

Oklahoma Clean Lakes and Watersheds Conference 2015, Stillwater, OK

# Machado Lake: Using Air to Treat the Water

April 6, 2015



*In association with* **PARSONS**

# Machado Lake Famous for...



- Machado Lake gained international attention when a 6 foot “pet” alligator named Reggie was released in to the lake back in 2005.
- The Reggie avoided capture for 2 years

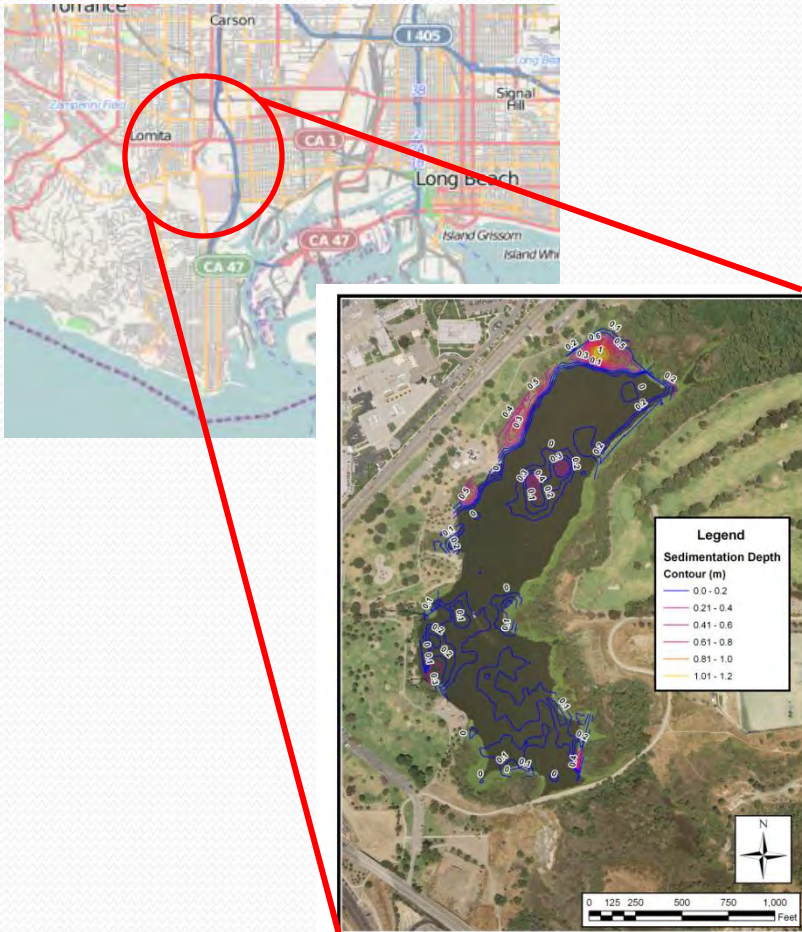
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# Agenda

- Machado Lake Intro and Background
- Lake Rehab Goals & Scope of Work
- Oxygenation System Choice
  - Project specific studies on oxygenation effectiveness
  - Machado Lake oxygen demand
- Oxygenation Devices Considered
  - Bubble Diffusers
  - Aspirator Aerator
  - Speece Cone
- Summary

# Introduction to Machado Lake

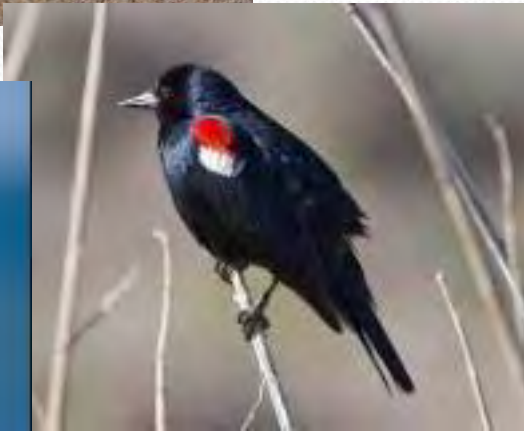


- Located in Harbor City, approx. 15 miles south of LA
- 290 acres park
- 35 acre Machado Lake
- Water Source: Urban Stormwater Run-off

# Coastal Wetland Ecosystem



- The largest remaining coastal wetland ecosystem in Southern California
- Threatened or endangered species known to inhabit the park include, California least tern, tri-colored blackbird, white tailed kite, brown pelican, and yellow warbler.



# Wilmington Drain



- Wilmington Drain
- ½ mile long, soft bottom storm drain channel
- collects stormwater run-off from 14 sq mile watershed
- Total Watershed: 100 sq miles



**Legend**

- Direction of Flow
- Existing Storm Drain

0' 250' 500' 1,000'



# Proposition O

- On November 2, 2004, Los Angeles voters passed Proposition O authorizing The City of LA to issue bonds for projects to protect public health by cleaning up pollution including bacteria and trash in the City's watercourses, beaches and ocean to meet Federal Clean Water Act requirements.
- Machado Lake is one of proposed projects listed to clean up trash, algae, ammonia, odors and pollution from pesticides and lubricants.
- For more information about Prop O see [www.lapropo.org](http://www.lapropo.org)

# Prop O Goals for Machado Lake

- Improve Overall Water Quality
- Improve Visual Aesthetics
- Improve Biological Diversity of the Ecosystem
- Attain and sustain its desired uses and characteristics:
  - Wildlife Habitat
  - Recreational Fishing
  - Bird Watching
  - Environmental Education
- Meet TMDL Requirements
  - DO > 5.0 mg/L (Nutrient TMDL Target)

# Scope of Work

- Storm Drain facility improvements (CDS Systems at storm drain inlets)
- Remove existing contaminated sediment (Dredging)
- Construct Oxygenation System to maintain WQ
- Recirculate some of the flow through treatment wetlands
- Remove invasive riparian vegetation
- Replant native species
- Installation of recreational features (fishing piers, walkways, etc.)

