San Jose-Santa Clara Regional Wastewater Facility: Treating Wastewater & Enhancing the Bay

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San Jose-Santa Clara Regional Wastewater Facility is working with regional agencies to monitor biological health of downstream marshes. The results are also being used to inform citizens about the value of both the wastewater treatment facility and restored salt marshes.

Problem: How can we evaluate the impact of treated wastewater on marsh habitat?

Approach: Over the past two to five years, we collected water quality data and collaborated with regional researchers who study Bay fish, benthic invertebrates, migratory birds, and other indicators of water quality beneficial use attainment. The goal was to document quality of wildlife habitat watered by facility effluent.

Results: Facility effluent provides high quality fresh water to local marshes, albeit it is still a significant source of nitrogen and phosphorus nutrients. Those nutrients attenuate very rapidly as they mix with tides and flow downstream. Meanwhile, abundance and species diversity in benthic, fish, and bird communities appear to be as good, or better, than seen in comparable nearby areas.

Conclusions: San Jose-Santa Clara Regional Wastewater Facility found it very productive to use biological abundance as indicators of beneficial use attainment. The results also provide a narrative that is now being shared with USFWS and the adjacent wildlife refuge.

Keywords: Wastewater, Nutrients, Fish, Ducks, Benthos, Tides, Nitrogen, Ammonia

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Nutrient Removal at the San Jose-Santa Clara Regional Wastewater Facility

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The San Jose-Santa Clara Regional Wastewater Facility (RWF) is the largest Biological Nutrient Removal (BNR) treatment plant discharging to San Francisco Bay. BNR incorporates full nitrification and achieves partial denitrification. The RWF's BNR process occurs in two locations, historically referred to "Secondary" and "Nitrification" areas. Each area is further divided in to "A-side" and "B-side" batteries, resulting in four separate BNR treatment trains.

Despite progress made by the RWF in reducing nutrient loads to Bay, there is a growing concern of nutrient enrichment in San Francisco Bay.

The RWF measures ammonia in influent and total nitrogen in effluent twice monthly. Staff calculated nutrient loads using concentration data and corresponding flow data for influent and effluent. Seasonal variations of concentrations and loads were evaluated for both influent and effluent. Changes in effluent nutrient concentrations were also compared to concentrations in each of the four BNR batteries to determine how performance of individual batteries ultimately affects effluent concentrations.

The majority of total nitrogen in the RWF influent was in the form of ammonia (NH3), whereas most of the total nitrogen discharged is in the form of nitrate, which is consistent with full nitrification. Influent flow volume has steadily declined, resulting in increased concentrations of influent ammonia and effluent total nitrogen. There was no significant difference in influent total nitrogen load by season. However, there was significant seasonal variability of effluent total nitrogen load, likely due to lower temperatures in the wet season, which affects BNR efficiency. Decreased effluent flows in the dry season due to recycled water demand also contributed to lower dry season total nitrogen effluent loads.

Conclusions: Even in an advanced BNR facility, managing nutrients is challenging due uncontrollable factors such as influent flow, influent ammonia concentration and seasonal effects.

Keywords: Wastewater, treatment, nutrient, nitrogen, ammonia, secondary, nitrification

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Nutrients Variation with Tides in Artesian Slough

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Elevated nutrient levels in San Francisco Bay have raised concerns over the potential for eutrophication. Wastewater treatment plants are an identified source of nutrients to the Bay and the San Jose-Santa Clara Regional Wastewater Facility (RWF) is the largest wastewater treatment plant discharging to the Bay. The RWF provides wastewater treatment for 1.4 million Silicon Valley residents and discharges tertiary treated wastewater to Artesian Slough, a tributary to Lower South Bay. Although the RWF achieved dramatic reductions in nutrient loads to the Bay through upgrades in 1998, RWF effluent still supplies consistent nitrogen loads to the Lower South Bay. Understanding the fate of these nutrients through unbiased monitoring is a necessary step towards understanding eutrophication potential. This analysis examines how tidal stage affects nutrient concentrations in Artesian Slough during consistent nutrient inputs from wastewater discharge.

RWF scientists have monitored nutrients monthly at six locations in Artesian Slough and lower Coyote Creek since 2012. Monitoring events target an equal mix of ebb and flood tides to avoid tidally biased concentration data. A statistical comparison of the ebb and flood tide concentrations of ammonia, total kjeldahl nitrogen, and nitrate indicates that tidal stage significantly affects nitrogen concentrations at stations proximate to the RWF. Nitrate concentrations are significantly higher during ebb tides when the influence of RWF discharge is greatest. In contrast, ammonia concentrations are significantly higher during flood tide, indicating that the ammonia in Artesian Slough comes mostly from the Bay rather than the RWF.

The RWF achieves complete nitrification and discharges very little ammonia, so these results are not surprising. Many factors can affect ambient nutrient concentrations including external loads, in Bay transformations, uptake, flushing, and mixing. This study demonstrates the importance of considering tidal variability to avoid biased results when designing monitoring, assessment, and modeling studies for nutrients.

Keywords: Nutrients, Wastewater, Tidal influence, Lower South Bay, Artesian Slough

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Tracking Benthic Communities in Artesian Slough

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The San Jose-Santa Clara Regional Wastewater Facility (RWF) discharges 80 to 100 million gallons per day of tertiary treated effluent into Artesian Slough, a tributary to Coyote Creek and Lower South San Francisco Bay. In 2005, the RWF connected Pond A18, an 856 acre former salt pond, to Artesian Slough. Between 2005 and 2006, an additional 5 ponds (Ponds A16, 17, 19, 20, 21) located within the immediate vicinity of Artesian Slough and Coyote Creek were also connected to the Bay. Benthic community data was collected just prior to and three times during the six months following the opening of these ponds. Additional events were conducted in 2014 by USGS under contract with City of San Jose. This study examines how the changes in the hydrology in Artesian Slough due to the opening of Pond A18 and surrounding ponds affected the benthic community.

