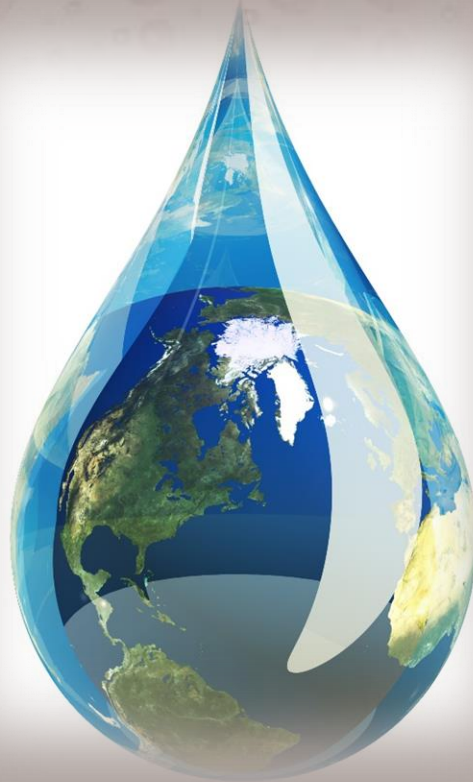


MANAGING WATER QUALITY IN YOUR DISTRIBUTION TANKS



Presented By
Dustin Dowdy

SOUTHEASTERN

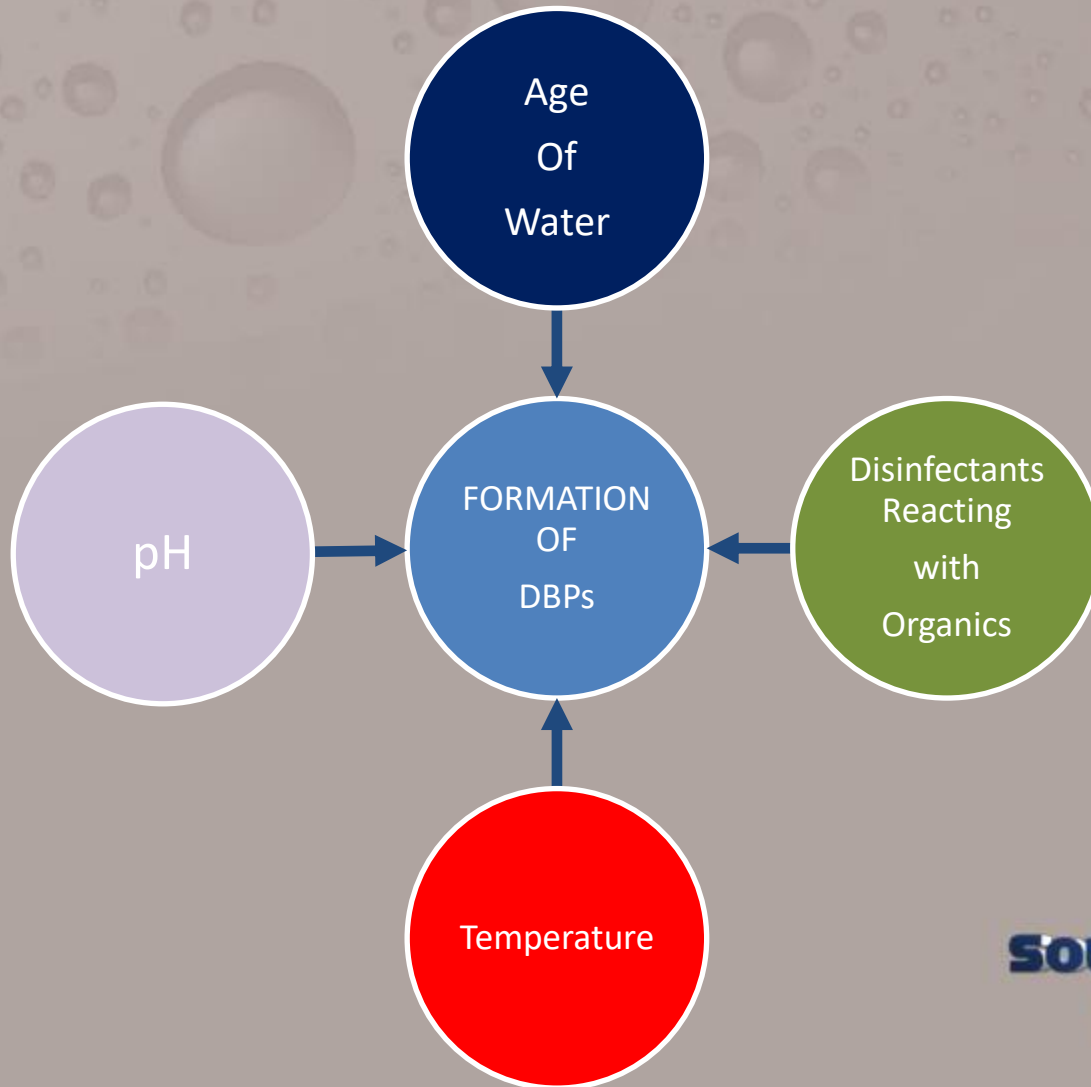


I.

WHAT ARE DISINFECTION BY-PRODUCTS?



FORMATION OF DBPs SIMPLY STATED....



FORMATION OF DBPs

THE HOTTER
THE WATER,
THE MORE
DBPs ARE
CREATED

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II.

**TRIHALOMETHANES (THM)
HALOACETIC ACIDS (HAA5)**



TRIHALOMETHANES

- Most Prevalent within the Distribution System, Tanks & Lines
- TTHM (Total Trihalomethanes)
- Chlorine degradation, water age & temperature stratification are the major catalysts
- Nitrification occurs in tanks at temperature stratification greater than 1 degrees F
- Occurs when water is more basic

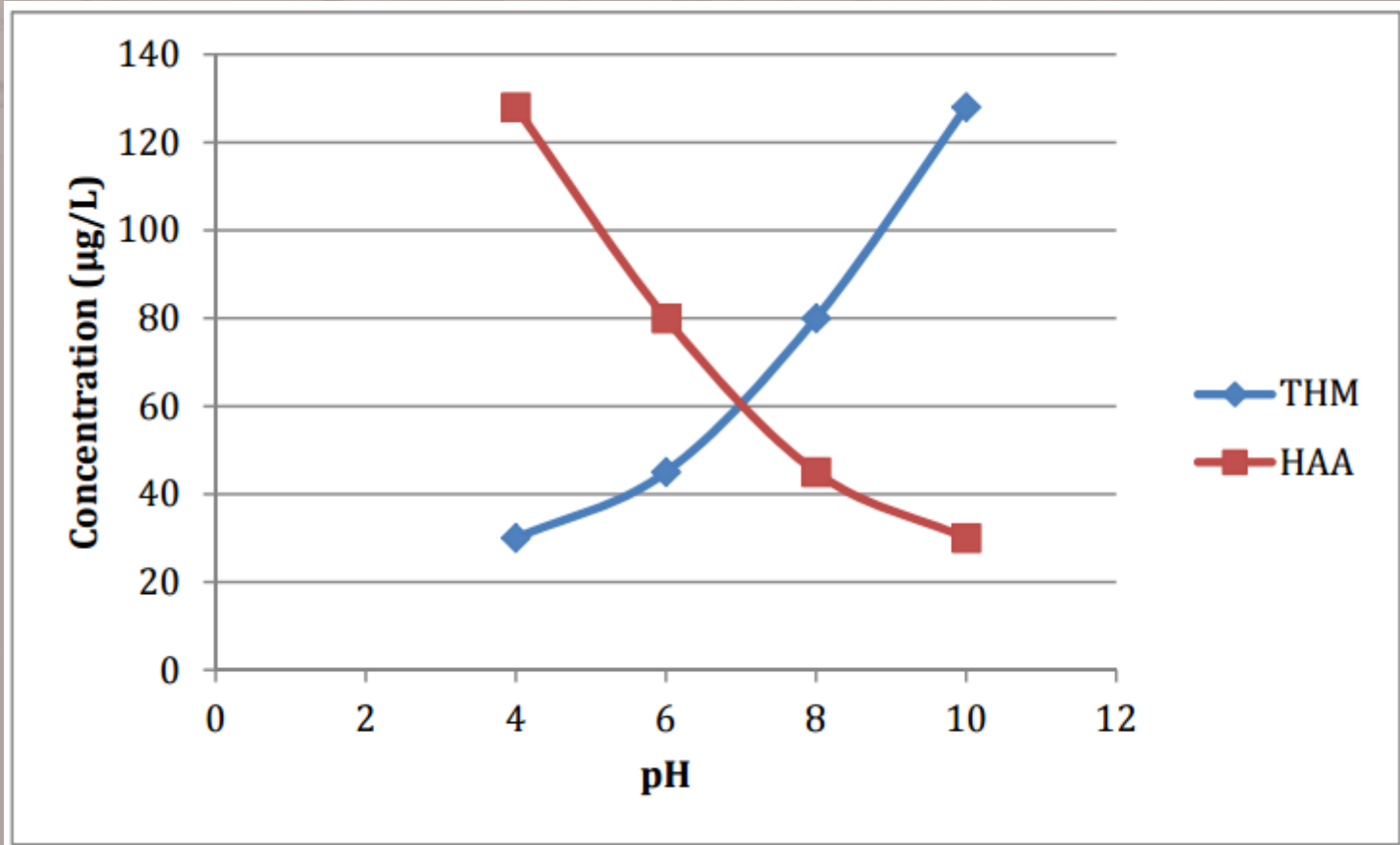


HALOACETIC ACIDS

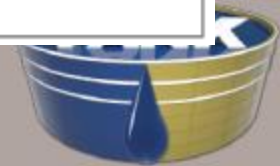
- HAA5s typically come from the source water and typically cannot be removed IN the system.
- Occurs when water is more acidic
- 3 Methods of Treatment
 - Chemical treatment to raise water pH
 - Activated Carbon filtering at WTP
 - Dissolved Air Flotation at WTP



