LOS ANGELES COUNTY SANITATION DISTRICTS

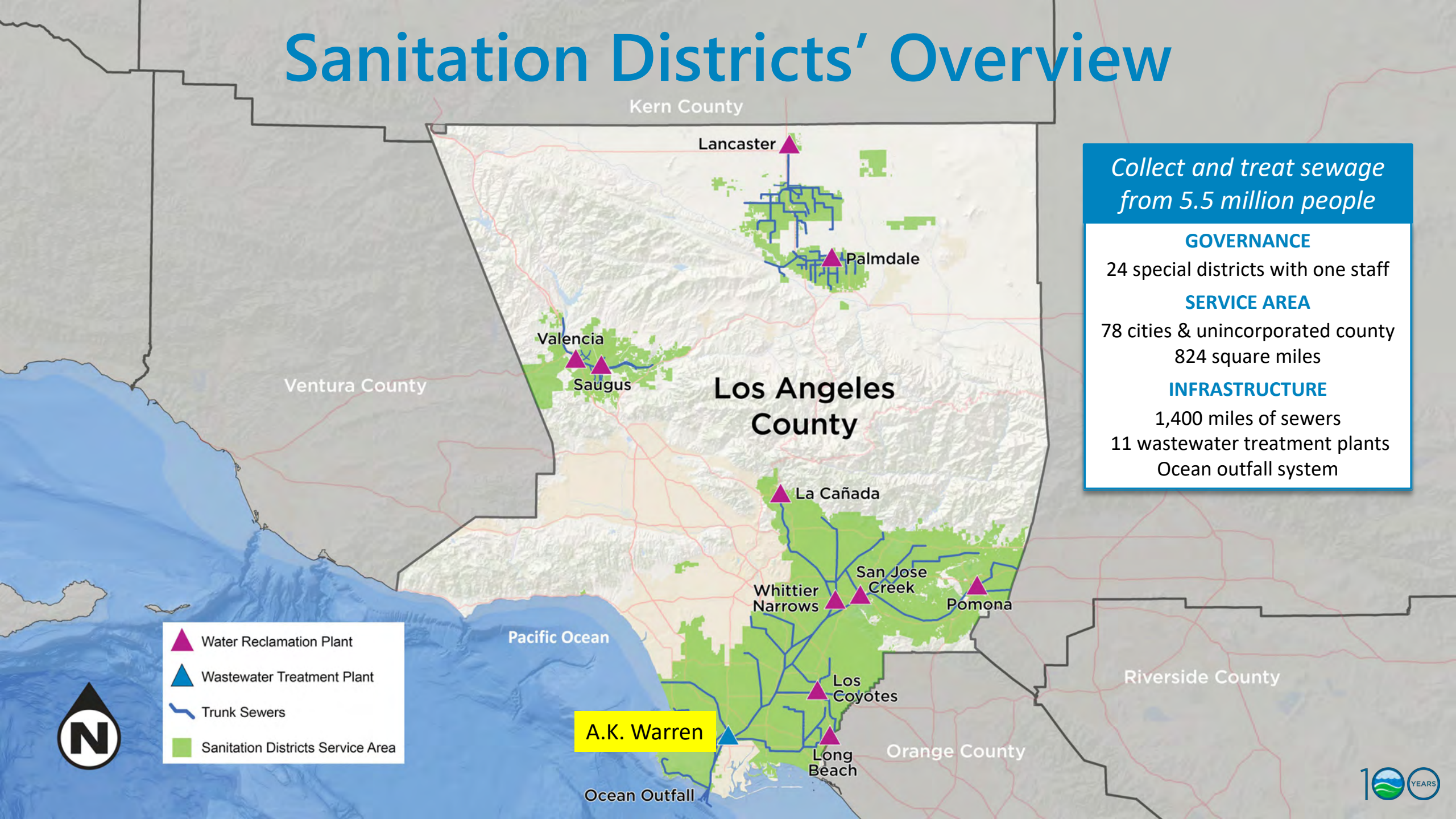
A Century of Service

A.K. Warren Water Resource Facility Nitrogen Management Research

May 2026

Bruce Mansell, PhD, PE
Manager, Wastewater Research Section

Sanitation Districts' Overview



Collect and treat sewage from 5.5 million people

GOVERNANCE

24 special districts with one staff

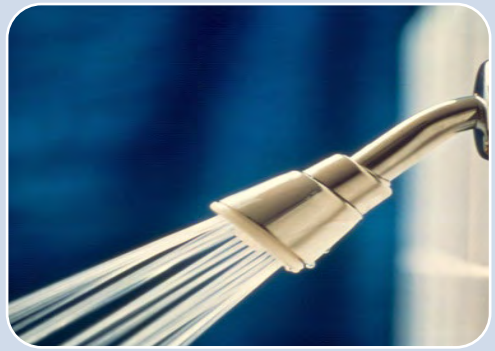
SERVICE AREA

78 cities & unincorporated county
824 square miles

INFRASTRUCTURE

1,400 miles of sewers
11 wastewater treatment plants
Ocean outfall system

PURE WATER SOUTHERN CALIFORNIA



① Wastewater from homes, businesses, and industries

② Treated at A.K. Warren Water Resource Facility

