CLEAN WATER
University researchers save Aspen Creek

By Melanie Robbins ’06M.A.

A sulphur mine in east Alpine County, Calif., that dates to the Civil War polluted the waterways so much that Aspen Creek, which ultimately flows into the East Fork of the Carson River in Nevada, was virtually dead. Water running over the waste rock miners left behind leached out acidic toxins that poisoned the life in the creek. But today, thanks to an Atlantic Richfield-University of Nevada, Reno bioreactor project, Aspen Creek is flowing clean and clear.

“It’s effectively as healthy as an unaffected stream nearby,” says Glenn Miller, professor of natural resources and environmental science, as well as University director of the Leviathan Mine bioreactor project.

Deemed a Superfund site in the late 1990s due to contamination by acid mine drainage, Leviathan Mine was one of the worst polluters on the river, according to Miller. But the bioreactor, a doctoral dissertation project for several students including Tim Tsukamoto, ’93, ’99Ph.D., now a principal owner of Ionic Water Technologies, Inc. in Reno, essentially reverses the geochemical processes that cause pollution.

Mining brings to the surface rock that has been buried for millions of years, exposing it to air and weather. This weathering causes the rock to oxidize, which forms sulfuric acids that lower the pH of water running over the rock to toxic levels. At Leviathan Mine, groundwater bubbles up from seeps, a spot where fluid in the ground oozes to the surface and forms a pool. Rainwater and snowmelt also run over the exposed waste rock piles. The acidic water then leaches metals out of the rock and poisons the waterways.

But the University’s bioreactor, like a sewage treatment plant, collects the toxic water before it flows into nearby streams and adds certain bacteria. Then the researchers feed the bacteria ethanol, and through a series of biological processes, the bacteria turn the sulfuric acid back into sulfides, which combine with toxic metals and pull them out of the water. This produces sludge at the bottom of the bioreactor ponds, which is later hauled away, while the clean water flows freely over the top.

The only problem is that ethanol costs between $2 and $4 per gallon, which can run up costs for a plant that operates all day, 365 days a year. So Kendra Zamzow, a University doctoral candidate in environmental sciences, has been experimenting over the summer with a biodiesel fuel waste product supplied by Bently Nevada, a Gardnerville corporation. Bently manufactures about 300,000 gallons of biodiesel fuel each year by recycling used French fry oil. This process leaves about 20,000 gallons of waste. This waste, which was originally food-grade oil with potassium hydroxide and methanol added to convert it to biodiesel fuel, appears to be as good as ethanol as a food for the bacteria and also raises the pH. The waste is composed of alcohols, fatty acids and glycerin, which bacteria can eat, and the leftover potassium hydroxide neutralizes acidic water. Testing is still ongoing, but so far, “It works very well in the laboratory,” Miller says.

If Bently Nevada can ultimately be paid for its waste product, the company could make biodiesel fuel more financially attractive. “It’s win-win-win,” Miller says.

University expertise in the remediation of environmental problems has helped pave the way for a success story at Leviathan Mine, above, in east Alpine County, Calif. A University bioreactor, similar to a sewage treatment plant, has collected and treated the toxic water near Aspen Creek to make it clean and clear.

LOOK ONLINE
- Environmental Protection Agency Leviathan Mine case study http://www.epa.gov/superfund/programs/aml/tech/leviathan.pdf
- Lahontan Regional Water Quality Control Board Leviathan Mine Project http://www.swqcb.ca.gov/swqcb6/leviathan/LEVII_index.htm