

Health Effects of Disinfection Byproducts (DBP) & Strategies to Reduce Exposure

Vance D. Fiegel

Co-Founder and Chief Science & Technology Officer

Creative Water Solutions



OVERVIEW

- Disinfection Byproducts (DBP)
- Toxicity and Health Effects of DBP
- Organic Load and DBP Production
- Strategies to Reduce Organic Load/DBP

Disinfection Byproducts (DBP)

- Disinfection with halides (Cl & Br) create DBP when combined with the organic matter contained in pools and spas
- Two major types
 - Trihalomethanes (from carbon compounds like oils & proteins)
 - Chloramines (from nitrogen containing compounds like urea (from urine))
- Many others now identified

Disinfection Byproducts (DBP)

- Trihalomethanes (THM)
- Halamines (HA)
- Haloacetic acids (HAA)
- Haloacetonitriles (HAN)
- Haloacetaldehydes (HAL)
- Haloketones (HK)
- Halonitromethanes (HNM)
- Haloacetamides (HAAM)
- Chloral hydrate (CH)
- Others

Toxicity and Health Effects of DBP

- Numerous DBP have known toxicity
- Many DBP are volatile - inhalation
- Many can be absorbed through the skin

Toxicity and Health Effects of DBP

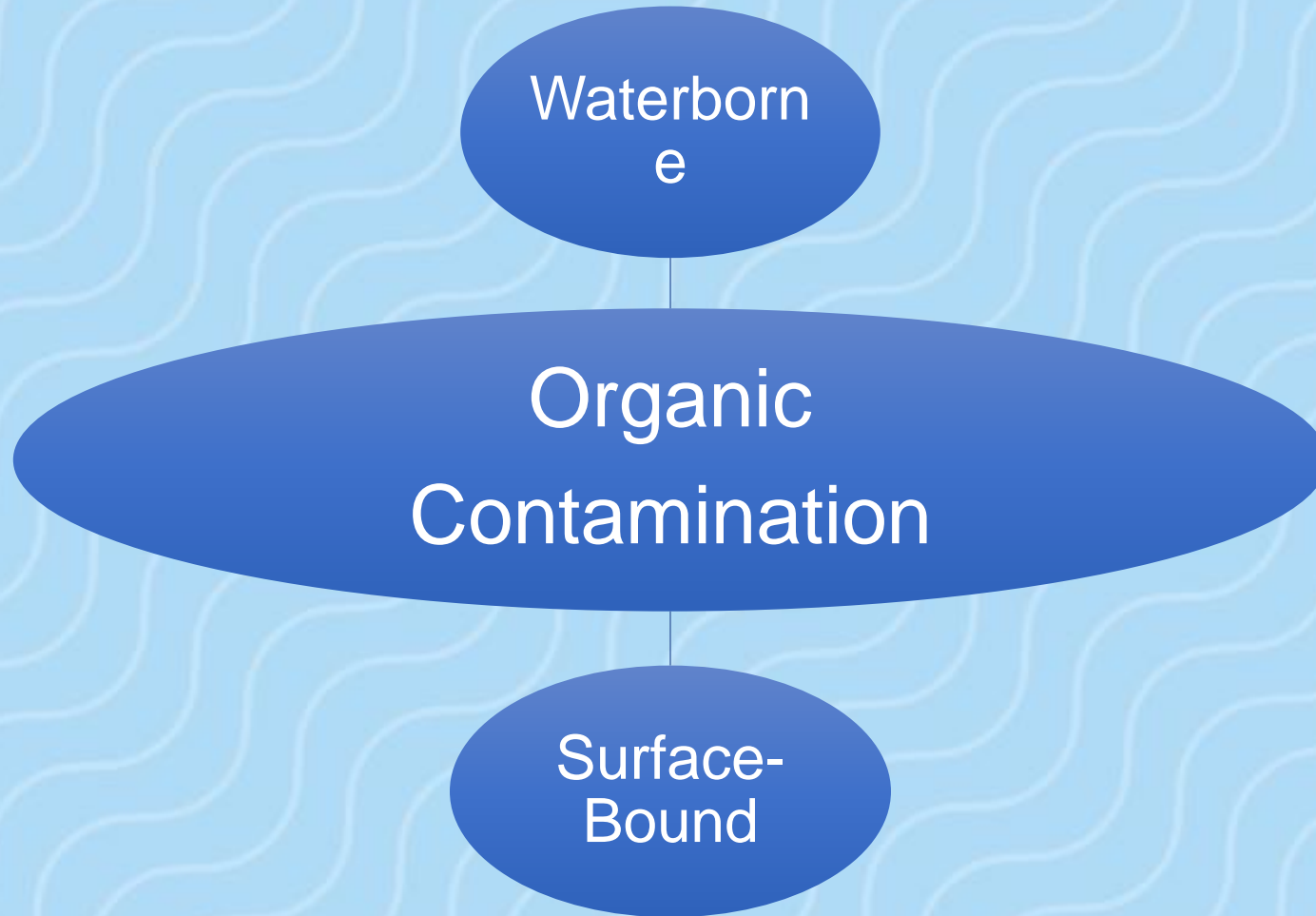
- Numerous studies associate exposure to DBP with lung ailments – reactive airway diseases (asthma)
- Can cause epigenetic changes in urinary bladder cells and an increased risk for bladder cancer
- Increased mutagenicity, cytotoxicity, genotoxicity

