

# Five Years of Evaluation and Investigation of Nature-Based Solution (NBS)

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(Valley Water)

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# Santa Clara Valley Water District (Valley Water)

- **2** Million people
- **15** Cities
- **3** Water Treatment Plants
- **1** Advanced Water Purification Center
- **13** Water retailers
- **10** Dams and surface reservoirs
- **275** Miles of Streams
- **150** Miles Pipelines
- **4500** Well Owners



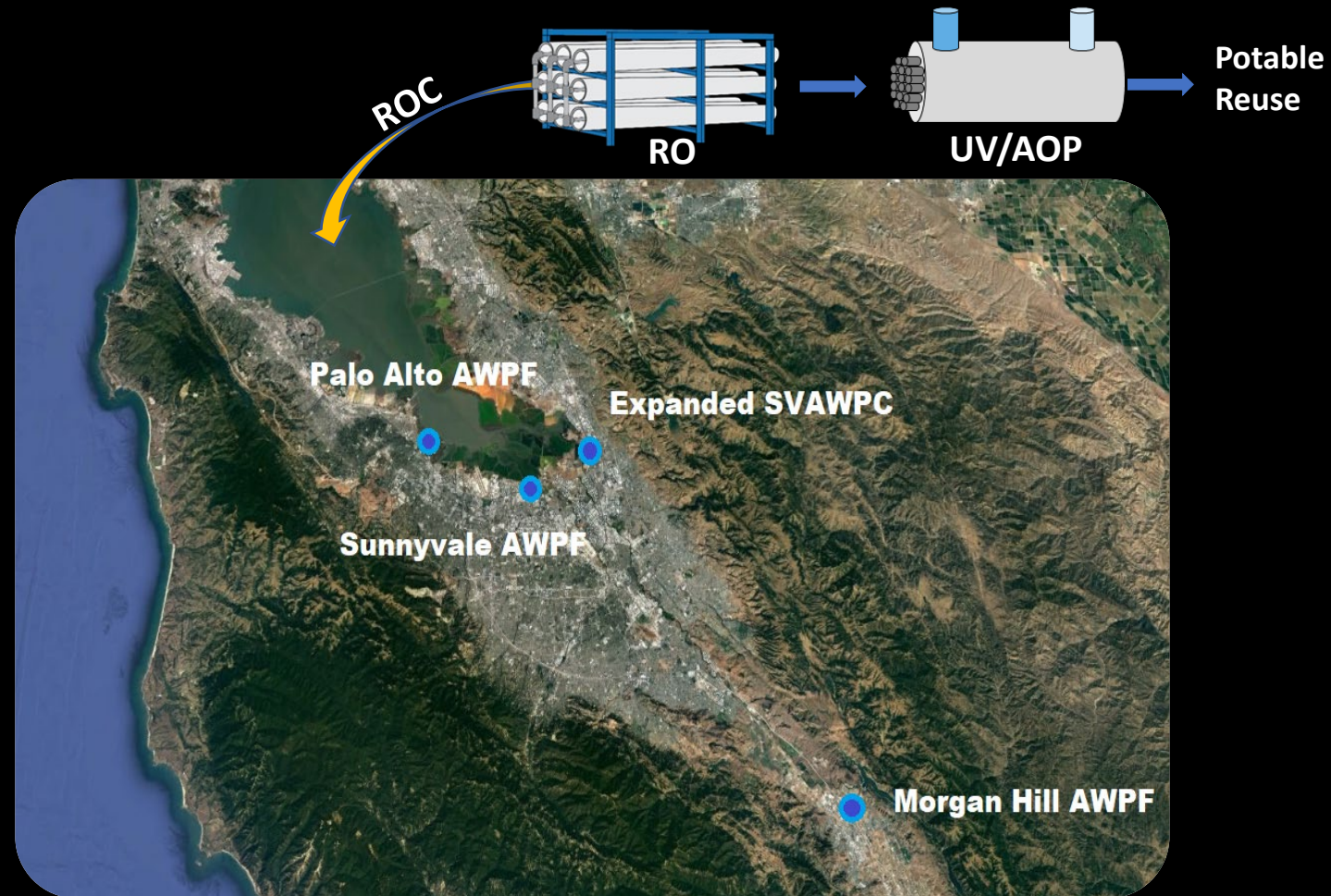
# Silicon Valley Advanced Water Purification Center (SVAWPC)

- In partnership with the City of San Jose
- Feedwater to SVAWPC is San Jose/Santa Clara Regional Wastewater Facility
- Largest advanced water purification plant in Northern California, 8MGD
- Enhancement of water quality for approximately 1000 users of recycled water in Santa Clara County
- Produced over 7.3 billion gallons of highly purified water since operation began in 2014



# Advanced Water Purification Facilities & RO Concentrate (ROC) Management Challenge

- Limits and constraints associated with ROC discharge
- May require nutrient, metals, and trace organic contaminant removal
- ROC Treatment could enable reuse in the region



# ROC Technical Studies and Evaluations

(2016 – Present)