# Oxygenation System

- Goals:
  - Improve overall water quality
  - Minimize algae blooms
    - Maintain oxic sediment to limit release of phosphate (and ammonia)
  - Prevent fish kills
    - DO > 5.0 mg/L (Nutrient TMDL Target)
- Objectives:
  - Add sufficient oxygen to meet sediment and water column oxygen demand
  - Maintain 5 mg/l oxygen throughout water column

# Project Specific Studies on Aeration/Oxygenation Effectiveness

- Lake WQ Modeling (Phase I & II)
  - Predicted significant improvements to P levels due to aeration



# Project Specific Studies on Aeration/Oxygenation Effectiveness

- Sediment Flux Study (by Dr. Alex Horne 2009)
  - Experiments showed:
    - Aeration lowered or eliminated releases of phosphate and toxic ammonia relative to fluxes from anoxic sediments
    - Once sediment is anoxic, aeration did not fully reverse the process (phosphate and nitrate in water column)
  - Conclusions:
    - Significant oxygen needed at sediment-water interface to inhibit internal nutrient cycling of phosphate and ammonia
    - Oxygenation should commence before the sediments go anoxic (~ March) and be continued till they no longer do so (~ November)

# Machado Lake Oxygen Demand

- Factors affecting demand:
  - Eutrophic status of ML
  - Physical Parameters
    - Post-dredge depth – 8 feet
    - Areal extent of deeper water – 35 acres
    - Volume - 250,000m<sup>3</sup>
  - Photosynthetic oxygen production
  - Occurrence of natural mixing
  - Time of year
    - Critical period is late summer/early fall
    - Need for external source of oxygen greatest on hot, windless, cloudy days



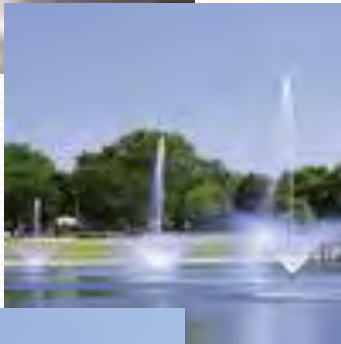
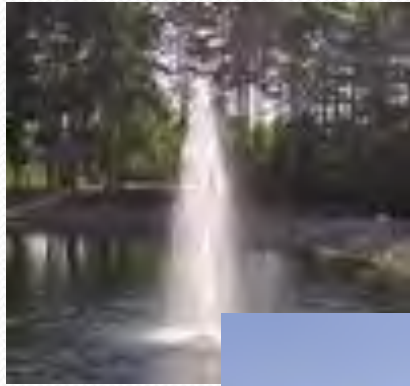
# Machado Lake Oxygen Demand

- Predicted oxygen demand:
  - 1.0 g/m<sup>2</sup>-d, Induced Demand Factor of 4 (=1,250 lbs/day)
- Conservative design demand determined to be 1,000 lbs/day
- Photosynthetic O<sub>2</sub> production on sunny day < 400 lbs/day
- March through November demand period





# Aerator - Fountains

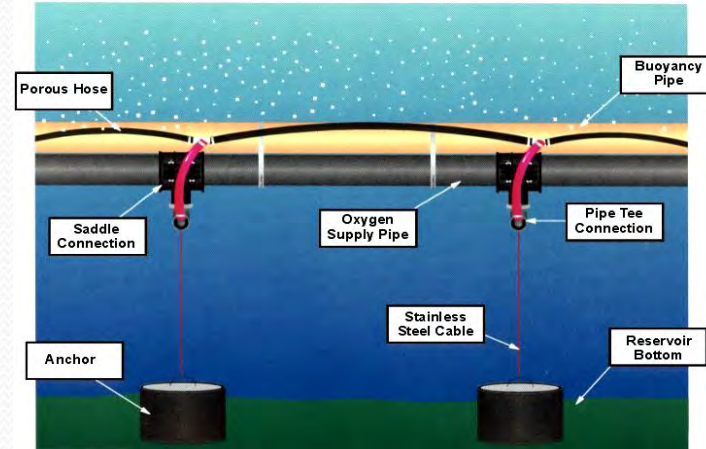


- Fountains are excellent aerators for many ponds and lakes
- The fountain creates the water air interface by pumping water straight into the air.
- Used for golf courses and recreation parks for its aesthetic appearance.
- Does not provide “natural” look to lake

