OSM TIPS SERVICE SHARES ADVANCED COMPUTER BASED TECHNOLOGY NATIONWIDE[1]

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Abstract. Providing a common set of technology tools to regulators and reclamation specialists in the Office of Surface Mining (OSM) is helping to streamline the mandates of the Surface Mining Control and Reclamation Act (SMCRA).

The Technical Innovation and Professional Services (TIPS) Team consists of 32 people in four OSM offices. In cooperation with State and Tribal regulatory and reclamation agencies, as well as OSM offices nationwide, TIPS provides the latest off-the-shelf scientific and engineering software and hardware tools to federal, state, and tribal experts. These are the same tools used commonly by the mining industry. With the industry regulators and reclamation specialists at the state, tribal, and federal level using the same tools, exchange of information is facilitated and the regulatory and reclamation processes are expedited. This has become an extraordinarily efficient way to carry out the reclamation and regulatory mandates of the Surface Mining Control and Reclamation Act.

TIPS began in 1987 as a team of nine persons serving 28 customer locations in 24 states. Today the Team provides scientific and engineering modeling software, hardware, and full training classes to 700 customers in 96 office locations at 24 states, three tribes, and 15 federal offices.

This team of innovators holds costs low through shared licensing of the software via the Internet and centralized federal procurement contracts. TIPS also provides full software support and training classes at no cost to its customers. These are specially tailored courses, customized specifically around mining applications of the software. Customers value this training so much that they volunteer as instructors. Over half of all TIPS instructors today come from the customer base.

The innovators of TIPS have fostered electronic exchange of data between federal, state, and tribal agencies for 20 years. Their hard work has brought mining reclamation and regulation to increasing levels of efficiency. The most recent two years have brought significant department cooperation and subsequent progress for TIPS, and they continue to pursue new technology and the tools to promote better and more efficient enforcement of the Surface Mining Act.

Additional Key words: TIPS, technology tools, software, hardware, OSM, GIS, GPS, CAD, mapping, geospatial, remote sensing, mobile computing, science and engineering tools, Surface Mining Act

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Background

"New capabilities emerge just by virtue of having smart people with access to state-of-the-art technology."

Robert E. Kahn

TIPS –Technical Innovation and Professional Services – Brings advanced scientific and engineering capabilities to coal regulatory and reclamation agencies

TIPS is a service developed by an innovative group of employees at the Office of Surface Mining. In cooperation with State and Tribal regulatory and reclamation agencies, as well as Office of Surface Mining offices nationwide, TIPS provides the latest off-the-shelf scientific and engineering software and hardware tools for Federal, State, and Tribal experts to do their jobs faster and more efficiently.

Interior's Office of Surface Mining regulates coal mining and helps to reclaim land devastated by past mining. The agency also provides funding and oversight for State and Tribal agencies to carry out the mandates of the Surface Mining Control and Reclamation Act of 1977. In the mid 1980's, many of these agencies were requesting funds to buy computer equipment and software to help evaluate coal mining and reclamation issues. A few far-sighted individuals at the Office of Surface Mining saw this as an opportunity – an opportunity to ensure that every coal-regulatory and reclamation agency was using the same tools to conduct their technical business. This was especially valuable to some smaller agencies that could not afford such technology. With the same tools these agencies would be able to exchange critical technical data, and the Surface Mining Control and Reclamation Act would be administered more uniformly nationwide. It also allowed for a large federal purchase of equipment, resulting in considerable cost savings. The result was the formation of TIPS in 1987.

