

**Marco Island, Florida**

**WBID 32780**

**Water Quality**

**Status & Trends**

**7.15.21**

**Eugene Wordehoff**

**[eugene\\_wordehoff@yahoo.com](mailto:eugene_wordehoff@yahoo.com)**

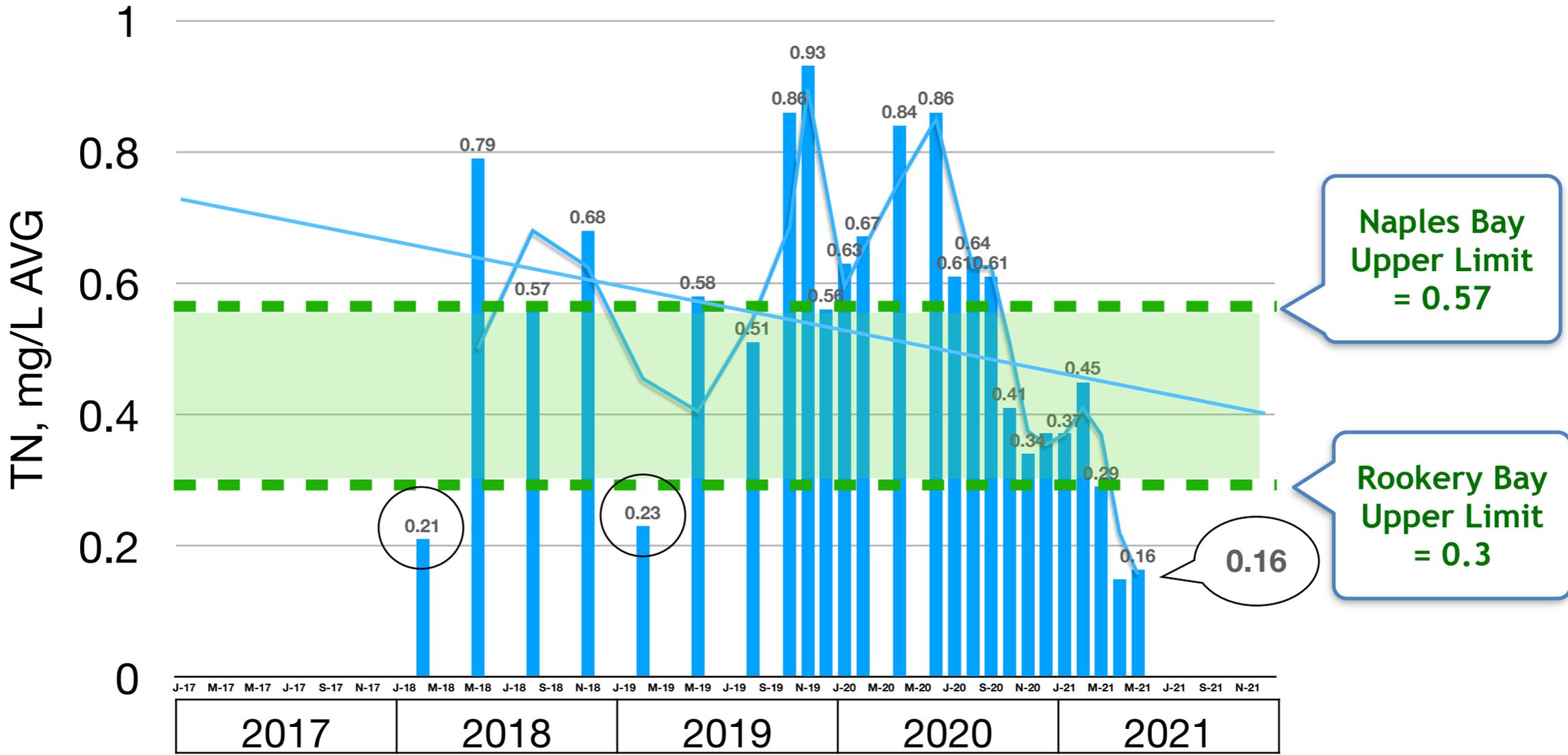
# 2021 Water Quality Status

Parameter	Rookery Bay Standard	J	F	M	A	M	J	J	A	S	O	N	D
TN	0.3 mg/L As AGM	0.37	0.45	0.29	0.15	0.16							
TP	0.046 mg/L As AGM	0.015	0.023	0.039	0.092	0.042							
Chlor-a	4.9 mg/mg3	4	4.9	4.5	2.8	3.8							

Sources of all data: 2017 WIN; 2018-2021 City of Marco Island, Water Quality Sampling Reports

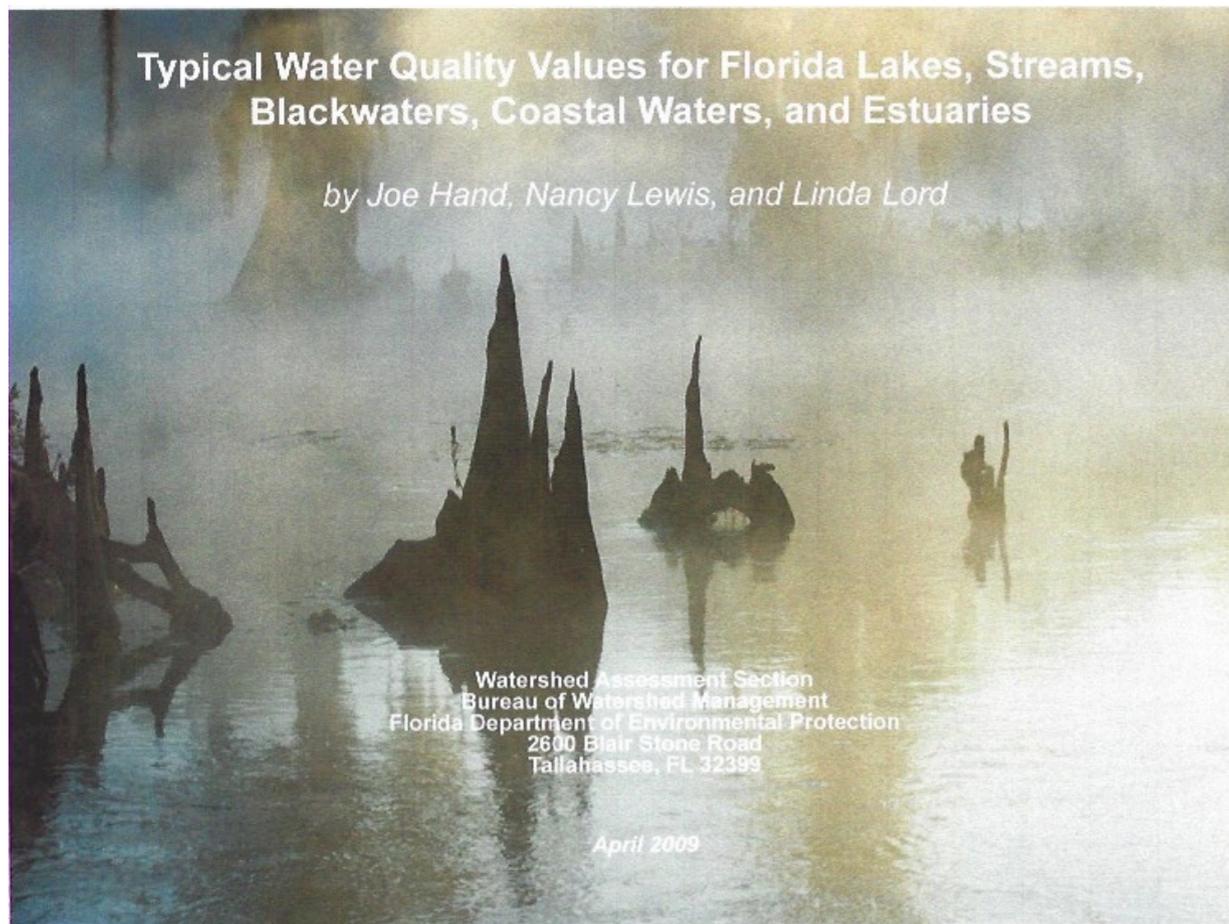
**May-21: Marco waterways currently below Rookery Bay limits**

# Total Nitrogen (TN) Trend



TN is cyclical and trending downward; currently at a 5-year low

# Source of Benchmarks: FDEP (2009)



**This document provides the typical surface water quality values found in Florida's rivers and streams, lakes, estuaries, springs, coastal waters, and blackwaters. It can be used to compare the water quality data that one collects with the typical values found in Florida.**

**If your data are at the 10th percentile level, for example, this means that only 10% of Florida waters have values lower than what you found; the 50th percentile represents the average data conditions found in Florida waterbodies.**

**Watershed Assessment Section  
Bureau of Watershed Management  
Florida Department of Environmental Protection**

# Source of Benchmarks: FDEP (2009)

## Table of Contents

*Note: Parameters are listed alphabetically in boldface type; regular type indicates cross-references.*

<b>INTRODUCTION</b> .....	4	<i>Fecal Coliform</i> .....	24	<i>Potassium as K</i> .....	55
<b>TYPICAL WATER QUALITY VALUES,</b>		<i>Fecal Streptococci</i> .....	65	<i>Residue, Total</i> .....	56
<b>BY PARAMETER</b> .....	5	<i>Flow</i> .....	29	<i>Residue, Total Filtrable Dried</i> .....	57
<i>Alkalinity</i> .....	6	<i>Fluoride</i> .....	30	<i>Salinity</i> .....	58
<i>Aluminum</i> .....	7	<i>Hardness</i> .....	31	<i>Secchi Depth</i> .....	59
<i>Ammonia, Unionized</i> .....	8	<i>Inorganic Nitrogen as N</i> .....	43	<i>Selenium</i> .....	60
<i>Antimony</i> .....	9	<i>Iron</i> .....	32	<i>Silver</i> .....	61
<i>Arsenic</i> .....	10	<i>Lead</i> .....	33	<i>Sodium as NA</i> .....	62
<i>Barium</i> .....	11	<i>Light Attenuation Coefficient</i> .....	34	<i>Solids, Dissolved</i> .....	63
<i>Beryllium</i> .....	12	<i>Magnesium as MG</i> .....	35	<i>Solids, Total Suspended</i> .....	64
<i>Biochemical Oxygen Demand</i> .....	49	<i>Manganese</i> .....	36	<i>Streptococci, Fecal</i> .....	65
<i>Cadmium</i> .....	13	<i>Mercury</i> .....	37	<i>Sulfate as SO4</i> .....	66
<i>Calcium</i> .....	14	<i>Nickel</i> .....	38	<i>Temperature</i> .....	67
<i>Carbon, Dissolved Organic as C</i> .....	15	<b>Nitrogen:</b>		<i>Thallium</i> .....	68
<i>Carbon, Total Organic as C</i> .....	16	<i>Ammonia, Unionized</i> .....	8	<i>Tin</i> .....	69
<i>Chloride</i> .....	17	<i>Nitrate</i> .....	39	<i>Total Cobalt</i> .....	23
<b>Chlorophyll:</b>		<i>Nitrate Nitrite as N</i> .....	40	<i>Total Coliform</i> .....	25
<i>Chlorophyll a</i> .....	18	<i>Nitrite Nitrogen as N</i> .....	41	<i>Total Kjeldahl Nitrogen as N</i> .....	46
<i>Chlorophyll b</i> .....	19	<i>Nitrogen Ammonia as N</i> .....	42	<i>Total Nitrogen as N</i> .....	45
<i>Chlorophyll c</i> .....	20	<i>Nitrogen, Inorganic as N</i> .....	43	<i>Total Organic Carbon as C</i> .....	16
<i>Chlorophyll, Corrected</i> .....	21	<i>Nitrogen, Organic as N</i> .....	44	<i>Total Orthophosphate as P</i> .....	48
<i>Chromium III</i> .....	22	<i>Nitrogen, Total as N</i> .....	45	<i>Total Phosphorus as P</i> .....	54
<i>Cobalt, Total</i> .....	23	<i>Nitrogen, Total Kjeldahl as N</i> .....	46	<i>Total Residue</i> .....	56
<i>Coliform, Fecal</i> .....	24	<i>Organic Nitrogen as N</i> .....	44	<i>Total Filtrable Dried Residue</i> .....	57
<i>Coliform, Total</i> .....	25	<i>Orthophosphate, Dissolved as P</i> .....	47	<i>Total Suspended Solids</i> .....	64
<i>Color</i> .....	26	<i>Orthophosphate, Total as P</i> .....	48	<i>Total Vanadium</i> .....	71
<i>Conductance</i> .....	27	<b>Oxygen:</b>		<i>Turbidity</i> .....	70
<i>Copper</i> .....	28	<i>Oxygen Demand, Biochemical</i> .....	49	<i>Unionized Ammonia</i> .....	8
<i>Corrected Chlorophyll</i> .....	21	<i>Oxygen, Dissolved</i> .....	50	<i>Vanadium, Total</i> .....	71
<i>Dissolved Organic Carbon as C</i> .....	15	<i>Oxygen Percent Saturation (Dissolved)</i> .....	51	<i>Zinc</i> .....	72
<i>Dissolved Orthophosphate as P</i> .....	47	<b>pH</b> .....	52	<b>SOURCES</b> .....	73
<i>Dissolved Oxygen</i> .....	50	<i>Pheophytin a</i> .....	53	<b>ENDNOTES</b> .....	75
<i>(Dissolved) Oxygen Percent Saturation</i> .....	51	<b>Phosphorus:</b>			
<i>Dissolved Solids</i> .....	63	<i>Orthophosphate, Dissolved as P</i> .....	47		
		<i>Orthophosphate, Total as P</i> .....	48		
		<i>Phosphorus, Total as P</i> .....	54		

## Nitrogen, Total as N (TN)

Milligrams per liter (mg/L)

Total nitrogen is the combined measurement of nitrate (NO<sub>3</sub>), nitrite (NO<sub>2</sub>), ammonia, and organic nitrogen found in water.

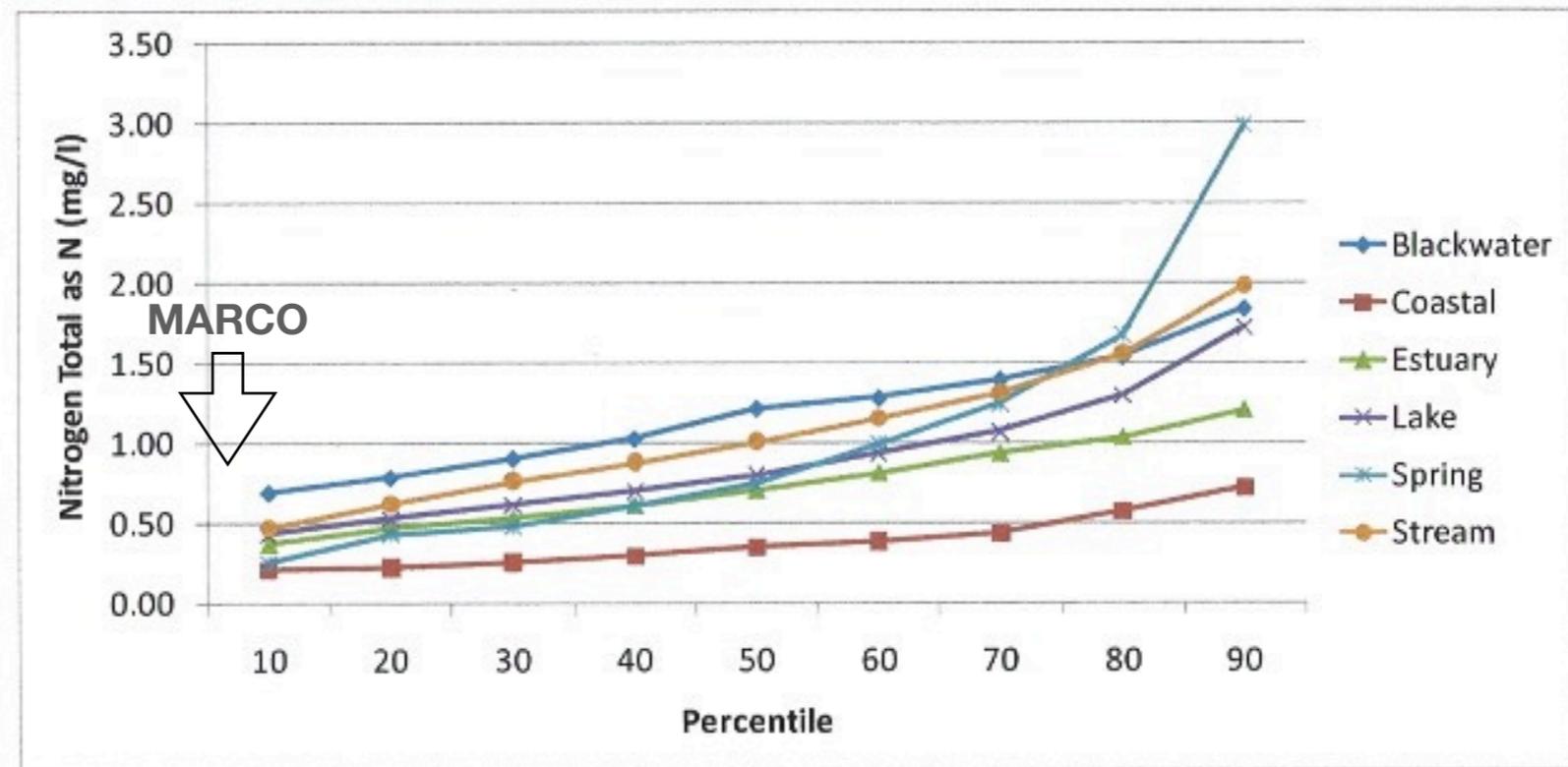
Nitrogen compounds function as important nutrients for many aquatic organisms and are essential to the chemical processes that occur between land, air, and water. The most readily bioavailable forms of nitrogen are ammonia and nitrate. These compounds, in conjunction with other nutrients, serve as an important base for primary productivity.

The major sources of excessive amounts of nitrogen in surface water are the effluent from municipal treatment plants and runoff from agricultural sites. When nutrient concentrations consistently exceed natural levels, the resulting nutrient imbalance can cause undesirable changes in a waterbody's biological community and increase the rate of eutrophication (or aging) in an aquatic system. Usually, the eutrophication process is observed as a change in the structure of the algal community and includes severe algal blooms that may cover large areas of a waterbody for extended periods. Large blooms are generally followed by a depletion in dissolved oxygen concentrations as a result of algal decomposition.

Source: FDEP

## Percentile distribution of water quality parameters by waterbody type

TN

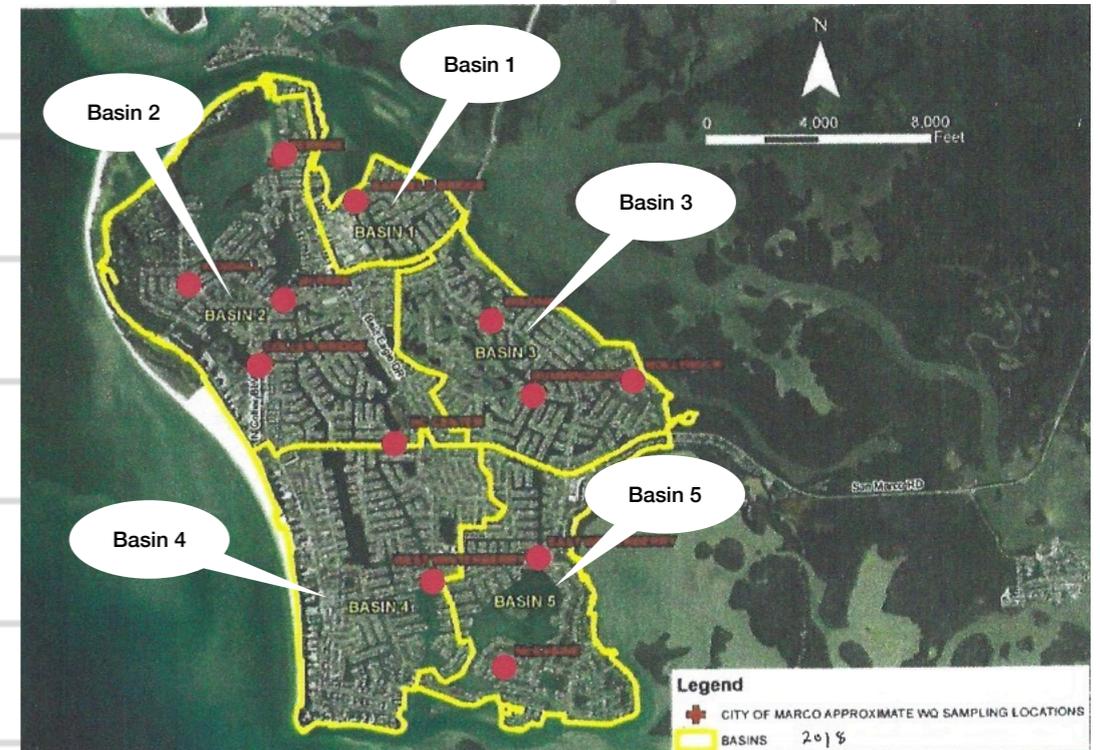
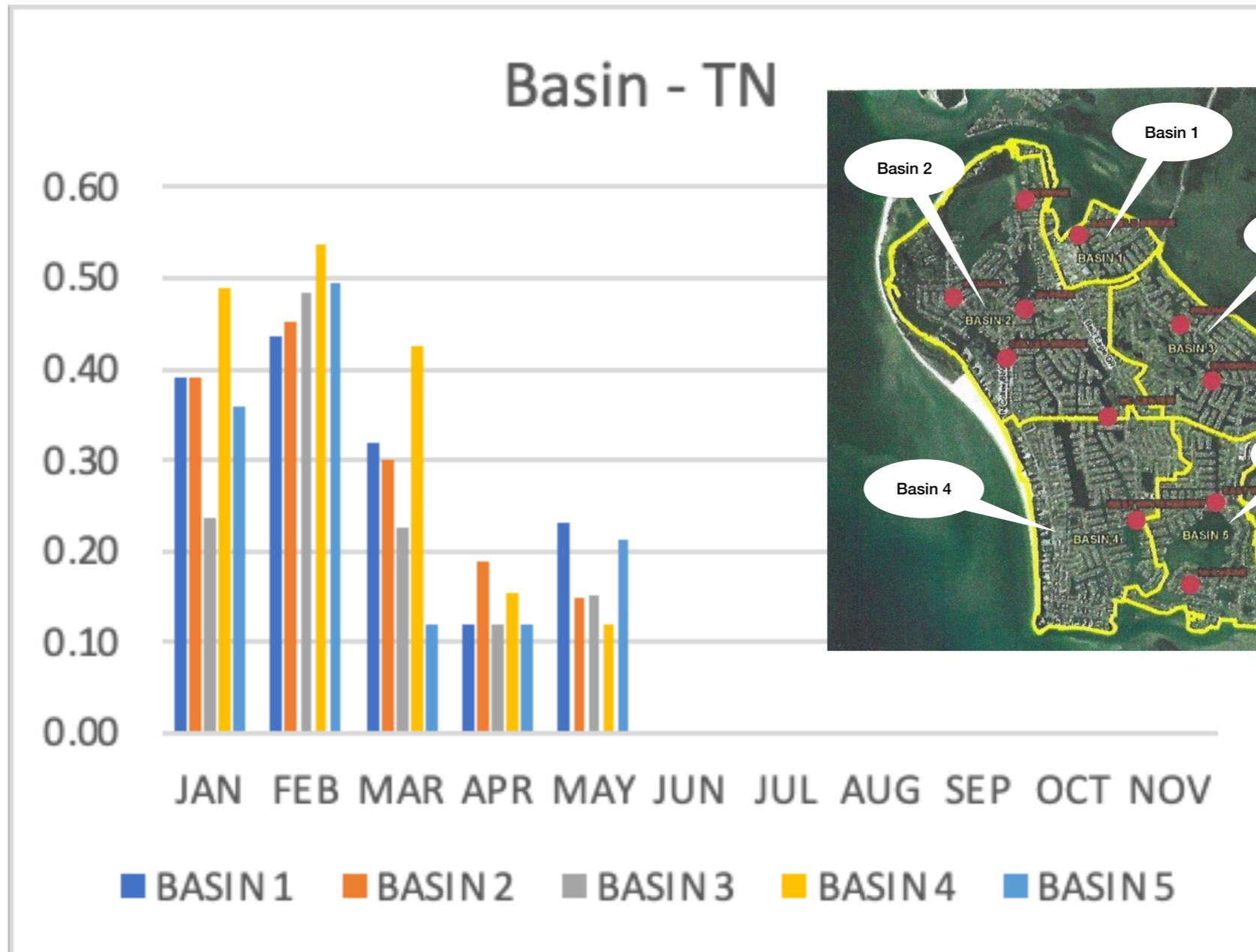


