Lake Topanemus Protection and Watershed Management Plan

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Introduction - Chris L. Mikolajczyk, CLM

- ✓Senior Manager - Aquatics
- ✓NALMS Certified Lake Manager
- ✓PH employee for 24+ years
- ✓33+ years experience
- ✓A.A.S. - Ecology & Environmental Technology
- ✓B.S. - Geography (Water Resources Emphasis)
- ✓M.S. - Geography (Watershed Management)
- ✓Immediate Past-President

  North American Lake Management Society

Contributing Authors

- ✓Jesse Smith
- ✓Will Kelleher
- ✓Katherine Walston
- ✓Paul Cooper
- ✓Patrick Rose

"Anyone who can solve the problems of water will be worthy of two Nobel Prizes – one for peace and one for science." - John F. Kennedy

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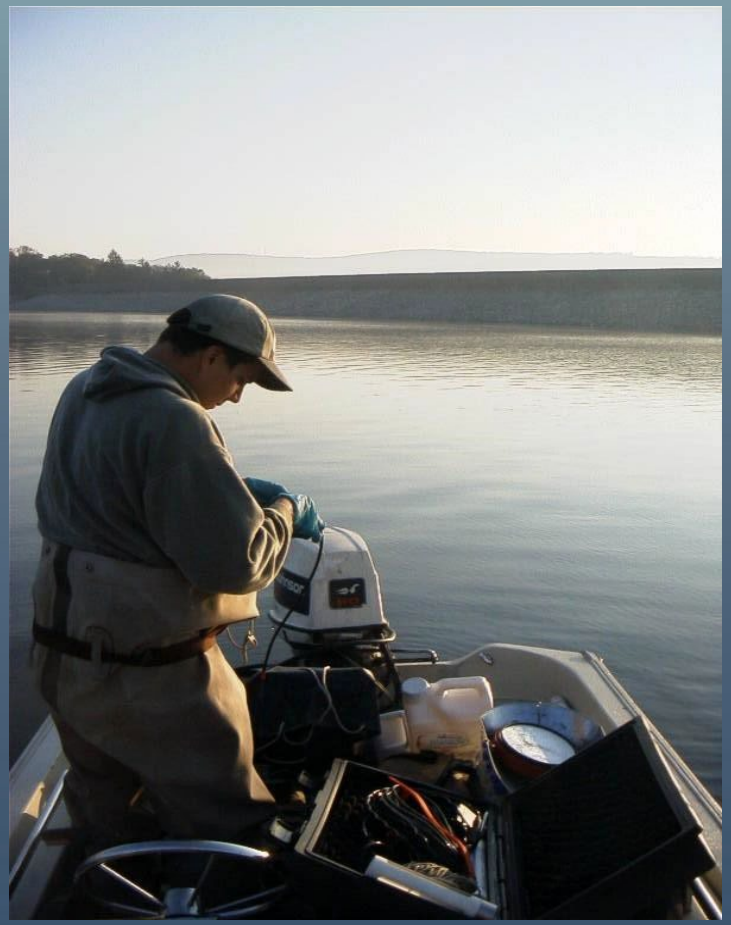
Why the Need For a Management Plan??



- Algae blooms
- Excessive SAV growth
- Taste and odor
- Degraded water quality
- Murky/muddy water
- Poor fishery
- Shoreline erosion
- Watershed loading
- **FUNDING!!**

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Keys To Any Successful Plan

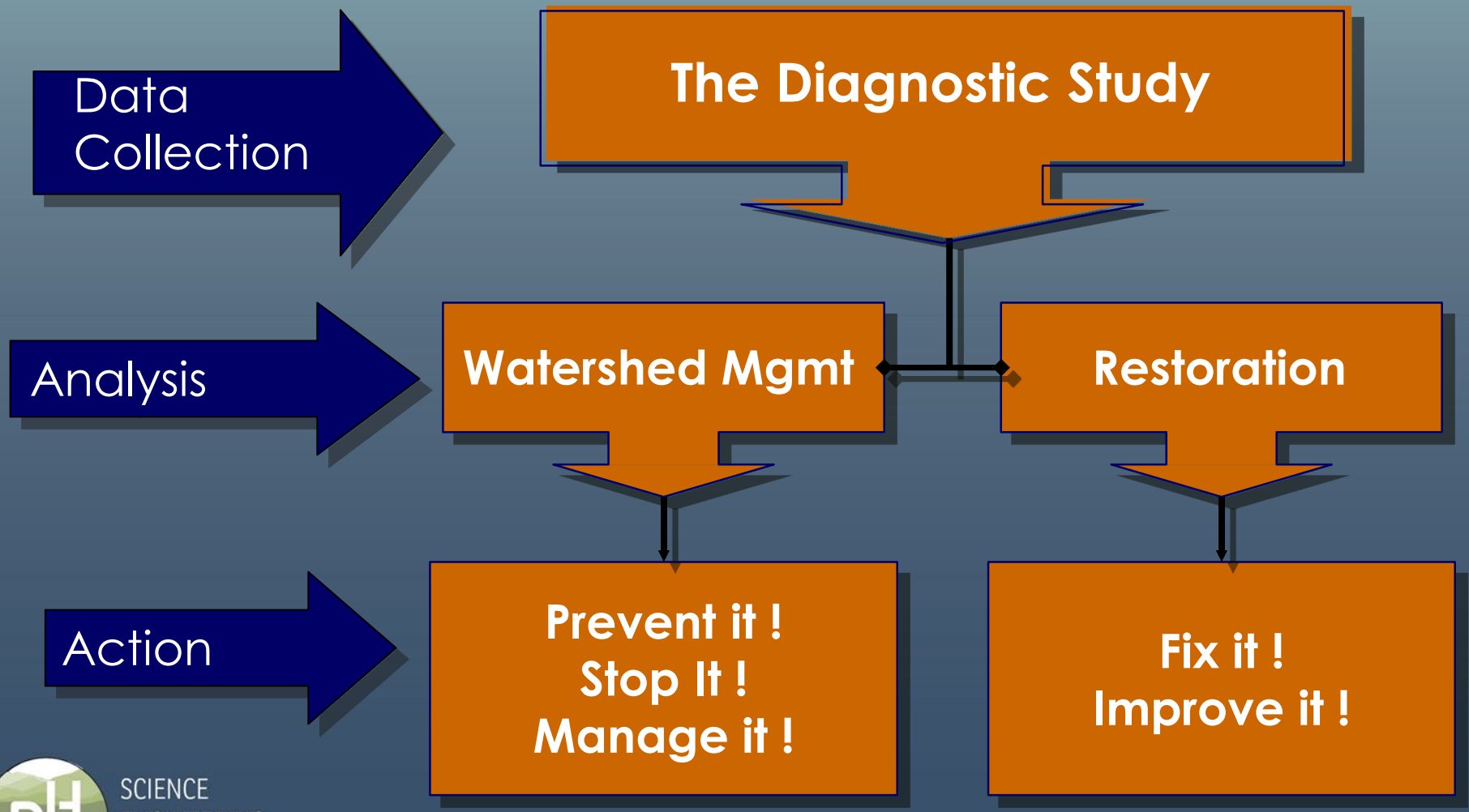
1. Have clearly defined, realistic goals and objectives.

2. Base management and restoration actions on a properly collected, technically sound dataset.

3. Put the plan into action using support and backing of the **community, membership or stakeholders**.

4. Review and revise goals and objectives as based on results of management and restoration efforts.

Flow Chart for Successful Lake and Pond Management



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Use The Data To Understand …

- Role of internal nutrient sources
- Role of external (watershed) nutrient sources
- Stratification, DO depletion
- Storm impacts on lake productivity
- Sediment sources, areas of rapid infilling
- Biological interactions
- Use impairments

This typically provides the direction needed to objectively and properly manage a lake and its watershed over both the short-term and long term.