The service evolves with the technology

When TIPS began it placed a 386 DOS-based computer with modem, digitizer, plotter, and printer at a central location in each of 28 office locations in 24 states. Each computer had scientific modeling software available for use by all users at each installation location. Over the years, this setup has now grown to advanced scientific and engineering modeling software available to all regulatory and reclamation staff directly at their desktop computers at 96 office locations nationwide. Scientists and engineers use 28 different modeling and analytical software programs from such companies as ESRI, AutoDesk, Dynamic Graphics, and Carlson Software to create maps, calculate material volumes, predict subsidence and water pollution, evaluate statistics, model ground-water, and even create three-dimensional images of mining effects below the earth's surface. A system of national license sharing developed in cooperation with each software developer allows TIPS to distribute costly scientific and engineering applications to 700 desktops nationwide at a fraction of the cost of buying individual licenses for each user. This kind of innovation allows TIPS to provide more technical tools to more of the technical specialists that need them.
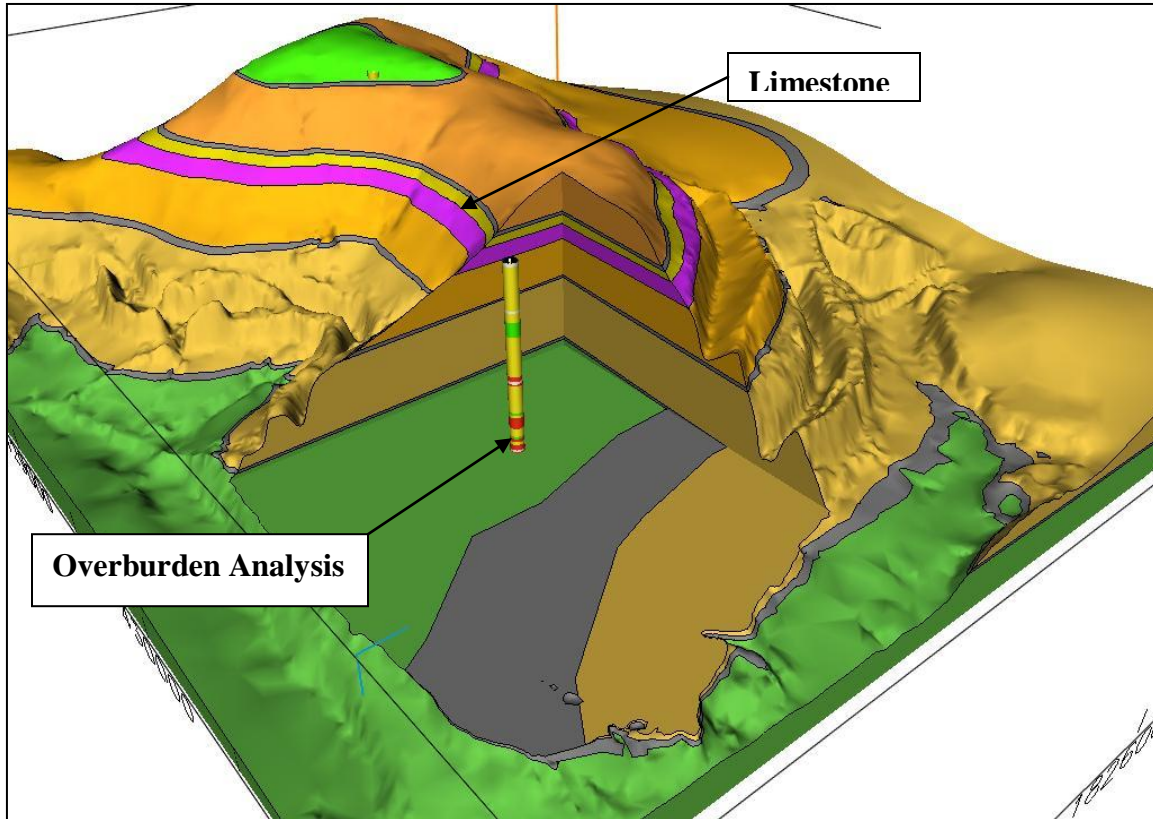
Figure 1: The Pennsylvania Department of Environmental Protection used earthVision modeling software from TIPS to help clean up acid mine drainage from this area near the Dent's Run watershed in rural Northern Pennsylvania.

By making the technology tools available to more people directly at their desktop, usage has grown from 56 licenses in use each business day in 2001 to over 100 licenses used daily in 2006.

Training is the most sought after commodity

Technology tools are not the only commodities provided by TIPS. TIPS also provide expert support and a full schedule of training classes for each of the software programs. Team members develop custom classes in each software application. They draw from real-life mining examples and their own experience to tailor the training to the type of work the students will be doing after class is over. This customized training for coal regulatory and reclamation customers is much more cost effective than general vendor-provided training.

"The people are what really make TIPS unique," says OSM Division Chief Billie Clark from his office in Denver. "Sure we have some computer specialists, and their contribution is critical to our success, but the majority of the team are scientists and engineers who knew the regulatory and reclamation work before TIPS even started. They knew the issues that the technology could solve, and therefore how to apply the technology. They made TIPS effective as soon as it left the gate."

