Aeration: A key tool in aquatic system restoration and management

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Research and Development

Vertex Water Features
Lake Aeration Systems & Floating Fountains

http://www.vertexwaterfeatures.com

Aeration

Aeration –the process by which air is circulated through, mixed with or dissolved in water to increase the oxygen saturation of the water.

Natural aeration

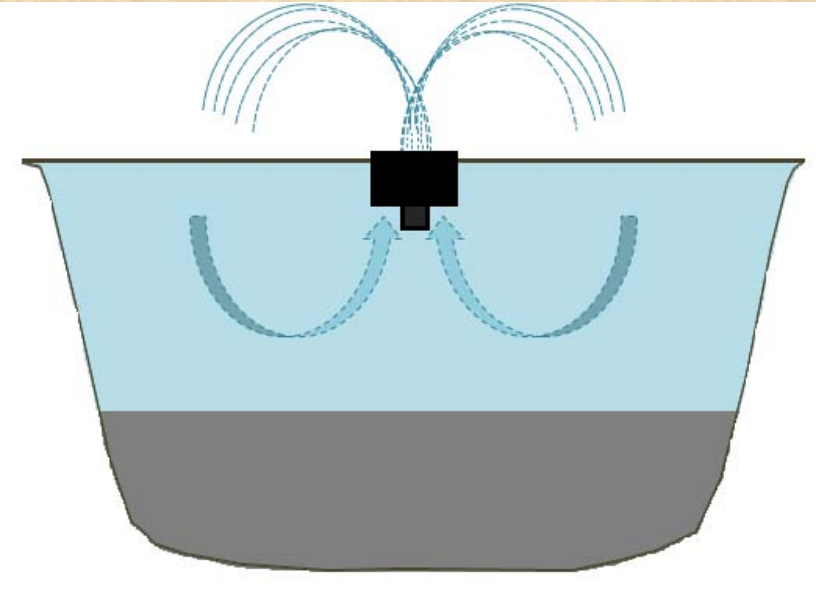
- Wind action

- Photosynthesis

Artificial aeration

- Water circulated using a device
- Types of circulation systems:
  - Surface
    - Fountain aerators
  - Subsurface
    - Diffusers

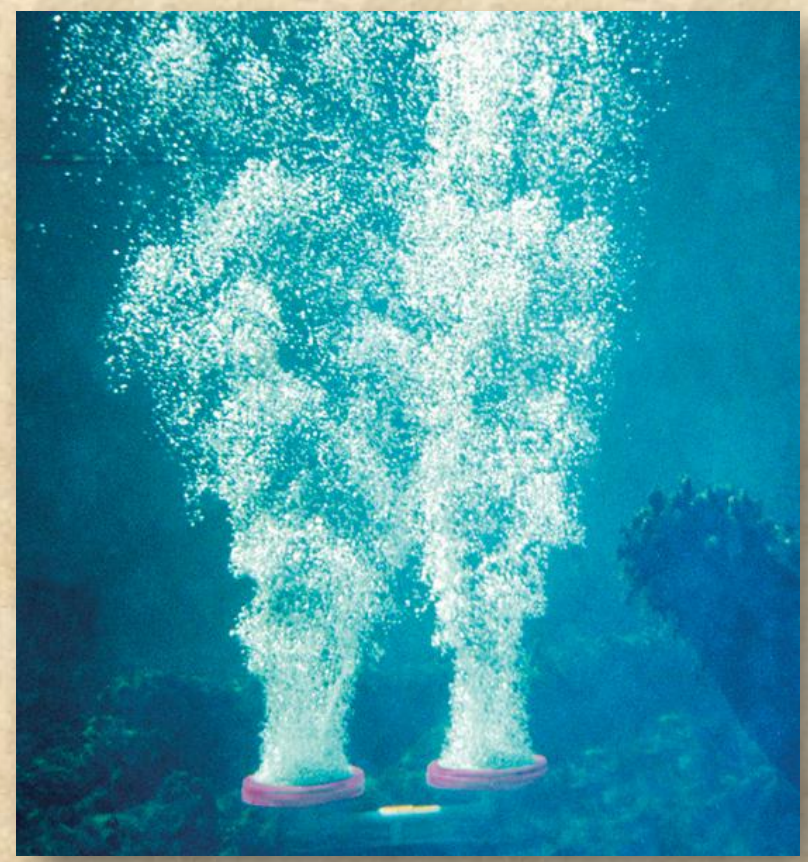
Fountains aerator

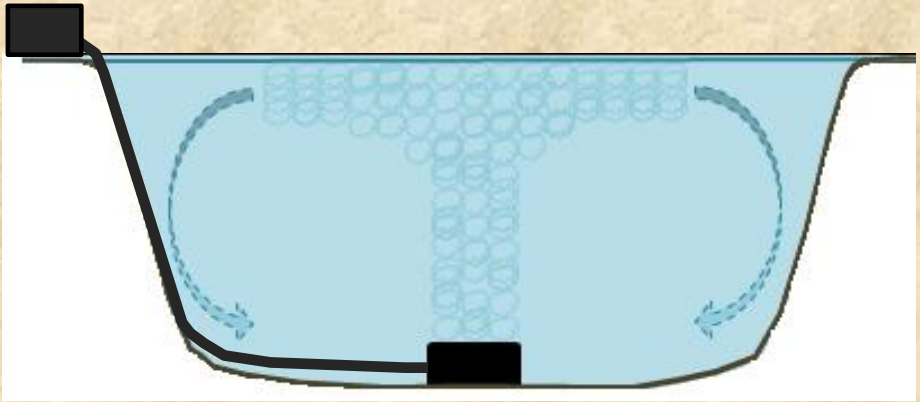


Aesthetically attractive
Aerates surface waters
Can scale to size of lake
Quiet operation

Not highly efficient system
Best in shallow lakes
Not energy efficient
Physical obstruction
Electricity in water
Relatively expensive