Lake Topanemus – Freehold Monmouth County, New Jersey

- Over 200 years of formation/use
- Approx. 71 acres
- Lake = 22 acres
- Activities include walking, hiking, fishing, birding

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Protection and Watershed Management Plan Tasks

- Historical Data Review
- Quality Assurance Project Plan (QAPP)
- Bathymetric Survey
- Watershed Modeling:
  - -Hydrologic Load
  - -Pollutant Load (sub-watershed)
  - -Pollutant Removal techniques
- Water Quality Assessment
- Visual Habitat Assessment
- Trophic State Analysis
- Assessment Report

Protection and Watershed Management Plan Tasks

- Historical Data Review - Previous studies conducted by the NJDEP (1981, 2003, 2005), USACE (2010), NJDEP F&W (2015), Hughes (2018), Souza (1983)

- Conclusions included: the Pond retains Total Phosphorus (TP) and Nitrate (NO3) from watershed-based sources and watershed based practices. Septic influence as well.

- TP concentrations as low as 0.05 mg/L can cause algal blooms and plant infestation.

Protection and Watershed Management Plan Tasks

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- **Bathymetric Survey**
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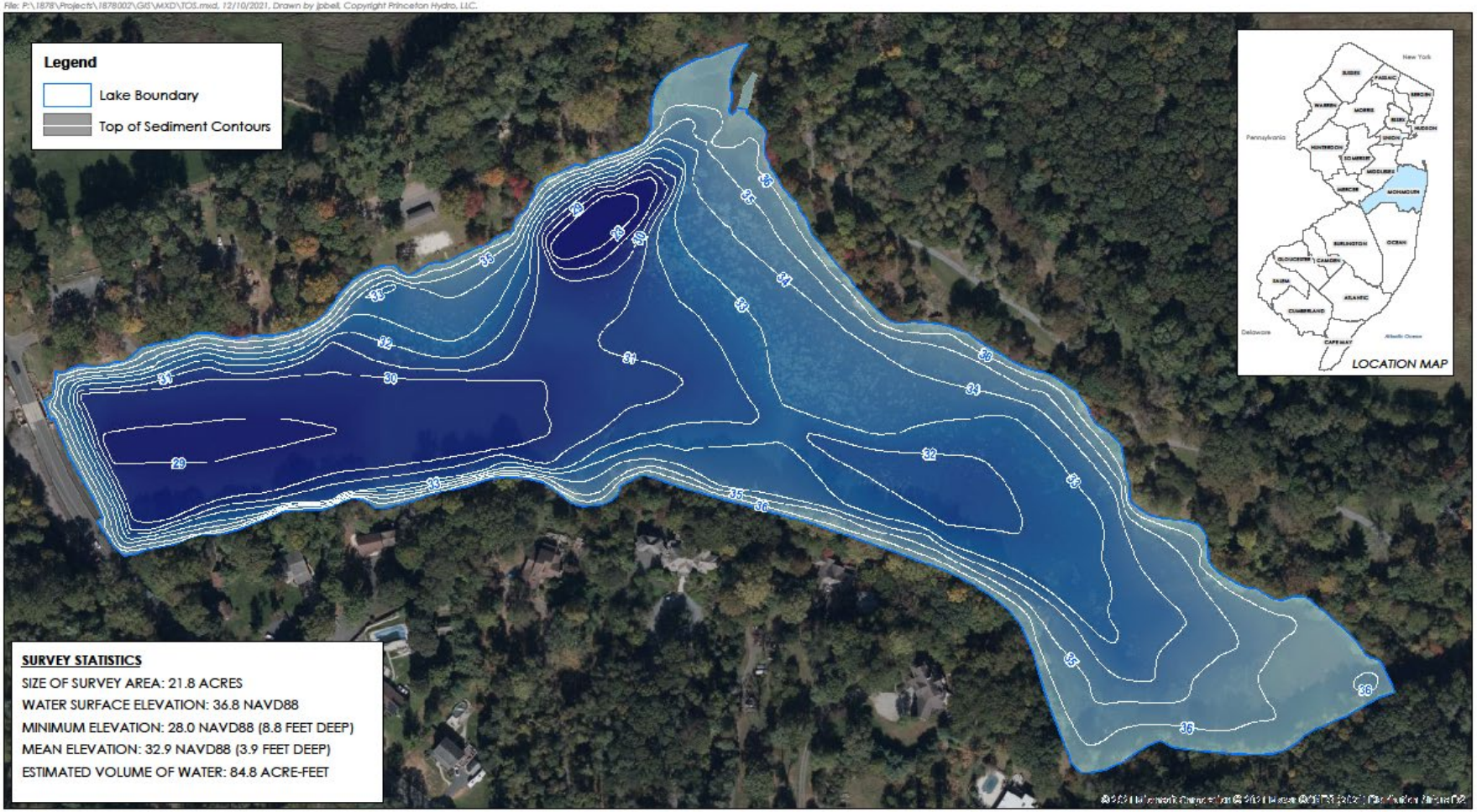
Protection and Watershed Management Plan- Tasks

- Bathymetric Survey

Table 4.1 – Bathymetric/Morphometric Characteristics	
Parameter	Value
Lake Surface Area	21.8 acres
Watershed Area	924.3 acres
Mean Depth	3.9 feet
Maximum Depth	8.8 feet
Lake Volume	84.8 acre-feet
Average Hydraulic Residence Time	23.9 Days
Average Flushing rate	15.3 Times/year
Watershed Area/Lake Surface Area Ratio	42.4

Protection and Watershed Management Plan- Tasks

- Bathymetric Survey – Water Depths



Protection and Watershed Management Plan- Tasks

- Bathymetric Survey – Sediment

Protection and Watershed Management Plan- Tasks

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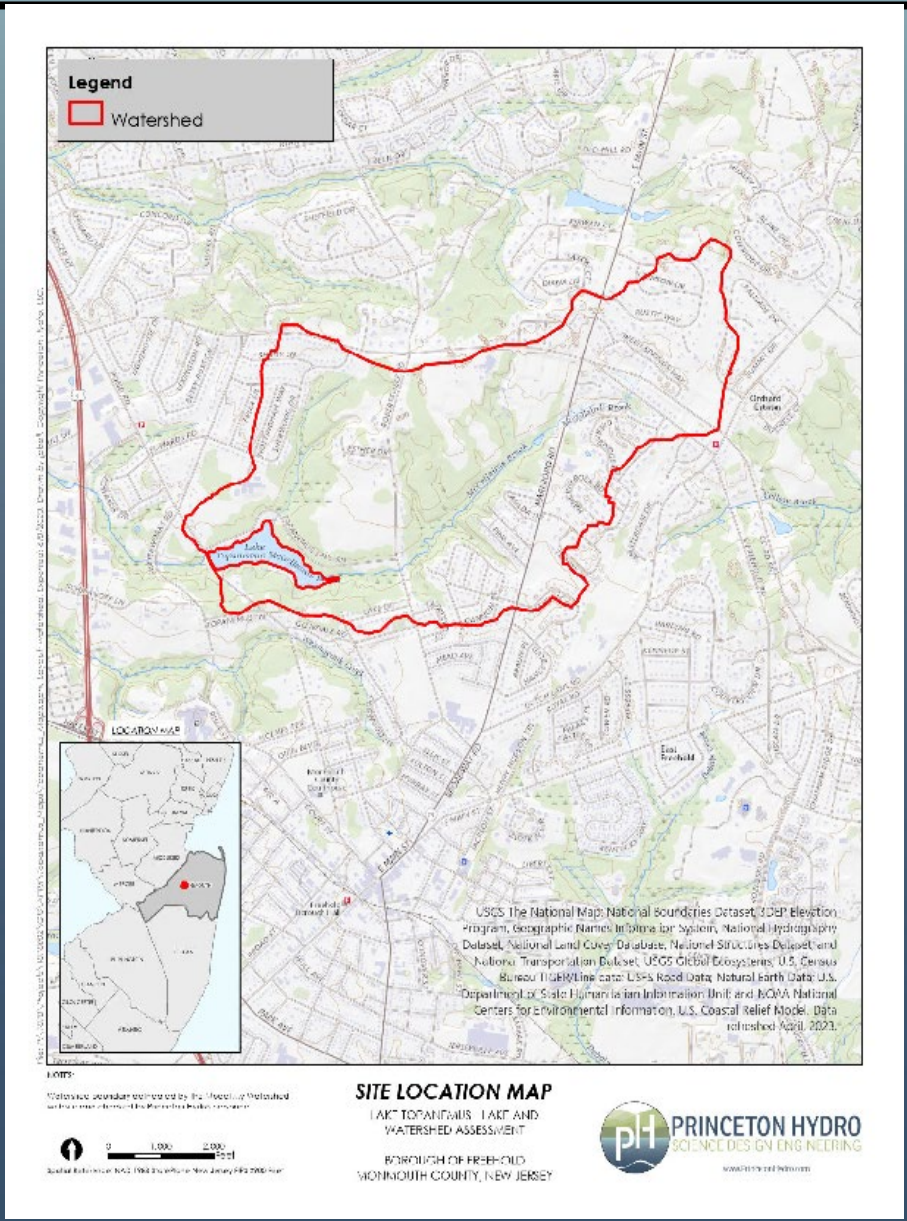
Hydrology of a Lake Influences...

