U. S. Department of Energy • Federal Energy Technology Center

Environmental Solutions

A Periodic Newsletter for FETC Stakeholders

Volume 1 Issue 2

Get the Red Out

It's not that they accept the color—no one looking at a rust-red stream thinks it's acceptable—but folks living close to streams affected by acid mine drainage become accustomed to it, and they learn to overlook it. Newcomers can't. The yellow, orange, and red streams seem otherworldly. The color is so startling it's like something Pathfinder would have found on Mars.

Hundreds of streams, some 7,500 miles of them, are affected by acid mine drainage (AMD) in Appalachia. Fourmile Run in southwestern Pennsylvania is one of them. Abandoned underground mines around Fourmile Run have slowly filled with water over the years, so that now, orange, iron-laden water oozes up through the ground along its banks. The water spills into Fourmile Run and is carried into Monastery Run, then Loyalhanna Creek, the Kiskiminetas River, the Allegheny River, and the Ohio.

Fortunately, Fourmile Run is not highly acidic. AMD can be more acidic than vinegar (pH 4.7), but Fourmile Run has a pH of about 6, close to water's neutral pH of 7. The biggest problem with Fourmile Run is its iron content. Fourmile Run pours so much iron into Monastery Run that when Monastery Run flows into Loyalhanna Creek, it spoils one of the region's best and most heavily fished trout streams.

Loyalhanna Creek isn't exactly lifeless below the mouth of Monastery Run, but it's close. Fish can swim through the contaminated section of the creek, but they can't live there long; there's nothing to eat. The food chain is disrupted because the stream bed is dead.

This is the problem that the Loyalhanna Creek Mine Drainage Coalition is trying to solve. For 6 years this coalition of citizens' groups, concerned individuals, public agencies, private sector businesses, and universities has worked to clean Loyalhanna Creek and its tributaries. The first

FETC researchers work with students at Saint Vincent College to monitor the water quality of Loyalhanna Creek and its tributaries.

Environmental Solutions is a periodic newsletter of the U. S. Department of Energy, Federal Energy Technology Center (FETC) that communicates information about FETC's environmental mission, programs, and current issues.

For further information about FETC, requests for copies of this newsletter, or suggestions for articles, please contact the senior editor, Heather Quedenfeld, at hquede@fetc.doe.gov.

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measure to be implemented has been the construction of three sets of wetlands, covering some 20 acres along Fourmile Run on the grounds of Saint Vincent College in Latrobe, PA. The last of the wetlands was completed and all three were dedicated in November 1998.