Organic Load and DBP Production

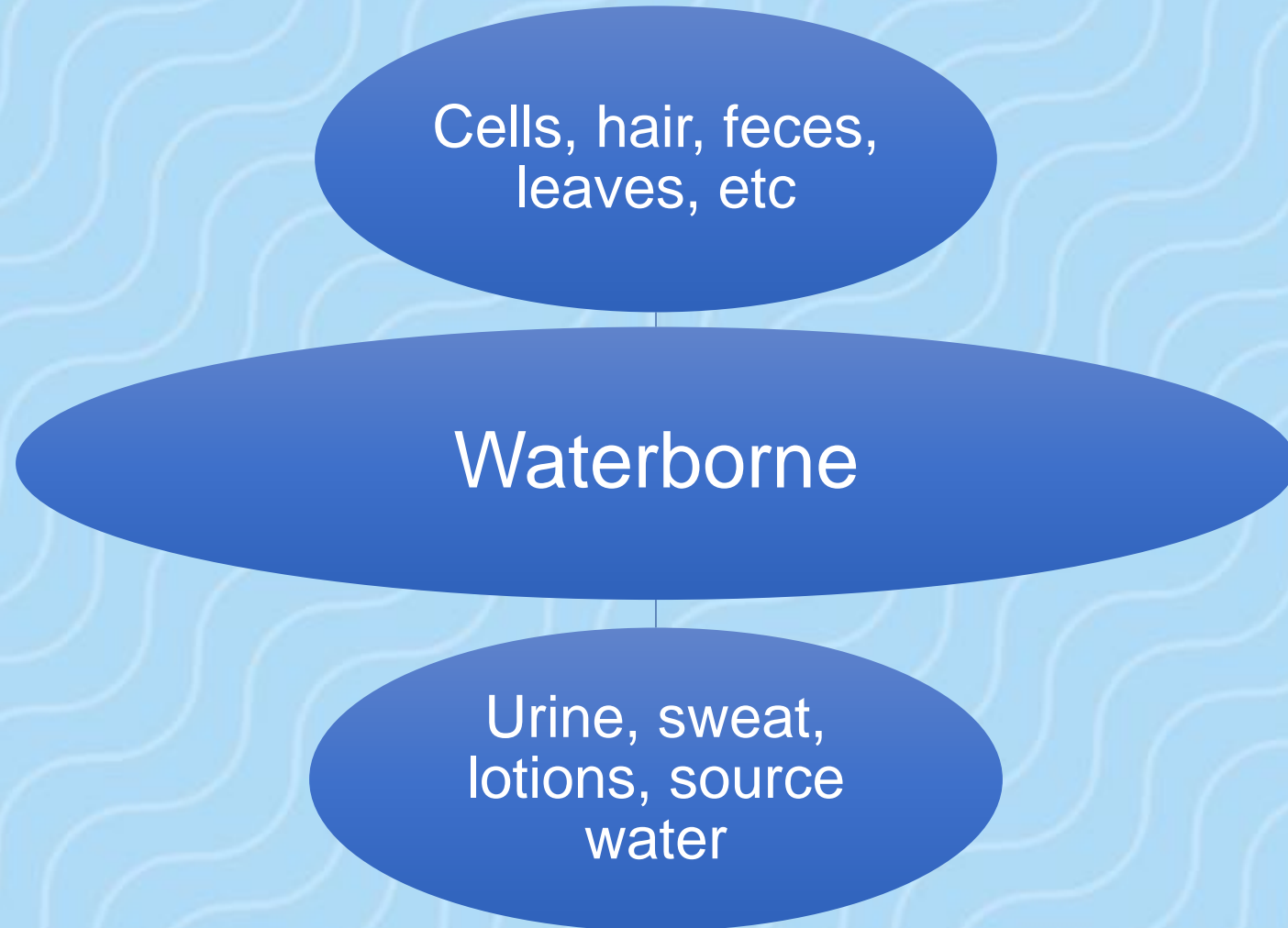
Organic
Contamination

Proteins, sugars, oils,
nitrogen and carbon
compounds

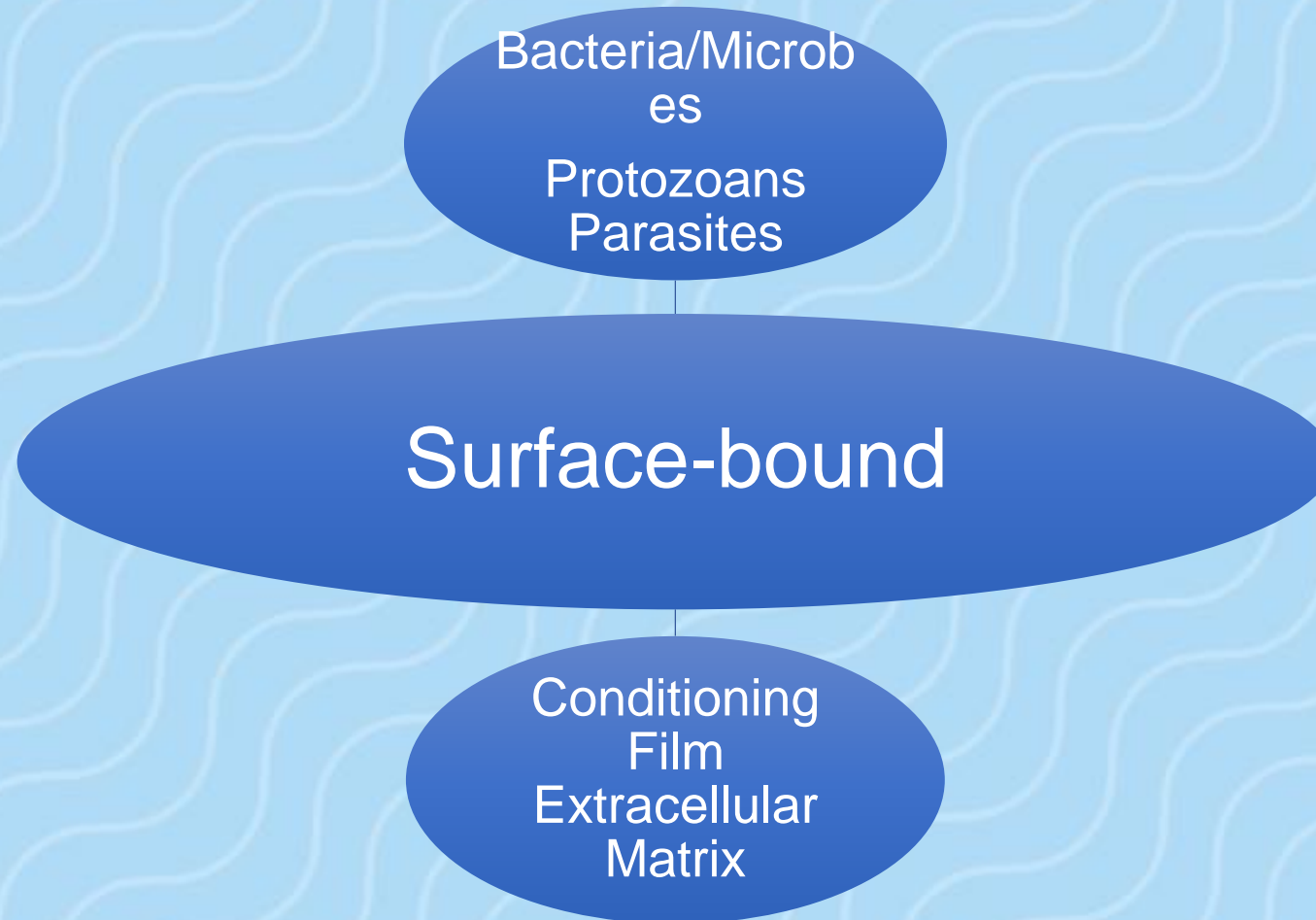
Organic Load and DBP Production



Organic Load and DBP Production



Organic Load and DBP Production



Organic Load and DBP Production

DBP Formation: Chlorine + Surface-Bound Organic Contamination

- Filter media obtained from spa sand filter
- Placed into small column and rinsed to remove unbound OC
- Various concentrations of Cl⁻ added
- Effluent evaluated for THM content

Organic Load and DBP Production

DBP Formation: Chlorine + Surface-Bound Organic Contamination

[Cl] (ppm)

DBP (ppb)

10

80

25

230

50

759

100

1948

Strategies to Reduce Organic Load/DBP

Because

$\text{Cl}^- + \text{Organic Load} = \text{DBP}$

And

$[\text{Cl}^-]$ is required and continuously fed

Then

Less Organic Load = Less DBP

Strategies to Reduce Organic Load/DBP

Reduce Presence of Organic Material in the Pool

- Source water
- Bathers
- Other external sources
- Surface-bound

Strategies to Reduce Organic Load/DBP

Reduce Introduction of Organic Material into the Water

- Require complete showering
- Clean apparel
- No urine in the pool
- Reduce introduction of human-related organics
- Reduce, eliminate and control non-swimming activities

