Lake Destratification with Venturi-type Eductor

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Drought Forces Water Solution

- Solution Sought by City of Bloomington for Lake Evergreen following the major drought of 1988 to improve water quality.
- Early attempts with floating type aerators
- In 1996 a venturi-type eductor system was installed that would destratify the lake, eliminate the thermocline, and have a more homogeneous distribution of DO and eliminate anaerobic zone in hypolimnion.

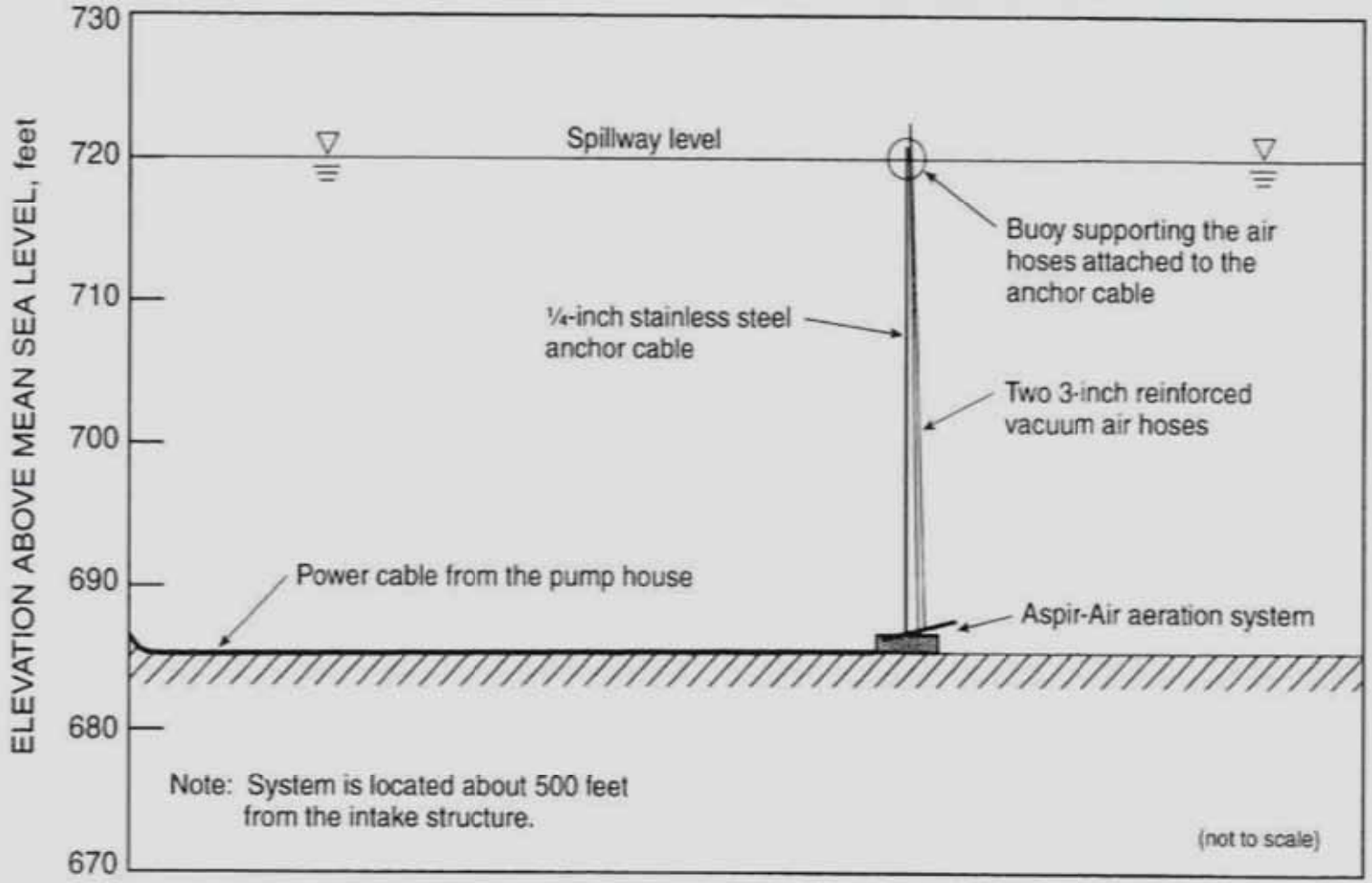


Figure 3. A schematic of the aeration system in Lake Evergreen

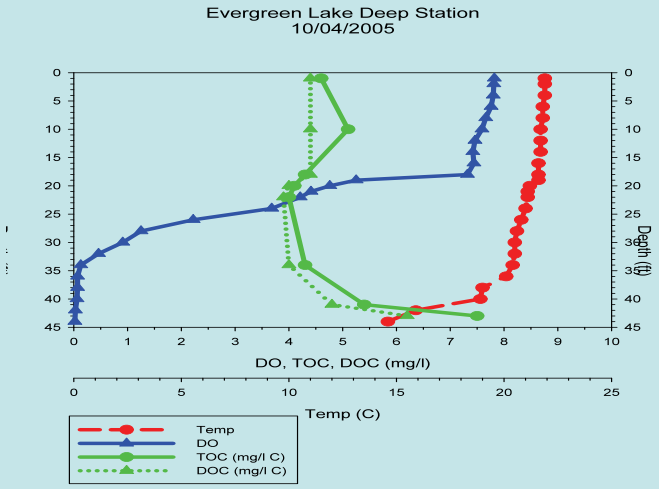
Theory of Operation

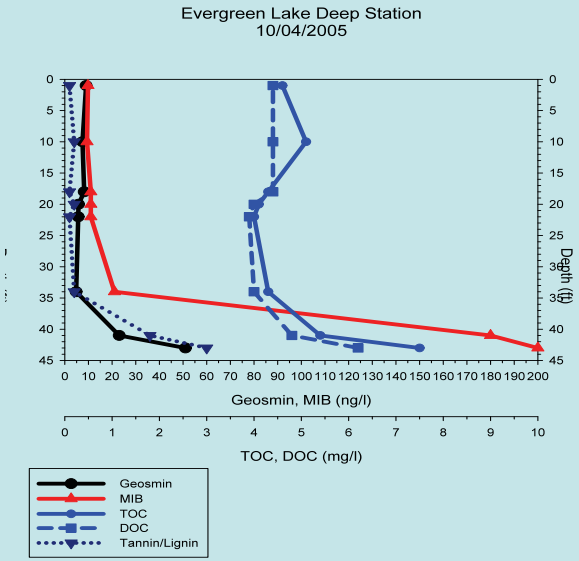
- Pull denser water from hypolimnion and push to surface adding DO thru an eductor
- Have colder water radiate out from point of discharge to eliminate thermocline
- Inhibit formation of algal blooms by binding up P, and N in sedimentary layer and anaerobic decomposition

1st Generation Eductor Destratifier

- Submersible pump into eductor on lake bottom at 30’ depth of 50’
- Effectively broke up thermocline >30’
- Inhibited formation of algal bloom
- Improved water quality for taste and odors (Geosmin and MIB)

Results Achieved with Eductor




Evergreen Lake Deep Station
10/04/2005
Depth (ft)
Geosmin, MIB (ng/l)
TOC, DOC (mg/l)
Geosmin
MIB
TOC
DOC
Tannin/Lignin

Lake Evergreen

- One Eductor system effectively treating 900 acres at Lake Evergreen, and 635 acres at Lake Bloomington

