SUPEROXYGENATION

A MEANS TO EFFICIENTLY DISSOLVE OXYGEN INTO WATER AND WASTEWATER

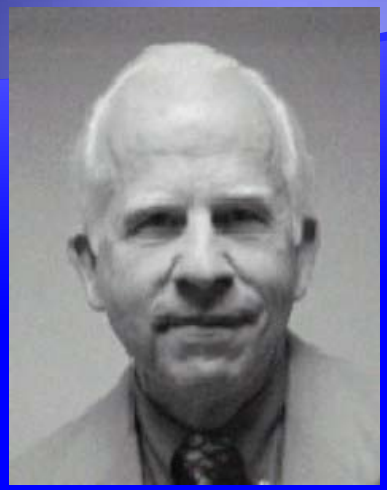
WATER QUALITY

2-1-2013

PRESENTATION OUTLINE

1. Speece Cone Roots
2. Technology Overview
3. Speece Cone Attributes
4. Case Studies
5. Conclusions
6. Q/A

PIONEERING EFFORTS – BRAIN TRUST



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MS – Yale University
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BS – University of the Pacific
MS – UC Berkeley
Ph D – Stanford University

SUPEROXYGENATION

WHAT

PURE OXYGEN

- No Addition of Chemicals
- Environmentally Friendly

WHY

SUSTAINS AEROBIC CONDITIONS

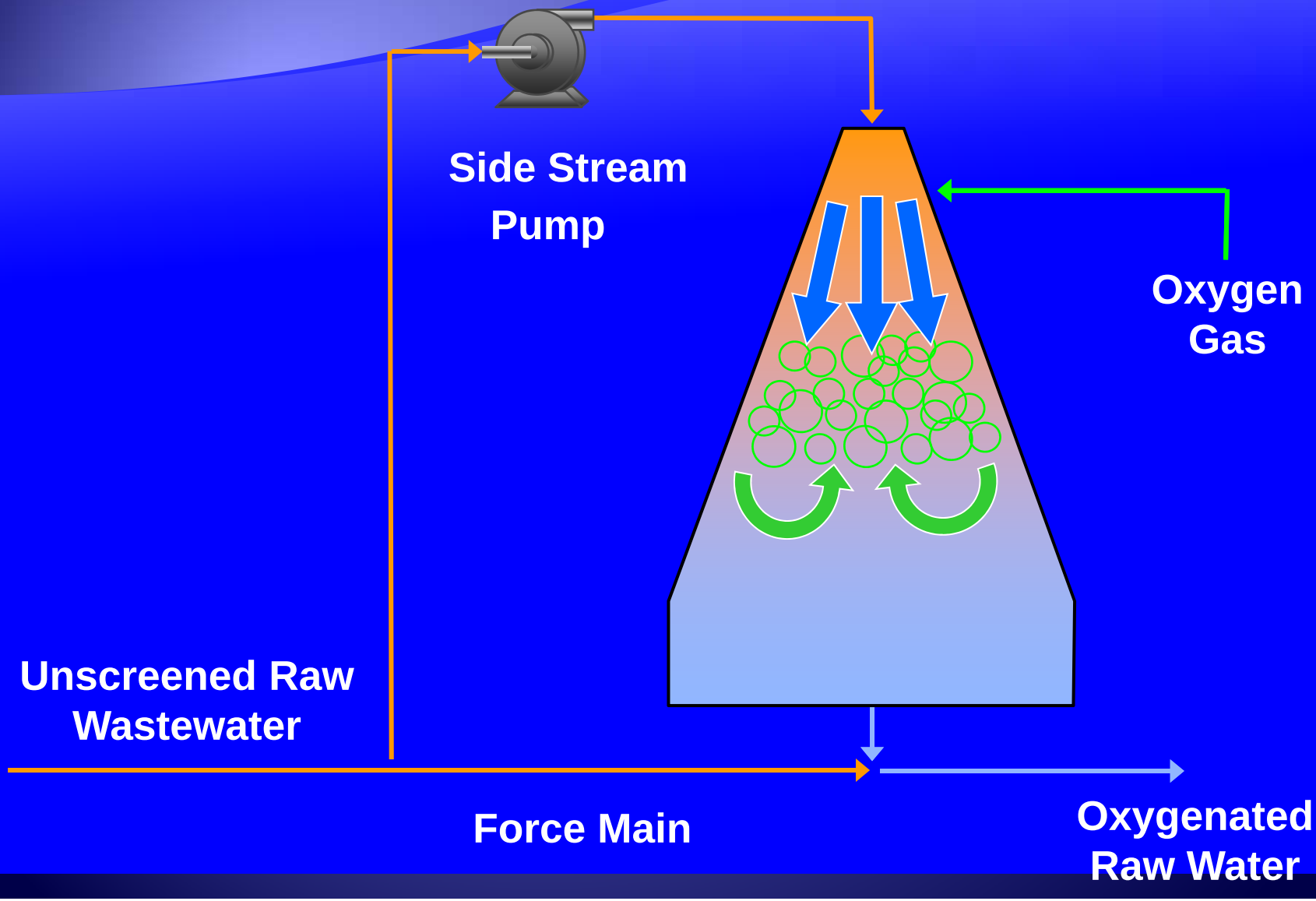
- Prevents Odor and Corrosion
- Sustains Aquatic Life

HOW

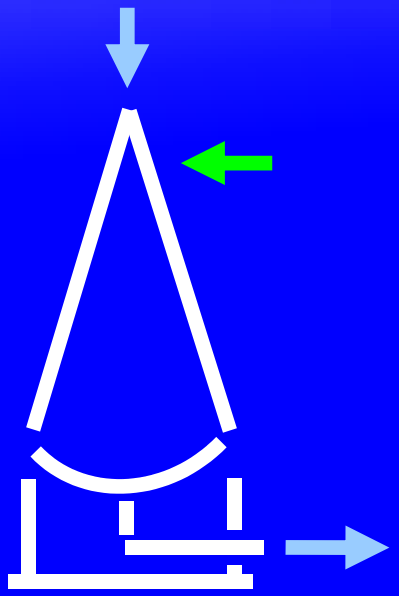
ECO2 TECHNOLOGY

- Simple Design
- Very Efficient (OTE > 90%)

TECHNOLOGY OVERVIEW



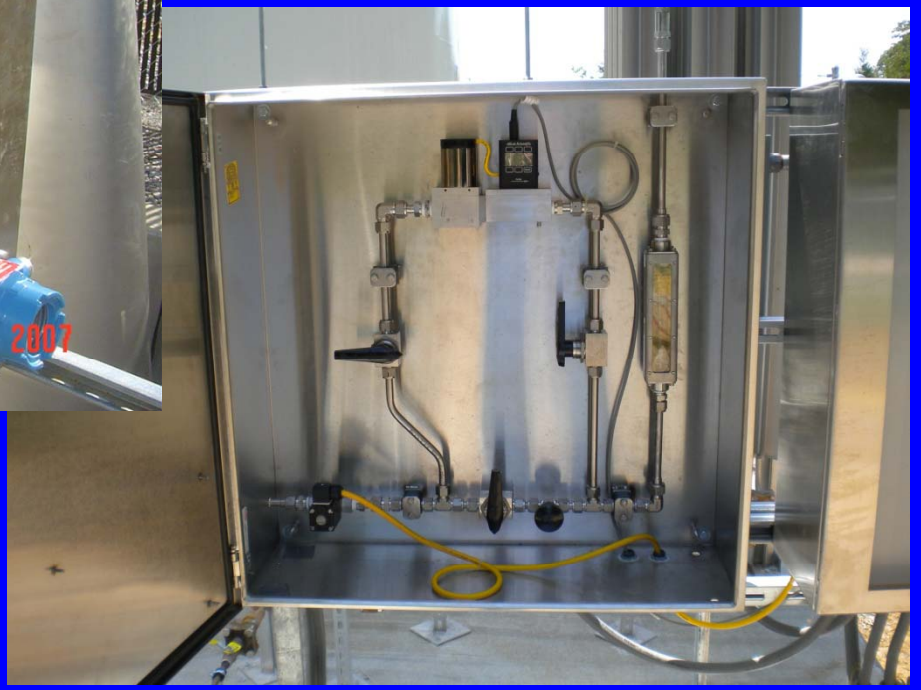
CONE DESIGN



- Stainless Steel Construction
- No inner mixers or baffles
- Self-cleaning device

SYSTEM COMPONENTS

ECO2 SYSTEM CONTROLS



SUPEROXYGENATION FOCUS

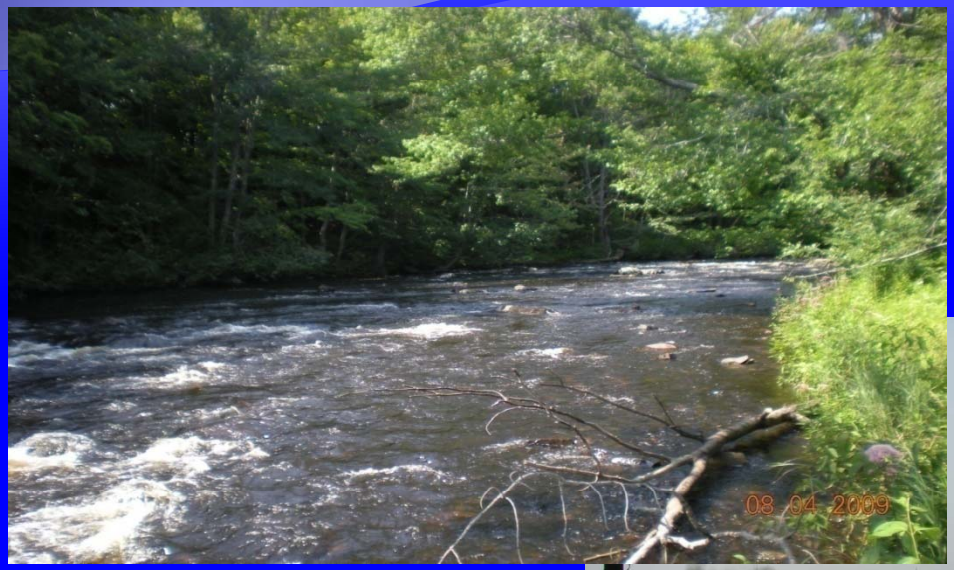
WASTEWATER

Odor / Corrosion Prevention

WATER QUALITY

Restore Water Quality

WATER QUALITY



IMPORTANCE OF D.O.

