mine shafts. On September 30, 2004, there were more than 700 abandoned vertical shafts that needed reclamation in Virginia

computer-generated three-dimensional model of the South Canyon underground coal fire. The model depicts the surface topography, geology, underground mine workings and fire zones. This model will allow the state to better understand the fire morphology, extent and depth, and will aid in designing future exploration and mitigation efforts.

Hydrologic and Biologic Impacts of Streams Overlying Longwall and other High-Extraction Mining Operations

The Office of Surface Mining has begun a partnering project with the West Virginia Department of

Environmental Protection to study the impacts of underground coal extraction on streams. The partnership project will focus on the hydrologic and biological impacts of various methods of underground mining techniques on the streams above mining operations. The project will include monitoring underground and surface waters, as well as biological sampling of the streams located above underground mines. Project findings should assist state regulatory agencies in making permitting decisions regarding underground mines and will aid in reducing and minimizing offsite impacts. In addition to West Virginia,



In the late 1800s lead mining left over 150 dangerous shafts, adits, prospects, and stope openings on Mine Hill near the southern New Mexico ghost town of Chance City. Closures included concrete caps, poly plugs, backfilling with rock, blasting, installation of steel bat grates with locking access doors, and cable nets. Because of the historical significance of the timber head frames, steel closures were constructed to fit around the timber posts. Today, people who visit the site to explore the ghost town and mine sites can do so without fear of falling into an open abandoned mine void. In addition, important bat habitat has been preserved and the reduction in disturbance by curious visitors should lead to an increase in the bat population inhabiting the mine workings. On September 30, 2004, there were more than 350 open portals that needed reclamation in New Mexico.

the study will include sites in Pennsylvania and Ohio. Those regulatory agencies will also participate in the study.

Technical Library Resource Center

In 2004 the Office of Surface Mining Technical Library expanded the website (www.wrcc.osmre.gov/glas) to include on-line access to recent acquisition lists in addition to the on-line library catalog. The library collection of books and reports, along with a growing electronic media library, on-line searches, research services, and interlibrary loans, enabled the librarian to respond to more than 600 requests from state regulatory agency staff, other Federal agency staff, citizens, coal industry, consultants, and academia, in addition to fulfilling more than 300 Office of Surface Mining requests for information. The technical library plays a large role in technology transfer in assisting with the dissemination of electronic information and publications to Office of Surface Mining's constituents.

Training, Consultations, Forums, and Conferences

National Technical Training Program

The Office of Surface Mining continued its emphasis on providing technical assistance to the states and tribes by enhancing the technical skills of regulatory and reclamation staff through the National Technical Training Program. In 2004, the program offered 55 sessions of 34 different courses. In addition to regularly scheduled courses, and in response to specific requests, a special session of the National Environmental Policy Act Procedures course focusing on public facility projects was held for the Navajo Nation and several sessions of the Effective Writing Course were held for the state of Montana and the Department of Justice. Blasting and Inspection courses were also offered internationally and for the U.S. Army Corps of Engineers.

A new course, Passive Treatment Systems for Acid Mine Drainage, was added to course offerings. The purpose of the course is to provide students with highly interactive information and exercises that can be used to evaluate the application of passive treatment in clean streams, abandoned mine lands, and active mining projects; estimation of treatment costs; development of actual treatment designs; and assessment of existing passive treatment projects. The audience for this course is permitting specialists, inspectors, and abandoned mine land reclamation specialists. Another recently developed course, Acid-

**Figure 5
Courses and Enrollment**

Course Name	Sessions	Students
Acid-forming Materials: Fundamentals & Applications	1	16
Acid-forming Materials: Planning & Prevention	1	15
Acid Forming Materials AML Workshop	1	10
Advanced Blasting: Investigations & Analysis	2	34
AML Design Workshop: Fires	1	12
AML Design Workshop: Landslides	1	13
AML Workshop: Subsidence	1	11
AML Reclamation Projects	1	13
Applied Engineering Principles	1	16
Basic Inspection Workbook		35 ¹
Blasting and Inspection	4	63
Bonding Workshop: Administrative & Legal Aspects	1	19
Bonding Workshop: Cost Estimation	1	20
Effective Writing	9	156
Enforcement Procedures	2	36
Enforcement Tools and Applications	1	16
Erosion and Sediment Control	2	35
Evidence Preparation and Testimony	1	16
Excess Spoil Handling	1	21
Expert Witness	1	7
Historic and Archeological Resources	2	39
Historic and Archeological Resources: Refresher	1	10
Instructor Training Course	1	18
NEPA Procedures	2	32
Passive Treatment	1	27
Permit Findings Workshop	1	9
Permitting Hydrology	1	15
Principles of Inspection	1	20
Quantitative Hydrology	1	14
Soils and Revegetation	2	32
SMCRA and the ESA:		
Implementation of the 1996 Biological...	2	42
Subsidence	2	45
Surface and Groundwater Hydrology	1	20
Underground Mining Technology	1	20
Wetlands Awareness	3	44
Total	55	916