Diffusers

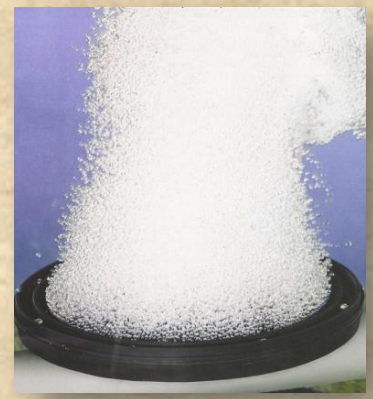




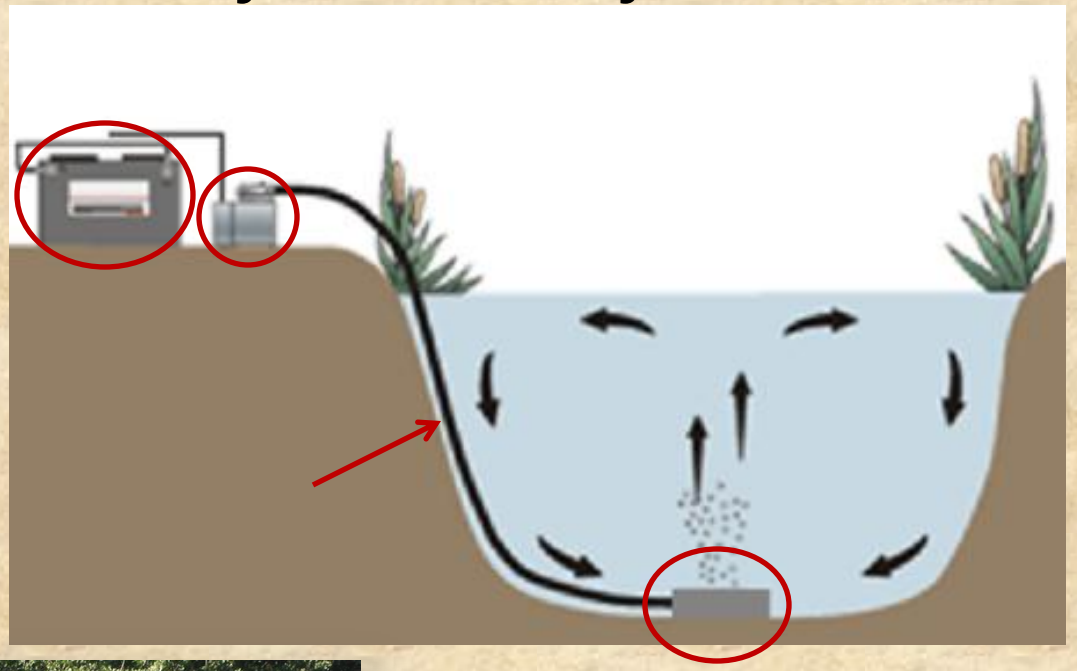
Highly efficient system
Can scale to size of lake
Energy efficient
No electricity in water
No physical obstruction
Complete destratification

Not suited for very shallow lakes
Compressor cabinet reduces noise
Complete destratification