Positive D.O.	No D.O.
Support Aquatic Life	Fish Kills
Reduces BOD Level	Increases BOD Level
Prevents H2S Production	Odors
Prevents Iron & Manganese Release	Taste and Odor in Drinking Water

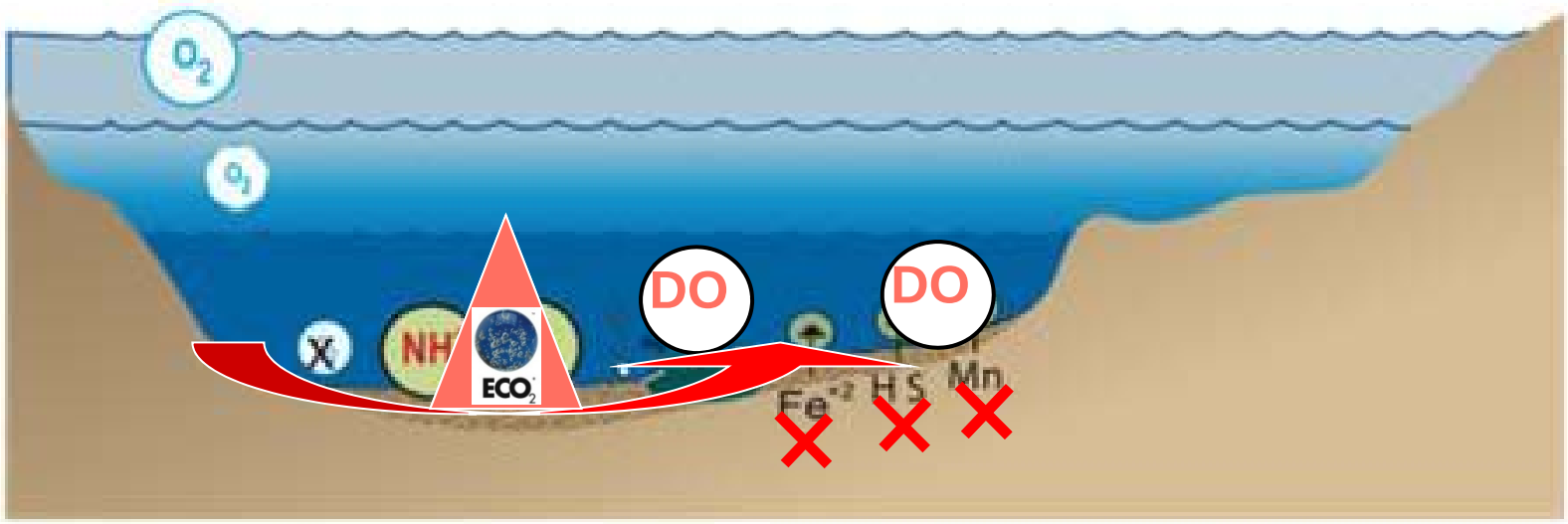
How can D.O. be added ?

Surface Aeration

Bubble Diffusers

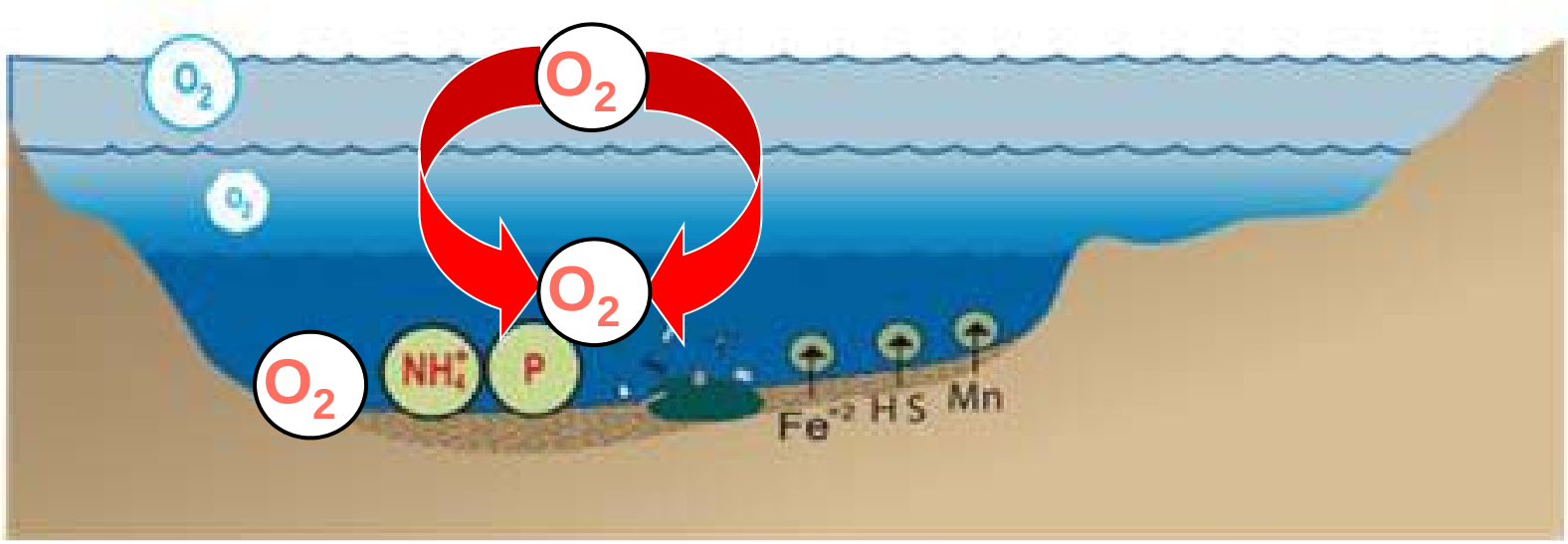
SuperOxygenation

ECO2: Hypolimnetic Oxygenation



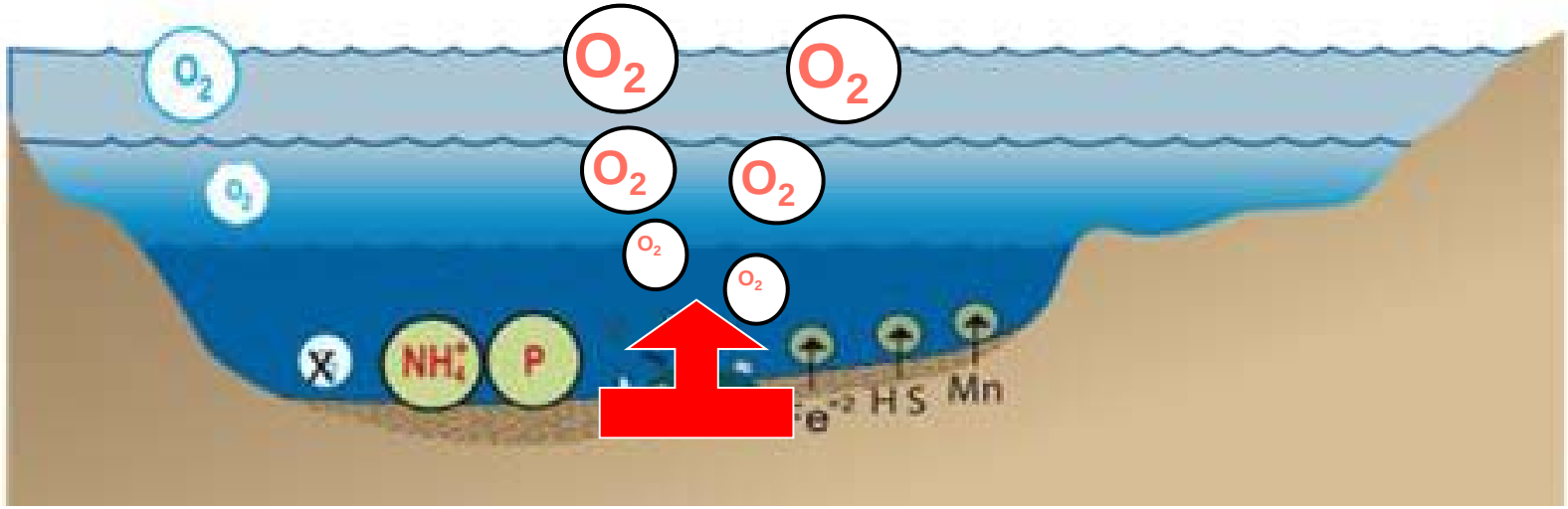
- Pulls water from hypolimnion & discharges oxygenated water back into the hypolimnion
- Water of same density remains in hypolimnion
- D.O. brought to the source where it is needed most to
- Prevent H2S Formation and Fe&Mn Release

SURFACE AERATION



- Mixing of the entire Volume required
- Destratification
- Cold water mixed with warm water from surface
- Nutrients from Sediment stirred up and brought to top → increase in algae growth