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	0.69	0.21	0.37	0.44	0.25	0.47
20	0.78	0.23	0.47	0.53	0.43	0.62
30	0.90	0.26	0.53	0.62	0.48	0.76
40	1.03	0.29	0.61	0.70	0.60	0.88
50	1.21	0.35	0.70	0.80	0.74	1.00
60	1.28	0.38	0.81	0.93	0.99	1.15
70	1.39	0.43	0.93	1.07	1.24	1.31
80	1.54	0.57	1.03	1.30	1.67	1.56
90	1.84	0.72	1.20	1.72	2.98	1.98
# of waterbodies	52	77	392	967	96	1313

Marco TN currently lower than 95% of Florida Estuaries (n=392)



# Total Nitrogen (TN) - by Basin



TN trend is down - consistently across basins



## Phosphorus, Total as P (TP)

Milligrams per liter (mg/L)

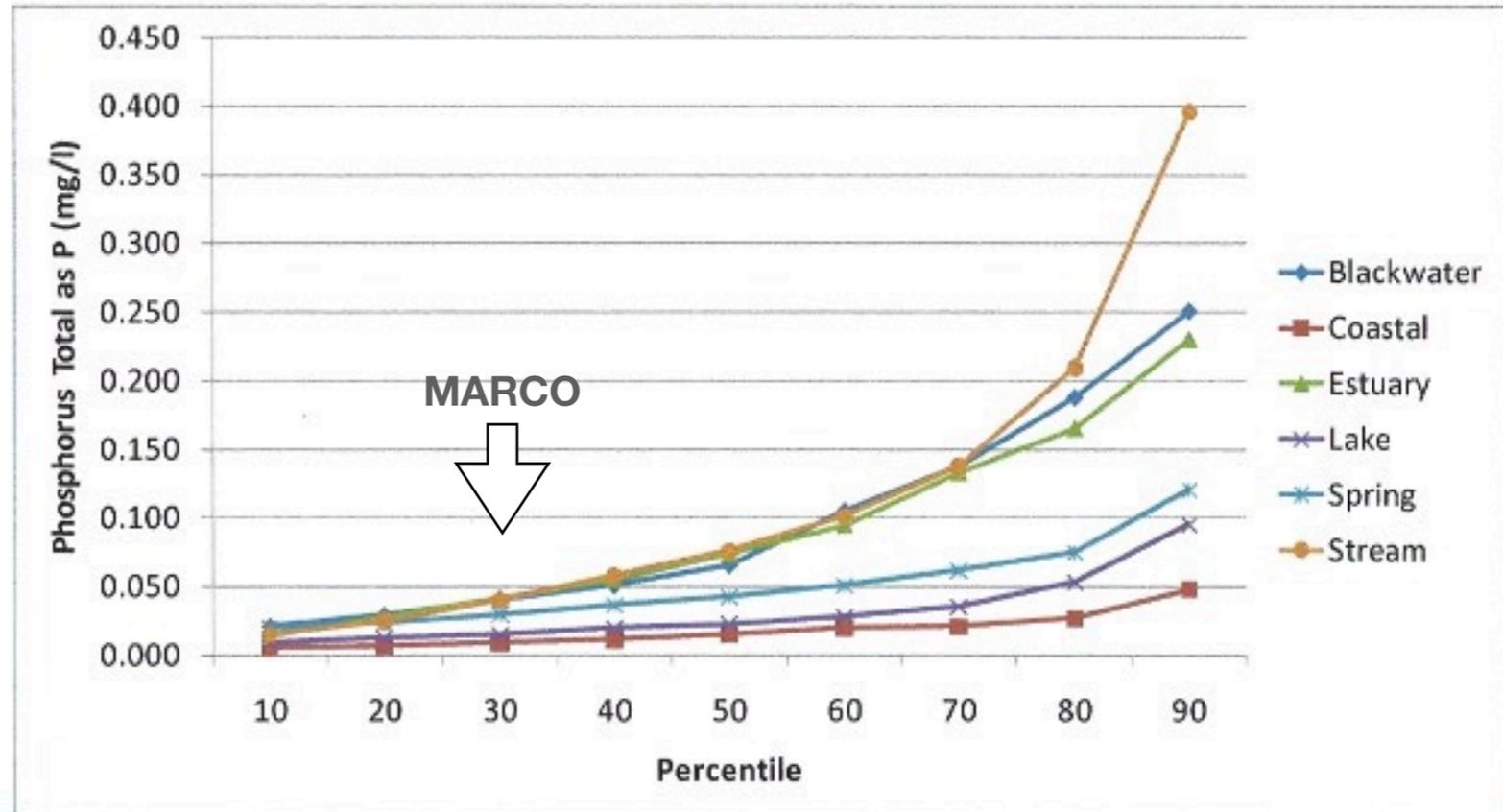
Phosphorus is one of the primary nutrients that regulates the growth of algae and larger aquatic plants, particularly in fresh water. Phosphate, the form in which almost all phosphorus is found in water, can enter the aquatic environment in a number of ways. Natural processes transport phosphate to water through atmospheric deposition, ground water percolation, and terrestrial runoff. Municipal treatment plants, industries, agriculture, and domestic activities also contribute to phosphate loading through direct discharge and natural transport mechanisms. The very high levels of phosphorus in some of Florida's streams and estuaries are usually caused by phosphate mining and fertilizer processing activities.

High phosphorus concentrations are frequently responsible for accelerating the process of eutrophication (or aging) of a waterbody. Once phosphorus and other important nutrients enter the ecosystem, they are extremely difficult to remove because they are taken up by plants or deposited in sediments. Nutrients, particularly phosphates, deposited in sediments generally are redistributed into the water. This type of cycling compounds the difficulty of halting the eutrophication process.

Source: FDEP

## Percentile distribution of water quality parameters by waterbody type

TP

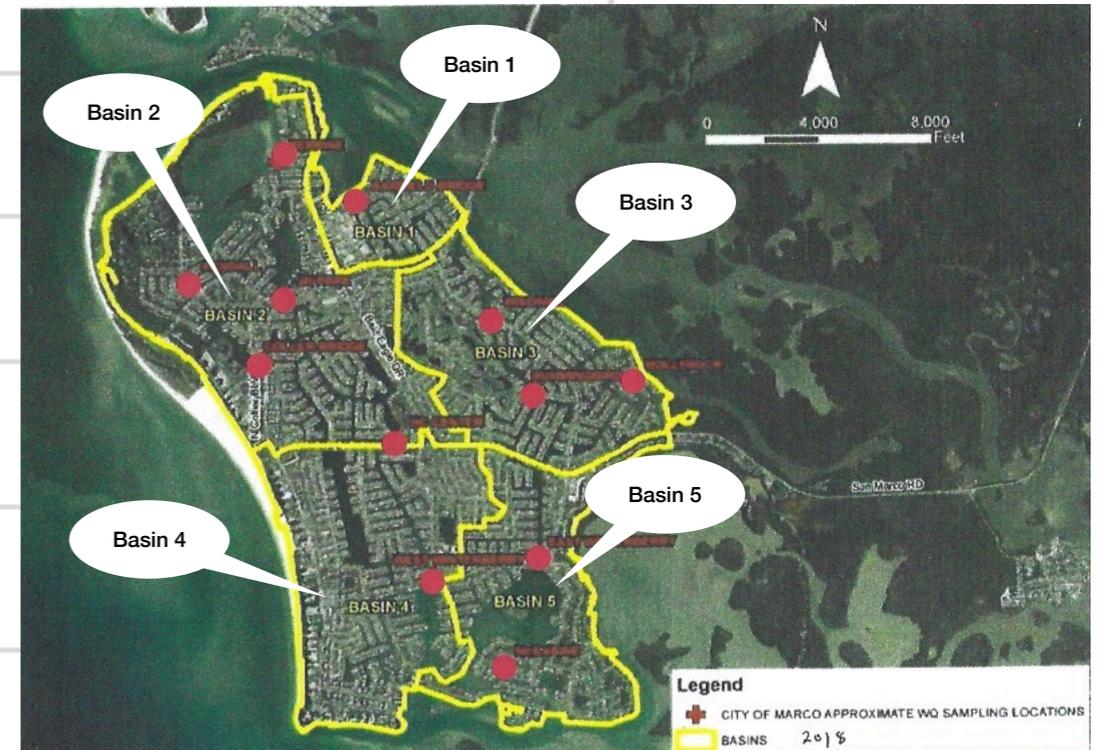
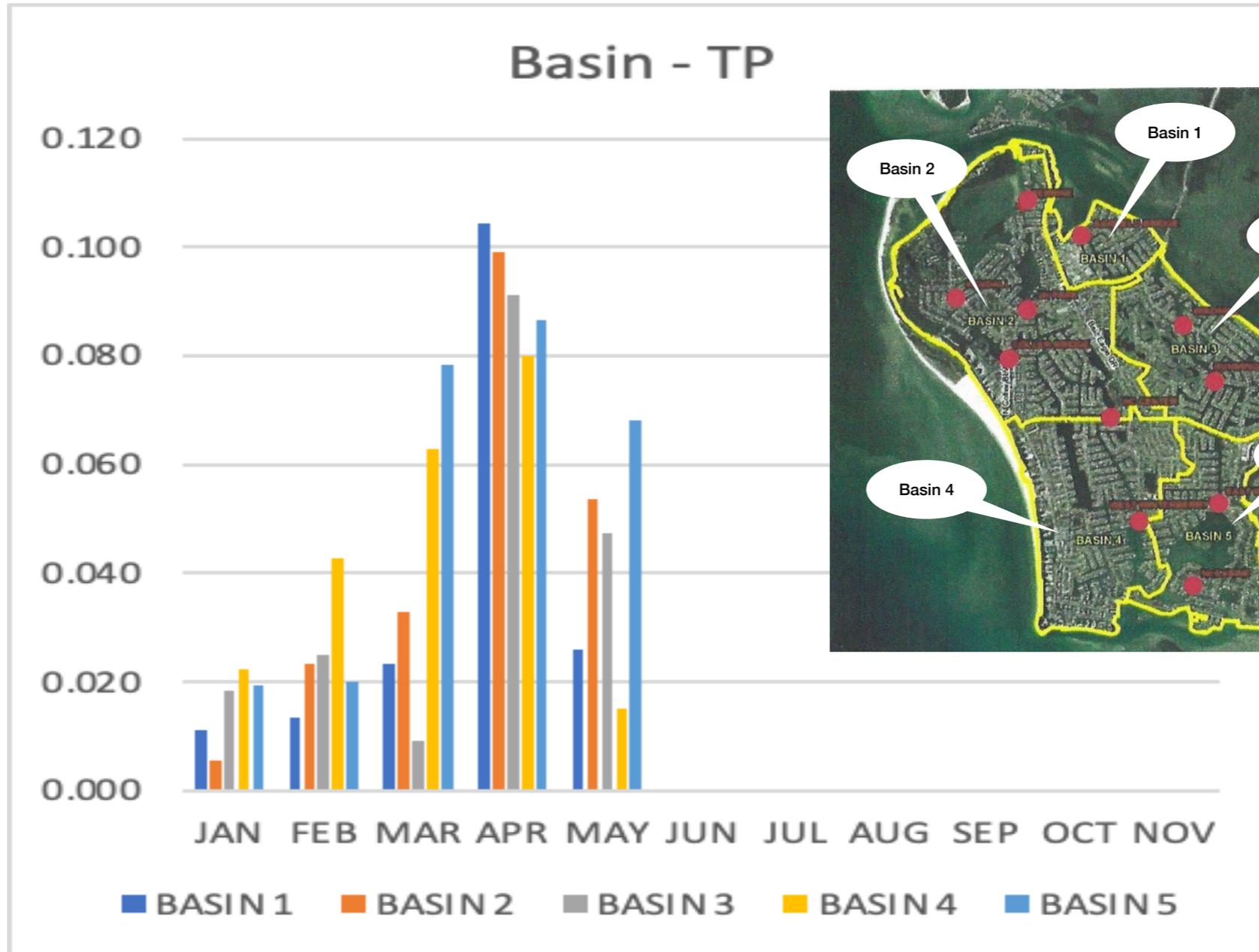


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	0.021	0.005	0.014	0.009	0.020	0.015
20	0.029	0.007	0.028	0.012	0.024	0.025
30	0.040	0.009	0.042	0.015	0.030	0.040
40	0.051	0.012	0.055	0.020	0.036	0.058
50	0.065	0.015	0.073	0.023	0.043	0.076
60	0.105	0.020	0.095	0.028	0.051	0.101
70	0.137	0.021	0.133	0.035	0.062	0.138
80	0.188	0.027	0.165	0.053	0.075	0.209
90	0.251	0.048	0.230	0.095	0.120	0.395
# of waterbodies	52	78	396	968	96	1317

Marco TP is lower than 70% of Florida Estuaries



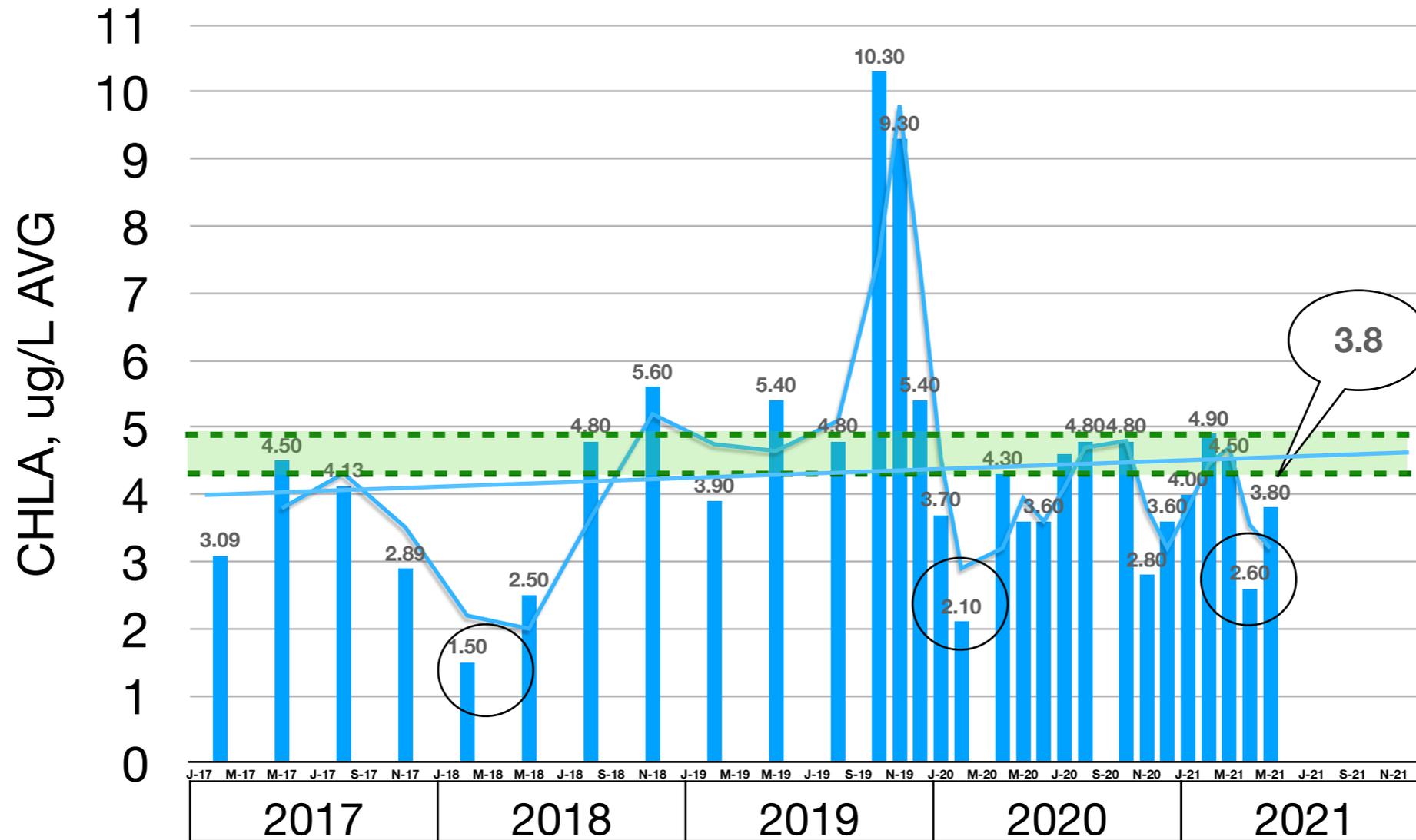
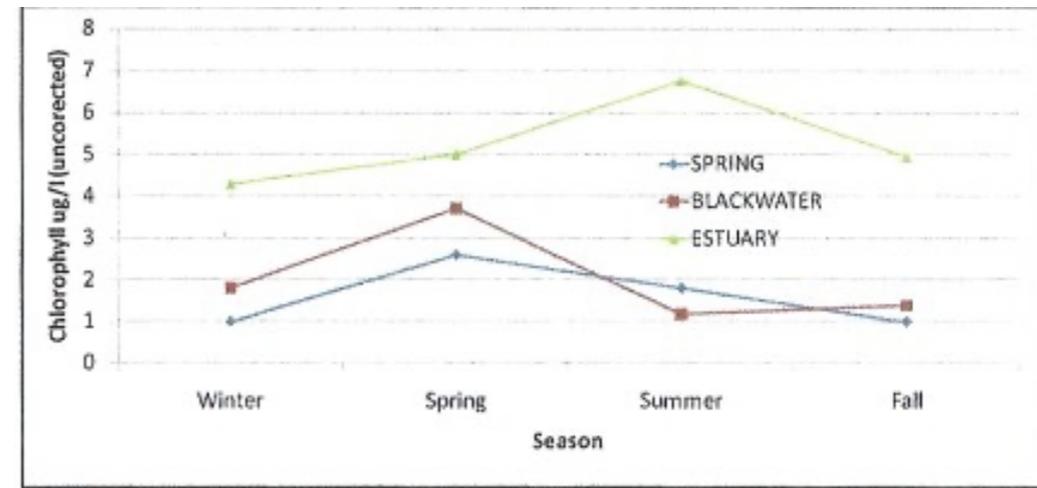
# Total Phosphorus (TP) - by Basin



TP is cyclical and trending upward



# Chlorophyll-a (CHLA)



CHLA variation more visible - without the S-20 outlier

## Chlorophyll a (CHLA)

Micrograms per liter ( $\mu\text{g/L}$ )

Chlorophyll, a green pigment found in plants, is an essential component in photosynthesis, which is the process of converting light energy into chemical energy. The predominant form of chlorophyll is chlorophyll a, a yellow-green pigment. Other pigments include chlorophylls b, c, and d, xanthophylls, and carotenes. Chlorophyll concentrations vary seasonally.<sup>3</sup>

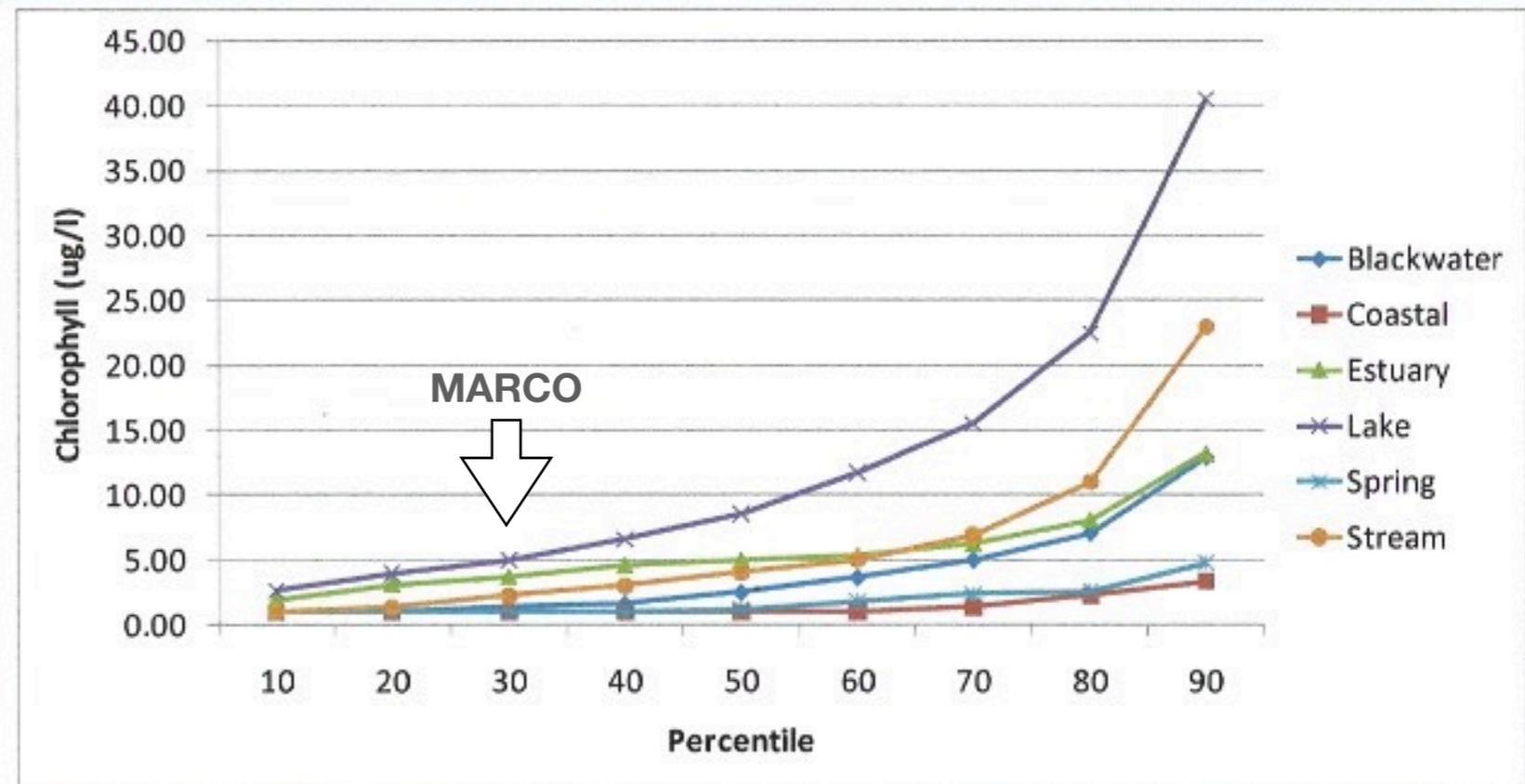
The amount of chlorophyll a in a water sample is most often used to estimate the amount of algal biomass in the water column. Chlorophyll a measurements are also used to estimate the trophic state of a waterbody, particularly lentic (still) waters. Defined as the degree of biological productivity of a waterbody, trophic state generally indicates the amount of algae, aquatic macrophytes, fish, and wildlife that a waterbody can produce and sustain.

Chlorophyll a values ranging from 0 to 14  $\mu\text{g/L}$  indicate oligotrophic conditions, 15 to 25  $\mu\text{g/L}$  represent mesotrophic conditions, 26 to 40  $\mu\text{g/L}$  indicate eutrophic conditions, and above 40  $\mu\text{g/L}$  indicate hypereutrophic conditions. These designations are useful only as a general guide, except when used in conjunction with other biological and water chemistry data.