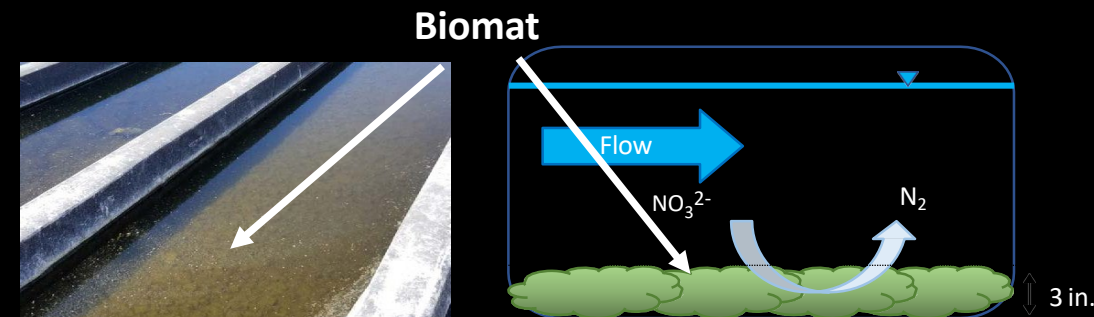
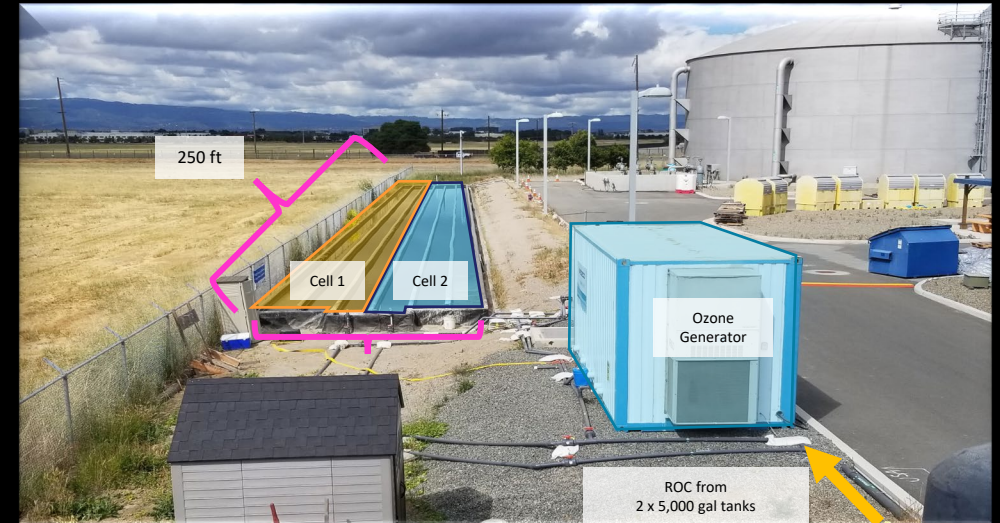
- Physicochemical and Biological Treatment options
  - Electrocoagulation
  - Capacitive Coagulation
  - Ozone/Biological Activated Carbon
- Nature-based Solutions (NBS)
  - Engineered Treatment Cells
  - Floating Wetland Treatment
  - Oro Loma Horizontal Levee
  - Calabazas Creek /STA Project and Horizontal Levee Pilot System at Pond A4
- ROC Generation from Palo Alto Effluent for Tox Analysis and CEC Monitoring



# Engineered Treatment Cells / Open Water Pilot Study

2017-2019

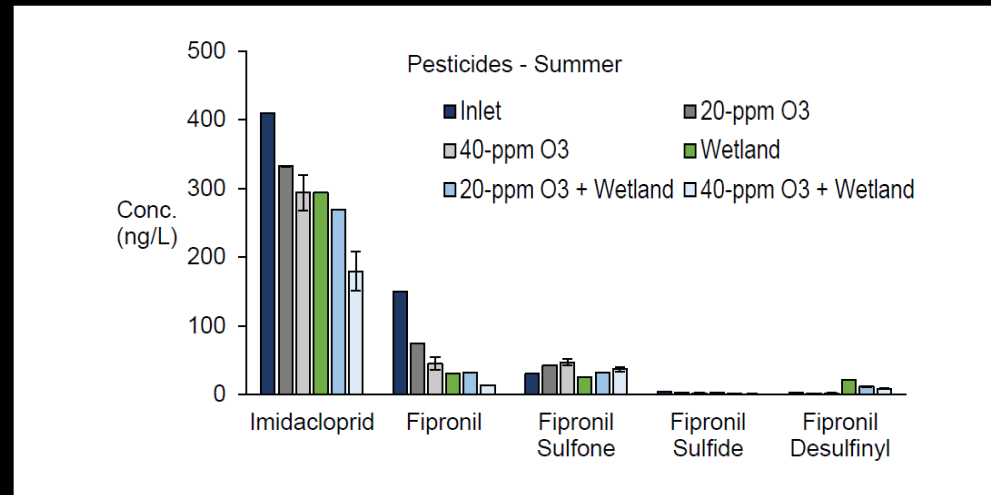
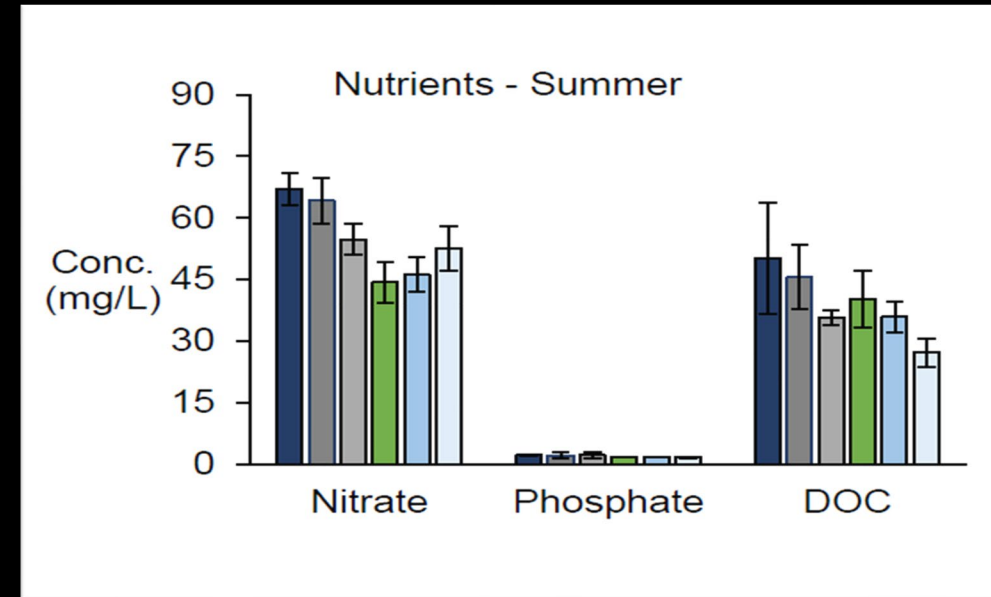
- Evaluate the effectiveness of treatment cell systems in processing ROC.
- Utilize two parallel flow-through oxidative open-water treatment cells:
  - One cell received untreated ROC
  - The other received pre-ozonated ROC
- Both systems designed with a Hydraulic Retention Time (HRT) of 3 days.



