The Horizontal Levee: Improving Water Quality while Providing Flood Protection and Habitat Improvement

Aidan Cecchetti*, University of California, Berkeley; ReNUWIt, acecchetti@berkeley.edu
Angela Perantoni, University of California, Berkeley; ReNUWIt, angela_perantoni@berkeley.edu
Jean-Paul Wallis, Seattle University; ReNUWIt, wallisj1@seattleu.edu
Devansh Jalota, University of California, Berkeley; ReNUWIt, djalota@berkeley.edu
David Sedlak, University of California, Berkeley; ReNUWIt, sedlak@berkeley.edu
Jason Warner, Oro Loma Sanitary District, jwarner@oroloma.org
Carlos Diaz, ESA PWA, cdiaz@esassoc.com
Mark Lindley, ESA PWA, mlindley@esassoc.com
Peter Baye, Freelance Wetland Ecologist, baye@earthlink.net
Donna Ball, Save the Bay, dball@savesfbay.org

In response to increased concerns about the effects of wastewater effluent discharges on the San Francisco Bay estuary, innovative approaches are needed that are consistent with other management objectives, such as flood control and habitat restoration. In 2016, the Oro Loma Sanitary District built a horizontal levee test facility to assess the effects of fill material, plant communities and operating conditions on the ability of the system to improve water quality and build organic materials to raise grades. The horizontal levee consists of twelve cells with different fill materials and native plant communities. Nitrified wastewater effluent passes through a surface flow wetland before it flows into a subsurface layer within the levee cells. A loam layer (to support plant growth) overlays sand and gravel subsurface layers that have been amended with organic carbon (i.e. woodchips) to enhance denitrification rates. Monitoring conducted during the first summer following introduction of wastewater into the system indicates that the horizontal levee efficiently removes nitrate and a suite of trace organic compounds (e.g., pharmaceuticals). Despite lowering nitrate concentrations to non-detect levels (<0.1 mg N/l), small but statistically significant ($p<0.05$) increases in dissolved organic nitrogen have also been observed in the subsurface of the horizontal levee and significant removal of phosphorus has not been observed. The ability of the horizontal levee to improve water quality decreased substantially when flow increased to a level that caused water to flow across the ground surface. Future research will focus on system performance during wintertime, when rates of microbial processes are expected to decrease, and the ability of plants to provide organic carbon to support denitrification when the labile organic carbon in the woodchips is exhausted.

Student Award Competition: Yes

Keywords: nitrate, denitrification, subsurface wetlands, trace organic contaminants

Poster Topic Emerging Contaminants

Delta Regional Monitoring Program: Current-use Pesticides and Toxicity Monitoring Results, 2015-16

James Orlando, U.S. Geological Survey, jorlando@usgs.gov
Marie Stillway, University of California Davis, mstillway@ucdavis.edu
Matt DeParsia, U.S. Geological Survey, mdeparsia@usgs.gov
Thomas Jabusch, Aquatic Science Center, thomasj@sfei.org
Phil Trowbridge, Aquatic Science Center, philt@sfei.org
Matt Heberger, Aquatic Science Center, matth@sfei.org

The Delta Regional Monitoring Program is a stakeholder-directed project formed to develop water quality data necessary for improving the understanding of Delta water quality issues. One of the initial research focuses is monitoring the occurrence of current-use pesticides and toxicity in Delta source waters. Monitoring began in July 2015 at five sites, representing the major surface water inputs to the Delta. Water samples were collected monthly and during five targeted events (first flush storm event, 2nd significant winter storm, spring runoff, spring irrigation, and summer/fall irrigation). Samples were analyzed for a suite of 154 current-use pesticides in water and 129 current-use pesticides in associated suspended sediment by the USGS Organic Chemistry Research Laboratory. Concurrently collected water samples were tested for toxicity at the UC Davis Aquatic Health Program Laboratory with the application of USEPA chronic assays for *Ceriodaphnia dubia*, *Pimephales promelas*, and *Selenastrum capricornutum*.

During the first 12 months of sampling a total of 54 pesticides were detected in the water and 11 were detected in suspended sediments. All samples contained mixtures of 2 to 29 pesticides and the greatest numbers of pesticides were detected during storm events. Pesticide concentrations ranged from non-detectable to 2630 nanograms/liter, and there were 18 detections above an EPA aquatic life benchmark.

Across all samples, there were 26 instances of toxicity: 13 observed with *C. dubia*, nine with *S. capricornutum*, and four with *P. promelas,* with three instances of fish toxicity diagnosed as pathogen-related. Only a few of the toxicity events coincided with pesticide detections above aquatic life benchmarks and there was no obvious relationship between detections above thresholds and observed reductions in related toxicity endpoints.

As part of a larger ongoing monitoring program these data provide valuable information to scientists and resource managers working to better understand the health of the Sacramento/San Joaquin Delta.

Keywords: Pesticides, toxicity, monitoring,

Poster Topic Emerging Contaminants