1. Workbooks Distributed

Forming Materials Abandoned Mine Land Workshop, which is designed to assist in reclaiming problematic areas, was modified for offering in Eastern states. Plans were made for extensively revising the five Abandoned Mine Land Design Workshops to meet the needs of staff who are being newly trained or cross-trained in abandoned mine land reclamation project work. Significant progress was made on redesigning the Dangerous Openings class, and work is underway on



The town of Victor is one of Colorado's most significant historic gold-producing areas. However, the town has recently become a major tourist attraction because of its location next to Cripple Creek, a popular gambling town. The Independence Mine was both dangerous and historically significant, so eliminating the danger required sensitivity to the area's history. The head frame, which is one of the largest all-wooden 19th century hoisting structures left in the country, was protected with an iron fence that blends with the historic setting. The 600-foot-deep opening was protected with an open grill that allows visitors to look into the mine opening and understand turn-of-the-century mining techniques. This project matches the local community's goals of encouraging tourism and ensuring visitor safety. On September 30, 2004, there were more than 7,000 abandoned vertical openings that needed reclamation in Colorado.

Administration as a follow-up to the Que Creek and Martin County slurry impoundment incidents. A follow-up to the 2004 session will be held in early 2005. The

the other four workshops including Dangerous Highwalls, Subsidence, Fires, and Landslides.

The training program conducted three low-cost workshops at the National Association of Abandoned Mine Programs conference. Topics included Acid-Forming Materials in Arid Lands, Speaker Presentation Skills, and a mini-course on Drilling and Grouting. The Drilling and Grouting course will be expanded to a full-length offering in 2005. Preliminary planning work was also done on a site investigation and Abandoned Mine Land Inventory System class. Another new course piloted in 2004 is Quantitative Geo-Hydrology. This course provides participants with a hands-on review of underlying assumptions and theories of aquifer characterization and the practical utilization of hydrogeologic principles to understand and analyze groundwater movement. Additionally, significant revisions were made to the Surface and Groundwater course and to the Bonding Cost-Estimation Workshop. Modeling on the success of the highly successful state and tribal 2002 Probable Hydrologic Consequences/Cumulative Hydrologic Impact Analysis benchmarking session, the training program worked with the Interstate Mining Compact Commission to offer a well-attended session on underground mine mapping. The session was offered in conjunction with Mine Safety and Health

benchmarking workshops provide the opportunity to share information about model state programs with the goal of adopting or adapting processes to more effectively delivering products and services (e.g., permitting) to customers.

All aspects of the National Technical Training program from identification of training needs through course development and presentation, are cooperative efforts of state, tribal, and Office of Surface Mining offices. This joint effort exemplifies Secretary Norton's 4Cs of cooperation, communication, and consultation, all in the service of conservation. In 2004, there were 171 instructors, 55 percent from 18 office of Surface Mining offices, 34 percent from 14 states, six percent from the Interior Department's Solicitor's Office, and five percent from other sources. The 55 sessions, attended by 916 students, were presented in 24 locations in 13 states. State agency students accounted for 74 percent of attendees; tribal students for three percent; Office of Surface Mining students for 13 percent, and 10 percent were other participants. The program exceeded its annual attendance goal of 900 students by training a total of 916 students. The customer effectiveness rating of 97 percent exceeded the goal of 92 percent by five percent. Training courses offered in 2004 are listed in Figure 5.

Scientific and Engineering Software Applications Training

Training of state, tribal, and Office of Surface Mining personnel in the practical application of analytical software is an integral part of the technical assistance function. Instructor-led courses incorporate the reclamation experience of its instructors and students to provide a unique shared-training experience. In 2004 there were 415 participants in 30 instructor-led classes, compared to 2003 levels of 393 participants in 32 instructor-led classes.

Thirteen instructor-led courses were held at customer sites with critical training needs for software use. In 2004 this training program employed 48 different instructors; 16 of these were state program experts. In 2004, the satisfaction rating for this training was 90 percent, broken down as follows: class satisfaction at 87 percent, facility at 87 percent, lead instructor at 93 percent, and co-instructor at 92 percent. New courses offered in 2004 included Mobile Geographical Information System Computing and Remote Sensing. Additional E-training courses offered to students in 2004 included 18 new one-hour Geographic Information System Workshops offered in individual sessions in addition to 15 on-line courses through a contract with the Environmental Systems Research Institute Virtual Campus for basic geographic information system training. During 2004, 58 students started new classes and 18 completed their courses by the year end.

New Technologies Implementation Workshops

In 2004, the Office of Surface Mining sponsored a series of three New Technologies Implementation Information Workshops, in which the seven Western primacy states defined the short- and long-term needs pertaining to records conversion, database design and mass storage, and progression to implementation of new technologies and geographic information systems and global positioning systems. The goal of these small regional meetings was to assist in making informed decisions on the different technologies available, gain a better understanding of and an appreciation for what is involved in implementing new technologies by providing hands-on opportunities, and seeing what individual states are accomplishing. The exchange of information and individual experiences, including both successes and failures, resulted in better-prepared staff and, more informed managers.

