WATER QUALITY AND HYDROLOGY OF A NATURAL WETLAND RECEIVING MINE DRAINAGE: IS IT BIOGEOCHEMISTRY OR DILUTION?[1]

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Abstract. We examined biogeochemical and freshwater dilution effects influencing water quality in a marsh and stream system at the Tar Creek Superfund Site, Oklahoma. Two abandoned boreholes discharge polluted mine water (pH 5.9, alkalinity 414 mg/L as $CaCO_3$, 170 mg Fe/L, 11 mg Zn/L, 0.01 mg Cd/L and 0.02 mg Pb/L) to an approximately 1-ha *Typha spp*.-dominated wetland. An understanding of water quality changes is required to differentiate between wetland biogeochemical processes and simple dilution effects in order to develop possible remediation designs. Samples were periodically collected at eight locations (two upstream, at two boreholes and four downstream) to determine water quality changes in the wetland and resultant effects upon receiving stream water quality. *In situ* measurements included pH, temperature, alkalinity, conductivity, dissolved oxygen, and turbidity. Samples were collected and analyzed for Fe, Zn, Cd, Pb, Ca, Mg, SO_4^{-2}, NO_3^-, NO_2^-, PO_4^{-3}, Cl^-, F^-, and Br^- concentrations. The drainage basin was surveyed and several surface models were created, allowing calculation of water column and sediment volumes. Two surface runoff models were also produced to better understand storm water flows. In general, concentrations of all cations and anions decreased with flow through the wetland. Nonetheless, Zn, Pb, Cd and Fe concentrations in wetland and stream waters demonstrated toxicity on all sampling dates. Decreases of conservative ion concentrations (e.g., Mg and Cl) indicate significant dilution effects from storm water runoff entering the wetland upstream from the boreholes. Influx of non-mine drainage related storm water flow, although causing contaminant concentrations to decrease, significantly increased metal loading to receiving waters. Modifications of surface runoff models demonstrated substantial peak flow reductions are possible by diverting storm water flows. Factoring dilution effects into our understanding of mine drainage-impacted areas is an important component of remedial design.

Additional key words: treatment wetland, iron oxyhydroxide, hard rock mining

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