THMs – HAAs – pH

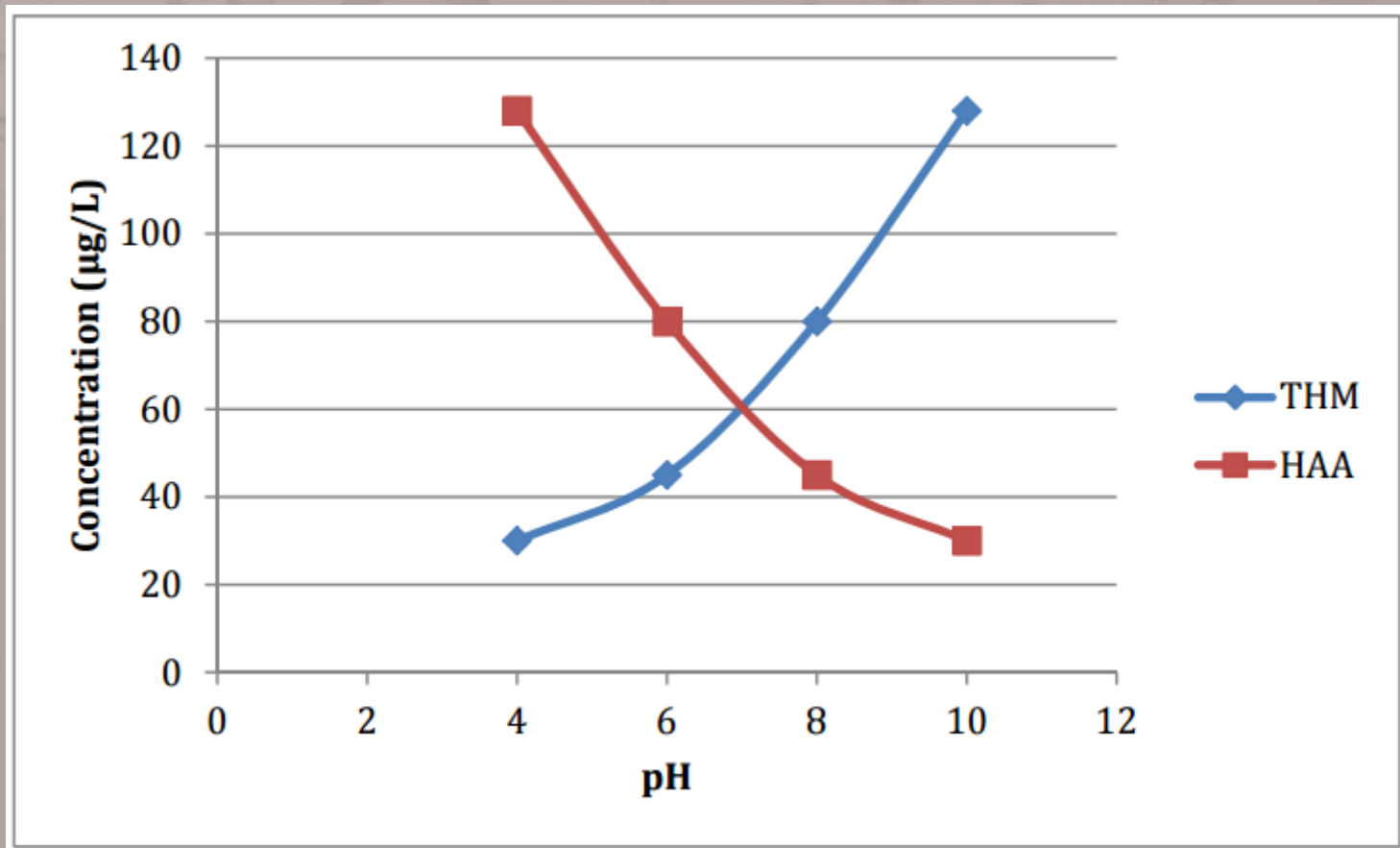


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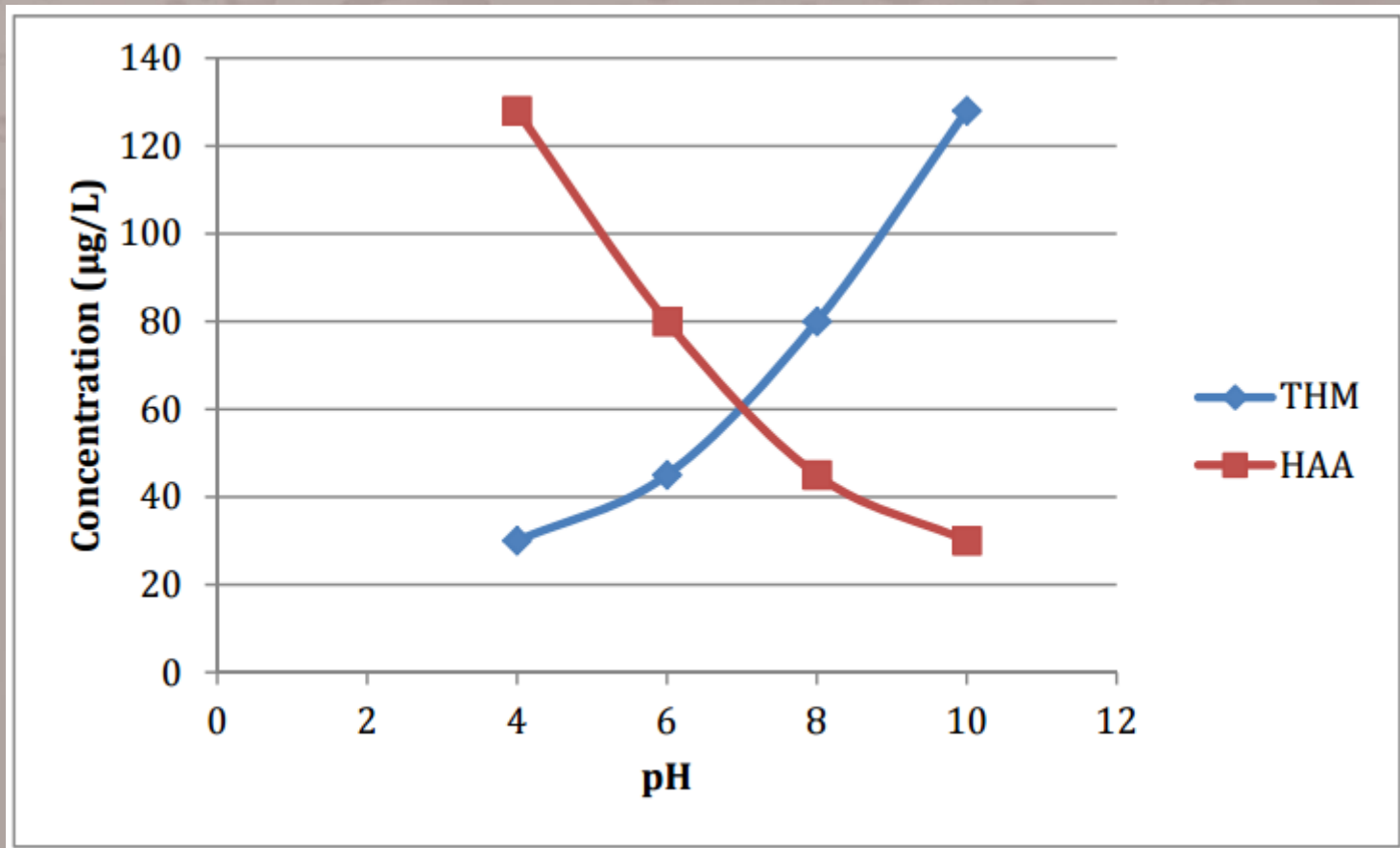
pH Balance: THMs vs HAA5s

Raising pH will raise THM Production



pH Balance: THMs vs HAA5s

Raising pH will lower HAA5 Production



III.

