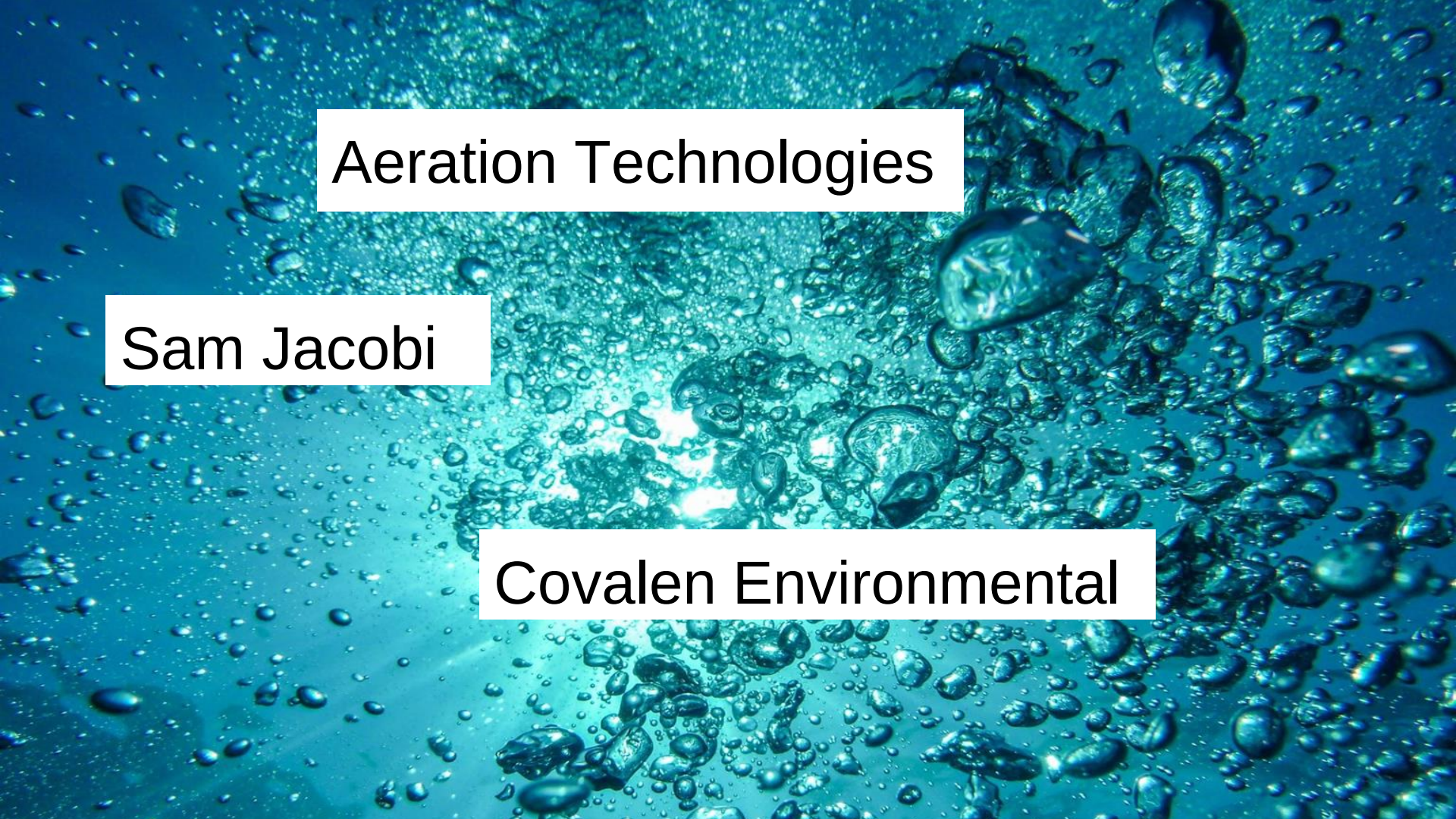

Aeration Technologies
Sam Jacobi
Covalen Environmental

LOCAL GOVERNMENT CLIMATE AND ENERGY STRATEGY GUIDES

Energy Efficiency in Water and Wastewater Facilities

A Guide to Developing and Implementing Greenhouse Gas Reduction Programs

Local Government Climate and Energy Guide:

- comprehensive, straightforward overview of greenhouse gas (GHG) emissions reduction strategies that local governments can employ.
- Topics include: energy efficiency, transportation, community planning and design, solid waste and materials management, and renewable energy.
- government staff and elected officials can use these guides to plan, implement, and evaluate climate and energy projects.