③ Purified through advance water purification (AWP) facility treatment

④ Conveyed to groundwater basins, industries, or drinking water plants

Warren Facility

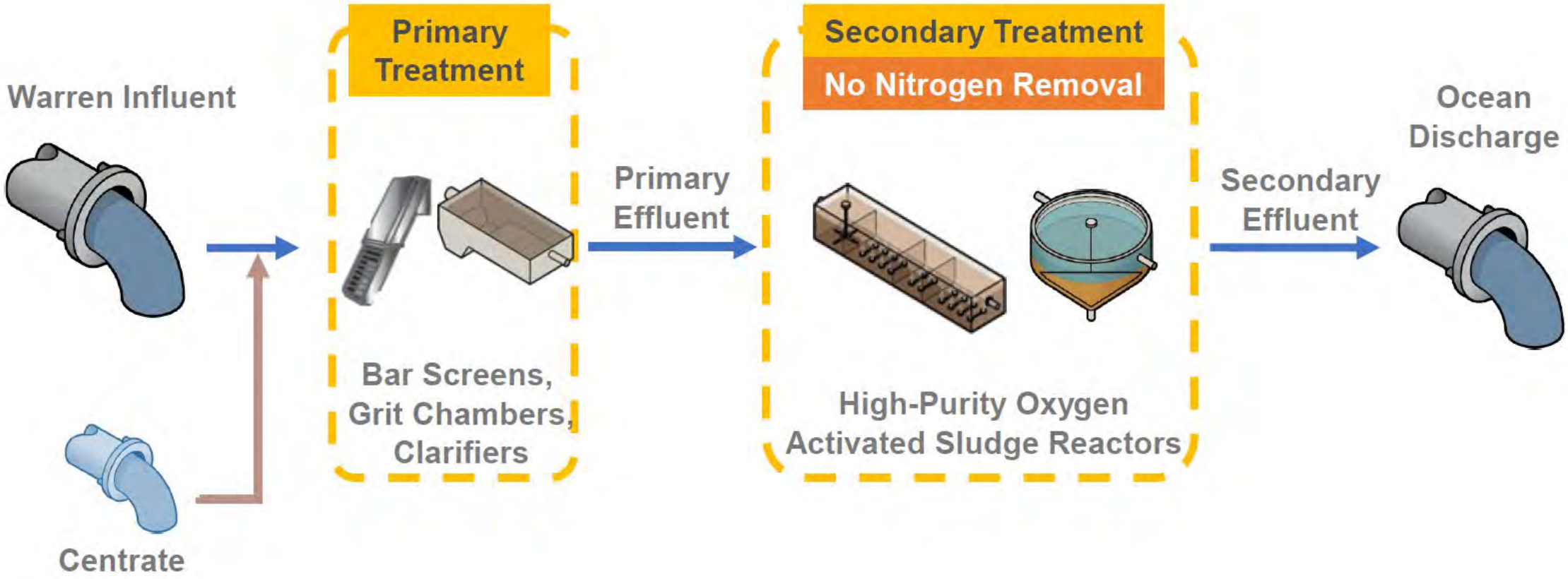
400 mgd capacity

~ 240 mgd currently treated and discharged to ocean

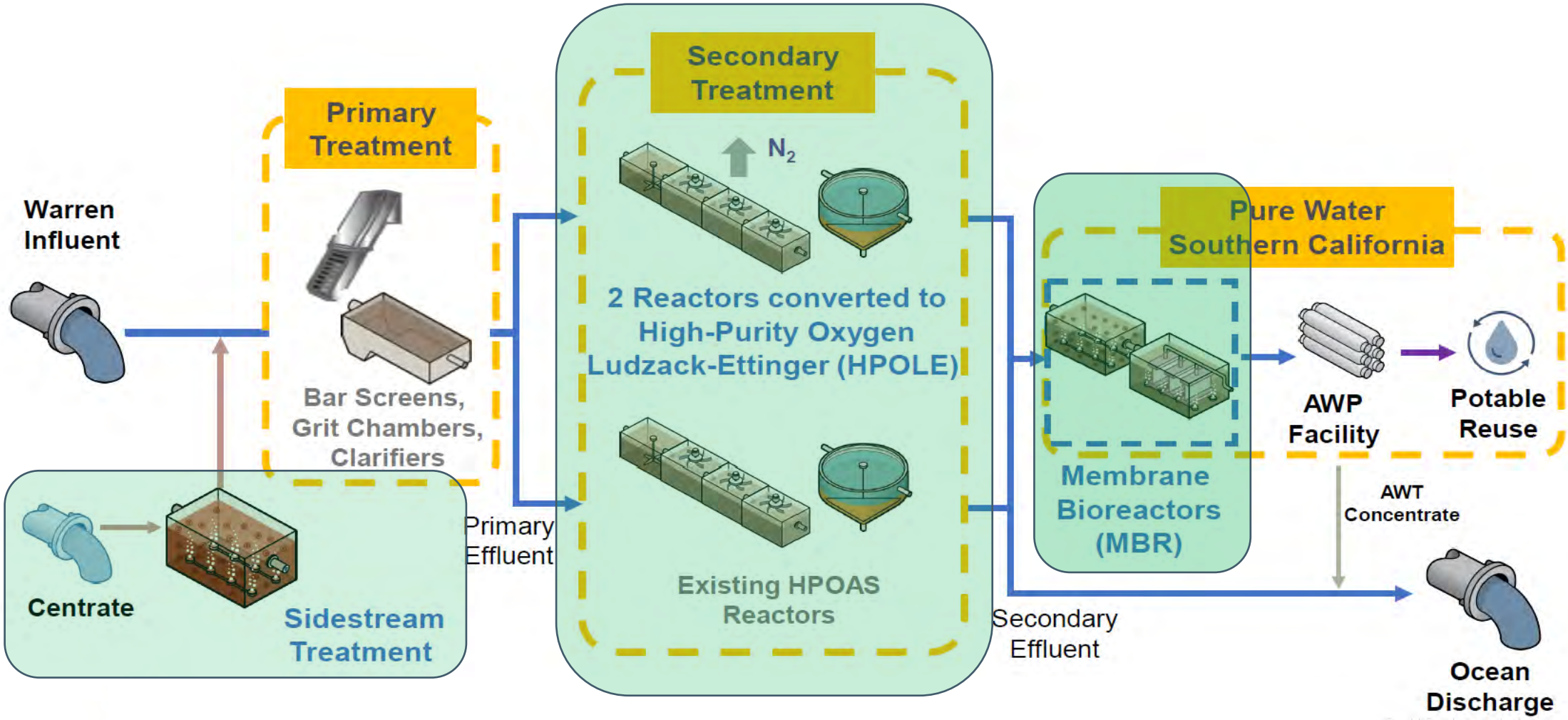
Removes solids and organics

Not designed for nitrogen removal

Warren Facility



Warren Facility: Planned Improvements



Warren Facility: Planned Improvements

- Sidestream Treatment (Partial Nitrification-Anammox)
  - Benefits
    - ✓Reduce influent nitrogen load
    - ✓Minimal impact on overall facility operation
    - ✓Less aeration energy compared to conventional nitrogen removal processes
    - ✓No carbon required
    - ✓Reduce operating costs for MBR