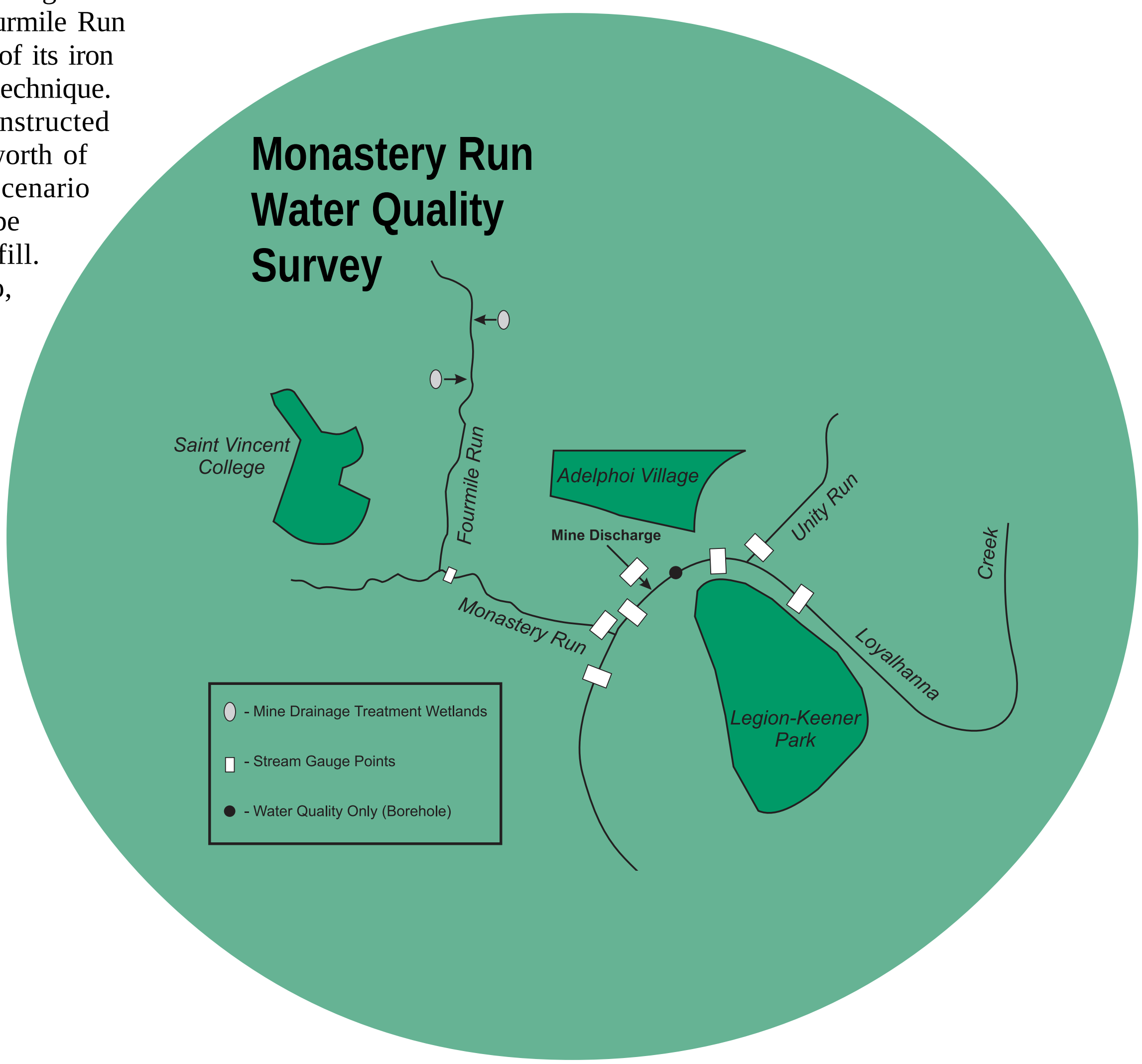
Visually, the wetlands are surprising. *Saint Vincent*, the alumni magazine for Saint Vincent College, described them as “an odd series of ponds with water the color of pumpkin soup.” It’s not really the water itself that’s orange, but the iron in the water that becomes oxidized and precipitates, forming a film of yellow, orange, and red sludge that chemists call “ferric oxyhydroxides” and miners call “yellow boy.” Although this precipitate is unsightly, its formation is what cleans the water; water leaving the wetlands and entering Fourmile Run has more than 90 percent of its iron removed by this passive technique.

The wetlands were constructed to hold 25 to 30 years’ worth of sludge. The worst-case scenario is that they will need to be reconstructed once they fill. A more positive scenario, and one that is being pursued, is that a market can be found for the precipitated chemicals, possibly as paint pigments. In this case, the life of the wetlands will be extended and they will generate income for Saint Vincent College.