Overall Energy Consumption

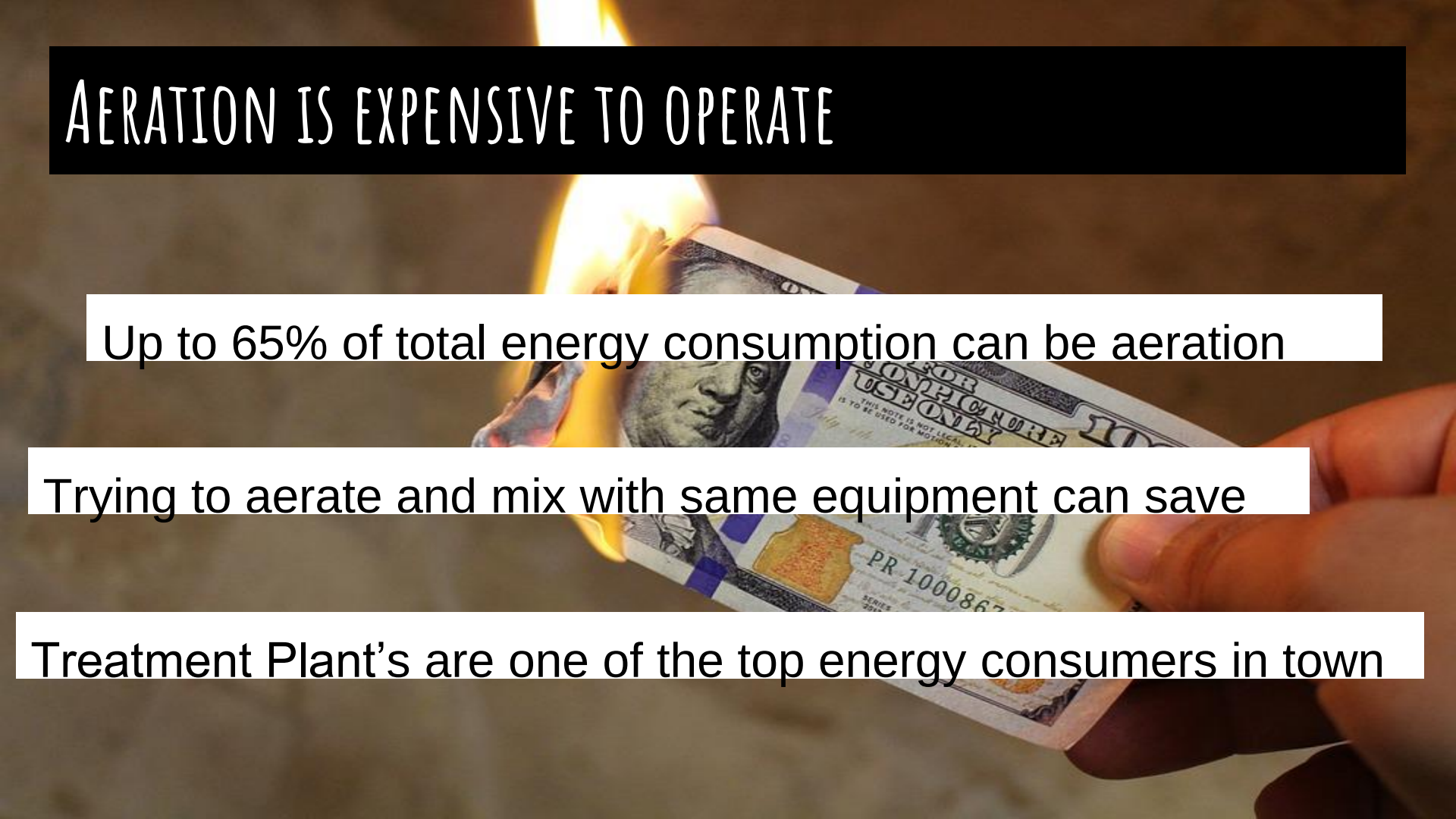
Energy can account 10% of a local government's annual operating budget

A significant amount of this municipal energy use occurs at WTP/WWTP

W & WW utilities accounts for 35% of typical U.S. municipal energy budgets

Electricity use accounts for 25–40 % of the operating budgets for WW utilities

Aeration is expensive to operate



Up to 65% of total energy consumption can be aeration

Trying to aerate and mix with same equipment can save

Treatment Plant’s are one of the top energy consumers in town

Where is it used?

What are we trying to accomplish?

Oxygen for BOD Removal

Oxygen for Ammonia Removal

Odor Control

Degassing

Mixing

Energy Audits and Energy Reduction Grants

Contact local wastewater trade associations: Suggestions?

Hire an independent contractor to audit

Contact your electrical service provider

Have you done this?

Possible Audit Avenue with FirstEnergy

Duke Smart $aver

How it Works

1

Apply

You submit your application and savings calculations.

2

Receive an offer

We'll evaluate your application within four to six weeks and send you a preliminary incentive offer.

3

Install

You have up to one year to install the project.

4

Get paid

It takes up to four weeks for Duke Energy to evaluate your installation and process the incentive payment.

Smart $aver Custom Incentives range from 25 to 150 percent of the project's annual electric savings. The simple payback time must be greater than one year after applying for the incentive and cannot exceed 50 percent of the incremental project costs for customers in Indiana, or 75 percent for customers in Kentucky, Ohio and the Carolinas.

Start with the easiest first…EQ Basins

Flow Equalization Basins (EQ Basins)

Not looking for full treatment

Often overlooked

Should Focus on mixing

Degassing for Algae Control

Same technology and equipment as aeration basin

How much Oxygen

Pounds of Oxygen to Remove BOD and Ammonia

Many factors contribute, such as sludge age, temperature, etc.

1.0-1.2 Pounds of Oxygen per Pound of BOD

4.6 Pounds of Oxygen per Pound of Ammonia

Oxygen requirement example .200 MGD plant

Aerator Loading = Flow(MGD)x mg/l x 8.34

BOD = .200 MGD x 350 mg/l x 8.34 = 584 lbs/BOD

BOD = 1.2 lbs O2 x 584 lbs = 700 lbs of O2/Day

Ammonia = .200 MGD x 35 mg/l x 8.34 = 58 lbs/Ammonia

Ammonia = 4.6 lbs O2 x 58 lbs = 267 lbs of O2/Day

Oxygen requirement example .200 MGD plant

Aerator Loading = Flow(MGD)x mg/l x 8.34

700 lbs O2 BOD + 267 lbs O2 Ammonia = 967 lbs O2/day

967 lbs O2/day / 24 hours = 41 pounds O2 per Hour

Standard Oxygen Transfer Efficiency (SOTE)

