Wastewater Mixing:

The Opportunity for

Energy Savings

in Wastewater Basins

through the use of

Long Distance Mixers

Two Critical Needs

- In most wastewater basins and ponds, there are usually two critical needs that must be provided:

  1. To produce the required dissolved oxygen (DO), and

  2. And to thoroughly mix the basin so the oxygen, bacteria, and other nutrients are in constant contact.

The source of your opportunity for energy savings:

- Equipment which is *efficient* at producing DO, is usually *very inefficient* at mixing.

- However, because energy was inexpensive in the past, engineers typically chose just one type of equipment for each basin, to produce the DO, and then over-sized it in order to perform the mixing too. The result is, there a huge opportunity to save on energy costs today by adding a low cost supplemental mixing system.

Analogy #1:

- Would you put 5,000 watt light bulbs throughout your house to both light it and heat it?
  - No, to save energy and get better results you would treat lighting and heating as two separate problems needing two separate solutions.
  - Similarly, in wastewater, the machinery that produces the DO should be supplemented with machinery to perform the mixing.

Analogy #2:

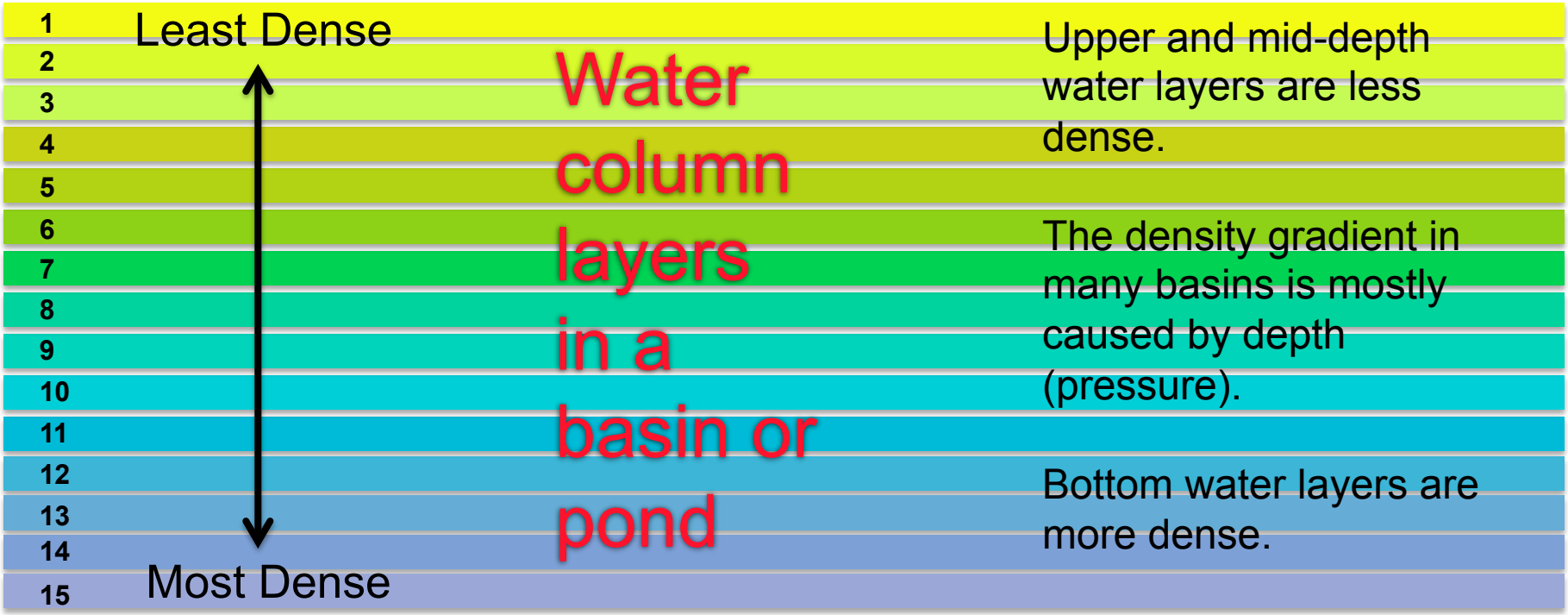
- Houses in the northern US have a large furnace. So would you leave the doors and windows off the house since heat has been provided for?
  - No, the doors and windows will have a quick payback by reducing the run time of the furnace.
  - In wastewater, if you install supplemental mixers, the aeration intensity can be cut back to just produce the required DO, resulting in a quick payback from huge energy savings..

