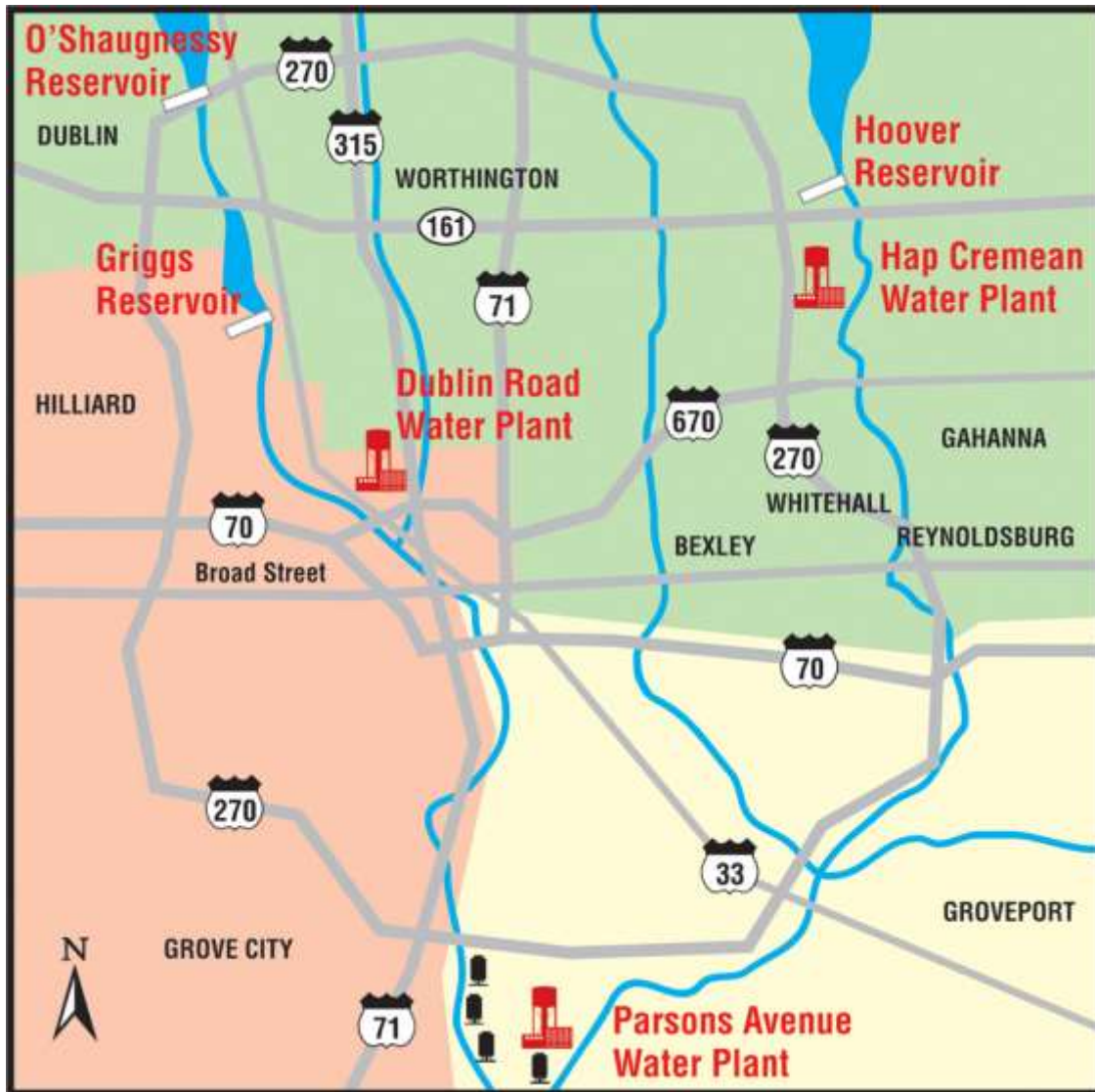


Columbus Taste and Odor Event



THE CITY OF
COLUMBUS
MICHAEL B. COLEMAN, MAYOR

DEPARTMENT OF
PUBLIC UTILITIES



Hap Cremean Water Plant (HCWP)



Hoover Reservoir



Dublin Road Water Plant (DRWP)