UNDERSTANDING THE SYSTEM

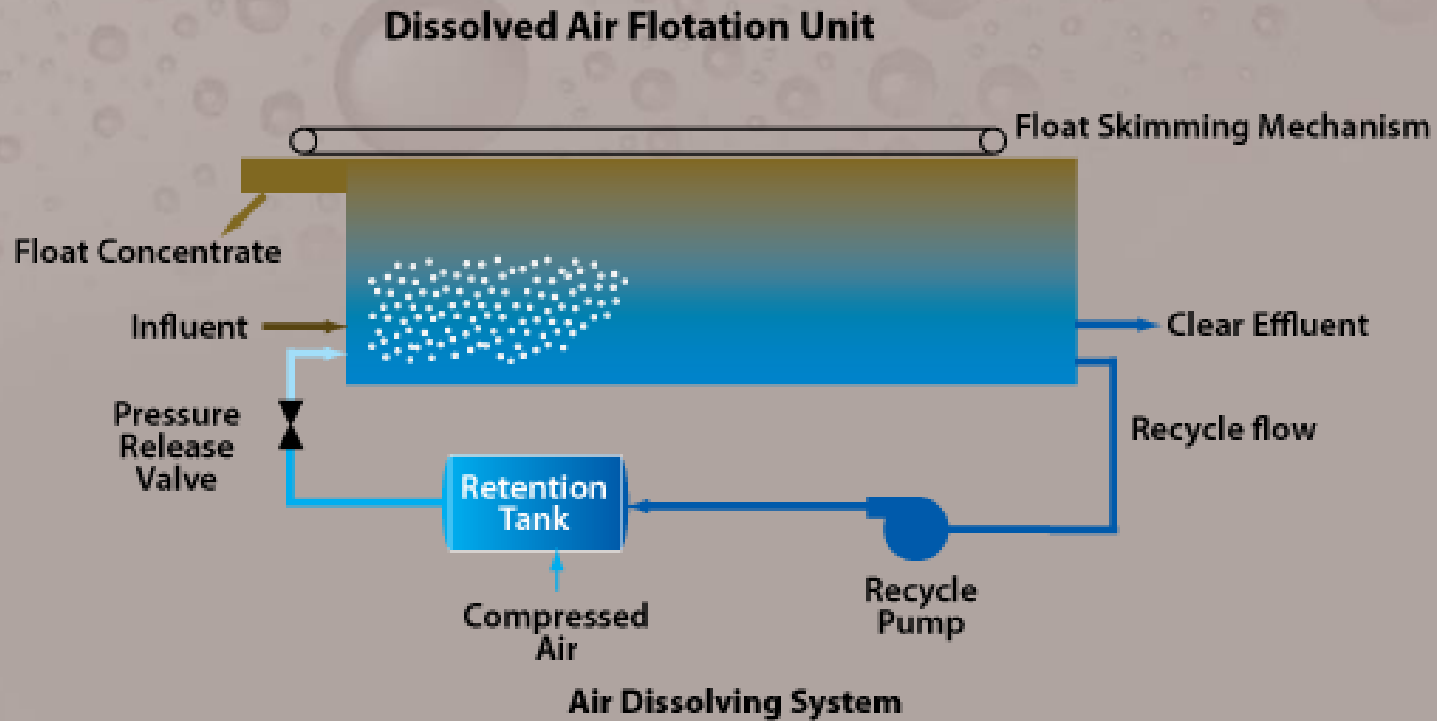


UNDERSTANDING THE SYSTEM

1. Storage Tank Operation
2. Capacity
3. Water Source and Quality
 - Ground water
 - Surface Water
 - Complete Purchased System
 - Combined Distribution System
4. Treatment Process
5. Distribution System Flushing



HAA5 Treatment – Pre Treatment



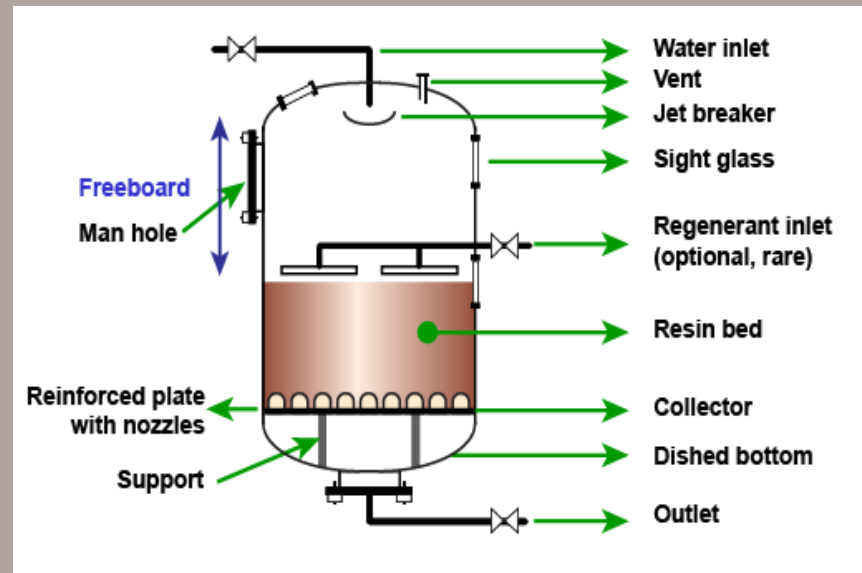
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HAA5 Treatment – DAF Unit



Activated Carbon – Post Treatment



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Activated Carbon

- Scalable sizes for pump station placement within the system
- Post installation cost is carbon replacement



IV.

DISTRIBUTION TANKS



DISTRIBUTION TANKS

Example (Summer):

- Where:
 - $V_{\max} = 500,000$ gallons
 - $V_{\min} = 400,000$ gallons (Drop to approx. $\frac{3}{4}$ full)
 - $N = 2$ (drops to $\frac{3}{4}$ full and fills 8 times during the day)

$$\text{Avg Time} = \frac{500,000}{\frac{(500,000 - 400,000)}{2}}$$

– Average Residency Time = 2.5 days!



DISTRIBUTION TANKS

- TANK TURNOVER
 - Recommended: 50% turnover daily (30% min)
 - Reduce Age of Water
 - Reduce Temperature Stratification in Tank
- TANK CYCLING
 - Increasing Level Between Draw and Fill
 - Continuous drawdown vs. Incremental drawdown
 - Sudden draw down can introduce DBPs into system



DISTRIBUTION TANKS

Stratification Variance - >3 degrees F

	Floor (F)	Surface (F)
Clearview	86	72
Druid Hills	80	65
France	87	69
Hwy 47	70	60
Pomona	82	72
Sleepy Hollow	83	69
White Bluff Road	88	67
Colesburg	66	56
Hafner Road	60	58

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Stratification Variance Greatest in Elevated Tanks

3/25/2015 12:40:58 PM



H: 108.4 °
D: 20.30 ft
Temp: 88.3 °F

V.

TANK PIPING MODIFICATIONS

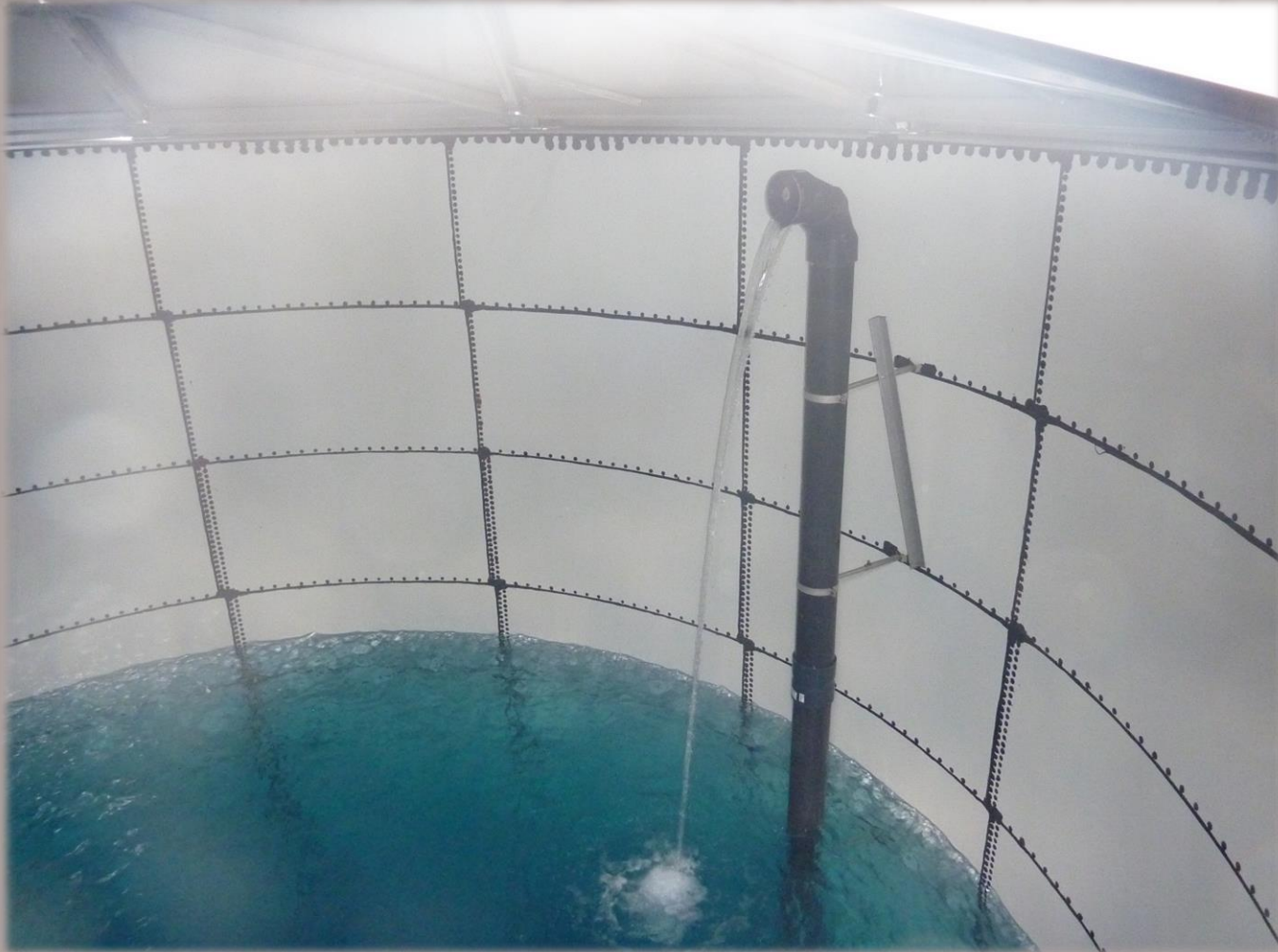


TANK PIPING MODIFICATIONS TO AID IN THM PREVENTION

- **AVOID:** Single Inlet/Outlet in bottom of tank
 - Last water in is first water out ie Elevated Tanks
 - Leads to aged water and temperature stratification
- **GOOD:** Fill to the top and drain from the bottom
 - Oldest water leaves first
 - Measure of mixing by falling water
- **BETTER:** Intermittent Nozzles/Check Valves
 - Multiple levels of water disbursement



TANK PIPING MODIFICATIONS GOOD!