- Mixing, both horizontal and vertical
- Flushing and residence time
- Influx & retention of pollutant/nutrients
- Sediment infilling
- Development, length of algae blooms
- **Success of restoration efforts**

Hydrologic Budget (aka the watershed!)

- Surface water in-flow
- Out-flow or discharge
- Groundwater in-flow
- Precipitation
- Evaporation
- Flushing (annual and/or seasonal)

Lake Topanemus -Watershed



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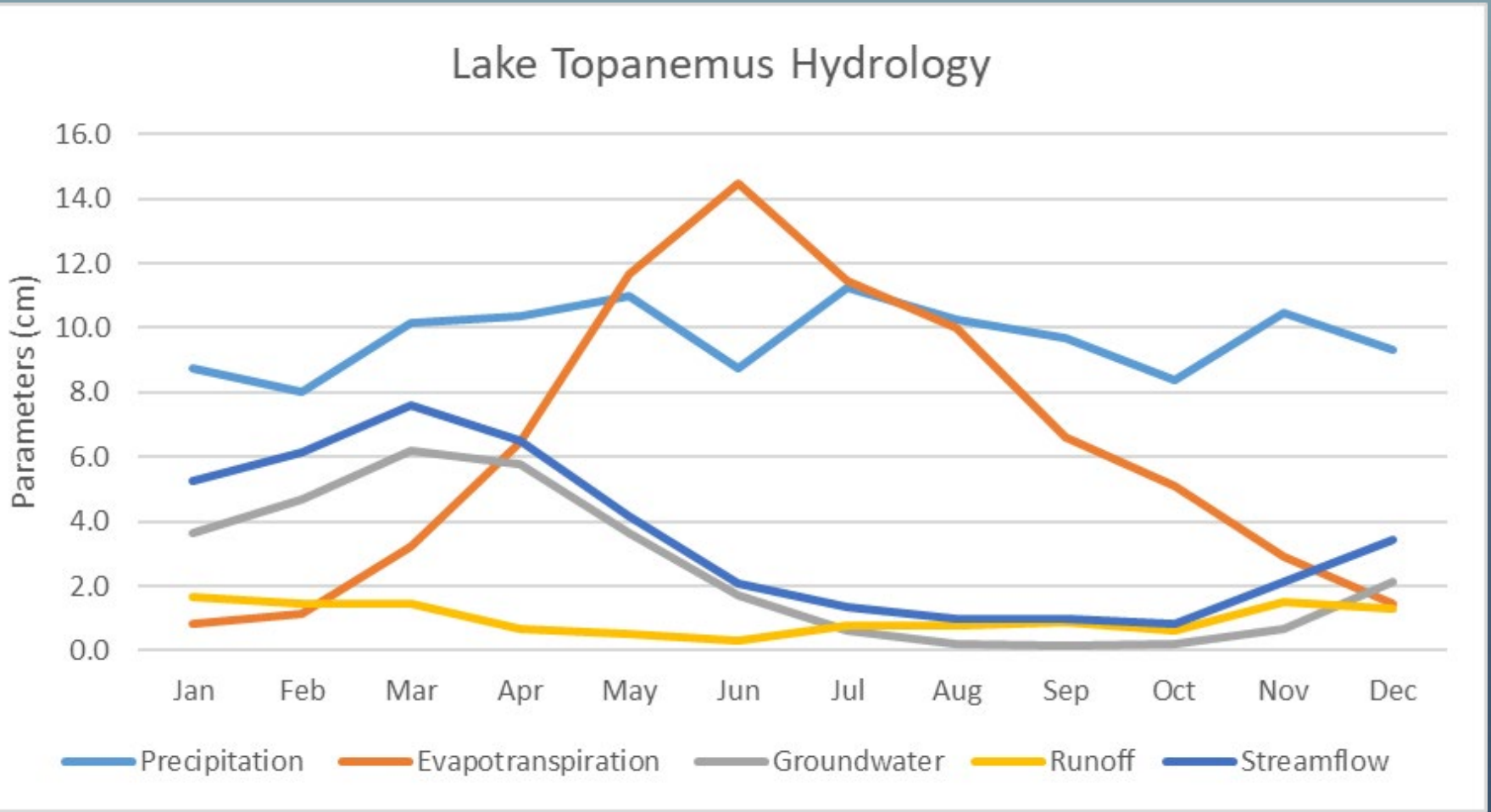
Hydrologic Budget (aka the watershed!)



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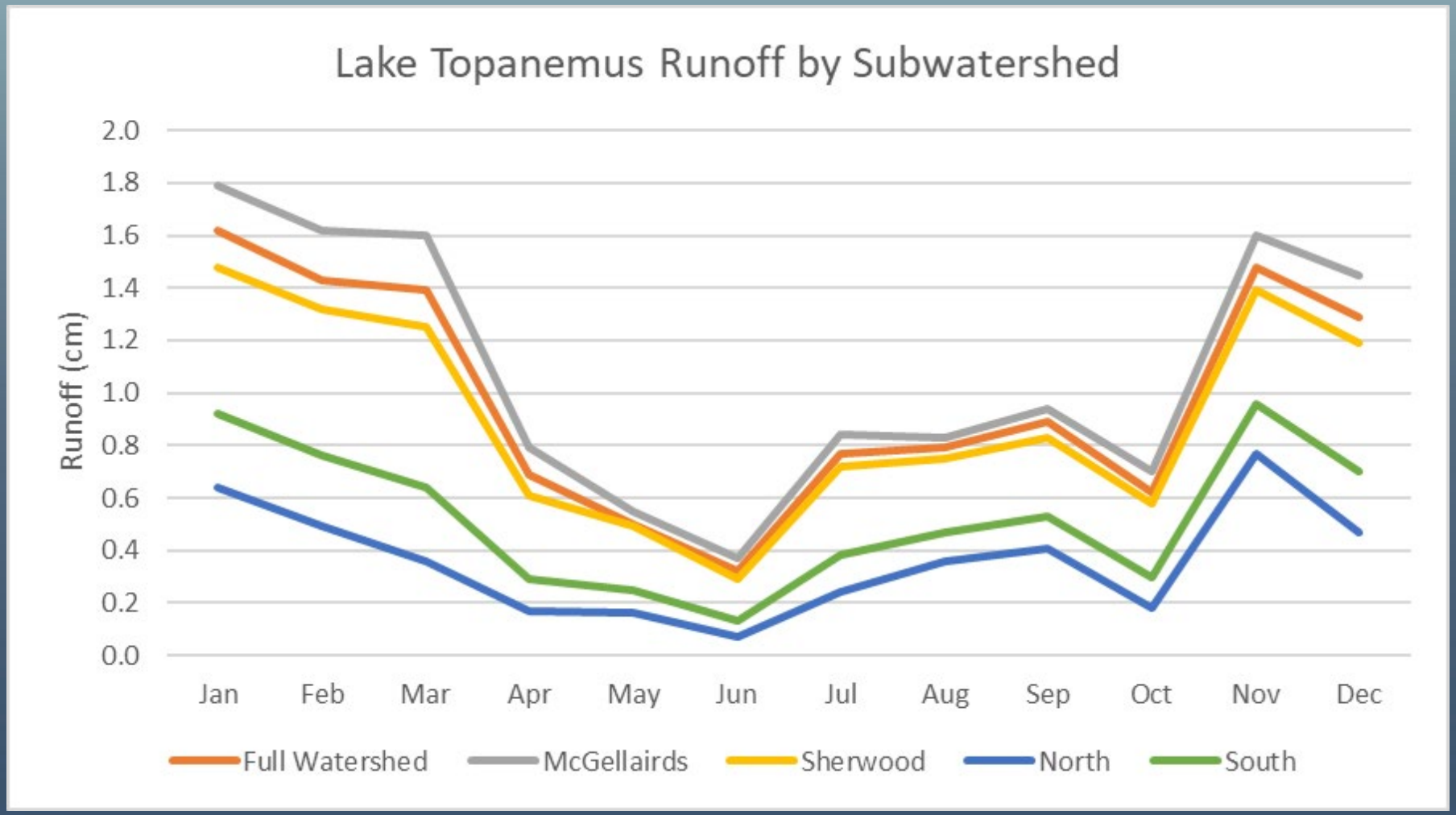