"How can a Gridbee (electric) or SolarBee (solar) machine mix a wastewater basin with far less energy than my existing aeration system?"

- By taking advantage of the manner in which water in all reservoirs forms thin horizontal layers
- By using the intake side of the mixer very effectively instead of relying only on the discharge of the machine
- All of our machines have an intake design which can be set at a precise depth (the bottom of the reservoir or else higher up, depending on the basin function) so the machine pulls water and bacteria in horizontally, at exactly the set depth, from across the entire footprint of the pond

Water in reservoirs forms thin horizontal layers

- Each layer of water is progressively more dense as you move down through the water column
- Even in wastwater basins where water is often nearly the same temperature, just the depth difference causes a density-gradient and corresponding layering that resists mixing.

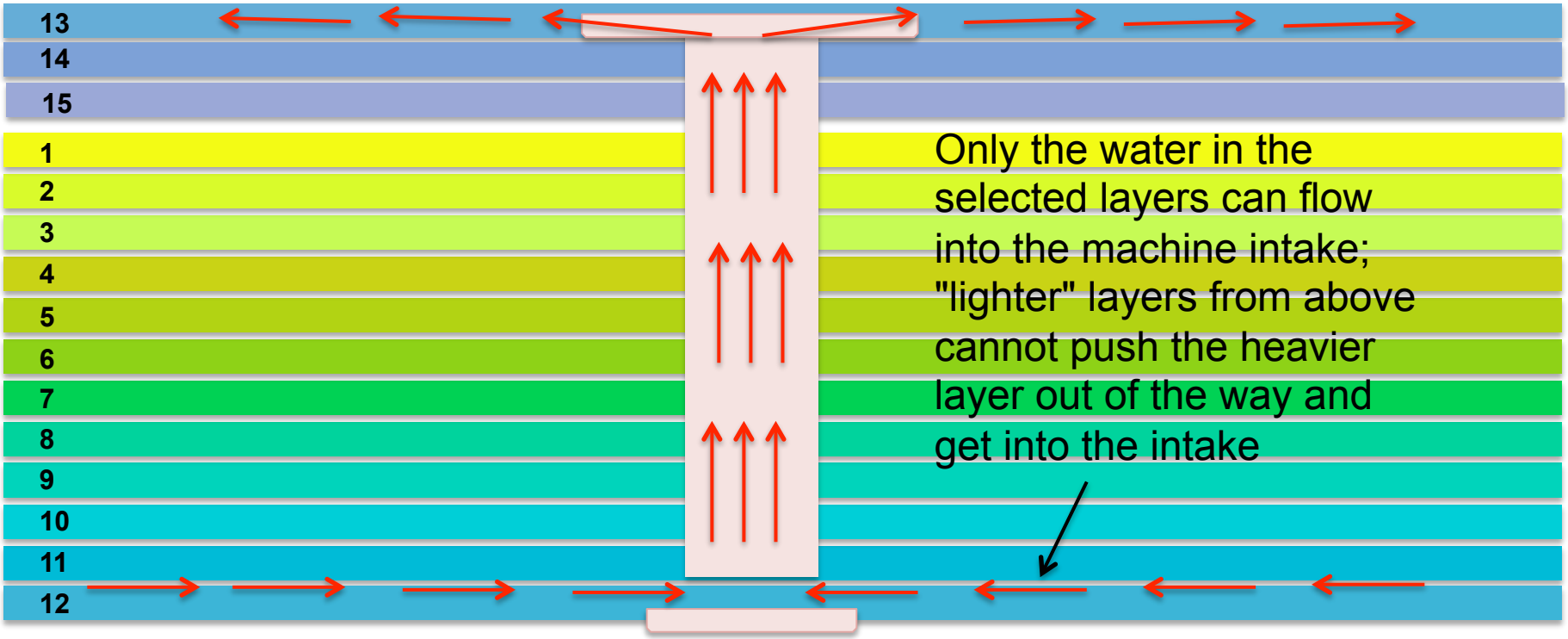


Aspects of density differences and water layering :