- Destratifier located 500 ft from intake to pump station to WTP

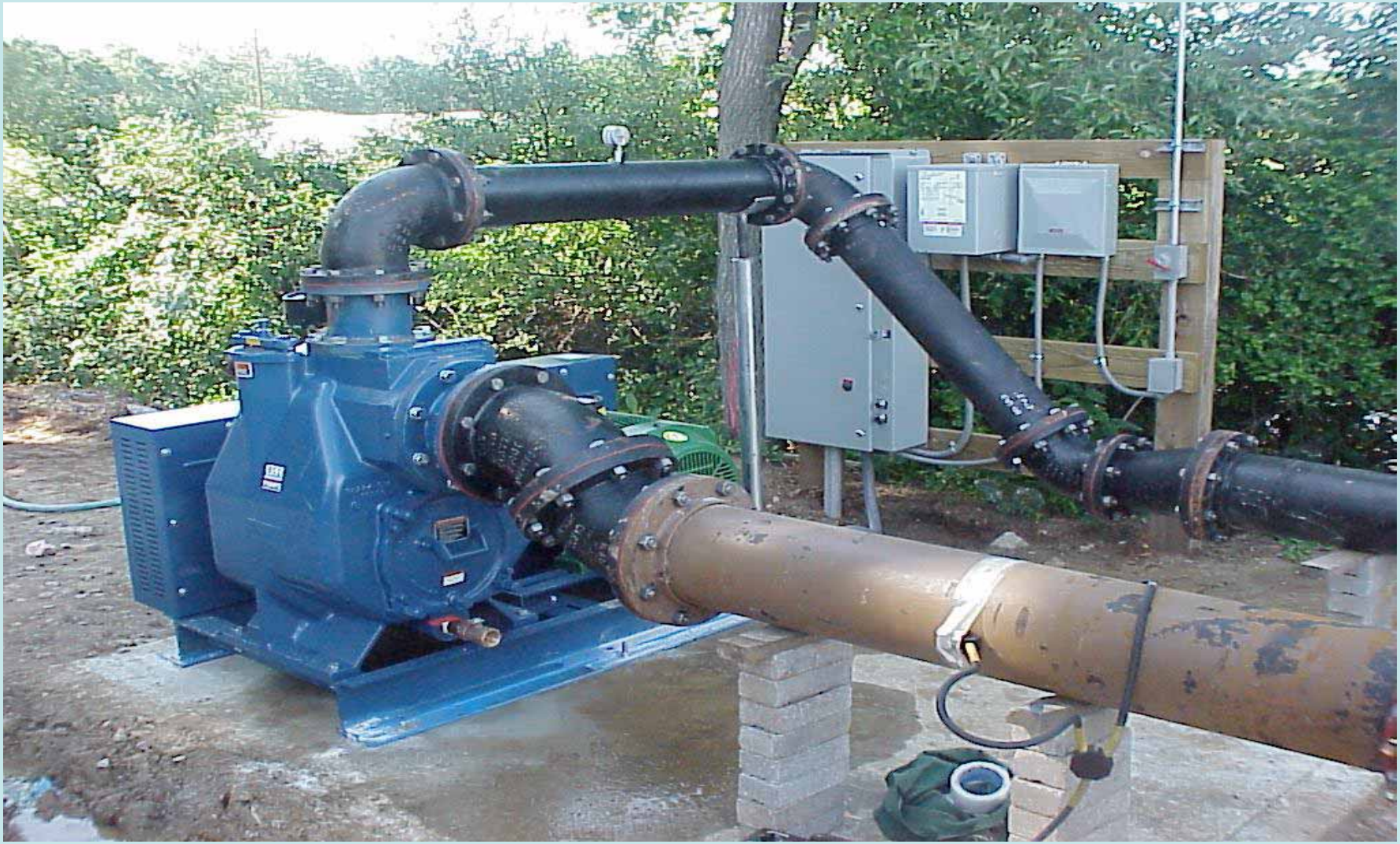
2007 Modifications at Gov Bond Lake

- Similar design principles used and learned at Lakes Evergreen and Bloomington
- Submerged venturi-type eductor
- Displace hypolimnion water to surface to destratify the thermocline
- Locate pump on shore for access and ease of maintenance eliminate power cable to pump
- Place “offset” suction manifold to increase hydraulic flow
- Increase dissolved oxygen