Source: Florida LakeWatch

## Percentile distribution of water quality parameters by waterbody type

CHLA

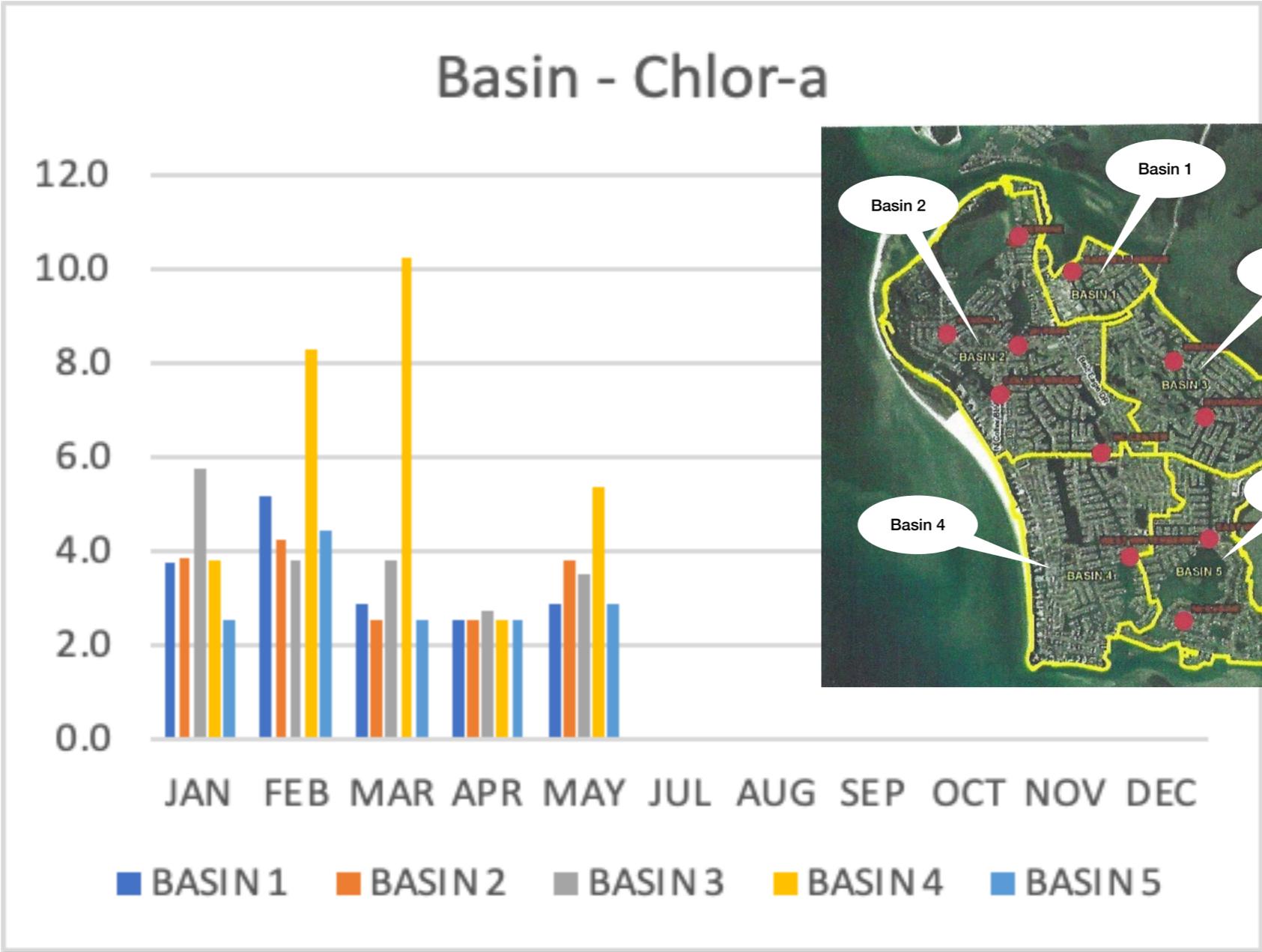


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	1.00	1.00	2.00	2.67	1.00	1.00
20	1.03	1.00	3.15	4.00	1.00	1.40
30	1.35	1.00	3.72	5.00	1.00	2.24
40	1.63	1.00	4.60	6.60	1.00	3.00
50	2.50	1.00	5.00	8.55	1.18	4.00
60	3.63	1.05	5.35	11.75	1.80	5.00
70	4.98	1.40	6.23	15.50	2.40	6.89
80	7.06	2.30	8.10	22.50	2.60	11.00
90	12.90	3.40	13.20	40.50	4.75	22.93
# of waterbodies	20	71	295	848	56	684

Marco CHLA lower than 70% of Florida Estuaries

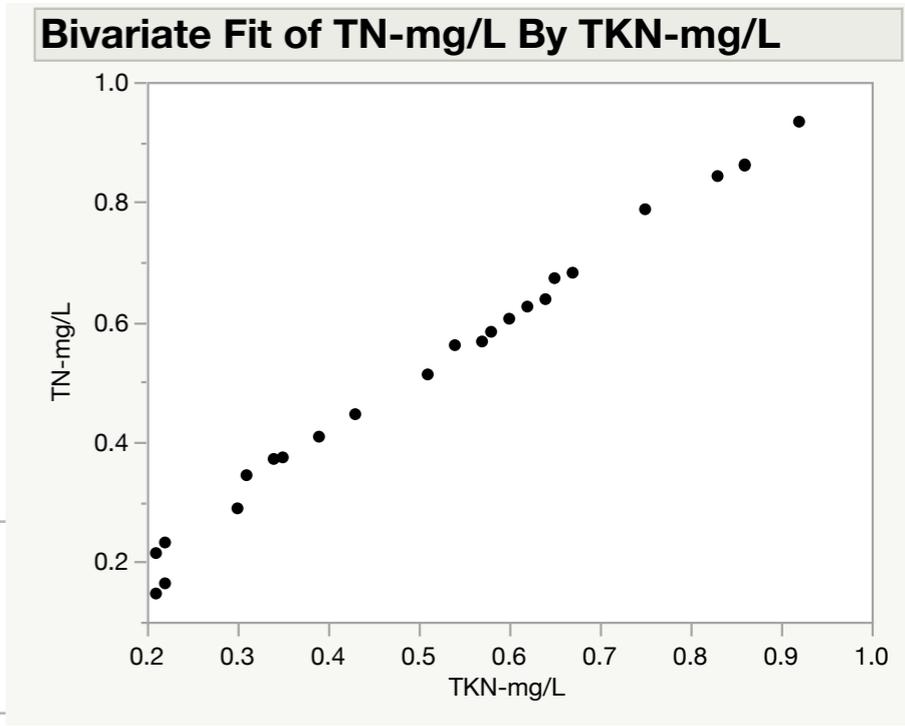
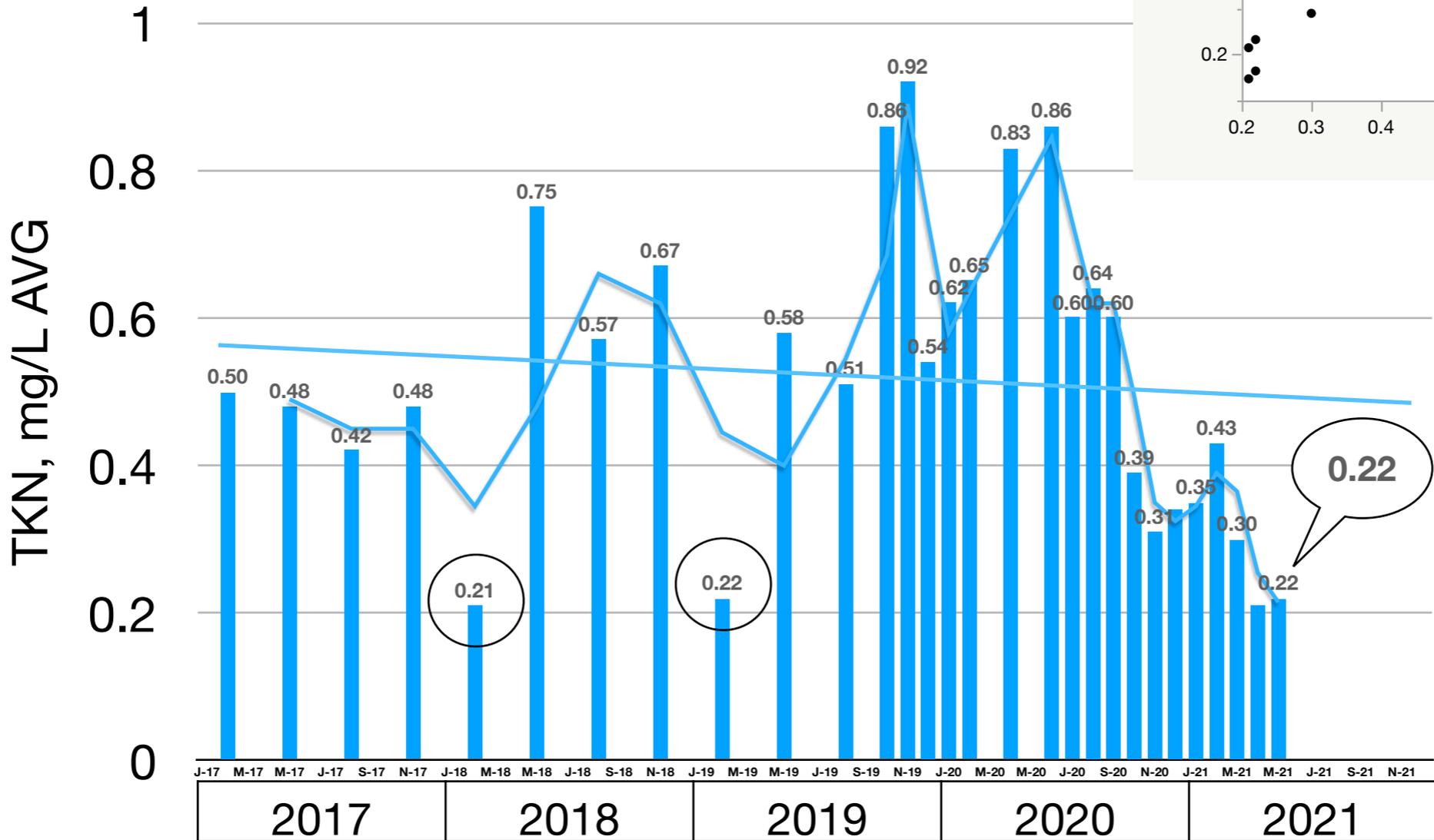


# Chlorophyll-a (CHLA) - by Basin



CHLA trend is flat - consistently across basins

# TKN Trend



TKN highly correlated with TN - cyclical and trending down

### Nitrogen, Total Kjeldahl as N (TKN)

Milligrams per liter (mg/L)

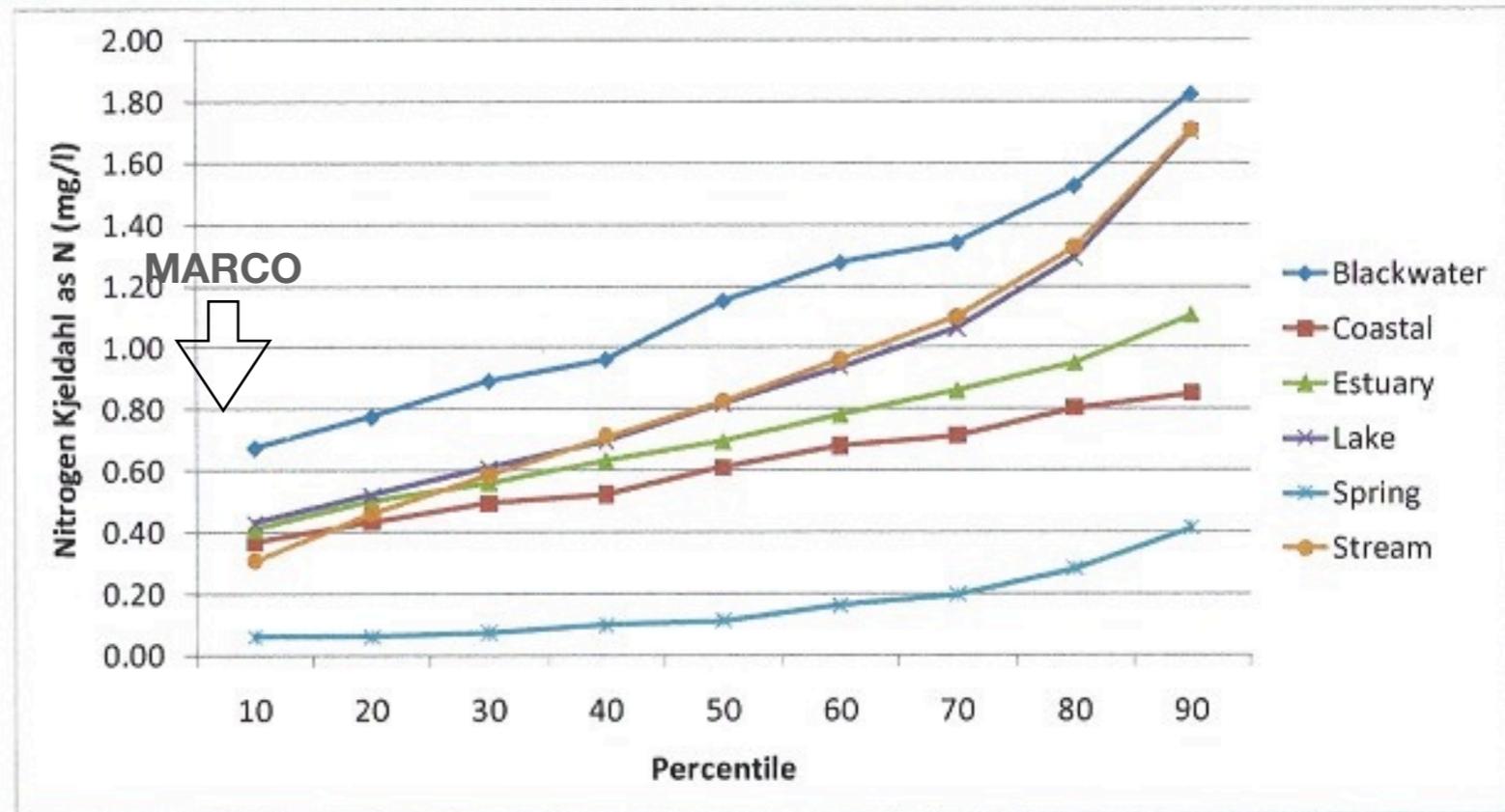
Total Kjeldahl nitrogen (TKN) is the analytical method used to measure the amount of organic nitrogen from plant and animal matter in a water sample. TKN is the combination of ammonia and organic nitrogen. Organic nitrogen includes such materials as proteins, peptides, nucleic acids, urea, and numerous synthetic organic compounds.

The Kjeldahl method breaks down the proteins and other organic substances in a water sample using sulfuric acid, in the presence of other catalysts. The nitrogen present is converted to ammonium sulphate, which is then measured by a titration or a colorimetric method.

Source: Orange County, Florida

### Percentile distribution of water quality parameters by waterbody type

TKN

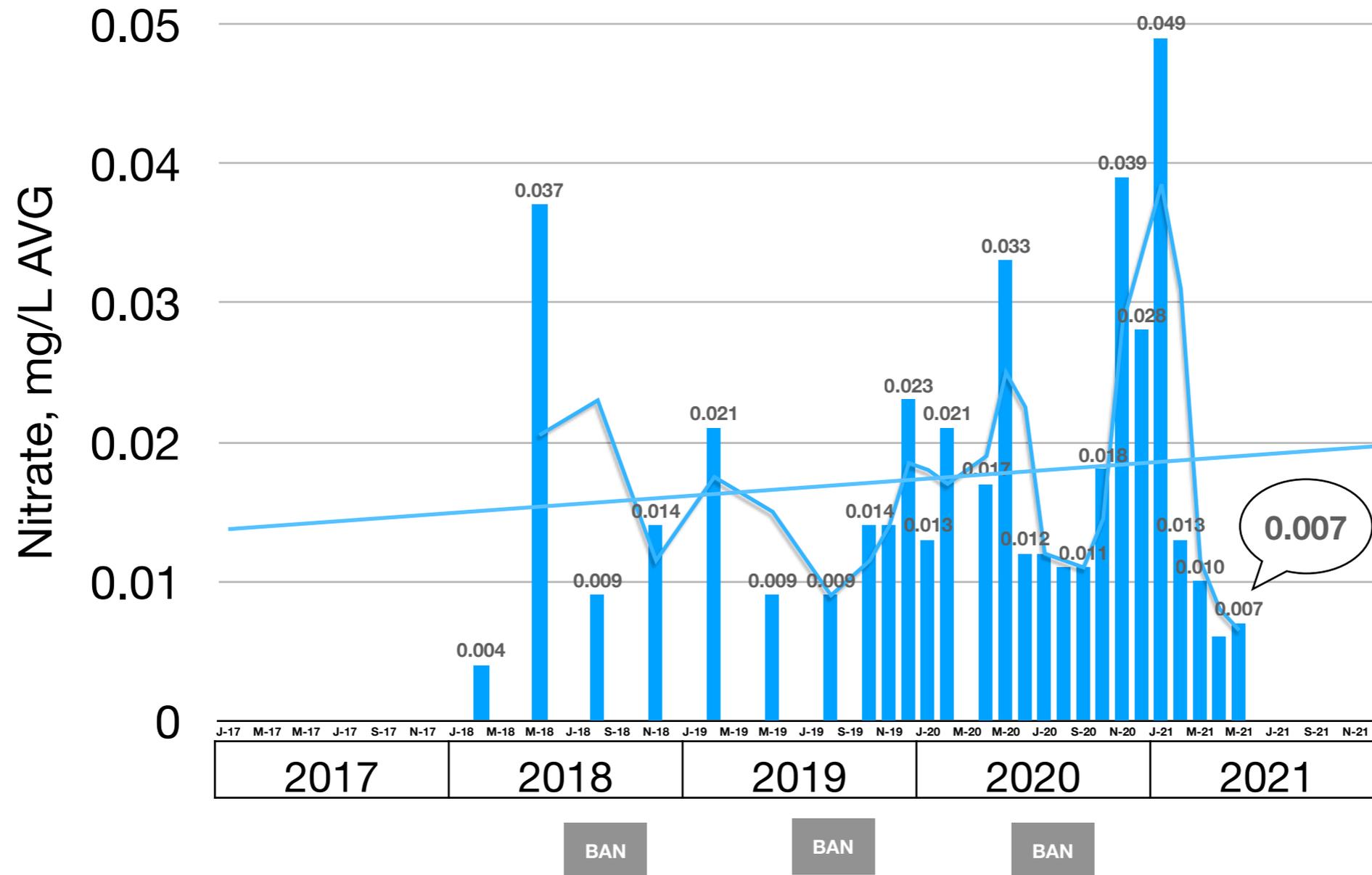


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	0.67	0.37	0.41	0.43	0.06	0.31
20	0.77	0.44	0.50	0.52	0.06	0.46
30	0.89	0.50	0.56	0.61	0.07	0.59
40	0.96	0.52	0.63	0.70	0.10	0.71
50	1.15	0.61	0.69	0.82	0.11	0.83
60	1.28	0.68	0.78	0.94	0.16	0.96
70	1.34	0.72	0.86	1.06	0.20	1.10
80	1.53	0.80	0.95	1.29	0.28	1.33
90	1.83	0.85	1.11	1.70	0.41	1.71
# of waterbodies	51	39	372	721	94	1292

Marco TKN lower than 95% of Florida Estuaries



# Nitrate Trend



Fertilizer ban appears to reduce Nitrate levels

## Nitrate (NO<sub>3</sub>)

Milligrams per liter (mg/L)

Nitrate is a form of nitrogen. Organic nitrates come mainly from septic systems, animal feedlots, fertilizers, manure, industrial wastewater, sanitary landfills, and garbage dumps. The primary inorganic nitrates are potassium nitrate and ammonium nitrate, both of which are widely used as fertilizers.

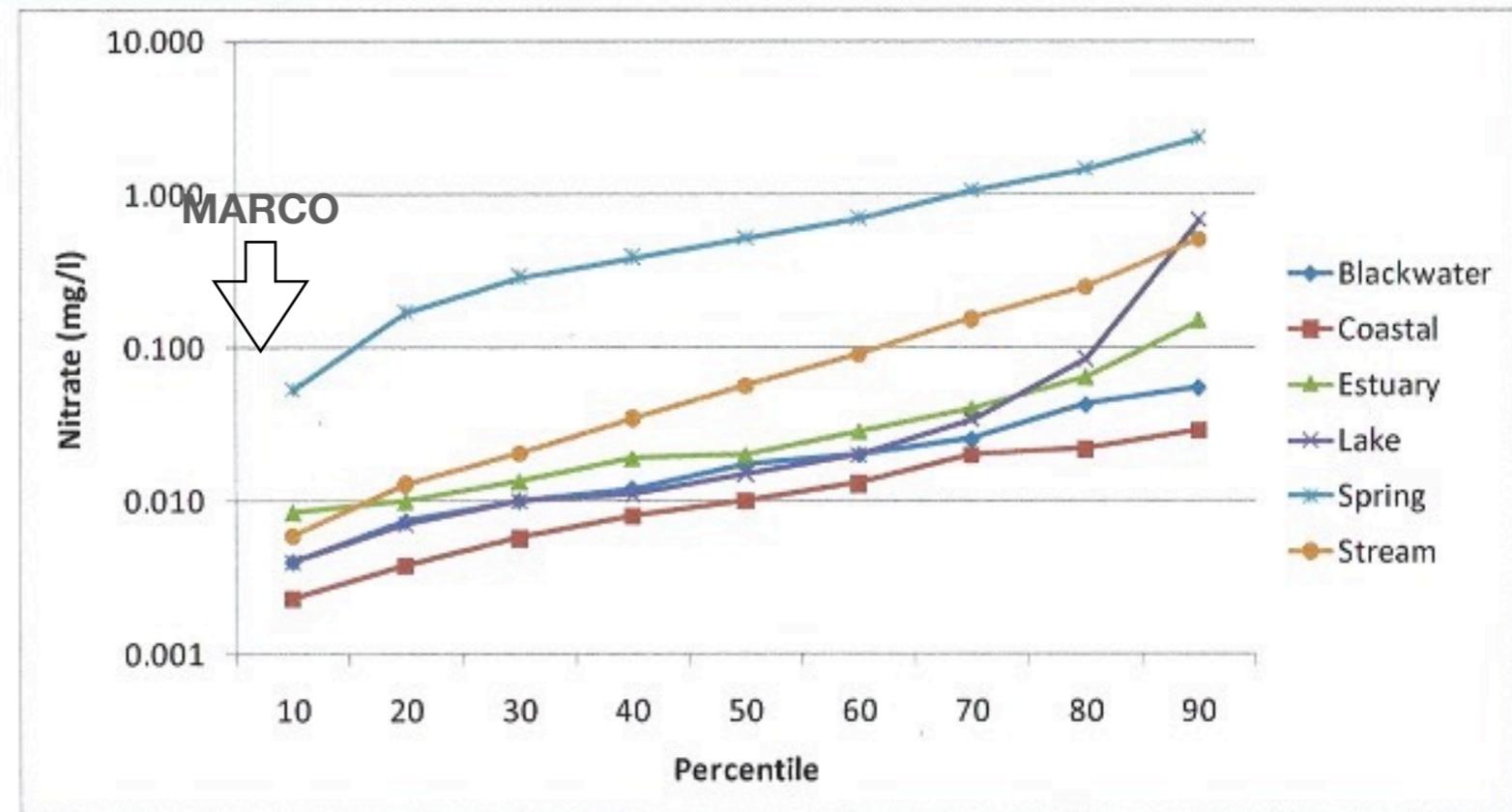
Since they are soluble and do not bind to soils, nitrates can easily enter ground water and surface water. Short-term exposure to drinking water with a nitrate level at or just above the maximum contaminant level (MCL) of 10 mg/L is a potential health problem primarily for infants. It can lead to a condition called "blue baby syndrome," or methemoglobinemia, in which the red blood cells cannot carry oxygen. Because nitrates are found in sewage or animal waste, excessive levels in drinking water may indicate the presence of other potentially harmful contaminants.

Excess nitrogen in surface water, in combination with other nutrients such as phosphorus, can accelerate the growth of algae and other aquatic plants. This can decrease oxygen levels and harm aquatic life.