THE CITY OF
COLUMBUS
MICHAEL B. COLEMAN, MAYOR

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PUBLIC UTILITIES

Griggs Reservoir



O'Shaughnessy Reservoir



Upground Reservoir





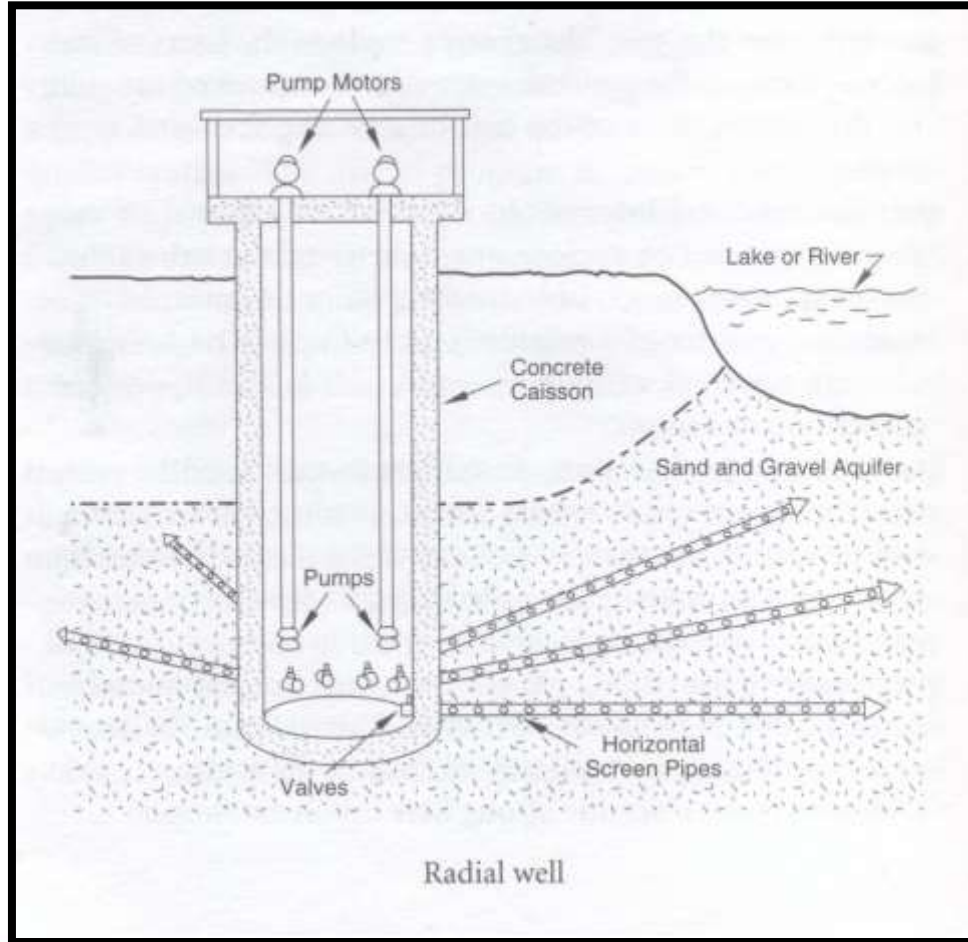
Parsons Avenue Water Plant (PAWP)

