2019 Duck Lake & Associated Canals

Northwest Aquatic Eco-Systems
Tumwater, WA

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Year In Review 2019

- Lowest Water Levels Statewide in Years
- Lower Historic Inflows
- Increased Weed Treatment
- Seasonal Toxic Algae Issues
- Pennywort Issues

Timeline Milestones

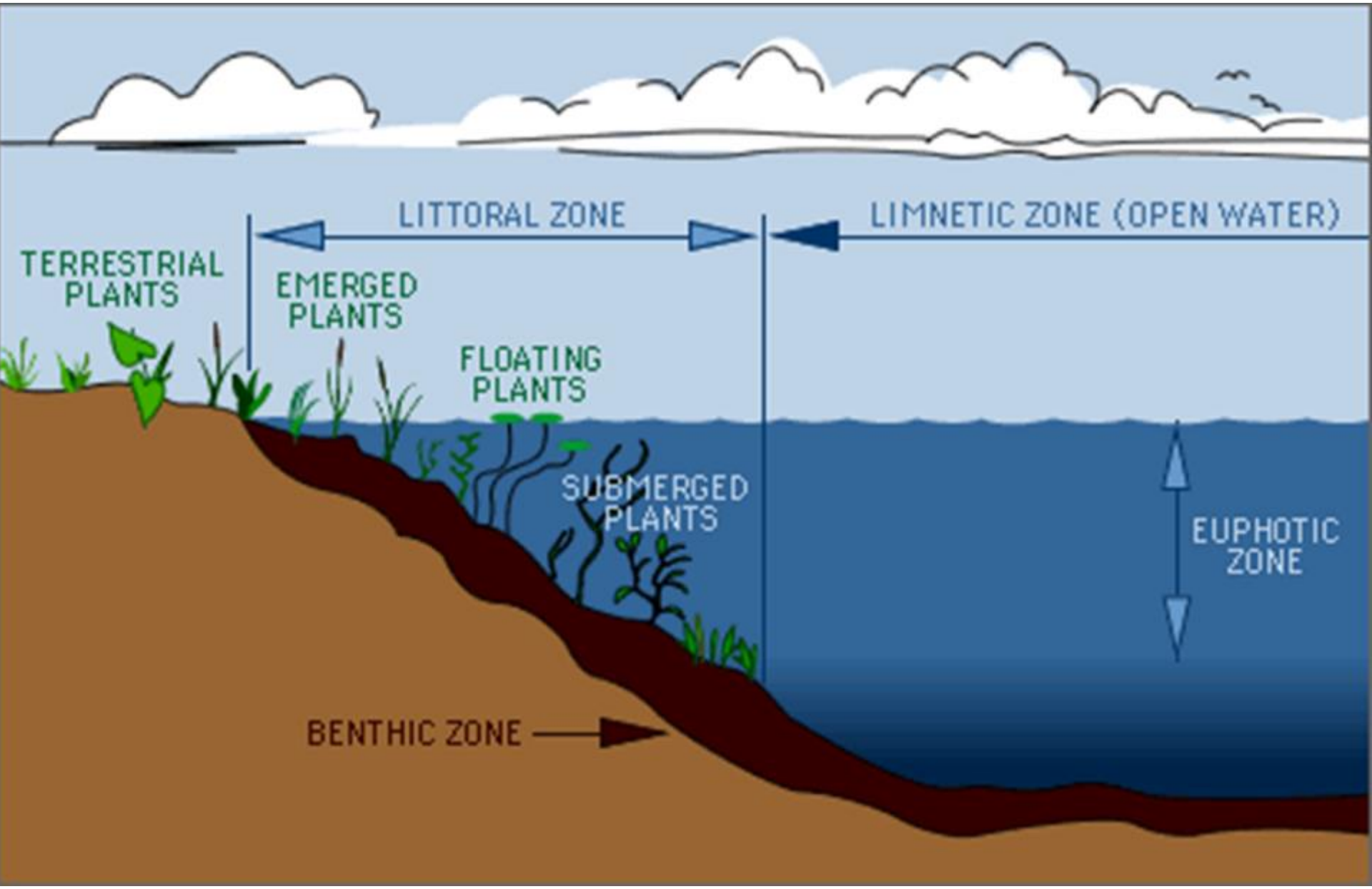
- 1970's Algae Issues
- 1980 Consultant Recommends Sewers (Algae Issues)
- 1990 Ecology Implements New Environmental Policy (15,000 sq. ft. lot)
- 1991 OSFWC Formation
- 1994 KCM Study
- 1998 City Sewer Completed
- 2007-2009 Fluridone Treatments
- 2009-2010 Grass carp
- 2015 Treatment

Duck Lake 252 acres
Grand Canal 98 acres
Lake Minard 57 acres
Bell Canals 32 acres
Bass Canal 32 acres
Associated canals 28 acres

Inflow
Oyehut Creek
Clover Creek

Outflow
Grand Canal

Rate of turnover
1.4 years


LITTORAL ZONE
LIMNETIC ZONE (OPEN WATER)
TERRESTRIAL PLANTS
EMERGED PLANTS
FLOATING PLANTS
SUBMERGED PLANTS
EUPHOTIC ZONE
BENTHIC ZONE

Native & Non- Native Species

- Both native & non-native species can cause a number of problems in lakes:

- By crowding out species that provide quality food and shelter for aquatic life, they can restrict fish production and cause fish populations to become unhealthy or decline.
- Plant masses can form large surface mats, which can entangle boaters and swimmers.