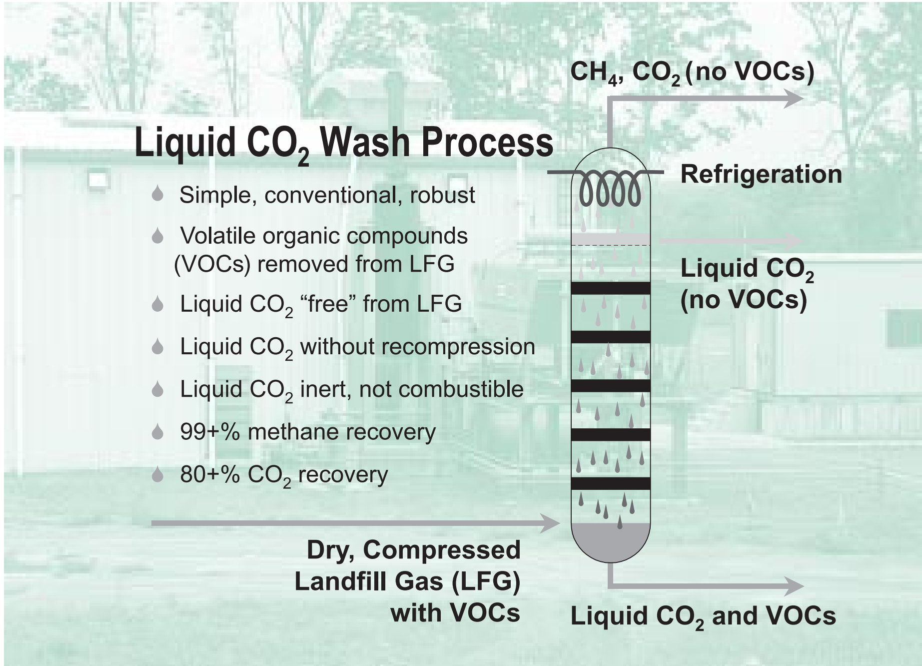
The results seen to date, and those that are anticipated, could not have been possible without a large number of individuals and agencies working together toward a common goal. FETC’s role has been to assess the impact of treatments on receiving streams. Included in the wetlands is a four-cell “mesocosm,” an outdoor laboratory where students study the impact of the cleanup and evaluate different treatment methods to remediate AMD. Researchers at FETC have worked with students to collect water samples from Monastery Run and Loyalhanna Creek, have the samples analyzed for water quality, and interpret the data.

If the wetlands and other cleanup efforts along the Loyalhanna are successful—and indications are that they will be—the 21-mile stretch of Loyalhanna Creek between the mouth of Monastery Run and the creek’s confluence with the Conemaugh River may once again run clear by the year 2000. Cleaning 21 out of 7,500 miles of contaminated streams is a small step, but it’s a step in the right direction, a step toward a future in which no one is accustomed to bright orange water, and our streams once again teem with life.

For more information, contact Bill Aljoe at aljoe@fetc.doe.gov.



New Beginnings at the Landfill



When the Mobro 4000, the infamous Long Island garbage barge, wandered the Atlantic just over a decade ago looking for a place to dump its load, landfills were in the news and on our minds. Since then, they've faded from the headlines and our thoughts as they quietly go about their business, collecting and managing over half of the 200+ million tons of municipal solid waste that Americans generate each year.

If we think of landfills at all, we tend to think of them as an ending; our waste goes in, and that's the end of it. But this view shows a misunderstanding of what landfills are and what they do; it misses their potential for generating electricity and other revenue-producing products.

As waste decomposes in a landfill, it generates landfill gas—typically, methane (49 percent), carbon dioxide (39.5 percent), and nitrogen (9 percent), with small amounts of water, oxygen, and undesirable trace compounds. Uncontrolled, landfill gas is a safety hazard—it can be explosive under certain conditions—and it contributes to global warming, smog, and, unsurprisingly, odor problems.

Federal law requires that most large landfills install gas collection systems so that the gas is not released into the atmosphere. While it is acceptable to burn the gas, it could be used for other purposes. About 140 landfills in the United States currently put their landfill gas to good use by generating electricity, using it in industrial processes and greenhouses, or upgrading it for pipelines and vehicle fuel. According to the U.S. Environmental Protection Agency, five times that many landfills could cost-effectively produce energy—enough energy to meet the energy needs of 3 million homes in the United States.