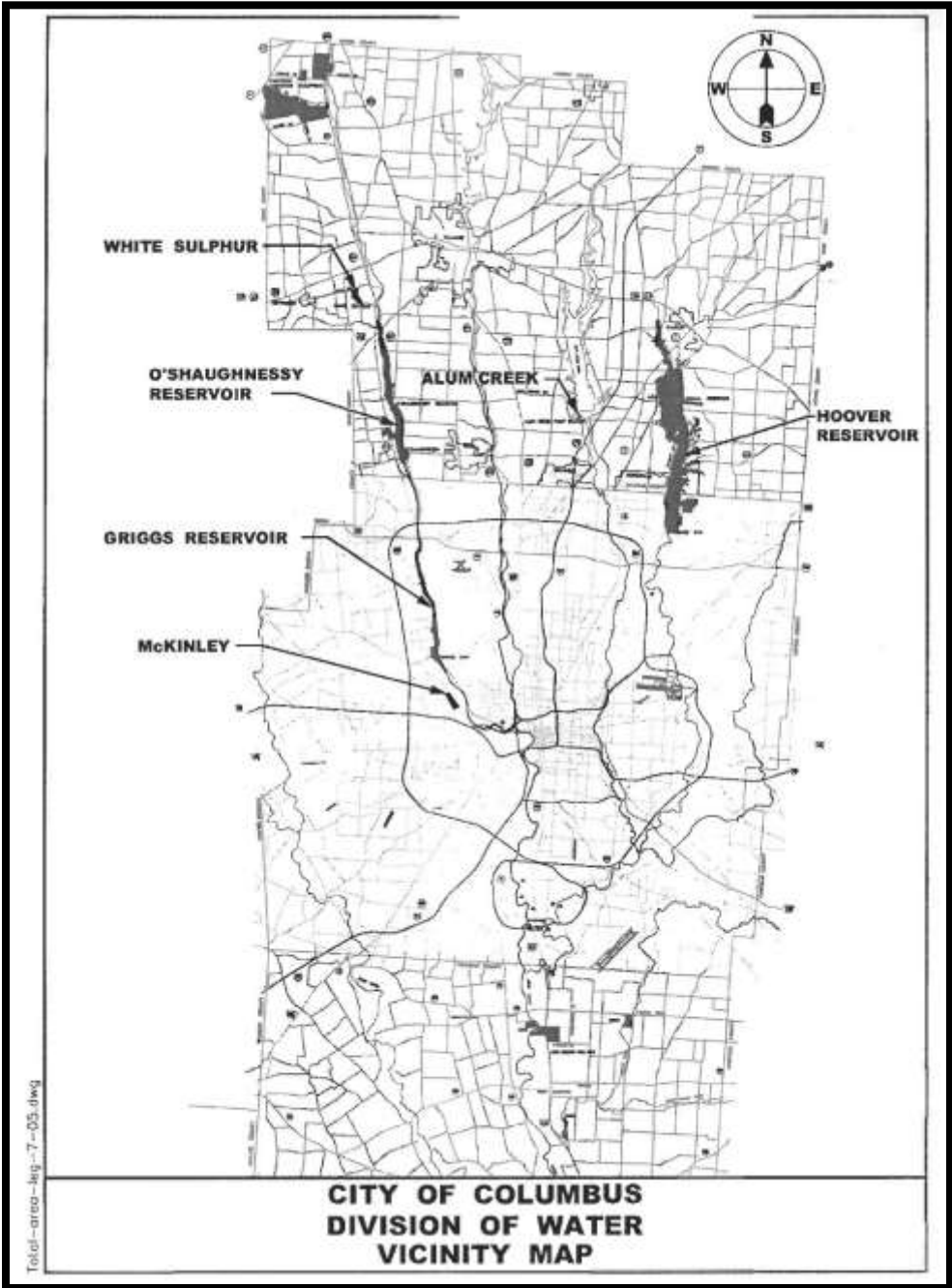


PAWP Collector Well 115



Example of Collector Well





Toklat-arrao-lag-7-05.dwg

Population Served

HCWP	535,000
DRWP	413,000
PAWP	167,000
Total	1,115,000

Treatment and Supply Capacity

	Plant Capacity (mgd) Max. Day	Supply Safe Yield (mgd) Avg. Day
HCWP	125	83.4
DRWP	65 (80)	47.8 (68.7)
PAWP	50	19 (36)

2012 Plant Production

	Avg. Day	Max Day	Min Day	% Demand
HCWP	68.5	105.4	48.4	49
DRWP	49.0	68.7	37.5	35
PAWP	22.4	27.8	16.7	16
System	139.9	196.5	109.7	100

Primary Goals of Water Treatment

- Kill disease causing organisms
- Remove unwanted chemicals
- Remove sediment
- Fluoridate the water
- Produce water that has a pleasant appearance and taste
- Meet USEPA Drinking Water Regulations and Ohio EPA (OEPA) Drinking Water Rules

Watersheds are Different

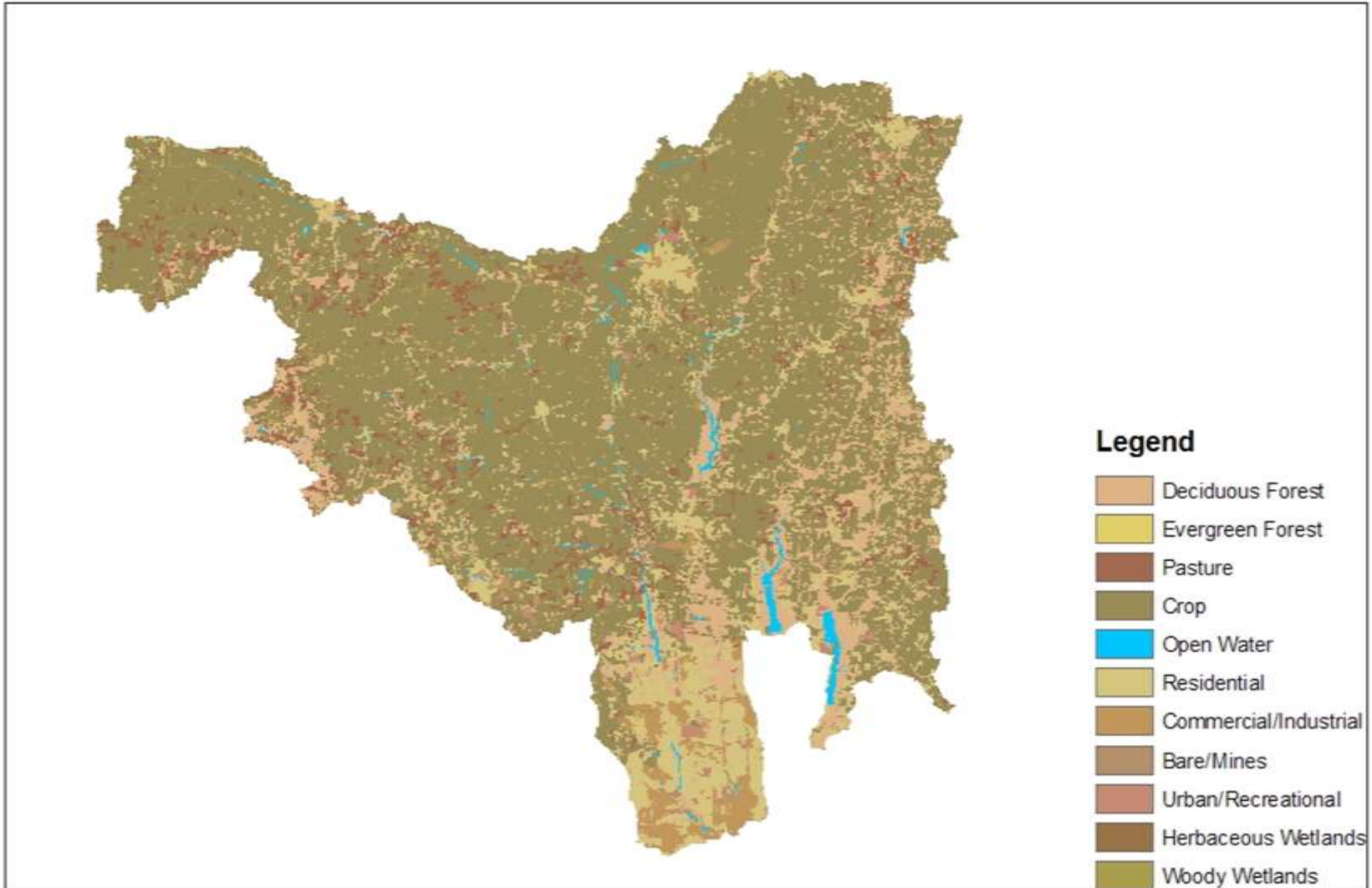
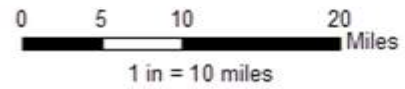
DRWP