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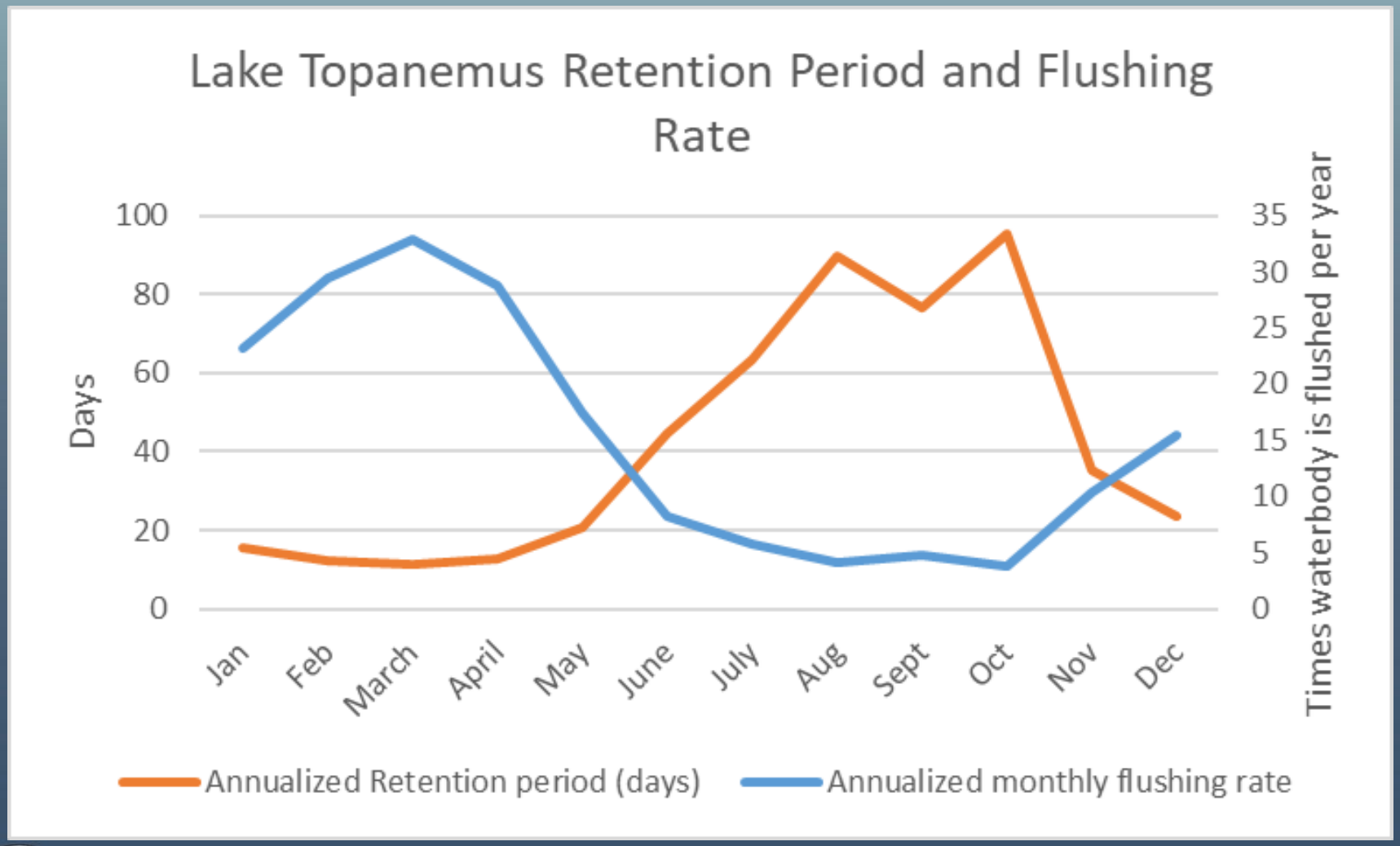
Hydrologic Budget (aka the watershed!)



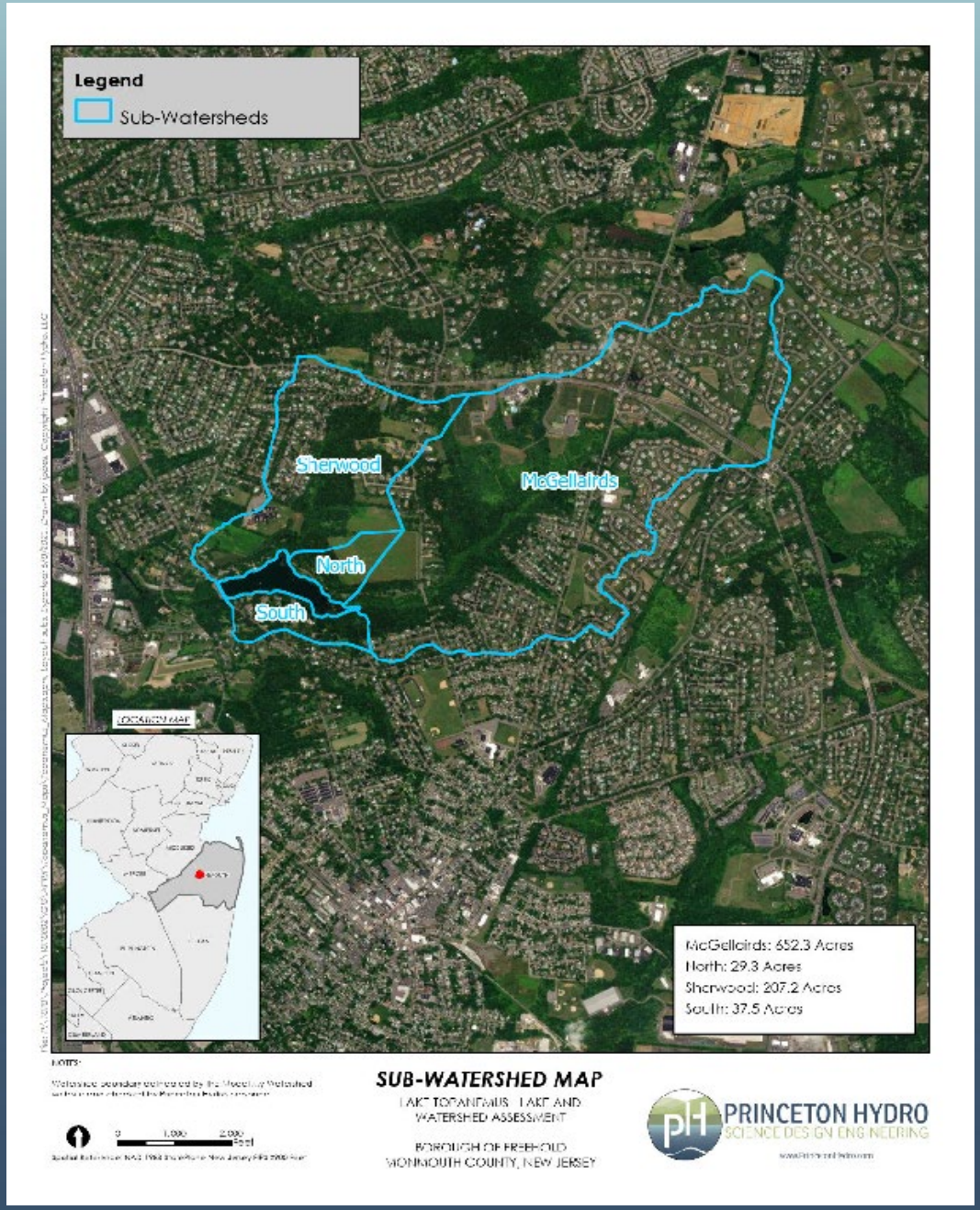
Phosphorus Loading

- The overall phosphorus load strongly determines the extent of in-lake productivity
- The more phosphorus, the more algae and SAV growth
- Loading can vary seasonally and originate from both internal and external sources
- A detailed analysis & quantification of the Phosphorus load is the "cornerstone" of a successful diagnostic study.