Strategies to Reduce Organic Load/DBP

Maintain and Periodically Flush Spas and Sand Filters



Strategies to Reduce Organic Load/DBP

Removal of Organic Contamination from Filter Media



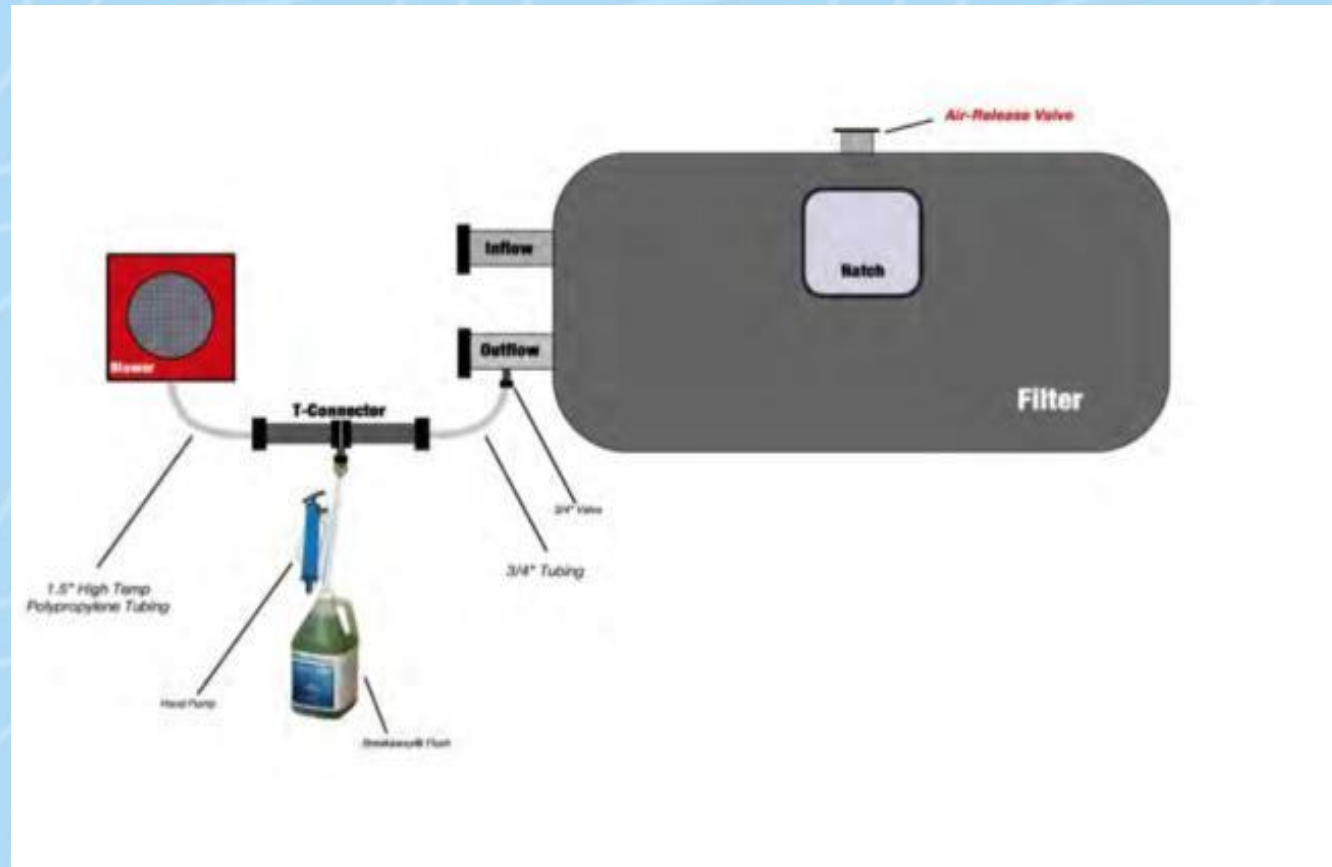
Strategies to Reduce Organic Load/DBP