Pennywort

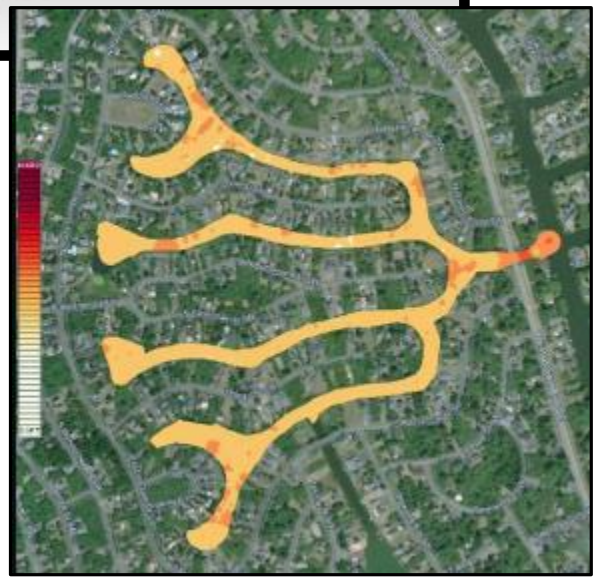
Elodea

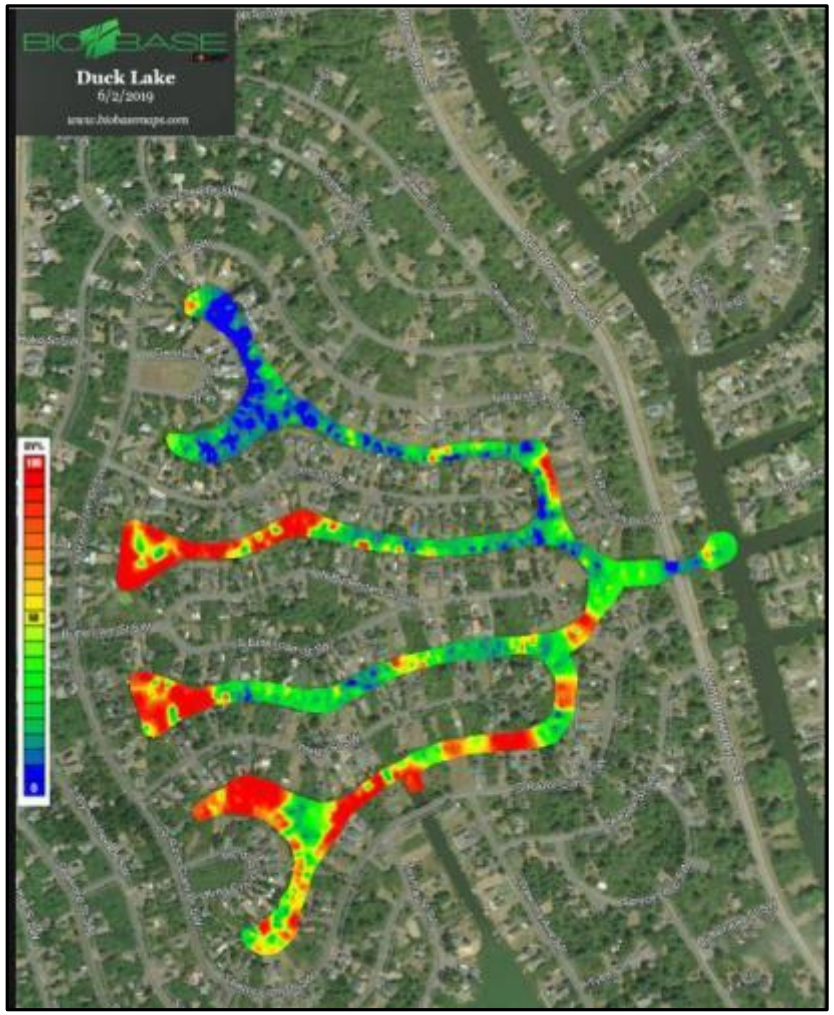
Milfoil

STOP AQUATIC HITCHHIKERS!™

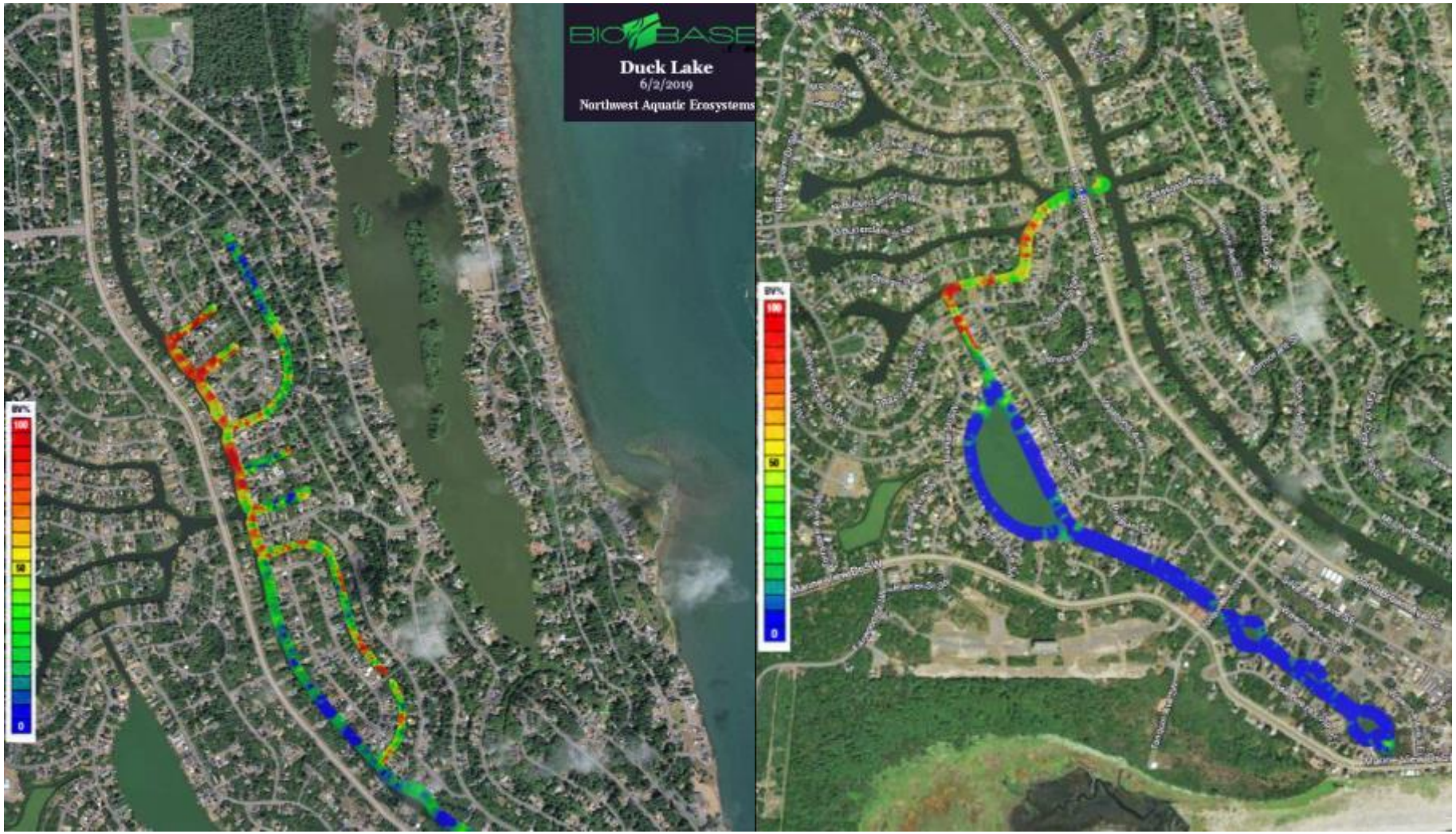
Parrotfeather

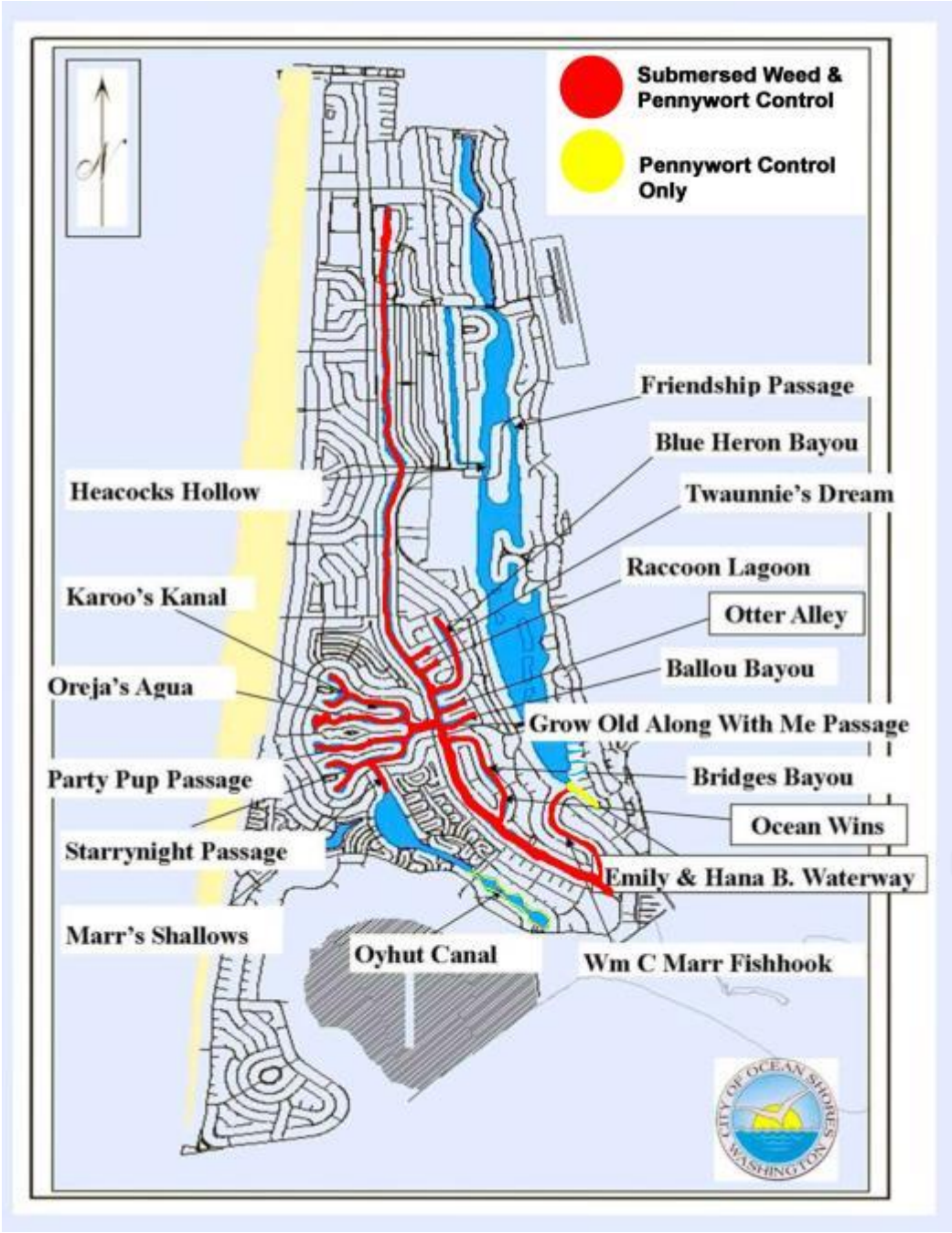
Weed Survey Spring 2019





Weed Survey Spring 2019





Weed Treatment

July 8th & 9th, 2019

- **120 acres – Diquat**
- **Pennywort**
- **Parrotfeather**

<u>No Glyphosate Use</u>

How Toxic is Diquat?

** Toxicities are measured using the LD50, which is the dose of active ingredient required to kill 50% of test animals. The lower the LD50 the more toxic.

Most toxic

Substance	Oral LD50 (mg/kg)	Use	Notes
Cyanide	1	Rodenticide	
Strychnine	2	Rodenticide	
Nicotine	1-50		
Parathion	6-50	Insecticide	
Verapamil	108	Blood pressure	1 tablet = 120mg. 108mg x 70kg person = 63 tablets 10kg child = 7 tablets