Warren Facility: Planned Improvements

- HPOLE
  - Benefits
    - ✓No new infrastructure
    - ✓Operator familiarity
    - ✓Reduce operating costs for MBR

Warren Facility: Planned Improvements

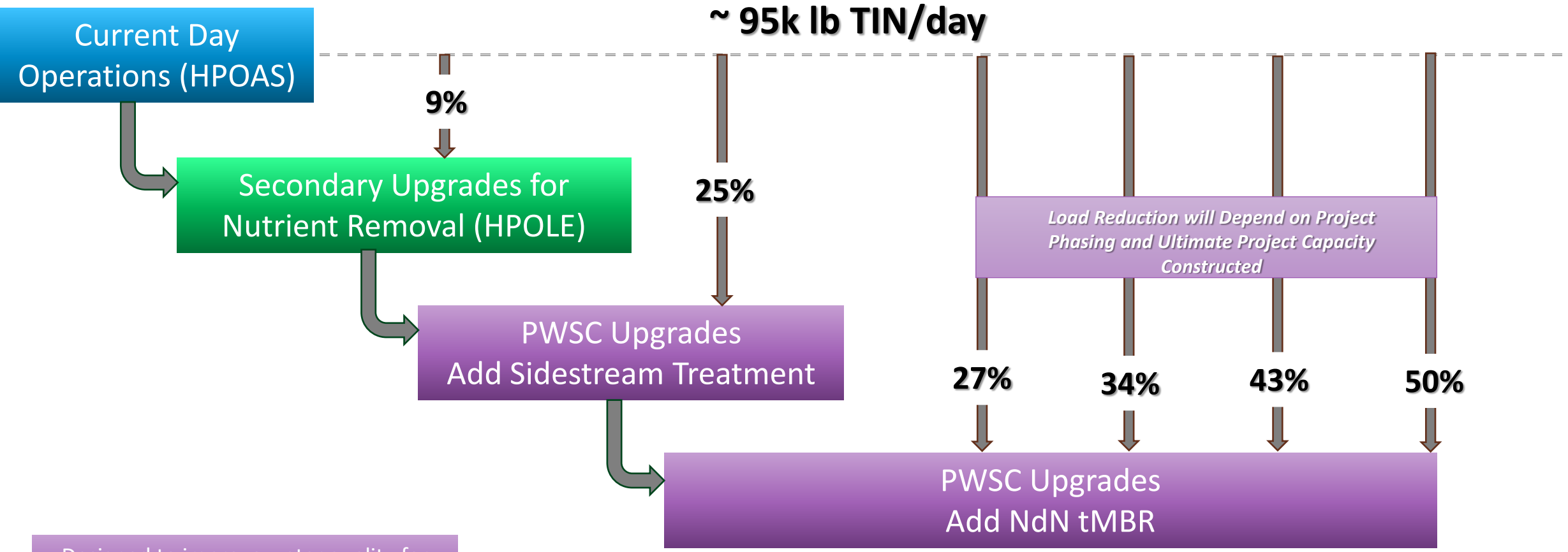
- ❑ **Flex MBR**
  - ❖ **Benefits**
    - ✓ **Space efficient pretreatment for AWP Facility**
    - ✓ **Multiple nitrogen removal process configurations**
    - ✓ **Modular design for expansion from Tertiary MBR (tMBR) to conventional Secondary MBR**

Flex MBR

1. Demonstration Facility
2. Bioreactor Influent Pump Station
3. Fine Screen Facility
4. Bioreactors
5. Membrane Tanks and Equipment Building
6. Carbon Facility
7. Phosphoric Acid Facility
8. MBR CIP Chemical Facility
9. Odor Control Facility