- Two small reservoirs (6.8 billion gallons)
- Just finished John Doult Upground Reservoir
- Detention time 12.7 days
- Large watershed (1044 sq mi)
- 80% agricultural
- Erratic water quality
 - Nitrates, phosphorus, atrazine, and sediment

HCWP

- One large reservoir (20.8 billion gallons)
- Supplemented by Alum Creek Reservoir
- Detention time 177 days
- Small watershed (190 sq mi)
- 70% agricultural
- Stable water quality
 - Atrazine and sediment

Columbus Surface Water Land Use 1999 - 2003



Source Water Quality Monitoring

- Bi-monthly during spring, summer, and fall
- Monthly during winter
- Event monitoring
- Real-time water quality sensors in all reservoirs and plant intakes
- Test parameters (nitrate, phosphate, atrazine, algae, taste and odor compounds, algal toxins... just to name a few)



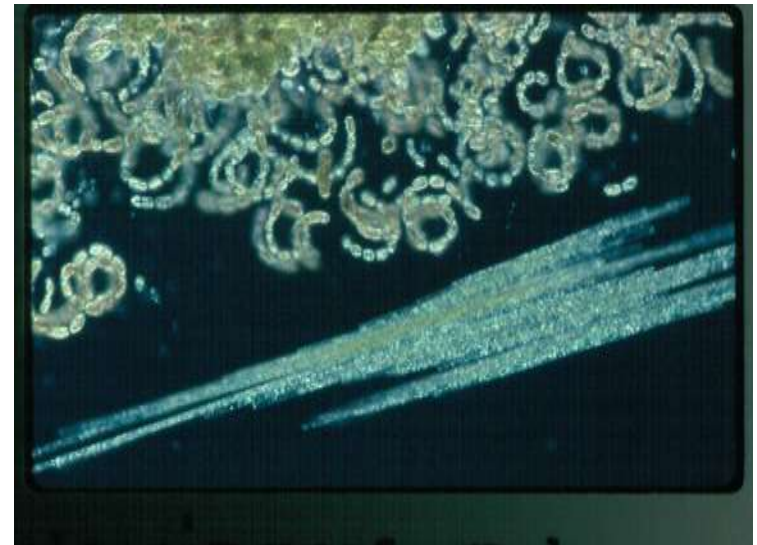
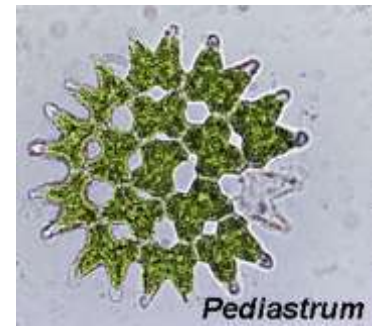
What Causes Algal Blooms?

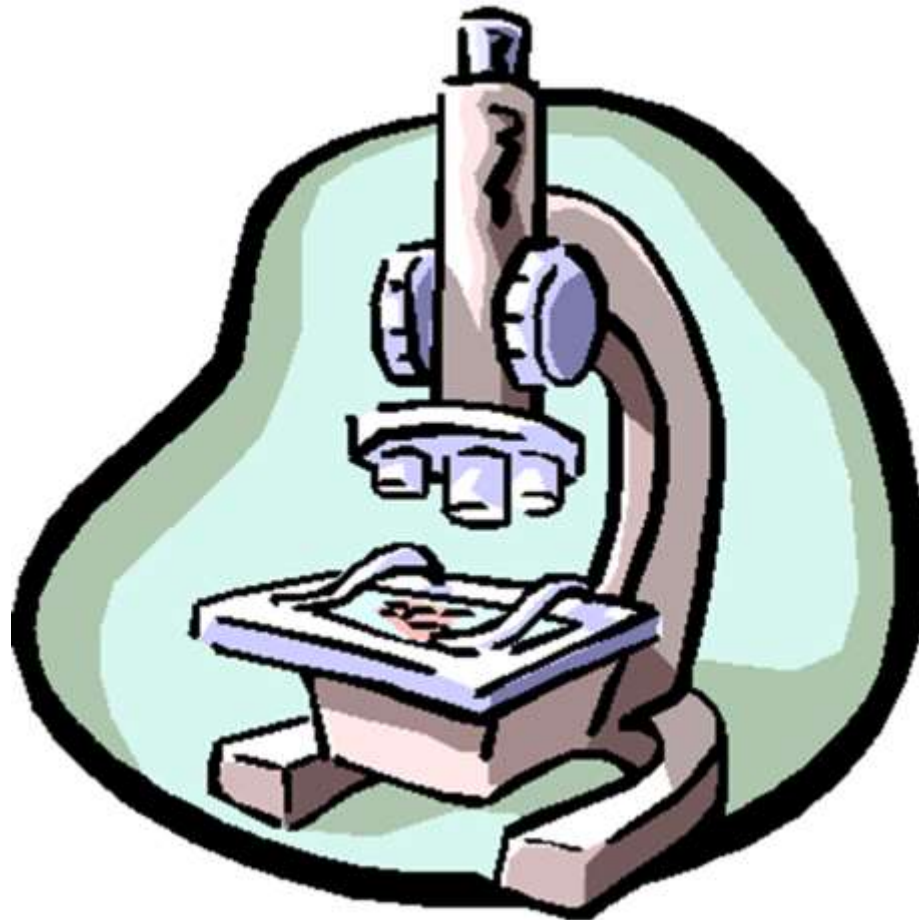
- Excess nutrients
 - The more phosphorous the bigger the bloom
 - Type of bloom depends on N:P ratio
- Sunlight
- Warm water– not always
- Reservoir turnover