Sub-surface diffusers

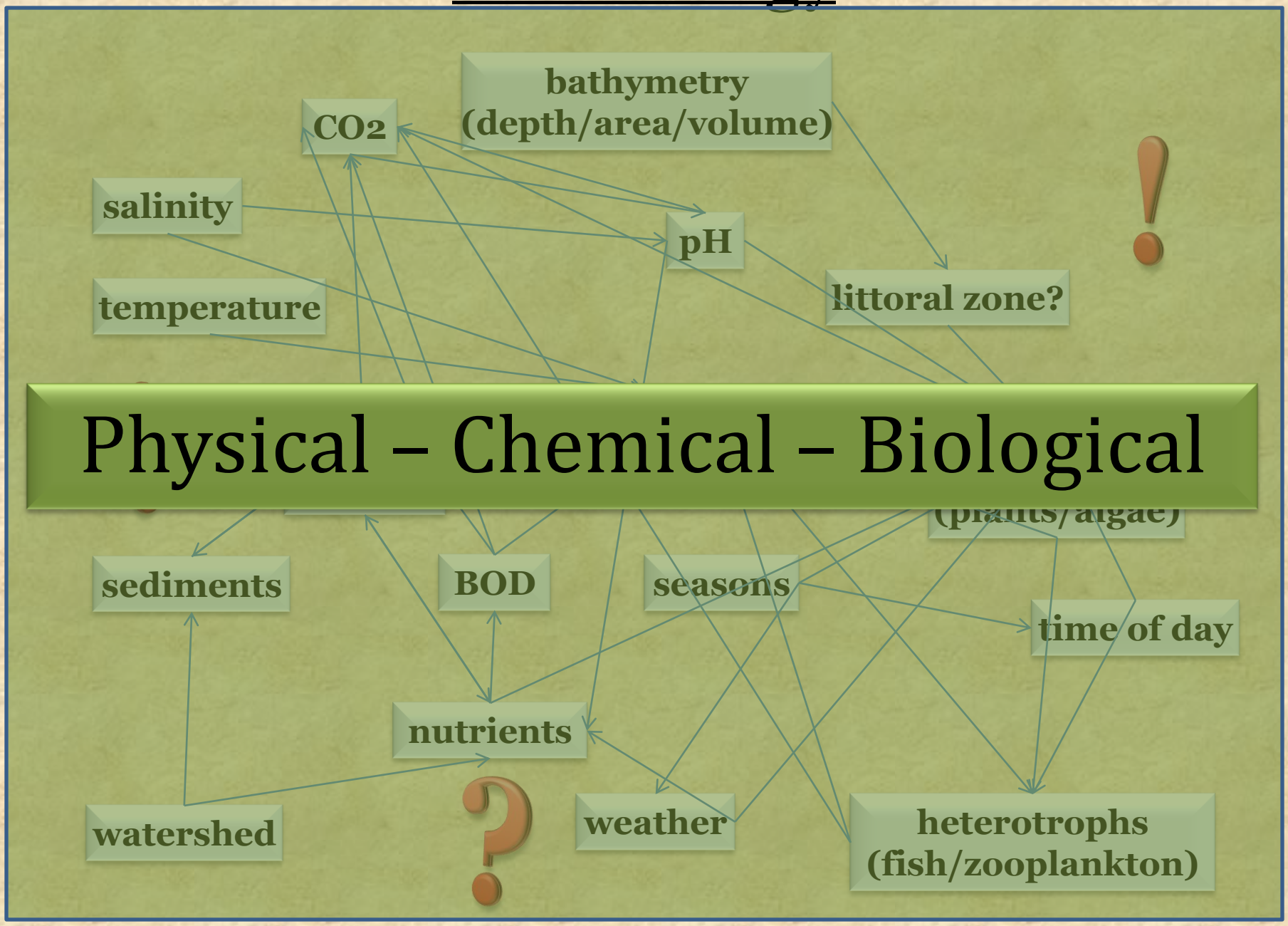


- Aerators are powered by electricity
- Sources:
  - Wind
  - Solar

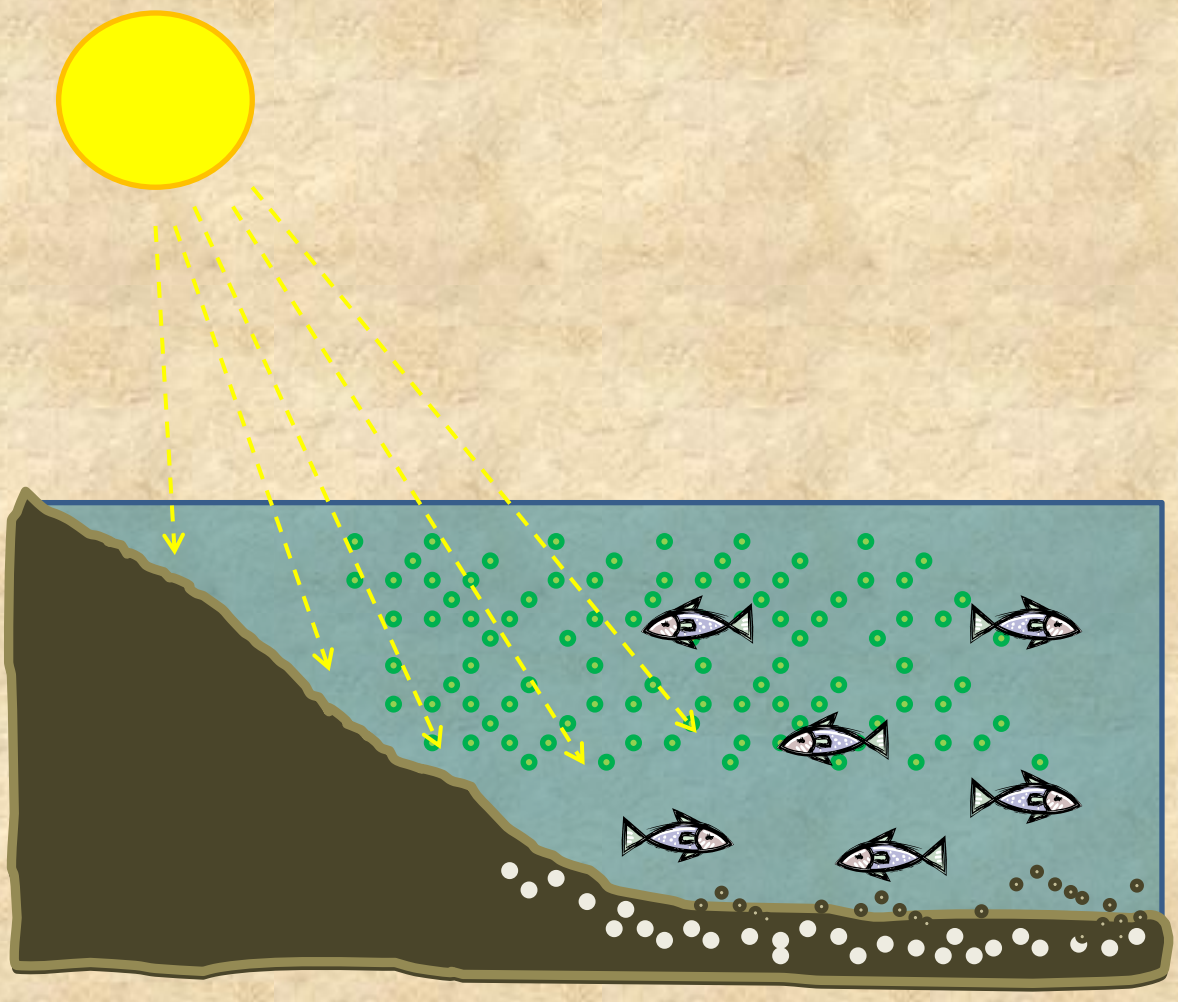


How does aeration improve lake health?