Sources: EPA; Michigan and Idaho Departments of Environmental Quality; Orange County, Florida

## Percentile distribution of water quality parameters by waterbody type

NO<sub>3</sub>

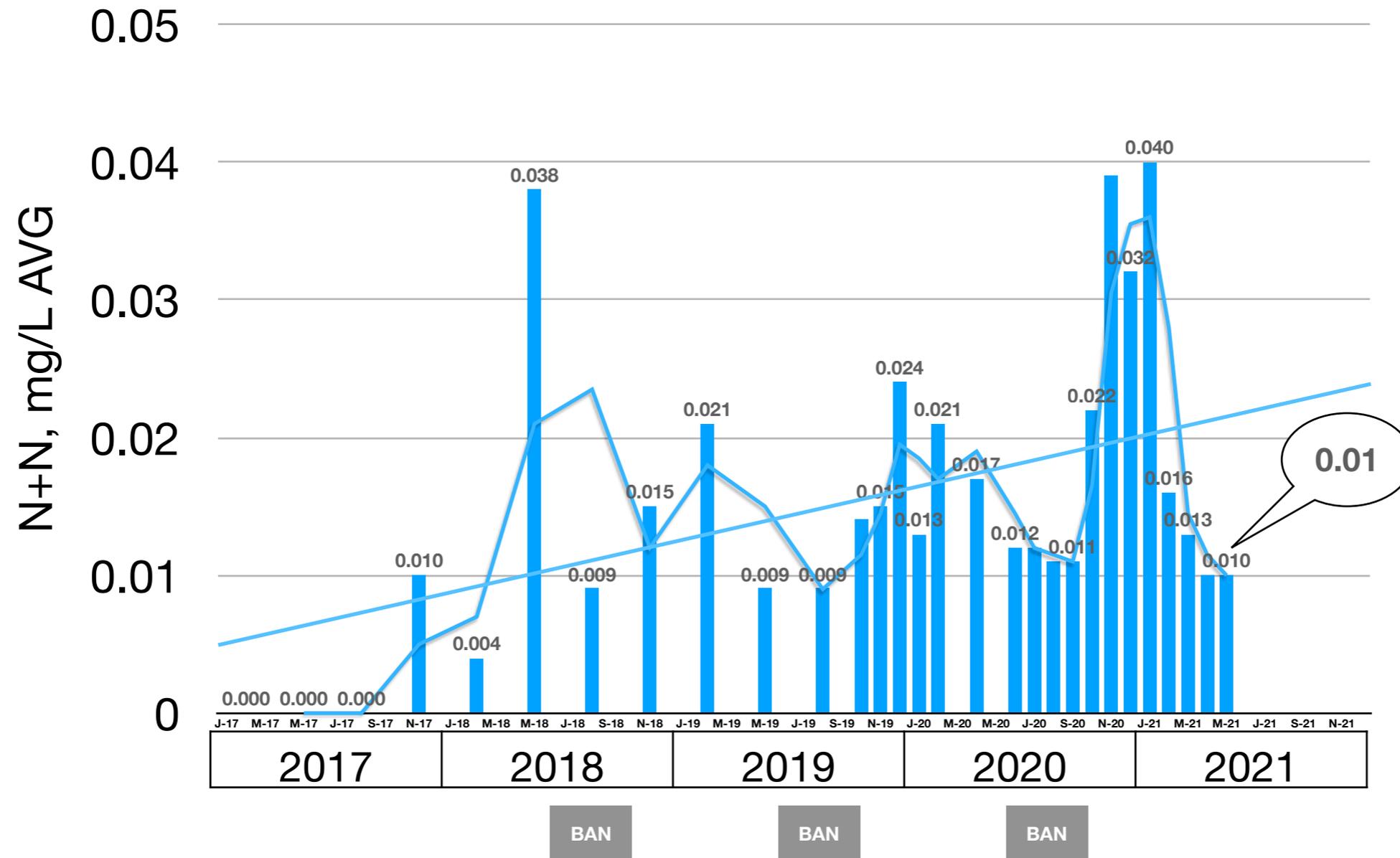


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	0.004	0.002	0.009	0.004	0.054	0.006
20	0.007	0.004	0.010	0.007	0.171	0.013
30	0.010	0.006	0.014	0.010	0.290	0.021
40	0.012	0.008	0.019	0.011	0.390	0.035
50	0.017	0.010	0.020	0.015	0.518	0.057
60	0.020	0.013	0.029	0.020	0.700	0.091
70	0.025	0.020	0.040	0.034	1.060	0.155
80	0.043	0.022	0.064	0.085	1.480	0.250
90	0.055	0.029	0.150	0.678	2.340	0.512
# of waterbodies	51	52	385	831	96	1303

Marco NO<sub>3</sub> lower than 95% of Florida Estuaries



# N+N Trend



Fertilizer ban appears to reduce N+N level during the Summer

## Nitrate Nitrite as N (NO3O2)

Milligrams per liter (mg/L)

Nitrate nitrite, which is highly water soluble and easily used by algae, is a combination of all the intermediate forms of nitrogen in the oxidation process.

Nitrate does not normally cause health problems unless it is reduced to nitrite, which can cause a condition in infants known as "blue baby syndrome" (methemoglobinemia), in which the red blood cells cannot carry oxygen.

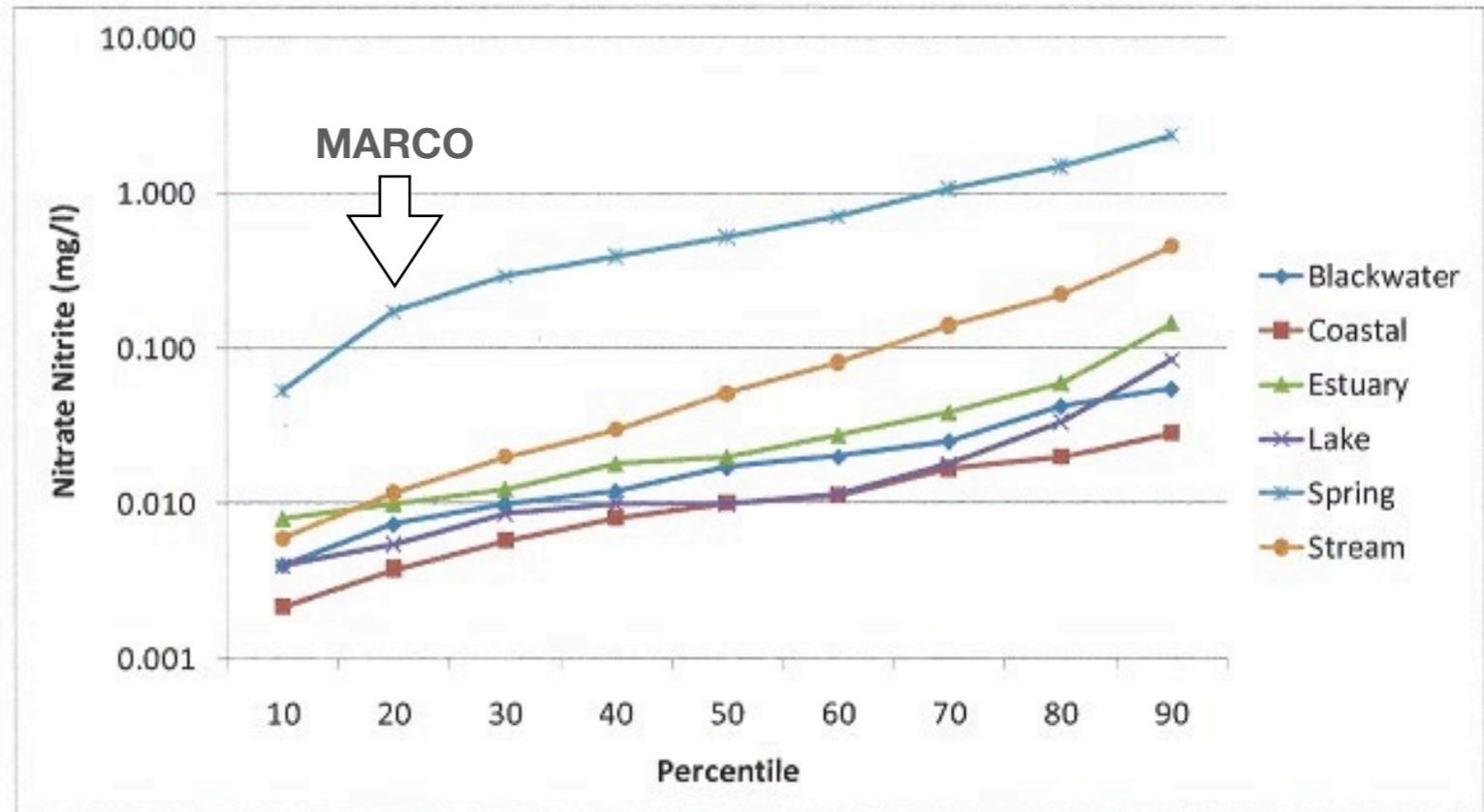
Nitrite can be toxic to fish. It is usually not a problem in waterbodies, however, because if enough oxygen is available in the water bacteria readily convert the nitrite to nitrate.

The EPA has established an MCL of 1 mg/L for nitrite in drinking water.

Source: Florida LakeWatch; Orange County, Florida

## Percentile distribution of water quality parameters by waterbody type

NO3O2



Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	0.004	0.002	0.008	0.004	0.054	0.006
20	0.007	0.004	0.010	0.006	0.171	0.012
30	0.010	0.006	0.012	0.009	0.290	0.020
40	0.012	0.008	0.018	0.010	0.390	0.030
50	0.017	0.010	0.020	0.010	0.518	0.051
60	0.020	0.011	0.028	0.012	0.700	0.081
70	0.025	0.017	0.039	0.018	1.060	0.140
80	0.043	0.020	0.060	0.034	1.480	0.223
90	0.055	0.029	0.145	0.085	2.340	0.451
# of waterbodies	51	51	384	792	96	1297

Marco N+N lower than 80% of Florida Estuaries





**Nitrite Nitrogen as N (NO<sub>2</sub>)**

Milligrams per liter (mg/L)

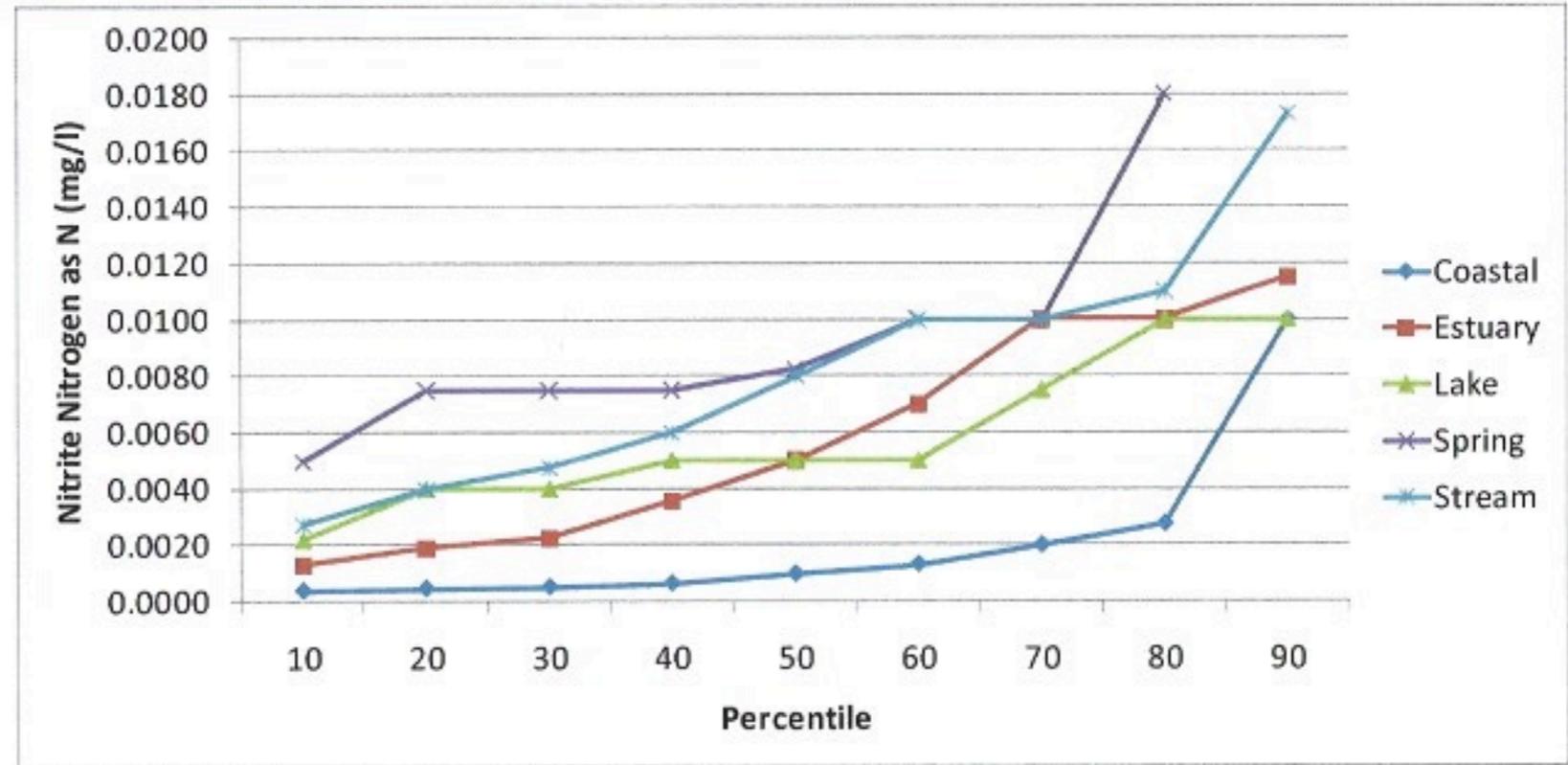
Nitrite nitrogen is a product of the oxidation of ammonia nitrogen. It is found in wastewater treatment plants and water distribution systems.

While nitrite nitrogen is not as toxic as ammonia nitrogen, it is harmful to aquatic species.

Source: Aquasol, Inc.; Orange County, Florida

**Percentile distribution of water quality parameters by waterbody type**

**NO<sub>2</sub>**

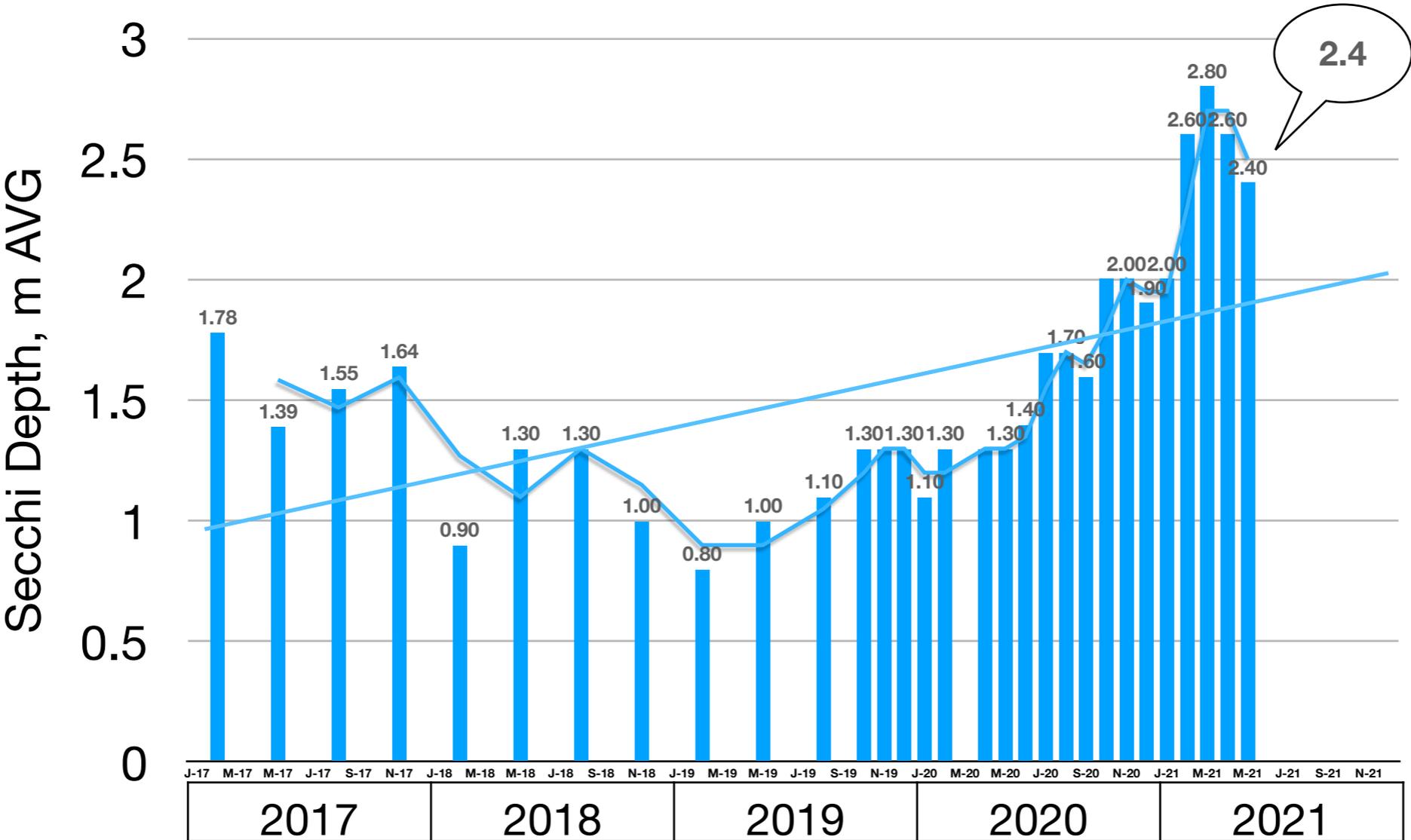


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	.	0.0004	0.0013	0.0022	0.0050	0.0028
20	.	0.0005	0.0019	0.0040	0.0075	0.0040
30	.	0.0005	0.0022	0.0040	0.0075	0.0048
40	.	0.0007	0.0035	0.0050	0.0075	0.0060
50	.	0.0010	0.0050	0.0050	0.0083	0.0080
60	.	0.0013	0.0070	0.0050	0.0100	0.0100
70	.	0.0020	0.0100	0.0075	0.0100	0.0100
80	.	0.0028	0.0100	0.0100	0.0180	0.0110
90	.	0.0100	0.0115	0.0100	0.1110	0.0173
# of waterbodies	.	25	105	459	18	284

**Nitrate can not be detected in Marco waterways**



# Secchi Depth Trend



Secchi Depth trending upward

## Secchi Depth (SD)

Meters (m)

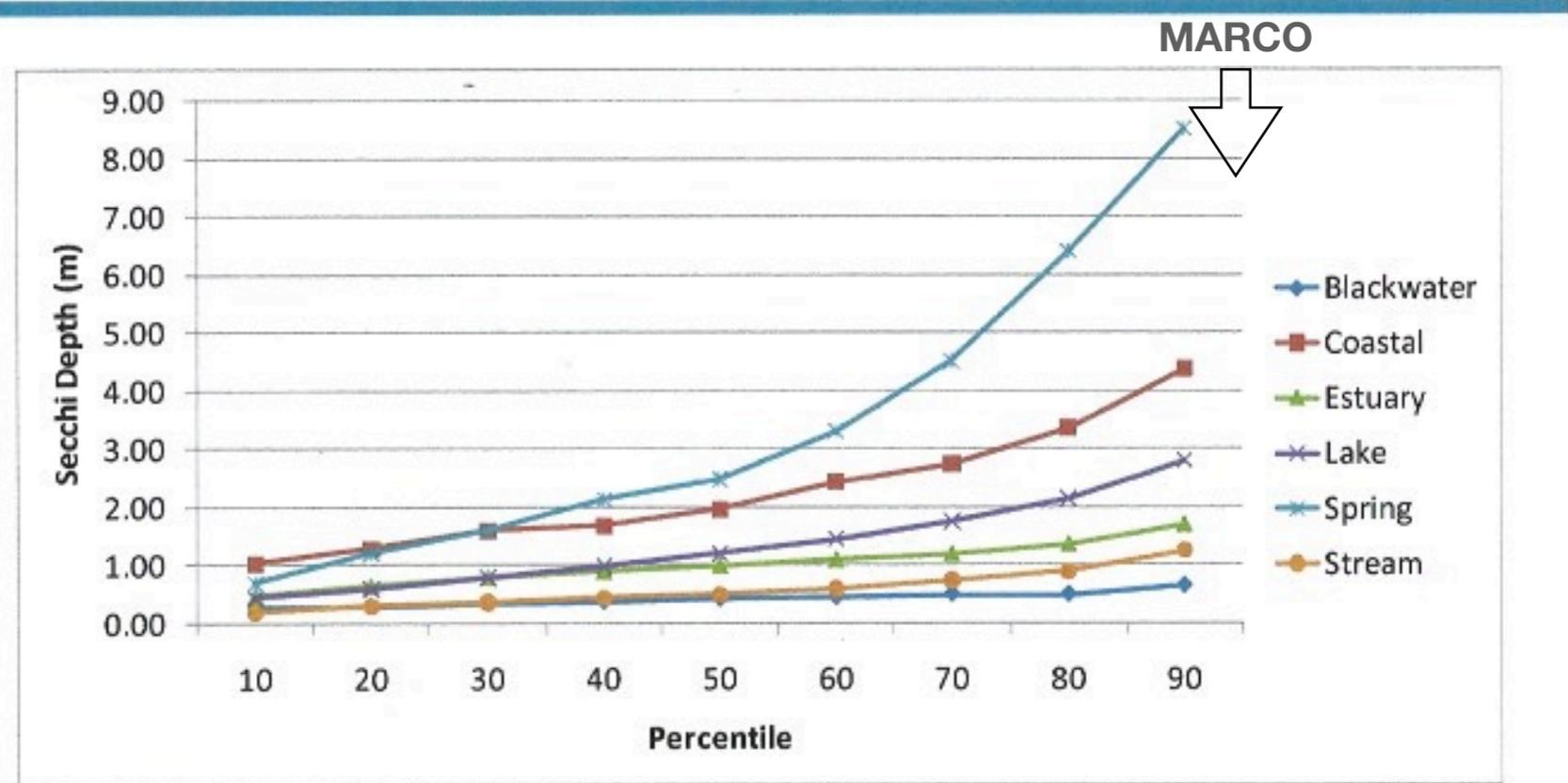
Secchi depth is a simple, effective measurement of water clarity. It is determined by observing the depth at which an 8-inch-diameter, black-and-white painted disc (named for its inventor, Pietro Angelo Secchi) becomes indistinguishable when viewed from the water's surface. A cord is attached through the center of the disc and marked off in intervals such as meters or feet. The disc is then lowered into the water to find the depth at which it first vanishes from sight. If the disc can still be seen as it rests on the lake bottom or if it disappears into plant growth, the depth at which this happens is not considered the Secchi depth.

The recorded Secchi depth largely depends on turbidity, water color, and total suspended solids. High values generally indicate good water quality; however, some highly colored waters (such as blackwater streams and some estuaries) may have very good water quality but a low Secchi depth value.