Paraquat	58-150	Herbicide	
Chlorine	150-200	0.5-1.5ppm used in swimming pools.	Intense irritation to humans at 5ppm
Warfarin	185	Rodenticide	
Caffeine	192-355		
Diquat cation	214-420	Herbicide at 1ppm for weed control	Reglone = 20% diquat dibromide diquat dibromide = 54% cation (Toxicity of product = x 10 lower) Safe for skin contact at 30ppm
Asprin	350-1000	Pain killer	1 tablet = 300-500mg. 350 x 10kg child = 12 tablets
Salt	3000	Food additive	3000 x 70kg = 210 gms 70kg person = 1 cup (210gms) 10kg child = 3 Tbsns (30gms)

Least toxic

Harvesting (Grand Canal)

2-3 acres/day
$1,200.00 /acre/cut
2-3 cuts per year
$150,000 /cut

Disposal
Fish entrapment
Cutting timeline
Center area cut only

Herbicide (Grand Canal)

Treatment completed in 4 hours

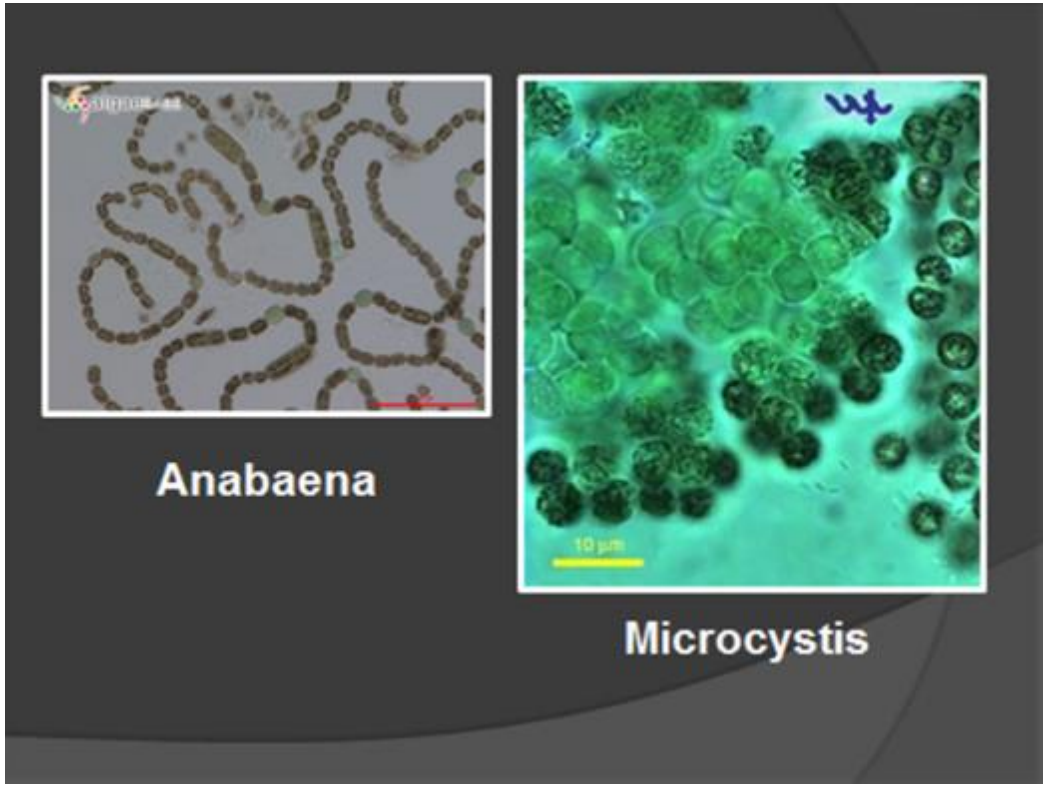
- $300 /acre
- 1 treatment per year
- $30,000 total cost