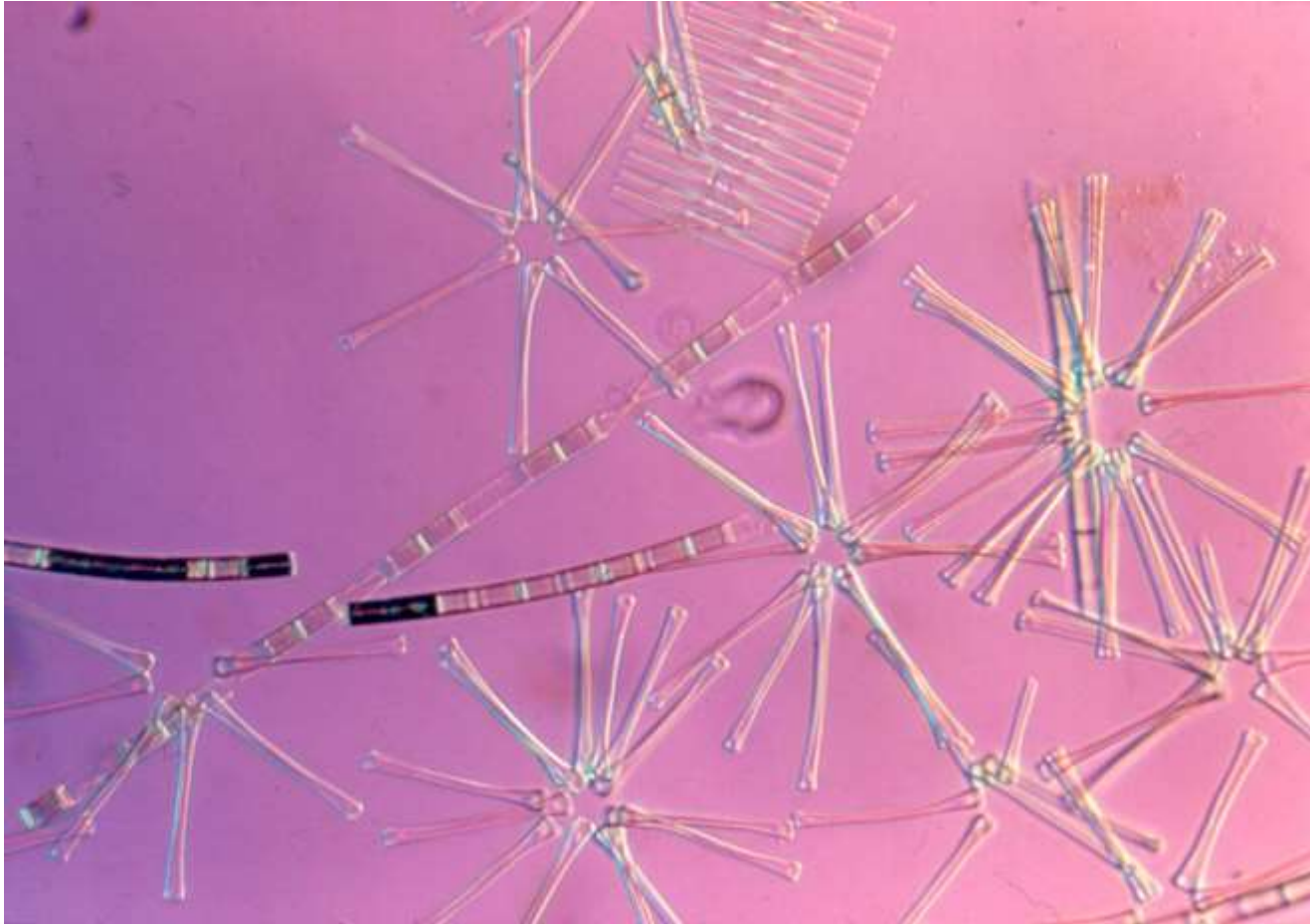
Algal Blooms

- Algae are always present in our water
- Depending on nutrients and water quality some algae thrive while others die off
- Cause various treatment issues
 - Interrupt coagulation
 - Plug filters
- Some cause taste and odors... some don't
 - Earthy, musty, fishy, cucumber, etc.
- Some produce toxins... some don't