- The different-density layers are caused by:
  - Temperature differences, as low as 0.001c (this is the main factor in ww ponds, such as lagoons, with longer detention times) , and
  - Pressure differences, deeper water is slightly compressed (this is the main factor in activated sludge basins)
  - Salinity difference of 5-10 mg/l or less causes density layers
- Together with hydrogen bonding, the density differences cause a huge resistance to mixing.
- Gravity rules! A lighter layer cannot, by mild convective forces, mix with or displace a heavier layer, in the same manner that a layer of styrofoam balls could not mix with or displace an underlying layer of steel balls.
- The best approach to mixing is to have the mixer pull water in horizontally, and then directly lift the heavier water from the bottom and spread it across the top of the basin.

GridBee and SolarBee Unique Mixing Capability:

- As the impeller at the top of the machine pushes water outward, new water enters from the selected deep layer, rises through the 36-inch diameter intake hose, and is placed onto the top of the pond
  - The horizontal intake pull extends to over 800 ft in all directions
- HP of any water pump = (GPM x Ft of Lif)t / (3960 x pump eff)
  - For our mixers, since Ft of Lift is nearly zero, HP is very low

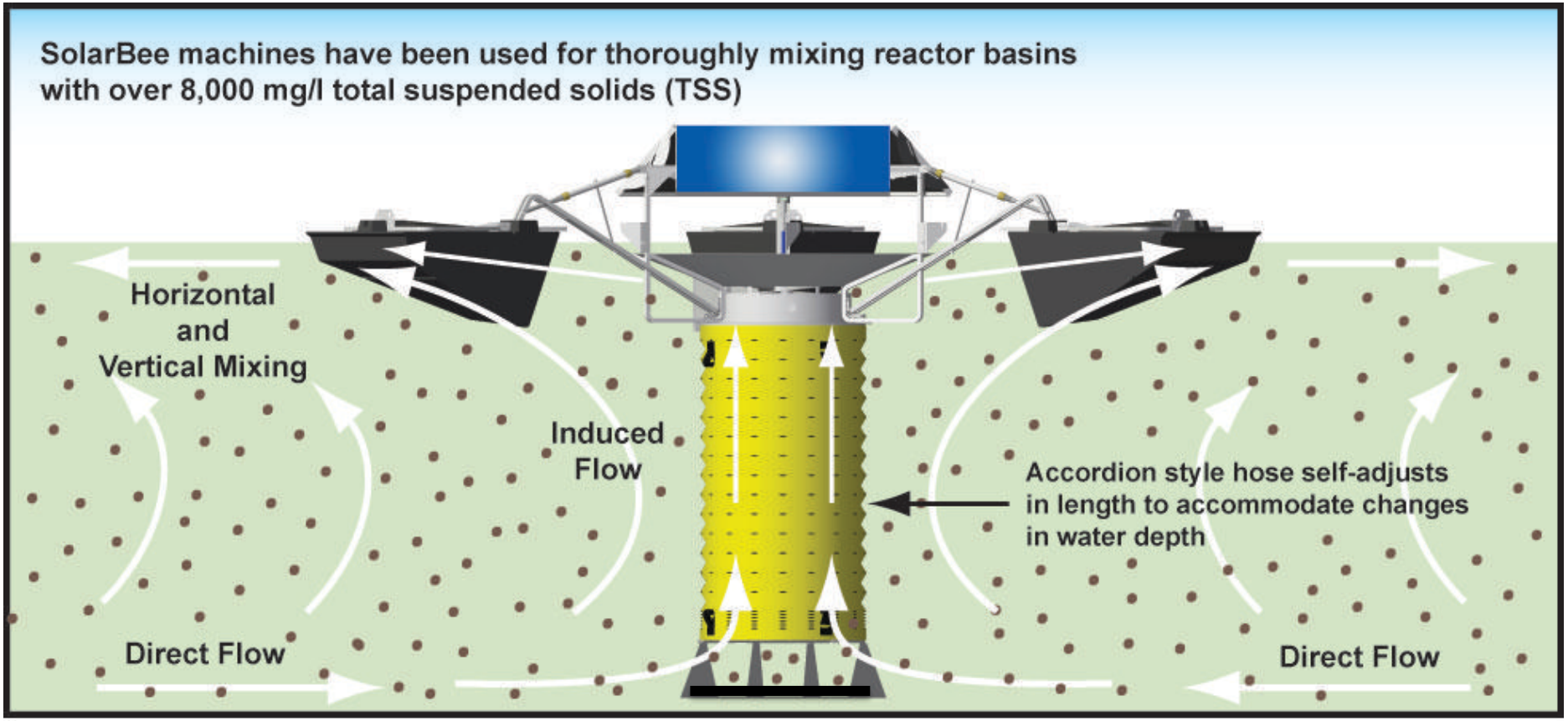


The primary energy-savings applications in wastewater:

- Full Depth mixing applications
  - Activate Sludge Aerated Reactor Basins
  - Anoxic Basins
  - Complete Mix Aerated Lagoons

- Partial Depth mixing application
  - Partial-Mix and other Aerated Lagoons
  - Odor-capping of Waste Storage Sludge Ponds

Use Full Depth Intake Setting For Complete-Mix Basins and Ponds



Water and suspended solids (TSS) from across the bottom of the basin enter the hose just above the floor, travel up the hose, and are then spread across the surface