Because of this potential, FETC awarded a Small Business Innovative Research grant to Acrion Technologies of Cleveland, OH, to develop and demonstrate an innovative process to clean landfill gas. The Acrion process captures the naturally occurring gas from the landfill, dehydrates and compresses it, then feeds it into the bottom of a 15-ft tall column packed with stainless steel mesh. Refrigeration at the top of the column condenses the carbon dioxide in the gas into a liquid. A portion of this liquid washes down through the packed column; the remainder is drawn off as purified liquid carbon dioxide.

As the ascending gas moves past the descending liquid carbon dioxide, the carbon dioxide "washes" the gas by picking up the environmentally harmful substances and carrying them to the bottom of the column. At the bottom, the liquid carbon dioxide and contaminants are heat exchanged, returning them to a gaseous state, and they are sent to the landfill flare for destruction. Clean methane-carbon dioxide gas leaves the top of the column.

The clean methane-carbon dioxide gas can be processed to pipeline gas or alternative transportation fuel, and commercial carbon dioxide. Alternatively, it can be used as a feedstock for methanol, which in turn can be used in niche markets for windshield wiper fluid, racing fuel, or sewage treatment.

After successfully demonstrating the technology at the Al Turi landfill in Goshen, NY, last summer, Acrion Technologies is now actively marketing their process. Its success will mean that more landfill gas is put to productive use instead of being burned off and wasted.

In the future, perhaps when we think of landfills, we won't think of them as an ending; perhaps we'll think of products, opportunities, and new beginnings, as we should.

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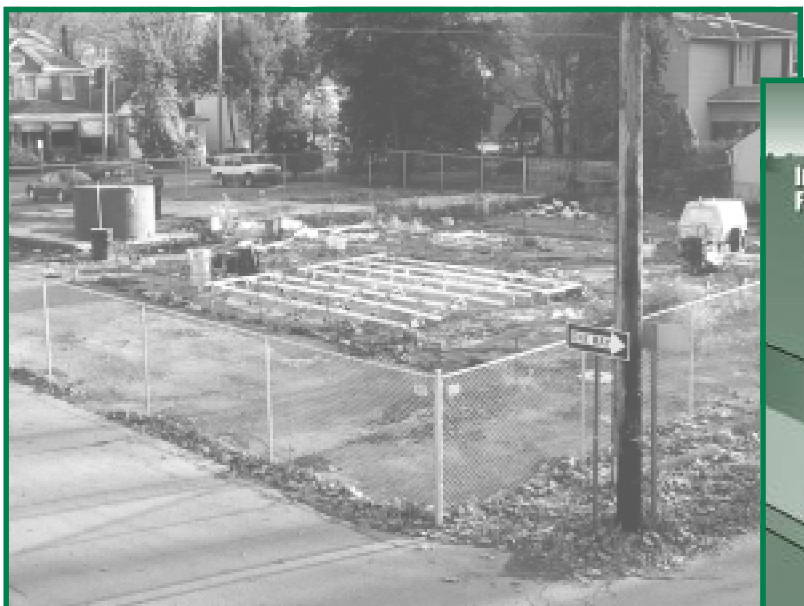
Cleaning up the Dirt

Below the earth's surface—in the cracks and pores of underground rocks, and running between grains of sand and gravel—lie more than 2 million cubic miles of fresh groundwater. This water—enough to cover the surface of the United States over half a mile deep—provides drinking water for one-half of the U.S. population. It is also one of our most important sources of irrigation water, and much of it is threatened. At thousands of contaminated sites nationwide, soil pollutants are poised to seep into the groundwater unless they are cleaned up.