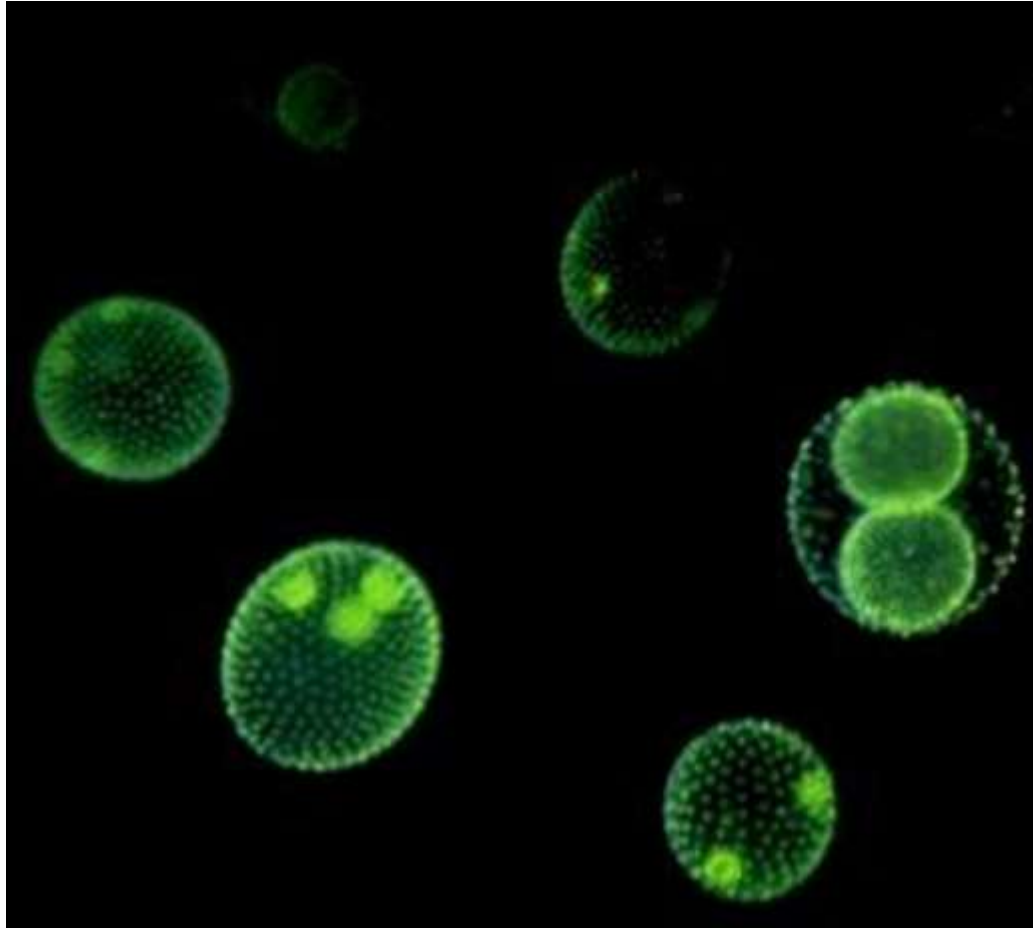


Diatom: *Asterionella*



Chlorophyta (Green Algae)