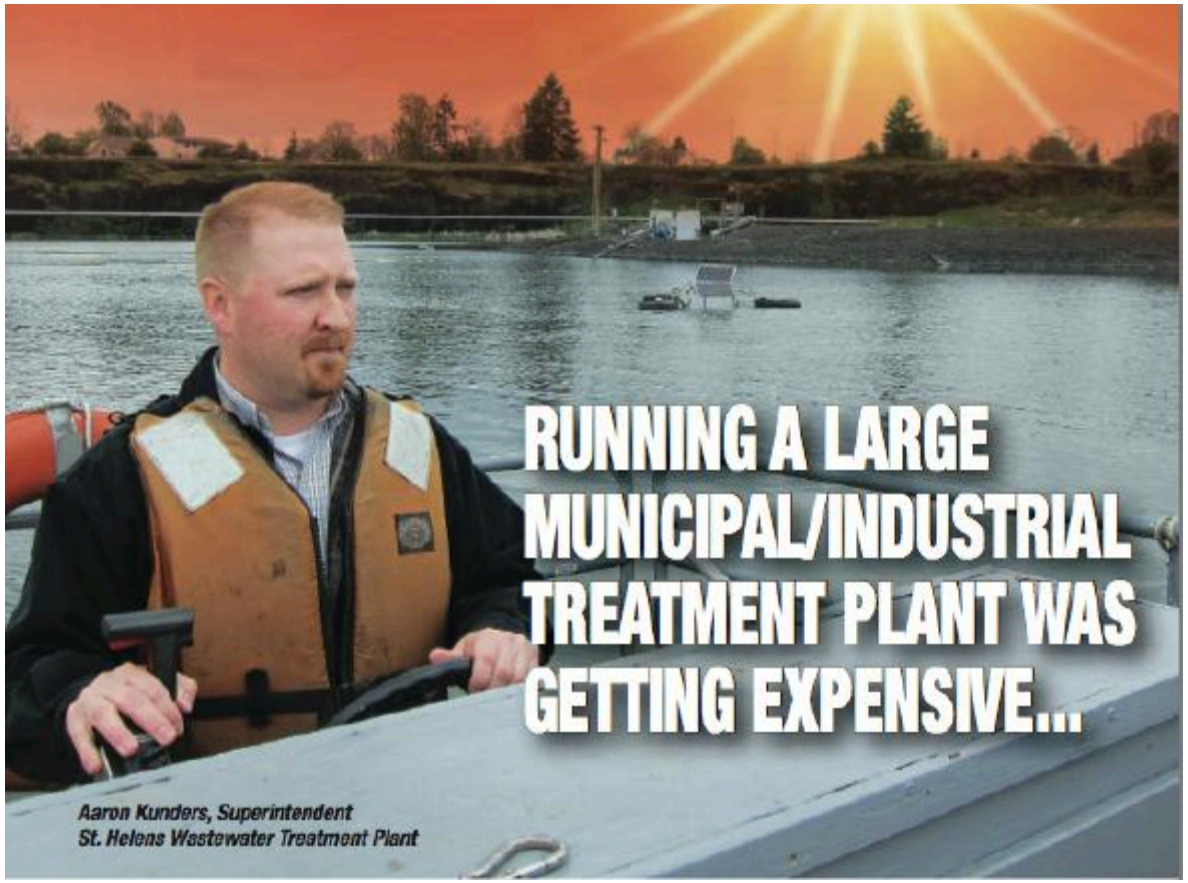
Full Depth Mixing

- Use for Activated Sludge Reactor Basins, Anoxic Basins, Extended Aeration Basins, and Complete-Mix Lagoons
- The machine intake plate is on the floor of the basin
- TSS to 8,000 mg/l are kept in suspension
- The direct flow is 3,000 gpm up the intake hose, 4.2 MGD, plus there is induced flow off the flow dish
- The number of machines to use is determined by factory formulas for various type and sizes of basins
- Choice of GridBee electric (1/2 hp, single or three phase) or else SolarBee solar units
- Each machine typically replace 40-80 hp or aeration run time on a continuous basis

Example 1: Full Depth Mixing Results

Application in Eden, North Carolina: Activated sludge main reactor basins, (3) SolarBee mixers allowed aeration energy to be lowered from 180 hp to 60 hp.