Photos from Aqua Control Water Features

# Oxygenation Devices

- Bubble Diffusers
  - Line/Hose
  - Disc Diffusers



- Speece Cone

- Aspirator

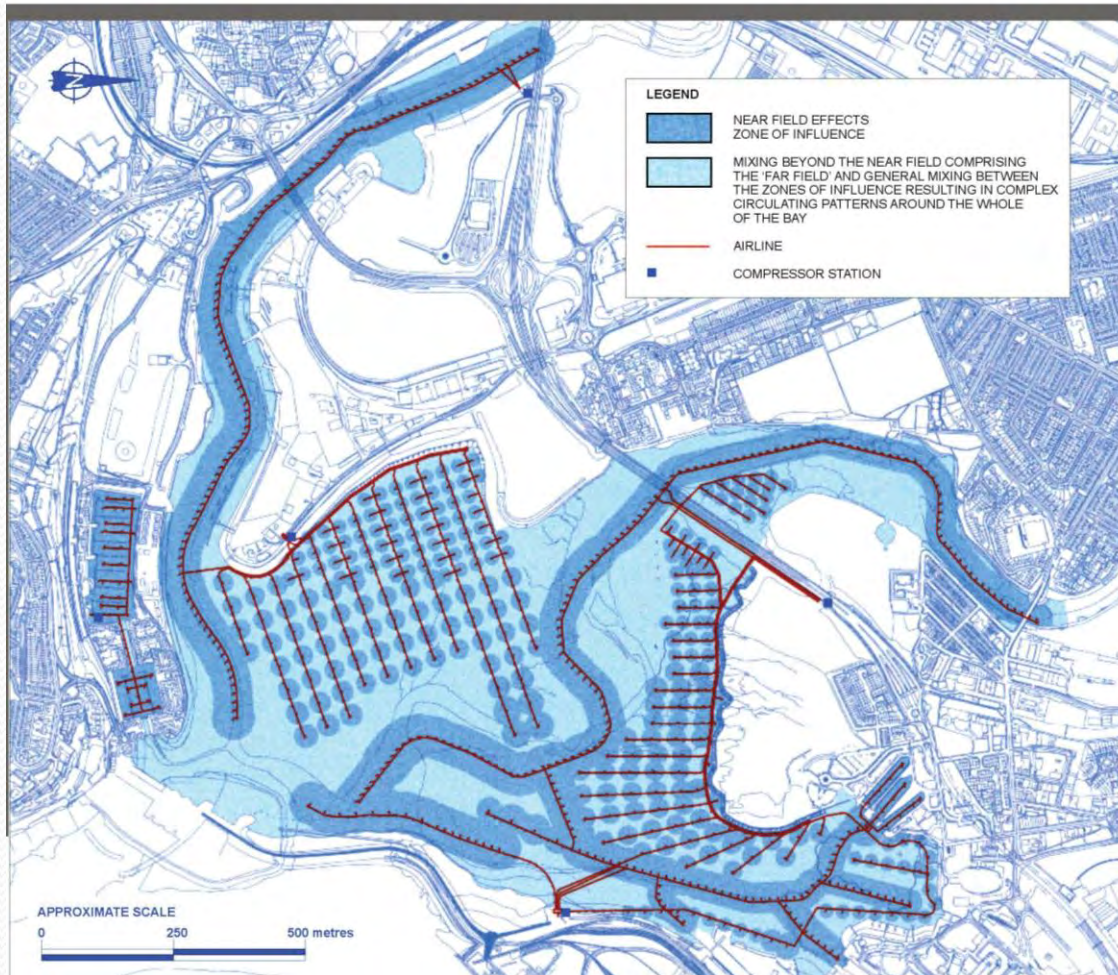


# Bubble Line Diffusers

- Developed for Tennessee Valley Authority (TVA)
  - Water quality of hydropower reservoir releases
- Oxygen Source
  - Pure oxygen bubbles ( $\leq 2\text{mm}$ )
    - Limited depth means inefficient transfer and  $\text{O}_2$  wastage
- Assessment
  - Low oxygen utilization (wasteful)
  - May not be able to meet project DO goals

