Case Example

Occidental Petroleum Corporation: Protecting the Watershed in the Tennessee Copper Basin

A demonstration passive system developed by Glenn Springs Holdings, Inc. (a subsidiary of Occidental Petroleum) successfully reduced the concentrations of key metals and reduced acidity in an entire targeted watershed.

For more than 150 years, the Copper Basin in southeast Tennessee was the site of extensive copper and sulfur mining activities. Numerous companies and individuals were involved in mining, refining, and manufacturing operations in the area. By the late 1800s, vegetation refused to grow, acidic conditions and leaching metals impaired the water quality and deforestation resulted in severe erosion. It became one of the most dramatically impacted mining areas in the eastern U.S.

In 1987, the EPA began investigating the Basin, but by then operations had ceased and bankruptcies had left no viable party at the site. Despite never having engaged in any mining activities in the Basin, Occidental, which had acquired a company that once held an interest in the Basin (the mining operations had been sold prior to Occidental's acquisition) agreed to a role in the remediation process through its Glenn Springs subsidiary. In 2001, an unprecedented agreement by Glenn Springs, the Tennessee Department of Environment and Conservation (TDEC), and the Environmental Protection Agency (EPA), was reached formalizing a partnership to direct the clean up and redevelopment of the Basin.

As one part of the clean-up efforts, Glenn Springs addressed a 410-acre watershed known as the McPherson Branch. Near its confluence with North Potato Creek, this stream exhibited low pH, moderate acidity, and elevated metals. Additionally, remediation was challenged by high sediment load from eroded areas upstream. The conditions indicated that the drainage was a good candidate for treatment in a constructed wetland using the physical, chemical and biological processes that occur in natural marshes. However, evidence of very high flows and obviously high sediment loads required an innovative approach to implementing passive treatment.

Glenn Springs constructed a anaerobic wetland demonstration project that has successfully captured base flow from McPherson Branch, routing it through a cattail-dominated wetland. Limestone dissolution and bacterial sulfate reduction is now converting the acidic, metal-laden stream to an alkaline discharge with greatly reduced concentrations of problem metals. A rock filter system provides habitat for manganese reducing bacteria while increasing alkalinity and hardness. Addition of a one-acre, three-cell aerobic wetland has increased dissolved oxygen and provides more retention time for sulfide volatilization and oxygen demanding processes to occur. Additional grading and revegetation of the area surrounding the wetland and removal of a 10,000 cubic yard pile of mine waste has accelerated the very gradual improvement in water quality that had been occurring since the mines became idle decades ago.

As success of the passive system became evident, further work showed that the most important limiting factor for aquatic life in McPherson Branch downstream of the wetland was lack of habitat. Years of sediment deposition hampered the development of in-stream and stream bank vegetation. Without vegetation, aquatic insects did not flourish. So, in 2003, a 215-foot "restored stream segment" was constructed to improve habitat and to demonstrate that the McPherson Branch, having passed through the treatment wetland, would support aquatic life. Shrubs and plants native to the area were placed alongside recovering species. Rock, cobbles and aquatic insects were "transplanted" to the stream from nearby

waterways. Biologists are carefully monitoring the performance of the wetland, changes in habitat, macro invertebrate populations and water chemistry in the restored stream segment. Results have been encouraging and are being used to refine plans for stream recovery efforts elsewhere in the Basin. In addition, bench scale tests of passive systems are being conducted to determine the optimum components and sizing for future passive applications at other sites in the Basin.