The Team includes members from all three of the Office of Surface Mining's major regional centers in Pittsburgh, PA; Alton, IL; and Denver, CO. Also included are members from the Knoxville Field Office in Tennessee.

The demand for training has outpaced team resources from the very first day. "The Team has a limited staff," says TIPS Training Program Leader Karyn Evans. "They weren't hired as instructors, they were hired for their scientific knowledge and expertise. The teaching grew out of a need to train people in how to use the software for a very specialized purpose – coal mining regulation and reclamation."

Figure 2: Students attend Mobile Computing Training at the TIPS Training Center in Pittsburgh, PA; one of three TIPS computer training centers. Others are located at Denver, CO and Alton, IL.

"As our students become proficient in use of the software in mining applications, we impose upon the best ones to become teachers," says Karyn. "Thankfully, many have

accepted. Today over half of the instructors for TIPS courses are state employees. They know how short staffed we are, and they share a commitment to the program."

During the past year, TIPS trained 362 students in 33 classes. Through a contract for eight on-line Geographic Information System courses from ESRI's Virtual Campus, e-training is available and in 2006 45 students have taken the on-line classes.

No state, tribal, or OSM office is required to use TIPS. Participation is voluntary, and the Federal government as part of the TIPS budget underwrites all software, equipment, and training costs. Participation is limited to Federal, State, and Tribal agencies that carry out the functions of the Surface Mining Control and Reclamation Act.

A variety of tools for a variety of uses

The software that TIPS provides is listed in Table 1 below. Coal mine inspectors may use TIPS technology tools to precisely locate mine facilities and mining areas in relation to permit areas, and to perform comprehensive inspections over a greater area in less

Table 1: Software Provided by TIPS	
AMD Treat (Acid Mine Drainage)	**AQTESOLV** (Analysis of aquifer data)
ArcGIS and Extensions (GIS)	**AquaChem** (Water-quality analysis)
ArcView (GIS)	**AutoCAD/AutoDesk Map** (Computer-aided drafting)
ArcPad (Mobile computing and mapping)	**ERDAS Imagine** (Remote Sensing)
Blast Log Evaluation Program (Blasting analysis)	**EarthVision** (Create 3-D earth models)
ERDAS (remote-sensing analysis software)	**Galena** (Slope stability analysis)
HEC-RAS (Surface-water analysis)	**GMS** (Ground-water modeling system)
Geochemist's Workbench (Water-quality analysis)	**Groundwater Vistas** (Ground-water modeling)
Image Analysis for ArcGIS (Remote Sensing)	**HEC-RAS** (Surface-water modeling)
Natural Regrade (Reclaimed stream channel design)	**Pathfinder Office** (GPS)
Planimeter (Calculate acreage from maps)	**RUSLE** (Soil loss analysis from erosion)
StatGraphics (Statistical analysis)	**Stereo Analyst for ArcGIS** (3D Imaging)
Surface Deformation Prediction System (Subsidence modeling)	**SEDCAD** (Surface-water modeling)
SurvCADD (Mapping and 3-D modeling)	**TerraSync** (Mobile Computing and mapping)

time. Satellite and air photos provide a tool to quickly evaluate vegetation success and to locate areas of greater erosion. Global Positioning System technology can be combined with mapping software on laptop computers for inspectors to use interactively while at a mine site.

With TIPS, reclamation specialists design the most effective post-mining landscapes using precise volumes of earth material, preventing erosion and minimizing landslides. Potential mining impacts on both ground and surface water can be modeled and what-if scenarios created and evaluated. Statistical tools help validate water-quality analyses and other software can help detect the source of contaminants in water samples.

TIPS GIS is Adapted to Surface Mining Applications

TIPS has selected the suite of Geographic Information Systems (GIS) software from the Environmental Systems Research Institute (ESRI) as its standard for GIS software. A GIS can portray the total picture of pre-and post-mining environmental conditions and monitoring of regulated activities is easier. Well-informed decisions about proper waste rock and soil handling and storage are possible in less time with less effort. Such decisions ensure that proper drainage is preserved and sensitive plants, animals, and water are protected. With GIS software, natural features and man-made activities can be mapped and characterized (attributed) for comparison and interrelationship analyses. For example a map of wildlife areas can be combined with a map of vegetation species to determine the appropriate plant species composition for each wildlife area (Fig. 3). With this information, post-mining land use can be better planned with more successful results.