Source: Florida LakeWatch

## Percentile distribution of water quality parameters by waterbody type

SD

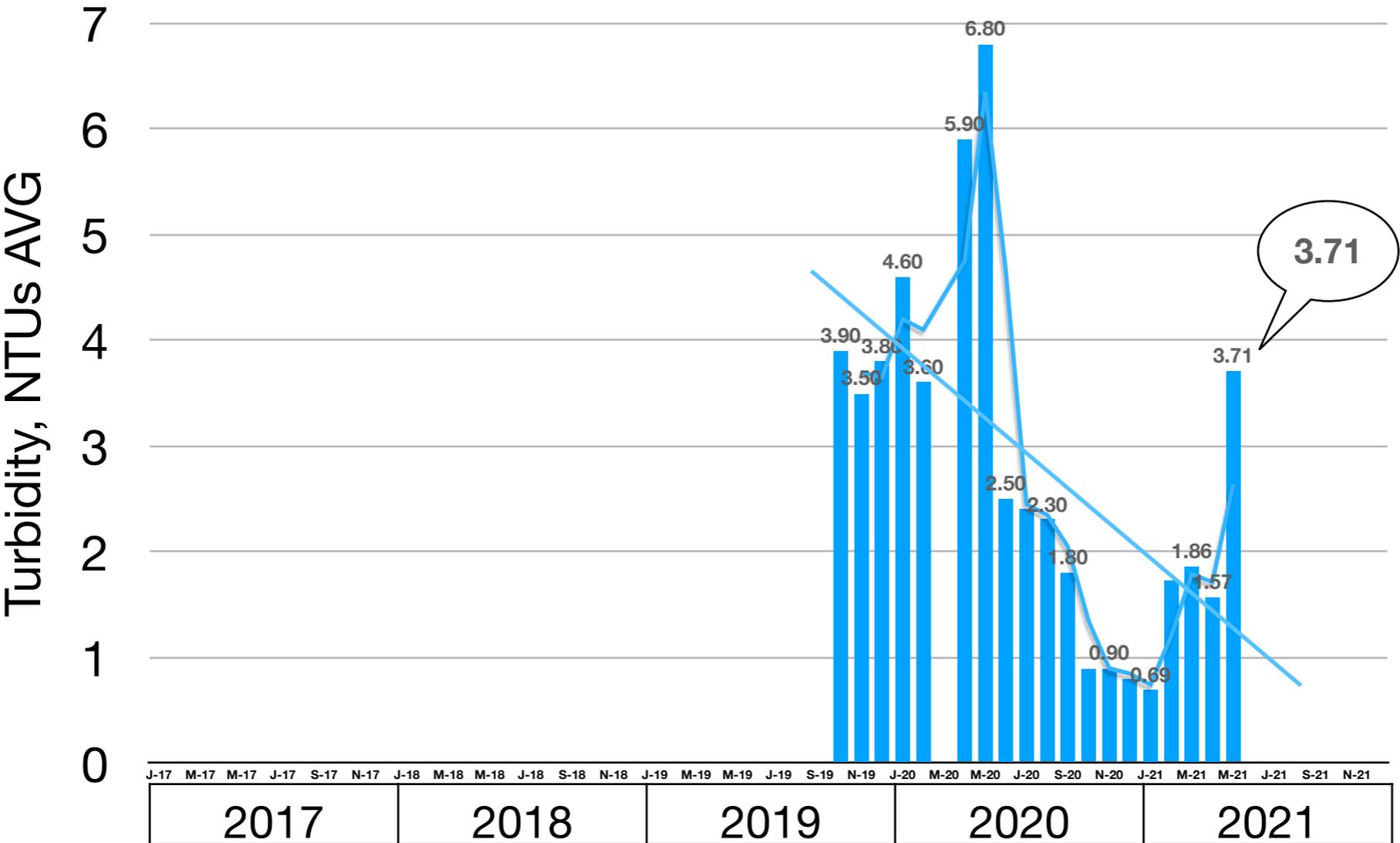


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	0.30	1.05	0.48	0.46	0.70	0.20
20	0.30	1.30	0.65	0.61	1.20	0.30
30	0.35	1.60	0.80	0.80	1.60	0.38
40	0.38	1.69	0.90	1.00	2.13	0.45
50	0.43	1.98	1.00	1.21	2.48	0.50
60	0.45	2.44	1.10	1.45	3.30	0.60
70	0.50	2.75	1.20	1.75	4.50	0.74
80	0.50	3.36	1.37	2.14	6.40	0.90
90	0.65	4.37	1.70	2.79	8.50	1.25
# of waterbodies	53	51	346	941	86	1211

**Marco Secchi Depth higher than 95% of Florida Estuaries**



# Turbidity Trend



Turbidity trending downward

## Turbidity (TURB)

Nephelometric turbidity units (NTUs)

Turbidity is the measurement of light dispersion caused by particulate material in the water column. Organic matter, including phytoplankton and inorganic particles, both contribute to turbidity. Obviously, turbidity and total suspended solids (TSS) are closely related.

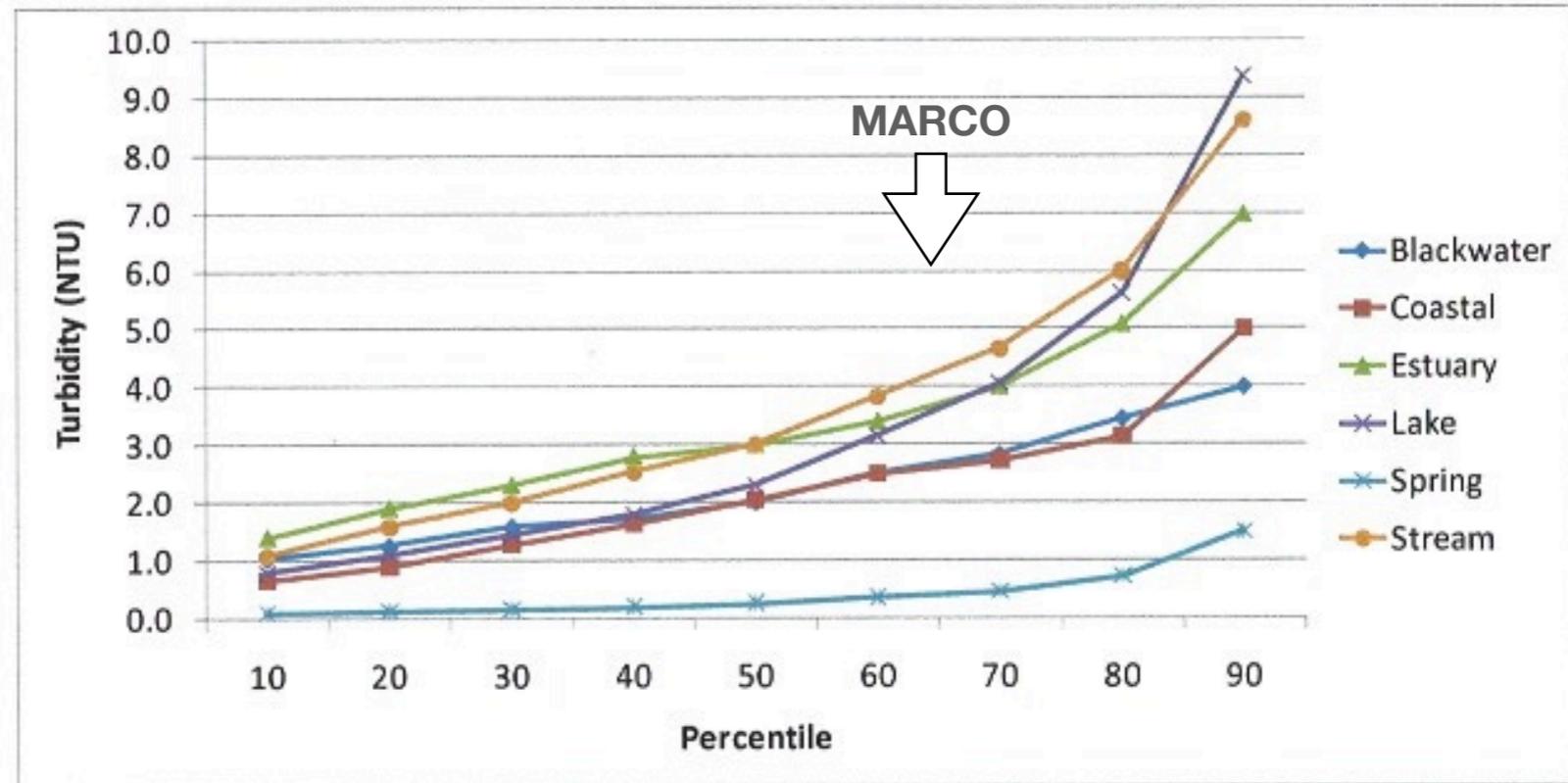
Turbidity and TSS contribute to decreased light penetration in the water column, and thus affect primary productivity. In turn, as primary productivity declines, the entire food chain is affected. Generally, material causing turbidity is eventually deposited in a stream bed, a downstream lake, or an estuary.

The deposition of excessive amounts of organic and inorganic matter has many adverse effects, including damage to the macroinvertebrate community, the reduction of areas used as spawning beds, and the removal of dissolved oxygen from the water column if the material is organic.

Source: FDEP

## Percentile distribution of water quality parameters by waterbody type

TURB

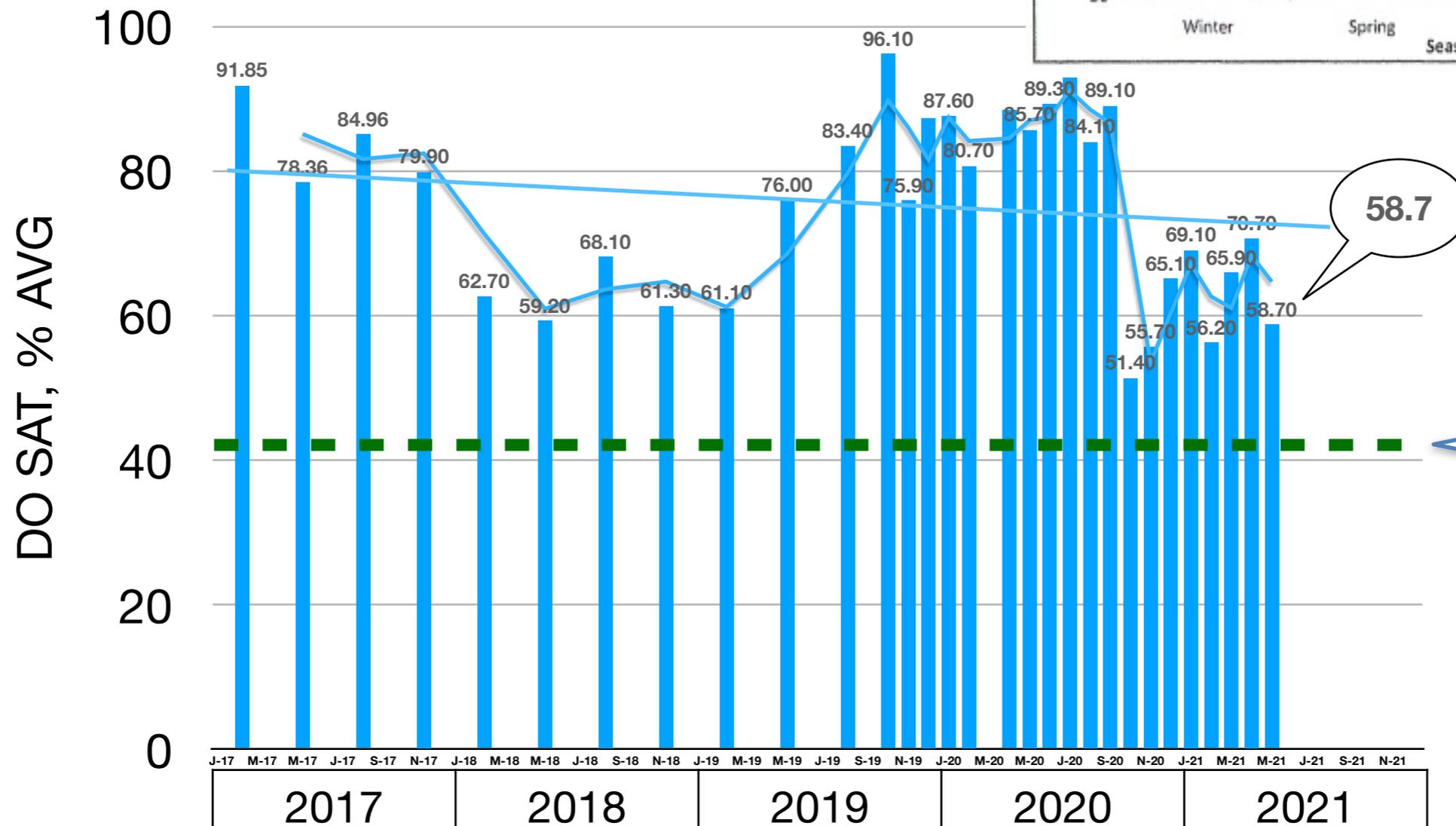
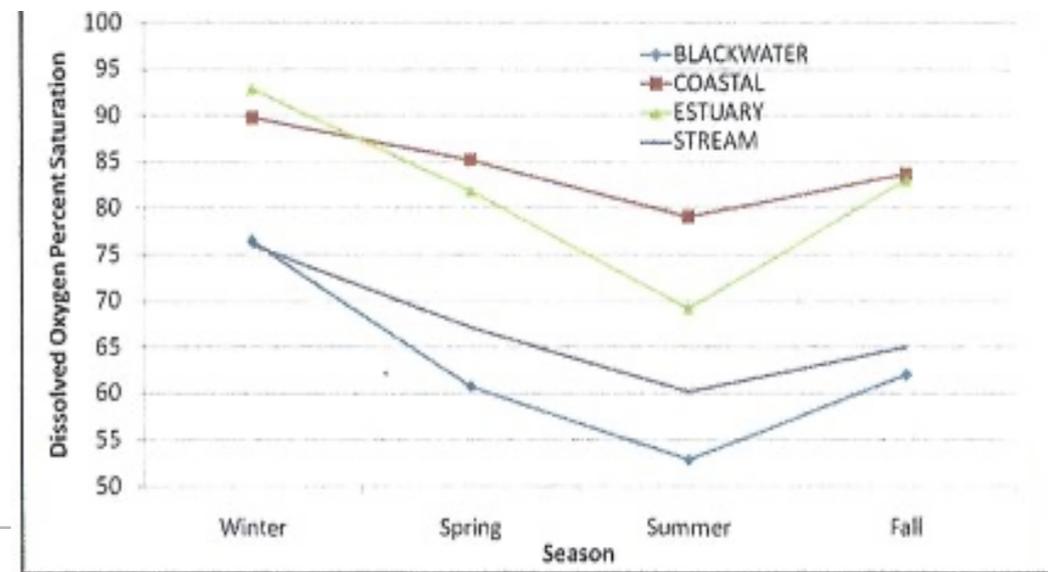


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	1.0	0.7	1.4	0.8	0.1	1.1
20	1.3	0.9	1.9	1.1	0.1	1.6
30	1.6	1.3	2.3	1.4	0.2	2.0
40	1.7	1.7	2.8	1.8	0.2	2.5
50	2.0	2.1	3.0	2.3	0.3	3.0
60	2.5	2.5	3.4	3.2	0.4	3.8
70	2.8	2.7	4.0	4.1	0.5	4.7
80	3.5	3.2	5.1	5.6	0.7	6.0
90	4.0	5.0	7.0	9.4	1.5	8.6
# of waterbodies	53	69	427	821	92	1320

Marco Turbidity higher than 65% of Florida Estuaries



# DO SAT % Trend



Lower Limit  
42

DO SAT % has a seasonal effect

### Oxygen Percent Saturation, (Dissolved) (DOSAT)

Percent (%)

Although the concentration of dissolved oxygen (DO) in the water column is an important indicator of existing water quality and reflects the ability of a waterbody to support a healthy and diverse biological community, measuring the percent saturation takes into account water's varying ability to hold oxygen, which is based on temperature and conductivity.

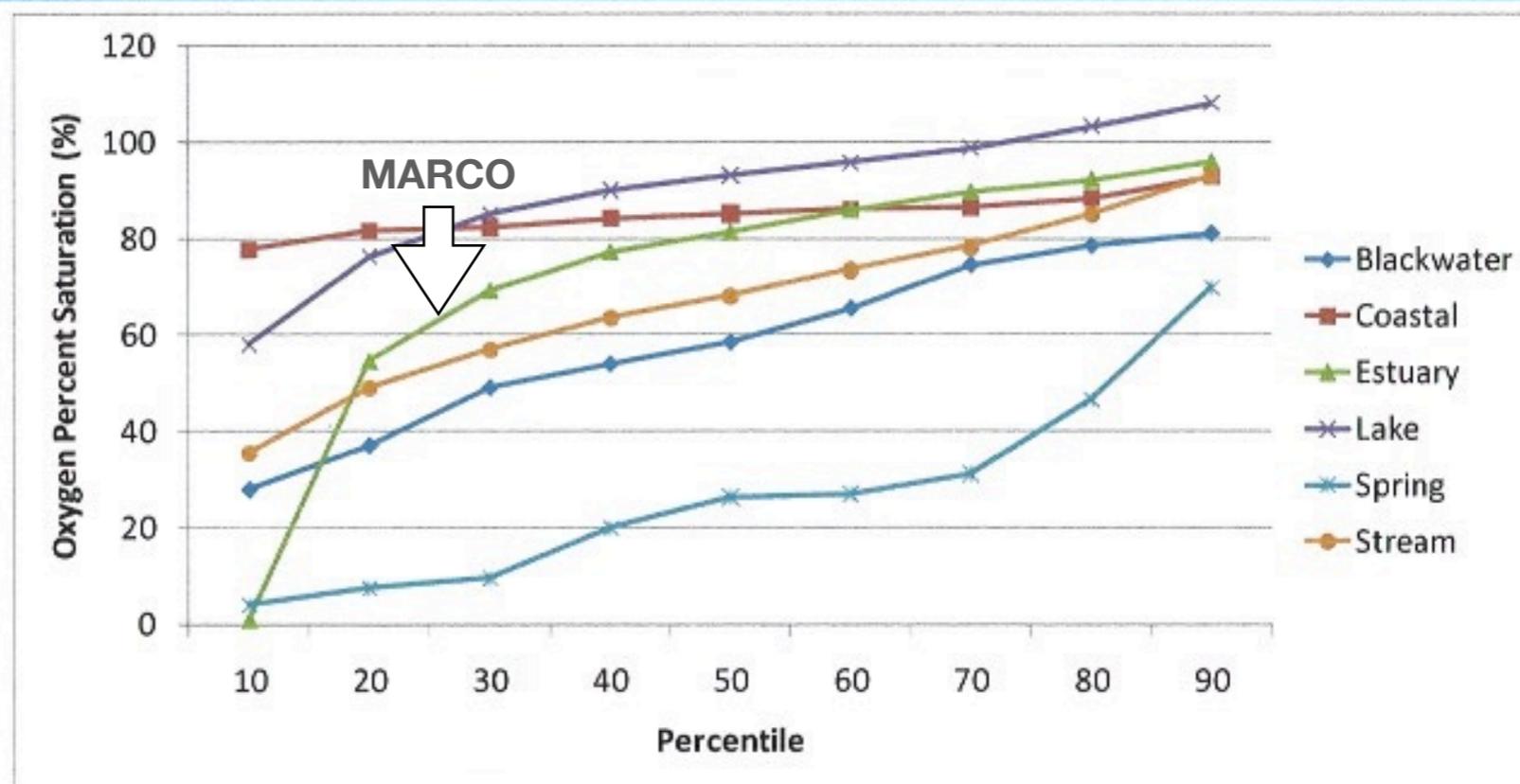
The maximum amount of oxygen that can be dissolved in water (saturation concentration) decreases with increasing temperature. For example, air-saturated water at 15° Celsius contains 10.1 mg/L DO. At 25° Celsius, a common temperature for many waterbodies in Florida, a stream is air saturated at about 8.3 mg/L of DO. As conductance increases, the saturation concentration also declines.

Water may receive substantially more DO from the pure oxygen produced by photosynthesis. In contrast, air is only 21 percent oxygen. Typically, pure oxygen enters a waterbody through the photosynthetic processes of algae and other submerged aquatic plants; oxygen exchange between a waterbody and the atmosphere occurs where there is rippling, wave and/or wind action, and fast-moving water.

Source: YSI Environmental

### Percentile distribution of water quality parameters by waterbody type

DOSAT

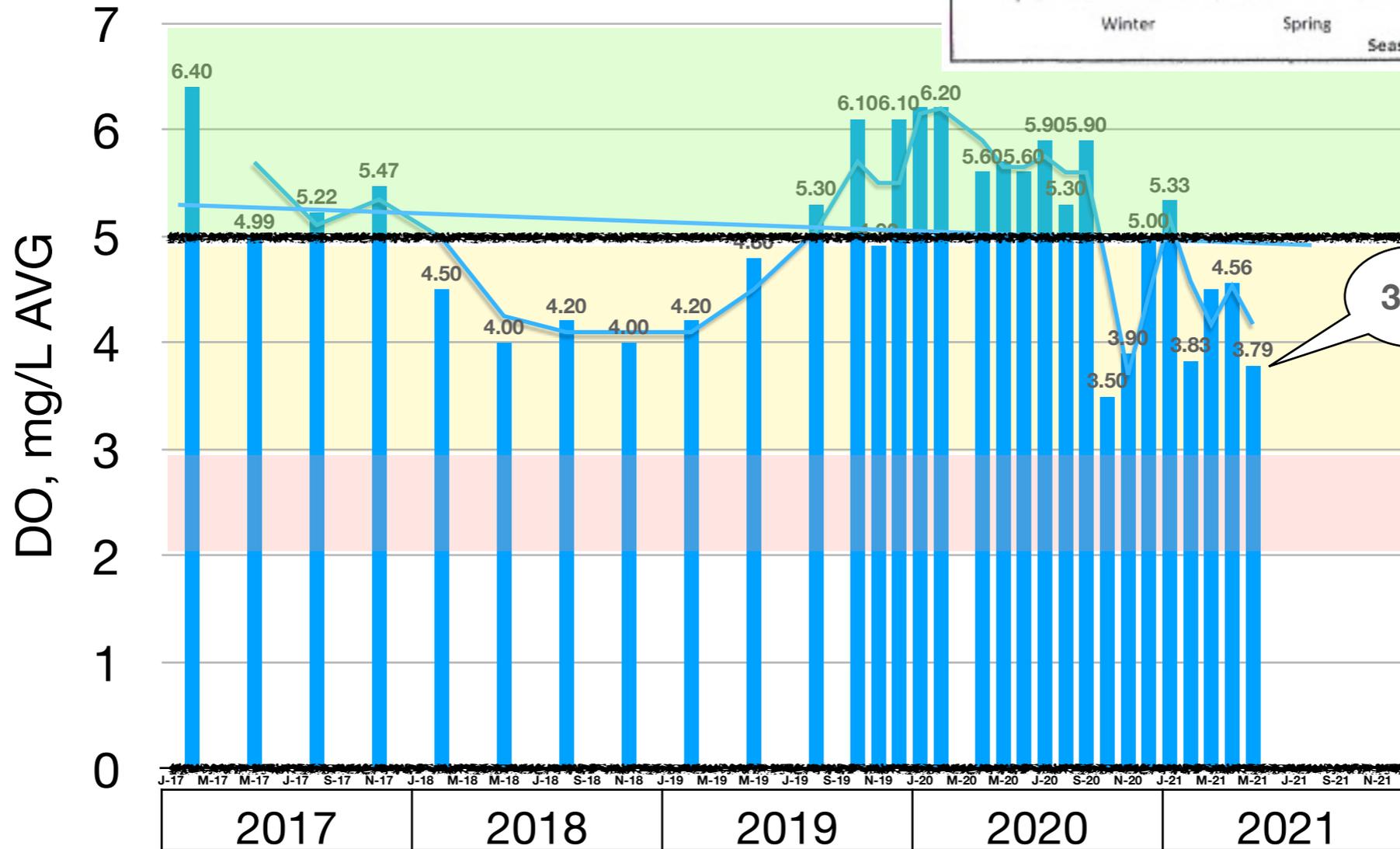
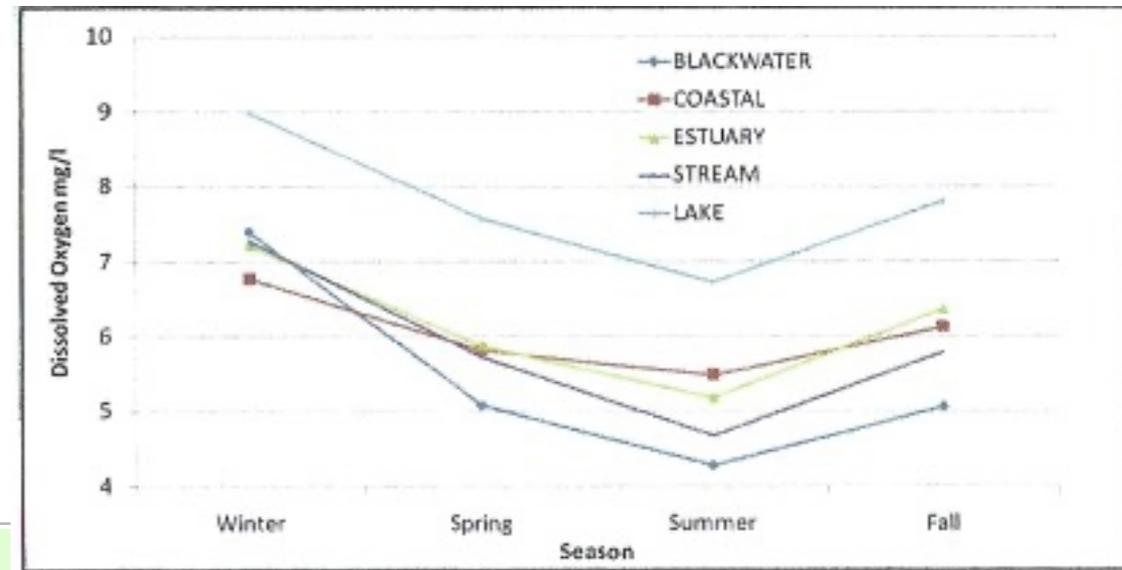