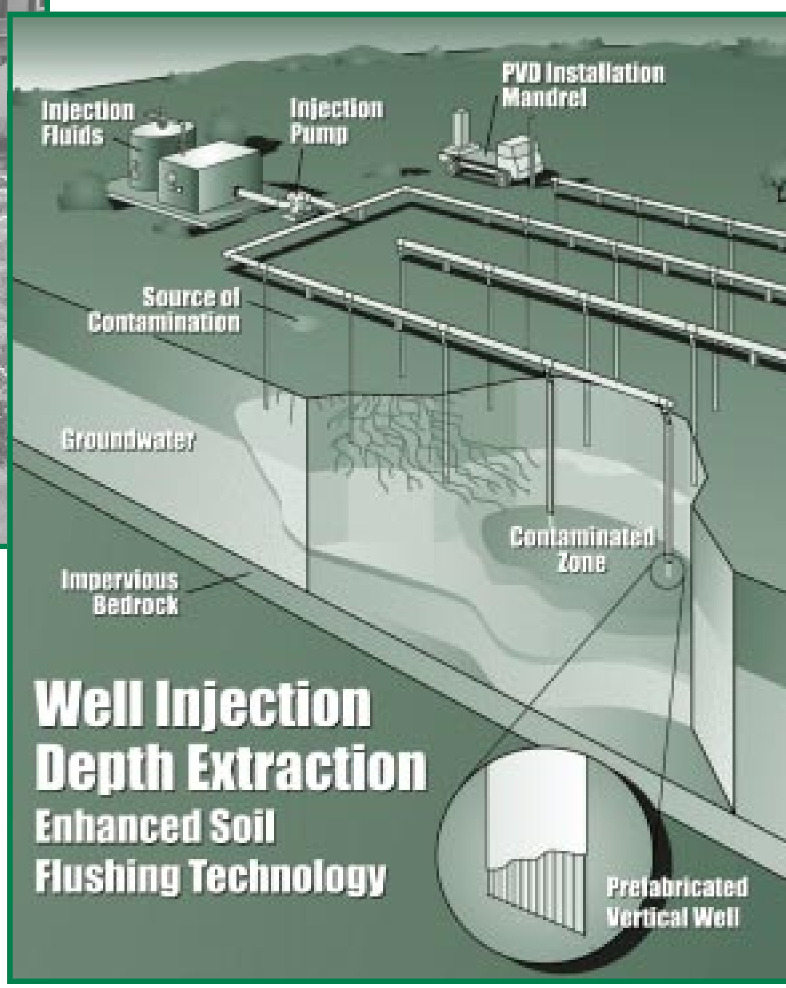
Many human activities have contributed to this problem. Industries large and small have left behind an "alphabet soup" of chemical contaminants—BTEX, PCBs, and TCE (benzene, toluene, ethyl benzene, xylene; polychlorinated biphenyls; and trichloroethylene), to name a few—as well as radiological and biological hazards. Some of this contamination occurred from spills or accidents, but most of it occurred through normal handling of substances that are now considered hazardous—at a time when less was known about their long-term effects, and regulations were more lax than they are today. Technologies exist to remediate soil contamination but they are limited and costly.

FETC is developing a faster, cheaper way to "clean up the dirt" through a joint project with its industry and university partners. Working with researchers from West Virginia University and NILEX Corporation, FETC has developed a cost-effective, efficient method of in situ soil decontamination. Rather than digging up and removing huge volumes of soil—an effective but expensive process—the contaminants alone are removed. The new method saves time and money by using an adaptation of a common, off-the-shelf technology: prefabricated vertical wells (PVWs).

PVWs are "wick" drains that have been used by the construction industry for decades to remove water from soil. Each drain looks something like a long, flattened hose, 4 inches wide and about ¼ inch thick. Each has an inner core of extruded polypropylene—with grooves along its length to provide a flow-path for fluids—and an outer jacket of a non-woven



A pilot-scale test of the Well Injection Depth Extraction system was conducted at an abandoned gas station in Weston, WV. The system effectively removed chemical contaminants that were threatening the nearby West Fork River.



polypropylene geotextile fabric that filters out soil particles while allowing fluids to pass through.