Most of the TIPS state and tribal partners, and OSM offices use the ESRI ArcGIS and ArcView software to: (1) create and manage GIS databases and (2) to produce GIS maps. The following licensed ArcGIS software products are distributed to all TIPS participants:

- Spatial Analyst,
- 3-D Analyst,
- Geostatistical Analyst,
- ArcPress,
- ArcScan, and
- COGO

These ESRI products are licensed using FLEX*lm* from Macrovision™. TIPS users have access to ArcView through the KeyServer® License Manager produced by Sassafras Software.
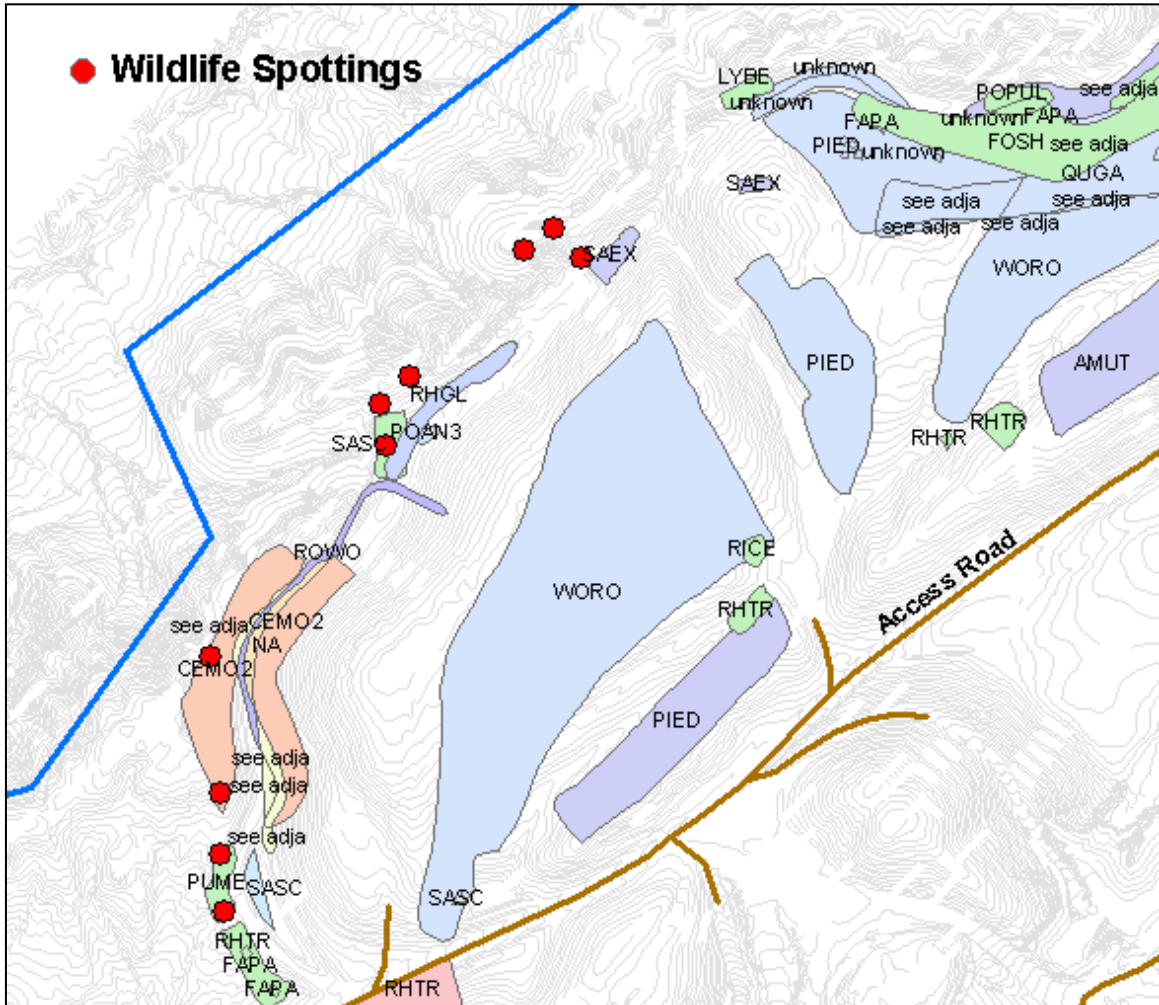
Figure 3: This GIS map shows wildlife areas relative to seedling planting areas.