Species richness data at four stations from the RWF into Coyote Creek was compared across sampling events as a measure of benthic community health. Data collected prior to and three times within six months following the opening of Pond A18 was collected by S.R. Hansen & Associates with a Van Veen sampler. Comparable benthic data was also collected in 2014 by USGS.

Species richness data indicate a diverse and stable benthic community composition across all stations, with disturbances only occurring immediately following initial release of salt ponds. Species richness was consistent among events conducted prior to pond opening, at 6 months after and 9 years after pond opening.

Benthic community species composition in Artesian Slough, characterized in the context of species richness, is diverse and stable despite considerable changes and disturbances in the hydraulic regime of Artesian Slough over the course of the past nine years.

Keywords: Benthos, pond restoration, wastewater effluent

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Tracking Fish Communities in Artesian Slough

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General description: The San Jose-Santa Clara Regional Wastewater Facility (RWF) discharges 80 to 100 million gallons per day of treated effluent. The effluent flows via Artesian Slough, a productive fishery, into shallow marshes in Lower Coyote Creek and the Lower South San Francisco Bay. The effluent channel runs along the western boundary of former salt pond A18 which was purchased by the City of San Jose in 2004/2005 and has been circulating ever since. Pond A18 encompasses 856 acres. Circulation flow is one-direction: Bay water enters the pond at a point furthest from RWF discharge then leaves the pond close to the RWF outfall. Flow volume from Pond A18 averages about 15 million gallons per day; a little more than a quarter of total hydraulic flow through Artesian Slough. The hydraulic structures that control pond flow allow reversing the flow, but this has never been attempted until now.

Problem: Due to equipment failure, Pond A18 flow had to be reversed from February through May 2015. What was the impact on the Artesian Slough fish community during the period that A18 was drawing away fresh RWF discharge water at the base of the slough and discharging it at the mouth?

Approach: Fish community data was collected at three stations in Artesian Slough over a four year period that includes the three months in 2015 when Pond A18 flow was reversed. This fish data was collected by monthly otter trawls by UC Davis principal investigator, Dr. Jim Hobbs.

Results: Trawl catch data for a dozen species shows strong temporal trends over recent years. However, fish population changes appear to be driven by larger factors such as drought, local habitat restoration, and decadal climate cycles.

Conclusions: Reversing Pond A18 flow had no discernible impact on fish populations in Artesian Slough.

Keywords: Fish, fishery, habitat, wastewater, treatment, pond, restoration,

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Ducks at the Regional Wastewater Facility

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Populations of ducks have been increasing on San Jose-Santa Clara Regional Wastewater Facility property. Facility personnel have been noting a large increase in ducks roosting and feeding in Biosolids processing areas in recent years.

Problem Statement: What has caused this explosive increase in duck populations?

Approach: Facility staff compiled 40 years of Audubon Society Christmas Bird Count data from the "Alviso Complex" in Lower South San Francisco Bay that provide an annual historic census. Staff also conducted a number of photo surveys to establish current population density and species diversity on RWF property. Fifteen species of ducks were identified on RWF by discrete photography during the 2014/15 winter season.

Results: Audubon Christmas Bird Counts document dramatic increases in winter time duck populations following restoration or circulation of several nearby salt ponds. The population increase is most dramatic in Pond A18 where water is maintained at one to two foot depth. Duck populations fluctuate in tidal or muted tidal ponds, but nonetheless, have increased in those ponds as well. Roughly 1,000 ducks regularly roosted on RWF property through 2011. This number steadily increased to over 4,000 by 2014 after the last large block of former salt ponds were opened to circulation with Bay water. The same data show that local gull populations appear to be declining as ponds were restored.

Conclusions: The increase in duck populations on facility property is real, not a figment of imagination. The increase clearly correlates with restoration or circulation of former salt ponds in the vicinity.

Keywords: Ducks, restoration, wildlife, habitat, wastewater, treatment, pacific, flyway

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Outreach Collaboration: Wastewater Facility and the Wildlife Education Center

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Effluent from the San Jose-Santa Clara Regional Wastewater Facility (Facility) is discharged into the South Bay waters of the Don Edwards SF Bay National Wildlife Refuge (Refuge). Visitors to the Refuge's Environmental Education Center in San Jose learn about the wastewater facility, and the need for water quality, habitat restoration and pollution prevention. This partnership meets the regulatory requirements for public outreach of the NPDES permit.

Problem Statement: How can the Regional Wastewater Facility educate the public about its function, and its impact on the South Bay environment?

Approach: San Jose has partnered with the neighboring federal environmental educators, and other agencies, to develop messages for the general population about the Facility. Refuge staff provide programs for children and young adults on the ecosystem of the South Bay and the importance of salt marshes, the impact of the facility on clean water, and how to prevent pollution. Through additional partnerships and funding, the City and Refuge provide education on water conservation and recycled water, riparian restoration, and how to prevent litter and trash impacts in local creeks.

Results: Visitors to the wildlife refuge have grown from almost 13,000 in 1997 to 25,000 in 2014. For the 2013/2014 school year, between the various programs for kids, 5,000 children learned about what the wastewater facility does to provide clean water to the South Bay.

Conclusions: The refuge is uniquely located and staffed for providing the valuable in situ public education about this important environmental topic: the role and impact of human activity on the watershed. The City's funding of these educational programs meets the regulatory requirements for public education in an effective way.

Keywords: wastewater, permit requirement, public education, South Bay

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