New Design Suction Manifold

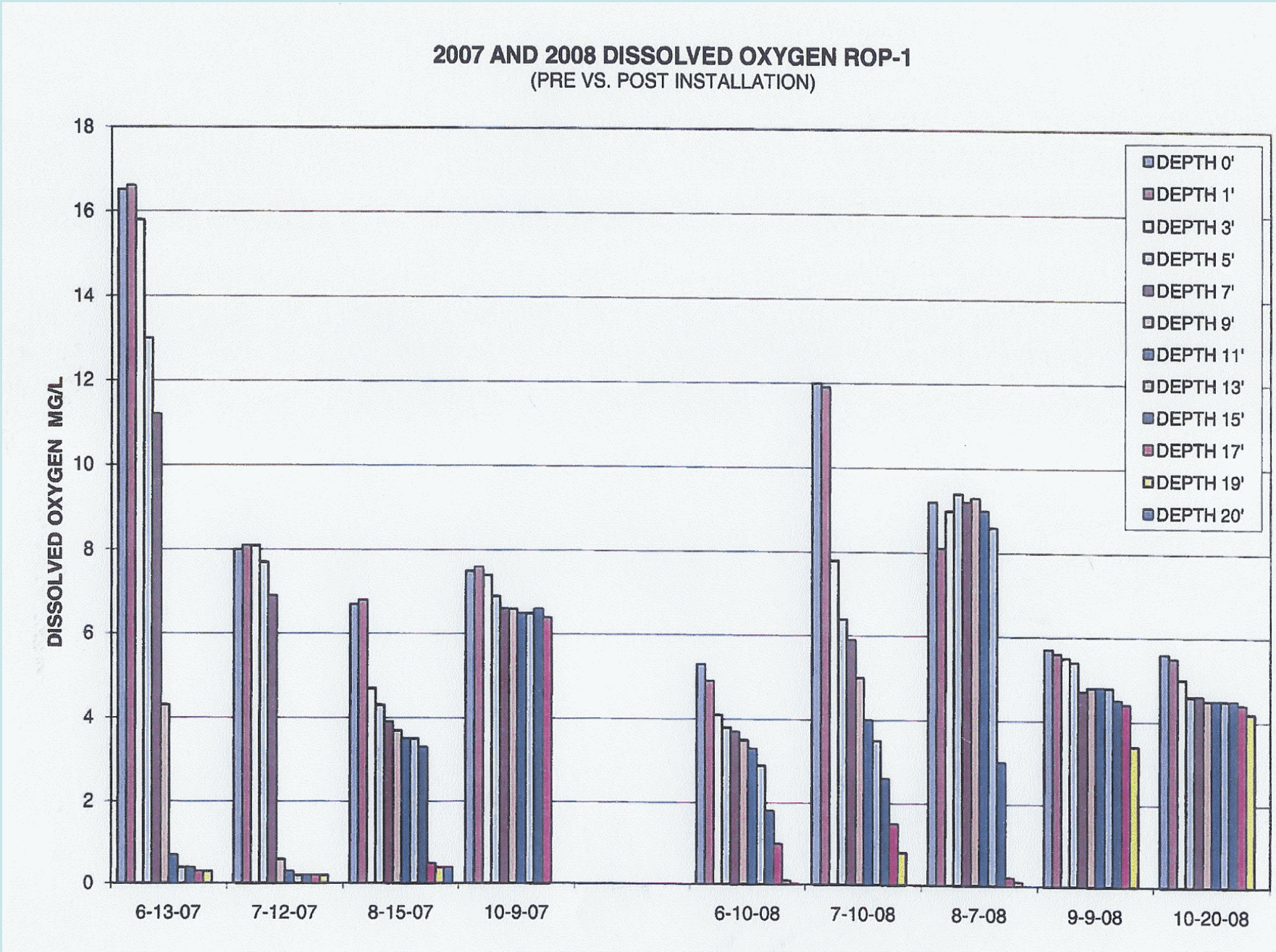
Submerged Venturi-type Eductor

Centrifugal Pump 8” x 6”