The New Mexico Energy, Minerals & Natural Resources Department co-hosted the first workshop that included New Mexico's geographic information systems initiatives, the integration of database systems for geographic information systems, and hardware and software needs for geographic information systems and electronic permitting.

The second workshop, co-hosted by the Colorado Division of Minerals and Geology, highlighted the Colorado permitting system and stepped the participants through Colorado's, massive document conversion into electronic format activity (more than 3 million text pages and 27,000 maps). The Office of Surface Mining demonstrated the Wyoming Bond Release Geographic Information System Pilot Project followed by a one-day Geographic Information System - Digital Imagery and Modeling Workshop.

The third workshop was co-hosted by the Utah Division of Oil, Gas and Mining. The workshop highlighted Utah's progress in the electronic permitting process, its Water Quality Database System, and electronic laboratory data exchange with mine operators.

Building on the success of these workshops, four additional New Technologies Implementation Workshops are scheduled to be held in 2005. They will



A 1960s underground mine operator left this Tennessee site unreclaimed, with acid mine drainage flowing from the abandoned mine openings. During reclamation the drainage from two portals was joined and diverted to a series of four constructed wetlands. These wetlands eliminate acid conditions during the warm season and reduce the amount of acid in the water when the air temperature drops below 70 degrees. After the site was graded, the wetland was constructed by placing clay, limestone, and highly organic loam in layers, then planting cattails and moss. This reclamation has eliminated the abandoned mine problems, restored the water quality to the nearby stream, and established an aquatic wildlife habitat.

be co-hosted with Montana, North Dakota, Wyoming, and Colorado.

Valley Fill Workshop

The Office of Surface Mining sponsored an interactive workshop on valley fill construction and regulation in Ft. Mitchell, Kentucky. The event featured presenters from State Regulatory Authorities, the Office of Surface Mining, and Industry representatives. The workshop addressed permitting and inspection requirements for valley fills focusing on durable rock underdrain construction, drainage control and engineering inspections and certifications. The valley Fill Workshop was attended by 46 mining and reclamation professionals from the Office of Surface Mining, the states, and industry. Case studies, permitting procedures, inspection requirements and analysis of transportation fills were addressed by the workshop.

Underground Mine Pool Workshop

In June, 2004, the Office of Surface Mining hosted a workshop on underground mine pools that addressed the growing concern over flooded mine pools and their potential to discharge. Interconnected flooded underground mines have long been a concern in the Appalachian Region. Over the past 100 years many underground operations have become flooded. Many of these mines are interconnected with active operations. Pumping at active operations maintains the pool elevation below drainage. However, if pumping should cease, toxic discharges are possible. The workshop contained mine pool modeling and monitoring technologies, including recent findings of various researchers and scientist. Perspectives from industry, the Environmental Protection Agency, state regulatory authorities, and academia were presented. Marketing of water captured in the mine pools was also addressed. Scientists from industry, state and federal agencies, academia, as well as managers charged with monitoring and preventing mining related environmental problems attended the workshop. Approximately 60 professionals from the Appalachian states, academia, industry, the Office of Surface Mining, and the Environmental Protection Agency participated in this workshop.

Appalachian Hydrologic Issues Workshop

This two-day workshop addressed regional hydrology issues associated with longwall mining, including water loss and stream replacement, evaluation of mine pools, and the major recommendations made at the National Benchmarking Workshop on Probable Hydrologic

Consequences/Cumulative Hydrologic Impact Assessments. The forum was interactive, with state regulatory authorities, the Office of Surface Mining, and industry representatives presenting current studies and application of technology to these hydrologic issues. Approximately 75 representatives from the state regulatory programs, industry, academia, the Office of Surface Mining, and other federal agencies attended.

Bonding Assistance

During 2004, the Office of Surface Mining contracted for on-site administrative bonding technical assistance by a bonding specialist who provided training to the states of Alaska, Colorado, Montana, New Mexico, Utah and Wyoming. The specialist provided updates and advice to all Western state bonding staff on the U.S. Treasury Department's Circular 570. Specific state assistance also was provided on the status of specific surety companies, bond forms for use with phased bonding, self-bonding evaluation, bond riders for permit renewals, and standby letters of credit to secure collateral bonds.

Technology Transfer

During 2004, the Office of Surface Mining/State National Technology Transfer Team continued to coordinate Office of Surface Mining technology transfer activities. The Team, formed in 2003, serves as the clearinghouse for technology transfer activities to assure that the Office of Surface Mining and the states make the most efficient use of technical resources, including both dollars and staff. Within each Office of Surface Mining region, there are technology transfer teams that actively solicit technology needs. When transfer activities are identified, they are reviewed to determine appropriateness for regional or multiple-regional transfer. During 2004, two technology transfer activities were expanded to include more than one region.

The Team has developed plans for reviewing applied science proposals and has worked closely with state mining and reclamation associations on technology transfer events. The Team also publishes a compendium of technology transfer activities related to coal mining and reclamation and sponsors technology transfer events that cross regional boundaries.