Conducted in a ASCE Certified Lab

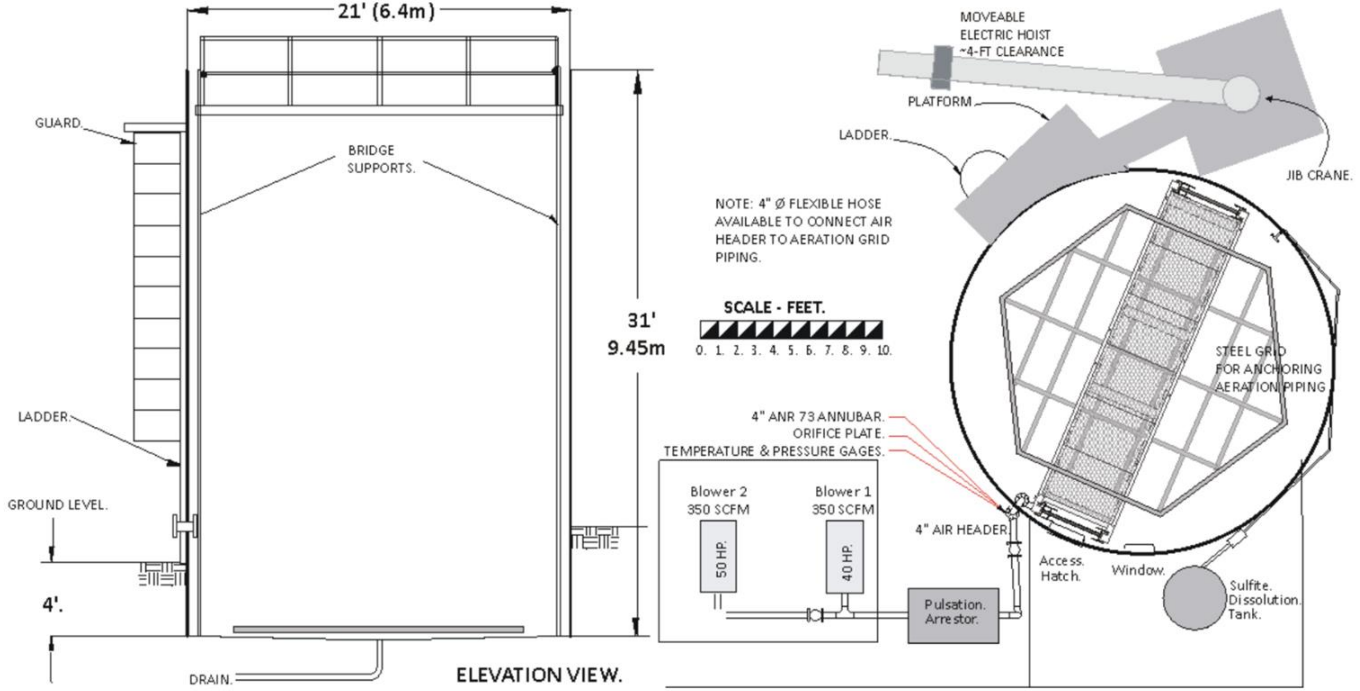
Chemicals used to deplete O2 from clean water

Aeration turned on and O2 recharge monitored by multiple probes

Gives industry standard to compare different types of aeration

Andrew Elvidge

Testing Facility for Oxygen Transfer



Standard Oxygen Transfer Efficiency (SOTE) Ranges

1.5 to 10 lbs O2/BHP-Hour

Mechanical Surface Aerators

Coarse Bubble Diffusers

Jet Aerators/Aspirators

Fine Bubble Diffusers

Mechanical Surface Mounted Aerators

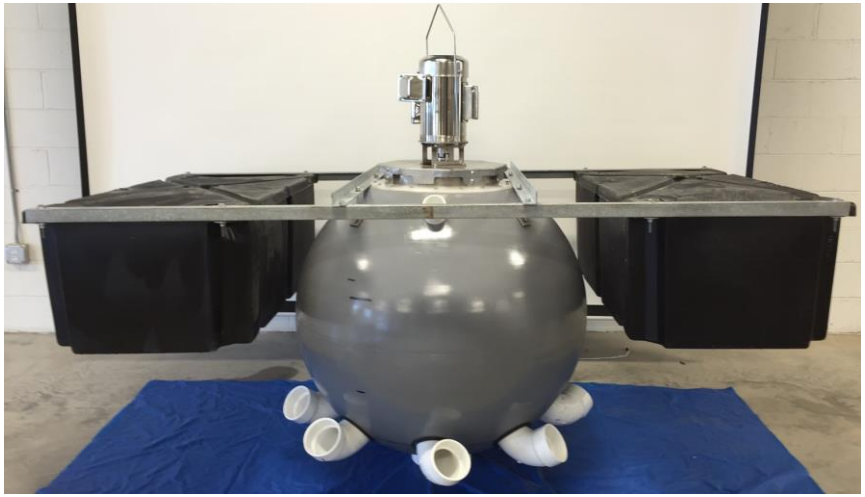
Splash Aerator

Surface Mixer Aerator

Mix water well horizontally, lower SOTE

Mechanical Surface Mounted Aerators

Bradley ProFusion with Floats and Sphere



Bradley ProFusion Removable Core

Deep water mixing, bubble contact chamber

Video

- BIG ProFusion's Video:
- https://www.youtube.com/watch?v=GoGkCBHmOk8
- See how it works here!

Coarse Bubble Diffusers

Good at Mixing, Fair SOTE

Fine Bubble Diffusers

FAir Mixing, good SOTE

Distance can hurt, Place the energy where it is needed

Blower/Diffuser	Duty	Operational Horsepower
Blower 25 HP positive displacement rotary lobe blower with 90% efficiency motor for 640 CFM @ 6 PSIG 25 HP @ 50% efficiency = 12.5 HP	Boost ambient air for a discharge pressure of 6 PSIG	12.5 HP
Piping High pressure piping system requiring 2.4 PSIG pressure loss for delivery of 640 CFM 40% x 12.5 HP to transport air from blower to diffuser = 5 HP	Deliver high pressure air from blower to diffuser	5 HP
Diffuser Fine bubble diffuser to an oxygen aeration and mix the waste sludge 60% x 12.5 HP for aeration/mixing	Injection of small air bubbles in waste sludge for aeration and agitation	7.5 HP