- Water restrictions
- Controversial
- Non selective
- Notifications
- Shoreline control

Manual/Biological

Algae Types

Toxicity Guidelines WA State



Anatoxin a 1ug/l (15)
Microcystin 6ug/l (8)

Gray Harbor County Health - Lead agency responsible for monitoring toxicity levels throughout Grays harbor.

Since 2009 toxicity has been noted only 5 times. These occurrences usually occur during September and are short in nature.

No means to determine when an active bloom will turn toxic.

1 second in 32 years
1 penny in 10 million dollars
1 blade of grass in a football field

Cyanobacteria

(Bluegreen algae)

Bloom forming?
Bloom or scum visible?

No

No Action

Yes

TIER I:
Local Health posts **CAUTION** sign
Samples taken and sent for toxicity tests
Weekly sampling until bloom dissipates

Bloom dissipates
Remove Sign

Microcystin level ≥ 6 µg/L
and/or Anatoxin-a ≥ 1 µg/L

No

Microcystin < 6 µg /L
and/or Anatoxin-a < 1 µg/L
for at least one week
(e.g., two consecutive
weekly samples)

Yes

TIER II:
Local Health posts **WARNING** sign
Local Health takes additional site-specific steps
Minimum weekly sampling

Return to
Tier II at LHJ
discretion

- History of high toxicity, or
- Reports of illness, pet death

TIER III:
Local Health posts **DANGER** sign
Lake Closed

Toxin Health Effects

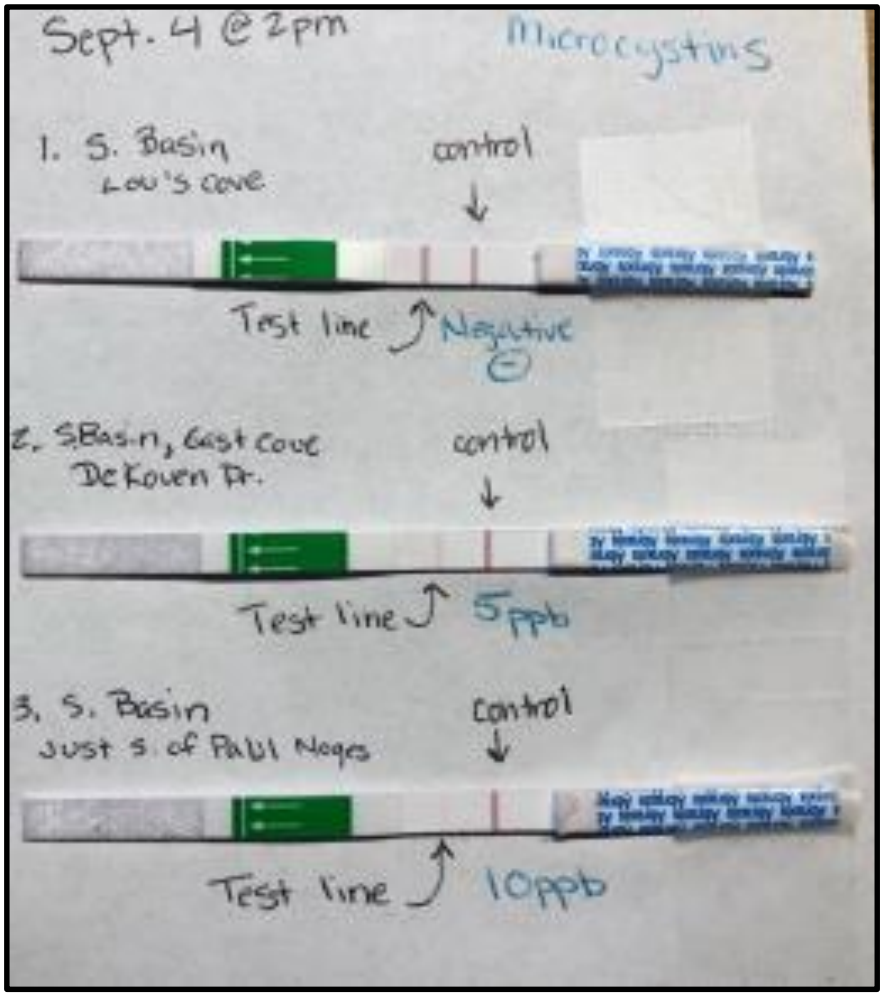
Table 1. Cyanotoxins and associated types of cyanobacteria (Source EPA)

Cyanotoxin	Primary Organ Affected	Health Effects	Most Common Cyanobacteria Producing Toxin
Microcystin-LR	Liver	Abdominal pain Vomiting and diarrhea Liver inflammation and hemorrhage	*Microcystis* *Anabaena* *Planktothrix* *Anabaenopsis* *Aphanizomenon*
Cylindrospermopsin	Liver	Acute pneumonia Acute dermatitis Kidney damage Potential tumor growth promotion	*Cylindrospermopsis* *Aphanizomenon* *Anabaena* *Lyngbya* *Rhaphidiopsis* *Umezakia*
Anatoxin-a group	Nervous System	Tingling, burning, numbness, drowsiness, incoherent speech, salivation, respiratory paralysis leading to death	*Anabaena* *Planktothrix* *Aphanizomenon* *Cylindrospermopsis* *Oscillatoria*

Signs of Cyanotoxin Exposure in Animals

- Weakness or staggering
- Difficulty breathing
- Convulsions
- Vomiting or Diarrhea
- Foaming at the mouth
- Dark urine or blood in the urine
- Algae in the vomitus or stool

Cyanobacteria Monitoring



Example: Lake Steilacoom – Lakewood, WA

Cyanobacteria FYI

1. Toxins produced by multiplying cyanobacteria generally stay inside the cells, but some toxins may leak out into the surrounding water, particularly if the bloom has been growing over a long period of time. ***Treating early reduces the density of potential toxin producing cyanobacteria.***

2. Testing does not ensure all areas of a lake are safe. Toxin producing algae may move from one area of the lake to another within hours.