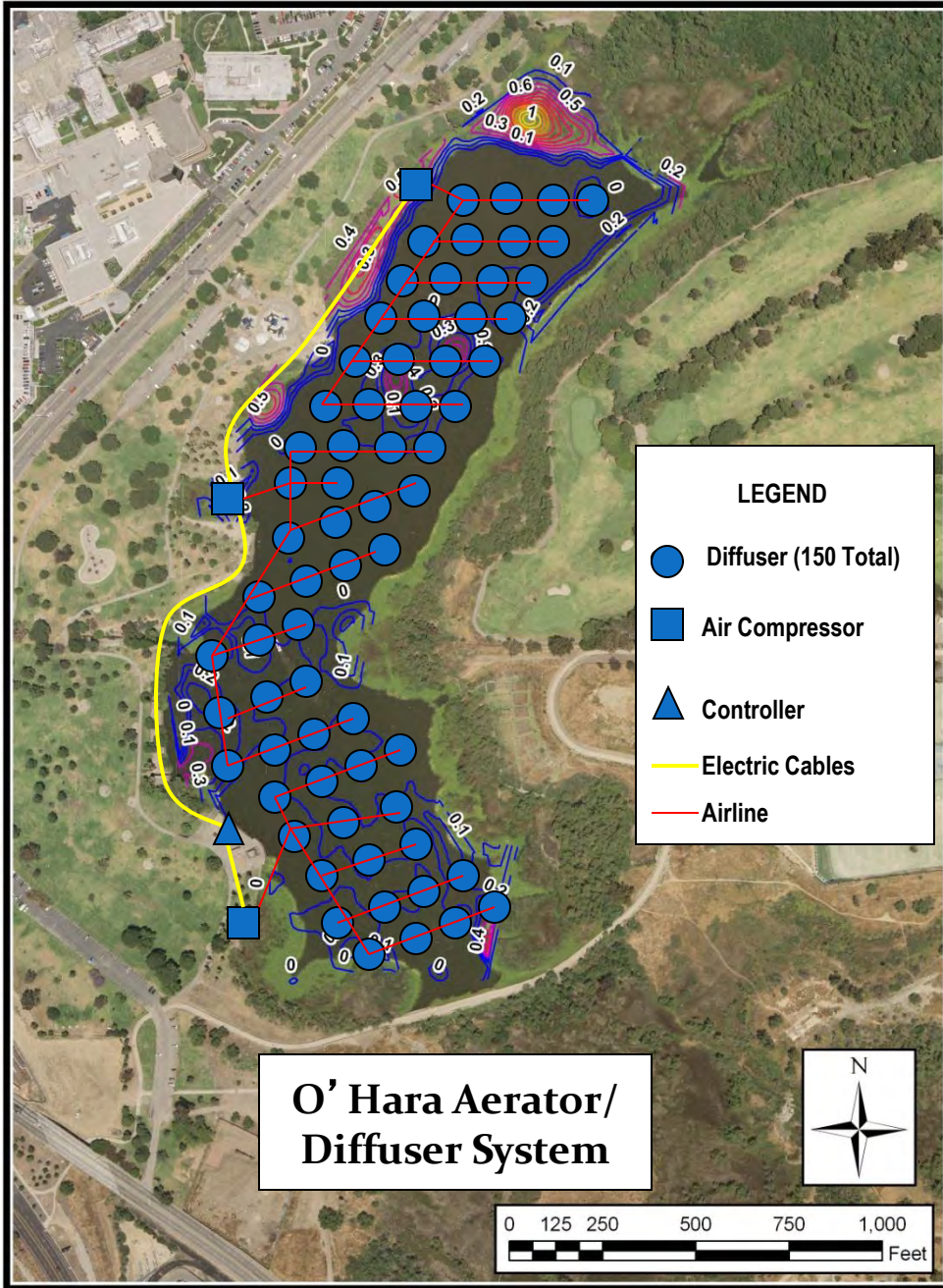
# Disc/Tube Bubble Diffusers

## CARDIFF BAY



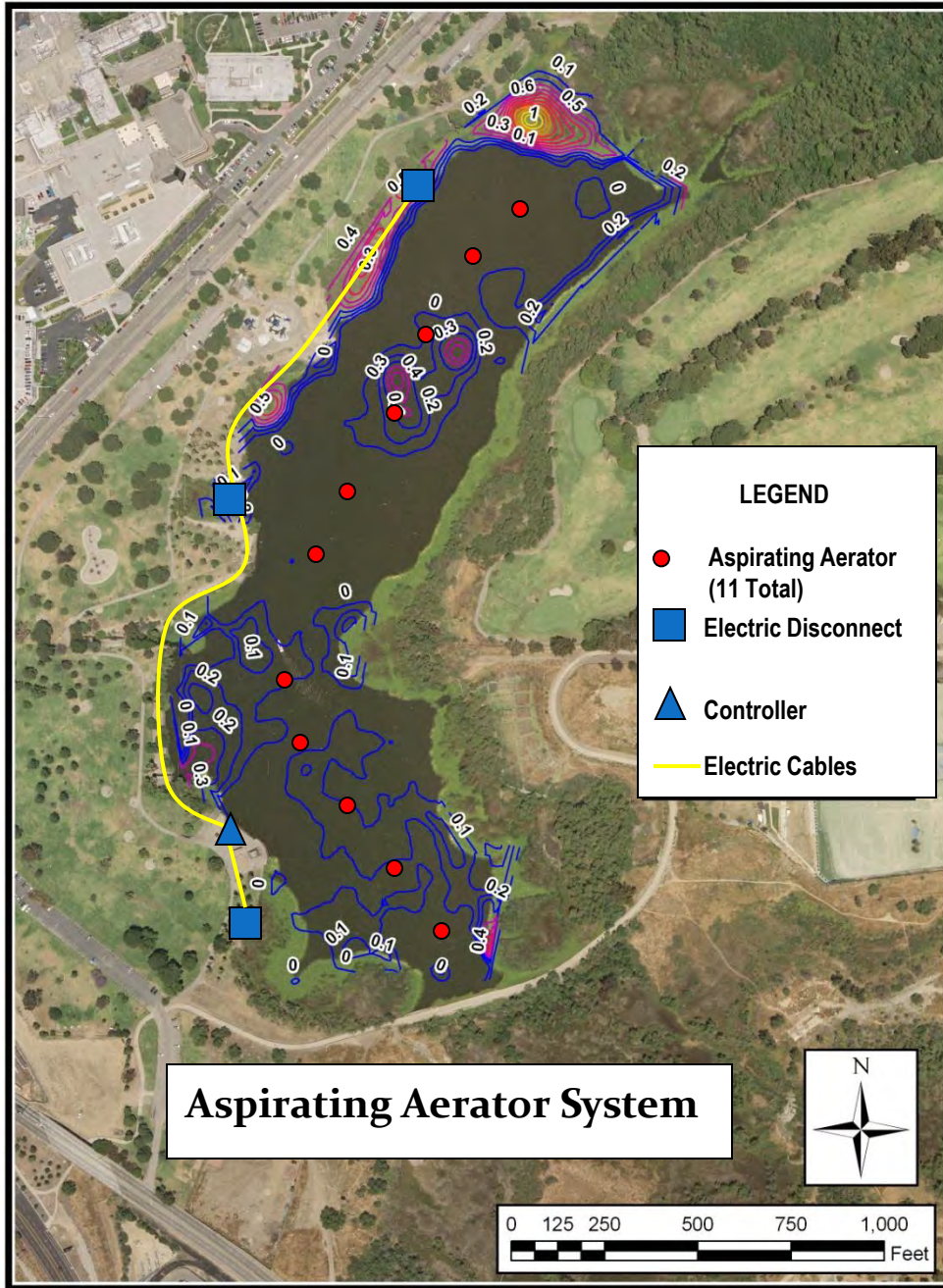
# Disc/Tube Bubble Diffusers

- Aerator arrays developed by O' Hara
  - Patented airflow balancing, Low airflow per disc
- Oxygen source
  - Air bubbles
  - Shallow depth, low mixing energy compensated for by numbers
  - Estimate: 150 diffusers fed by compressors, 6 feed lines
  - Delivery lines, diffusers inexpensive
- Assessment
  - Capable of meeting project DO goals