Oxygen is important, but so is mixing

Keep solids in suspension

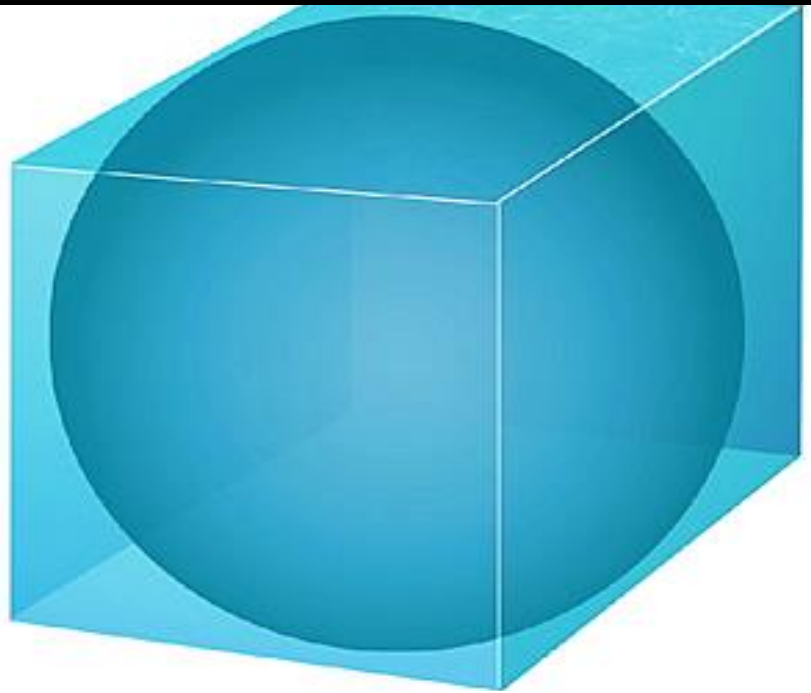
Odor control

Decrease short-circuiting

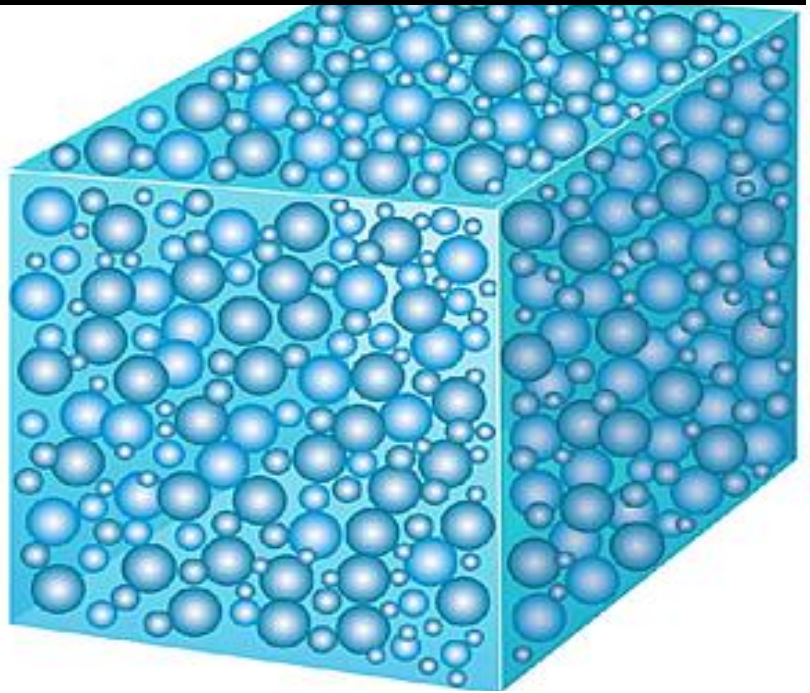
Bring oxygen, pollutants and bugs together