BUBBLE DIFFUSERS



- Bubbles rise – O2 must dissolve while bubble is rising
- O2 that reaches the surface is wasted
- O2 is needed in sediment
- Air Diffusers must operate continuously to prevent clogging from bio-growth
- Destratification

ECO_2 Advantage: No Destratification

- **ECO2 Technology** maintains the natural stratification of the lake
- No nutrients are stirred up from the sediment and brought to the upper algae growth zone
- Colder water remains on the bottom:
  - Easier Water Treatment
  - Maintains cold water fish habitat

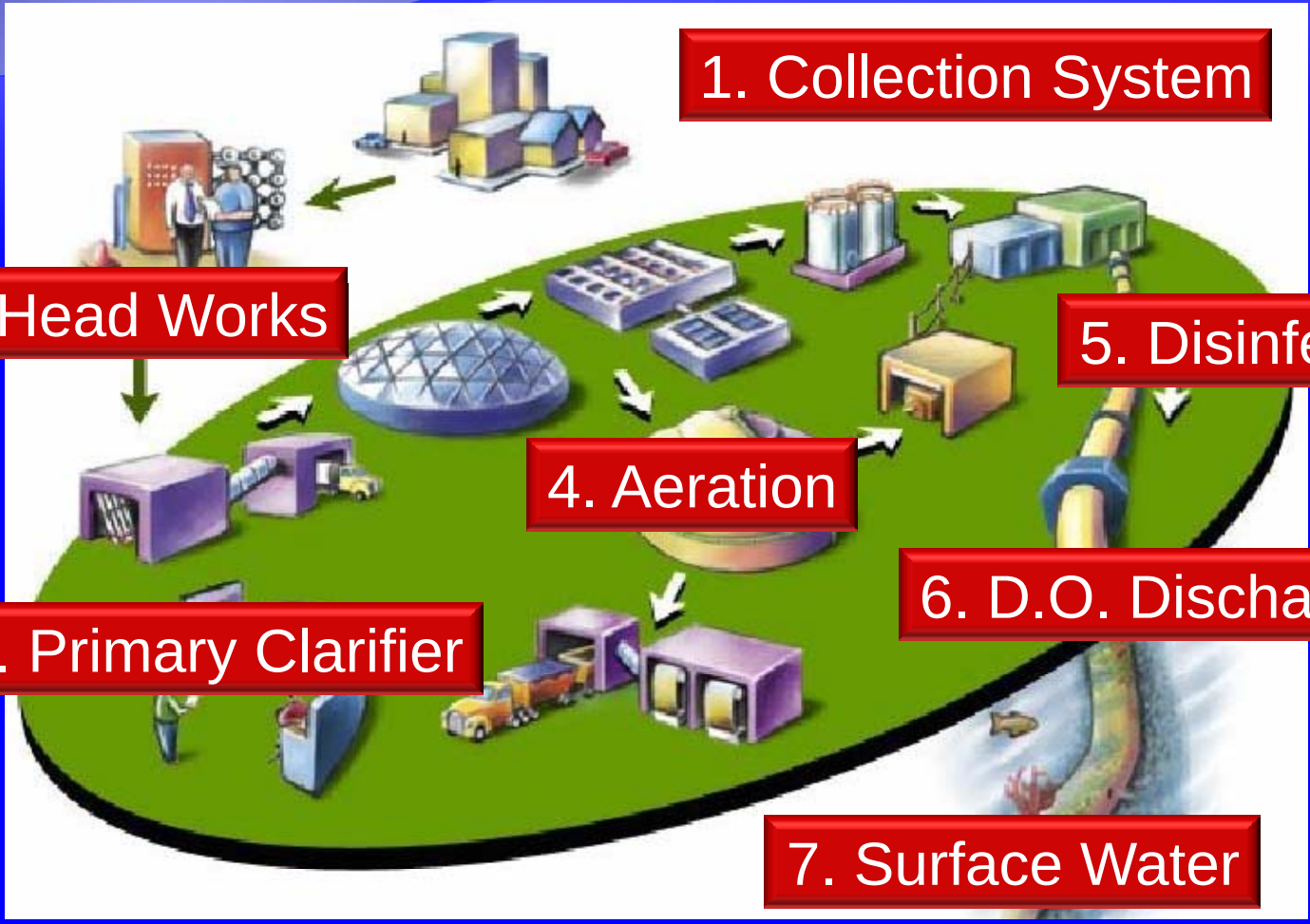
ECO2 Advantage: Natural Water Surface

- No Mixers or Aerators on the surface
- No visual impact on the lake's surface
- No obstacles for recreational activities such as boating, waterskiing or fishing

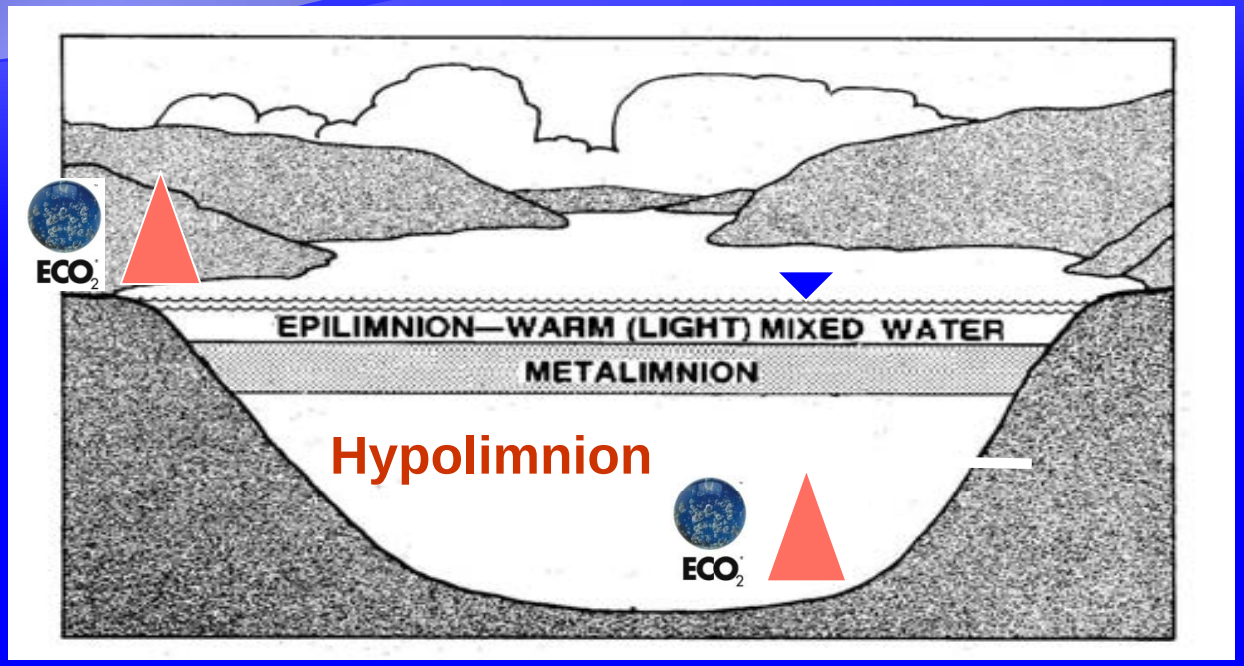
ECO2 Advantage: No Bubbles

- **ECO2 Technology** adds already dissolved oxygen to the water
- Liquid-to-liquid mixing allows for faster & broader distribution of O2
- Does not waste any oxygen
- O2 feed rate can be precisely controlled and adjusted to respond to DO levels in water body
- Robust system can be turned off as needed without danger of clogging delivery pipes