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TANK PIPING MODIFICATIONS BETTER!



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TANK PIPING MODIFICATIONS

Tideflex Operation



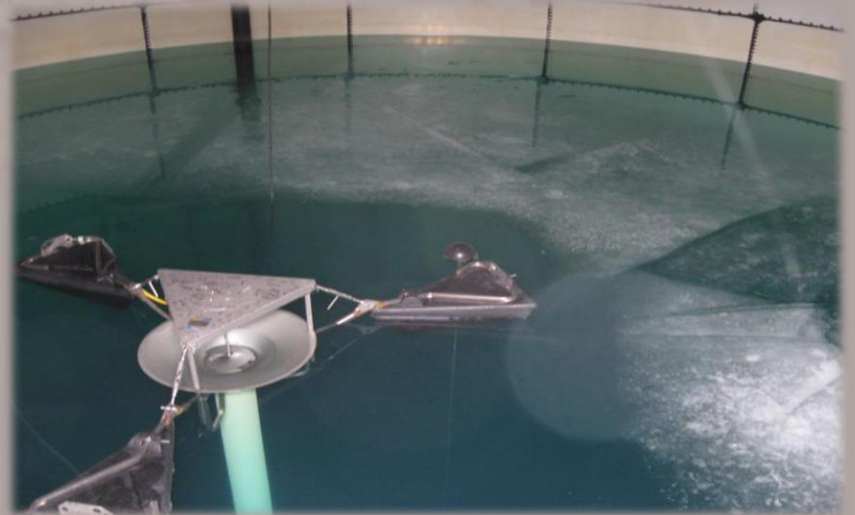
VI.

MIXING TECHNOLOGIES



MIXING TECHNOLOGIES

- If the tank is cycling properly, mixing technologies are excellent for:
 - Blending old and new water
 - Uniformity of disinfectants
 - Reduce temperature variances
 - Prevent ice formation
 - Allows THMs below the surface to evaporate
- Manufacturers:
 - Tideflex
 - Pax
 - Medora
 - Solar
 - Electric
- New and Existing Tanks



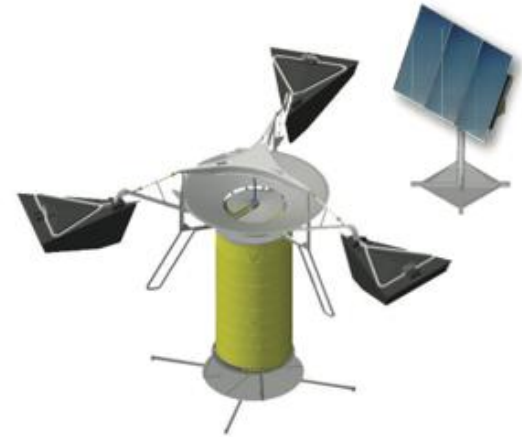
Potable Water Mixers



Passive Mixer



**Solar-powered Mixer
(Small / Medium Tanks)**



**Solar-powered Mixer
(Large Tanks)**



**Elevated
Impeller Mixer**



**Elevated
Nozzle Mixer**

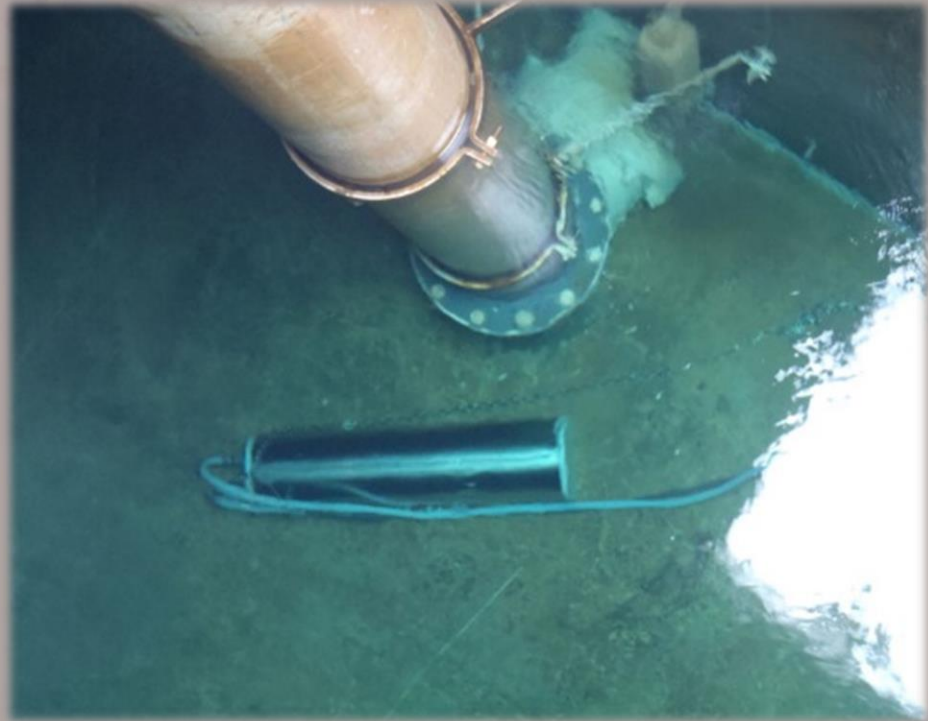


**Submersible (floor)
Sheet-flow Mixer**

MIXING TECHNOLOGIES

SET GridBee Program

- GS-9 & 12, <\$10,000
 - SET Install
 - Electrical by Others
 - Elevated & Ground
 - Grid stratification testing available
 - Multiple units can be used in sequence



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Medora Corporation

]Grid**Bee**[®] *Solar***Bee**[®]