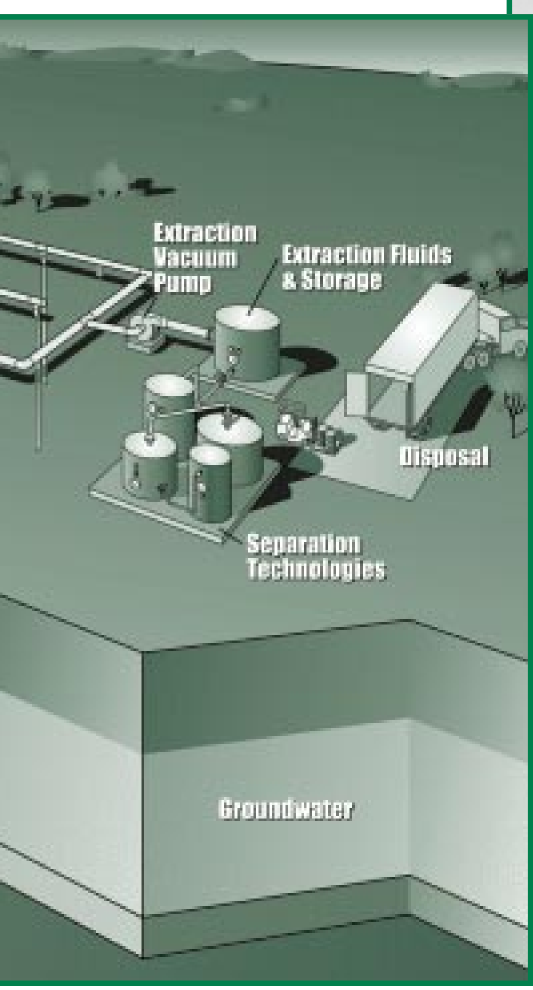
The PVWs are installed in the contaminated area in a grid pattern, 2- to 3-feet apart. A crane-mounted mandrel punches them down into the ground, much like a sewing machine needle punches through cloth. Anchor plates attached to the underground ends of the drains keep them in place when the mandrel is removed. Once the PVWs are in the ground, the aboveground ends are connected by drain pipes to form a manifold.

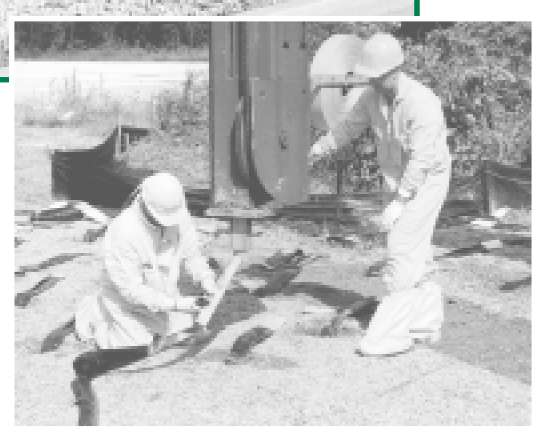
The entire manifold can be attached to a suction device that extracts water and contaminants from the ground. Alternatively, one part of the manifold can be used to inject specially formulated surfactants that “loosen” and flush out the contaminants, while another part is attached to the suction device to remove water, surfactants, and contaminants. The extracted fluids are subjected to membrane filtration to remove contaminants, and the contaminants are put into containers for final disposal. The cleaned water can be released to the environment or to the local public-owned water-treatment facility.

A pilot-scale test of the PVW system at an abandoned gas station in Weston, WV, verified the effective and efficient removal of BTEX. At the Weston site, 424 PVWs were installed in three different test pads. The PVW system successfully cleared BTEX from the test areas. The system was then deployed sitewide to remediate the remaining contamination, protecting neighbors, businesses, and the nearby West Fork River. The system is now being tested on a larger scale at a former industrial site in Ashtabula, OH, that is contaminated with TCE, technetium-99, and uranium.

The successful development of this technology shows how government, the private sector, and academia can work together to deploy a novel technology in a shorter time. And it gives us an efficient tool to “clean up the dirt” to protect our groundwater and create a better environment for all.

For more information, contact Karl-Heinz Frohne at kfrohn@fetc.doe.gov.