Computing Phosphorus Load

- Account for all external sources (point sources, septic source, stormwater runoff, atmospheric, etc.)
- Account for internal sources (internal recycling, SAV and algae die-off, etc.)
- Account for reduction of nutrient load due to "sinks" (wetlands, upstream lakes or ponds)
- Role of hydrology and seasonality of loading Input data into model – AVGWLF, BASINSim, Wikiwatershed, etc.

Sub-Watershed Map



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Phosphorus Load – Watershed Land Use

Hay/Pasture – 13.0%
Cropland – 6.1%
Forest – 0.8%
Wetland – 0.7%
Open Land - 0.2%
Low-Density Mixed – 5.8%
Medium-Density Mixed – 3.7%
High-Density Mixed – 0.6%
Low Density Open Space – 5.0%
Farm Animals – 1.9%
Stream Bank (erosion) – 18.1%
Groundwater – 44.0%

Phosphorus Load – Unknown Sources

Watershed – 100%

Internal Load – 0.0%

Could Carp Bioturbation be a factor?

Protection and Watershed Management Plan- Tasks

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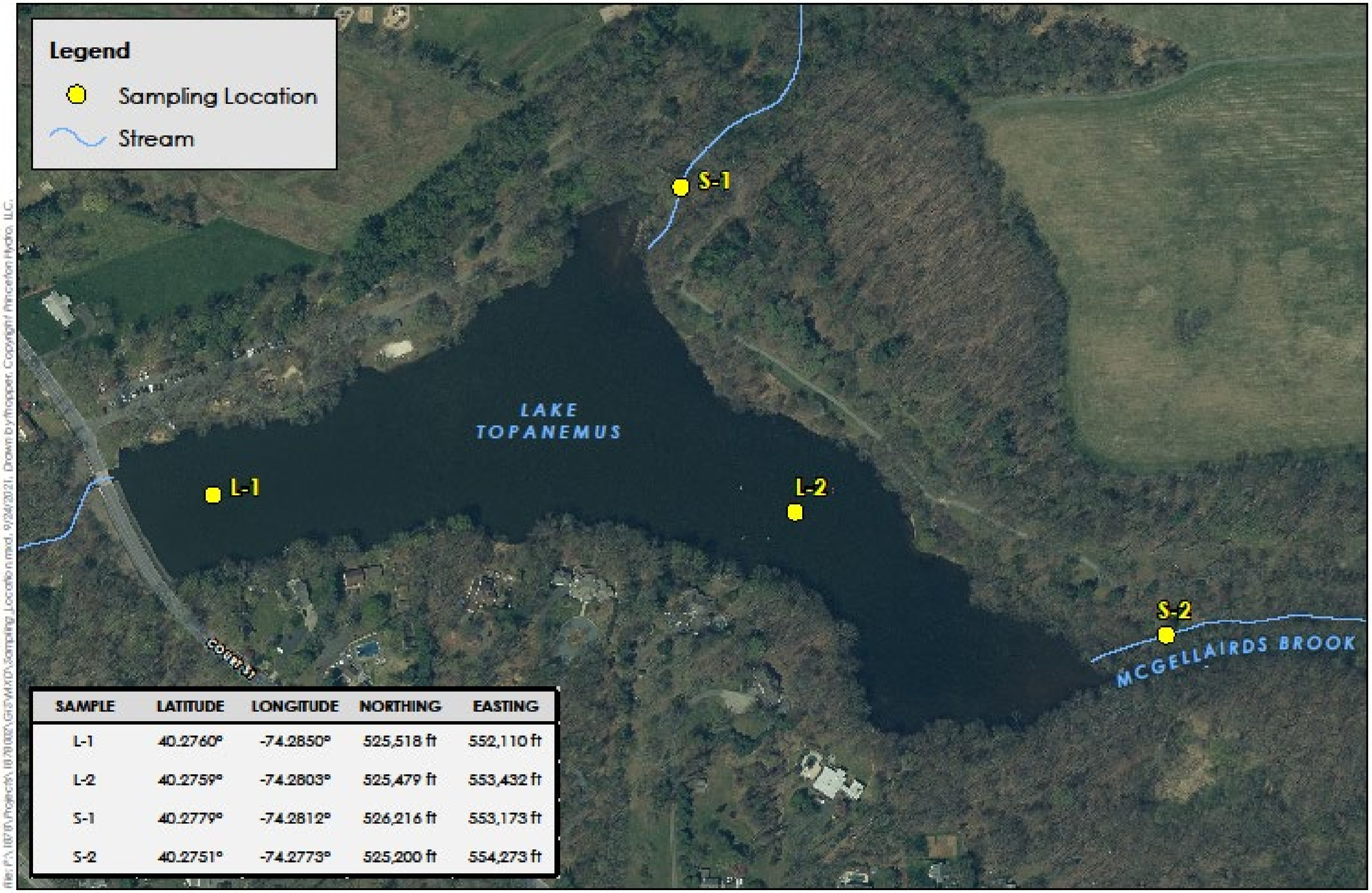
Water Quality Sampling



SAMPLE	LATITUDE	LONGITUDE	NORTHING	EASTING
L-1	40.2760°	-74.2850°	525,518 ft	552,110 ft
L-2	40.2759°	-74.2803°	525,479 ft	553,432 ft
S-1	40.2779°	-74.2812°	526,216 ft	553,173 ft
S-2	40.2751°	-74.2773°	525,200 ft	554,273 ft

NOTES:
1. Sampling locations are approximate. Latitude and longitude are referenced to the North American Datum of 1983. Northing and easting are referenced to the New Jersey State Plane Coordinate System.
2. Streams obtained from NJDEP GIS website: www.state.nj.us/dep/gis/
3. 2020 orthoimagery obtained from NJ Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS).