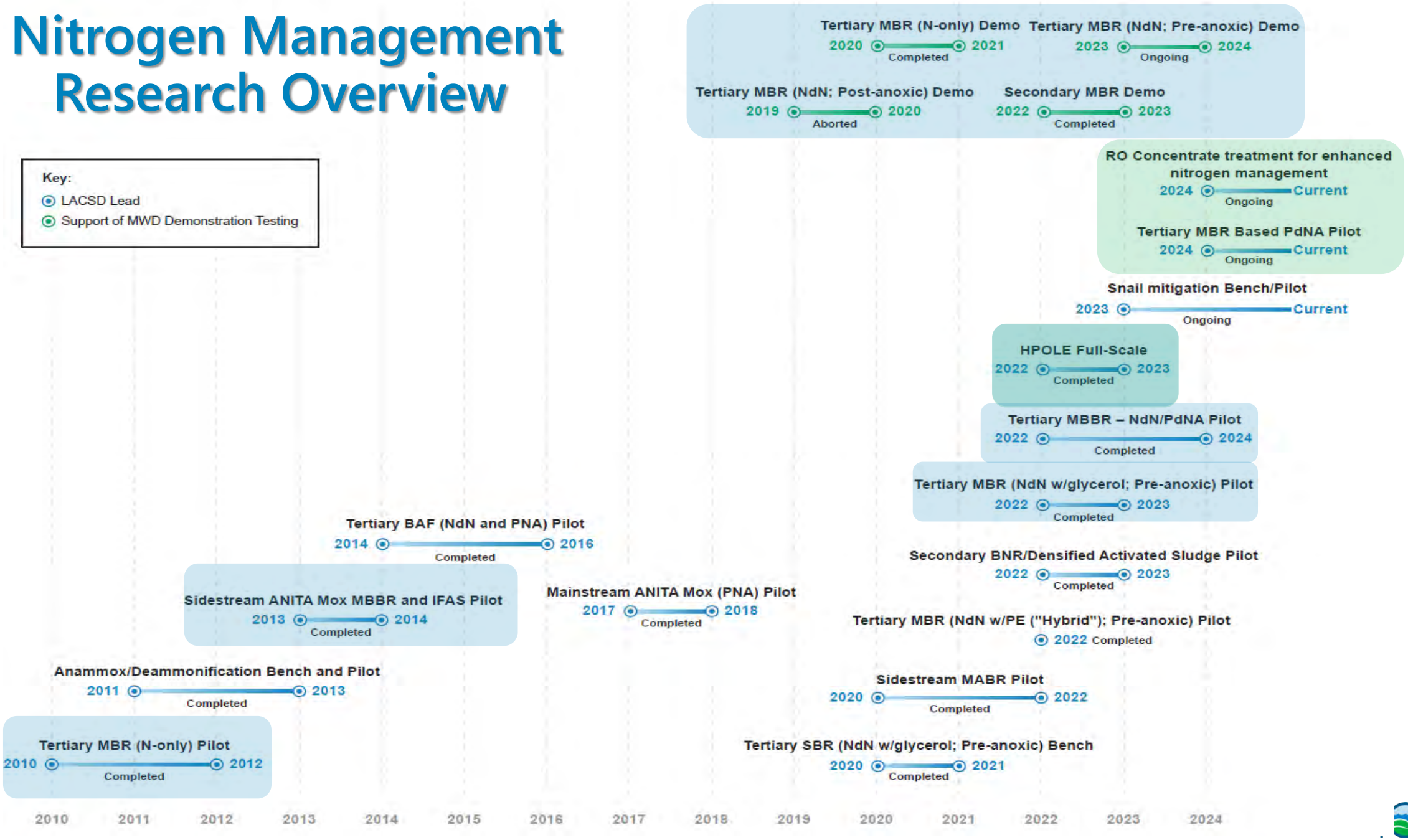
Phase 1
Phase 2
SMBR Expansion

Estimated Ocean Nitrogen Load Reduction



Designed to improve water quality for PWSC AWP Facility, resulting in incidental nitrogen reduction to ocean