# Aspirator Aerators



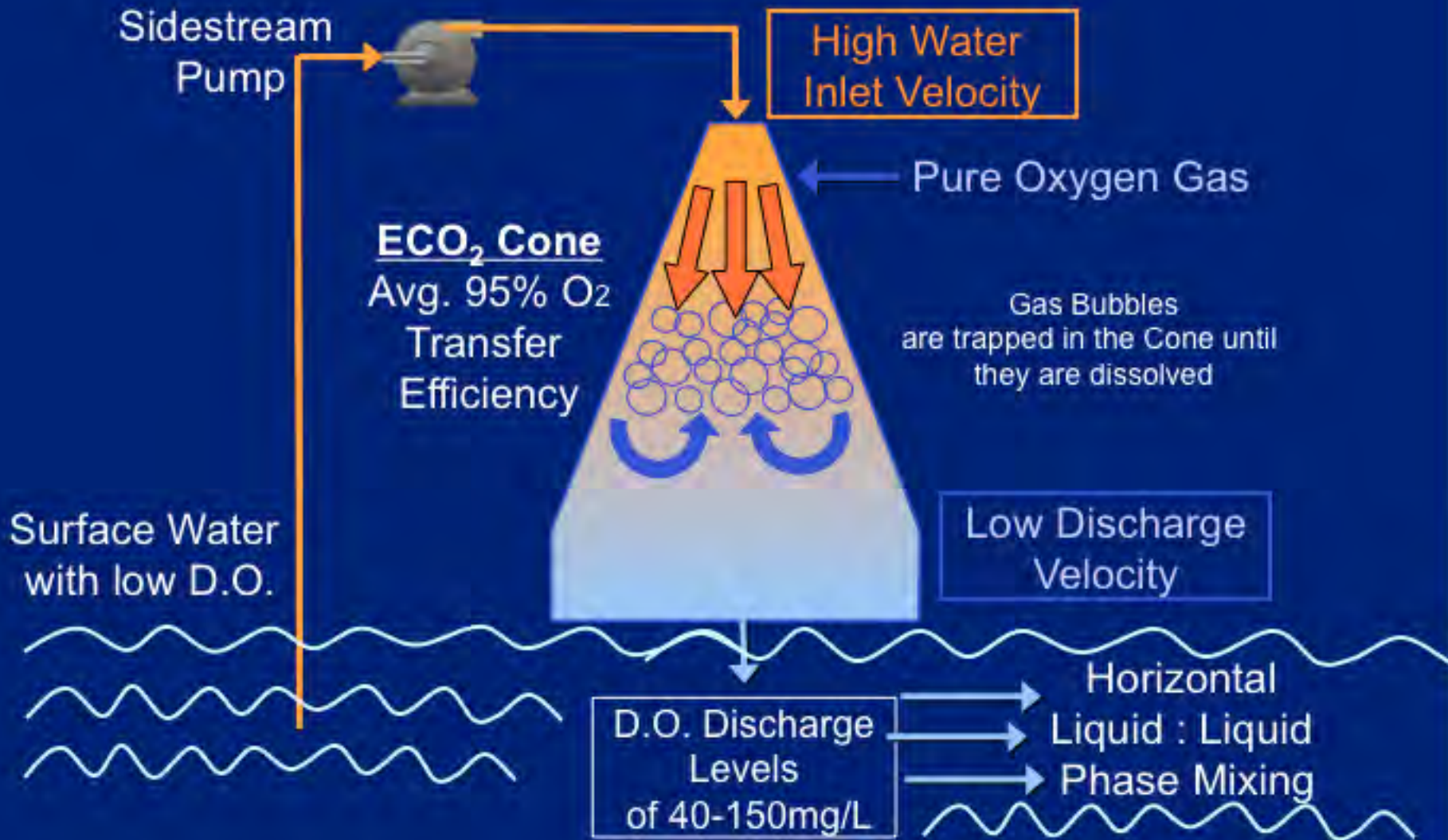




# Speece Cone



# Speece Cone

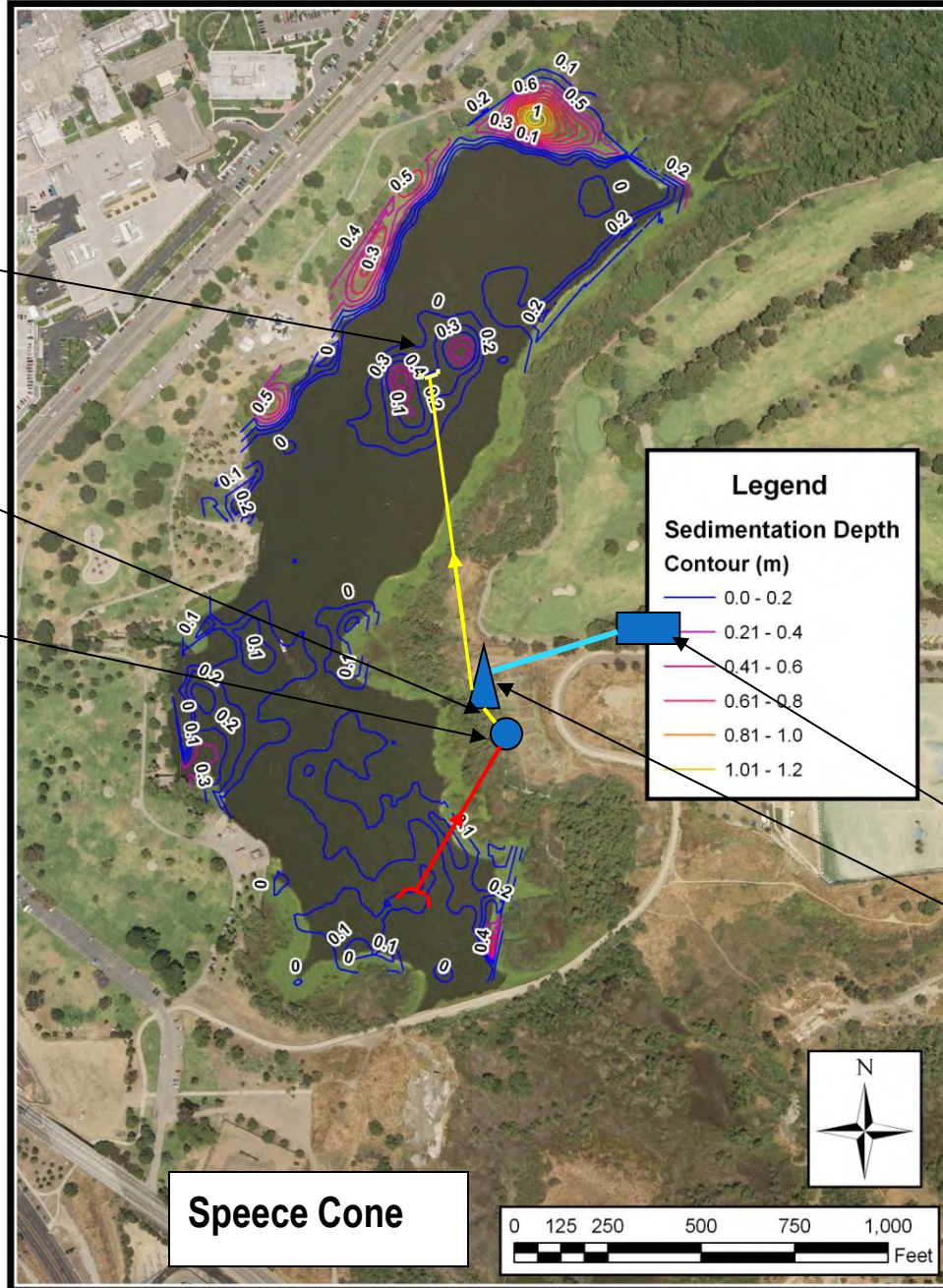


Oxygenated Water Discharge Piping

Piping to Speece Cone

Pump Station

Speece Cone

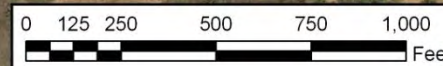


Legend

- System Intake
- System Discharge
- Pump Station
- ▲ Speece Cone
- LOX Tank
- Oxygen Pipe