# Engineered Treatment Cells / Open Water Pilot Results

2017-2019

- Achieved reductions in nutrients and organic compounds (15% winter–30% in summer).
- Removed CEC's such as pharmaceuticals and pesticides (5%–20% in winter, 40%–80% in summer).
- The removal of CECs was facilitated through a combined treatment approach.
- Targeted and removed substances with high reactivity to ozone, such as sulfamethoxazole and carbamazepine.
- Limited reduction of metals.



# Floating Wetland Treatment

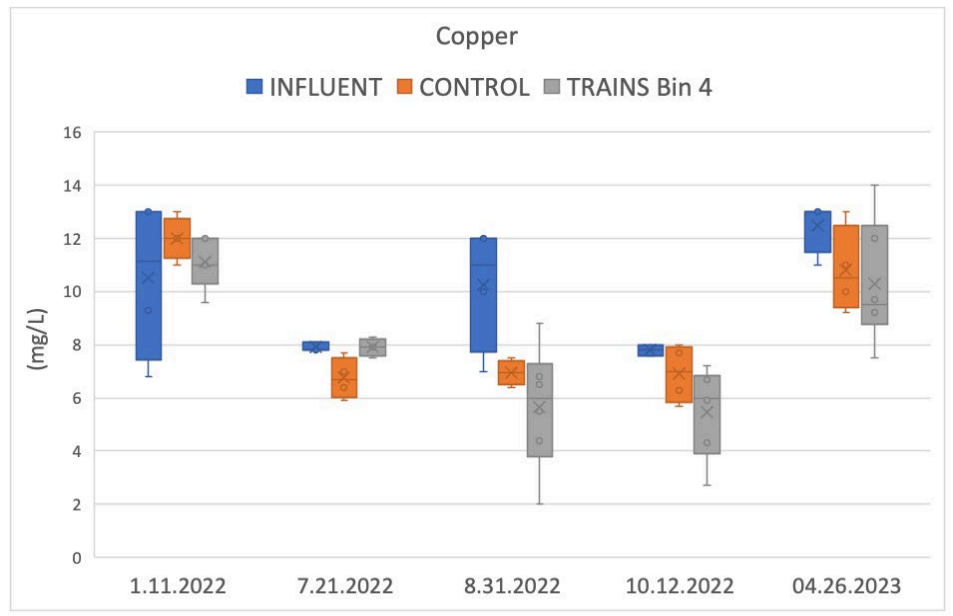
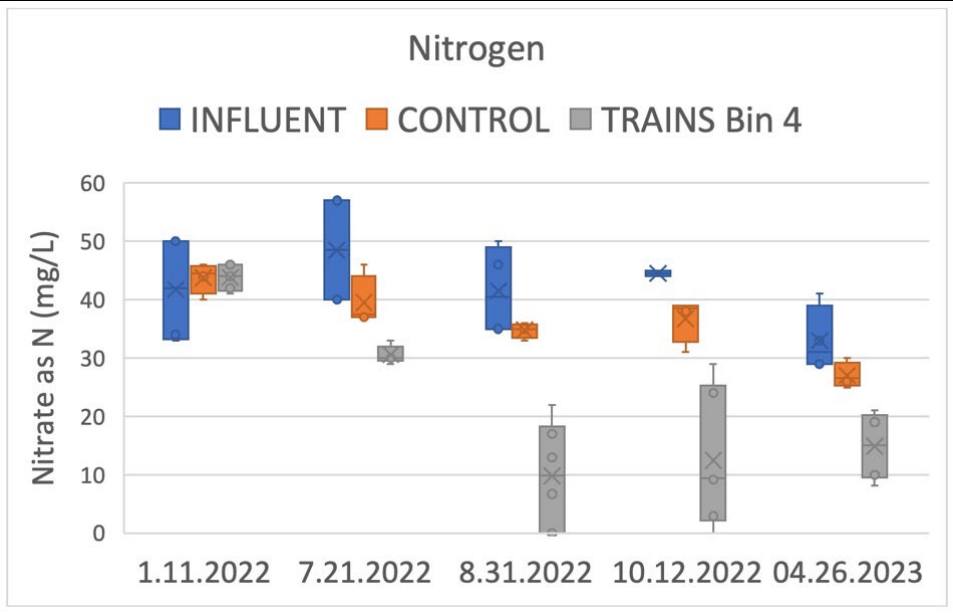
2020-2023

- A form of phytoremediation
- Using hyperaccumulating plant species
- 32 bins (48"X48"X52")
- 39"X39" porous fibrous platforms, 16" thick, recycled PET
- 8 treatment trains, 4 tanks linked in series, residence time of 3-6 days.
- Flow rate started at 1 l/min, then 0.5 l/min in 2022
- Three mixed communities tested for growth and accumulation of metals (Cu, Ni) and nutrients (N, P)