0 150 300 Feet

Map Projection: NAD 1983 2011 StatePlane New Jersey FIPS 2900 Ft US

SAMPLING LOCATION MAP

319 PROJECT
LAKE TOPANEMUS
FREEHOLD TOWNSHIP
MONMOUTH COUNTY, NEW JERSEY

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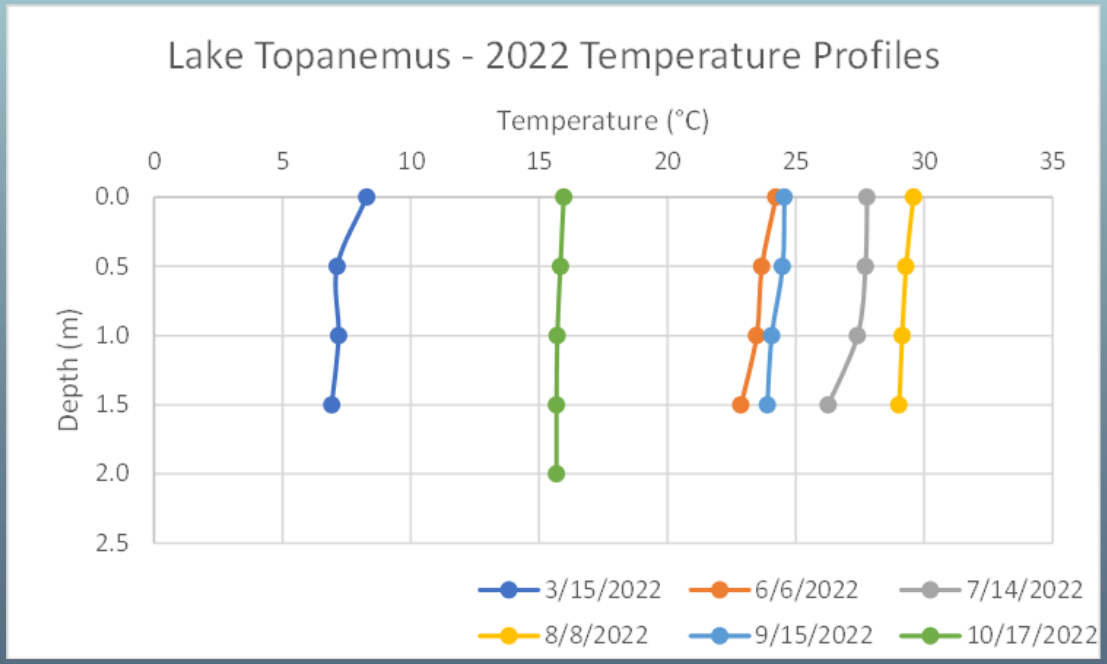
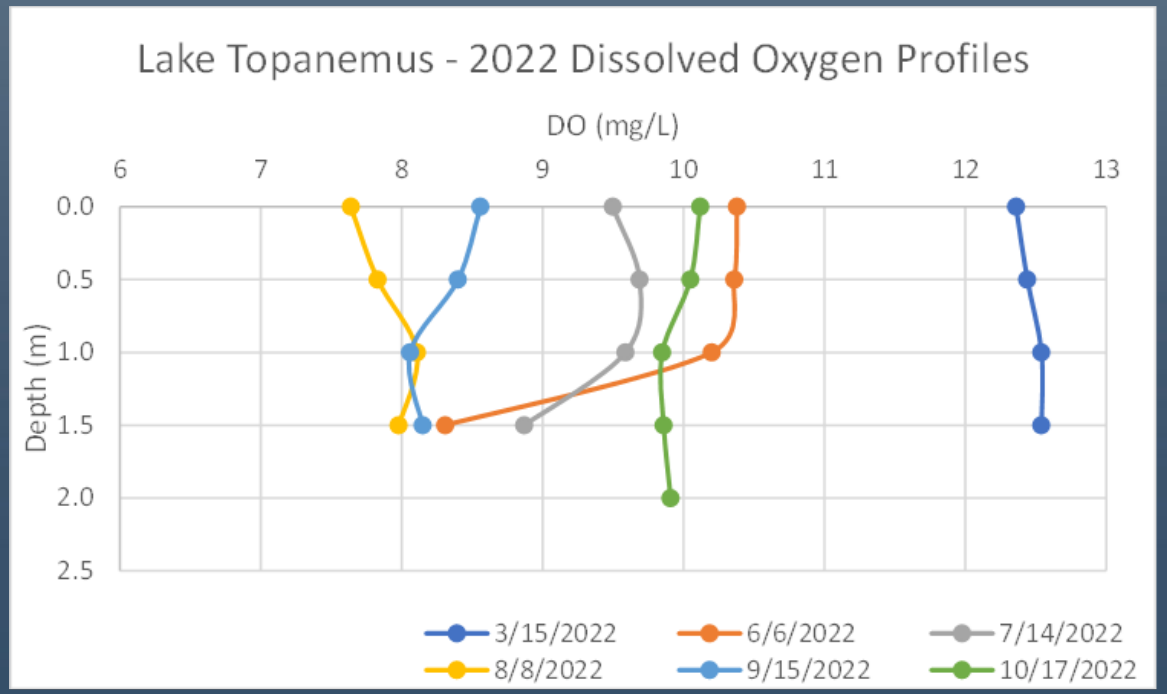


In-Situ Data



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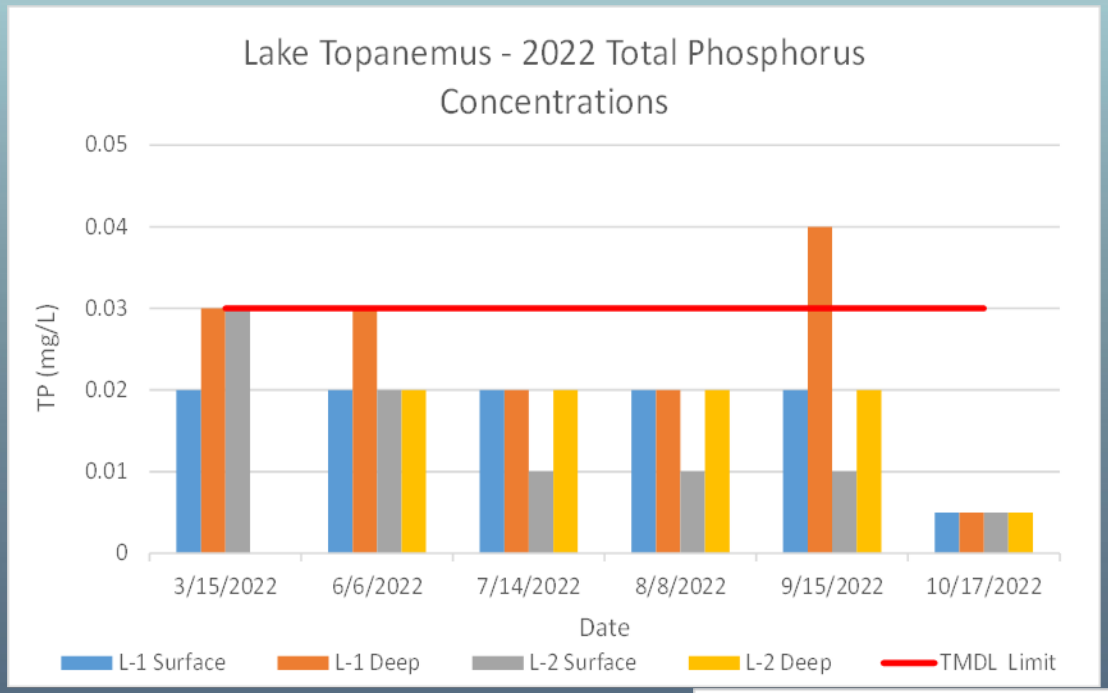
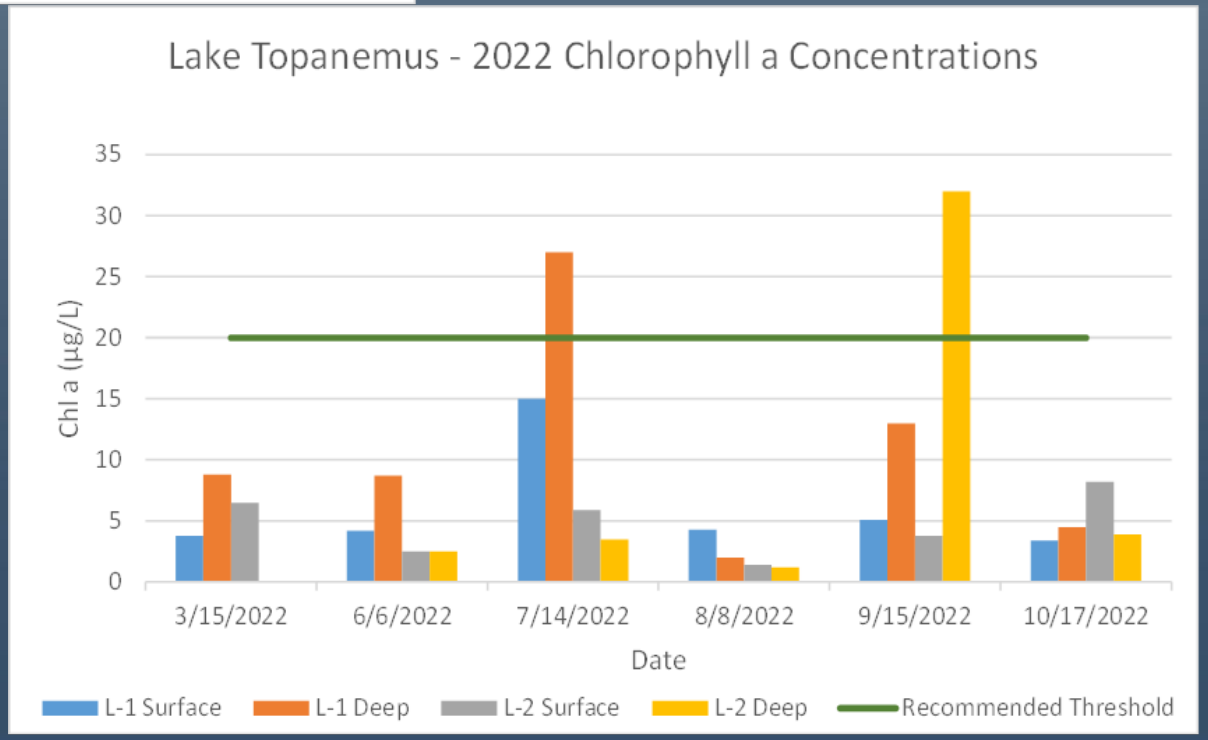
Discrete Data