Air • Electric • Solar

MIXING TECHNOLOGIES

Gridbee Operation

8/19/2015 10:48:50 AM



H: 226.4 °
D: 13.55 ft
Temp: 78.0 °F



Watts Bar Utility District

Gridbee Mixing Project



STRATIFICATION TESTING

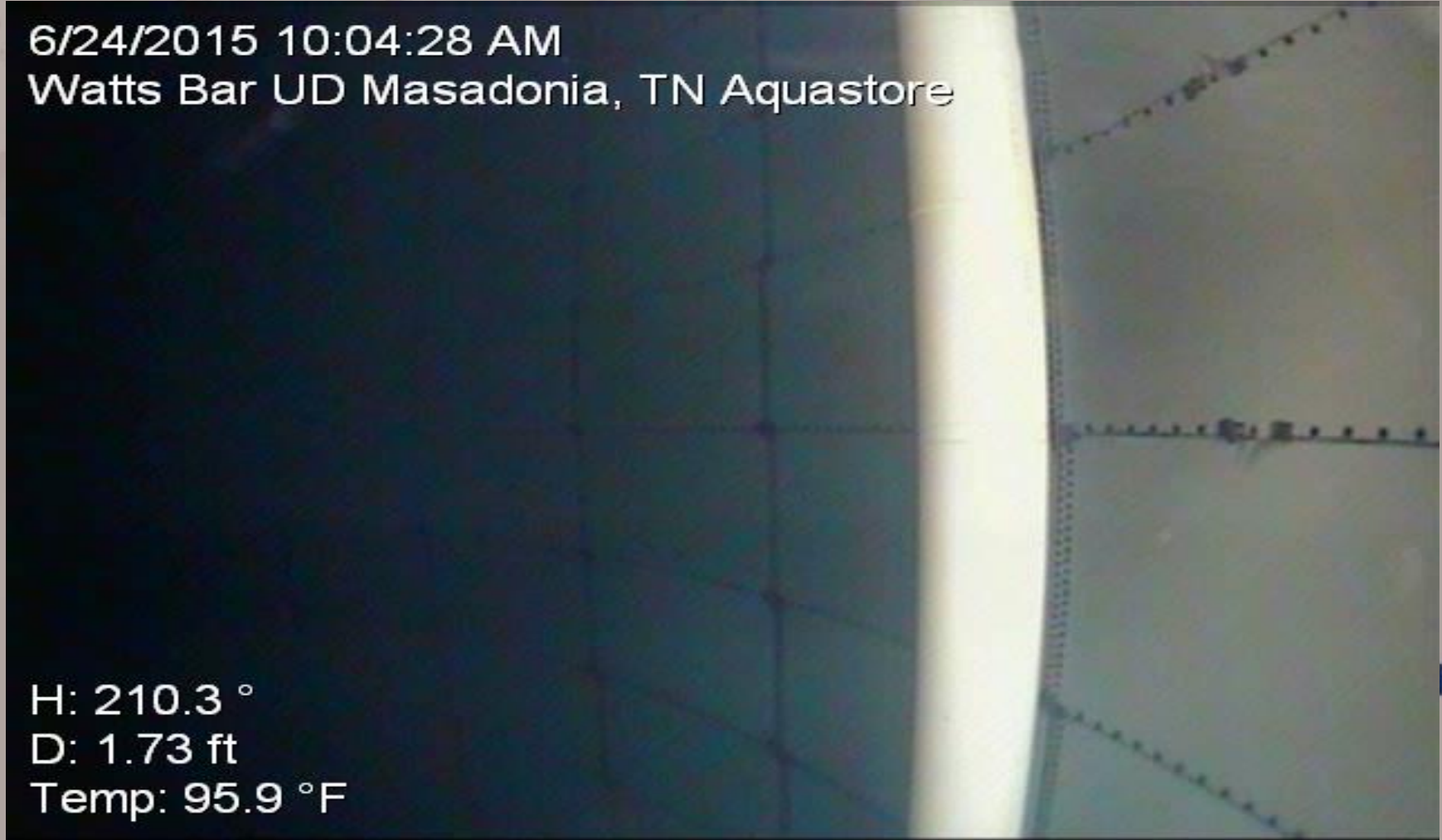
6/24/2015 10:04:28 AM

Watts Bar UD Masadonia, TN Aquastore

H: 210.3 °

D: 1.73 ft

Temp: 95.9 °F



TEST RESULTS

- **Temperature Variance, 85 to 96 degrees F**
- **Existing Piping Modifications (\$25-30k) Not Alleviating Stratification**
- **Decision Made To Add GridBee GS-12**



Gridbee Installation



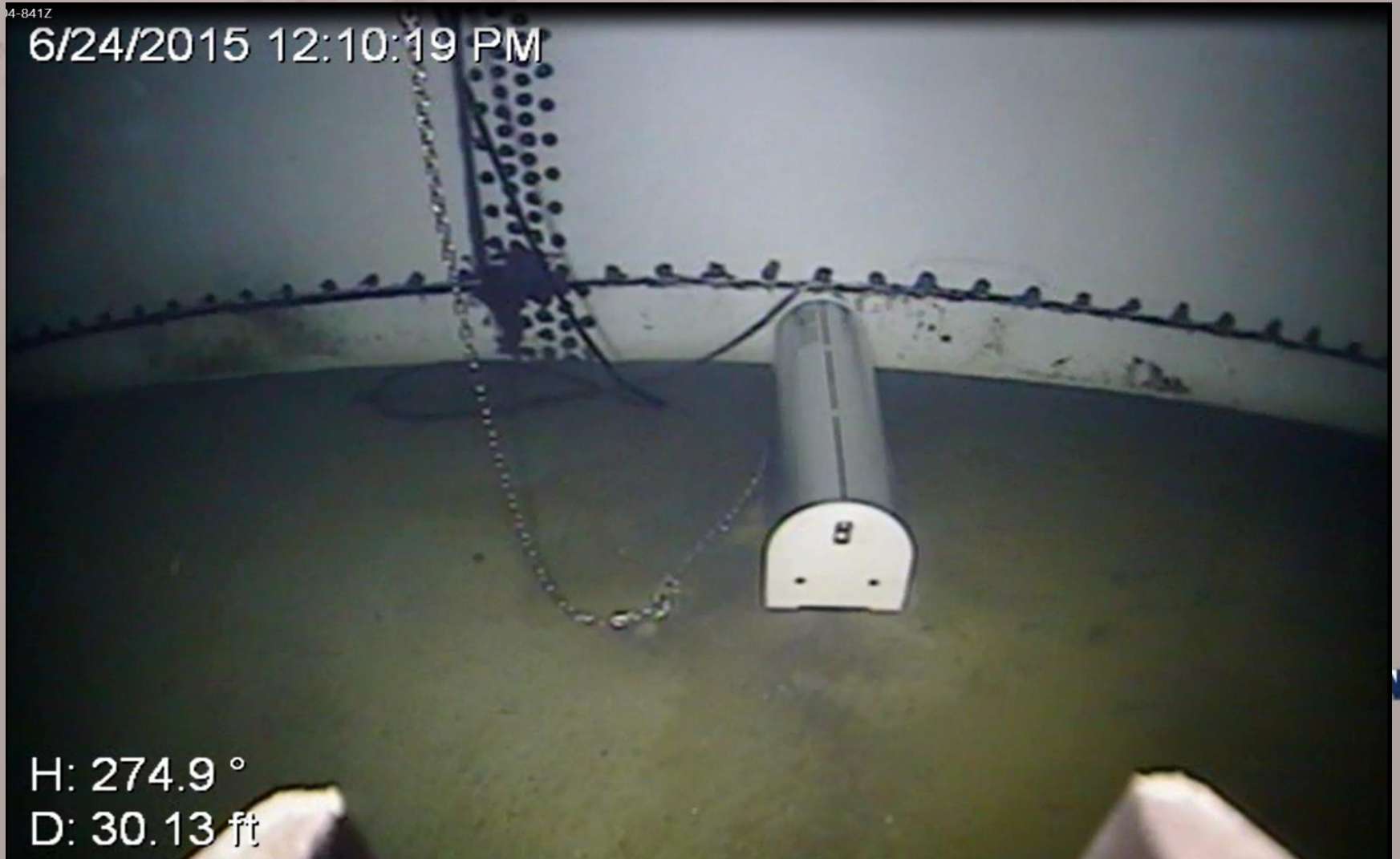
Gridbee Installation



Gridbee Installation

4-841Z

6/24/2015 12:10:19 PM



H: 274.9 °
D: 30.13 ft

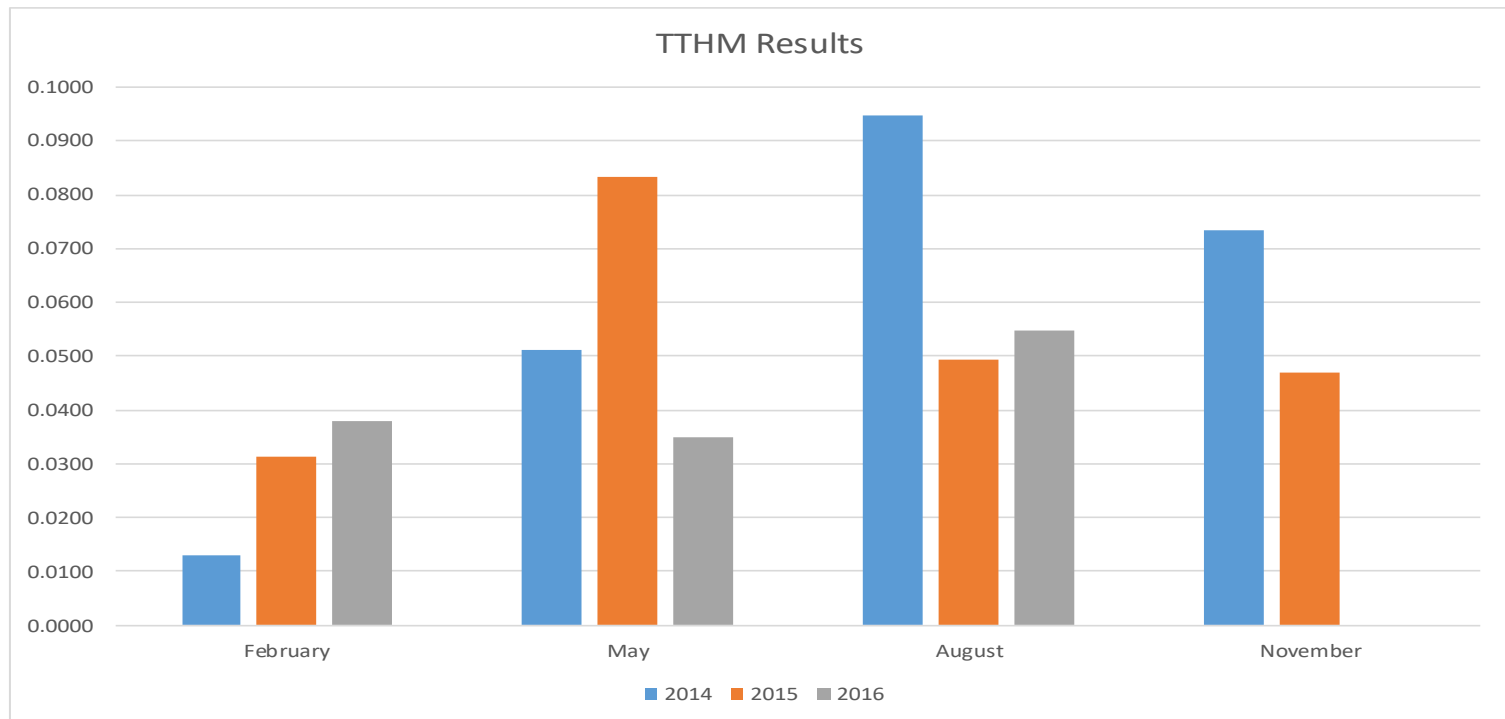
Gridbee Results

Install, Between May & Aug 2015 Test

	2014	2015	2016
February	0.0130	0.0312	0.0380
May	0.0512	0.0833	0.0349
August	0.0947	0.0493	0.0549
November	0.0734	0.0468	

THM only. No HAA5 is required to be analyzed.

