

Targeted Maintenance Efforts to Ensure a Decade of Successful Passive Treatment¹

Robert W. Nairn*, Bryan J. Page and Nicholas L. Shepherd²

Abstract: Construction of the Mayer Ranch passive treatment system was completed in late 2008. The large multi-process unit passive treatment system addresses legacy flows from abandoned mines in the Oklahoma portion of the Tri-State Lead-Zinc Mining District (TSMD). The targeted discharges (pH 5.95±0.06, Fe 192±10 mg/L, Zn 11±0.7 mg/L, Cd 17±4 ug/L, Pb 60±13 ug/L and As 64±6 ug/L) have flowed at approximately 400-1000 L/minute for almost 40 years. The system, the first mine water treatment system of any kind in the TSMD, includes an initial oxidation pond followed by parallel treatment trains of aerobic wetlands, vertical flow bioreactors, re-aeration ponds, and horizontal-flow limestone beds, which flow into a single, final polishing wetland/pond. From a biogeochemical performance perspective, the system has met design expectations and produces net alkaline waters meeting in-stream water quality criteria for ecotoxic metals. However, the system demonstrated signs of longer-term hydrologic and hydraulic failure which necessitated maintenance procedures in 2017. Over a period of several years, hydraulic conductivity in both parallel vertical flow bioreactors decreased from 10⁻¹ to 10⁻⁴ cm/s, resulting in water level increases and subsequent impacts to upstream process units. These units were dewatered and the organic substrate (45% spent mushroom substrate, 45% wood chips and 10% manufactured sand) mixed with a small excavator in March 2017. Despite areas of considerably degraded substrate, the original hydraulic conductivity was restored. In addition, the buried piping system between the initial oxidation pond and parallel aerobic wetlands exhibited substantial water throughput issues over several years. Although calculated head losses were approximately 5 cm in this piping system, measured water level differences in these units were as much as 0.7 m, likely due to decreases in cross-sectional areas of the pipes. In December 2017, a wide, open water outlet channel feeding two inlet weir structures was installed to replace the buried piping system.

Additional Key Words: O & M, clogging, precipitation, air pockets, excavation.

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 2. Robert W. Nairn, Professor, Bryan J. Page, Research Scientist and Nicholas L. Shepherd, Graduate Research Assistant, Center for Restoration of Ecosystems and Watersheds, School of Civil Engineering and Environmental Science, University of Oklahoma, Norman, OK 73019
 3. Work reported here was conducted near 36° 55' 20" N; 94° 52' 24" W.