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Biological Data

- Phytoplankton (Algae) – Overall diverse species composition. In addition to cyanobacteria, a variety of diatoms, chrysophytes, green algae and cryptomonads were also observed. Cyanobacteria (blue-green algae) only present in low to moderate densities.

- Zooplankton (micro-organisms) – Again, overall diverse species composition. A mixture of cladocerans copepods and rotifers were noted throughout the 2022 season. Relatively light densities of arthropods were noted during the March, July, September and October events. Consistent lack of herbivorous species.

- Aquatic vegetation – Bladderwort (floating) coontail and brittle naiad (invasive). Floating lily species.

Biological Data

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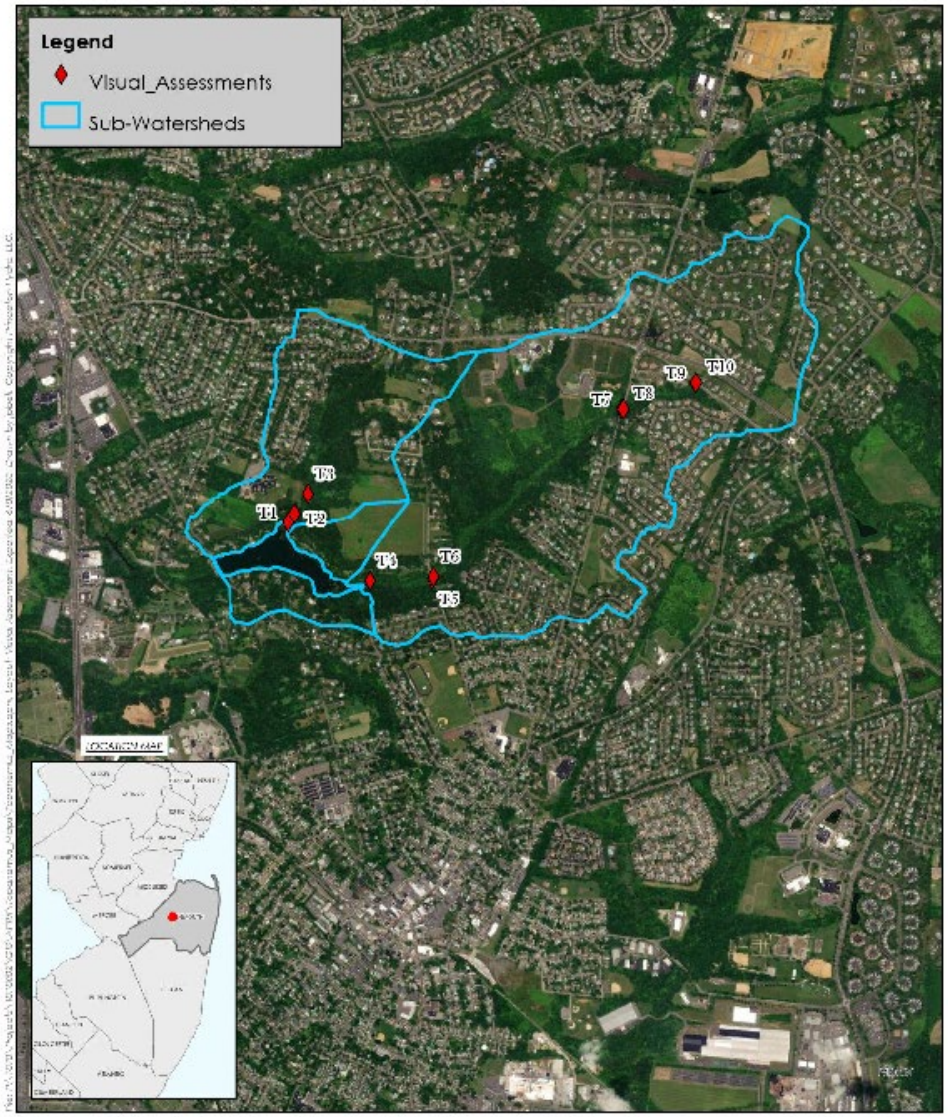
Visual Habitat Assessment



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Visual Habitat Assessment

Table 5.3: Lake Topanemus - 2022 Habitat Assessment Scores										
Category		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
Epifaunal Substrate/ Available Cover		10	5	3	11	12	6	15	14	15	13
Pool Substrate Characterization		8	6	4	13	16	11	17	13	18	16
Pool Variability		0	3	10	10	4	9	9	7	2	4
Sediment Deposition		15	8	4	9	10	7	9	7	5	15
Channel Flow Status		20	13	8	17	16	15	9	7	5	9
Channel Alteration		15	12	20	18	12	14	11	12	7	12
Channel Sinuosity		5	7	15	14	5	9	4	8	5	7
Bank Stability	Left Bank	6	3	0	8	4	8	6	8	1	9
	Right Bank	6	2	2	7	5	5	5	8	4	8
Bank Vegetation Protection	Left Bank	5	2	3	7	1	5	4	2	7	4
	Right Bank	4	2	3	7	2	4	6	2	7	3
Riparian Vegetative Zone Width	Left Bank	6	9	10	9	4	5	4	7	9	2
	Right Bank	7	9	6	8	5	4	8	6	7	1
Overall Habitat Value		**107**	**81**	**88**	**138**	**96**	**102**	**107**	**101**	**92**	**103**
Overall Habitat Score		**Marginal**	**Marginal**	**Marginal**	**Sub-Optimal**	**Marginal**	**Marginal**	**Marginal**	**Marginal**	**Marginal**	**Marginal**