Mixer installed after May 2015 sample and before August 2015 sample.



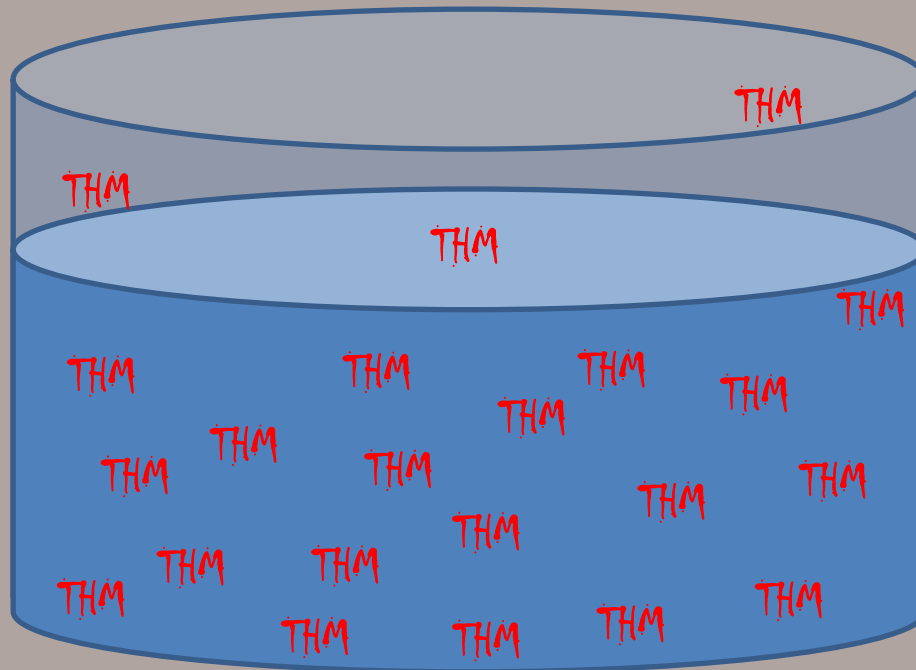
VII.

AERATION TECHNOLOGIES

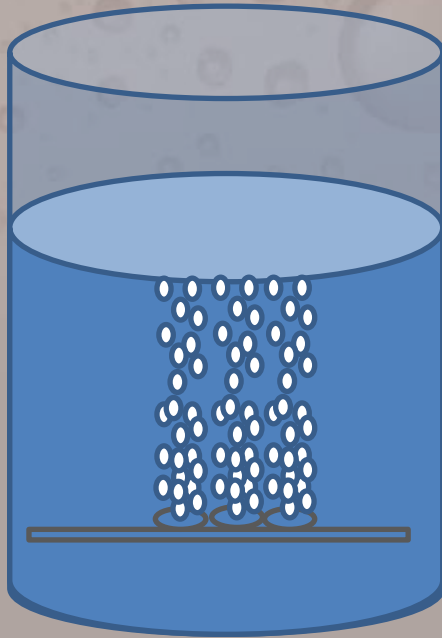


AERATION TECHNOLOGIES IN THM REDUCTION

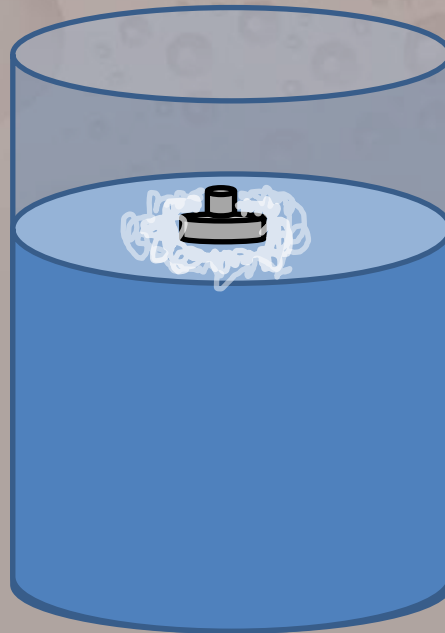
- Why is aeration a good method for THM reduction?
 - THM are a volatile organic compound (VOC)
 - Brings THM in direct contact with air
 - In the presence of air, VOC will evaporate into the air



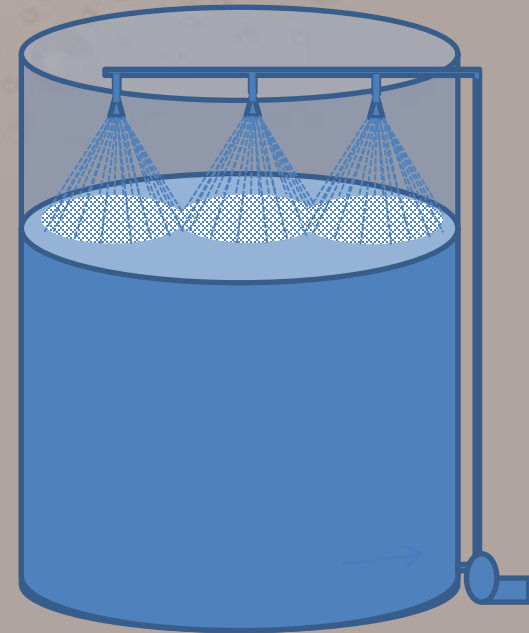
IN-TANK AERATION SYSTEMS



Bubble aeration



Surface aeration



Spray aeration

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IN-TANK AERATION FLOATING AERATOR

Solar Bee GridBee™ Floating Spray Nozzle

- Design Goal THM Reduction of 10-90%
- Mixer, floating frame with intake hose and pump/nozzle assembly
- Roof Mounted Blower
- Small horsepower requirements for mixer, floating spray nozzle and blower
- \$20-150K

3 Separate Power Cables,
each with 3-Power and 1-Ground Conductor

Single Stage Blower
2hp TEFC Motor

3 Power Panels & Circuits
Required:

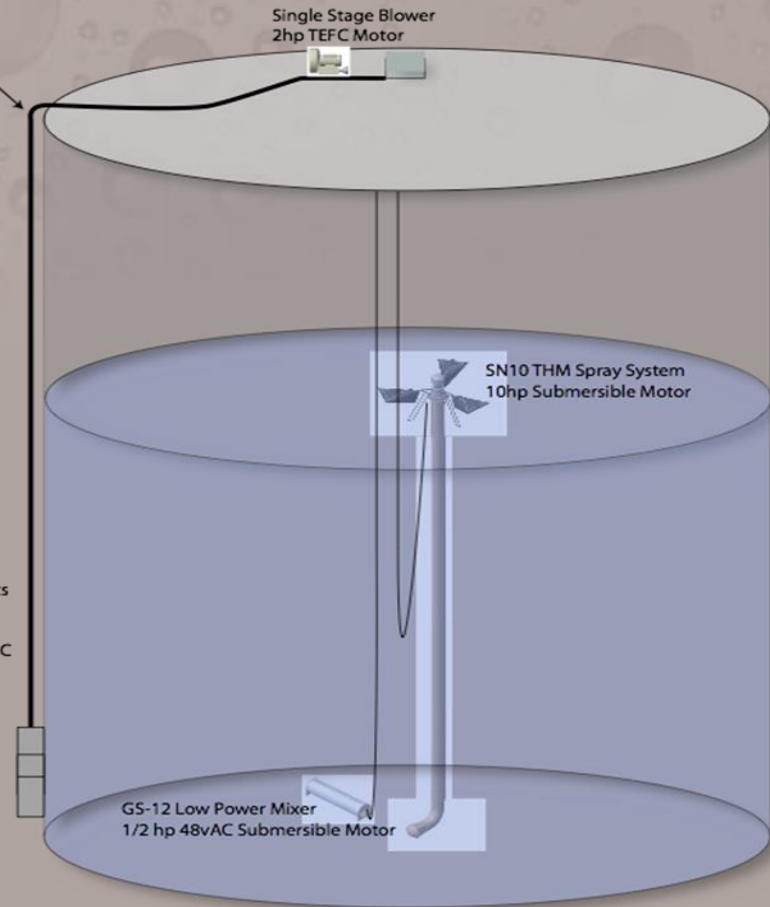
3-Phase 208/230/460VAC
for SN10

1 or 3-Phase
208/230/460VAC
for 2hp Blower

1-Phase 120VAC
for GS-12 Mixer
120VAC:48VAC Panel
Provided by
SolarBee

GS-12 Low Power Mixer
1/2 hp 48vAC Submersible Motor

SN10 THM Spray System
10hp Submersible Motor



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Medora Corporation

[[GridBee[®] SolarBee[®]

