Advanced Design and Construction Techniques for Staged Passive Wetland Treatment Systems for Coal Ash Leachate

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ABSTRACT. Passive wetland treatment systems represent a viable alternative for the chemical treatment of leachate waste waters from coal ash disposal. Ash resulting from the burning of coal commonly contains many trace metals. Leachate from active and closed disposal areas is often regulated as a solid waste discharge requiring the removal of trace elements to meet water quality standards in the receiving stream. For many of these sites, topographic constraints limit the availability of land for large passive systems. To meet these conditions, the Springdale Passive Wetland Treatment System represents a more engineered configuration with advanced design and construction techniques, with specific design considerations for future maintenance access. The Springdale facility is a passive wetland system designed to treat leachate from a closed fly ash disposal site near Pittsburgh, Pennsylvania. The project is jointly funded by the Electric Power Research Institute and Allegheny Power Service Corp. The project was developed to provide initial compliance with iron, pH and TSS under a current NPDES permit for a toe of fill discharge. To meet pending discharge criteria, the system was designed as a multiple stage system for research and development of passive design criteria for the removal of trace metals. Flows average 45 gpm, and the discharge is characterized by circumneutral pH, elevated iron, manganese, boron, and other trace metals typical of fly ash leachate. The leachate is collected at the toe and pumped to a flow equalization basin for initial iron oxidation and precipitation prior to entering a series of eight passive treatment units, each approximately 30 feet in width by 150 feet in length. The first four units are vegetated aerobic wetlands to remove residual iron. The fifth and sixth units are two rock drains for bacterial manganese removal. The seventh unit is a sulfide-generating organic upflow bed for trace element removal. System discharge occurs through a final algal and sand filter unit. Construction was completed in October 1995.

Performance of the system is monitored by water quality sample points located at the discharge of each type of passive treatment, so as to identify the most effective removal environment for each target parameter. The system is being monitored for 38 water quality parameters of interest on a semi-annual basis and monthly for selected parameters relating to current compliance objectives. Average removal efficiencies for Aluminum, Total Iron, Dissolved Iron and Manganese have been 99, 92, 96, and 66 percent respectively since the system was completed in 1995. A comprehensive monitoring program for water quality and substrate analyses will continue for at least 24 months. Detailed plant uptake and metal cycling studies will be undertaken with the University of California, Berkeley, through 1998. The ultimate goal of this work is to provide improved sizing and design standards for passive removal of trace metals.