Maintain and Periodically Clean Pool/Spa Sand Filters



Strategies to Reduce Organic Load/DBP

Maintain and Periodically Clean Pool/Spa Sand Filters



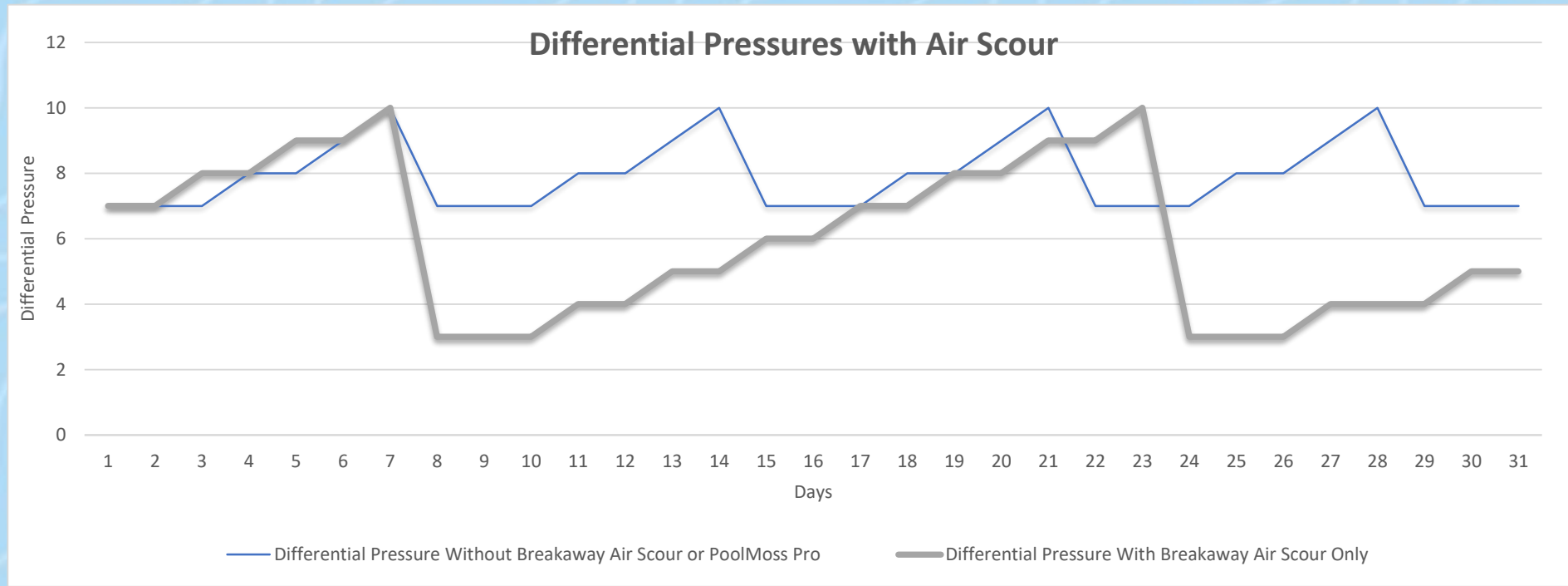
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Strategies to Reduce Organic Load/DBP