Air • Electric • Solar

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Medora Corporation



SN Series THM / VOC Removal System
30-Second Operation Demonstration

866-437-8076

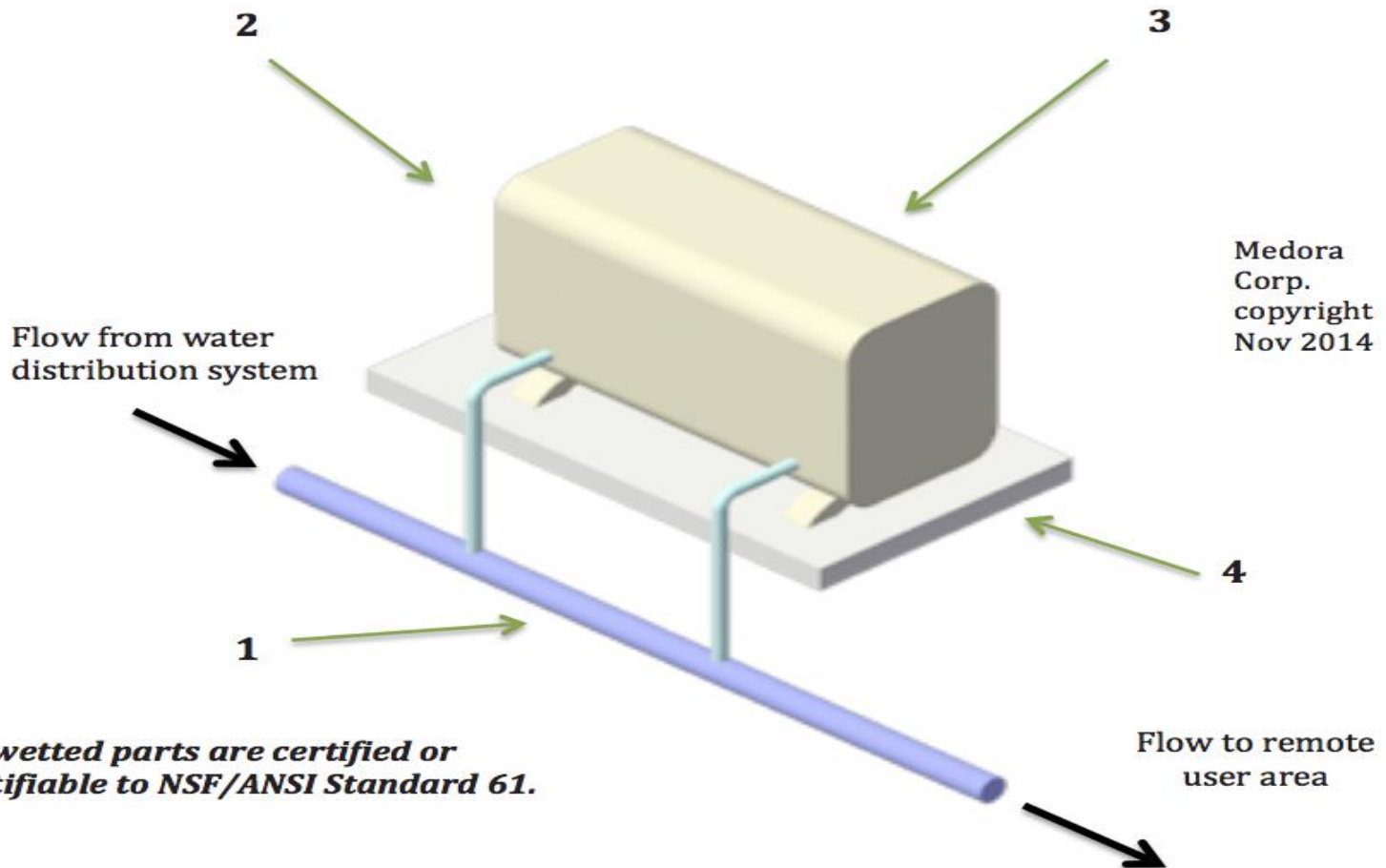
www.medoraco.com

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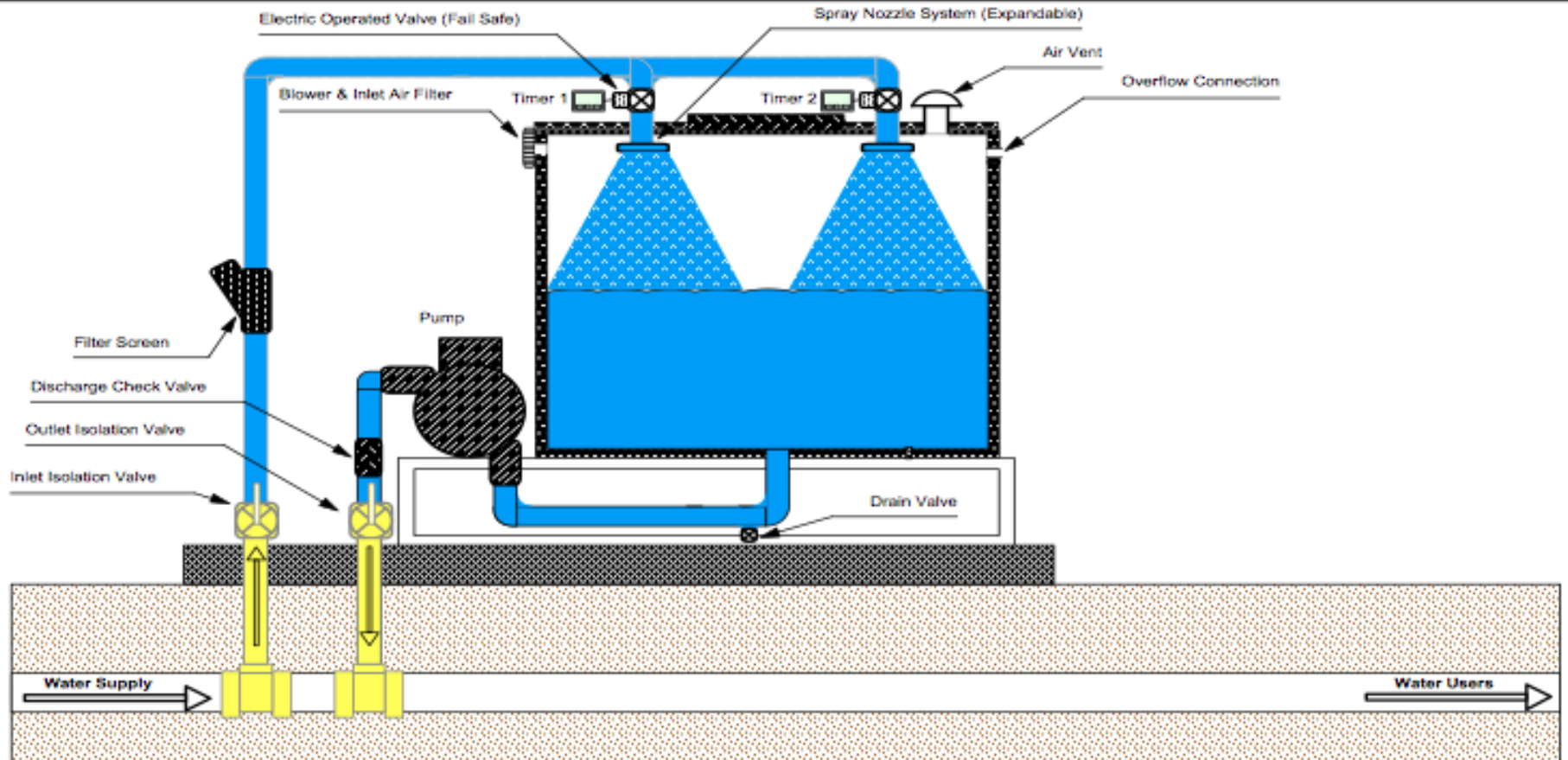


GridBee® Skid-Mounted THM Removal System For Use in Remote Areas of the Water Distribution System

GridBee® Skid-Mounted TTHM Removal System For Use in Remote Areas of the Water Distribution System



GridBee® Skid-Mounted THM Removal System For Use in Remote Areas of the Water Distribution System





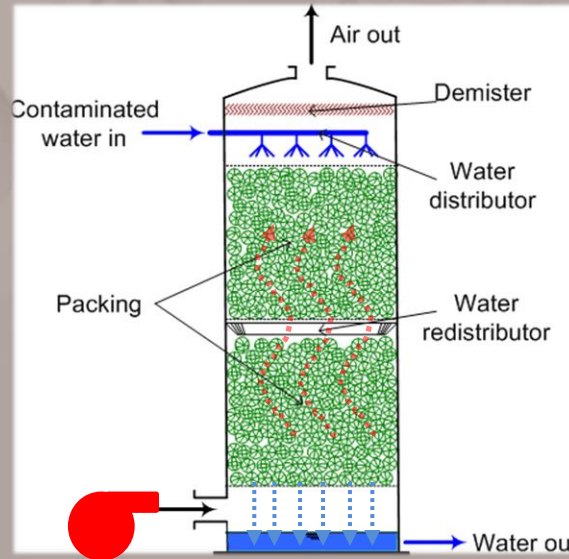




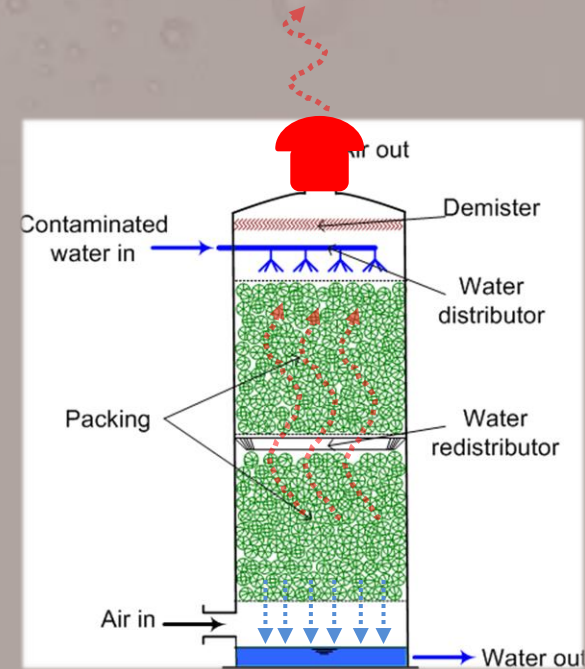
OUTSIDE TANK AERATION DRAFT AERATORS

DeLoach Industries

- THM Reduction Evaluated on Each Case. 25% - 50%
- Forced Draft – Blower pushing air through
- Induced Draft – Fan pulling air across
- Utilizes Incoming Water Pressure and Jet Nozzles
- Water is sprayed over media/slats
- \$90-125k



Forced Draft Aeration



Induced Draft Aeration



Packed Media

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OUTSIDE TANK AERATION SYSTEM

WATERFALL AERATION



VIII.