APPLICATIONS



7. SURFACE WATER

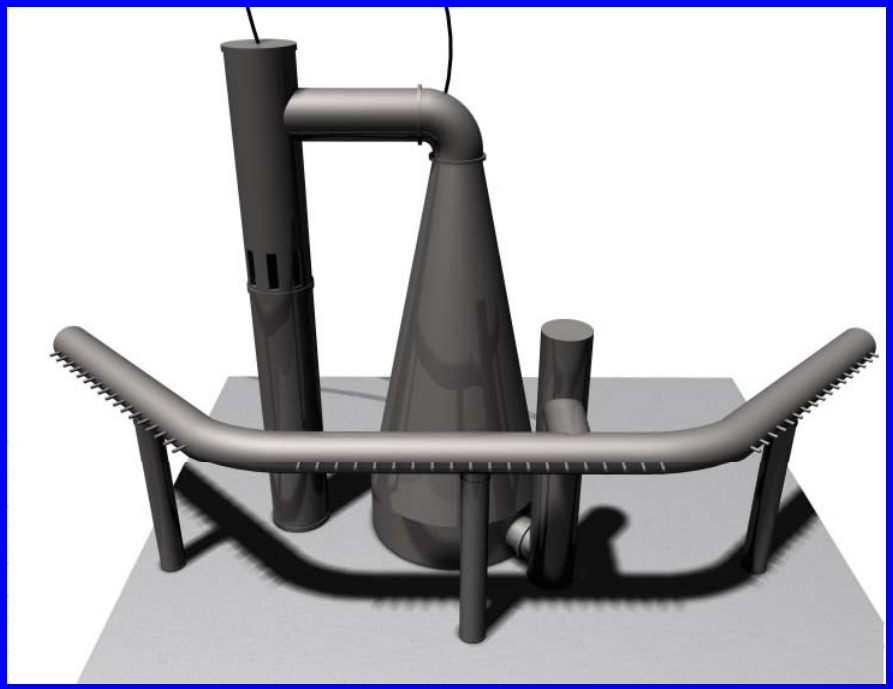


GOALS

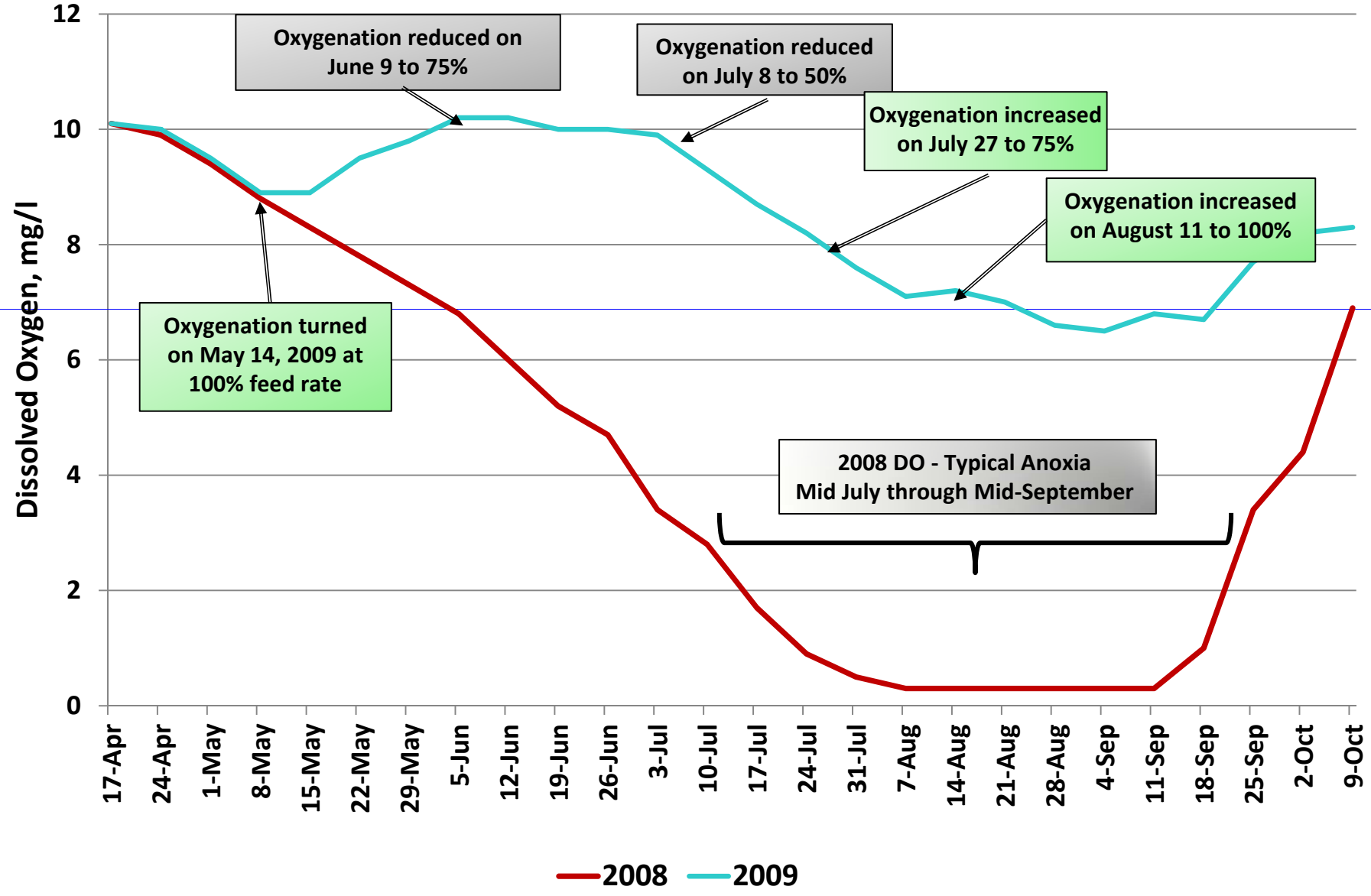
- Supplement D.O. to Sustain Aquatic Life
- Prevent H_2S Formation
- Prevent Iron and Manganese Release

DRINKING WATER RESERVOIR

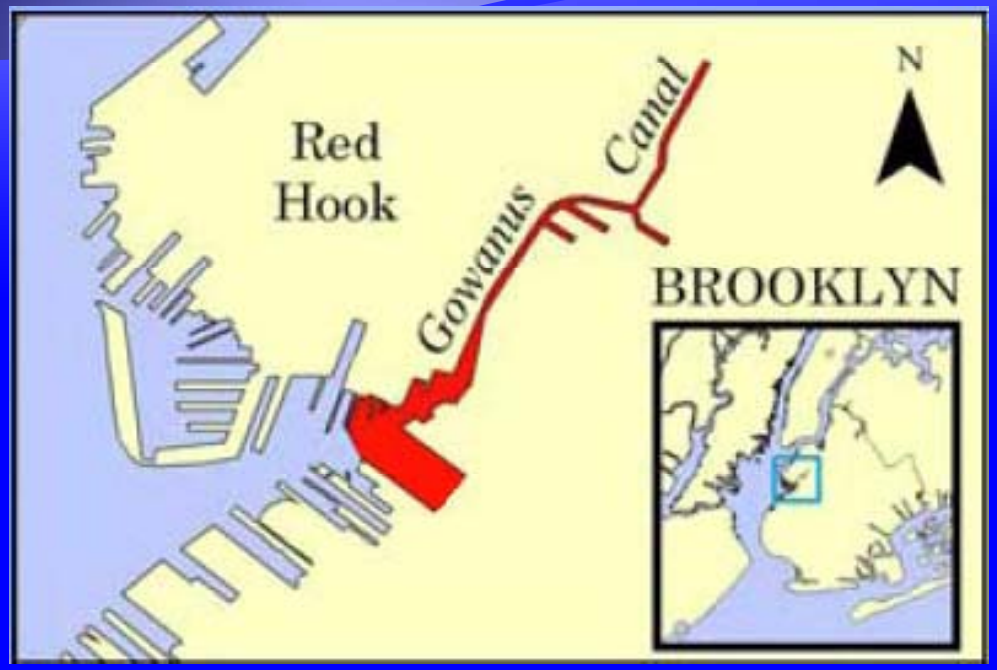
4.2 MGD . 2,200 lb O2 / day
Results: Cone D.O. Discharge 60 mg/L