Because many States have limited budgets, they can't afford to pay for much GIS training. TIPS fills this gap by offering instructor-led classes in ArcView, ArcGIS, and ArcGIS Spatial Analyst. These courses are customized to provide students with exercises that use actual mining data and examples. TIPS also pays for eight of ESRI's on-line courses on topics ranging from Visual Basic programming to Metadata compliance. Over the past year, TIPS trained 229 students in GIS and provided the opportunity for tribal and state personnel to receive this otherwise expensive training at no cost to them. TIPS customers frequently consult with the GIS instructors and software managers to solve problems with software, hardware, and application problems so they can get their work done with fewer headaches. Chances are someone on the TIPS GIS team has already "been there and done that!"

Mobile Computing goes to the Active Mine Site

One of the hottest developments in geotechnology is the integration of maps and data with real-time GPS positioning. This technology allows the field inspector (Figure 4) to: (1) field verify information provided by the mining company and (2) collect new information using real-time GPS logging. The ability to add detailed attributes right in the field means that nothing is forgotten later and the background maps and images allow inspectors to verify the accuracy of their collected GPS data.

TIPS has deployed many such systems to the field. Systems currently being tested include (1) handheld, supercharged Personal Data Assistant (PDA) devices and (2) fully sunlight readable, ruggedized tablet computers all linked with real-time differentially corrected GPS units. Eventually TIPS envisions that field inspectors, engineers, and technical staff will supplement, if not replace, their clipboards, paper maps and rangefinders with this amazing technology.

Figure 4: An OSM specialist and a Missouri state inspector measure topsoil depth at a mine site in southwest Missouri using a Global Positioning System-enabled tablet computer.

A Top Down View Promotes Greater Efficiency

Remote sensing using aerial and satellite imagery is having a major impact on the way some TIPS customers do business (Fig. 5). Surface coal mining regulators and reclamation specialists have always appreciated the benefits of aerial photography but it is simply too costly to use routinely. Off-the-shelf data (like Digital Orthophotoquads) are frequently old and may lack the needed resolution. With the advent of powerful desktop computers, user-friendly software, and several new high-resolution satellites, TIPS customers are lining up to use remote sensing technology. Focusing on one-meter or better satellite imagery, TIPS has developed projects with state personnel in Pennsylvania, Virginia, West Virginia, Kentucky, and Tennessee. In the West, TIPS is providing high-resolution imagery on a quarterly basis to inspectors, permitting staff, management, states, tribes, and other federal agencies for mines in Arizona, New Mexico, and Washington.