Prefabricated vertical wells (PVWs) are punched into the ground using a crane-mounted mandrel. The system is now being used to remove contaminants at a former industrial site in Ashtabula, OH.

Ready for the Rain

It's said that when flatlanders visit the mountains, they come down with something called "horizon fever," a yearning for wide-open views, the sight of the horizon far in the distance. The converse is also true: When mountain folks leave their hills, they often miss the feel of the mountains around them, the sense of being held in the arms of the earth.

Nowhere is this feeling of being embraced by trees and rocks and soil stronger than in Randolph and Tucker Counties in the Allegheny Mountains of eastern West Virginia. With few exceptions, the land here seems to go up or down, but is never flat, and settlements are restricted to narrow river valleys. The danger with this kind of development is that when it rains, the rivers swell, and if the rivers jump their banks, homes and businesses and dreams are quickly washed away.

Randolph and Tucker Counties have suffered more than their share of devastating floods. Since 1967, flooding in these counties has led to Presidential disaster declarations five times. In 1996, Randolph and Tucker Counties received a total of $65 million in disaster aid. More important than numbers, however, is the human toll of these events; each flood has brought destruction, and many have taken lives.

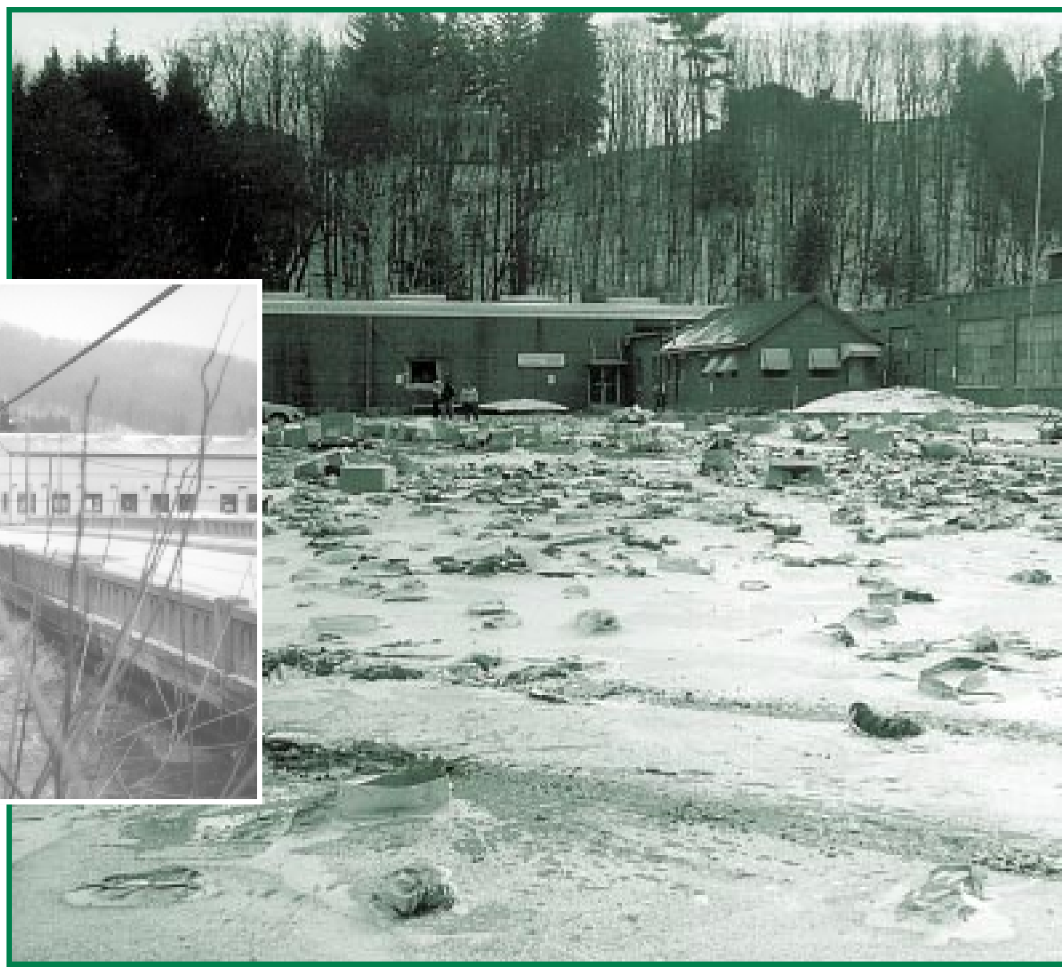
Because of this history, Randolph and Tucker Counties were chosen in 1998 as one of seven pilot communities for a new Federal Emergency Management Agency (FEMA) program called Project Impact: Building a Disaster-Resistant Community. Project Impact helps communities protect themselves from the devastating effects of natural disasters by taking preventative actions to reduce disruption and loss.