LOX Tank

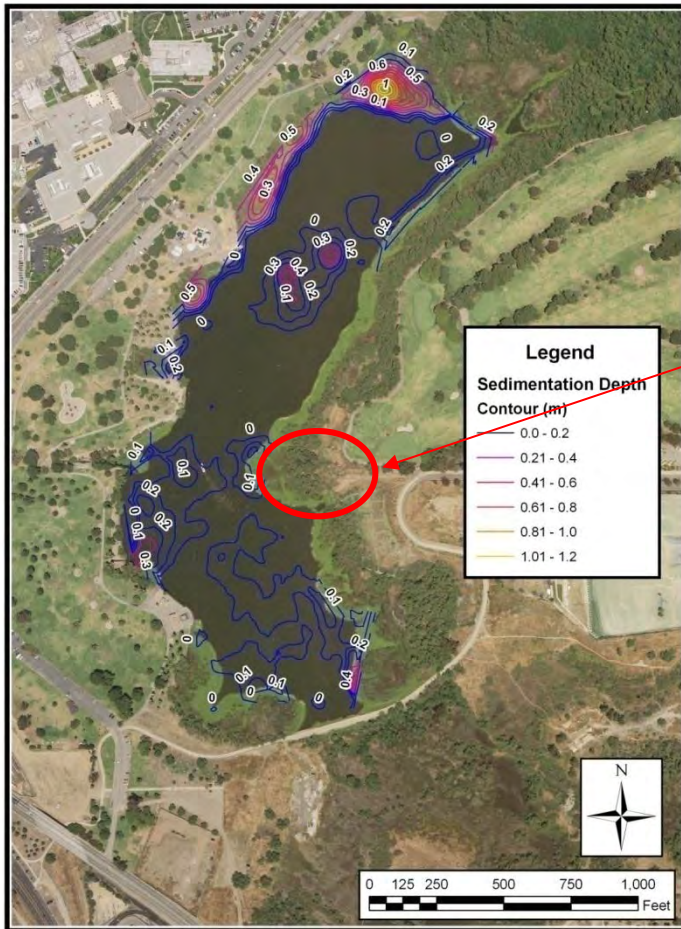
Speece Cone



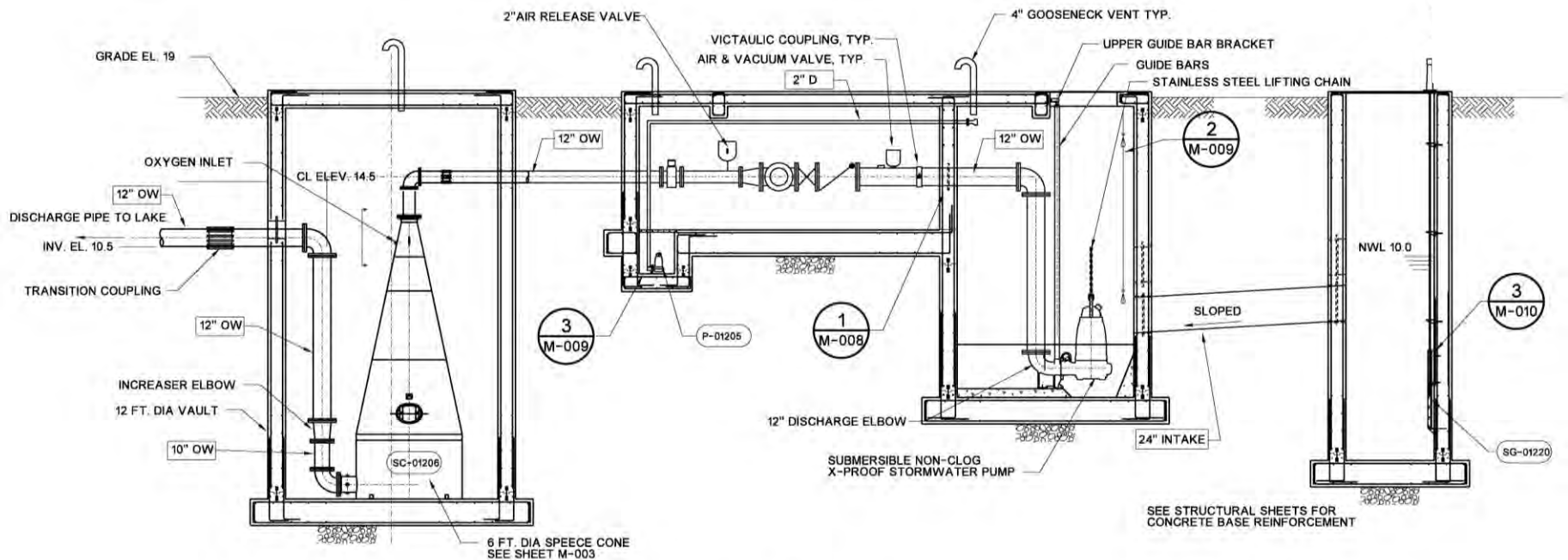
# Recommendation – Speece Cone

- Advantages
  - Can achieve Machado Lake DO requirements
  - Successful applications in CA
  - Relatively minor visual and noise impacts
  - Relatively simple maintenance requirements
- Disadvantages
  - Capital expense relatively higher than other technologies
  - Requires pure oxygen (O<sub>2</sub> generator)

