Community Science on Missouri Lakes

The Lakes of Missouri Volunteer Program

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Columbia, MO 65211

University of Missouri
The Missouri Department of Natural Resources
Missouri Department of Health and Senior Services

Region V11, US Environmental Protection Agency, through the Missouri Department of Natural Resources, has provided partial funding for this project under Section 319 of the Clean Water Act

The Lakes of Missouri Volunteer Program

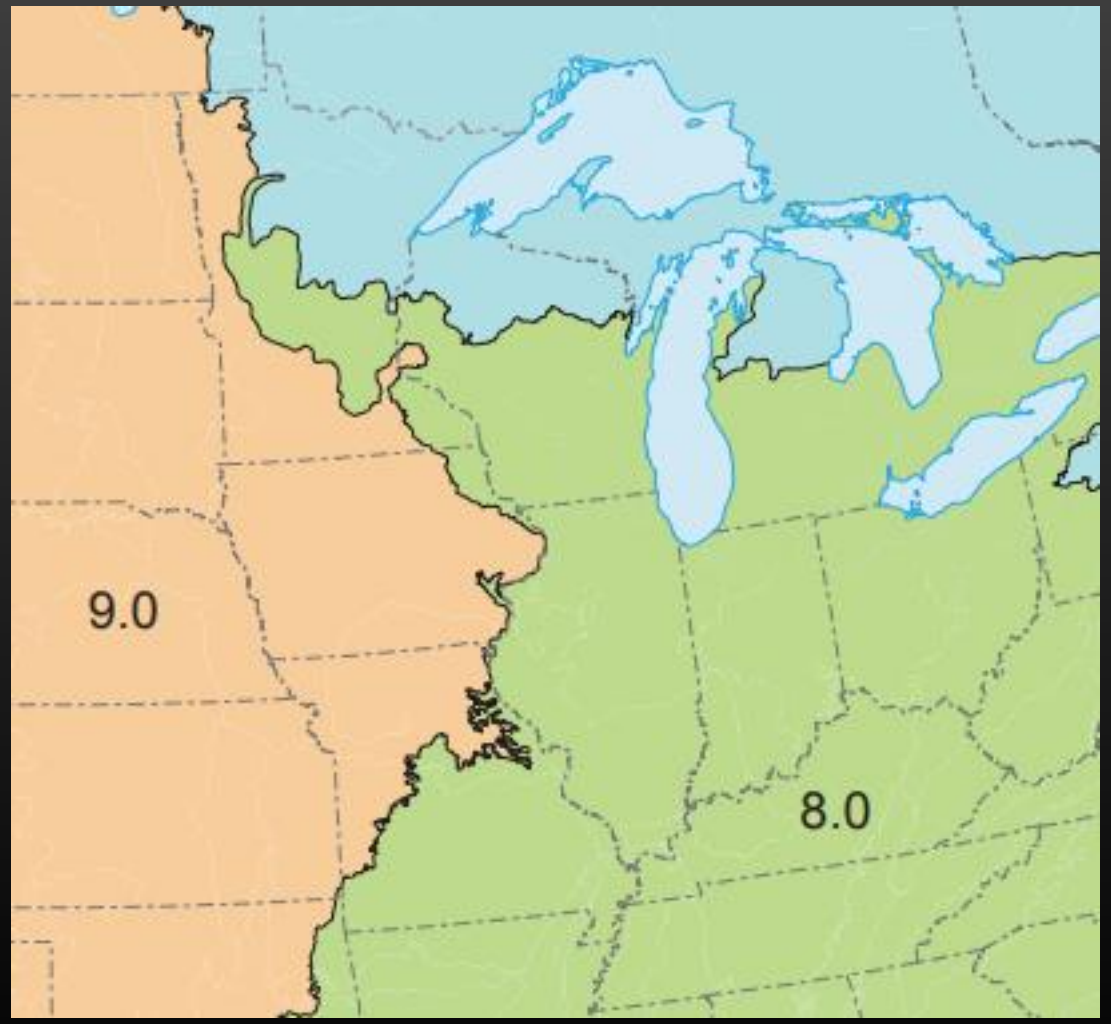
- To determine the current water quality of Missouri's lakes
- To monitor for changes in water quality over time
- To educate the public about aquatic ecology and water quality issues

Reservoirs, not lakes

Photo: Ktrimble (English Wikipedia)