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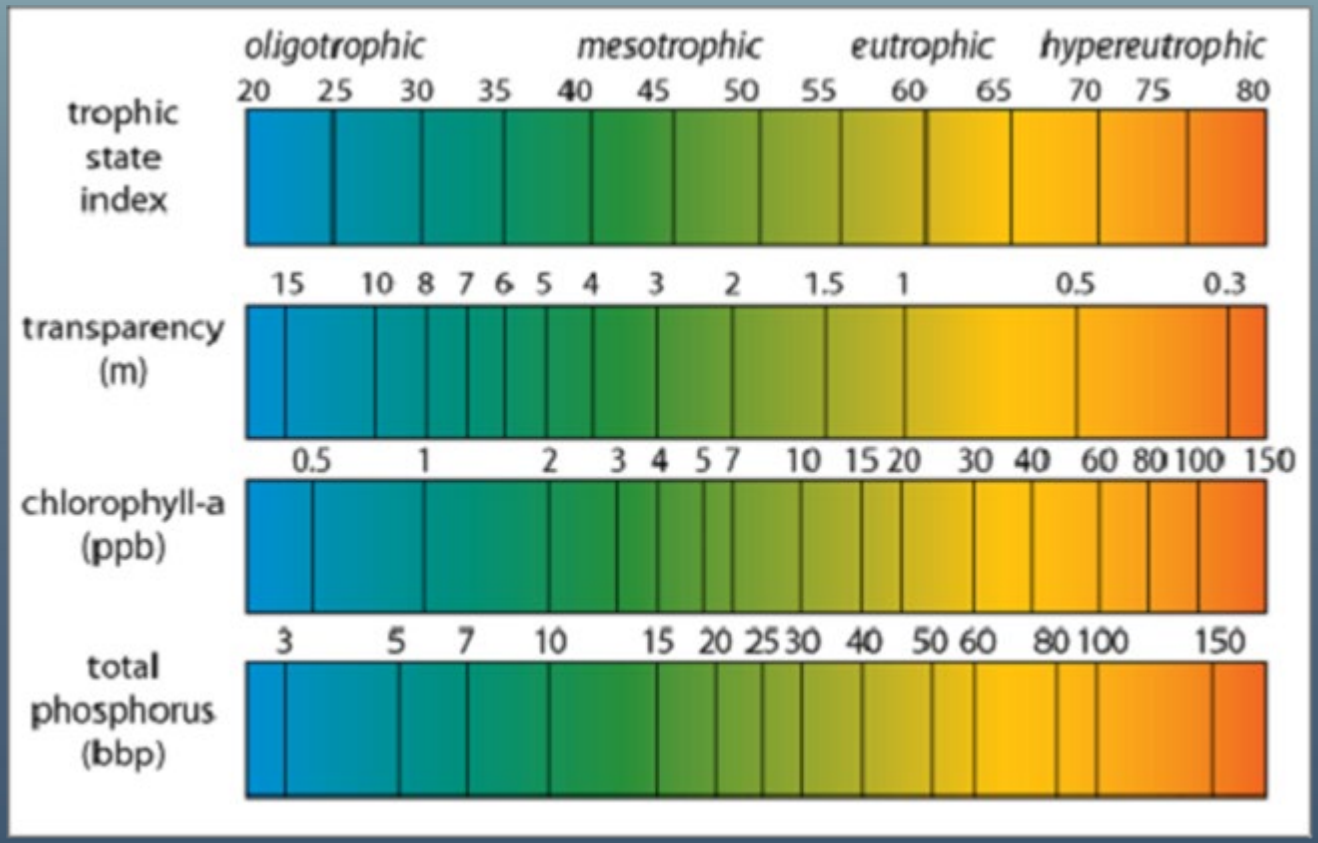
Trophic State Analysis



TP – 47; Chl a – 57; Secchi - 52

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Putting The Plan Together

- Base decisions on diagnostic data
- Address short and long term problems
  - In-lake = short-term
  - Watershed = long-term
- Prioritize projects accordingly
- Develop budget
- Develop implementation schedule
- Make sure plan is cost-effective

Typical Elements of a Good Plan

Source Control - Reduce pollutant load at point of origin, by decreasing inputs you decrease rate of eutrophication

Delivery Control - Intercept and decrease pollutants before they enter lake

In-lake Restoration – Use in-lake techniques to both correct the cause of eutrophication and lessen WQ impacts

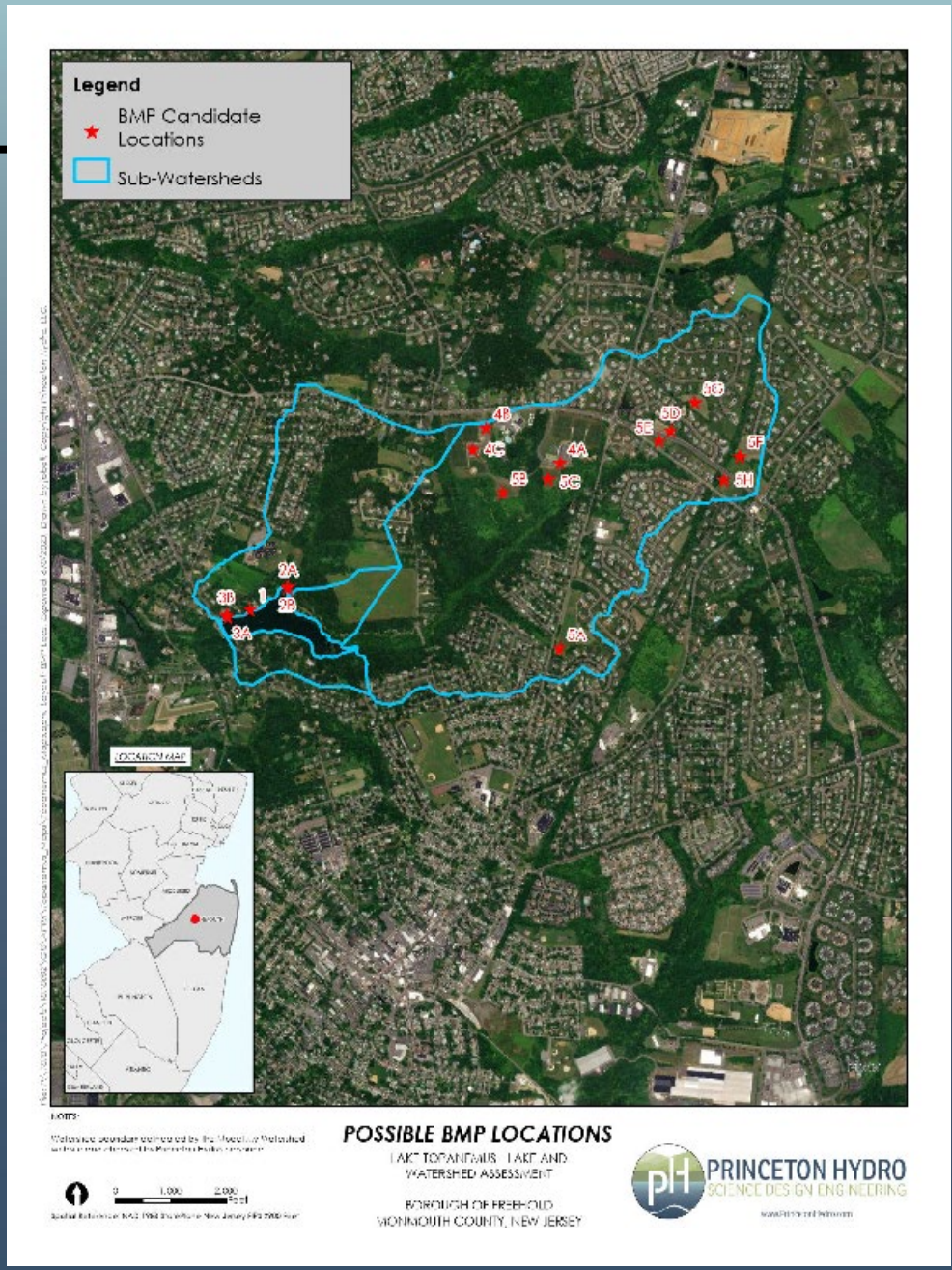
Setting Management Goals

- Establish goals using easy to understand threshold values
- Based on measured water quality data, observations of phytoplankton, SAV and mat algae growth, and lake clarity.
- Example management thresholds…
  - Clarity > 1.0 meter
  - Chlorophyll *a* < 15 µg/L
  - TP < 0.05 mg/L
  - Maximum 20% SAV coverage

Put Plan Into Motion

- Make full use of the data
- Listen to stakeholders
- Make sure plan prioritizes the correction of cause of problems
- Make sure plan addresses lake users
- Develop an implementation schedule
- Coordinate finances and create budget
- Put plan into action

Put Plan Into Motion – Best Management Practices



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Put Plan Into Motion – Best Management Practices

- Site 1 – Shoreline Stabilization
- Site 2 – Inlet Restoration
- Site 3 – Porous pavement and vegetated swale
- Site 4 – Porous pavement for parking lots
- Site 5 – Overall stormwater infrastructure (8 sites)

- In-Lake – Dredging, Aquatic Plant Management, Hydro raking, Biochar, Floating Wetland Islands, Carp Assessment (Fishery Survey)

- General - Pet Waste Management, Stabilized Access Points, Riparian Zone Enhancement, Septic Management, Fertilizer Management

Lake and Watershed Management is not a leap, it's an ever changing and challenging climb! But, a slow and steady partnership will get you to the payoff!

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QUESTIONS?

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THANK YOU!

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