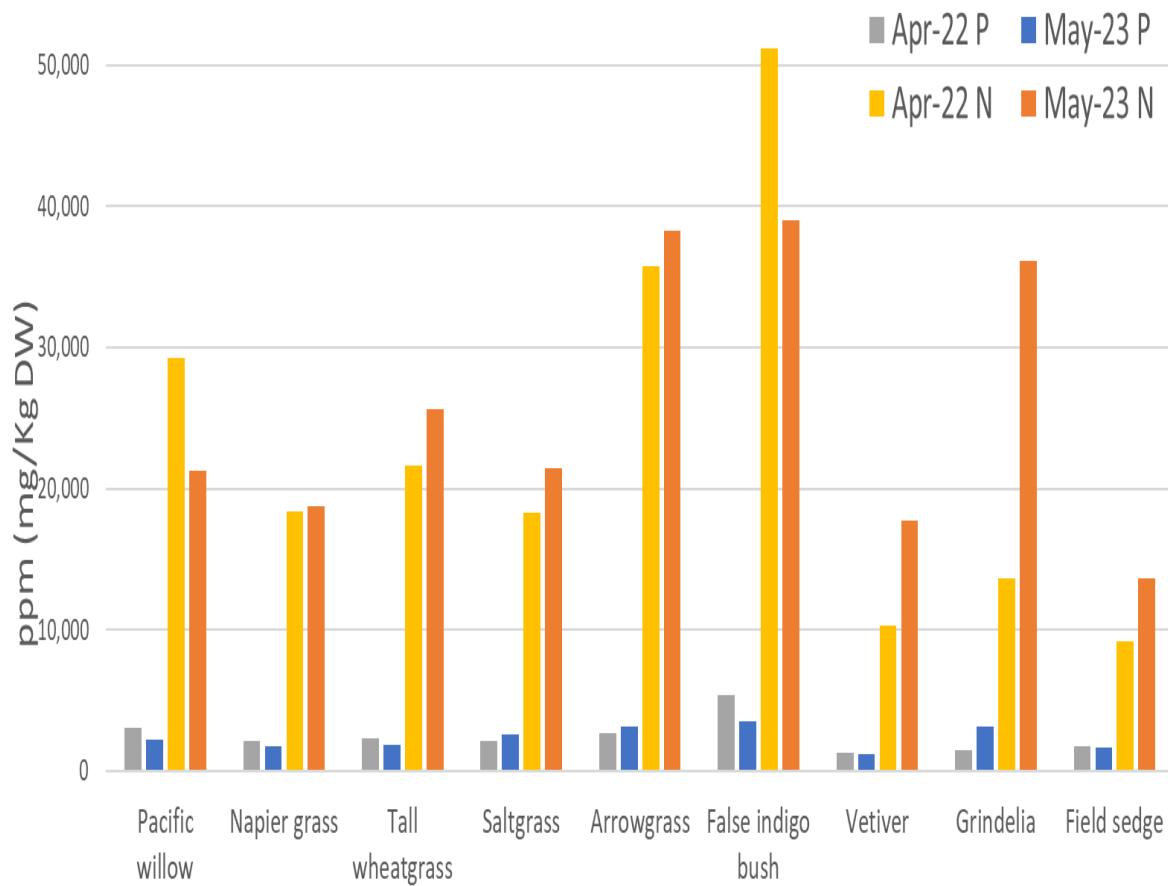


# Floating Wetland Treatment: Nitrogen and Copper Removal

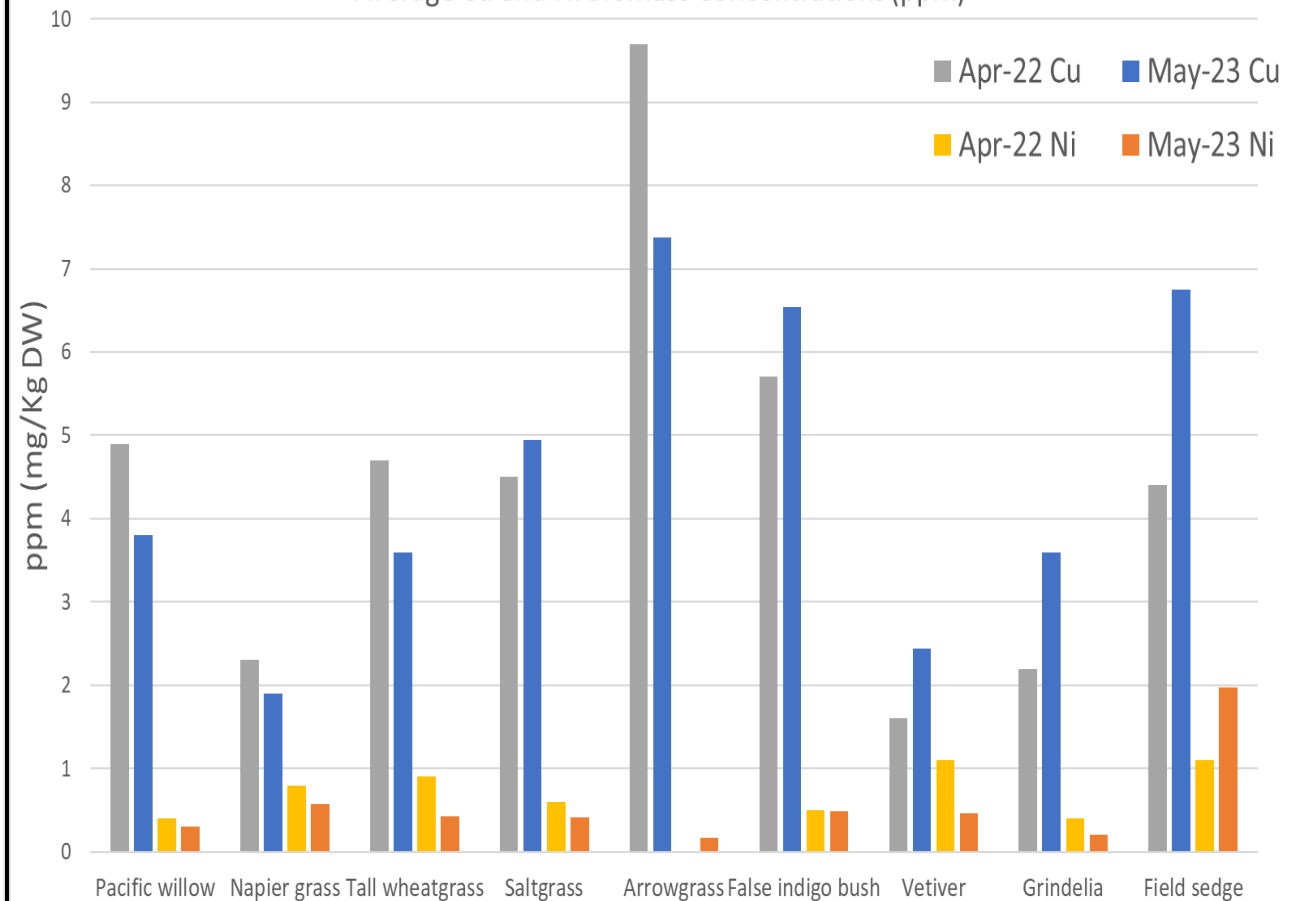


# Floating Wetland Treatment: Nutrient and Metal Mass Uptake

Average N and P Biomass Concentrations (ppm)



Average Cu and Ni Biomass Concentrations (ppm)