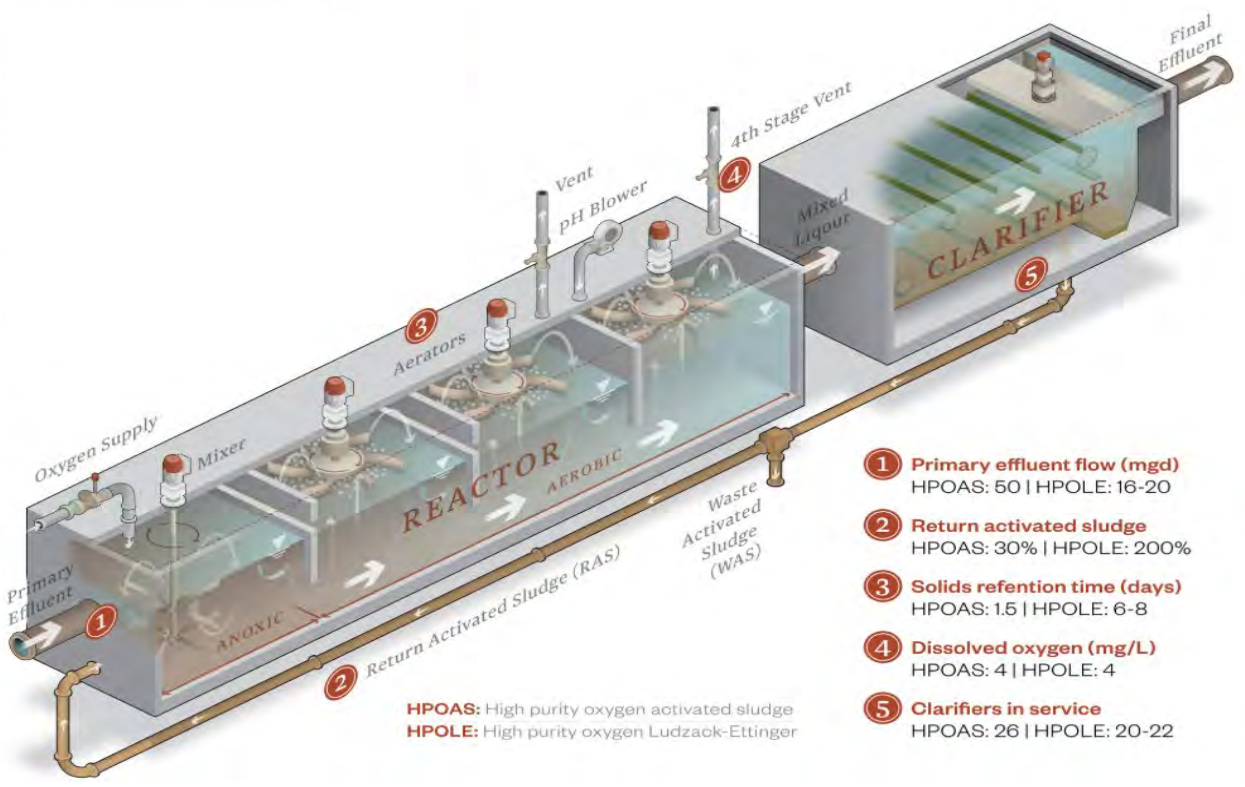
Nitrogen Management Research Overview

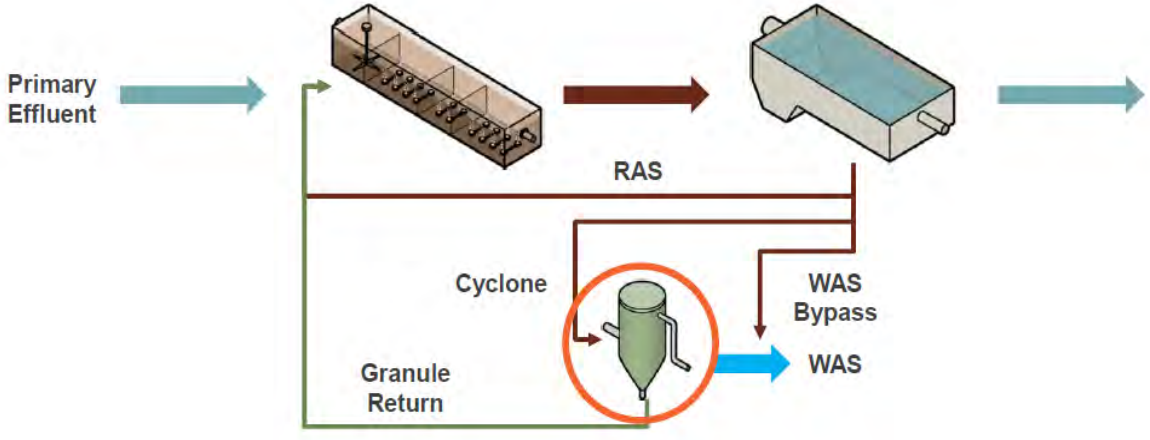


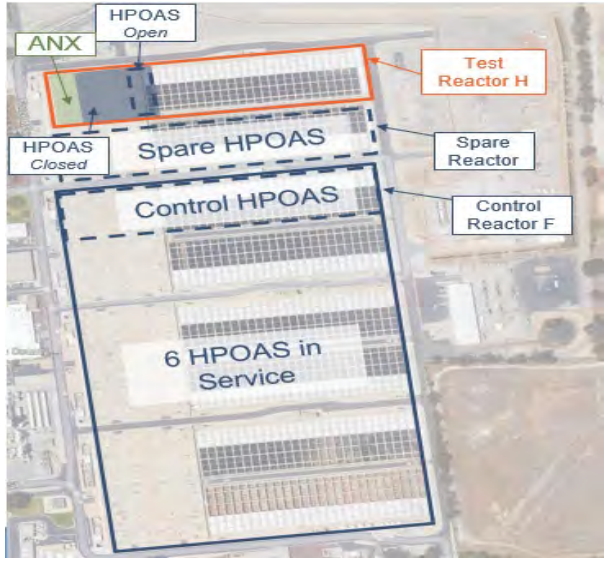
Ongoing Research

❑ HPOLE

- ❖ ***Goal: Full-scale proof-of-concept test for nutrient removal with existing infrastructure***
  - ✓ Testing in spare HPOAS reactor completed 2023
  - ✓ Verified model projected performance
  - ✓ Established **18 MGD** design basis
  - ✓ 1.5+ years of operation including wet weather
- ❖ **Planning to investigate capacity enhancement via implementation of Hydrocyclones**