Must Consider vertical and Horizontal Mixing

Different bubbles different jobs



Moves Water,
Coarse Bubbles



Transfers Gas,
Fine Bubbles

Combining technologies for improved efficiencies

Blade +

Fine +

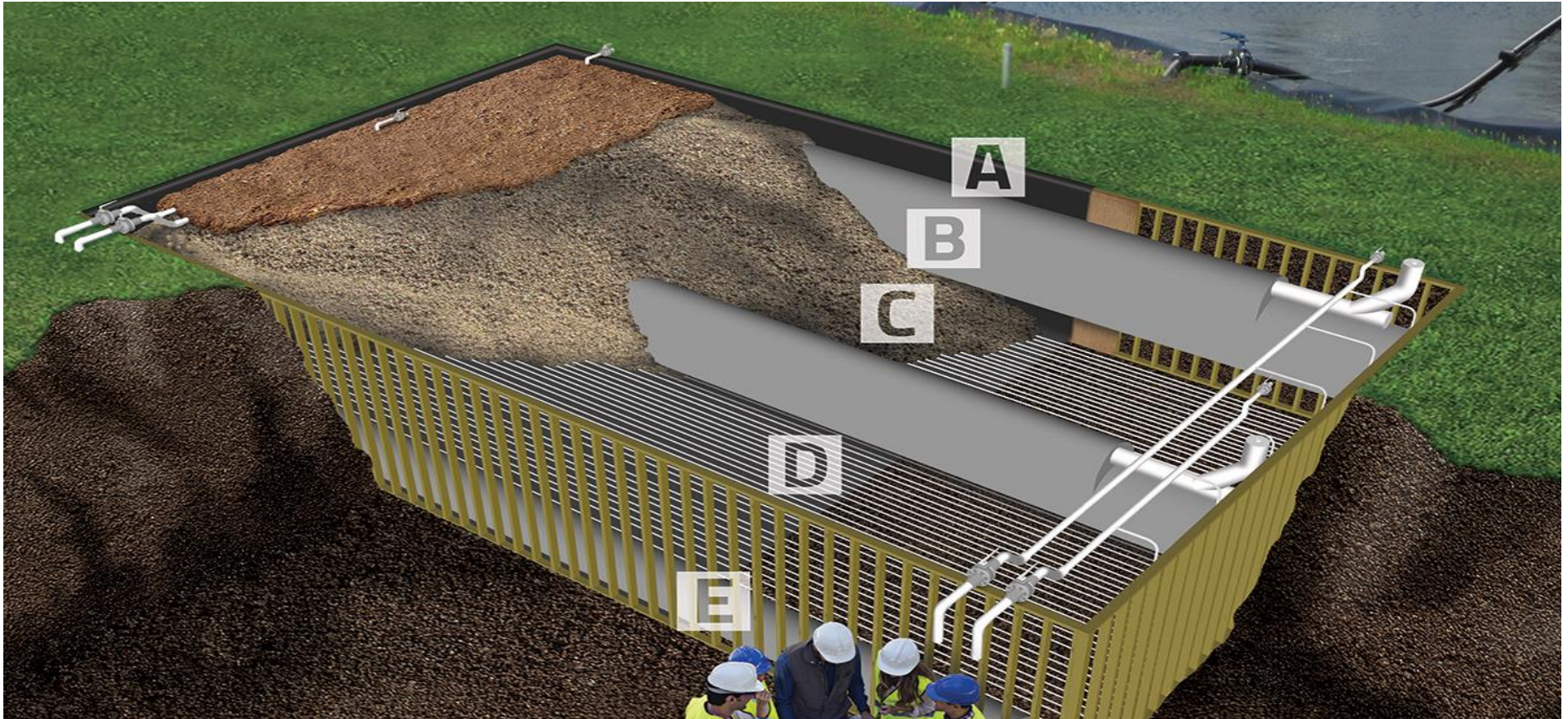
Coarse

Bubble

Fine bubble

blade + jet prop

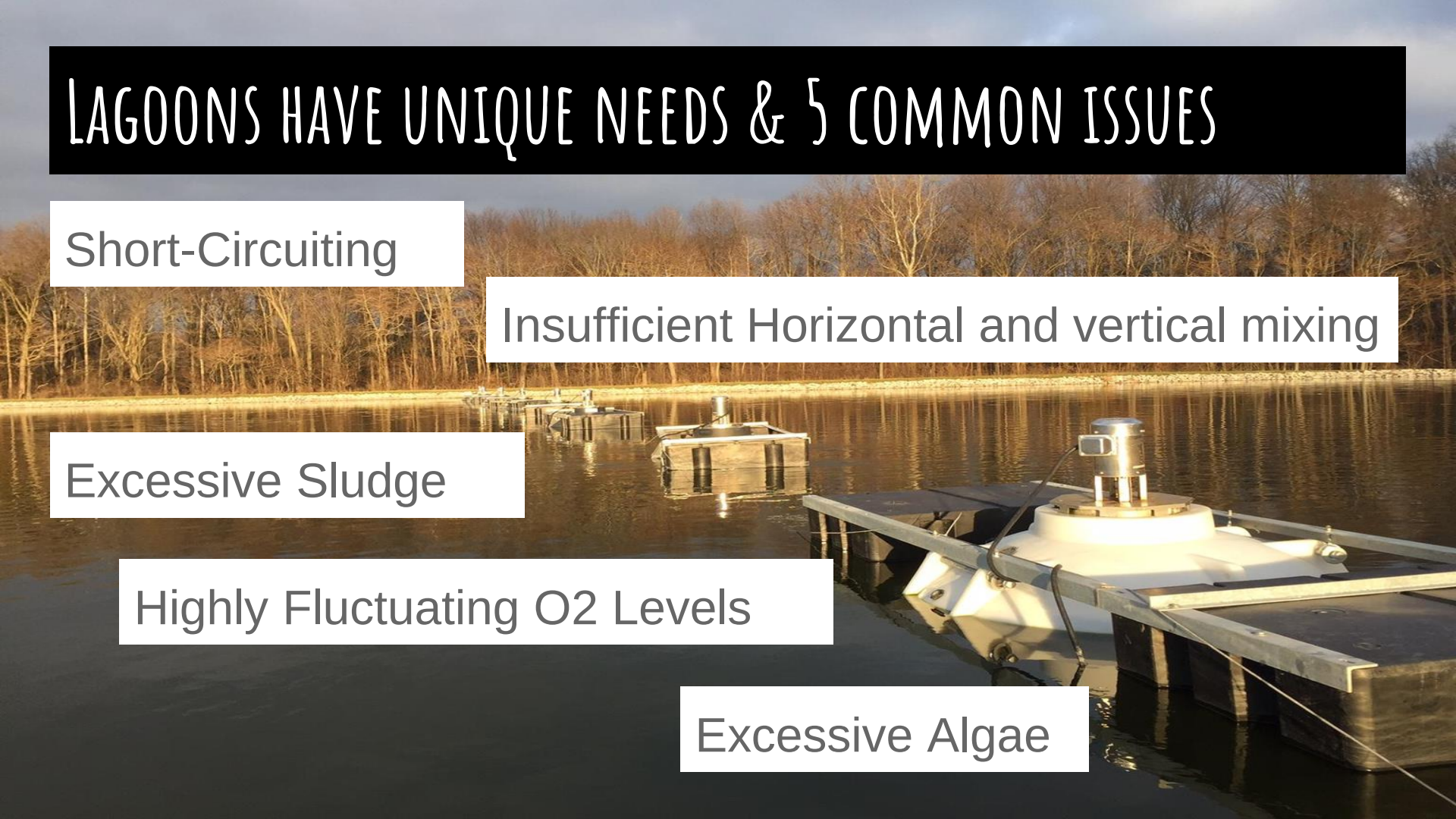
SAGR System



Cutaway view of SAGR:

A. HDPE liner prevents infiltration while sacrificial walls help the SAGR maintiain its shape during construction.
B. Influent distribution chamber ensures influent is spread across the width of the bed.
C. Clean stone provides surface area for bacteria while preventing temperature shock. Mulch-covered for insulation.
D. Linear aeration covers the base for fully-aerobic conditions.
E. Effluent collection chamber is gravity fed to minimize O&M.

Lagoons have unique needs & 5 common issues



Short-Circuiting

Insufficient Horizontal and vertical mixing

Excessive Sludge

Highly Fluctuating O2 Levels

Excessive Algae

Short-Circuiting

Need to utilize entire lagoon

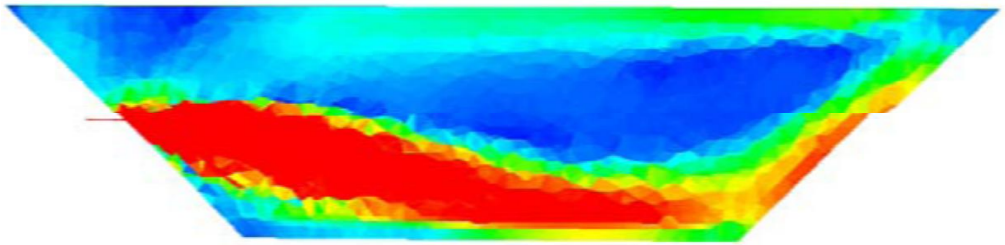
Large area to cover, placement critical

Horizontally Push Water

Hydraulic Curtain

Short- Circuiting

- Dr. Middlebrooks says it best:
- *“Short-circuiting is the greatest deterrent to successful pond performance, barring any toxic effects.*
- *The importance of the hydraulic design of a pond system cannot be overemphasized”*
- A jet force created by a horizontal influent structure powered by a lift station.
- Structure vertically/ manifold?