Lake ecology



Physical – Chemical – Biological



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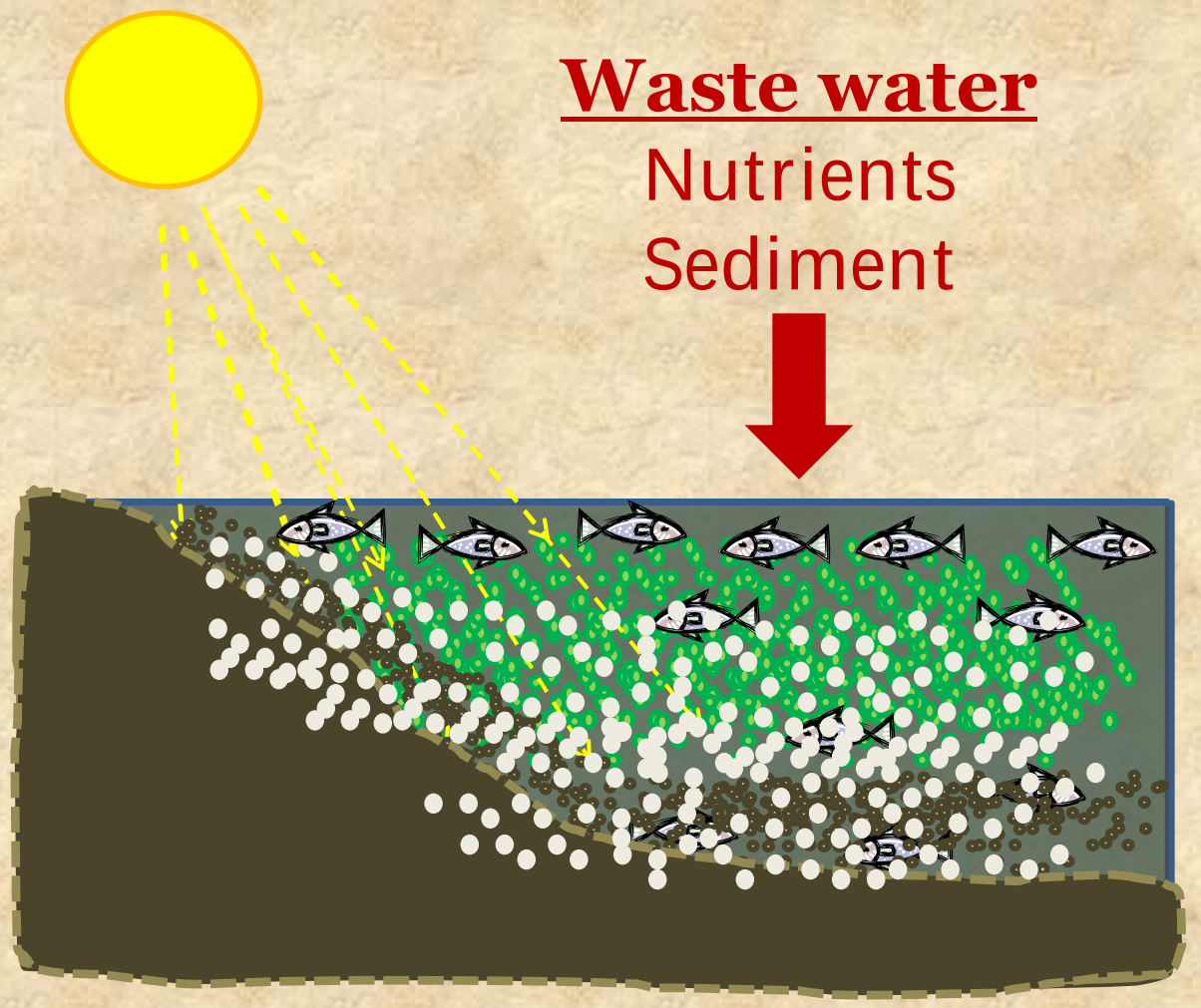
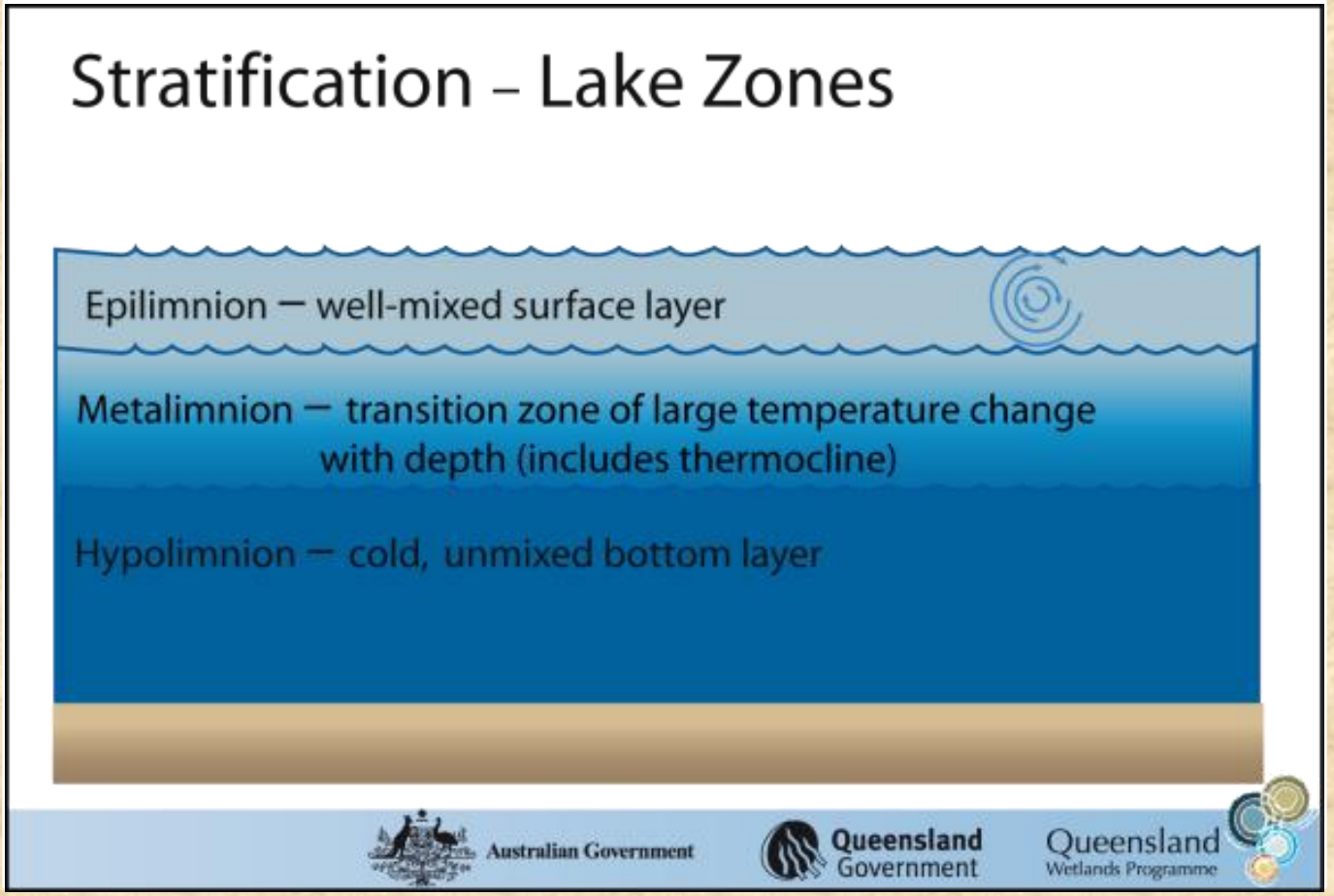