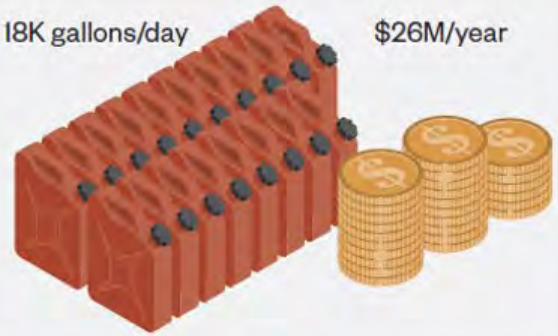
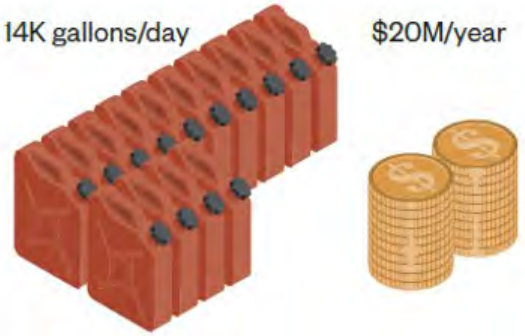
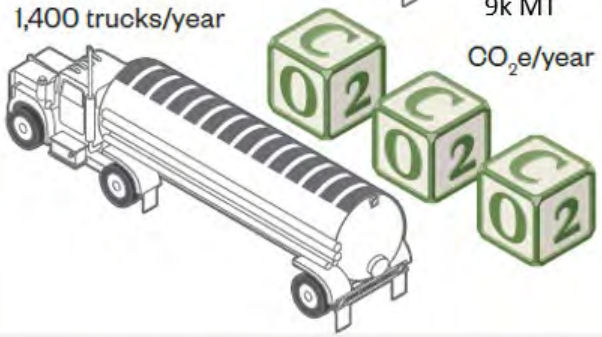
Hazen

Ongoing Research

- Partial Denitrification-Anammox (PdNA) tMBR
  - ***Goal: Reduce Supplemental Carbon***
  - Pilot-scale proof-of-concept testing in progress
  - To date, have demonstrated up to 65% reduction in supplemental carbon requirements while meeting effluent TIN goal of ≤ 19 mg N/L

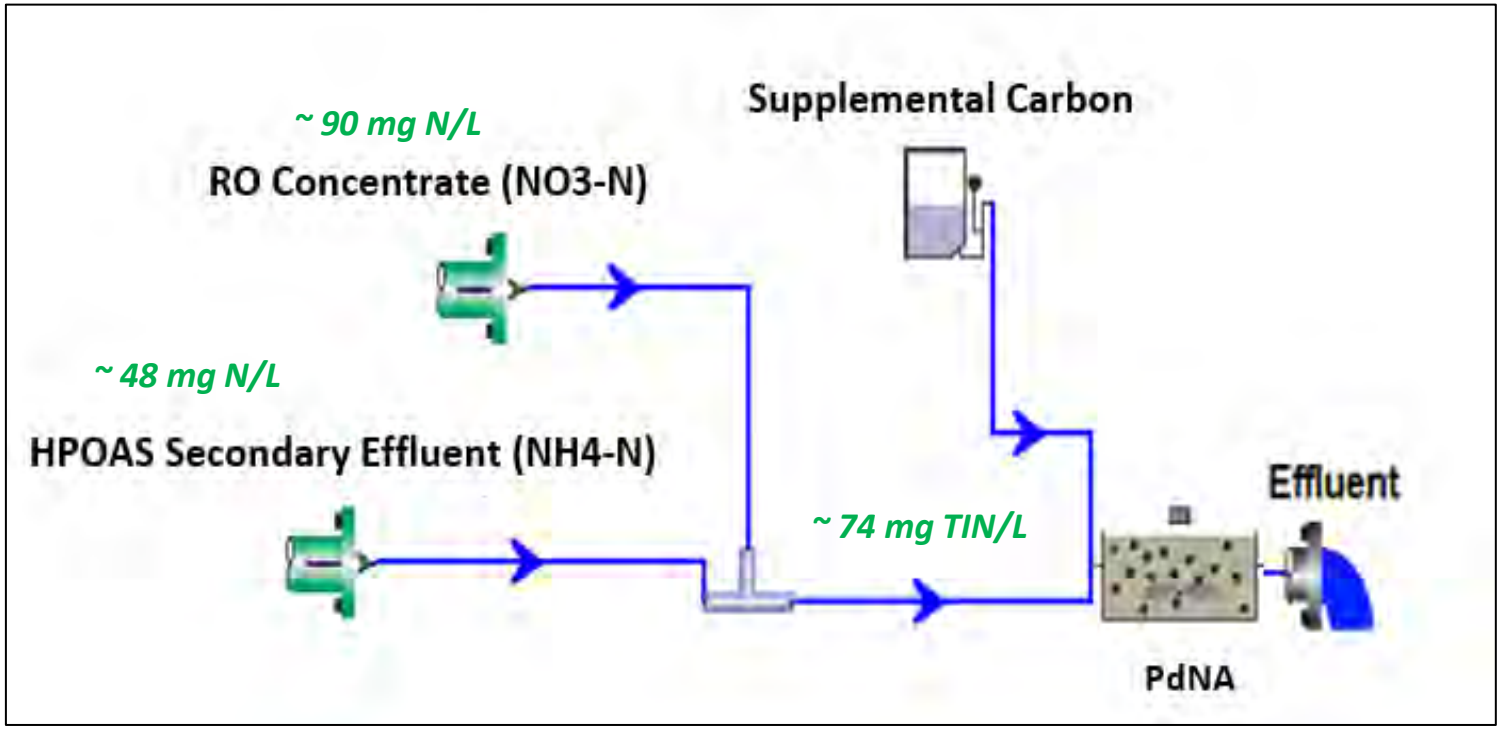
Ongoing Research

- Partial Denitrification-Anammox (PdNA) tMBR
  - Implications for Pure Water Southern California