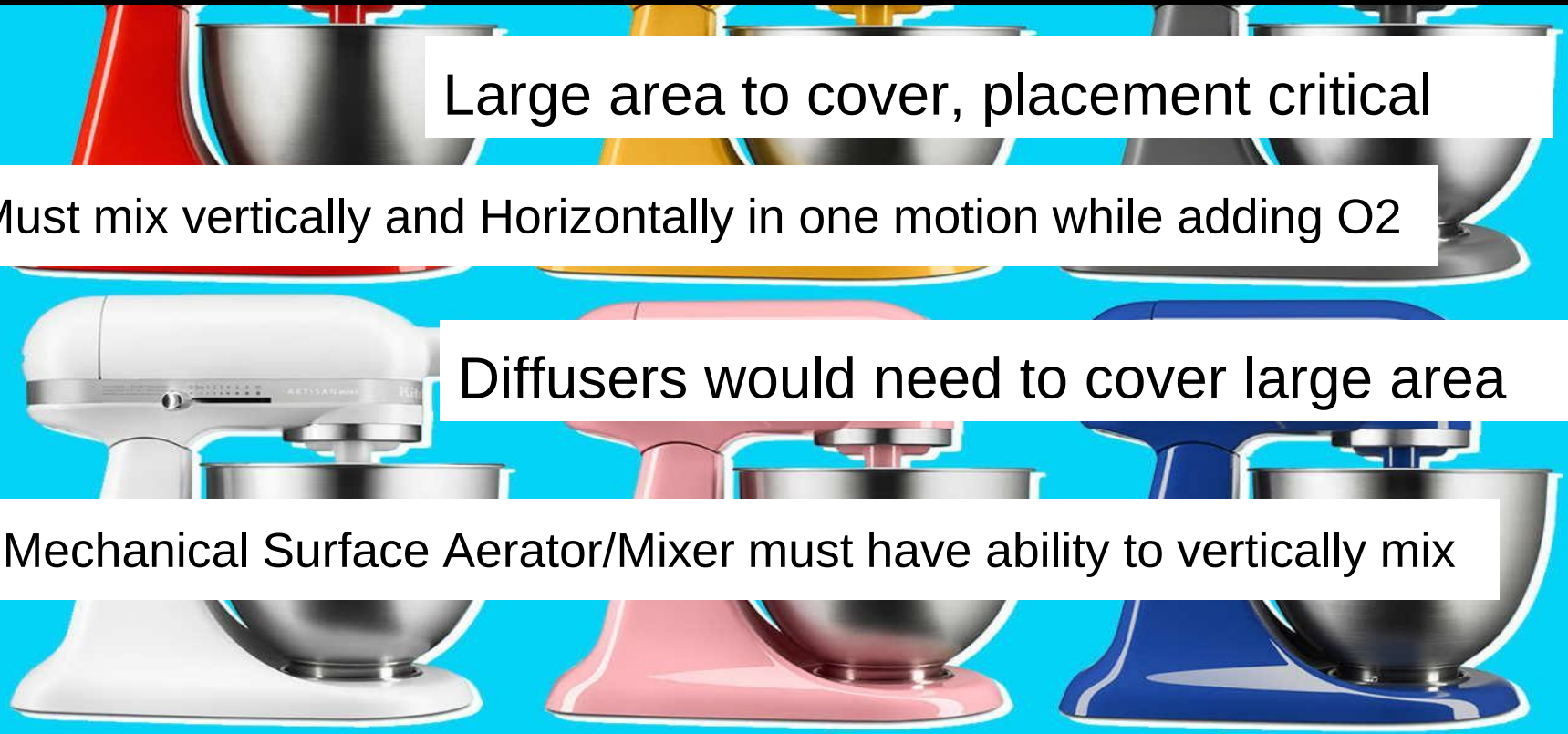
Short- Circuiting

- • Pond inlet position, size and location. A small inlet placed horizontally in the cell can force influent wastewater a third to a half of the way through a cell bypassing valuable treatment capacity
- • I&I and varied flow rates. Sewage under high pressure introduced to a pond will “jet” across the pond bypassing treatment capacity. Smaller influent piping accelerates sewage flow.
- • Pond outlet set too close to the influent
- • Temperature affects water density. Incoming sewage finds same water density and “ride” along that level.
- • Sludge accumulation. Sludge “steals” valuable treatment capacity…
- • Position of aeration equipment and baffles. Improperly placed baffles and aeration can contribute to short- circuiting
- • Wind. Good or bad

10% Return Flow

- Taking 10% of daily flow and returning back to head of plant.
- Takes good, aerated, “clean” water, back to the raw coming in.
- Lots of pumps can do this depending on flow.
- Can see multiple benefits to your treatment process and numbers.
- H&S recommends on all lagoons.

Insufficient Horizontal & Vertical Mixing



Large area to cover, placement critical

Must mix vertically and Horizontally in one motion while adding O2

Diffusers would need to cover large area

Mechanical Surface Aerator/Mixer must have ability to vertically mix

Excessive Sludge, mmmm

No solids handling like mechanical plant

Contributes to short-circuiting, BOD and capacity

Water and O2 needs to flow over sudge layer for toxin flushing to digest

Can foul diffusers for loss of efficiencies

Highly fluctuating O2 levels

Needs to be evenly distributed over a large area

Algae can be the cause

Needs to be balanced for a healthy ecosystem

Excessive Algae

Algae can produce free O_2

70% of Earth's O_2 is produced by Algae...NICE!

Algae needs to be controlled to prevent pH, TSS and BOD issues

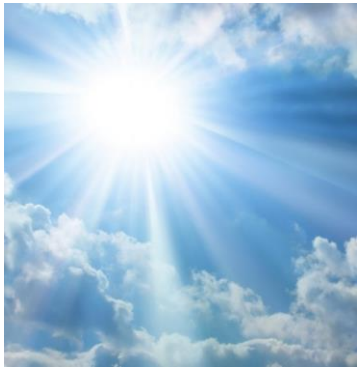
Mixing and Aeration can degas the CO_2 and break the thermocline for Algae Control

Water must be aggressively agitated for degassing

Algae in Wastewater

- TSS, BOD and pH Violations
- Dying Algae helps Increased Sludge
- Clogs Filters
- Difficult to Disinfect

