Treatment Plant Nutrient Removal Utilizing a Freshwater Marsh

Chase Campbell, The City of Palo Alto Watershed Protection Group, chase.campbell@cityofpaloalto.org
Samantha Engelage, The City of Palo Alto Watershed Protection Group, Samantha.engelage@cityofpaloalto.org

This study examines the effectiveness and regulatory constraints of utilizing a freshwater marsh as a treatment process for removal of nutrients from effluent of an advanced secondary wastewater treatment plant. San Francisco Bay Area wastewater treatment plants are facing potentially more restrictive NPDES permit limits for nutrients. This requires the treatment plants to seek cost effective techniques to optimize nutrient removal in the near term. Renzel Marsh is located adjacent to the City of Palo Alto Regional Water Quality Control Plant. The plant discharges treated wastewater to the freshwater marsh as well as directly to the San Francisco Bay. Typically, Renzel Marsh receives about 5 percent (1 MGD) of the total effluent flow from the plant. Data from phase I of this study has shown that the anaerobic bacteria residing on the root systems of the plants in the marsh has been effective at removing nitrate from the water via a process called denitrification. Statistics show that the marsh was able to significantly reduce total nitrogen mass load discharged by the plant by 2 percent at current flow levels. Phase II of the study evaluated the effectiveness of nutrient removal within the marsh with respect to an increase to 2 MGD. After the system reached steady state, water quality sampling occurred at the marsh inlet and outlet in summer 2015. Water quality data was used to determine the applicability of the marsh as a treatment process for enhanced nutrient removal at this larger scale. Data was also used to determine any potential compliance issues with existing NPDES permit limits.

Keywords: Nutrients, Nitrogen, Phosphorus, Wetland, Wastewater, NPDES, Treatment, Denitrification, Marsh, Watershed

Poster Topic: Nutrient Removal

Opportunities to Increase Bayshore Resiliency and Reduce Infrastructure Vulnerability by Re-plumbing the East Bay

Carolyn Doehring, San Francisco Estuary Institute, carolynd@sfei.org
Jeremy Lowe, San Francisco Estuary Institute, jeremyl@sfei.org
Robin Grossinger, San Francisco Estuary Institute, robin@sfei.org
David Senn, San Francisco Estuary Institute, davids@sfei.org
Mike Connor, East Bay Dischargers Authority, mconnor@ebda.org
Marc Beyeler, Marc Beyeler Asociates, marcbeyeler@me.com
Molly Mehaffy, Molly Mehaffy Design, mmmm@nets.com

The East Bay Dischargers Authority (EBDA) currently discharges treated wastewater effluent into SF Bay through a deep water outfall; however, this infrastructure is aging and vulnerable to rising sea level. This project assessed the opportunities and constraints of decentralizing EBDA's discharge and re-introducing freshwater inputs to the San Leandro to Fremont shoreline. Historically, freshwater interfaced with the baylands through creek connections and more diffusely via groundwater and surface runoff. These freshwater inputs were an important component of the baylands ecosystem, creating salinity gradients that added physical and ecological diversity to the baylands landscape as well as facilitating rapid vertical marsh growth. Today, the extent, magnitude, and seasonality of freshwater to the baylands has been greatly altered. Technical studies and stakeholder workshops were held to consider: 1) opportunities for re-using treated wastewater for improved ecosystem functions, 2) opportunities most appropriate given historical and present landscape features, and 3) regulatory and governance needs for successful implementation of these types of innovative projects. Workshop participants identified concept alternatives for the present discharge including: 1) routing freshwater to creek systems, 2) routing freshwater through a seepage slope as part of a horizontal levee, 3) contained wetland treatment systems, and 4) re-use of water. We assessed the seasonality, volume, and nutrient concentrations of EBDA's effluent and reviewed the area needed to treat EBDA's discharge through open water or vegetated wetlands. Conceptual models were also completed to illustrate how varies strategies could create a coherent landscape given physical and ecological considerations. While further research and planning is certainly needed to assess feasibility, this project was successful in informing EBDA of opportunities other than maintaining its existing outfall. Importantly it bought together diverse stakeholders to further the conversation on using treated wastewater as a resource for a resilient future East Bay shoreline.

Keywords: Wastewater, Freshwater, Baylands, Horizontal Levee, Water Re-use, Sea Level Rise

Poster Topic: Nutrient Removal

The Horizontal Levee: Combining Nutrient Removal from Wastewater With Flood Control and Habitat Restoration

Aidan Cecchetti*, University of California, Berkeley, acecchetti@berkeley.edu
Samantha Bear, University of California, Berkeley, samantha.e.beardsley@gmail.com
Jason Warner, Oro Loma Sanitary District, jwarner@oroloma.org
Carlos Diaz, ESA PWA, CDiaz@esassoc.com
Jeremy Lowe, ESA PWA, JLowe@esassoc.com
Jennifer Krebs, San Francisco Estuary Partnership, jennifer.krebs@gmail.com
Alex Horne, University of California, Berkeley, horne@ce.berkeley.edu
David Sedlak, University of California, Berkeley, sedlak@berkeley.edu

In response to increased concerns about the effects of nutrient discharges on the San Francisco Bay, wastewater utilities have begun to look for innovative nutrient management schemes. Subsurface-flow treatment wetlands provide a means of removing nutrients that also provides habitat restoration and flood control. To study these systems, a set of demonstration-scale wetlands is being constructed adjacent to the Oro Loma Sanitary District's wastewater treatment plant. The system capitalizes on heterogeneous conditions to remove trace contaminants from wastewater by combining subsurface wetlands with surface-flow wetlands. The surface-flow wetlands also provide additional water storage for flood control during heavy precipitation events while the subsurface wetlands can protect against sea level rise and can provide important habitats for migratory birds, and other vulnerable terrestrial species. The subsurface wetlands are divided into twelve cells to allow for experiments on the optimal conditions for removal of nutrients. As the system equilibrates over the next two years, we will monitor improvements in water quality that can be achieved in the horizontal wetlands. Microcosm experiments will be used to study nitrogen dynamics, as well as the potential for these systems to remove trace organic contaminants (e.g., pharmaceuticals and personal care products). Initial results from the microcosms suggest that organic amendments, such as woodchips, can enhance nitrogen removal by providing a carbon source for denitrification. They also indicate that dissolved organic nitrogen (DON) may be released from the subsurface wetlands. Although subsurface wetlands are a viable nitrogen management strategy, further research is required to optimize the systems and assess their long-term performance.

Keywords: nitrate, denitrification, subsurface wetlands, organic contaminants

Poster Topic: Nutrient Removal