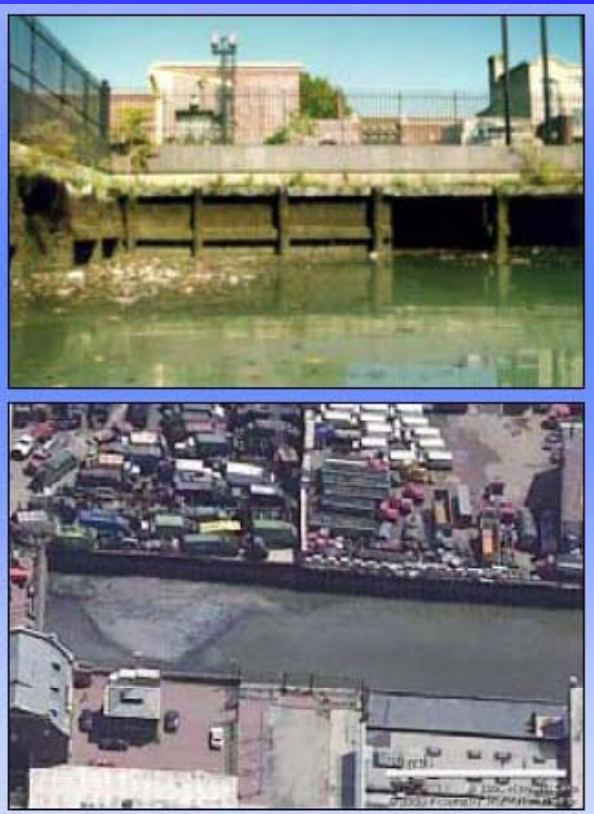


Marston Reservoir Bottom Dissolved Oxygen
2008 vs. 2009



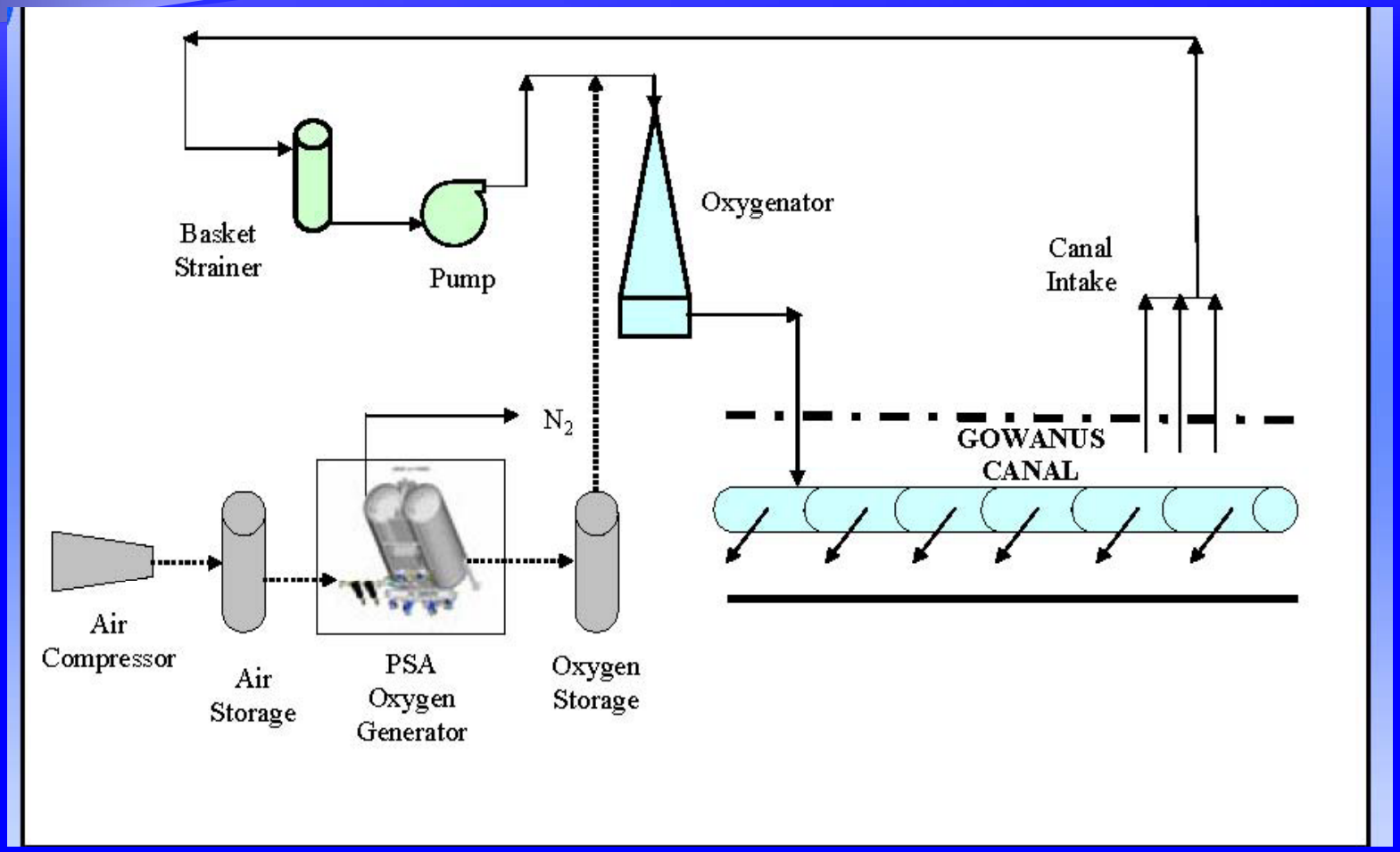
GOWANUS CANNAL, NY



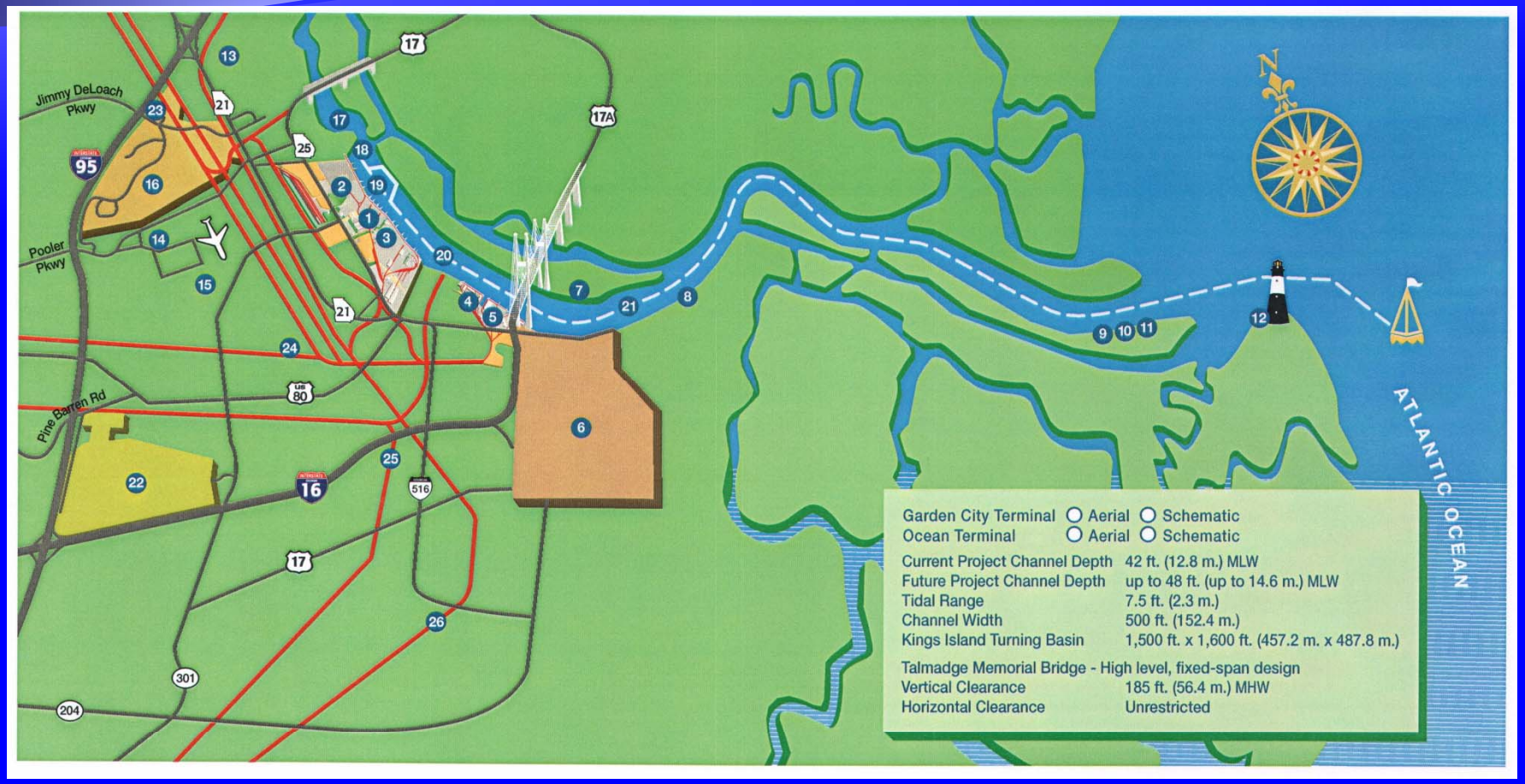


- 30 m Wide
- 24,00 m Long
- 4 m Deep

GOWANUS CANAL, NY



GPA - Savannah Harbor, GA



GPA - Savannah Harbor, GA

CONE: 12 ft Diameter, 24 ft tall (x2)
GOAL: Dissolve 30,000 lbs / day

D.O. DISCHARGE TMDL

GOALS

- Meet D.O. Discharge Standards
- Point Source Loads
- Offset Residual BOD – NET ZERO

NET-ZERO ULTIMATE OXYGEN DEMAND

- WWTP Effluent Contains Residual Pollutants i.e BOD and Ammonia
- Bacteria in the Receiving Water Biologically Consume Residual Pollutants
- This Biological Process Causes an Oxygen Demand in the Receiving Water
- Reduced Oxygen Damages Aquatic Life