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	28	78	1	58	4	36
20	37	82	55	76	8	49
30	49	82	69	85	10	57
40	54	84	77	90	20	64
50	59	85	81	93	26	68
60	66	86	86	96	27	73
70	75	86	90	99	31	78
80	79	88	92	103	47	85
90	81	93	96	108	70	93
# of waterbodies	39	26	171	162	28	516

**Marco DOSAT lower than 75% of Florida Estuaries**



# DO Trend



WELL BALANCED > 5.0

ENTERING HYPOXIA\* 2.0-3.0

ANOXIA\* = 0

\* Source: Assessment of Hypoxia in U.S. Coastal Waters, 2010

DO cyclical and trending downward

## Oxygen, Dissolved (DO)

Milligrams per liter (mg/L)

Dissolved oxygen (DO), which is the amount of free (not chemically combined) oxygen dissolved in water or wastewater, is an essential component in the aquatic environment. The most important and commonly used measurement of water quality, it indicates a waterbody's state of health—that is, the ability to support desirable aquatic life. A vast array of aquatic organisms depends on the presence of adequate levels of DO for survival. DO concentrations in a waterbody vary seasonally.<sup>3</sup>

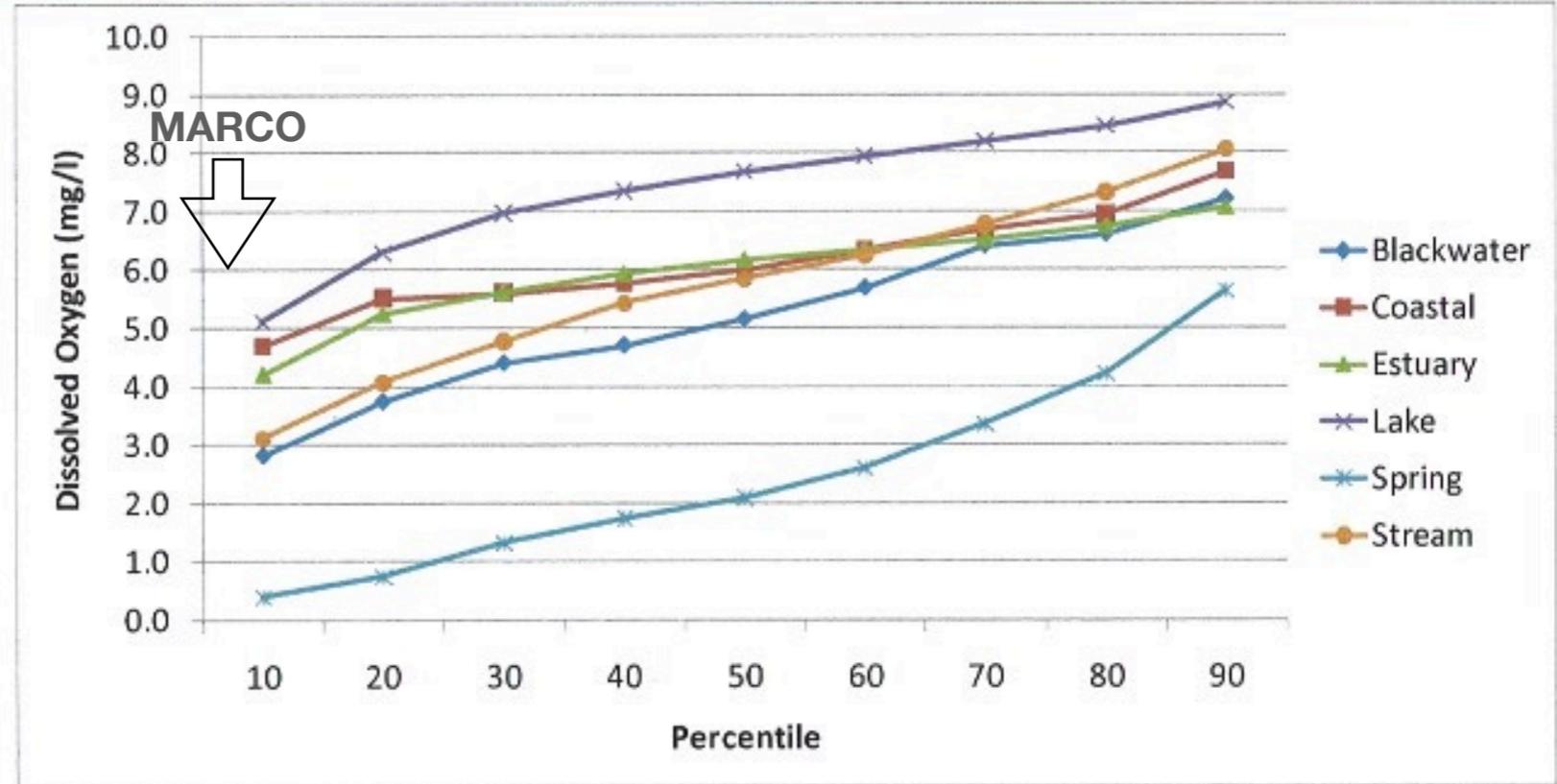
Generally, waters with DO concentrations of 5.0 mg/L or higher can support a well-balanced, healthy biological community. However, some species cannot tolerate even slight depletion, and when DO concentrations fall below natural levels, the result is often a complete alteration of the community structure. The consequences of these changes often have both ecological and economic significance.

Some systems with "good" water quality exhibit naturally low DO concentrations (e.g., swamps). Also, daytime and mean measurements of DO have limited significance, since nocturnal respiration and other episodic instances of low oxygen can significantly affect aquatic life. Diurnal DO studies are important to understanding the oxygen cycle in a particular waterbody.

Source: NALMS

## Percentile distribution of water quality parameters by waterbody type

DO

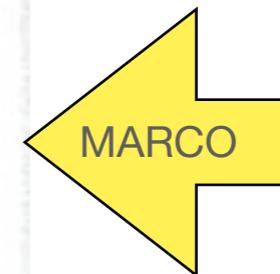
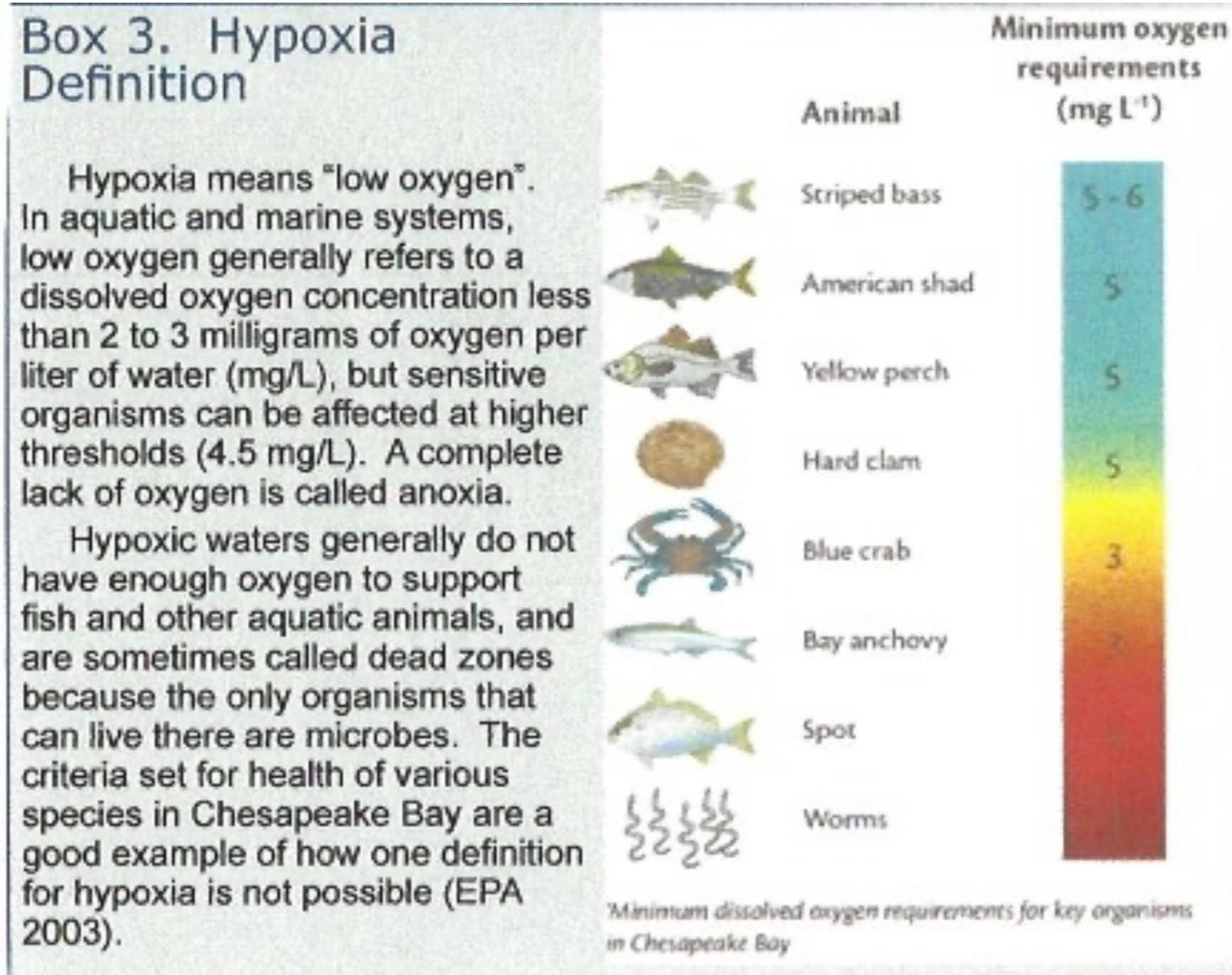


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	2.8	4.7	3.79	5.1	0.4	3.1
20	3.7	5.5	5.2	6.3	0.7	4.1
30	4.4	5.6	5.6	7.0	1.3	4.8
40	4.7	5.8	5.9	7.4	1.7	5.4
50	5.1	6.0	6.2	7.7	2.1	5.8
60	5.7	6.3	6.4	7.9	2.6	6.2
70	6.4	6.7	6.5	8.2	3.3	6.8
80	6.6	6.9	6.7	8.4	4.2	7.3
90	7.2	7.7	7.1	8.9	5.6	8.0
# of waterbodies	56	92	448	833	100	1394

Marco DO lower than 95% of Florida Estuaries



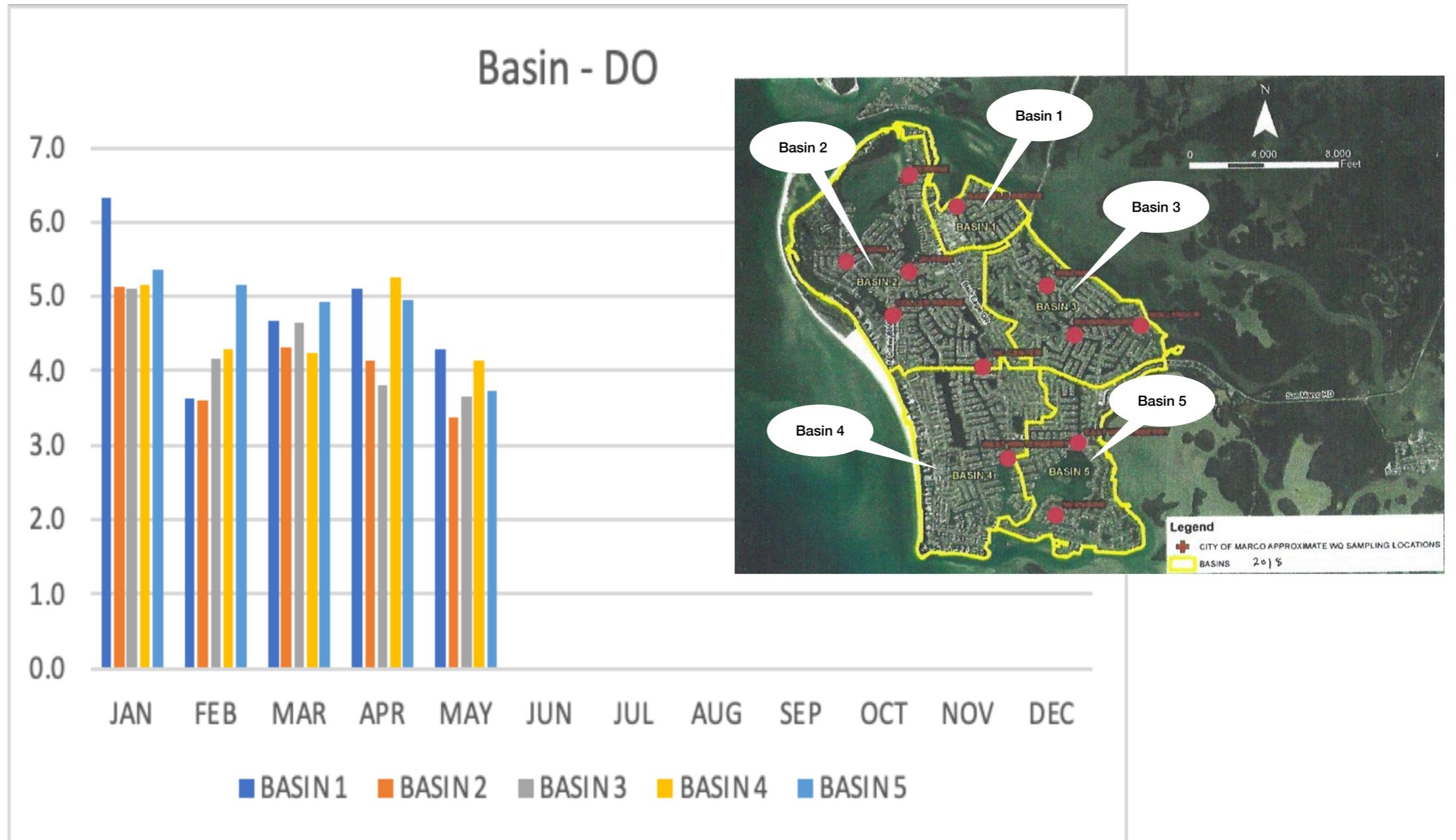
# Hypoxia



Source: Assessment of Hypoxia in U.S. Coastal Waters, 2010

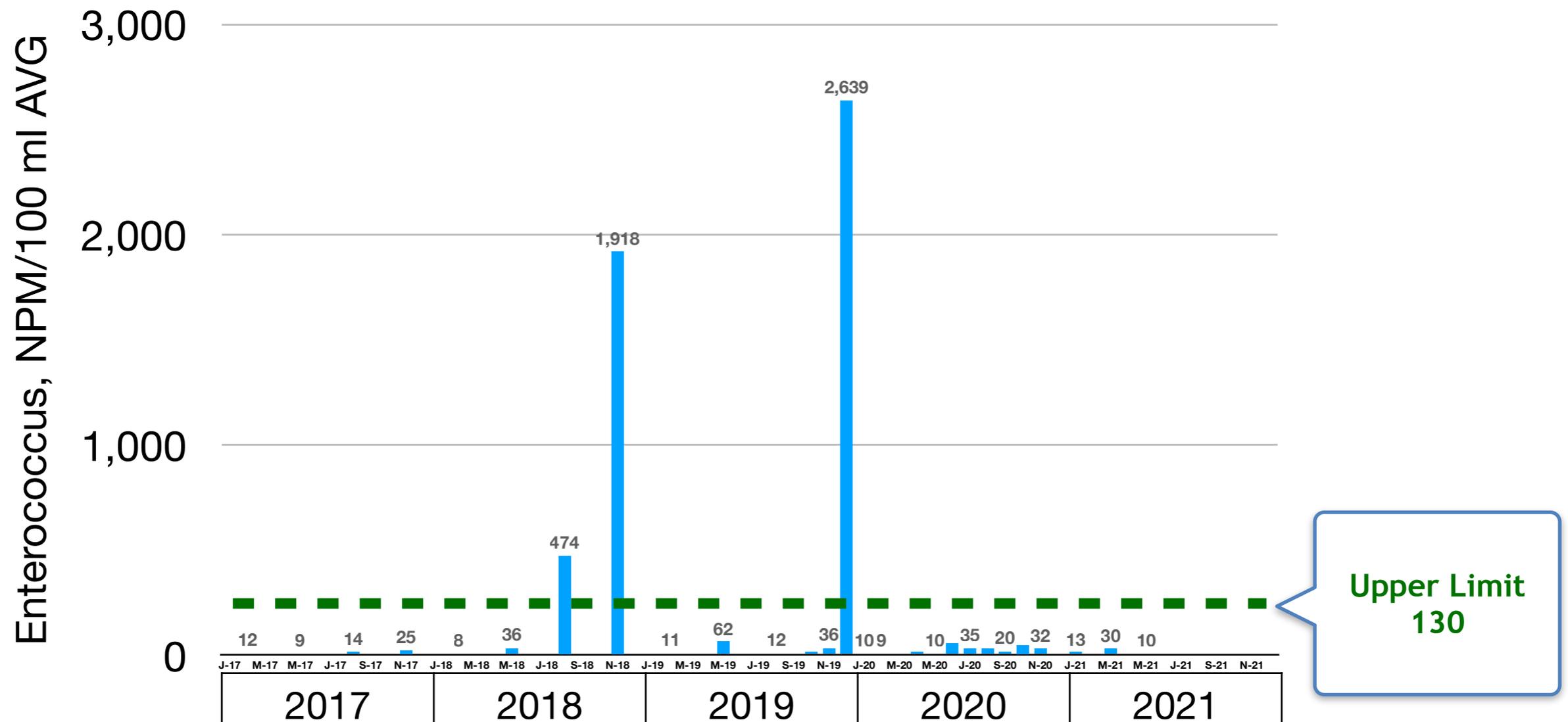
Root cause of depleted oxygen in Estuary not understood

# Dissolved Oxygen (DO) - by Basin



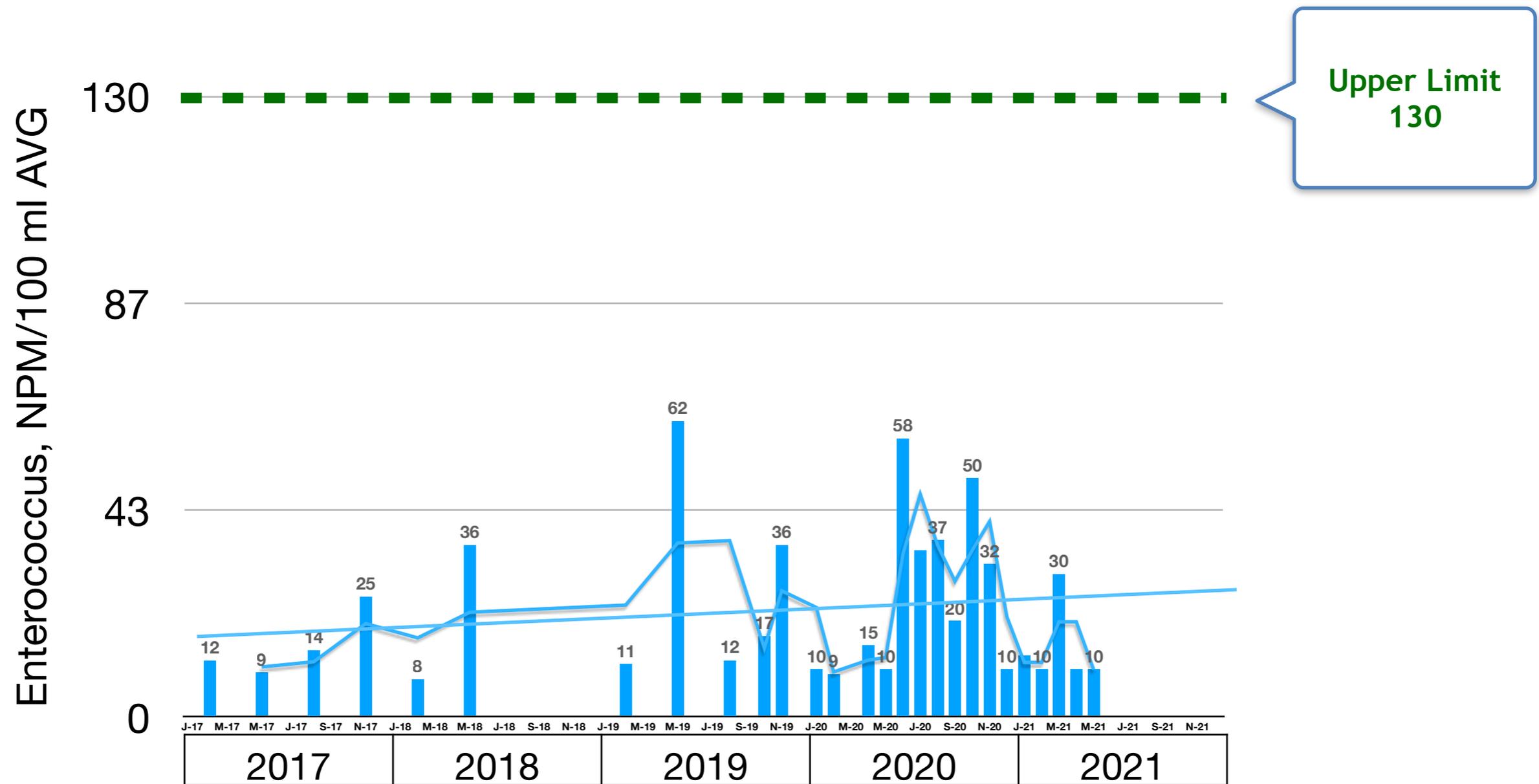
DO trend is down - consistently across basins