# Speece Cone Location



# Proposed Speece Cone Installation



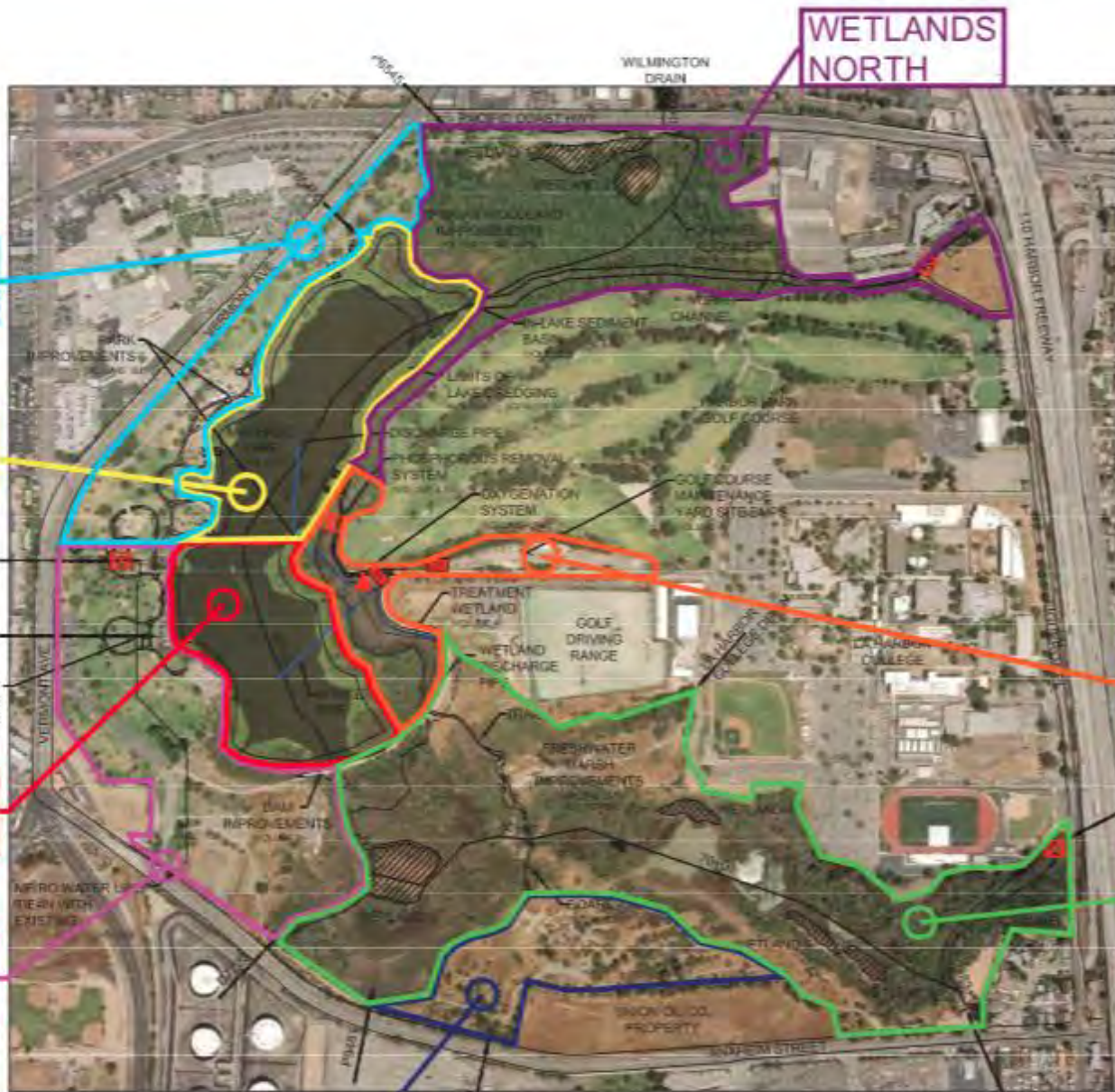
PROFILE VIEW

SCALE: 1/4" = 1'-0"

OXYGENATION SYSTEM SCHEMATIC

# Oxygenation - Summary

- Oxygenating the water will improve overall water quality, minimize algae blooms, maintain oxic sediment and eliminate fish kills.
- Speece Cone offers the best oxygenation solution to meet the Lake requirements



**LEGEND**

	PROJECT BOUNDARY
	CHANNEL ALIGNMENT
	WALKWAY
	EXISTING STORM DRAIN (D-20000 & P-20000 PLAN)
	RECYCLED WATER LINE
	OXYGENATION SYSTEM
	PUMP STATION
	OXYGEN GENERATOR BUILDING
	PHOSPHORUS REMOVAL SYSTEM
	SPEE CONE AND OXYGEN GENERATOR
	HYDRODYNAMIC SEPARATOR
	OFF-LINE TREATMENT WETLAND
	EMERGENT WETLAND
	FISHING PIER

PARK NORTH

LAKE NORTH

LAKE SOUTH

PARK SOUTH

CAMPGROUND

WETLANDS NORTH

TREATMENT AREA

WETLANDS SOUTH

OVERALL PROJECT SITE PLAN  
1" = 200'

# MACHADO LAKE PHASING PLAN



PROJECT 214  
MURBOR ODT  
D 15867 TAC  
D 15867

PROJECT 77  
D15323  
BIOSWALE  
(VOLUME 2)

PROJECT  
510 - LINE C  
D21575

DAYLIGHTED  
DRAINAGE  
BIOSWALE  
(VOLUME 2)

MICRO WATER  
LINES WITH  
EXISTING

LAKE IMPROVEMENTS

LAKE IMPROVEMENTS

LAKE IMPROVEMENTS

LAKE IMPROVEMENTS

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As For Reggie...