Example 2: Full Depth Mixing Results

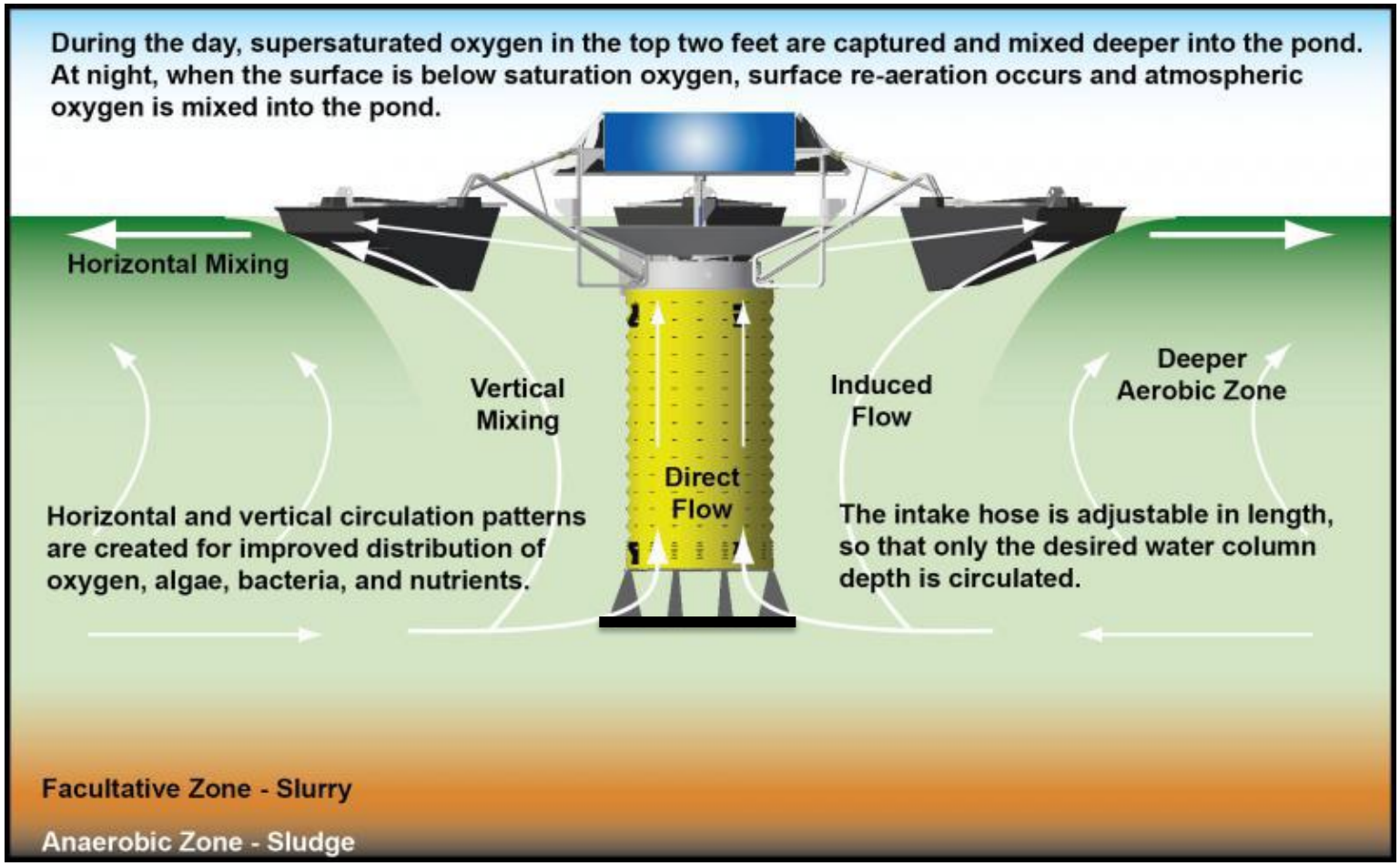


Application in St Helens, OR: Complete-mix followed by partial mix pond, (9) SolarBee units allowed total aeration energy to be lowered from 520 hp to 266 hp

Indicators that a large energy savings can likely be obtained by adding full depth supplemental mixers:

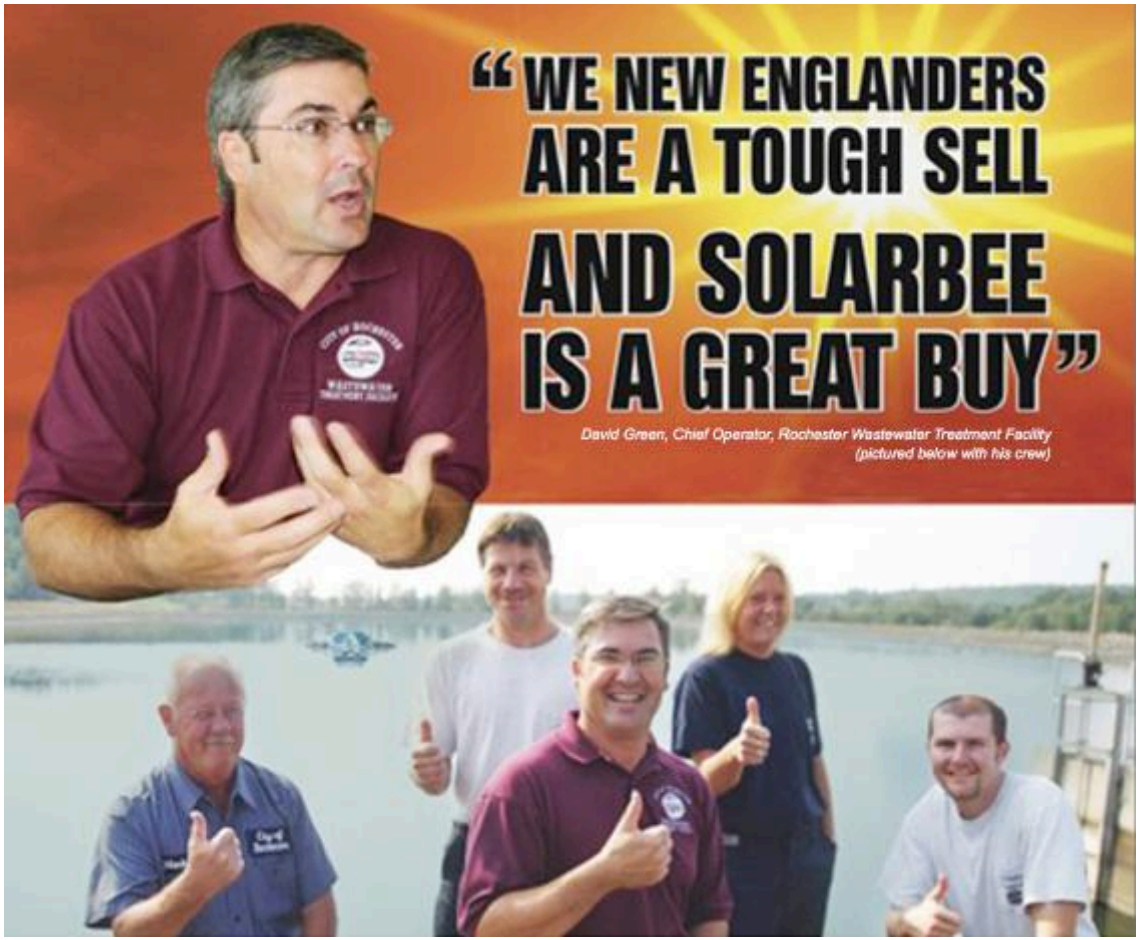
- **In activated sludge aerobic reactor basins:**
  - If, often in the day and during non-peak periods, the DO is > 2 mg/l, yet the aeration can not be turned down due to the loss of TSS which would occur and negatively affect both BOD and NH4 reduction
    - Supplemental full depth mixers will allow aeration to be turned down without a loss of TSS
- **In complete-mix and other aerated ponds:**
  - If the DO is > 2 mg/l, or if there is poor nitrification, or if there is a solids buildup at the bottom
    - Supplemental mixing will suspends TSS much better, resulting in less aeration run time and better treatment

Use Partial Depth Intake Setting For Partial-Mix Ponds



With the intake plate set above the slurry and sludge at the bottom of the pond, the water, bacteria, and oxygen can be thoroughly mixed without disturbing the bottom

Example 1: Partial Depth Mixing Results



Application in Rochester, NH: Aerated basin, some BOD reduction and some odor capping, with (5) SolarBees, the City saved $1.5 million initial cost, plus saves $10,000 per month in energy cost from reduced aearation.

Example 2: Partial Depth Mixing Results

Application in St Henry, OH: Partial-Mix aeration basins; with (7) SolarBees, the City saved $100K initial cost, plus saves $50,000 per year in energy cost from reduced aearation.

Indicators that a large energy savings can likely be obtained by adding partial depth supplemental mixers:

- **In partial-mix aerated basins in lagoon systems:**
  - By design, these basins are always operating far more aeration than needed for DO production, so huge energy savings can be obtained by adding GridBee or SolarBee mixer(s)
    - The partial depth hose setting stops short circuiting without re-suspending the slurry or sludge
- **in waste sludge storage ponds:**
  - GridBee and SolarBee mixers can be set for circulating just the top 2-3 feet of the lagoon for odor-capping, resulting in high energy savings compared to brush aerators.

Summary

- **This paper deals only with the potential for energy savings by adding GridBee or SolarBee mixers to wastewater basins, but there are many other benefits that can be obtained as mentioned below**

- **See** http://wastewater.medoraco.com/
  - For other benefits, including better BOD and ammonia reduction, sludge digestion to avoid dredging, and odor control
  - For product literature, many more customer experiences, complete specifications, and warranty information

Thank you!