Project Impact's common-sense approach to damage reduction is based on three simple principles:

(1) preventive actions must be decided at the local level,
(2) private sector participation is vital, and
(3) long-term efforts and investments in prevention measures are essential.

The project is implemented in four overlapping steps; the first is to build community partnerships. The idea is that focused, well-directed groups with complementary skills accomplish more than a collection of individuals. By April 1999, the Randolph-Tucker Partnership had 65 public- and private-sector partners—everyone from the phone company to the local newspaper; schools; banks; businesses; the YMCA; Rotary Clubs; and city,

Randolph and Tucker Counties (WV) were hard hit by floods in January 1996. The receding waters left debris like these shoes and shoeboxes outside a shoe factory in Parsons, WV.



county, state, and federal agencies, including FETC.

The next step is to identify risks. FETC is playing a critical role in this important area. FETC's experts have installed, and are providing training and technical support for, a desktop geographic information system (GIS) which can identify structures in the 100-year flood plains of rivers and streams—areas expected to flood, on average, once every 100 years. This information will be combined with on-site surveys of structures and facilities, data about historical damages and expected development trends, economic information, and other data to determine overall risk to structures and facilities in Randolph and Tucker Counties. In addition to collecting data using the GIS, FETC is lending its procurement expertise to help select the engineering firm that will complete the risk assessment.

Following risk assessment comes hazard mitigation: prioritizing needs and taking action to reduce or eliminate the future damage. Mitigation can include redirection (building flood walls, for example), interaction ("flood proofing" structures), or avoidance (removing some structures at very high risk). FETC anticipates being actively involved in this step as an outgrowth of its key role in risk assessment.

The fourth step is to communicate, communicate, communicate. An on-going effort to inform the community, and provide opportunities for involvement, builds support for the project and keeps the community focused on its benefits.

FEMA projects that an investment in mitigation has at least a 100 percent return. Anheuser-Busch, for example, made pre-disaster investments in mitigation that saved an estimated $300 million when the Northridge Earthquake struck southern California in January 1994—fifteen times the cost of investment.

These figures are impressive, and they are strong motivation to invest in disaster prevention. But cost-savings are not the only reason to make a community more disaster-resistant. Saving lives, preventing disruption to lives, and preserving a way of life are also strong motivators.

Life in a West Virginia river valley—nestled among oak, maple, and cherry trees, surrounded by deer, raccoons, woodpeckers, and wild turkey—is an indescribable joy; John Denver described it as "almost heaven." Preserving this, with an added measure of safety from forethought and preparedness, is priceless.

For more information, contact Randy Harris at harri@fetc.doe.gov or Susann Schreiber at sschre@fetc.doe.gov.

FETC works with other members of the Randolph-Tucker partnership to build disaster-resistant communities. Flood walls (left) have been built to help protect Parsons, WV, from future floods. Below, FETC employee Ray Lopez and Barb Elza, Coordinator of the Randolph-Tucker Partnership, use the desktop geographic information system (GIS) that FETC installed.

Building a Disaster Resistant Community
PROJECT IMPACT

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