3. Once toxin producing algae vacate an area non toxic waters may replace or reduce the toxin levels .

4. Testing is designed to produce the highest toxin levels within the sample by lysing the cells and releasing all the toxins contained within the cell.

Algae Control

(Grand Canal)

Seasonal Solution to Long Term Problem

Material	Material Cost	Amount Required
Hydrothol	$16,000	200 gallons
Green Clean Pro	$63,000	45,000 lbs.
Green Clean 5.0	$90,000	3,000 gallons

Life

Aerobic – Oxygen rich
Anaerobic – Oxygen depleted

Respiration

Aerobic

Ample oxygen
Things are great!

Anaerobic

Releases phosphorus back into the water-column

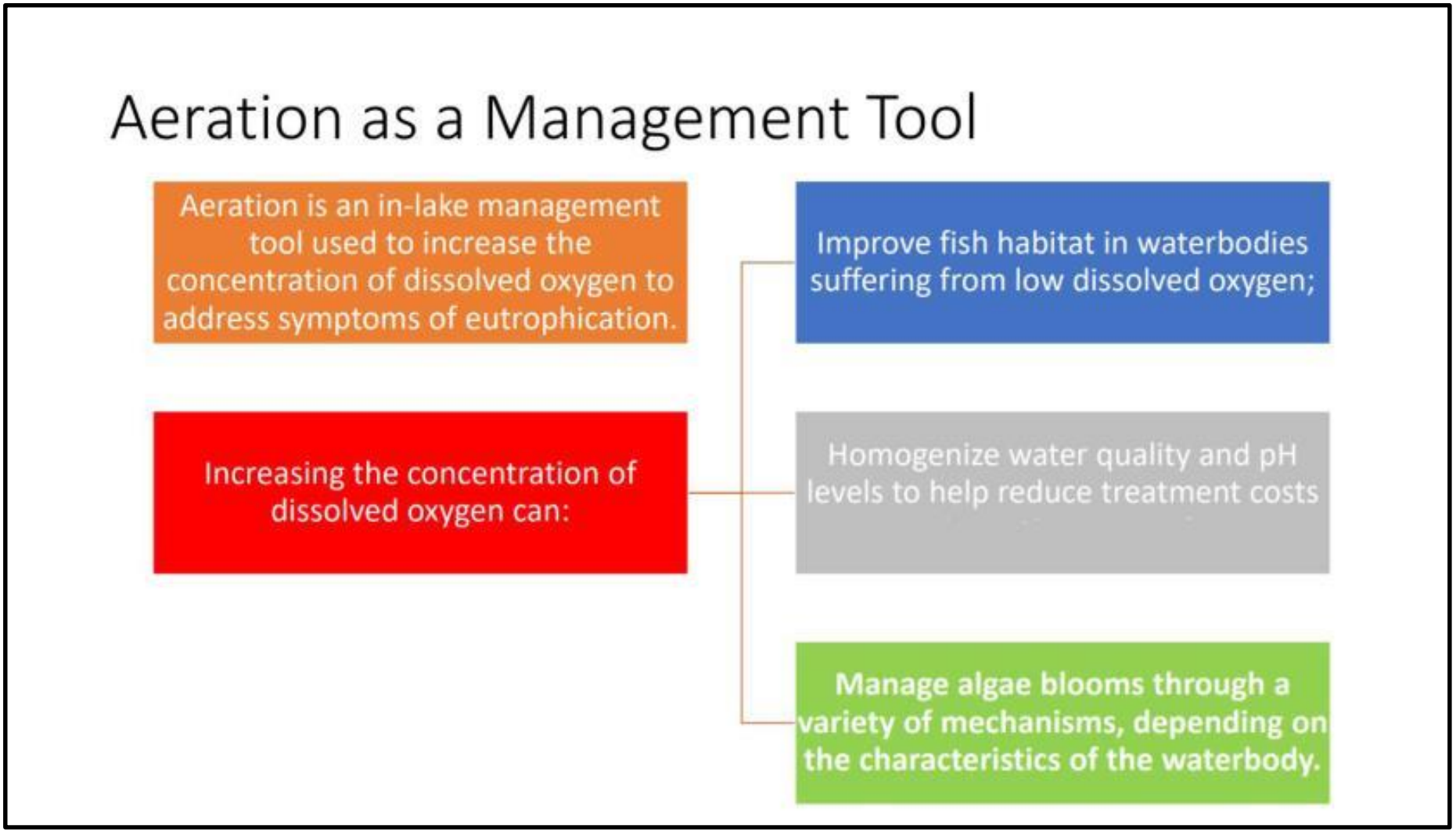
Fish mortality

Reduces sulfate to sulfides

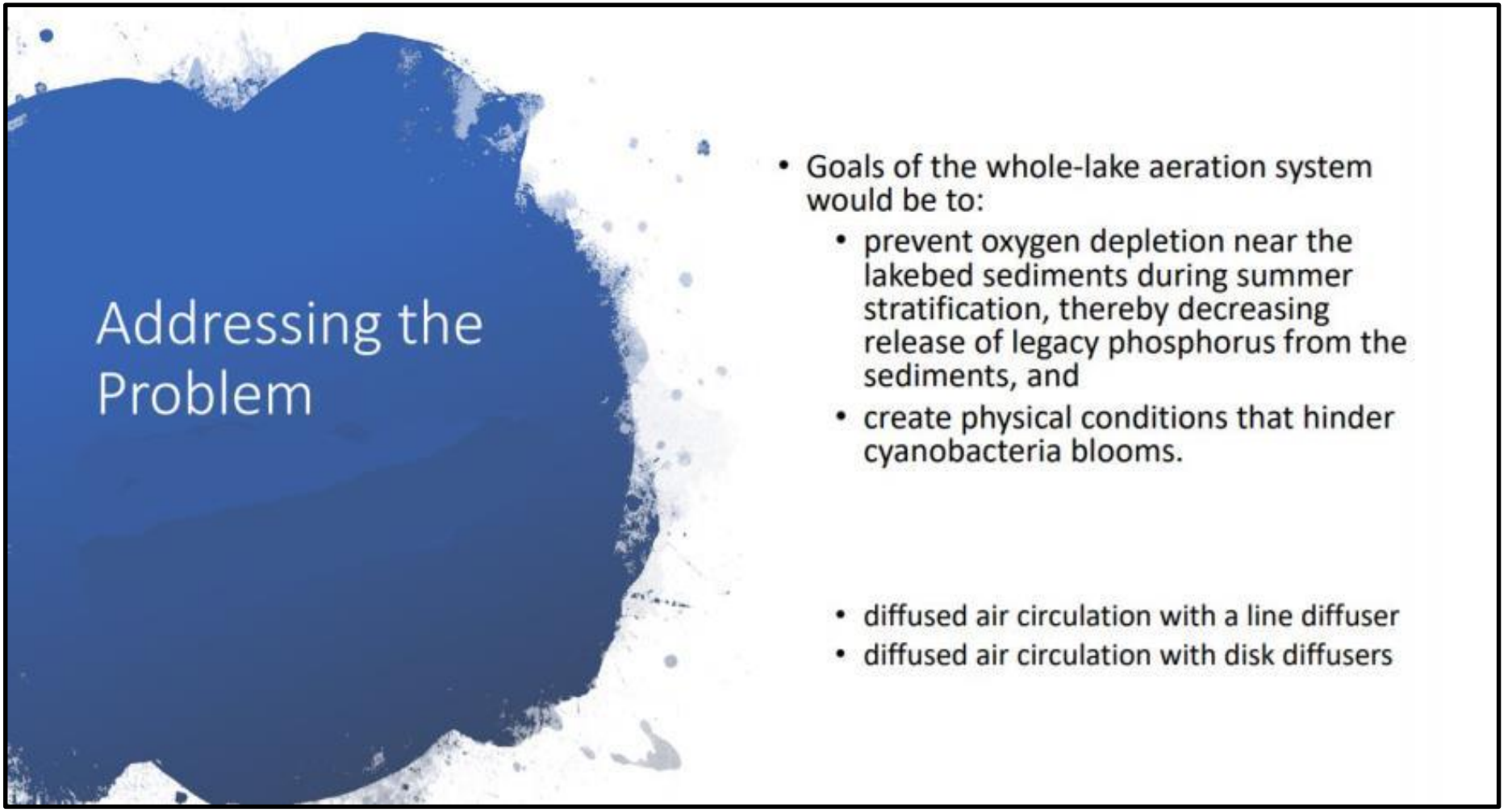
System stress

Aeration

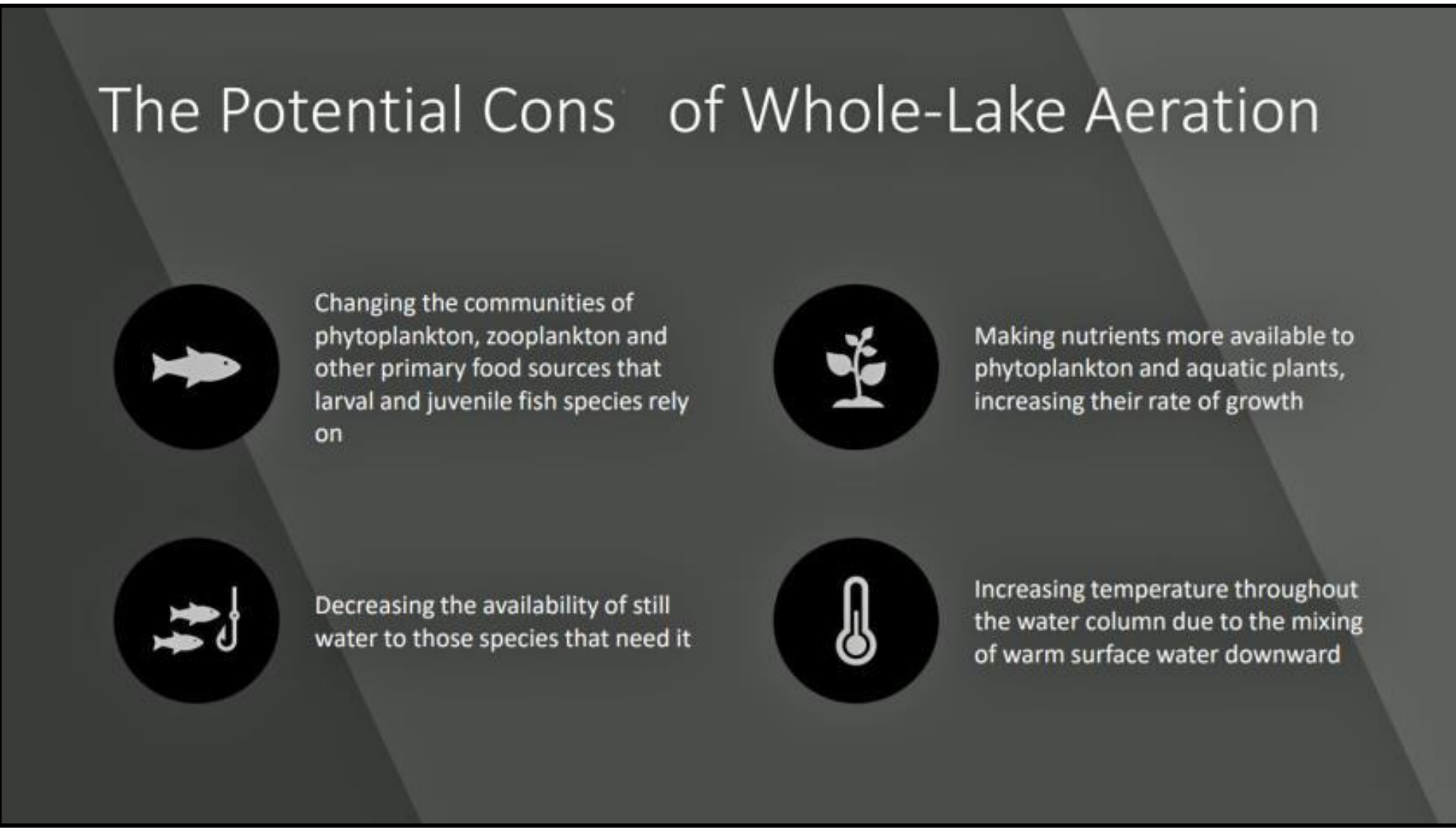
Bass Canal aeration
$233,000.00/$320,000.00