Volvox aureus

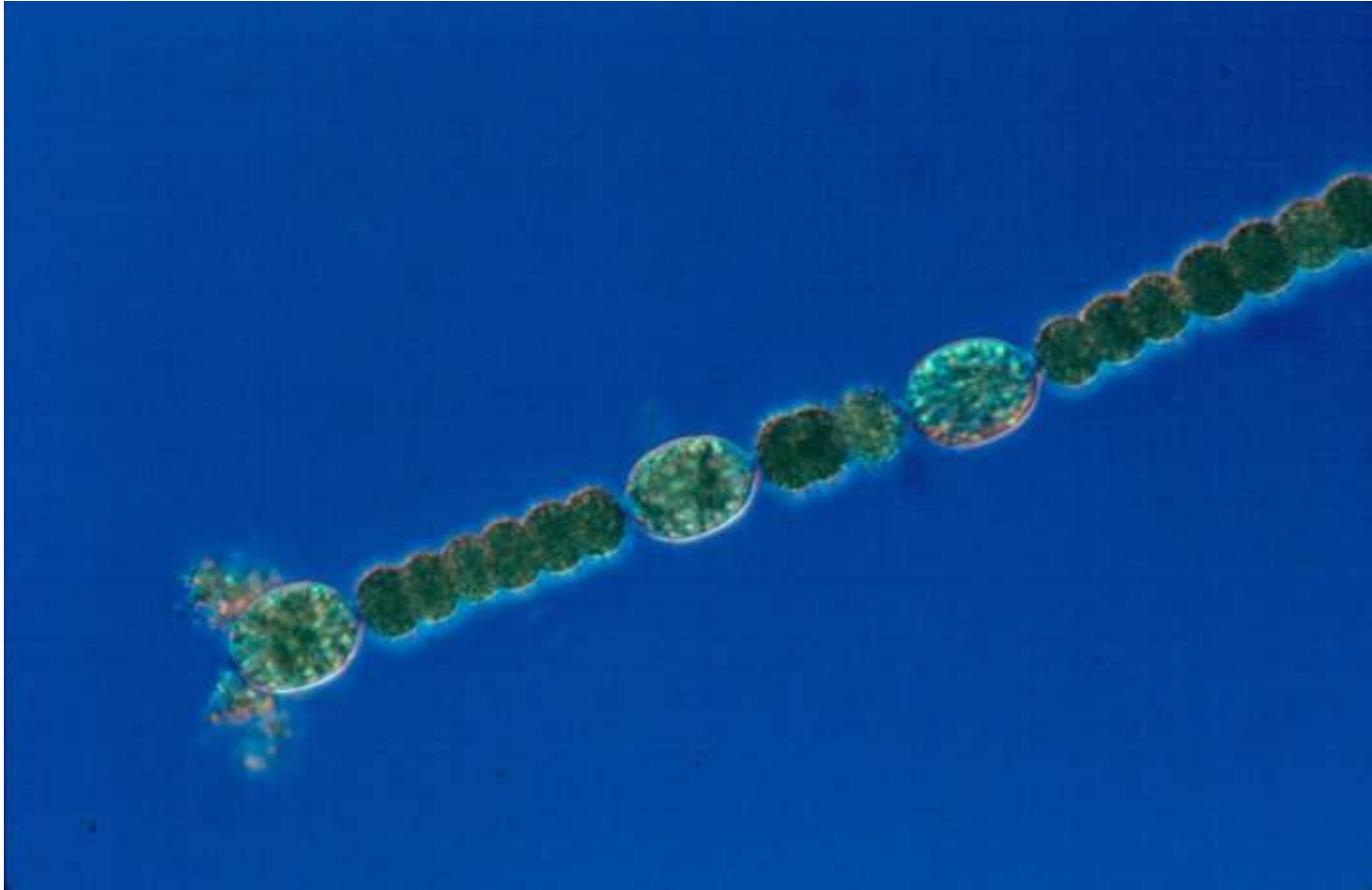


Chrysophyta, (Yellow-green Algae)



Cyanophyta (Blue-green Algae or Cyanobacteria)

Anabaena 400x



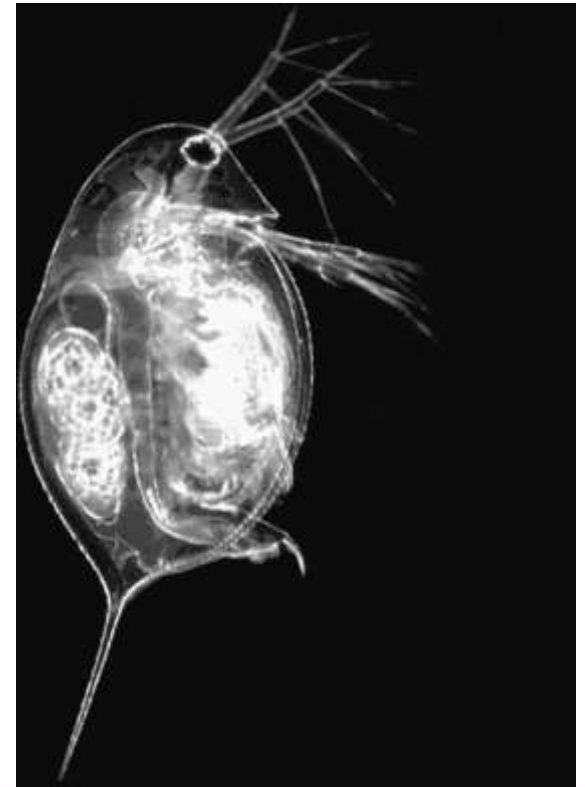
Our Treatment for Algae/T&O

- Reservoir manipulation (change gates)
- Coagulation and settling
- Powdered activated carbon (PAC)
- pH adjustment
- Filtration
- Chlorination
- Future: ozone/BAF



Previous T&O Events

- Almost annually we have algal blooms
- Most years treatment takes care of the problem
- 1998 was the last year that was this extreme
 - Lasted two months – September and October
 - Generated over 1,000 phone calls to the lab



This Event

- Algae were detected in the reservoir since May
- Reservoir turnover in late October
- T&O complaints began early November
- Peaked mid-December
- The type of algae is *Anabaena*
- Tastes described as earthy, musty, pond water
- No toxins present in reservoir or tap water