# Enterococcus Trend



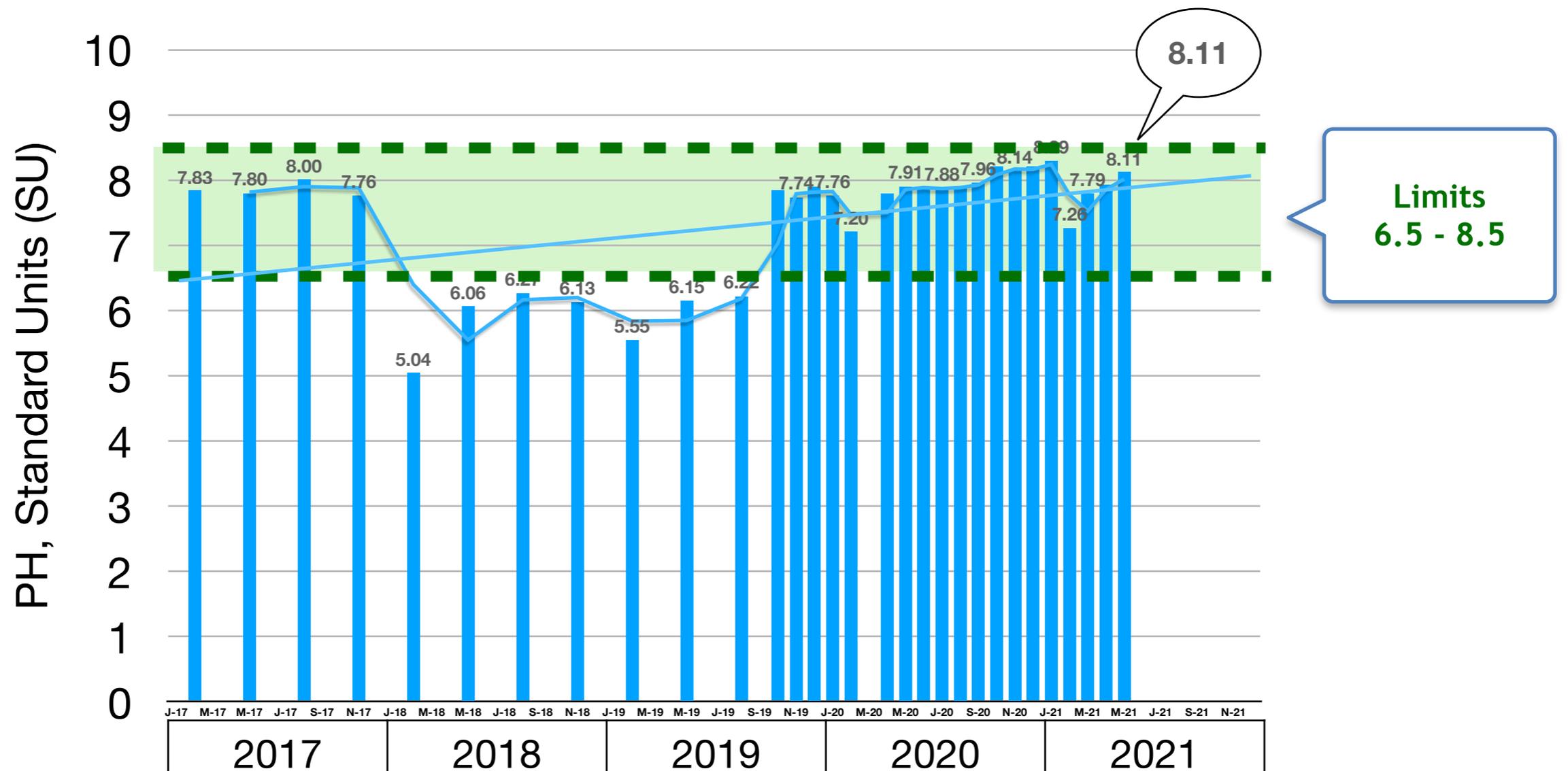
Significant outliers not explained

# Enterococcus Trend



Without the outliers, Marco waterways low in Enterococcus

# PH Trend



PH is trending upward

**pH (PH)**

Standard units (SU)

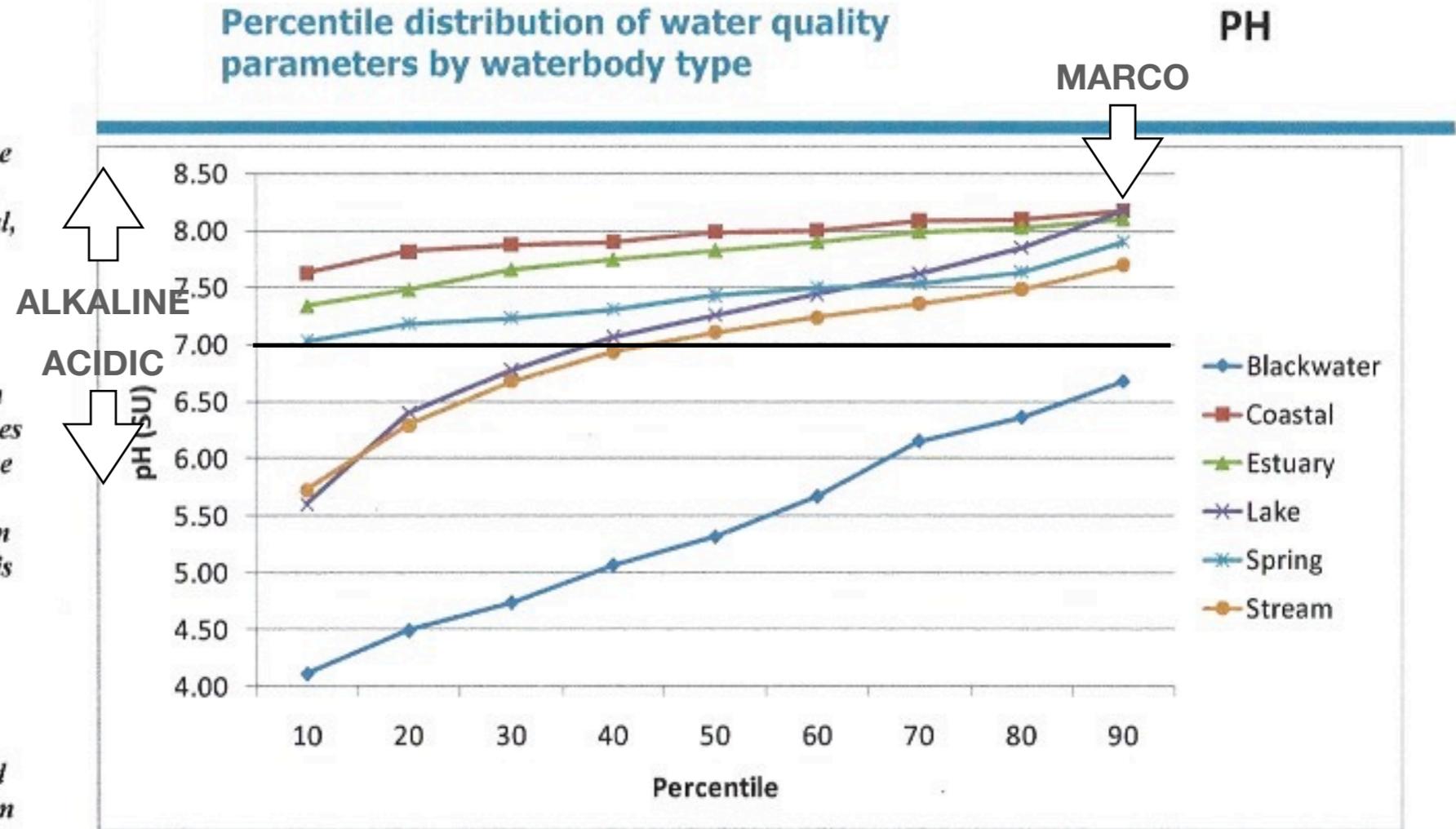
The pH of a body of water denotes its hydrogen ion activity, based on the negative logarithm of hydrogen ion concentrations. A pH of 1 to 7 is acidic, a pH of 7 is neutral, and a pH of 7 to 14 is alkaline.

pH significantly affects chemical and biological interactions in the aquatic environment. This is of particular concern in considering the effects of toxic substances on aquatic organisms, especially the release of metals from sediments. At certain pH levels, a particular toxicant may increase in toxicity or become more soluble, and thus is more likely to affect aquatic organisms.

The problems of acidic deposition and the acidification of lakes and streams have gained widespread attention. However, certain biological communities are adapted to acidic conditions (e.g., blackwater stream systems, where pH ranges from 4 to 5) or to slightly alkaline conditions (e.g., spring runs, where pH values of 8 are not unusual) and are endangered only when the natural conditions are altered.

Source: FDEP

**Percentile distribution of water quality parameters by waterbody type**

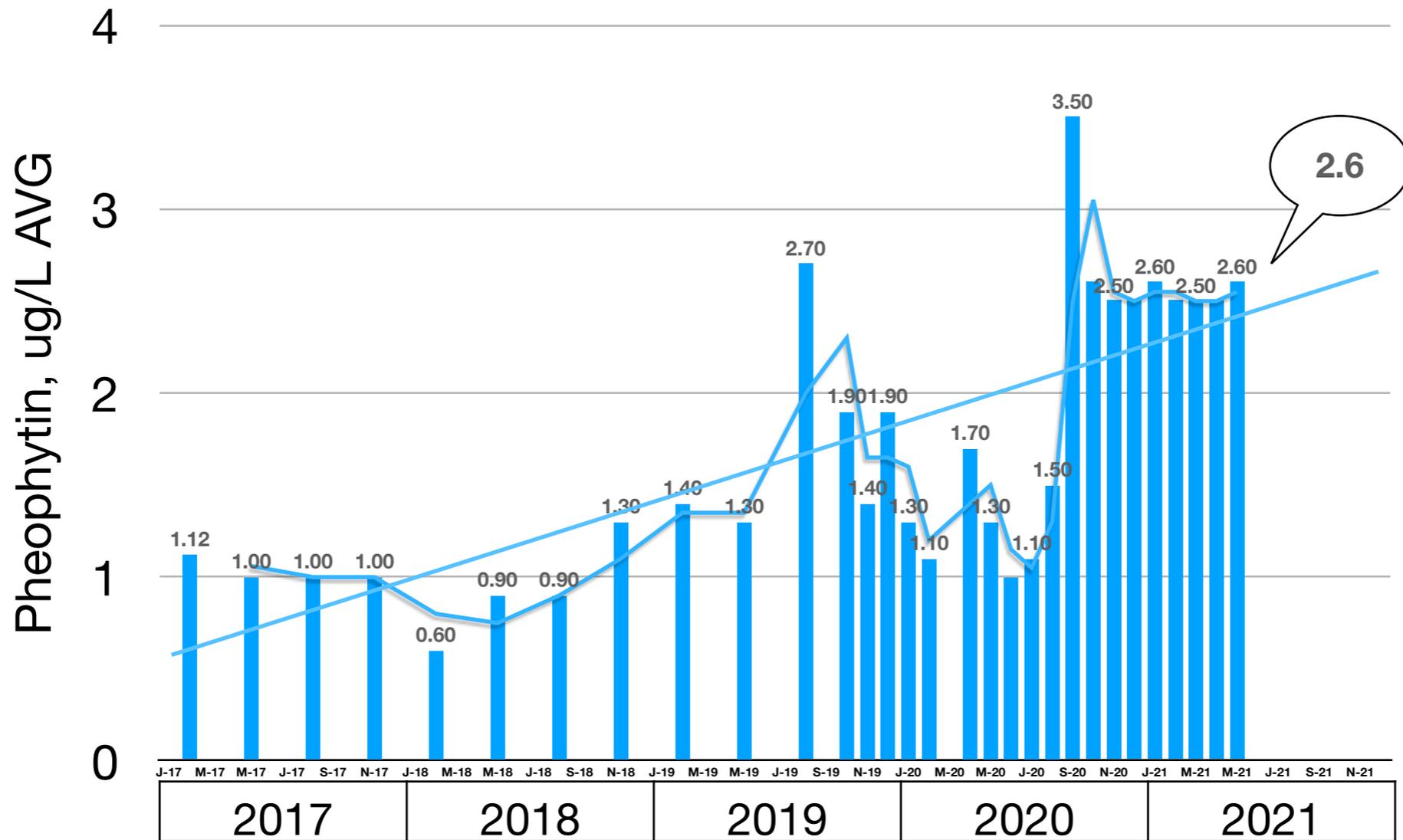


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	4.12	7.63	7.34	5.60	7.04	5.73
20	4.50	7.82	7.48	6.40	7.19	6.30
30	4.74	7.88	7.66	6.78	7.24	6.68
40	5.07	7.90	7.75	7.07	7.31	6.94
50	5.32	7.99	7.83	7.26	7.43	7.11
60	5.67	8.00	7.90	7.44	7.50	7.24
70	6.16	8.09	7.99	7.63	7.54	7.37
80	6.37	8.10	8.03	7.86	7.64	7.49
90	6.68	8.18	8.10	8.18	7.90	7.70
# of waterbodies	56	81	447	836	100	1397

**Marco PH higher than 90% of Florida Estuaries**



# Pheophytin Trend



Pheophytin trending upward

### Pheophytin A (PHEOA)

Micrograms per liter ( $\mu\text{g/L}$ )

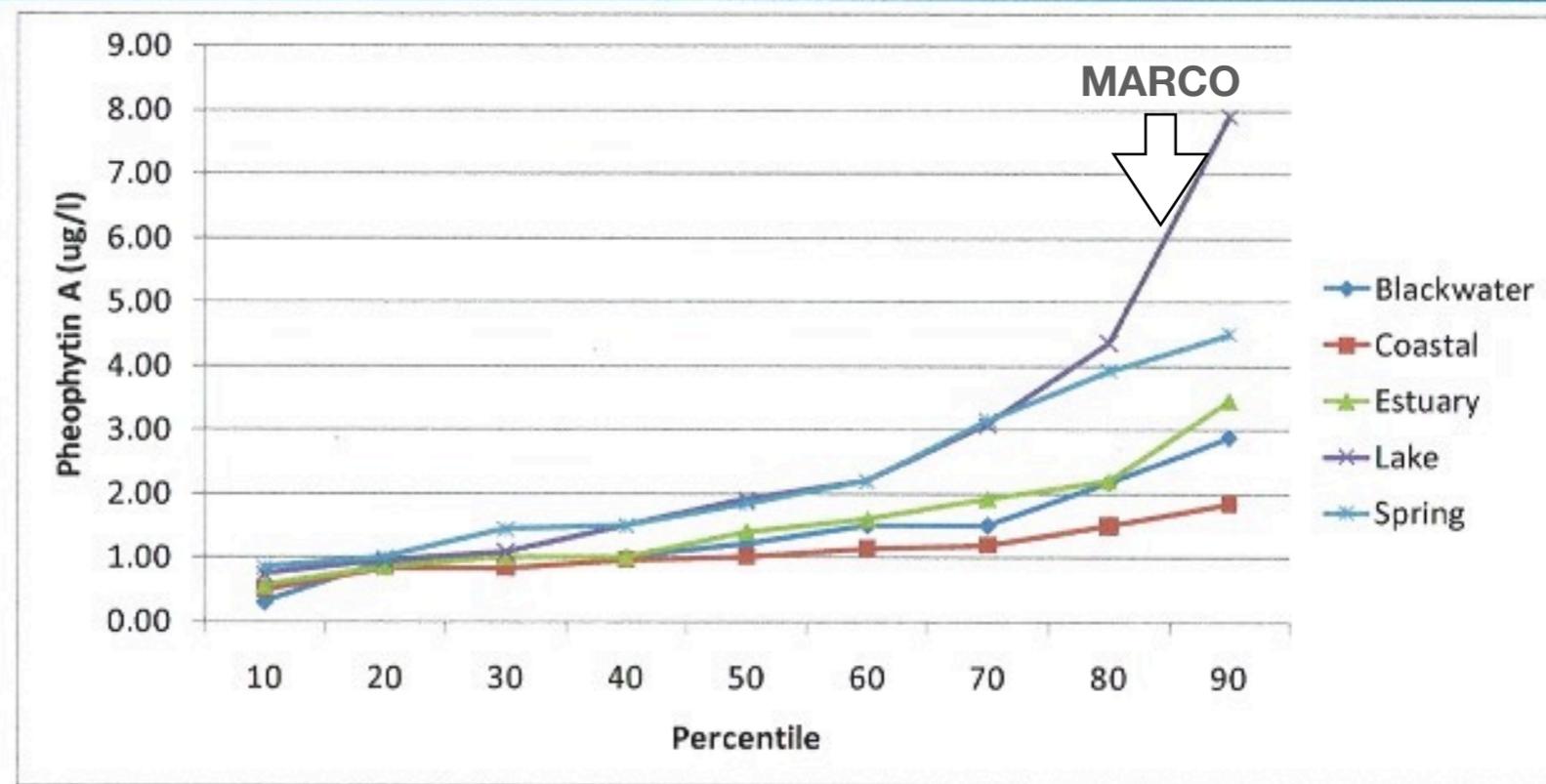
*Pheophytin a is a common breakdown product of chlorophyll a. Because it absorbs light and fluoresces in the same region of the spectrum as chlorophyll a, the presence of pheophytin a can cause errors in the measurement of chlorophyll a values.*

*The ratio of chlorophyll a to pheophytin a serves as a good indicator of the physiological condition of phytoplankton in a water sample.*

*Source: Soil and Water Conservation Society of Metro Halifax, Nova Scotia*

### Percentile distribution of water quality parameters by waterbody type

### PHEOA

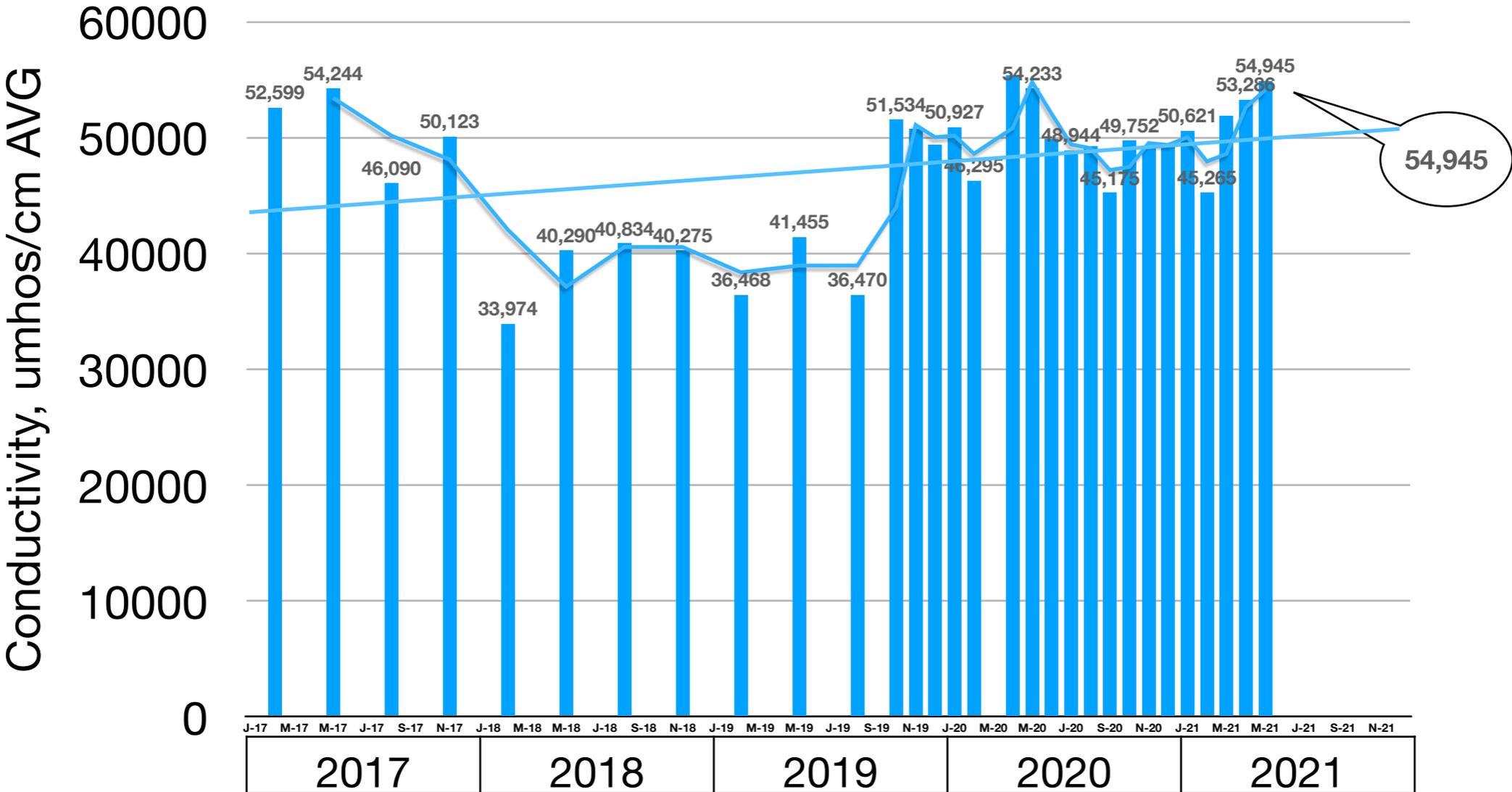


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	0.30	0.50	0.56	0.75	0.85	0.50
20	0.91	0.85	0.85	0.95	1.00	0.85
30	1.00	0.85	1.00	1.10	1.45	0.93
40	1.00	0.96	1.00	1.50	1.50	1.00
50	1.20	1.02	1.40	1.91	1.85	1.17
60	1.50	1.14	1.60	2.20	2.20	1.50
70	1.50	1.19	1.92	3.09	3.15	1.97
80	2.18	1.50	2.20	4.36	3.93	2.63
90	2.88	1.85	3.45	7.90	4.50	4.50
# of waterbodies	49	33	333	694	62	1150

**Marco PHEOA higher than 85% of Florida Estuaries**



# Conductivity Trend



Conductivity trending upward

### Conductance (COND)

Microohms per centimeter (umhos/cm)

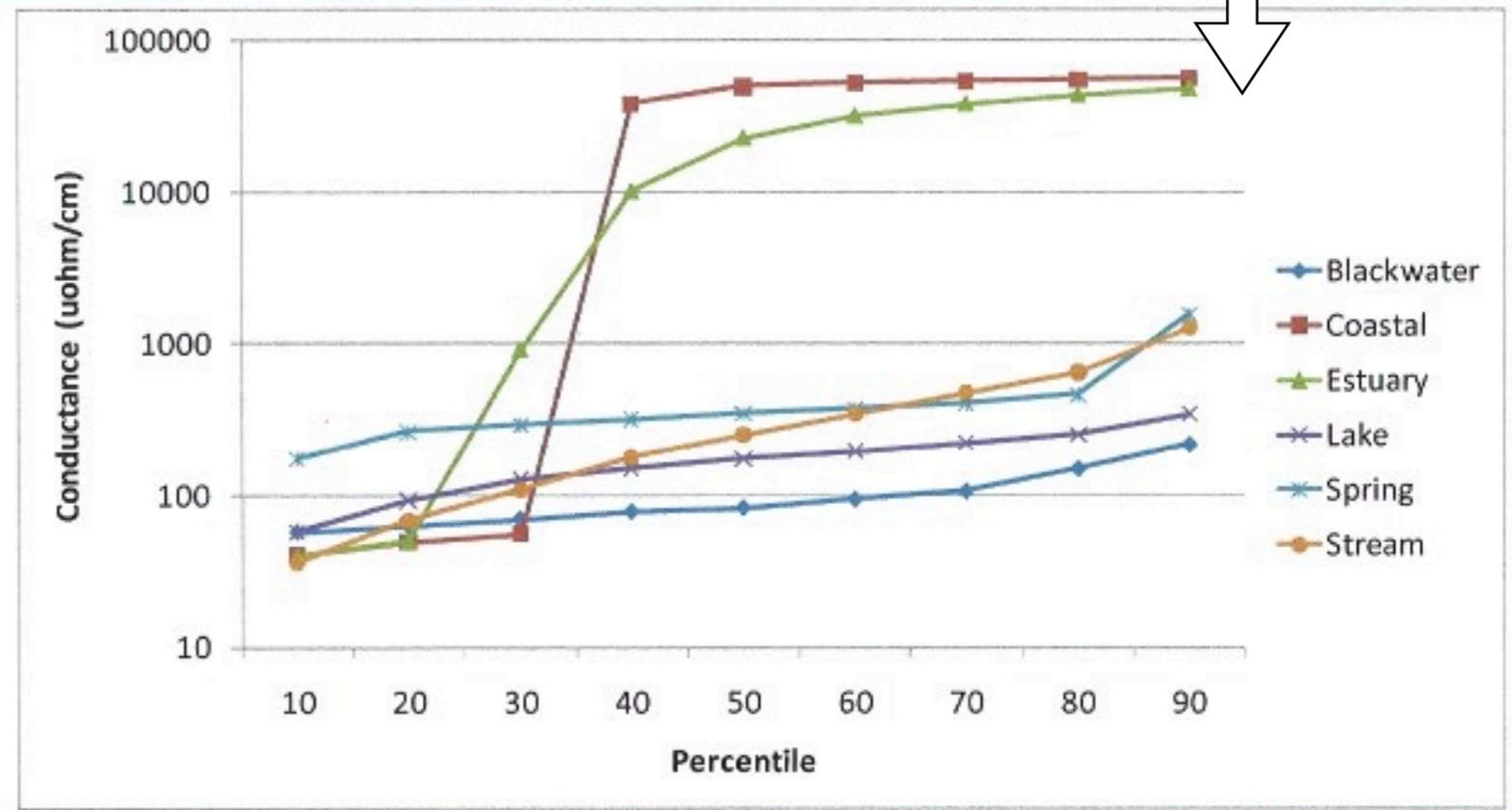
Conductance (also called specific conductance) measures the capacity of water to conduct an electric current and indirectly measures the concentration of ionized substances in water. Conductivity can be used to differentiate among various water sources, such as ground water, agricultural runoff, and municipal wastewater. Because it detects contamination from animal and human wastes, which contain salts, it can be used to detect septic tank seepage along shorelines. It can also be used to detect saltwater intrusion.