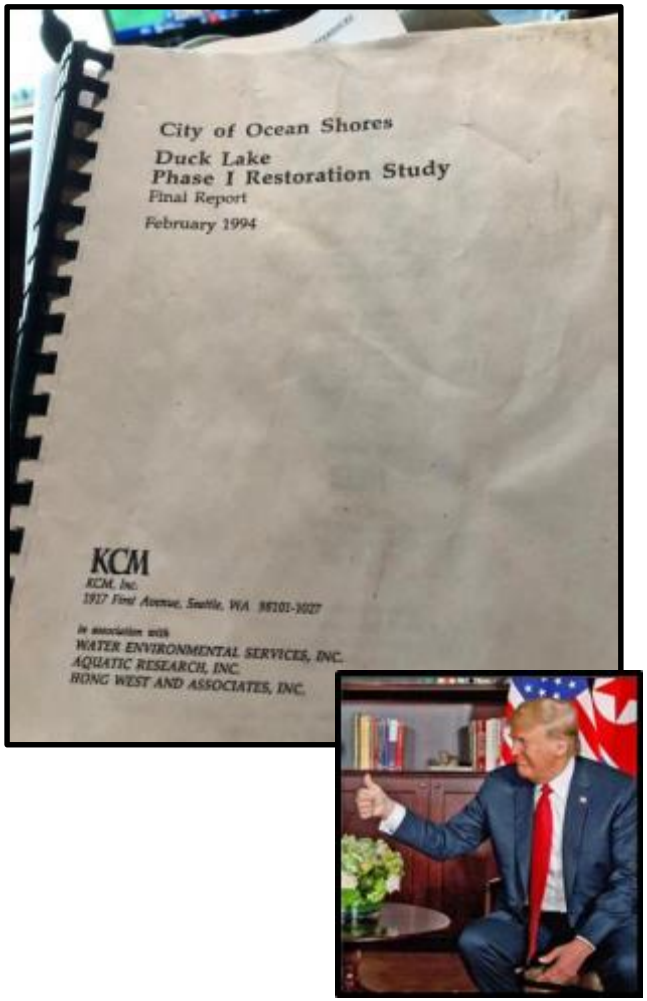
Aeration


Addressing the Problem
• Goals of the whole-lake aeration system would be to:
• prevent oxygen depletion near the lakebed sediments during summer stratification, thereby decreasing release of legacy phosphorus from the sediments, and
• create physical conditions that hinder cyanobacteria blooms.
• diffused air circulation with a line diffuser
• diffused air circulation with disk diffusers

Aeration


The Potential Cons of Whole-Lake Aeration
Changing the communities of phytoplankton, zooplankton and other primary food sources that larval and juvenile fish species rely on
Making nutrients more available to phytoplankton and aquatic plants, increasing their rate of growth
Decreasing the availability of still water to those species that need it
Increasing temperature throughout the water column due to the mixing of warm surface water downward