TREATMENT OPTIONS

1. Zero Effluent Discharge
   - Effluent Stored Onsite used for Reclaim Water

   NOT PRACTICAL

2. Tertiary / Reverse Osmosis Treatment
   - Residual Pollutants Removed

   VERY EXPENSIVE

3. Dissolved Oxygen Offset - SuperOxygenation
   - Satisfy Oxygen Demand of Residual Pollutants

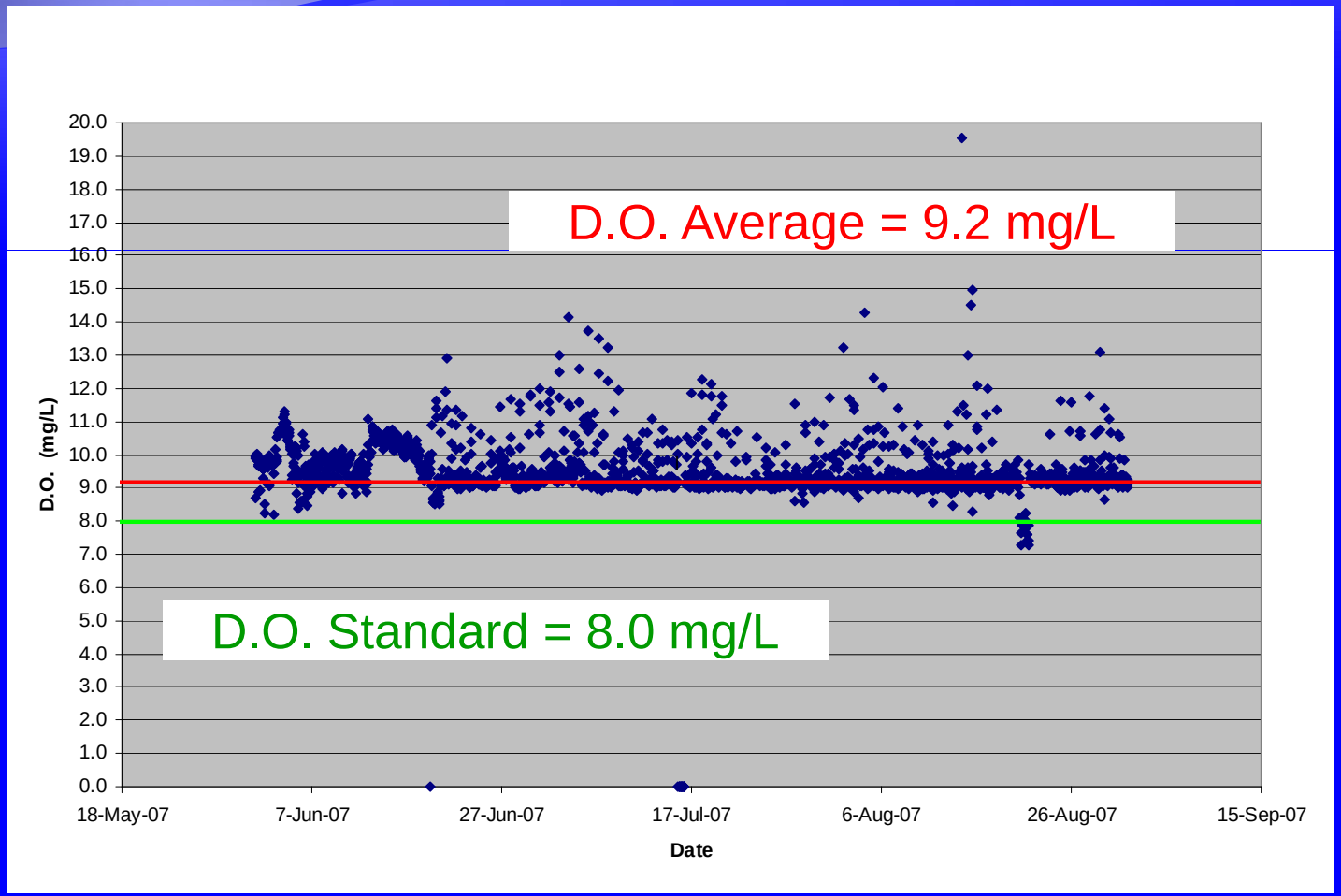
   PRACTICAL AND INEXPENSIVE

KENNEBUNK, ME

5.0 MGD · 210 lb O_2 / day

Results: WWTP Plant D.O. Discharge 8 mg/L

EFFLUENT D.O. LEVEL



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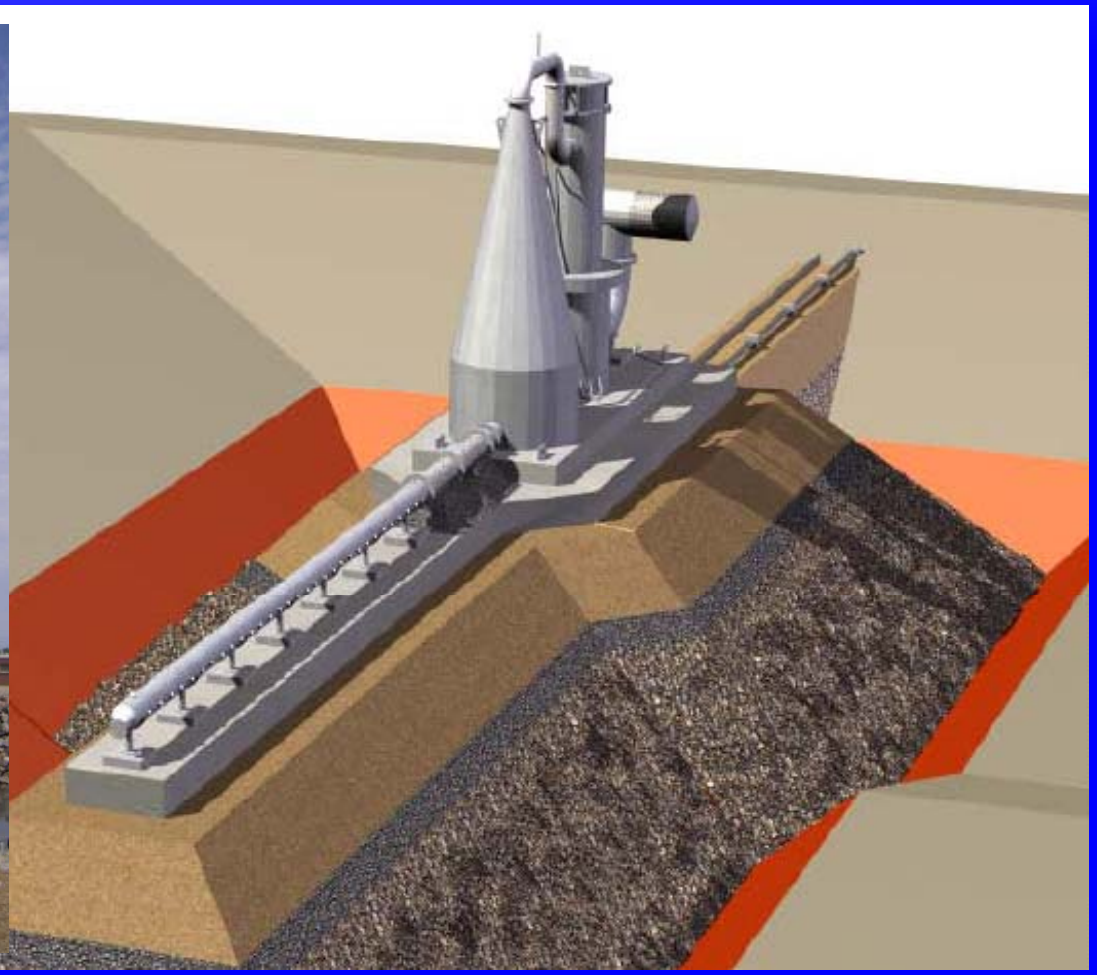

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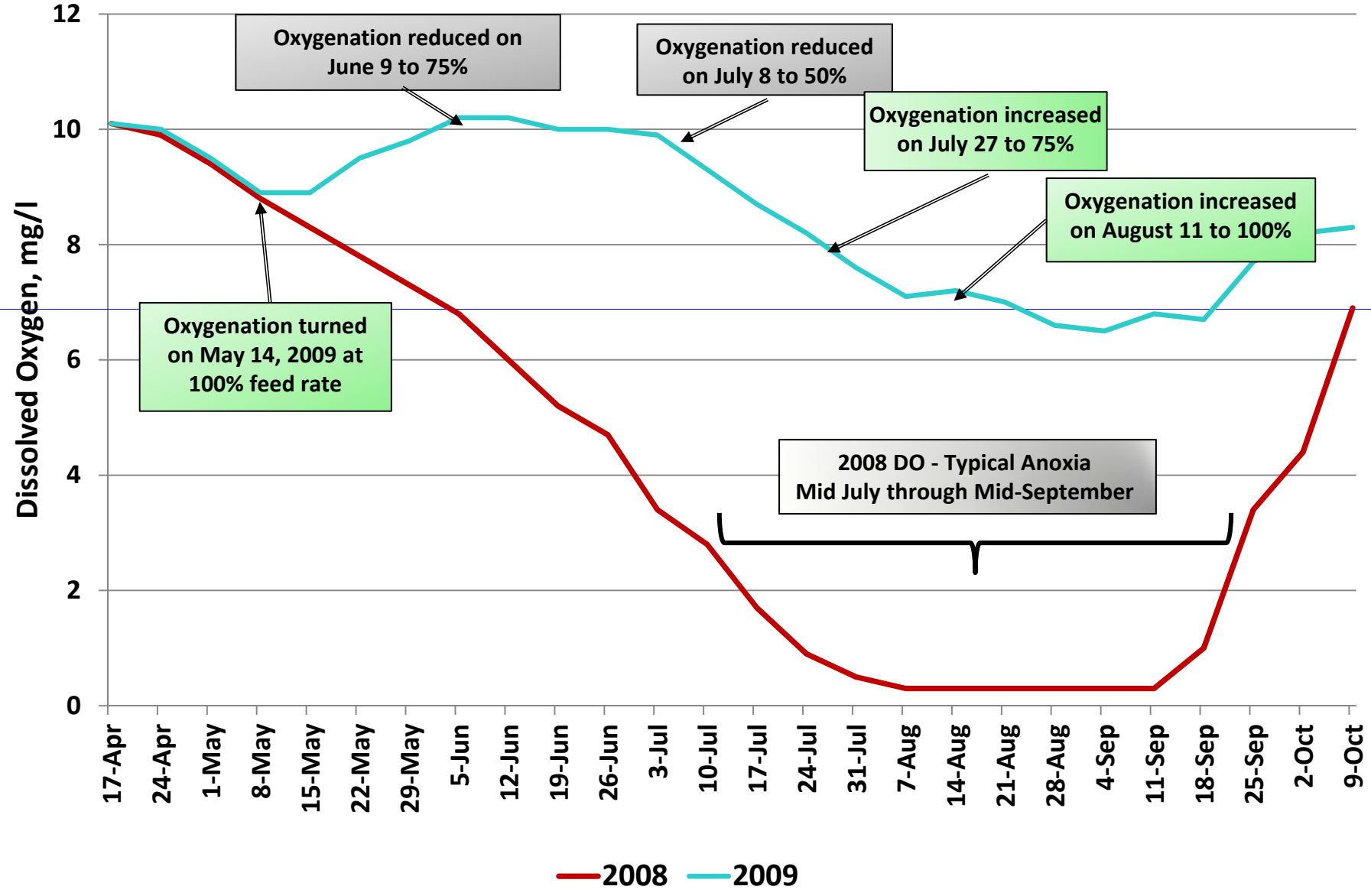


SUPEROXYGENATION FOCUS

WATER QUALITY

Restore Water Quality

WASTEWATER

Odor / Corrosion Prevention

ROOT CAUSE OF *ODOR*

Oxygen → **Nitrate** → **Sulfate**

Under ***Anaerobic*** Conditions:

- Bacteria consumes BOD
- Converts Sulfate to Sulfide

SO_4^{2-} + BOD + No D.O. → H_2S

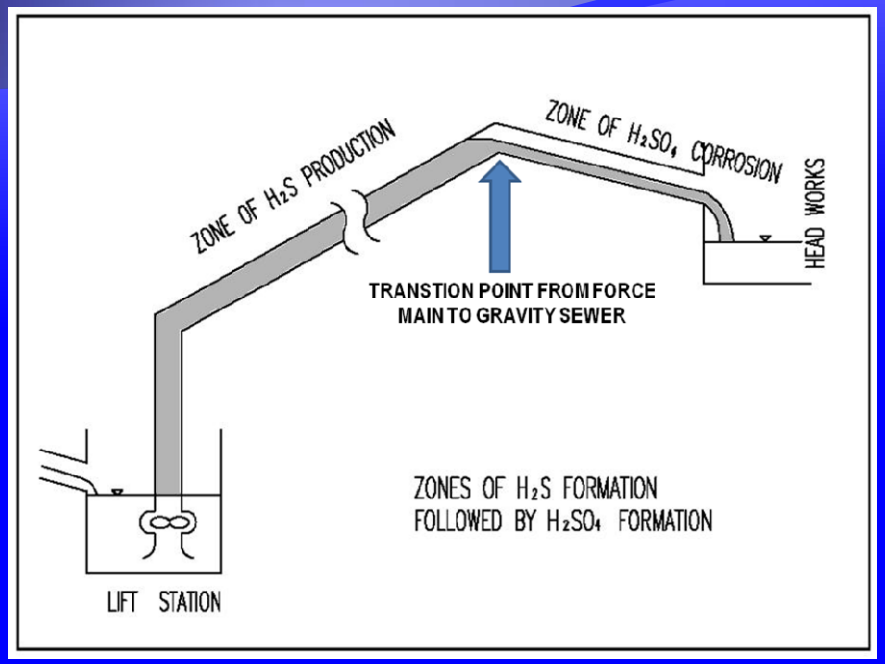
CORROSION CONCERN

Sulfuric Acid:

- Bacteria Converts Hydrogen Sulfide to Sulfuric Acid

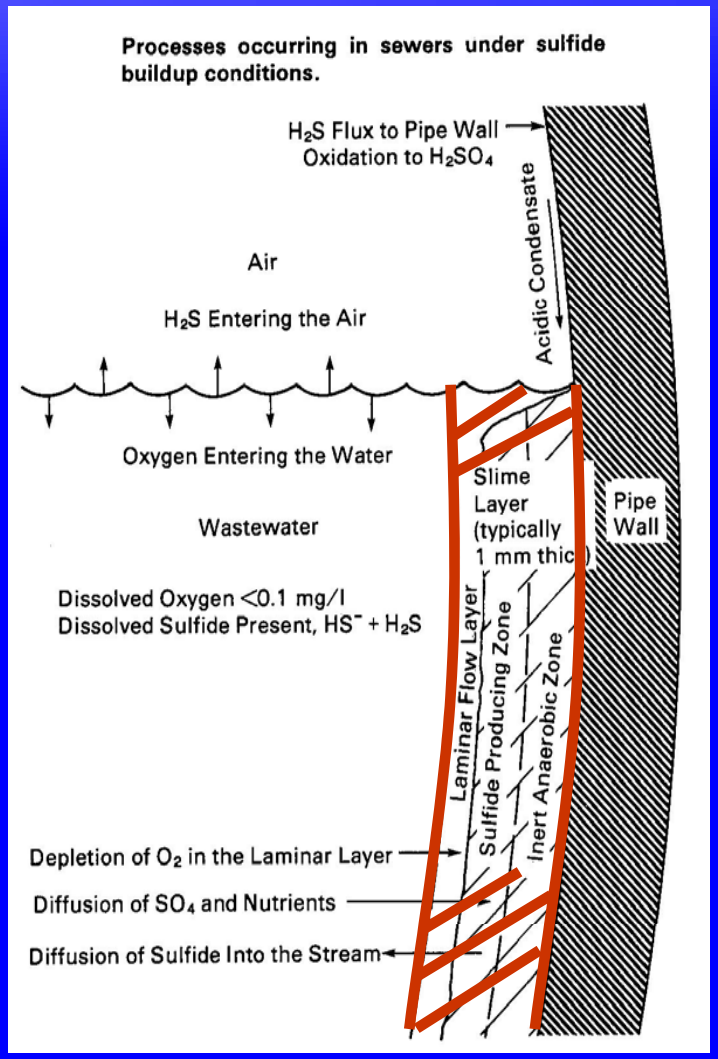
H_2S + bacteria --------- H_2SO_4

1. COLLECTION SYSTEM



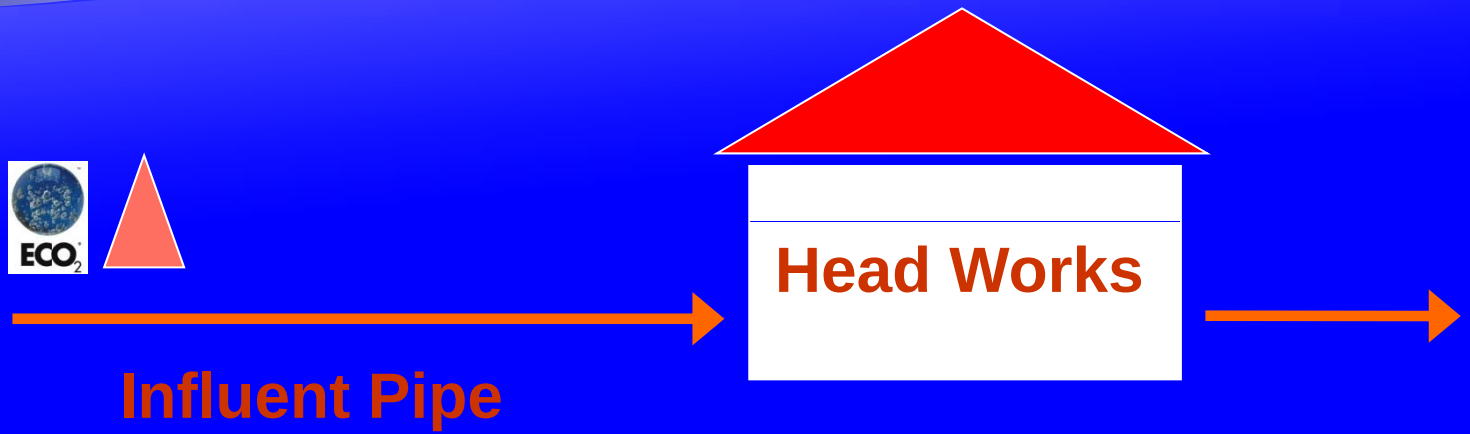
GOALS

- Sustains Aerobic Conditions
- Prevents H_2S and Corrosion
- Eliminates Cover and Scrub



LAGUNA BEACH, CA

2. HEAD WORKS



GOALS

- Sustains Aerobic Conditions
- Prevents H_2S and Corrosion
- Eliminates Cover and Scrub

Cheeney Creek WWTP - Fishers, IN

5.0 MGD · 5 hrs HRT

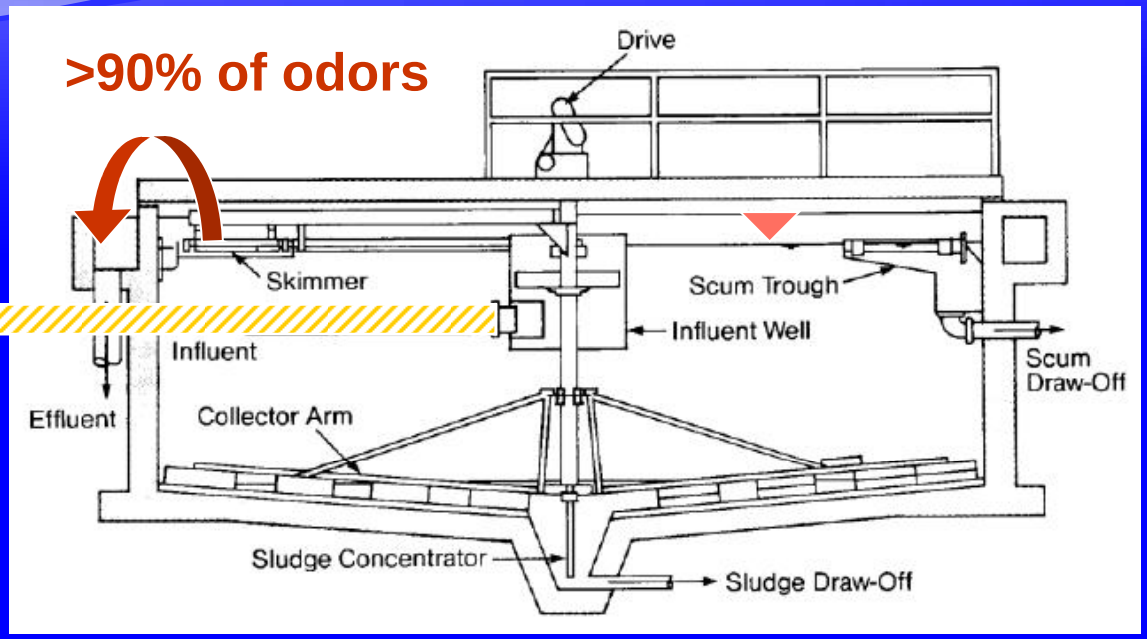
Results: 5 - 10 mg/L D.O. at Plant Head Works