Nitrogen Removal Process	Carbon Use and Cost	Trucking and GHG Emmissions
NdN Flex MBR + Centrate deammonification	18K gallons/day $26M/year 	1,800 trucks/year 12k MT CO_2e/year 
NdN Flex MBR + Centrate deammonification + HPOLE	14K gallons/day $20M/year 	1,400 trucks/year 9k MT CO_2e/year 
PdNA Flex MBR + Centrate deammonification + HPOLE	5K gallons/day $7M/year 	500 trucks/year 3k MT CO_2e/year 

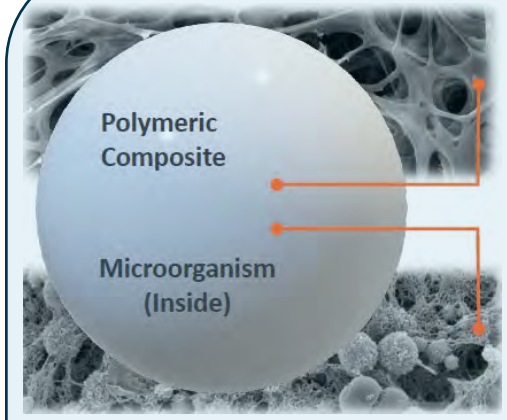
Ongoing Research

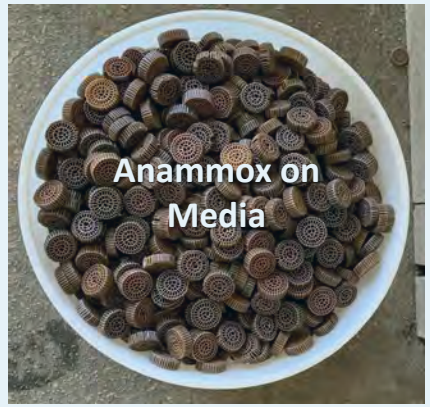
- RO Concentrate Treatment with PdNA
  - ***Goals: Ocean Nitrogen Load Reduction, Reduce Supplemental Carbon***
  - Phase 1 proof-of-concept testing complete
    - ✓ Demonstrated 50% reduction in supplemental carbon requirements with TIN removal up to 84%



Ongoing Research

- RO Concentrate Treatment with PdNA
  - Phase 2 testing in progress
    - ✓ Utilizing Microvi Biotechnologies Biocatalysts (Denitrovi™) for Partial Denitrification
    - ✓ Biocatalysts use carbon more efficiently than typical suspended biomass
    - ✓ Eliminates need for clarifier to retain suspended biomass

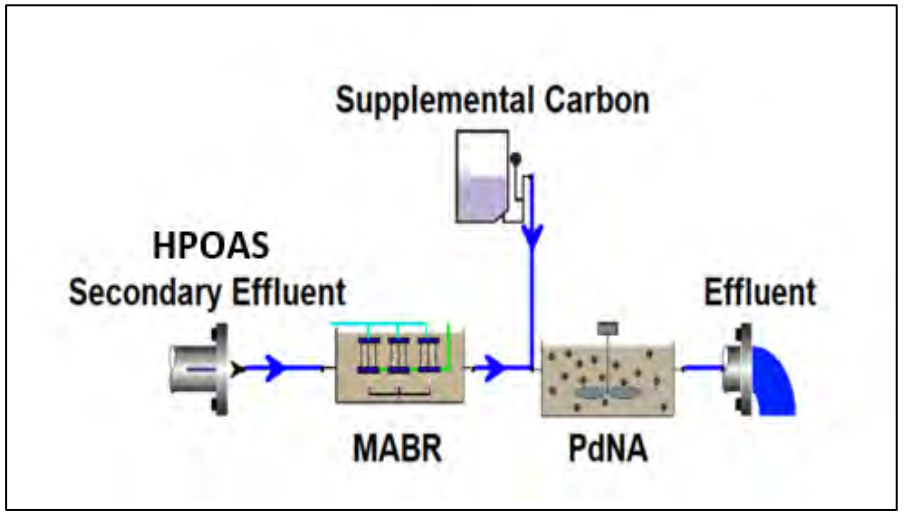


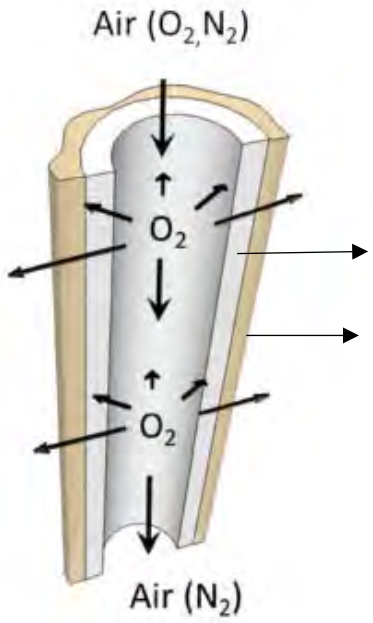


Denitrovi Biocatalysts

Ongoing Research

- HPOAS Secondary Effluent Treatment with Membrane Aerated Biofilm Reactor + PdNA
  - ***Goals: Ocean Nitrogen Load Reduction, Reduce Supplemental Carbon, Reduce Aeration Energy***
  - Phase 1 proof-of-concept testing complete
    - ✓ Demonstrated stable and energy efficient nitrification
    - ✓ Demonstrated PdNA treatment of MABR effluent with batch tests
  - Phase 2 testing with full-scale modules, flow through PdNA reactor, in progress