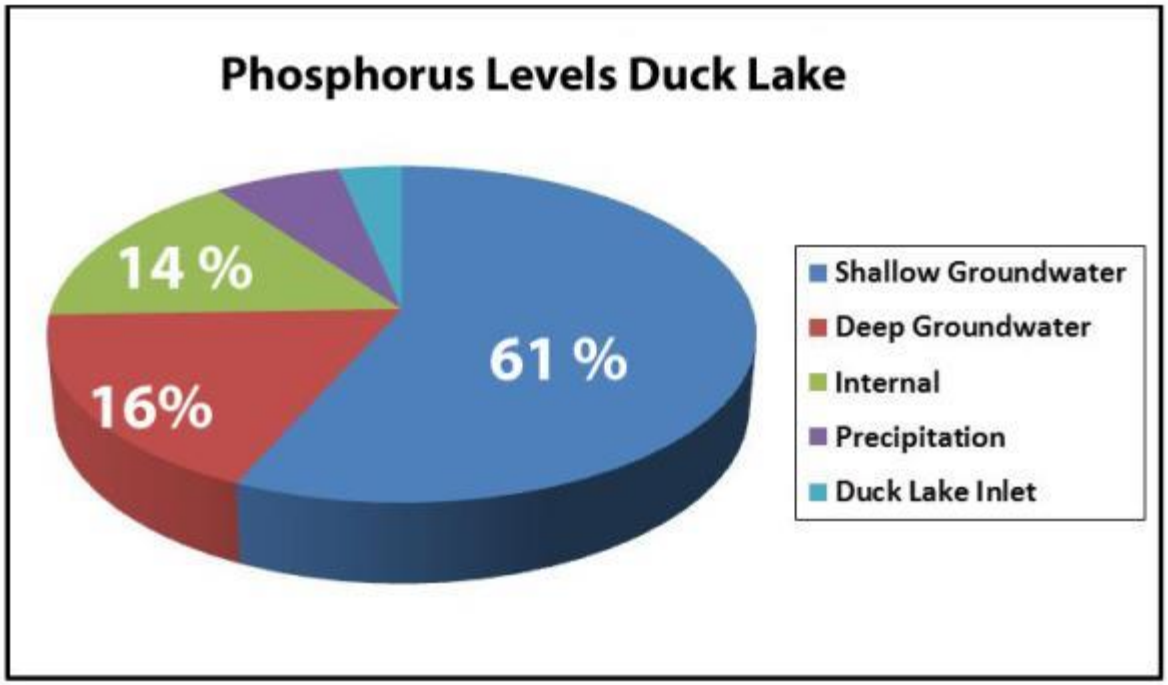
Houston We Have A Problem

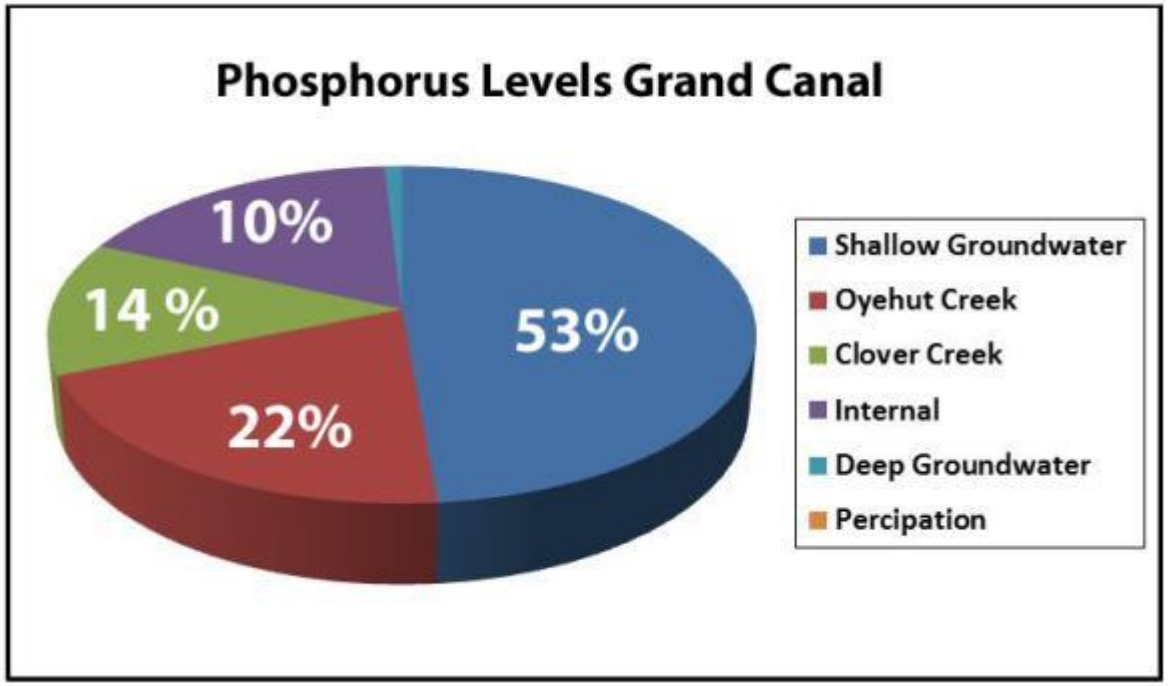


Findings

1974 – Very high trophic level, high nutrients
1981 - #2 of 25 urban lakes for nutrient levels
Naturally Nutrient Rich- Systems location in a wetland area consisting of peat soils.
Shape of Waterways – Shallow
(restricts water movement, limits nutrient dissipation)
Septic Systems – marine sands , silty clay, not suitable for on site waste disposal at current population densities.
Shallow Water Aquifer - supplies 60% of the nutrient load to the system
Wetland – Entire system is classified as a wetland.
Nutrients - Shallow aquifer: 61% Duck Lake 53% Grand canal
Deep aquifer: 16% Duck Lake 1% Grand canal

" In lake activities can be used to control macrophytes and improve navigation however substantial improvements in water quality are almost entirely dependent on watershed nonpoint source control."


Phosphorus Levels Duck Lake
14 %
16%
61 %
Shallow Groundwater
Deep Groundwater
Internal
Precipitation
Duck Lake Inlet


Phosphorus Levels Grand Canal
10%
14 %
53%
22%
Shallow Groundwater
Oyehut Creek
Clover Creek
Internal
Deep Groundwater
Percipation

Shallow Groundwater Aquifer

- Growth 2000 – 3,795 2018- 6,000 64% Increase
- Sewer – Currently 10,000 lots Capacity 11,520 lots
- Development
- Wildlife
- Wetland
- Nutrient Sink

Wetlands

1. Trap sediments and remove nutrients
2. Once threshold limits are reached a decline in the ecosystem may occur.
3. Typically shallow water tables some provide recharge to aquifers.
4. Flood storage
5. Fish & wildlife habitat
6. Shoreline stabilization
7. Positive and negative nutrient sinks.

KCM Recommendations

Priority Ranking	Action
1. As soon as possible	Conversion to sewers
2. As soon as possible	Implement Best Management Practices, Revise city ordinances
3. As soon as possible	Public education
4. 1994	Biofiltration wetland –Mouth of Oyehut Creek
5. 1995	Stock grass carp
6. 1995	Aeration Bass Canal
7. On going	Harvest Aquatic Plants

“The key to preventing further declines in water quality is the conversion of all properties within the watershed to a sewer system as quickly as possible .” KCM 1994

$1,000,000.00 (1984)

Does not include the following expenses

- ✓ Cost of Sewer System
- ✓ $100,000.00 Clover Creek Study
- ✓ $100,000.00 Oyehut Biofilter Wetland
- ✓ $130,000.00 Maintenance Expenses
- ✓ $60,000.00 Harvesting O&M
- ✓ $33,000.00 Grass Carp Planting & Monitoring
- ✓ $15,000.00 Bass Canal Annual Aeration System Maintenance
- ✓ $10,000.00 Public Education
- ✓ $15,000.00 Citizens Training and Water Monitoring

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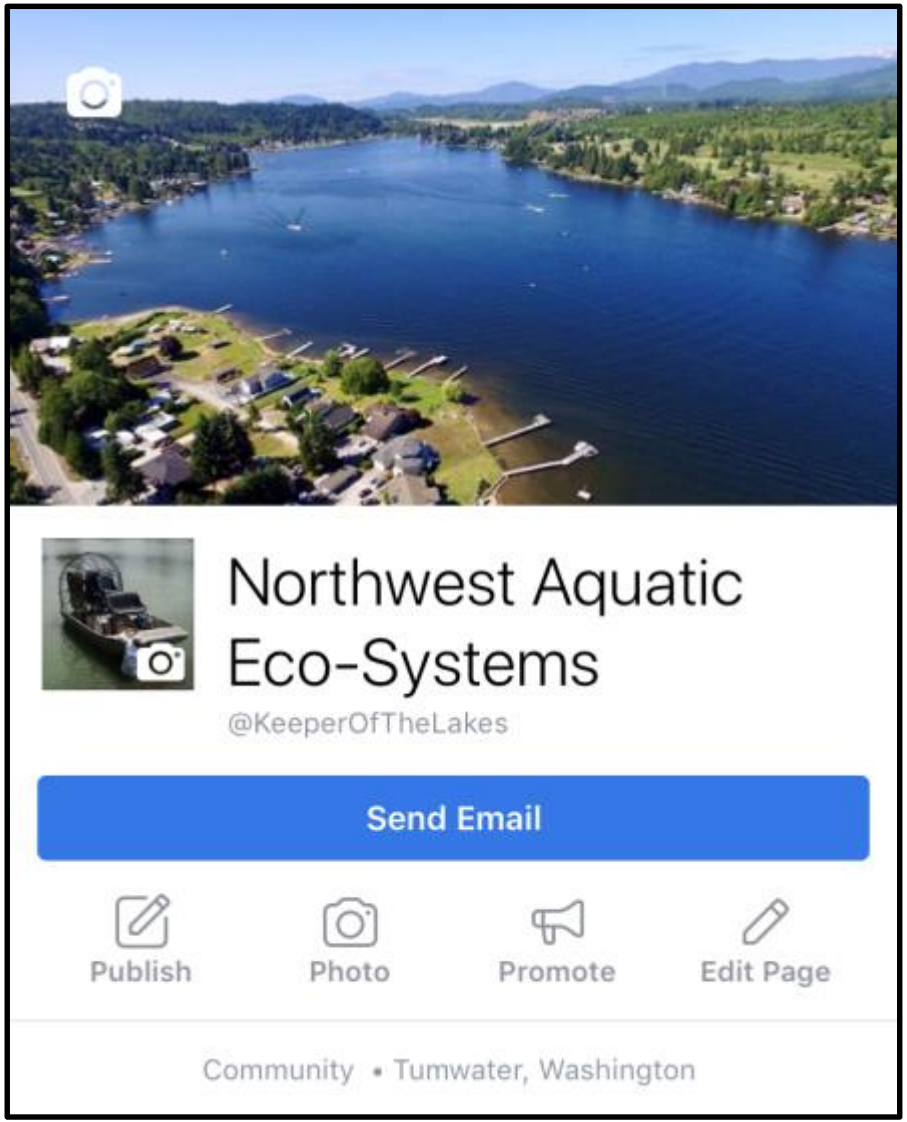

What do we post?

- Treatment Dates
- Treatment Restrictions
- When treatment is compete
- Youtube videos/Drone
- Before & After photos
- Updates on our whereabouts
- Toxicity updates & Explanations
- Using it as another way to keep the residents informed.

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See You Next Year