Allisonville Road

Hague Road

Smock Creek

3. PRIMARY CLARIFIER



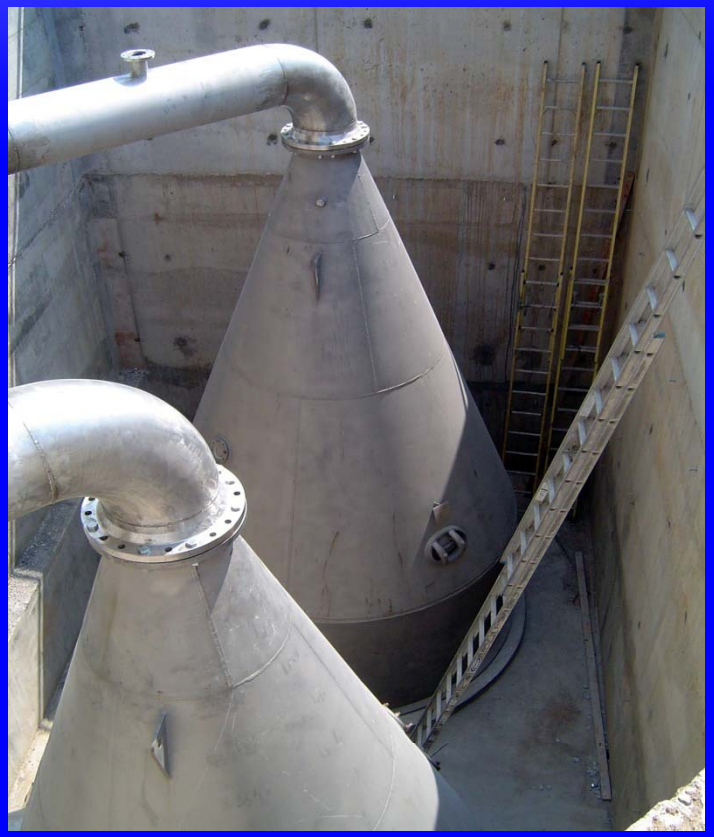
GOALS

- Eliminates Cover and Scrub
- Eliminates Confined Space Issues
- Does Not Impact Settling

TRA - Dallas, TX

150 MGD · 14,000 lb O_2 / day

Anticipated Results: 0.0 mg/L DS into Primary Clarifier

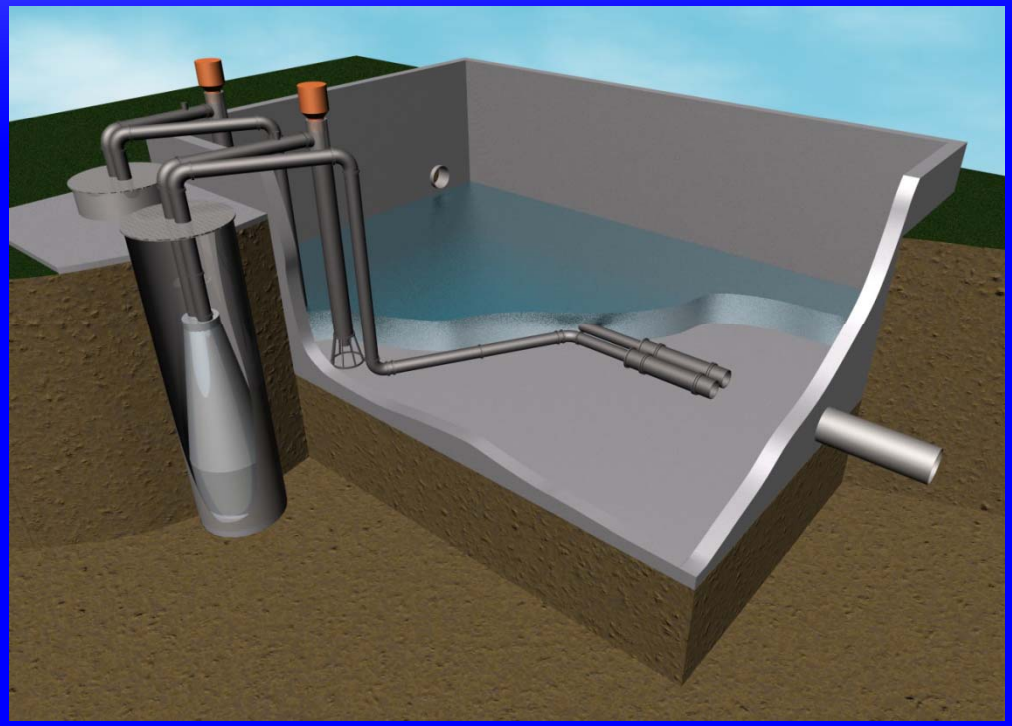


4. AERATION

GOALS

- Pure Oxygen Plants
- Increased Capacity
- Peak Power Shaving

INSTALLATION SCHEMATIC

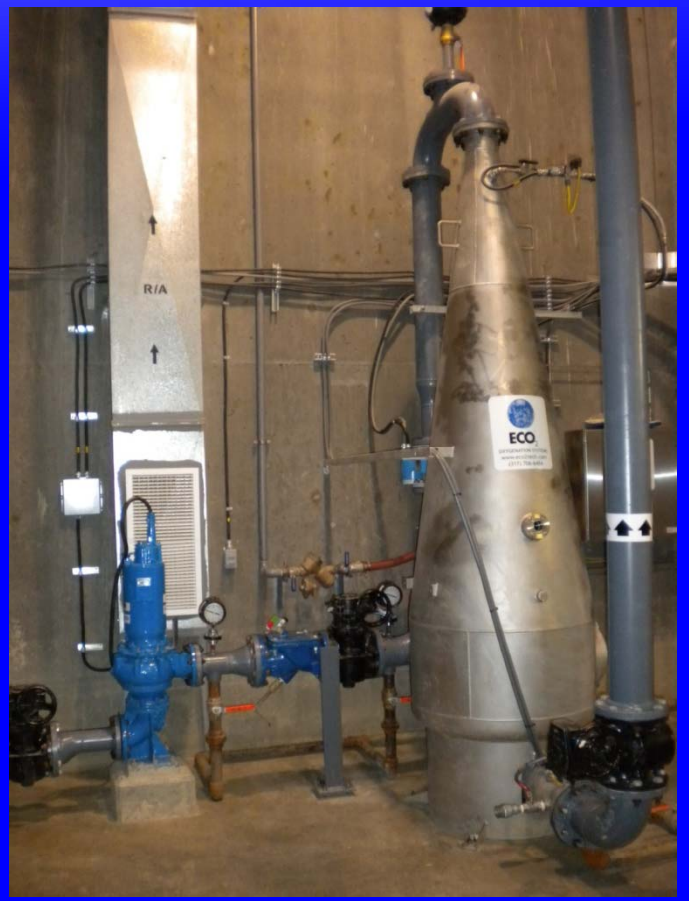


5. OZONE DISINFECTION

GOALS

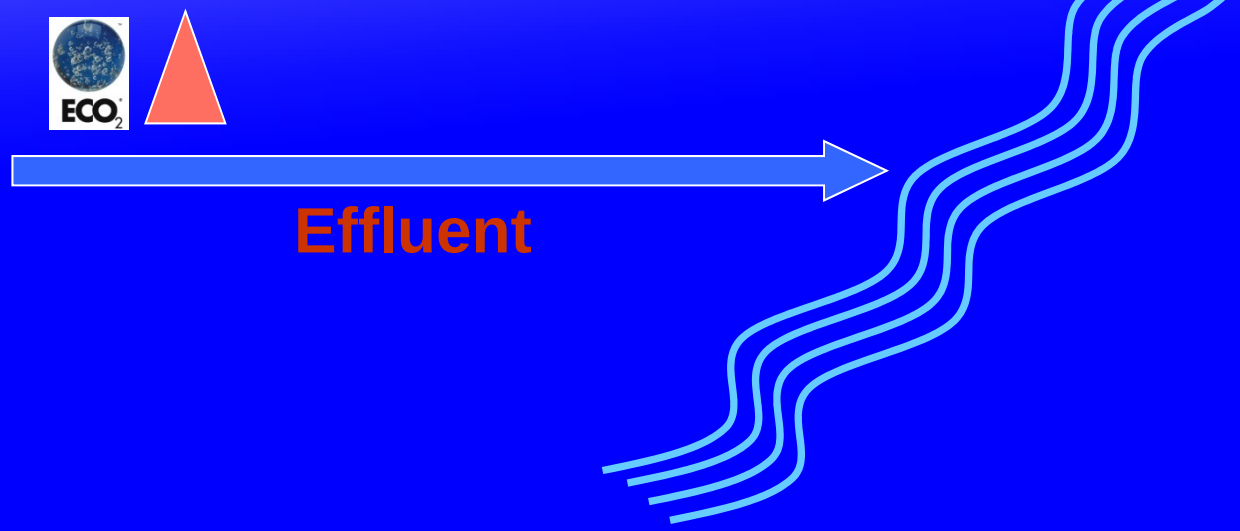
- Efficient Ozone Transfer
- Reduce Oxygen Feed Gas
- Reduce Residual Ozone Destruction

ECO_2 SYSTEM vs. DIFFUSERS



6. D.O. DISCHARGE / BOD OFFSET

Disinfection



GOALS

- Meet TMDL D.O. Discharge Standards
- Offset Residual BOD

KSD - Kennebunk, ME

5.0 MGD · 210 lb O_2 / day

Results: WWTP Plant D.O. Discharge 8 mg/L

CONCLUSIONS

- "Aerobic Cap" above sediment PREVENTS release of Fe & Mn and formation of H2S
- Robust System
- High Oxygen Transfer Efficiency
- Targeted Delivery of D.O.
- Extremely low O&M

QUESTIONS?

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