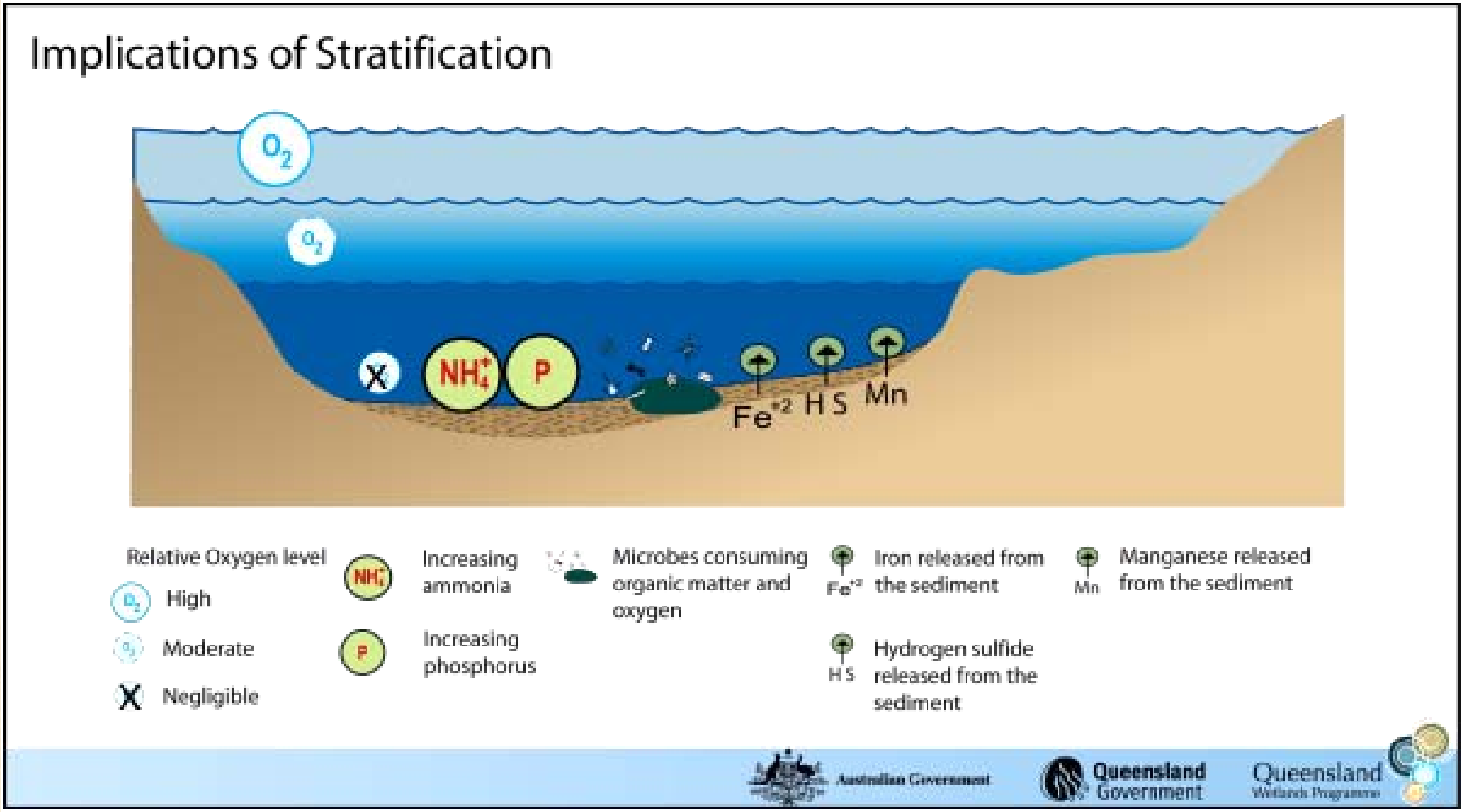
Stratification and Temperature



Varies depending on:

- System depth
- Time of year

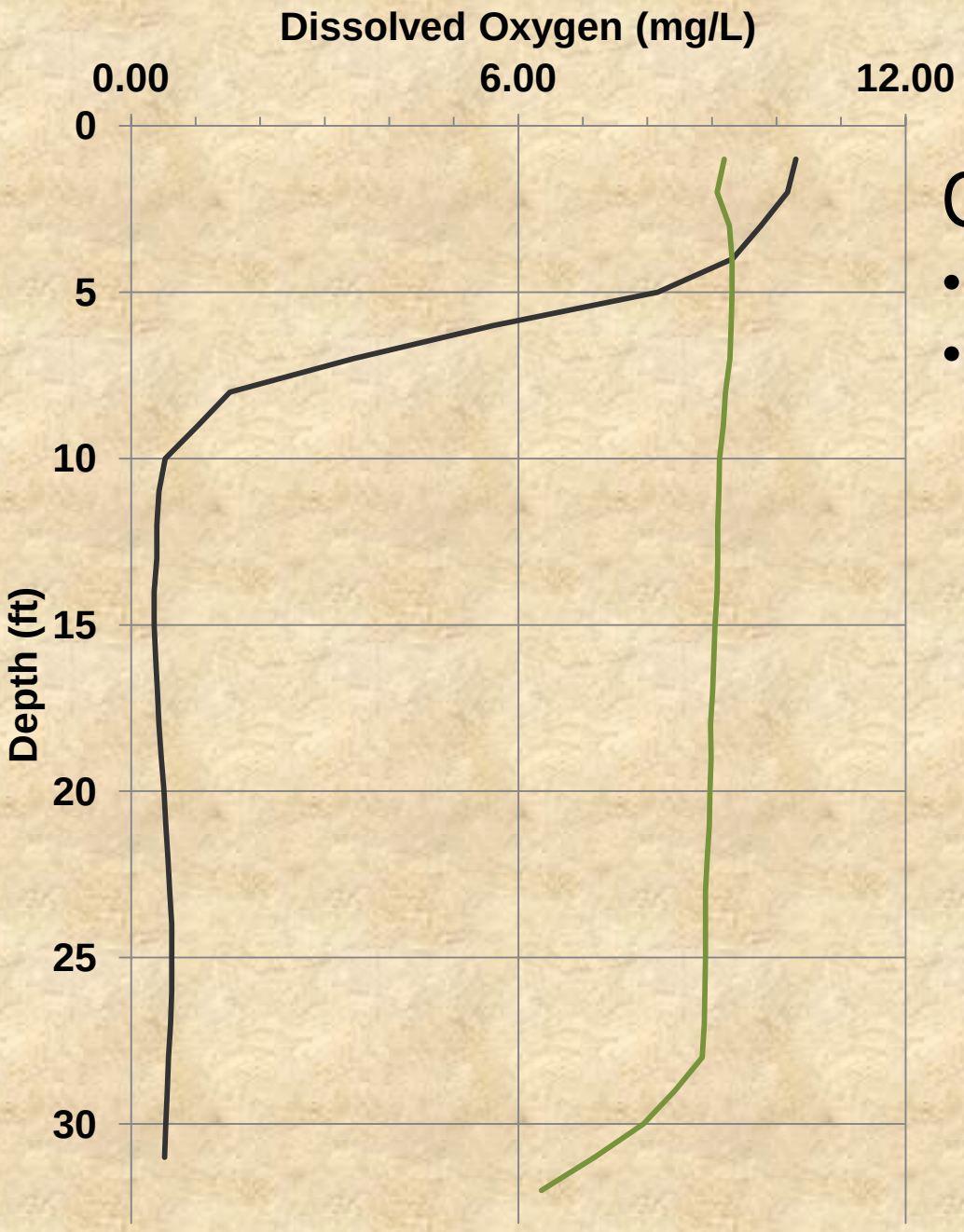
Stratification and Temperature



- Low <u>DO</u>, High <u>CO_2</u>
- High NH_4, P

Before aeration:

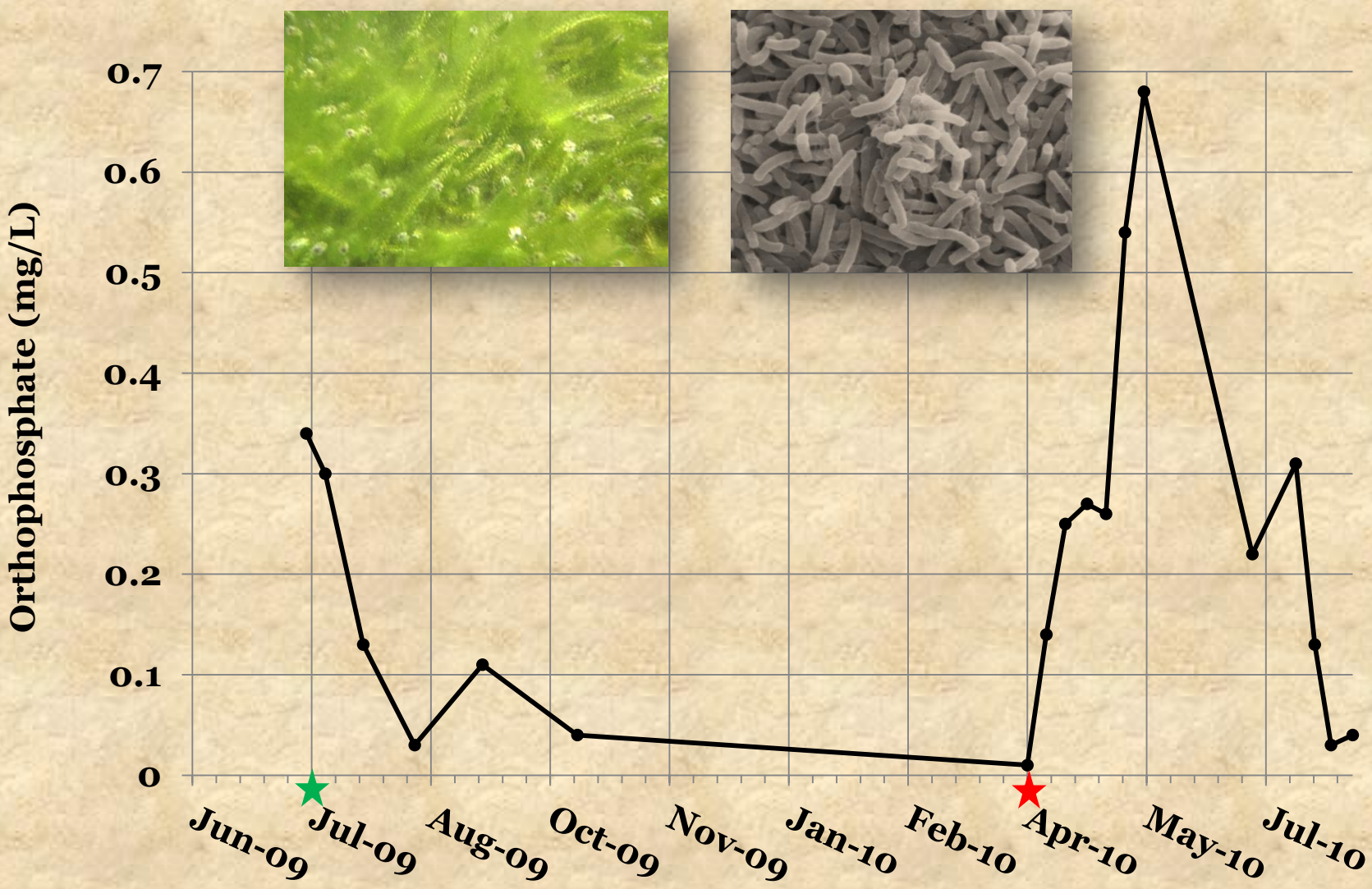
- DO is high at surface
- DO is near 0mg/L below 10ft



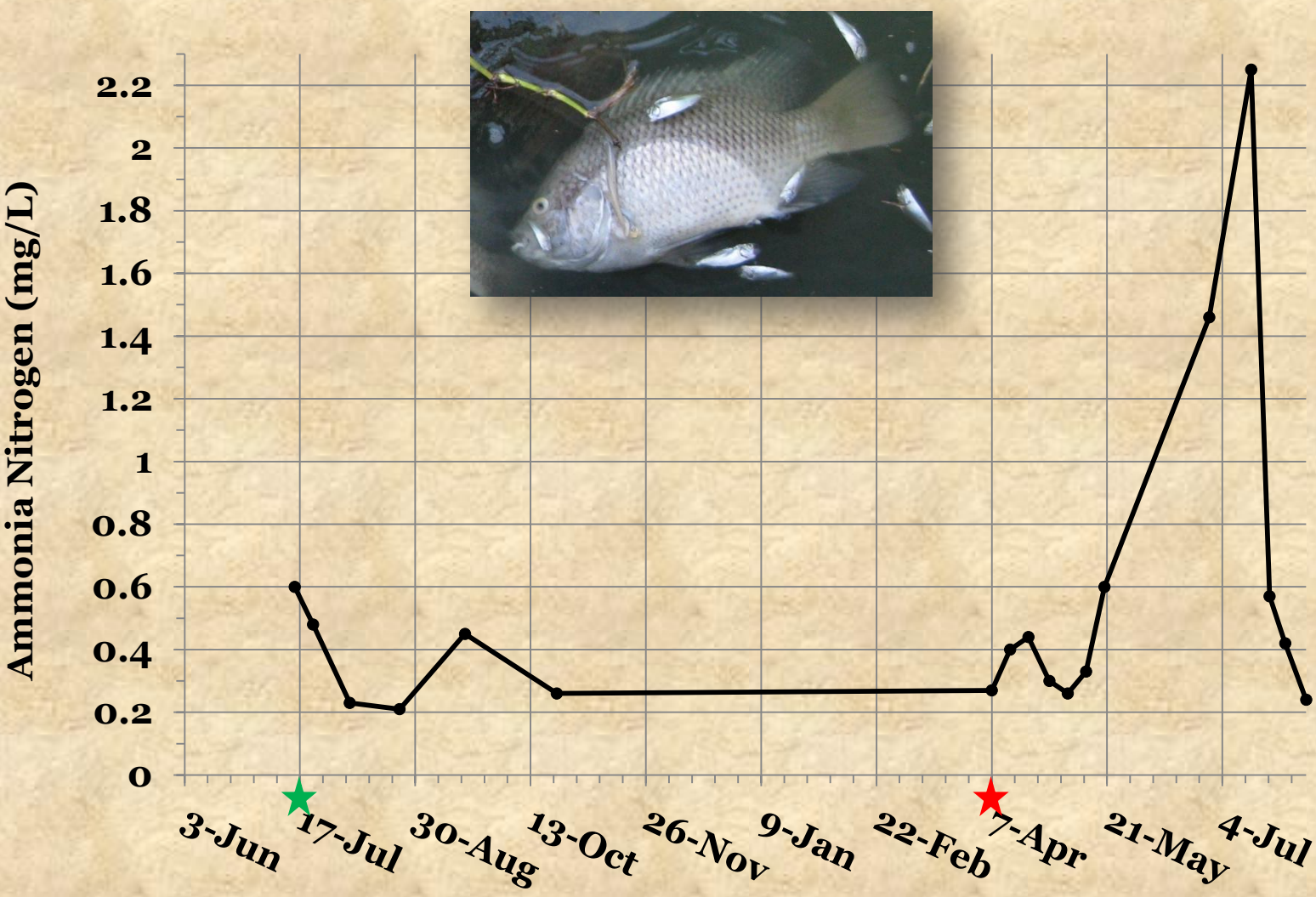
Complete aeration:

- DO is high at surface
- DO remains above 6mg/L

Phosphorus


Orthophosphate (mg/L)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jun-09
Jul-09
Aug-09
Oct-09
Nov-09
Jan-10
Feb-10
Apr-10
May-10
Jul-10

Nitrogen

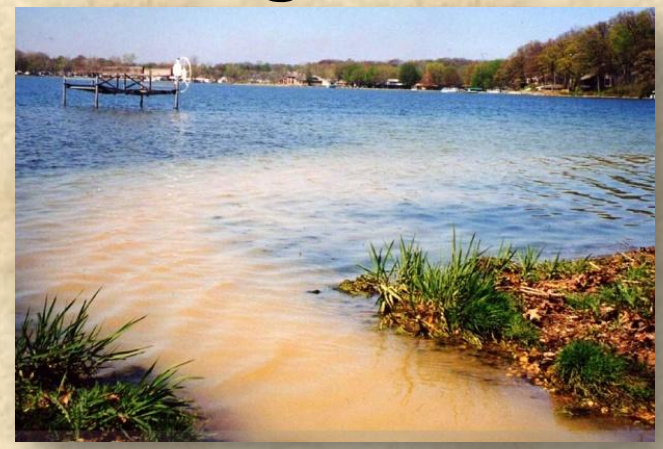

Ammonia Nitrogen (mg/L)
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
3-Jun
17-Jul
30-Aug
13-Oct
26-Nov
9-Jan
22-Feb
7-Apr
21-May
4-Jul

Color, Turbidity and Light reduction

- Color
  - Tint
- Turbidity:
  - Suspended sediment
  - Suspended phytoplankton

Muck build up and Water depth

- Silt accumulation
- Organic build up

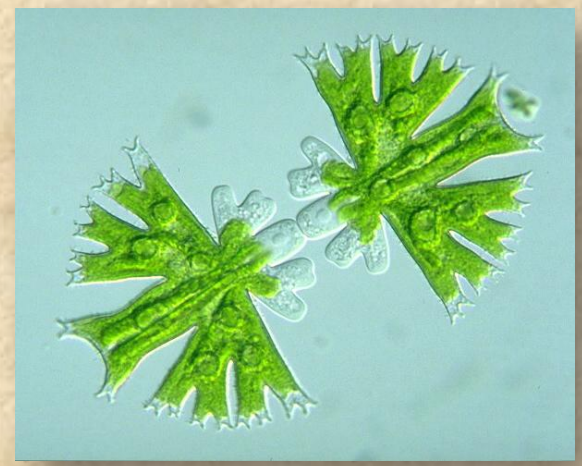


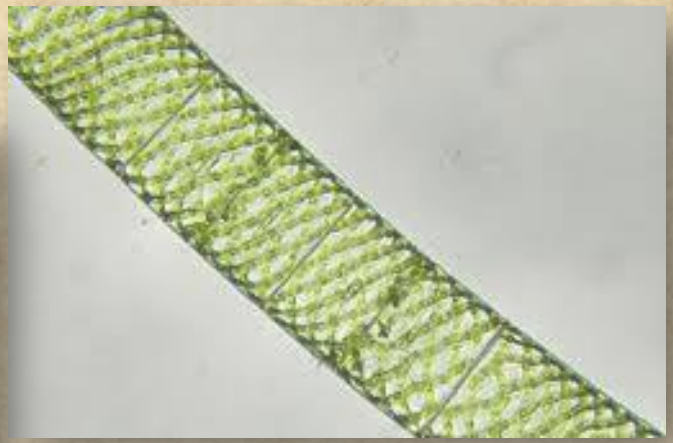
Odor

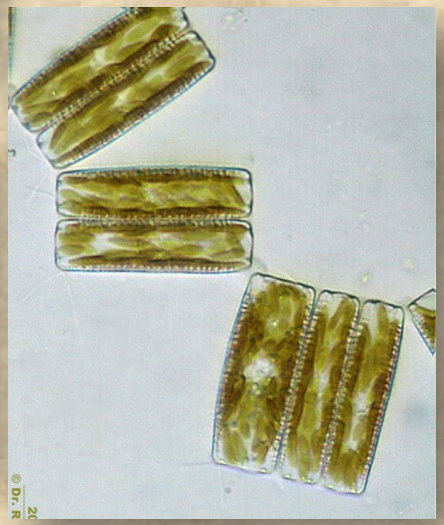
- Hydrogen sulfide gas (H_2S) is generated under **anaerobic** conditions
- Aeration reduces H_2S by:
  - Circulating water and increasing diffusion of H_2S out of water
  - Increasing oxygen, which encourages aerobic respiration

Algae and bacteria

- Algae and bacteria are natural components of aquatic systems:







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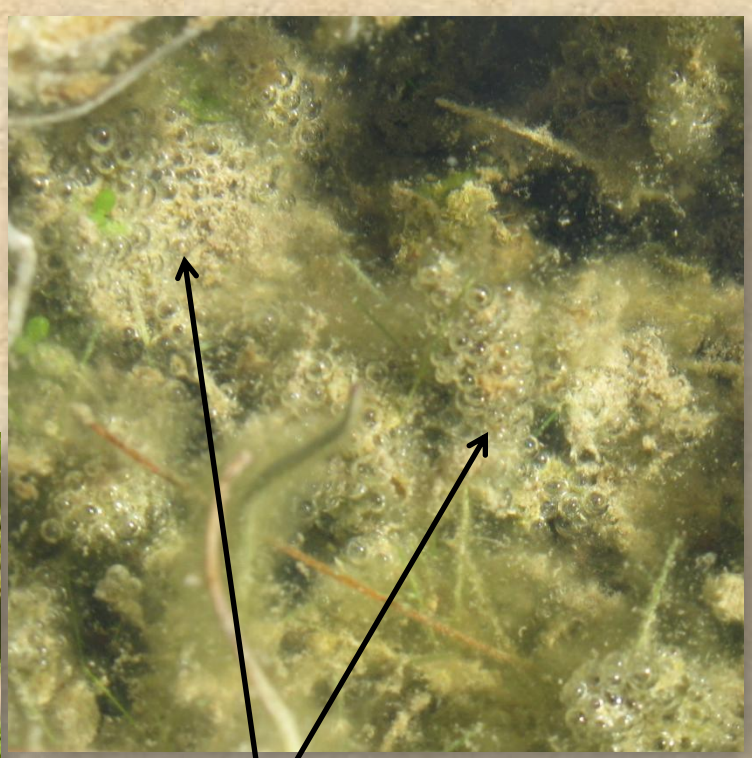


Oxygen

Algae and bacteria

- Nutrient enrichment encourages algae and bacteria overgrowth:
  - Periphyton mats
  - Phytoplankton blooms
  - Toxic algae
  - Pathogenic bacteria

- Aeration reduces algae and bacteria overgrowth by:
  - Circulating water
  - Increasing oxygen
  - Reducing nutrient availability
  - Killing bacteria

Fish kills

- Fish kills occur due mainly to:
  - low oxygen levels
  - high ammonia levels
  - high suspended solids levels
- Circulation is insurance against fish kills!

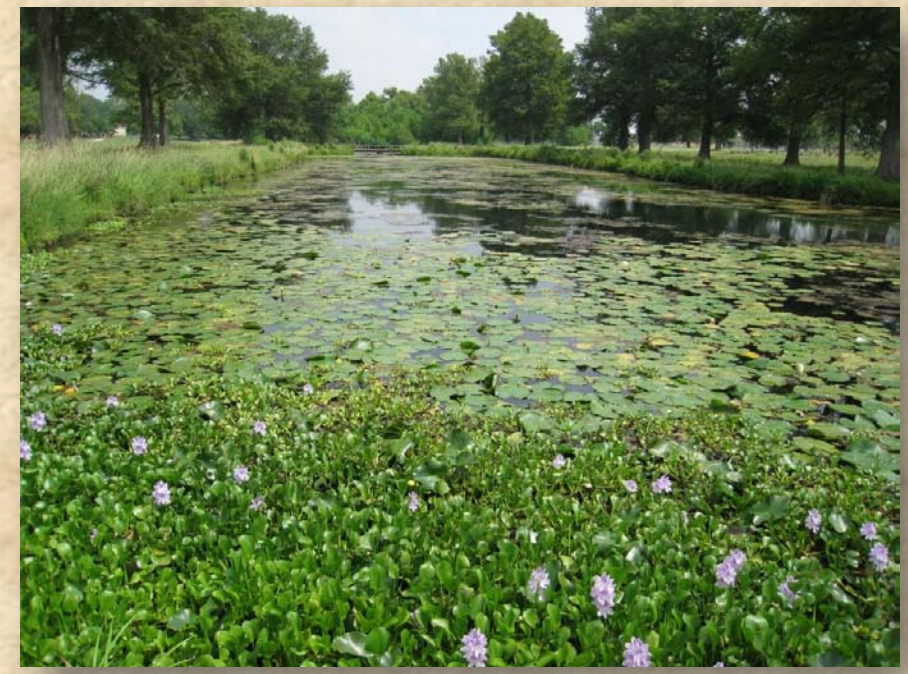
BUT…

- Must have a start up schedule

Mosquitoes and Midge Flies

- Stagnant water allows the establishment of:
  - Mosquitoes
  - Midge Flies
- Aeration reduces insect pests:
  - Circulates water
  - Removes stagnancy
  - Increases oxygen
  - Encourages insects and fish that consume pests

Macrophytes



- Macrophyte overgrowth
- Circulation is **NOT** weed control!

  BUT…
- Aerat[illegible]ay reduce or eliminate s[illegible]e of the conditions t[illegible] encoura[illegible]acrophyte overgrowth
  - high nu[illegible]nt levels

Aeration Summary

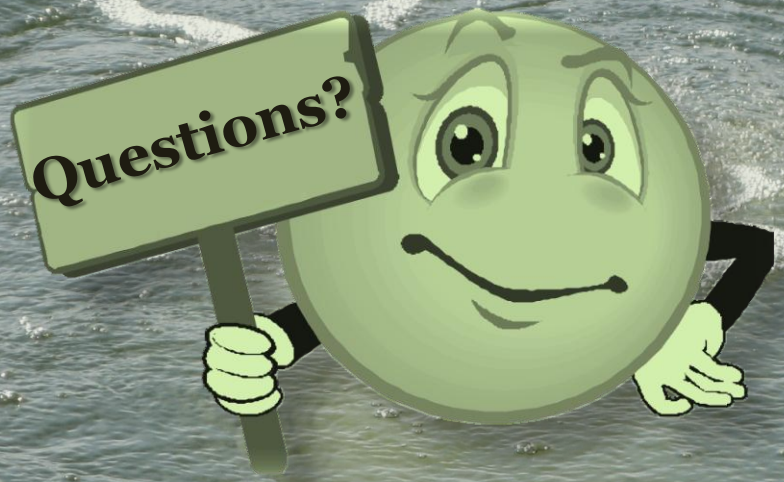
INCREASES:

- Circulation
- Dissolved oxygen levels
- Water clarity

DECREASES:

- Stratification
- Carbon dioxide levels
- Biological oxygen demand
- Toxic gases and chemicals (e.g. hydrogen sulfide and ammonia)
- Odor
- Phosphorus and Nitrogen levels
- Muck build up
- Algal over growth
- Pathogenic bacteria
- Fish kills
- Mosquitoes and midge flies

Thank you!



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