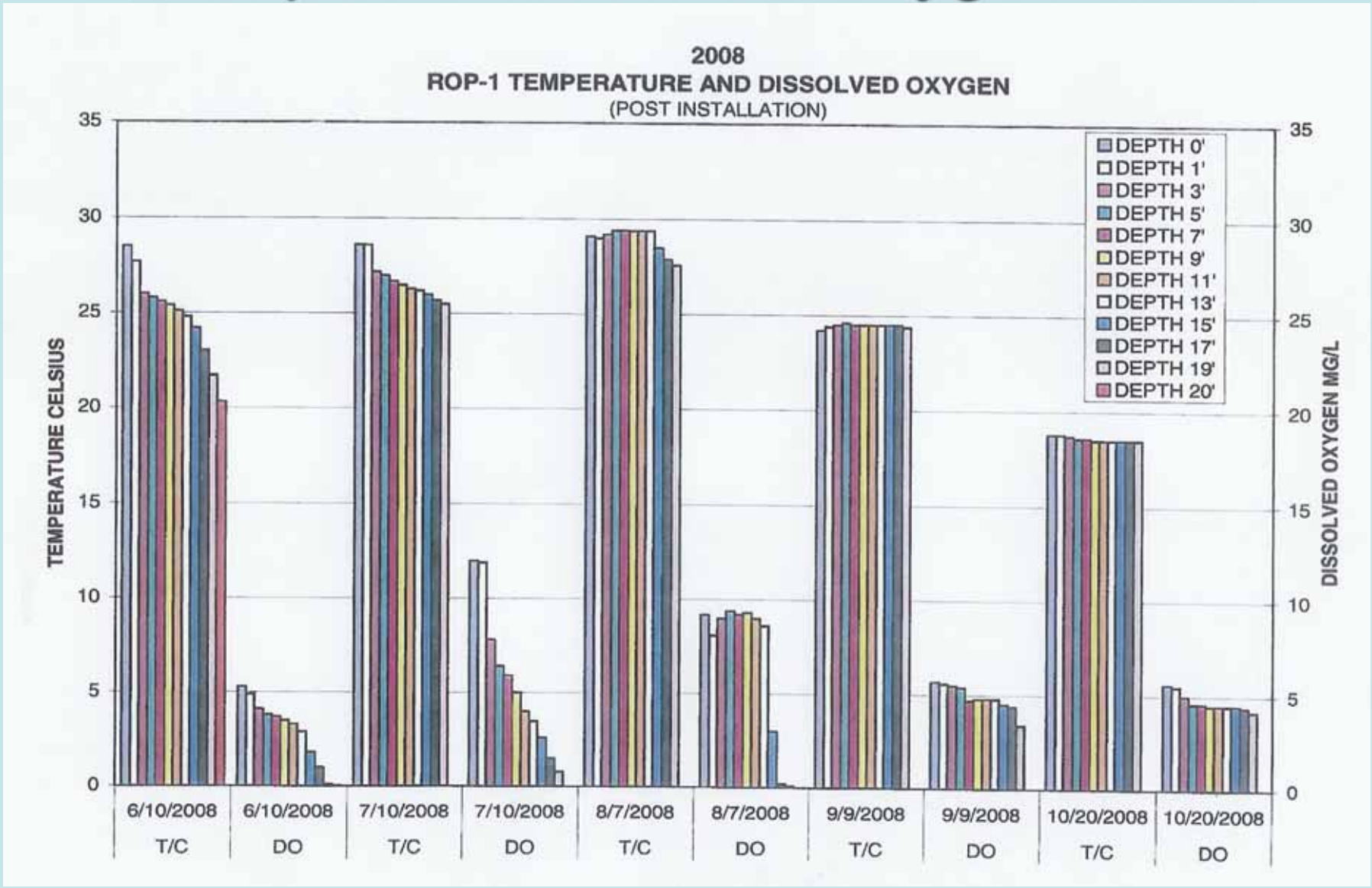



2
4
8
16
32
CAL
TEST
FPS
SIGNAL STRENGTH
OFF
ON
OPERATE
ALERT
GPM 1319.628
TOT OFF FPS 8.416
BATTERY
LOW
CHARGE
VELOCITY
0 20 40 60 80 100
PERCENT OF RANGE
SENSITIVITY
DAMPING
SPECTRAK
OFF
AUTO
24VDC POWER
RANGE FILTER
OFF
ON
TOTALIZER ON/HOLD
UPDATE RATE
PIPE I.D. STORE
CHANGE PARAMETER
1
2
3
F
TOTALIZER RESET
TOTALIZER UNITS
TOTALIZER MULTIPLIER
START
4
5
6
PRG
PIPE I.D. STATUS
RATE FACTOR
TEST
ENTER
7
8
9
NO
CLEAR
0
.
ENTER
YES
MA OUTPUT
SET
MA OUTPUT
POLYSONICS
HOUSTON, TEXAS
ULTRASONIC FLOWMETER
MADE IN U.S.A.

Effect at Surface


2007 AND 2008 DISSOLVED OXYGEN ROP-1
(PRE VS. POST INSTALLATION)
DISSOLVED OXYGEN MG/L
18
16
14
12
10
8
6
4
2
0
6-13-07
7-12-07
8-15-07
10-9-07
6-10-08
7-10-08
8-7-08
9-9-08
10-20-08
DEPTH 0'
DEPTH 1'
DEPTH 3'
DEPTH 5'
DEPTH 7'
DEPTH 9'
DEPTH 11'
DEPTH 13'
DEPTH 15'
DEPTH 17'
DEPTH 19'
DEPTH 20'

Temp and Dissolved Oxygen 2008



Summary After System Installation

- Richardson Stability No. Δ 7 vs. 6,388 (mixing)
- Elimination of thermocline due to efficient mixing to < 3˚C at 21’ Temperature uniformity
- Residual DO levels at 6 mg/L or>
- Reduced turbidity while aerating and mixing – organic bottom undisturbed
- Enhances the taste and eliminates odors in finished water (reduced Geosmin and MIB)
- 1 system is treating ~400+ acres SW of causeway, 900 acres in Lake Evergreen and 635 acres in Lake Bloomington