Algae Needs 3 Main Ingredients to Thrive



Want to Stop Algae? Remove 1 Ingredient

Other Alternatives that could help

Improved Headworks to remove extra organics

SCADA System for better control

MBBR requires less mixing power

Additional monitoring points throughout

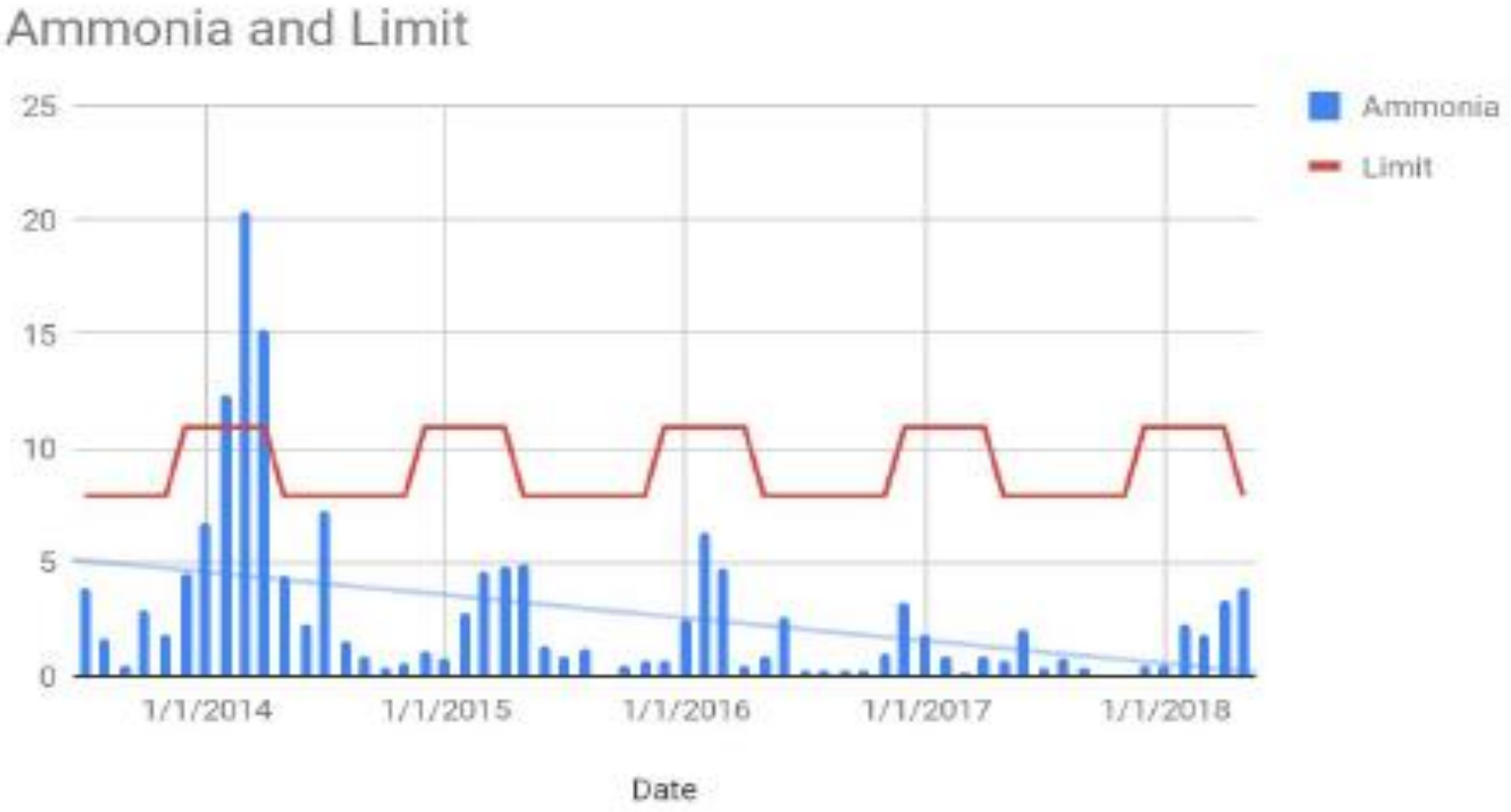
VFD’s

Other suggestions?