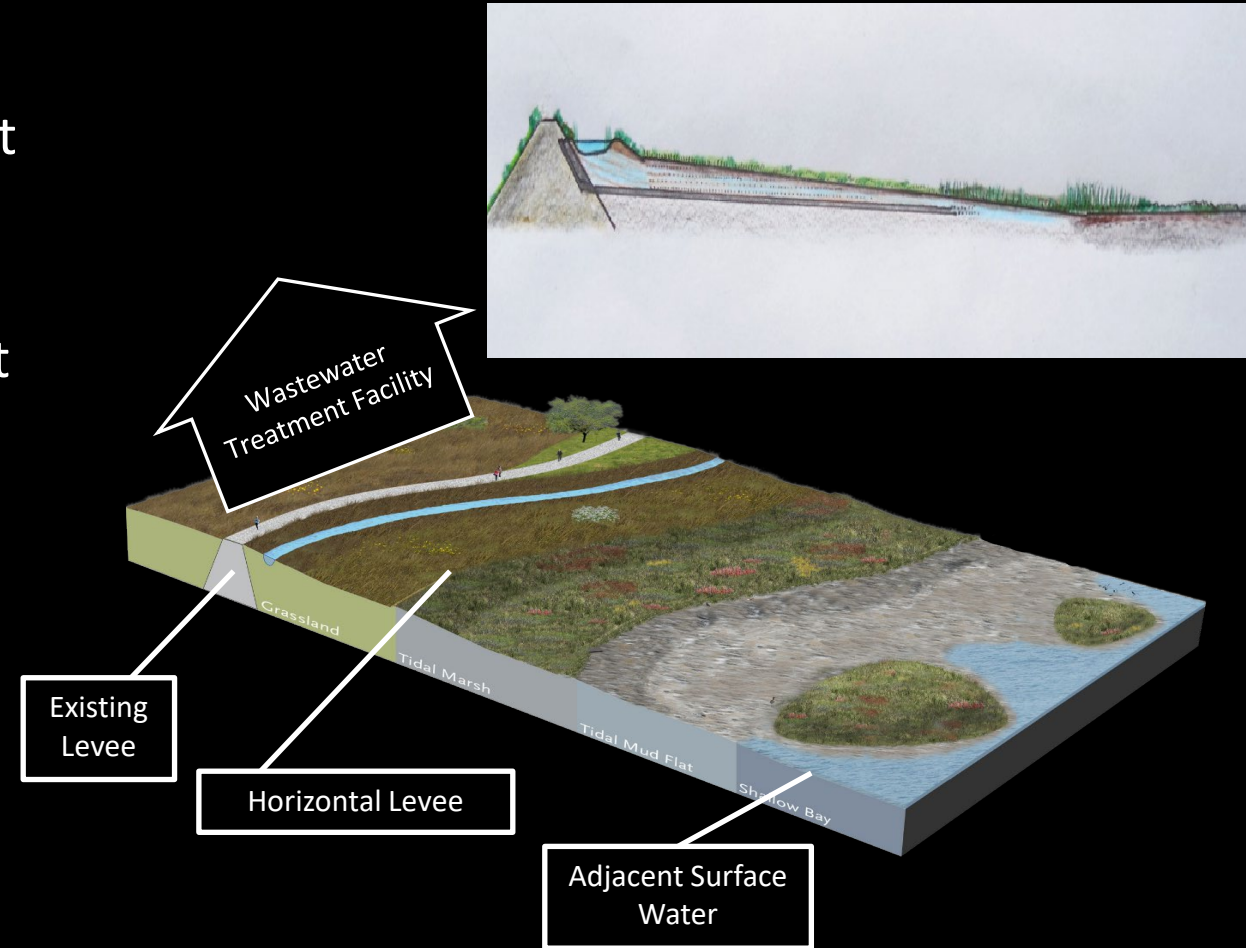
# Floating Wetland Treatment

2020-2023

- Visual inspection showed successful plant growth in high salinity conditions.
- No apparent toxicity or nutrient limitation to plants.
- Higher reduction of nitrogen and moderate reduction of copper.
- Long residence times (>six days) to achieve high removal rates.
- Removal rates were seasonally dependent.
- Nickel and phosphorous both resisted removal.
- Lessons learned: data collection, tank hydraulics, platform design, aeration, and plant species.

# Oro Loma Sanitary District Horizontal Levee

- Sloped subsurface treatment wetland to protect existing levee and provide habitat
- Experimental facility constructed and planted at the Oro Loma Sanitary District in 2015
- Research demonstrated potential to remove nitrate and trace organic contaminants from wastewater effluent
- Potential to be integrated into shoreline rehabilitation projects in multiple locations



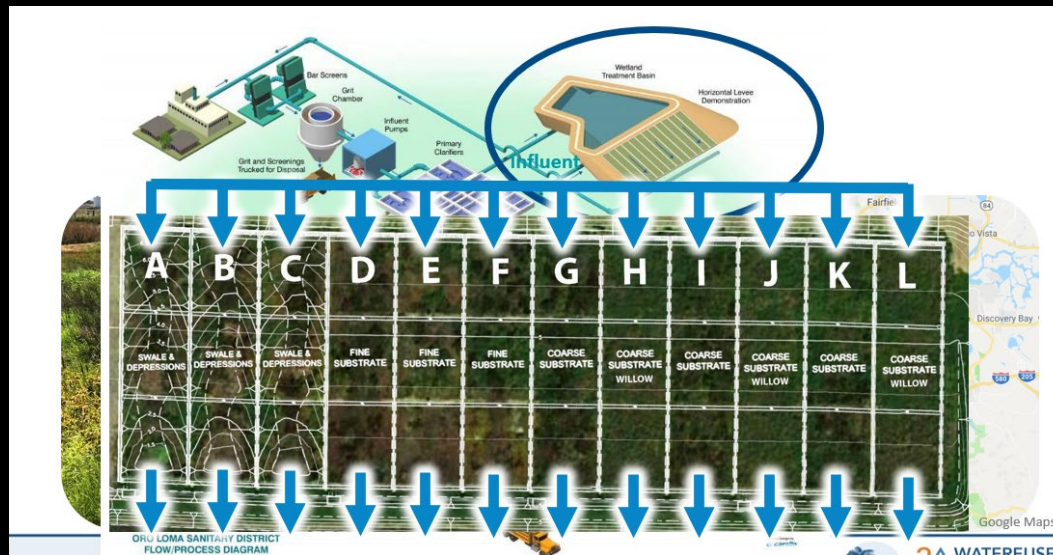
# ROC Treatment at the Oro Loma Horizontal Levee