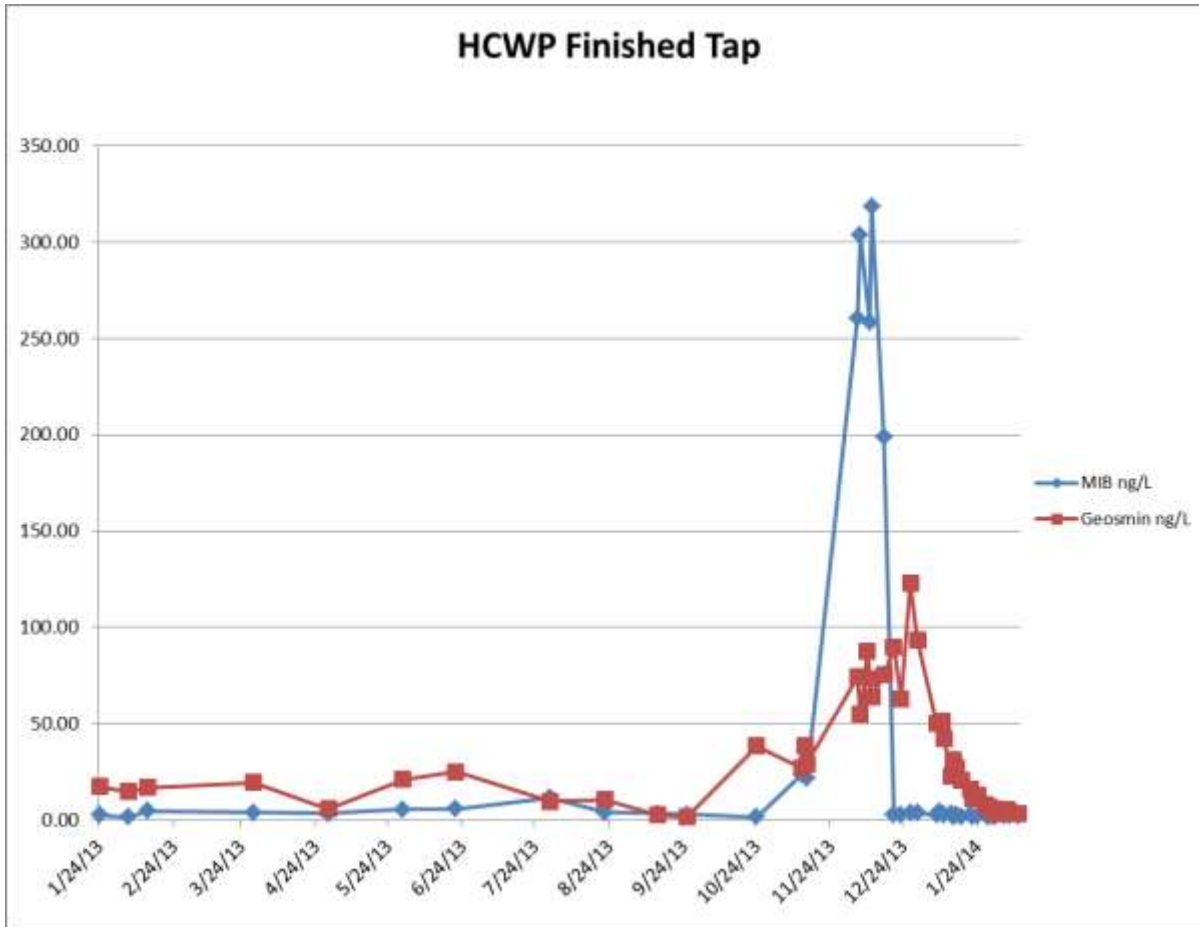
This Event (cont.)

- Generated over 1,800 calls to lab
- Treatment was achieving 60% removal of T&O compounds
- PAC treatment
 - Five times normal dose
 - \$10,000 per day – doubling normal treatment cost
 - \$820,000 for the event



This Event (cont.)

- T&O compounds
 - Geosmin and MIB
 - Can be detected by customers at 6-10 ppt
 - Can be detected by \$100,000 instruments at 2 ppt
 - Gesomin peaked >150 ppt
 - MIB peaked >300 ppt
 - Calls and T&O compounds were trending down by early January



2014 Prevention and Planning

- Withdrawing water from the bottom of the reservoir this summer
 - P is released from the sediment when the bottom goes anoxic in the summer
 - By sending it downstream, we reduce the amount of P available at turnover
- Second powdered activated carbon contract
 - Normal carbon contract for atrazine and TOC removal
 - Second carbon contract for T&O removal



T&O Carbon – proof of concept jar test results

HCWP - Carbon Study Results 2014														
Raw + Alum TOC Value (mg/L) =		7.726									50			
T + O Compounds(mib ng/l)		641.410												mg/L carbon used
T + O Compounds(Geo ng/l)		118.920												
Atrazine Spike Value (µg/L) =		10.50												
Vendor Number	Vendor Name	Sample Description	Atrazine Value	% Atrazine Removal	Efficiency µg /mg *	TOC Value	% TOC Removal	Efficiency mg /mg *	MIB Value	% MIB Removal	Efficiency ng /mg *	Geosmin Value	% Geosmin Removal	Efficiency ng /mg *
1	A		0.18	98.3%	0.21	5.716	26.0%	0.040	88.60	86.2%	11.06	9.040	92.4%	2.198
1 Dup	A		0.20	98.1%	0.21	5.733	25.8%	0.040	46.46	92.8%	11.90	6.090	94.9%	2.257
2	B		0.42	96.0%	0.20	6.215	19.6%	0.030	133.10	79.2%	10.17	10.650	91.0%	2.165
3	D	T/O carbon	0.34	96.8%	0.20	6.538	15.4%	0.024	222.90	65.2%	8.37	11.140	90.6%	2.156
4	C		1.10	89.5%	0.19	7.052	8.7%	0.013	344.33	46.3%	5.94	25.960	78.2%	1.859
5	D	current contract	0.35	96.7%	0.20	6.198	19.8%	0.031	235.17	63.3%	8.12	14.040	88.2%	2.098

* = µg of Atrazine or mg of TOC or ng of MIB or ng of Geosmin removed / mg of carbon added

This Summer

- Cool, wet summer – much like 2013
- We are seeing the same cyanobacteria species and numbers as we did in July and August of 2013
 - Including *Anabaena*, *Aphanizomenon*, *Aphanocapsa*, *Limnothrix*, and *Microcystis*
- There is a renewed sense of urgency and importance to T&O monitoring
- Increased our monitoring frequency to weekly from the reservoir for both algae and T&O
- We have started monitoring T&O at the middle and bottom gate levels
- We have started collecting a T&O sample from the distribution system each week to be evaluated by our taste test panel in the lab

Questions

- Will we have a T&O event this winter?