Bubble-less Oxygen Transfer

→ Membrane

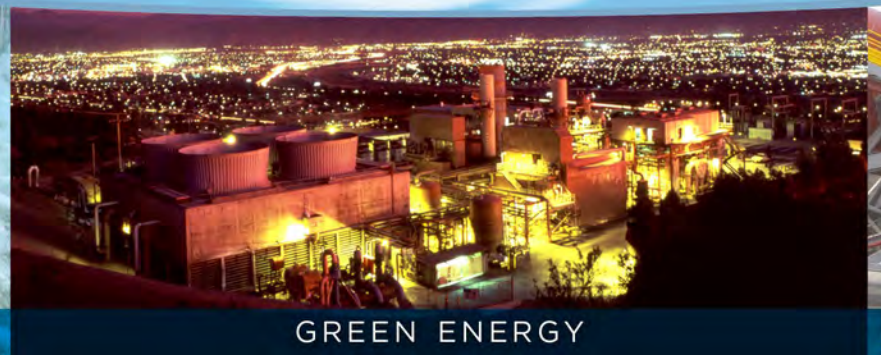
→ Nitrifying Biofilm

bmansell@lacsd.org

LOS ANGELES COUNTY
SANITATION DISTRICTS
Converting Waste Into Resources

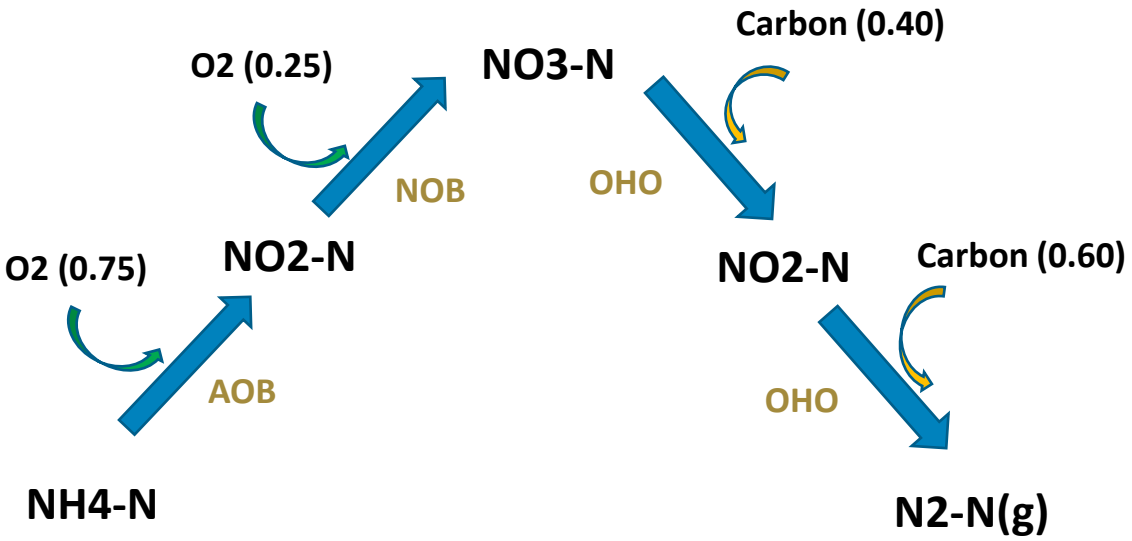
OUR MISSION

To protect public health and the environment through innovative and cost-effective wastewater and solid waste management and, in doing so, convert waste into resources such as recycled water, energy, and recycled materials.



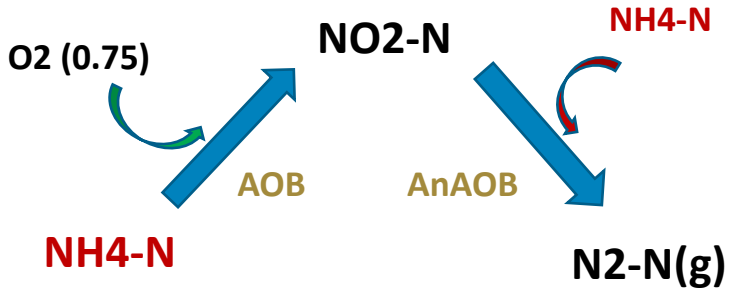
Nitrogen Removal Pathways

Nitrification-Only (N-only)
Nitrification-Denitrification (NdN)



AOB = ammonia oxidizing bacteria
NOB = nitrite oxidizing bacteria
OHO = ordinary heterotrophic organisms
AnAOB = anaerobic ammonia oxidizing bacteria

Partial Nitrification-Anammox (PNA)



Partial Denitrification-Anammox (PdNA)