Phase I (2019 – 2022)

- Concept: More mass of contaminants removed by treating ROC
- Introduced ROC into one of the existing treatment cells
- Weekly transport of 10,000 gallons of ROC from SVAWPC to the Oro Loma test facility



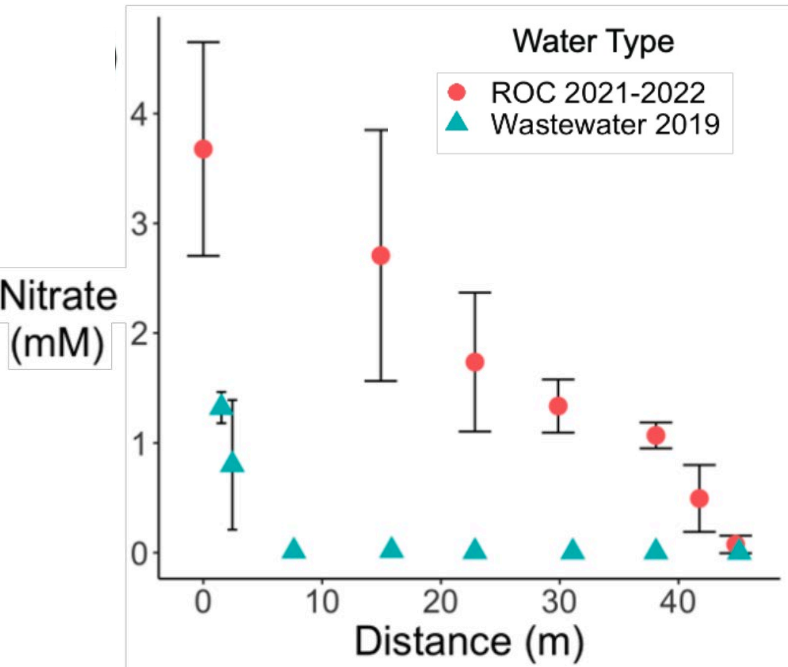
Trucking ROC to Horizontal Levee



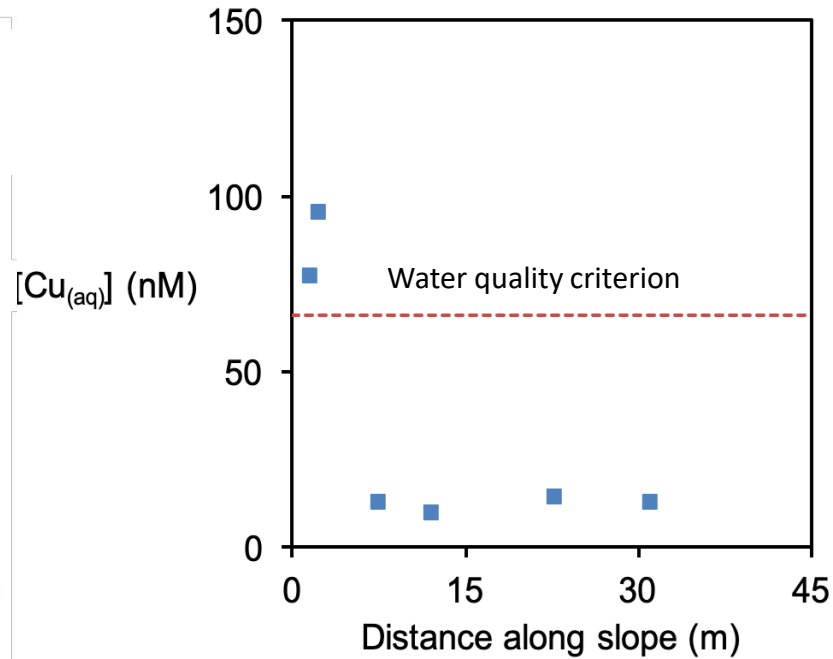
# ROC Treatment at the Oro Loma Horizontal Levee: Nitrate, Copper and Nickel

Phase I (2019 – 2022)