Along with providing imagery and conducting pilot studies, TIPS is providing training, software, and hardware support to customers based upon the ERDAS Imagine photogrammetry suite of software. TIPS trains state, tribal, and OSM officials to process satellite and aerial imagery into high-resolution digital elevation models and orthophotos. In addition, because much of the satellite imagery TIPS acquires is in stereo, advanced photogrammetric mensuration and 3-D GIS digitizing tools and techniques are being supported. TIPS remote sensing is truly state of the art. On several occasions, it has been recognized nationally for the early adoption of this technology.
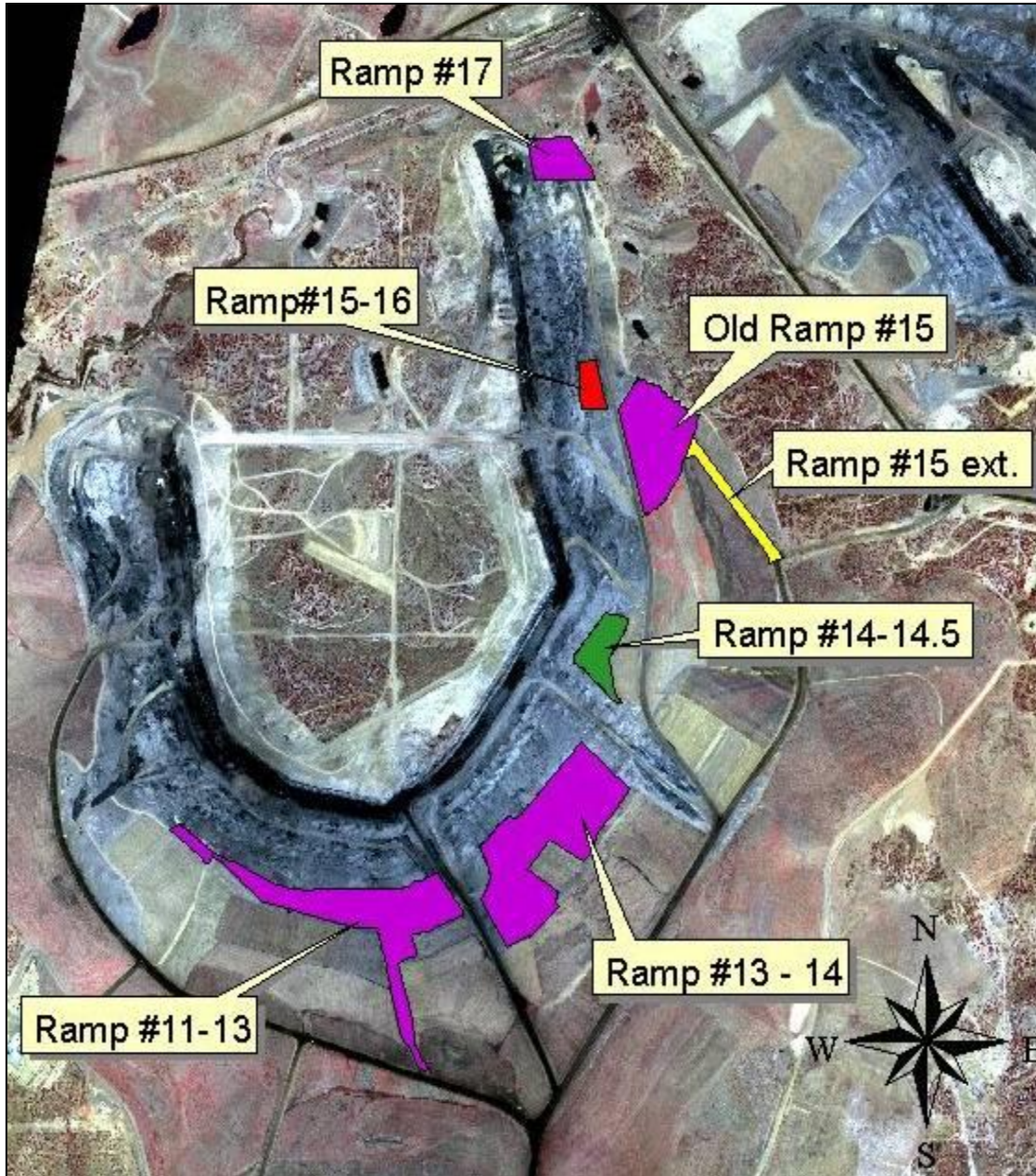
Figure 5: At a mine in Northern Arizona satellite photography is used to map the coal-pit reclamation areas.

Summary

TIPS is now in its 20th year of providing high-technology tools to the federal, state, and tribal agencies that regulate coal mining and reclaim dangerous abandoned mine areas nationwide. In those two decades the computing industry has changed constantly and experienced huge leaps in technology. TIPS keeps pace with the changing technology and the needs of its customer base through the guidance of the TIPS Steering Committee, comprised of representatives of its customer base. The tools provide a mechanism for faster and more efficient analyses that are fully compatible and exchangeable with each agency. Because the agency needs are partly based upon the capabilities of the mining companies involved, the products are compatible with much of the mining industry as well.

Beginning this year, plans for improvements in OSM's Technology Transfer initiative will create a better opportunity for collaboration between TIPS, individual technical experts in OSM, and the TIPS customer community. A major catalyst to this improved Technology Transfer collaboration within OSM is the fact that experienced technical experts that have long served as TIPS Team members have recently been placed in management positions in all three OSM regions. These individuals have direct experience in both the needs and the tools needed to provide effective and efficient SMCRA solutions.

TIPS sponsors efforts to provide coal mining spatial data standards for SMCRA related projects. This will result in standardized data for sharing more efficiently among state, tribal, and federal agencies and the public. In fact, lives may be saved as a result of this initiative by providing accurate locations of underground mine workings to emergency agencies for rescue purposes. Data standards simply improve the process of communicating mine map information. When accurate mine map information is readily available the Surface Mining Act works more efficiently, the environment is improved, and more lives can be saved.

Further information can be found on the TIPS website at www.tips.osmre.gov or by contacting TIPS Chief, Louis Hamm at lhamm@osmre.gov