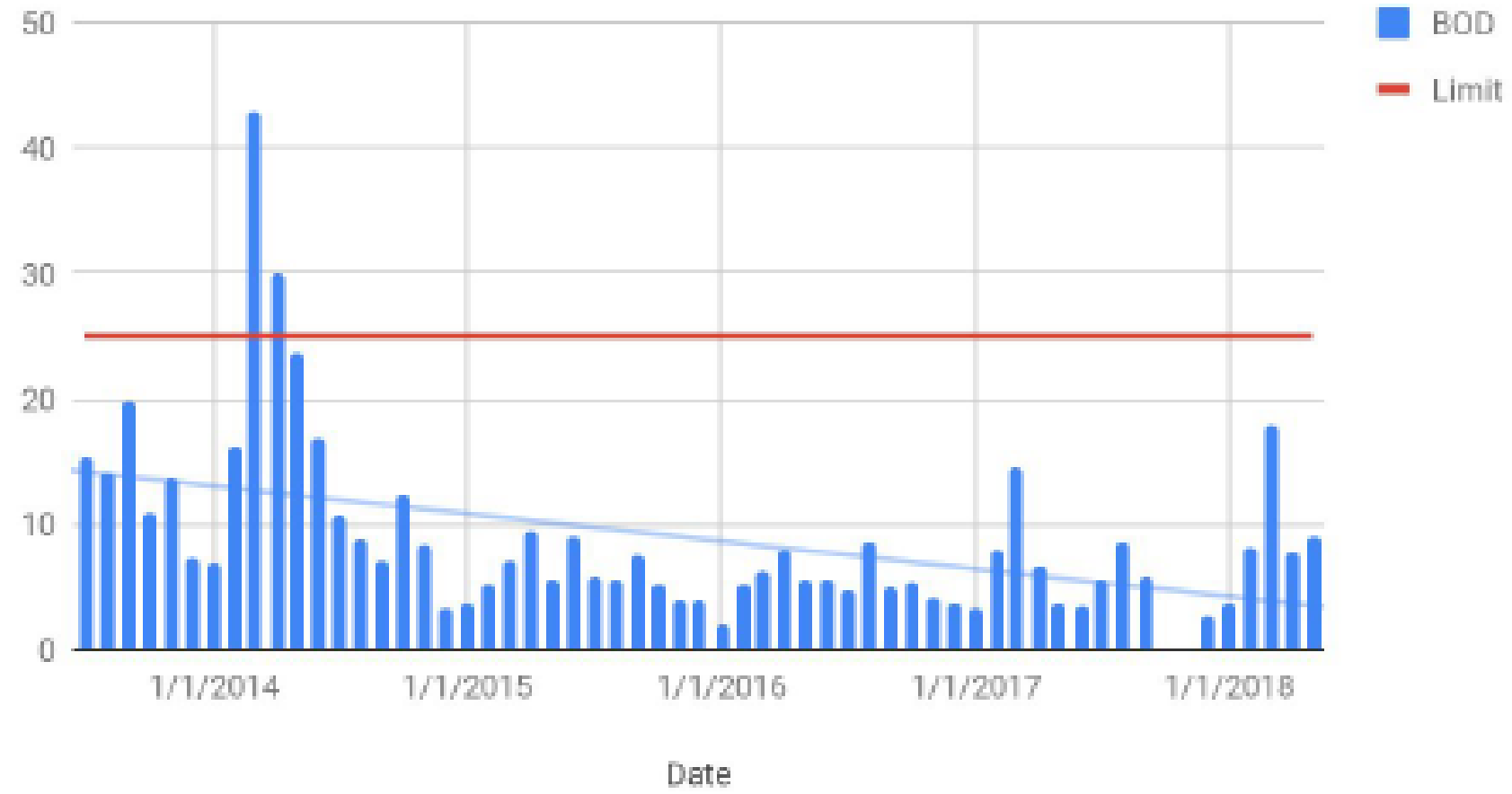
Consistent Maintenance plan

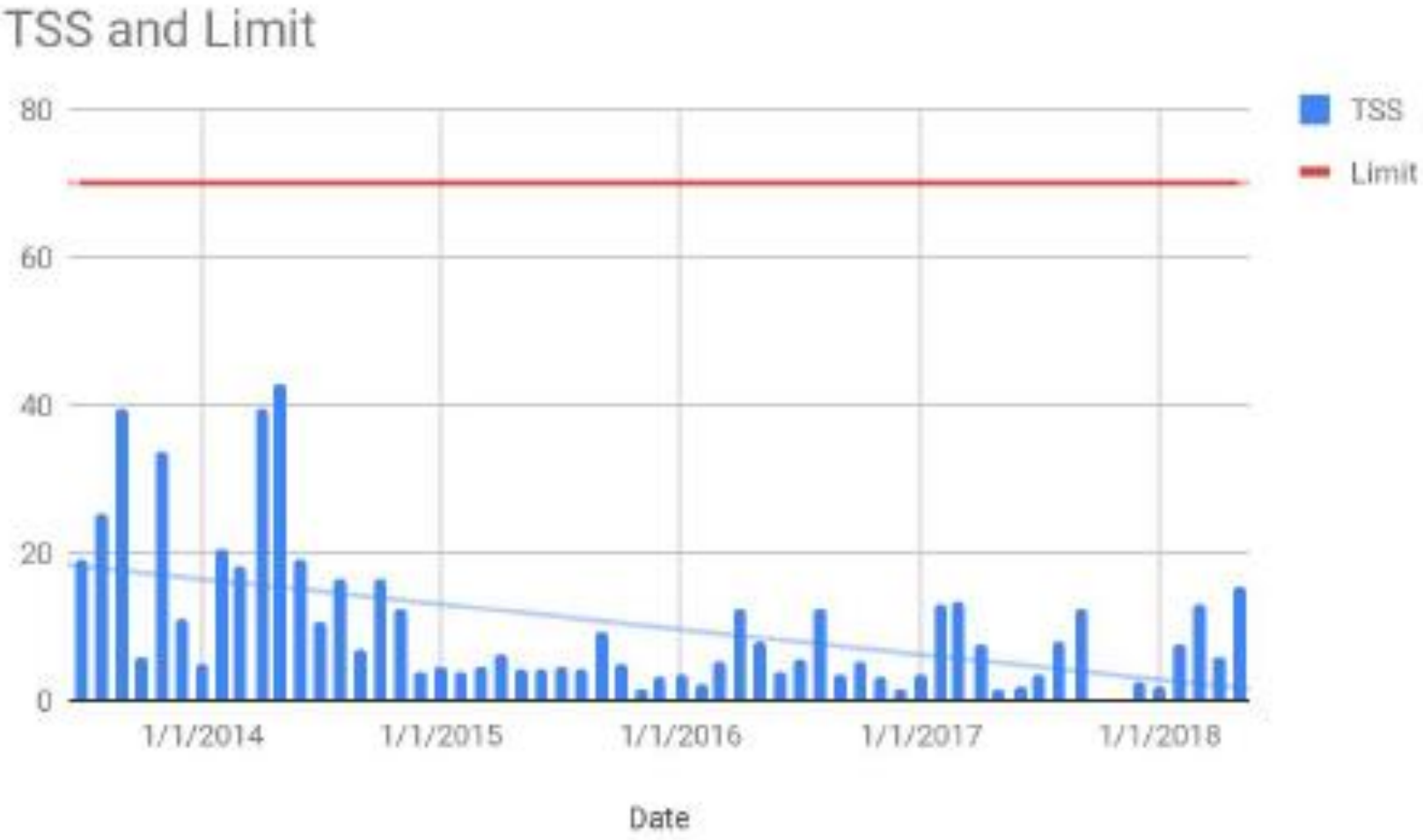
BainBridge Case Study

- Project Name: Bainbridge Indiana Lagoon Enhancement
- Installation Date: April 2014
- Equipment: 8 ProFusions in Lagoon 1 and 2 ProFusions in Lagoon 2
- Facility Design Flow MGD: .0820
- Summary:
- Bainbridge is a small town in West Central Indiana with a population of 750. Bainbridge was
- facing new permit limits for ammonia and wanted to keep their lagoon system rather than
- building a mechanical plant. They also treated algae with chemicals prior to the installation, but
- once the ProFusions were installed, they were able to stop applying chemicals and could rely on
- the ProFusions to keep the water clean. This is one of the first lagoon installations using the
- Bradley Innovation Group equipment. Bainbridge has been in compliance since the Bradley
- equipment was installed and data points are trending in the right direction for continued
- improvement.


Ammonia and Limit
25
20
15
10
5
0
1/1/2014
1/1/2015
1/1/2016
1/1/2017
1/1/2018
Date
Ammonia
Limit

BOD and Limit




TSS and Limit
80
60
40
20
0
1/1/2014
1/1/2015
1/1/2016
1/1/2017
1/1/2018
Date
TSS
Limit


covalen
environmental
smart infrastructure
Bradley Lagoon Enhancement Products
Bradley Aeration/Mixing
AUC Mechanical Treatment Plants
Aquionics UV Disinfection
Rehau Municipex Water Distribution
eOne Grinder Pump Collection
AdEdge Water Technologies (WTP)