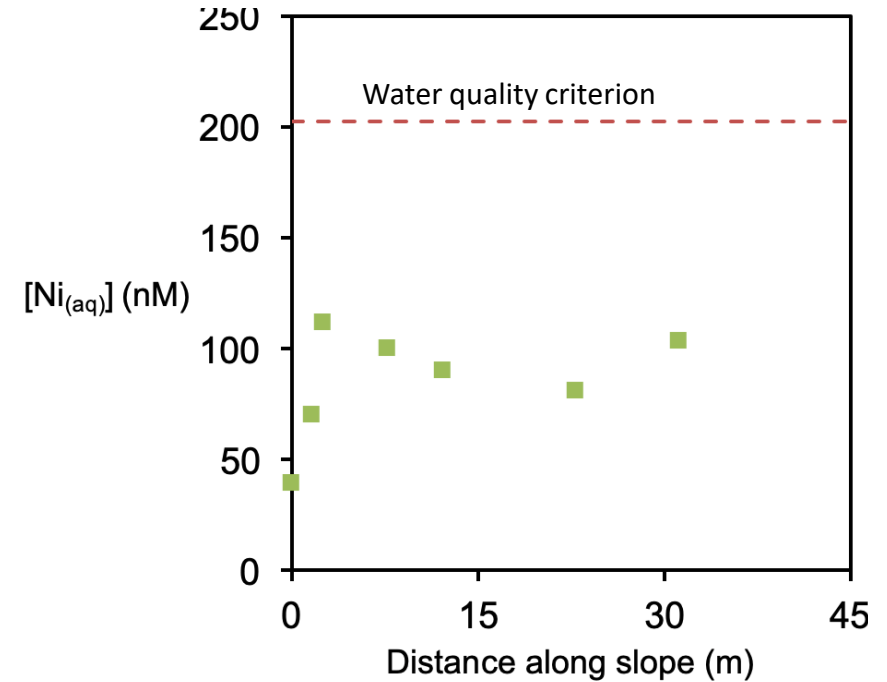
### Nitrate



### Copper

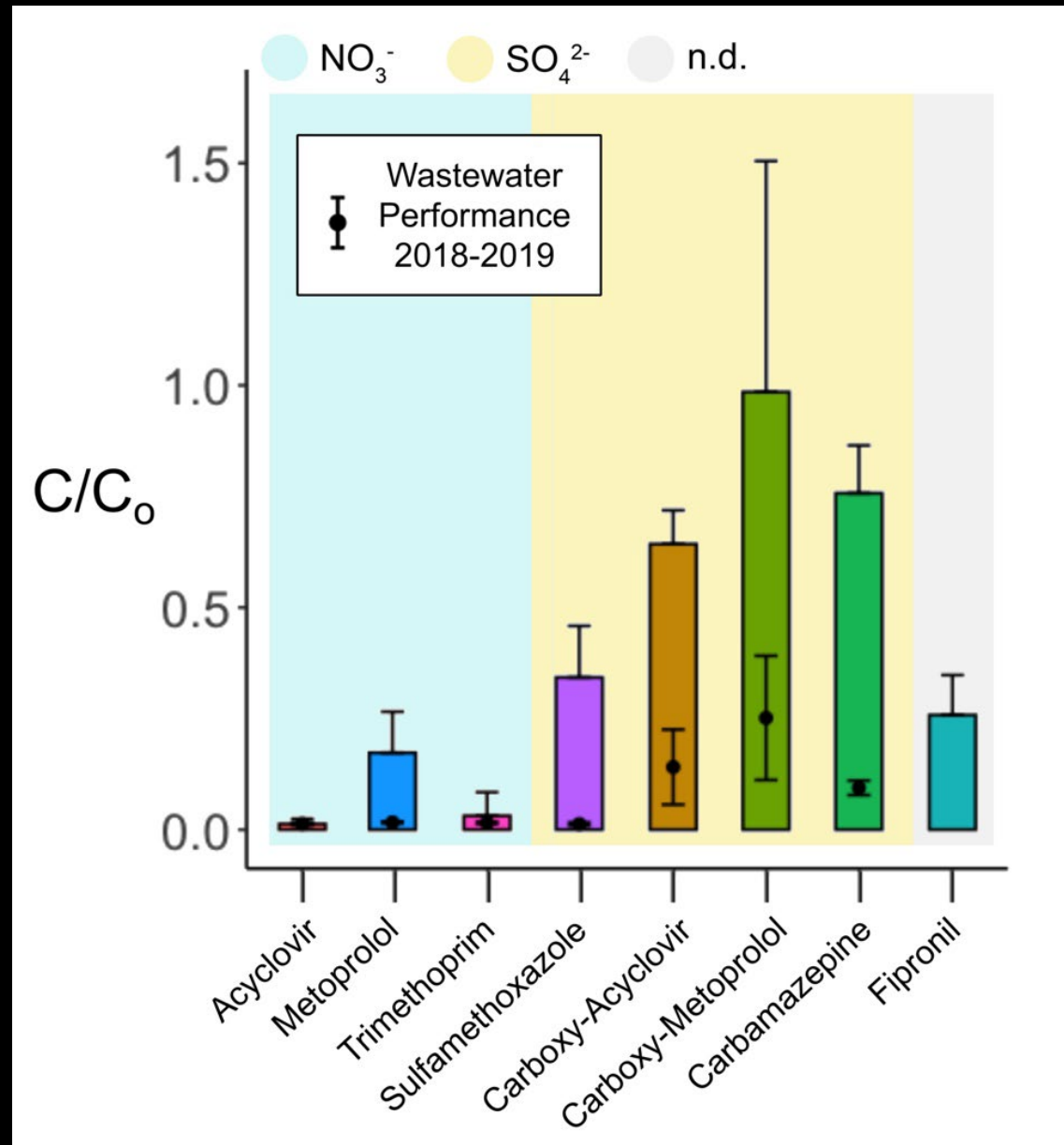


### Nickel



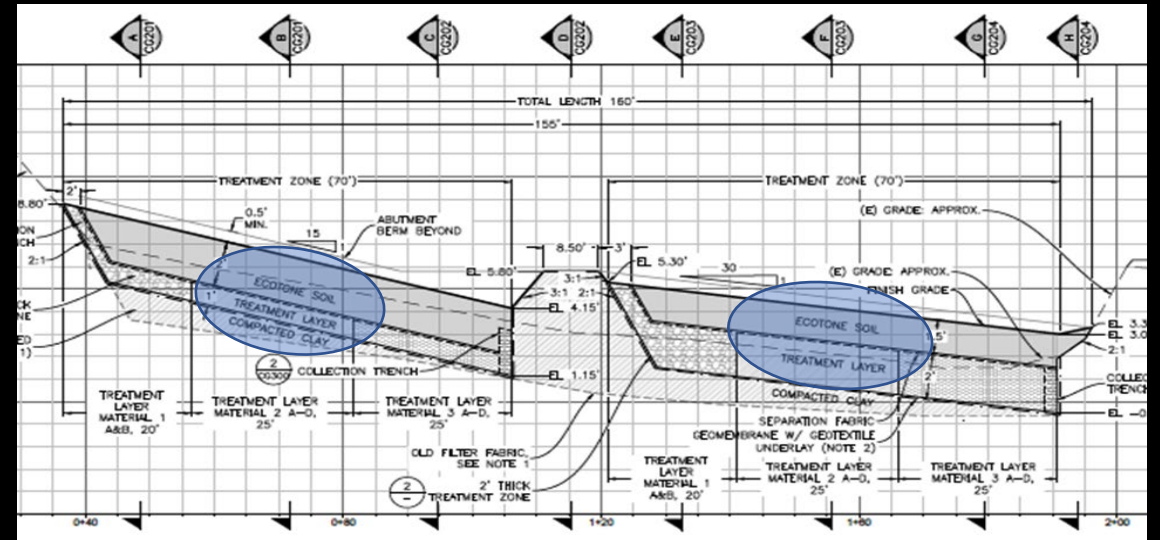
# ROC Pharmaceutical Removal

- Many pharmaceuticals were still removed
- Those requiring sulfate or iron reducing conditions were not as well removed



# Redesign for Footprint and PFAS Removal

Phase II (2022 – 2026)