OPERATIONS AND USAGE



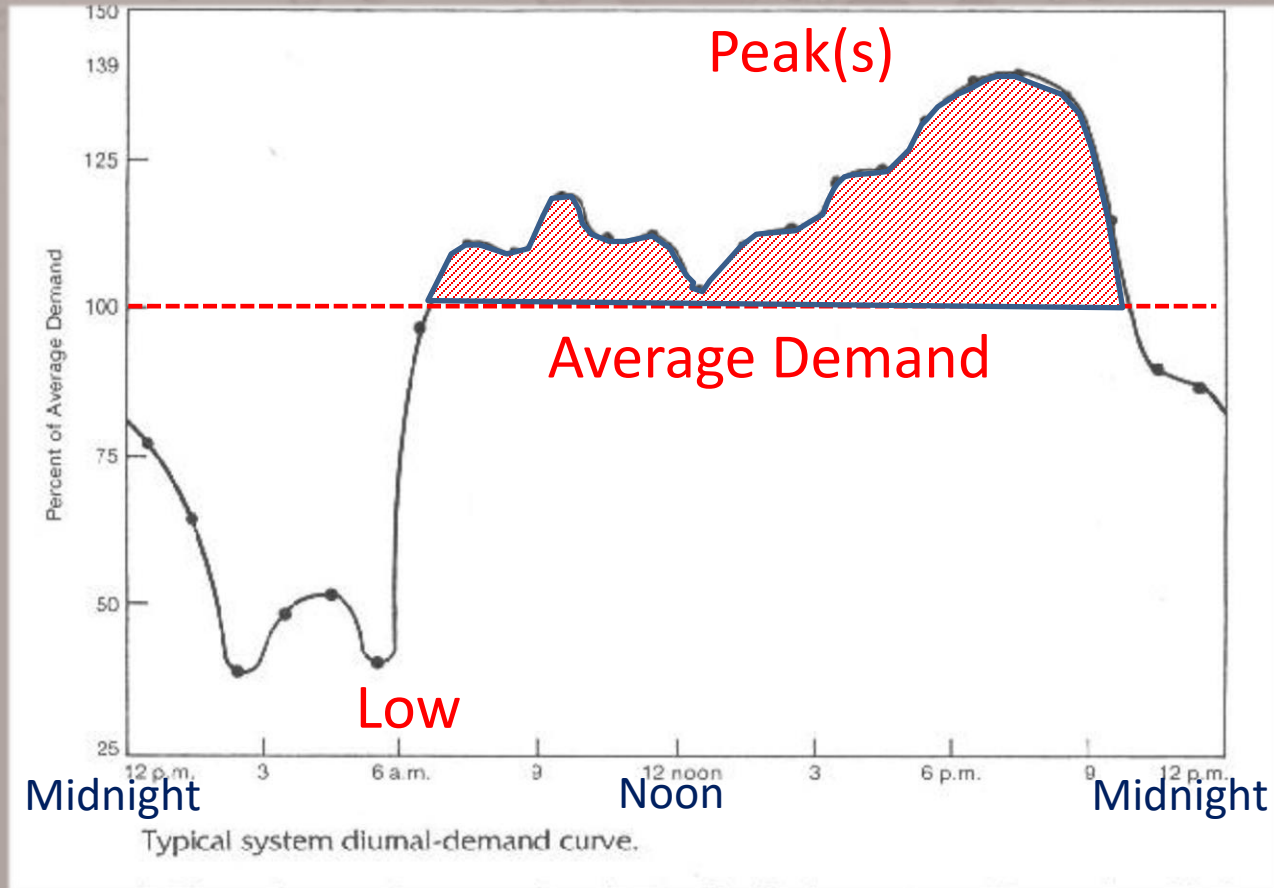
OPERATIONS AND USAGE IN THM CONTROL AND REDUCTION

- Maintenance of Tanks
 - Sediment in tanks to lead to formation of THM
 - Profile of tank walls
 - Microbial growth leading to nitrification
- Decentralized Disinfection
 - Disinfect at points throughout the system to maintain residuals
 - Reduce Disinfection at the Source
 - Applications in tank or at booster station sites
- Pumped Storage
 - Improve drain/fill cycles – Matching System Demands
 - Control Age of Water and Temperature
 - Utilizing Smaller Tanks Sized to Meet Demands



OPERATIONS AND USAGE

THE DAILY OPERATING CYCLE



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OPERATIONS AND USAGE

TOTAL DYNAMIC STORAGE

- PUMPED STORAGE that includes **EXPANDABLE** ground water storage tank coupled with engineering designed and owner selected pumps **PLUS** emergency power

EXPANDABLE
Ground
Storage Tank

Pumps

Electrical

Generator with
Automatic
Transfer Switch

Telemetry



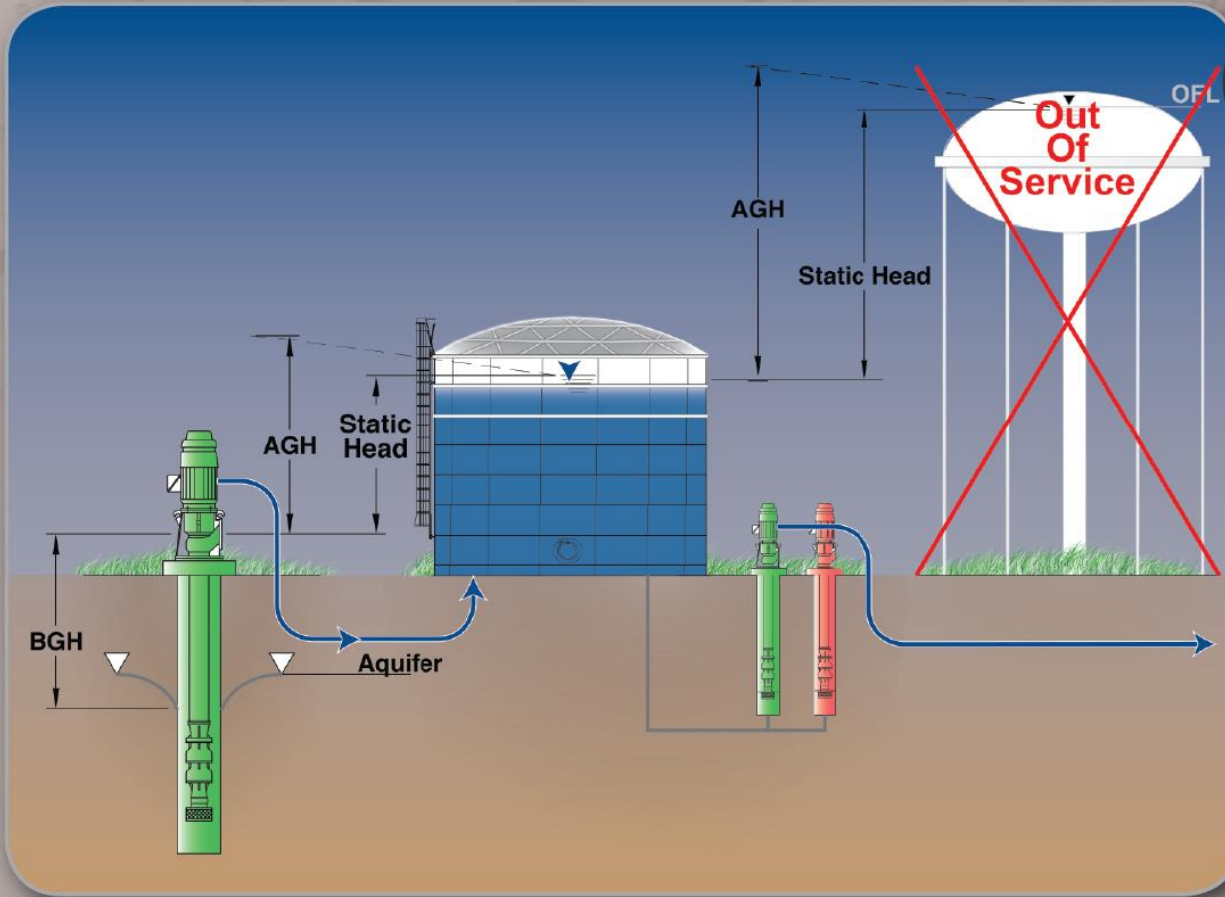
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EXPANDABILITY...VERTICAL BY JACKING

Operating Cycle: Elevated Out of Service

Example – Tank Maintenance



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MANAGING TANK QUALITY

- **THM & STRATIFICATION TESTING**
- **TURNOVER & MIXING**
- **AERATION & VENTING**
- **CHLORINE DOSING**



X. ACKNOWLEDGEMENTS

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