Conductance increases when more of any salt, including the most common one, sodium chloride, is dissolved in water. Higher values represent better conductance. In general, waters with more salts are more biologically productive, except where there are limiting nutrients or other environmental factors. Changes in conductivity beyond natural background variability can harm aquatic life.

Florida's current water quality criterion for Class III fresh waters allows a 50 percent increase in conductance, or 1,275 umhos/cm, whichever is greater. It is intended to preserve natural background conditions and protect aquatic organisms from stressful ion concentrations.

Source: FDEP; Florida LakeWatch

### Percentile distribution of water quality parameters by waterbody type

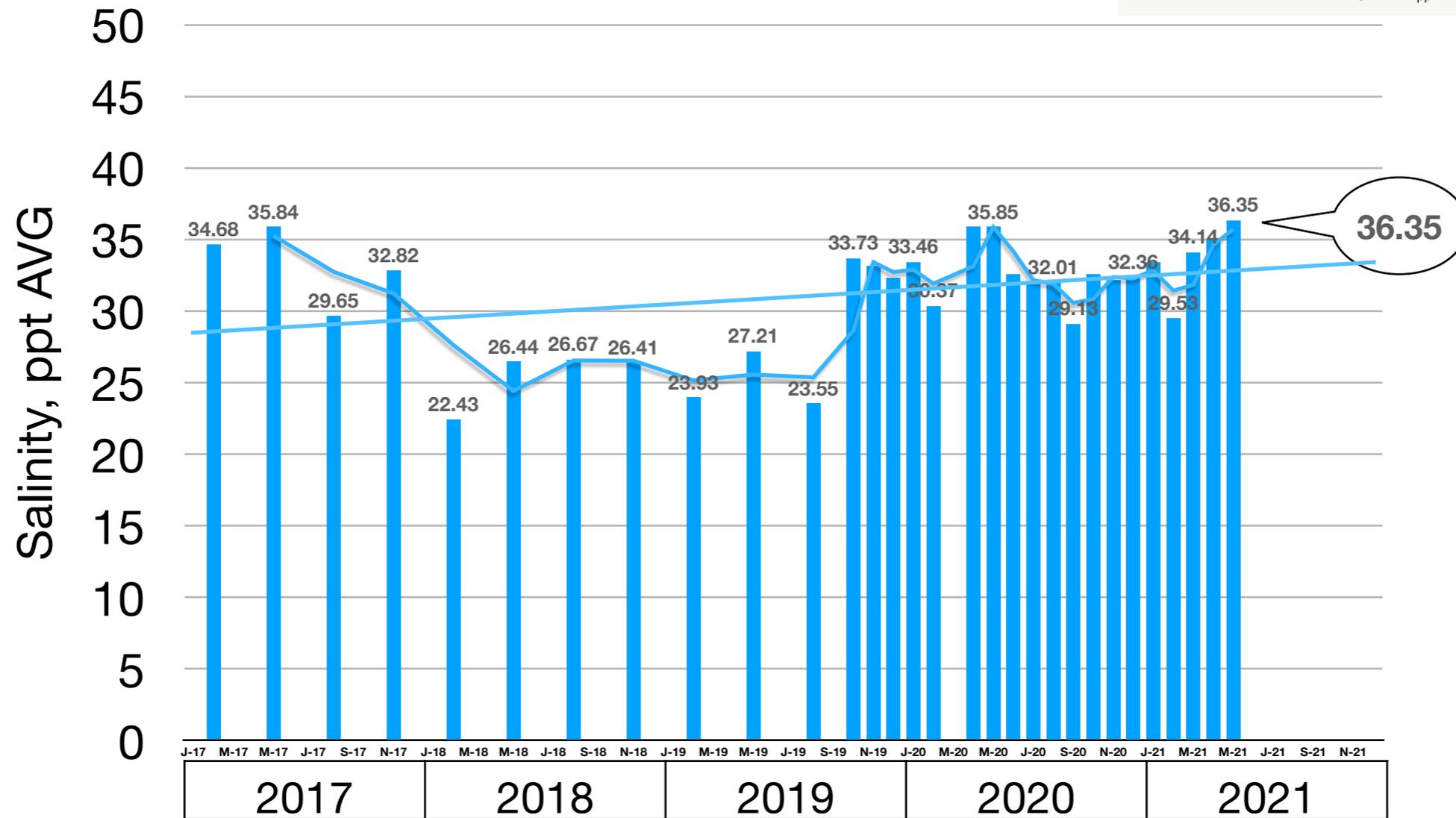
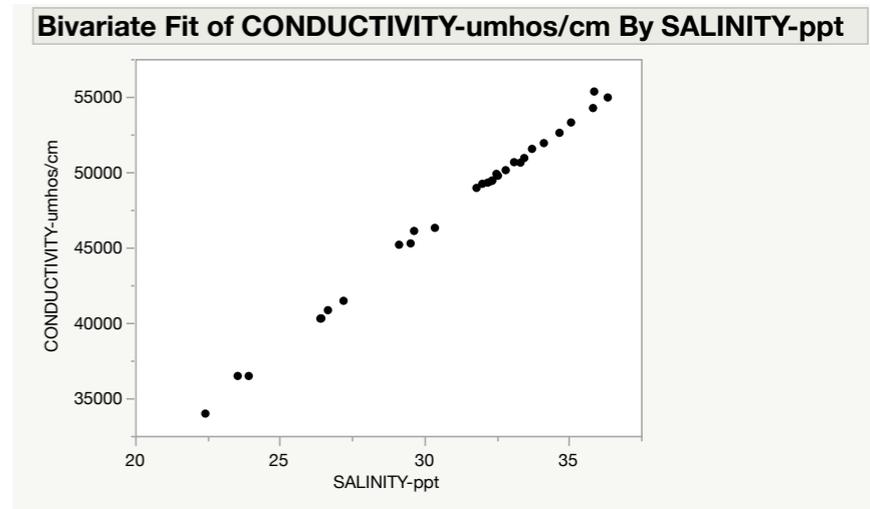


Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	57	40	40	58	176	37
20	63	49	50	93	264	69
30	70	56	923	128	295	110
40	78	38070	10170	151	321	180
50	83	49436	22732	175	348	251
60	94	52724	31800	197	372	346
70	107	53617	38250	222	409	475
80	151	55042	43885	253	464	645
90	218	56448	48400	344	1555	1264
# of waterbodies	56	58	416	822	100	1352

**Marco COND higher than 95% of Florida Estuaries**



# Salinity Trend



Salinity has a high correlation with Conductivity

### Salinity (SALIN)

Parts per thousand (ppt)

Salinity, or the saltiness of water, is influenced by leaching from rock and soil formations, runoff from a watershed, atmospheric precipitation and deposition, and evaporation. The Atlantic Ocean and Gulf of Mexico typically have salinity values around 35 parts per thousand (ppt), although there is significant variation, particularly in nearshore areas. Salinity is often lower in areas receiving flows of fresh water, such as the mouths of rivers. It is often higher in areas where the evaporation rate is high—for example, in hot, dry climates.

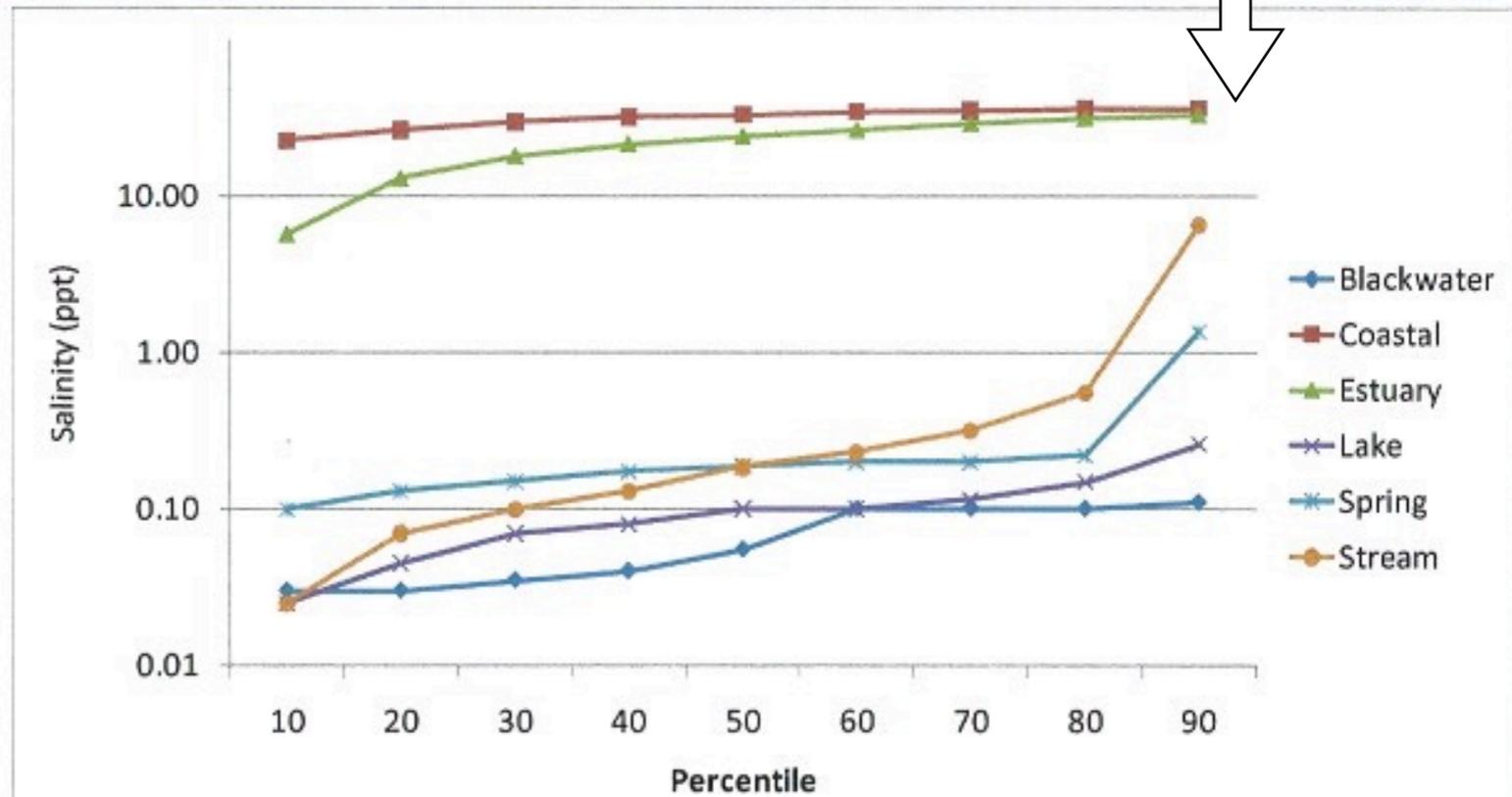
Source: Florida LakeWatch

Note: The graph at right does not include practical salinity unit (PSU) measurements.

### Percentile distribution of water quality parameters by waterbody type

SALIN

MARCO



Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	0.03	22.85	5.70	0.03	0.10	0.03
20	0.03	26.55	12.91	0.05	0.13	0.07
30	0.04	30.03	18.03	0.07	0.15	0.10
40	0.04	32.25	21.48	0.08	0.18	0.13
50	0.06	33.31	24.07	0.10	0.19	0.19
60	0.10	34.91	26.40	0.10	0.20	0.23
70	0.10	35.42	29.05	0.12	0.20	0.32
80	0.10	36.27	31.45	0.15	0.22	0.56
90	0.11	36.42	32.90	0.26	1.36	6.59
# of waterbodies	37	84	428	446	58	871

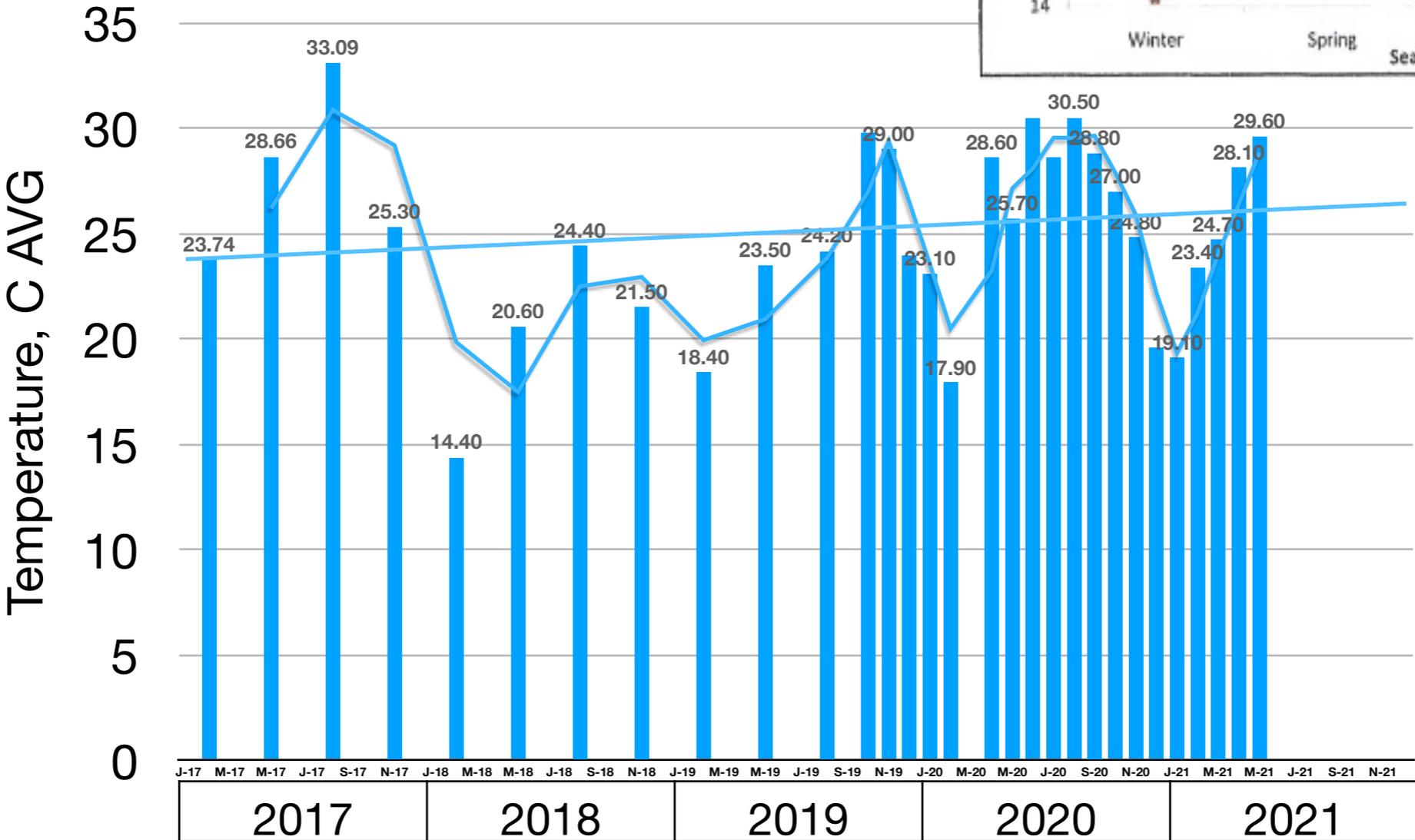
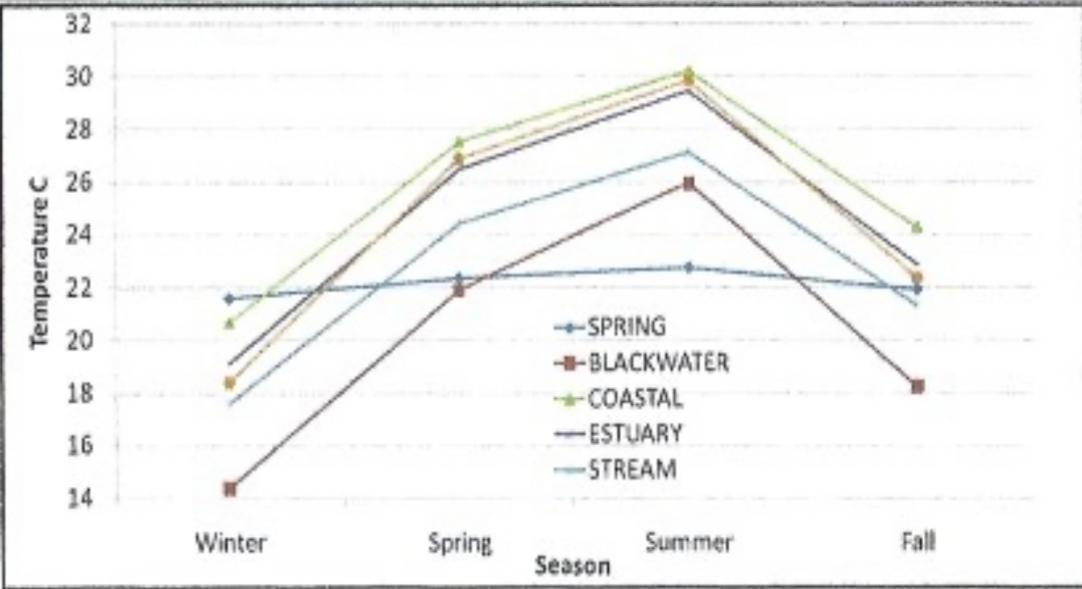
95%

36.35

Marco SALIN higher than 95% of Florida Estuaries



# Temperature Trend



Temperature has a seasonal effect

## Temperature (TEMP)

Degrees Celsius (°C.)

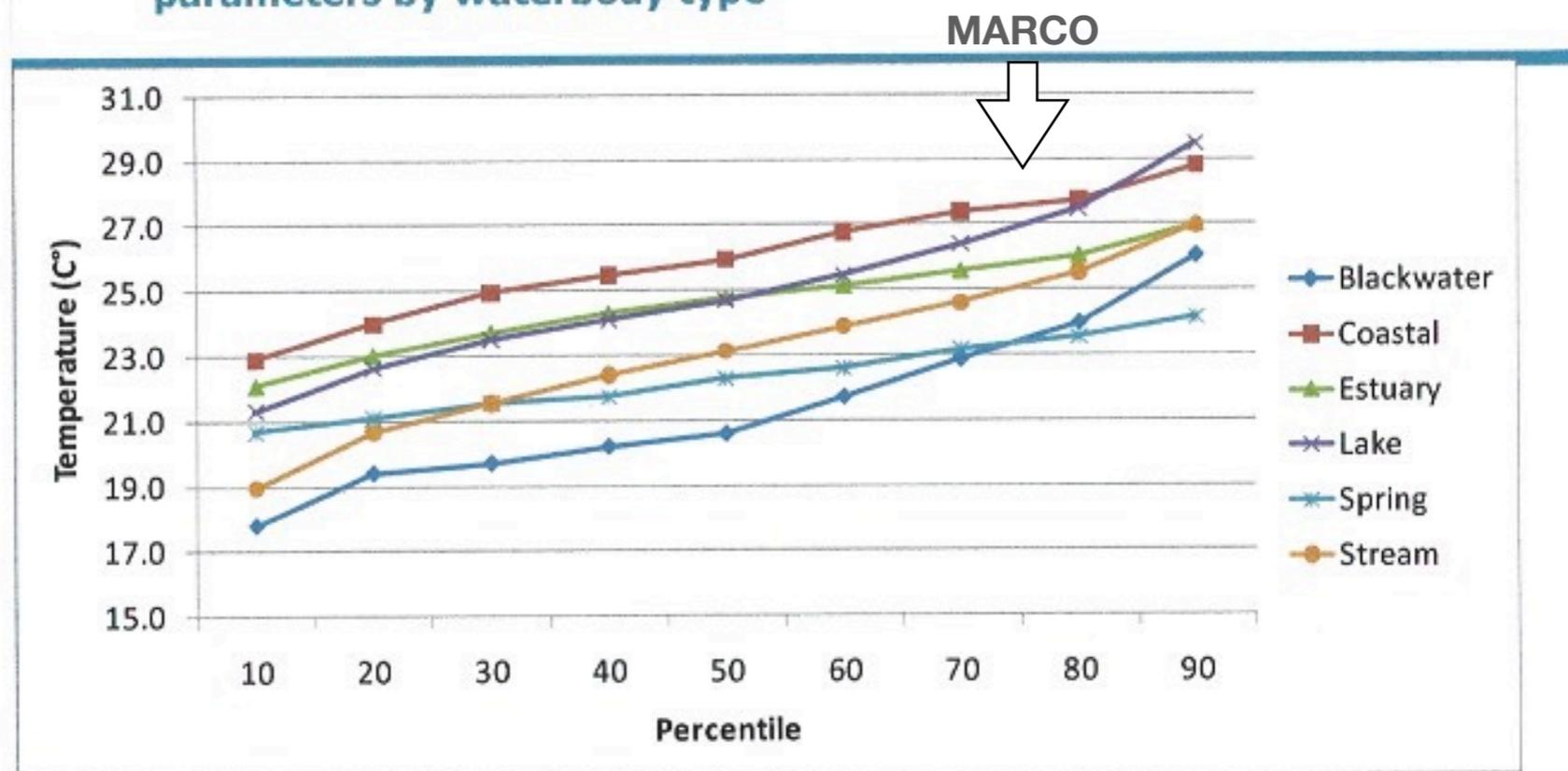
Water temperature is an important factor in controlling chemical interactions and reactivity in the water column. Temperature also affects biological activity, since many aquatic organisms have strict temperature requirements and thus are affected by temperature fluctuations.

There is a large variation in annual average water temperature from northern to southern Florida that significantly affects several water quality constituents such as dissolved oxygen saturation and biological productivity parameters. Water temperature in individual waterbodies also varies seasonally.<sup>3</sup>

Source: FDEP

## Percentile distribution of water quality parameters by waterbody type

TEMP



Percentile	Blackwater	Coastal	Estuary	Lake	Spring	Stream
10	17.8	22.9	22.1	21.3	20.7	19.0
20	19.4	24.0	23.0	22.6	21.1	20.7
30	19.7	25.0	23.7	23.5	21.6	21.6
40	20.2	25.5	24.3	24.1	21.7	22.4
50	20.6	25.9	24.8	24.7	22.3	23.1
60	21.7	26.8	25.1	25.5	22.6	23.9
70	22.9	27.4	25.6	26.4	23.2	24.6
80	24.0	27.7	26.1	27.5	23.6	25.5
90	26.1	28.8	27.0	29.5	24.2	27.0
# of waterbodies	56	89	447	833	100	1397

**Marco TEMP (2020) higher than 75% of Florida Estuaries**



# May-21: Marco vs. Florida Estuaries

		10	20	30	40	50	60	70	80	90	
TN	☆										
TP				☆							
CHLA				☆							
TKN	☆										
NO3	☆										
NO3O2			☆								
NO2											
SECCHI											☆
TURB								☆			
DOSAT				☆							
DO	☆										
PH											☆
PHEOA										☆	
COND											☆
SALIN											☆
TEMP									☆		

Marco percentile distribution compared to Florida Estuaries

**Marco Island, Florida**

**WBID 32780**

**Water Quality**

**Status & Trends**