Maintain and Periodically Clean Pool/Spa Sand Filters



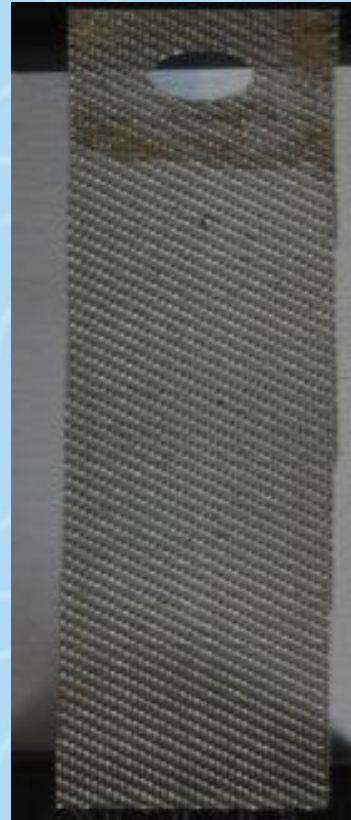
Strategies to Reduce Organic Load/DBP

Reduced Organic Contamination with Sphagnum Moss

w/o SM

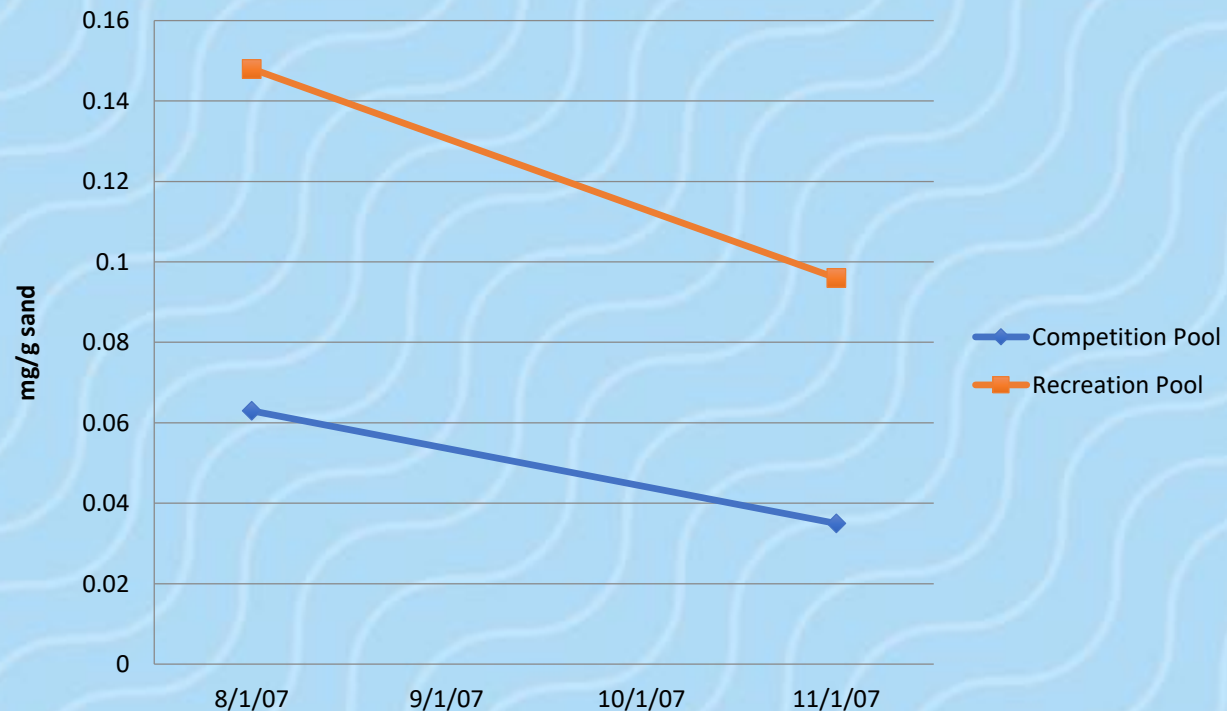


with SM



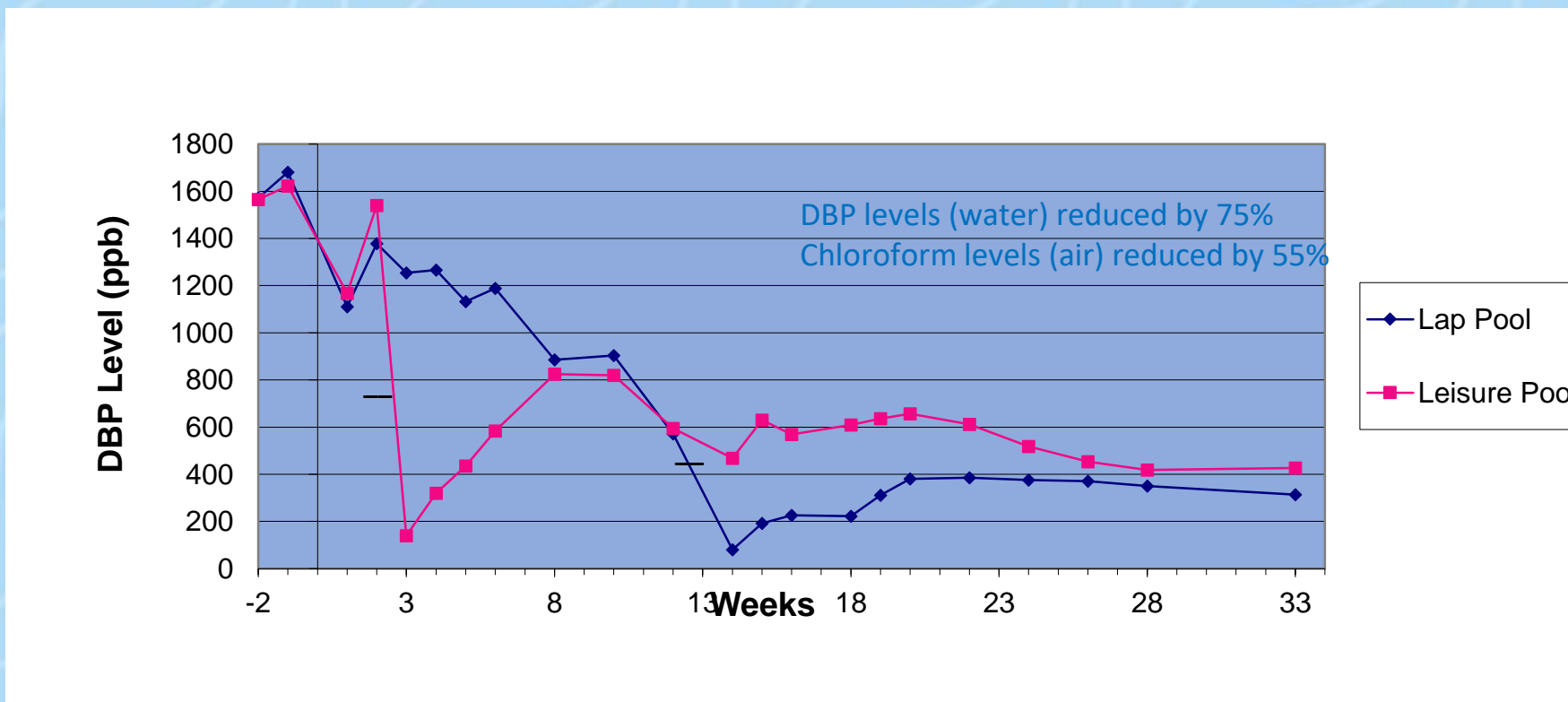
Strategies to Reduce Organic Load/DBP

Reduced Organic Contamination in Sand Filters with Sphagnum Moss



Strategies to Reduce Organic Load/DBP

Reduced DBP in Pool Water with Sphagnum Moss



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$\text{Cl}^- + \text{Organic Load} = \text{DBP}$

[Cl^-] is required, constant and in excess

Less Organic Load = Less DBP

Questions?

Thank you for attending my session.

[Email: vfiegel@cwsnaturally.com](mailto:vfiegel@cwsnaturally.com)

Cell: (612) 275-5824

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