Activated Carbon



Fluorosorb

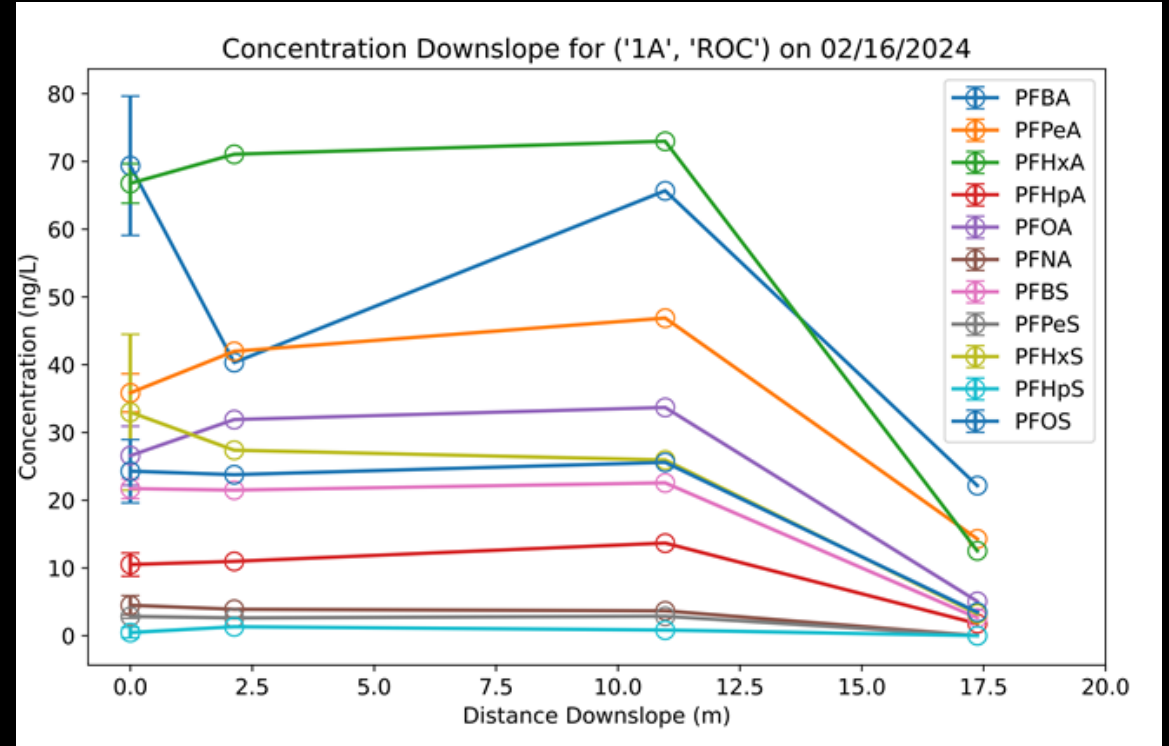
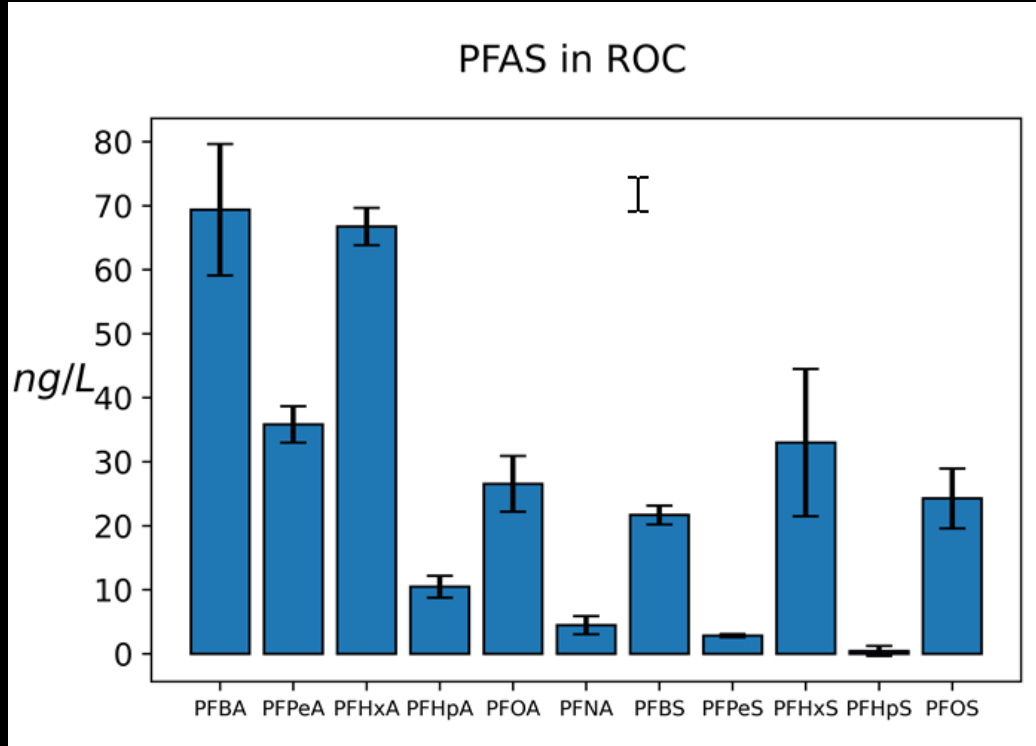
Source Credit: Oro Loma Sanitary District, and UC Berkeley



# ROC Treatment at the Oro Loma Horizontal Levee

## PFAS Removal

Phase II (2023 – Present)



Source Credit: UC Berkeley

# Key Points

## Completed Studies

All three completed pilots demonstrated various degrees of reduction of nutrients, metals, and CECs.

## Horizontal Levee Pilot Project

- Phase I has provided great results and demonstrated efficacy for removal of contaminants
- Phase II will deliver more information on removal of CECs, metals, scalability, and other practical aspects.



# Impact

## NBS as a Multifaceted Alternative

While blending ROC with effluent for dilution is the most cost-effective method of ROC management, NBS may have the potential:

- As an alternative treatment for ROC management
- Meeting the regulatory requirements (e.g. NPDES permit requirements)
- Protection of the shorelines against SLR and health of the San Francisco Bay





# Valley Water

Clean Water • Healthy Environment • Flood Protection