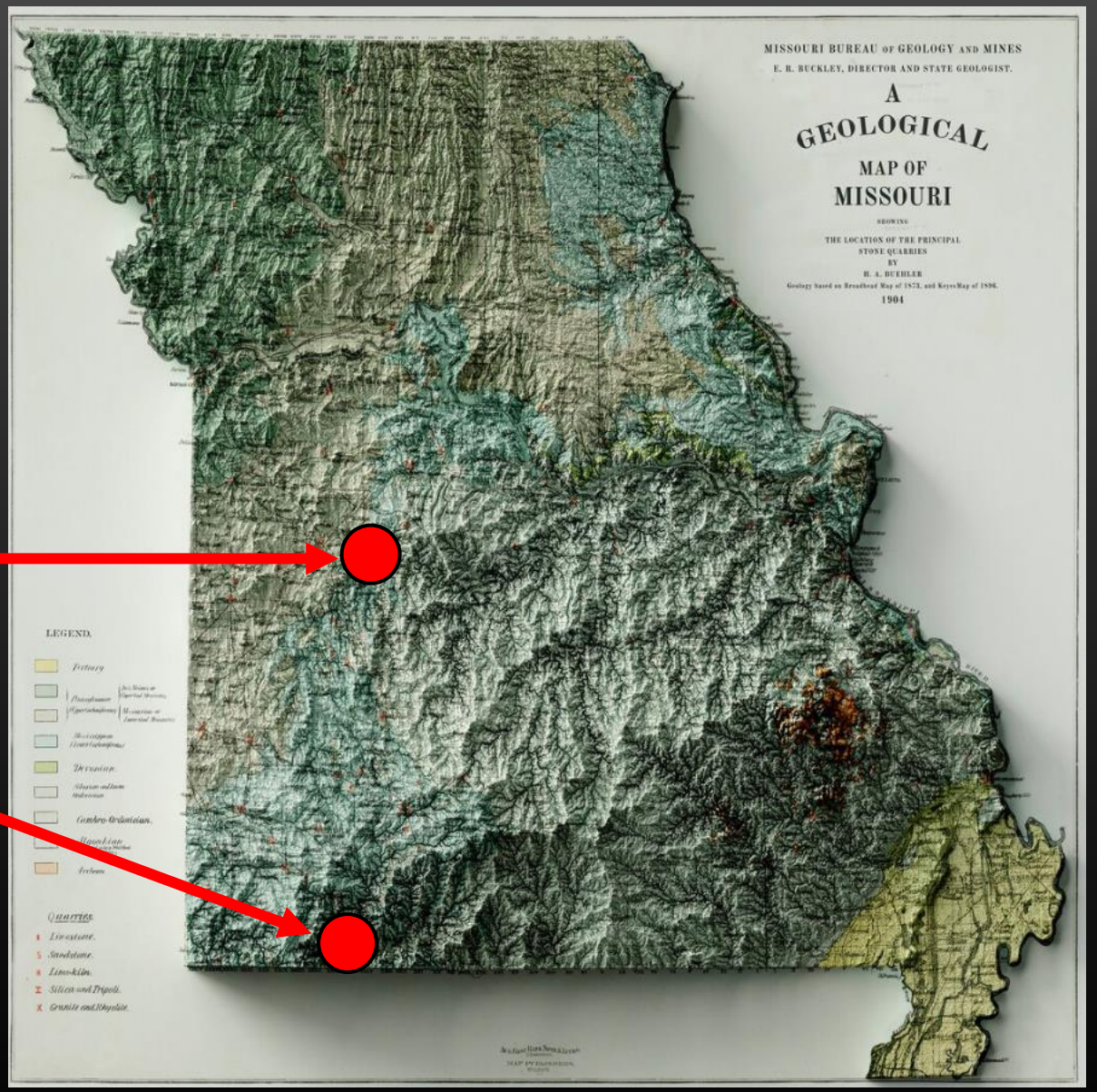
Missouri

At Level I Ecoregion, Missouri is similar to southern MN



Missouri's Lakes

- >300,000 lakes and ponds, most privately owned
- Almost exclusively reservoirs
- Largest by surface area in Missouri is Truman Lake, at 22,500 hectares (55,600 acres)
- Deepest is Table Rock, at 67 meters (220 feet)



Missouri's Lakes

Gross Generalization:

- North:
  Shallow lakes with HIGH watershed area to surface area ratio and nutrient-rich soil. Agriculture-dominated watersheds.

- South:
  Deep lakes with LOW watershed area to surface area ratio. Largely forested watersheds.

A Statewide Sampling Effort

- Across many parts of the US, volunteer lake sampling efforts are lake-specific, funded and staffed by lake associations.
- We cover the entire state of Missouri and are dependent upon Federal funding.

Our Funding Pathway

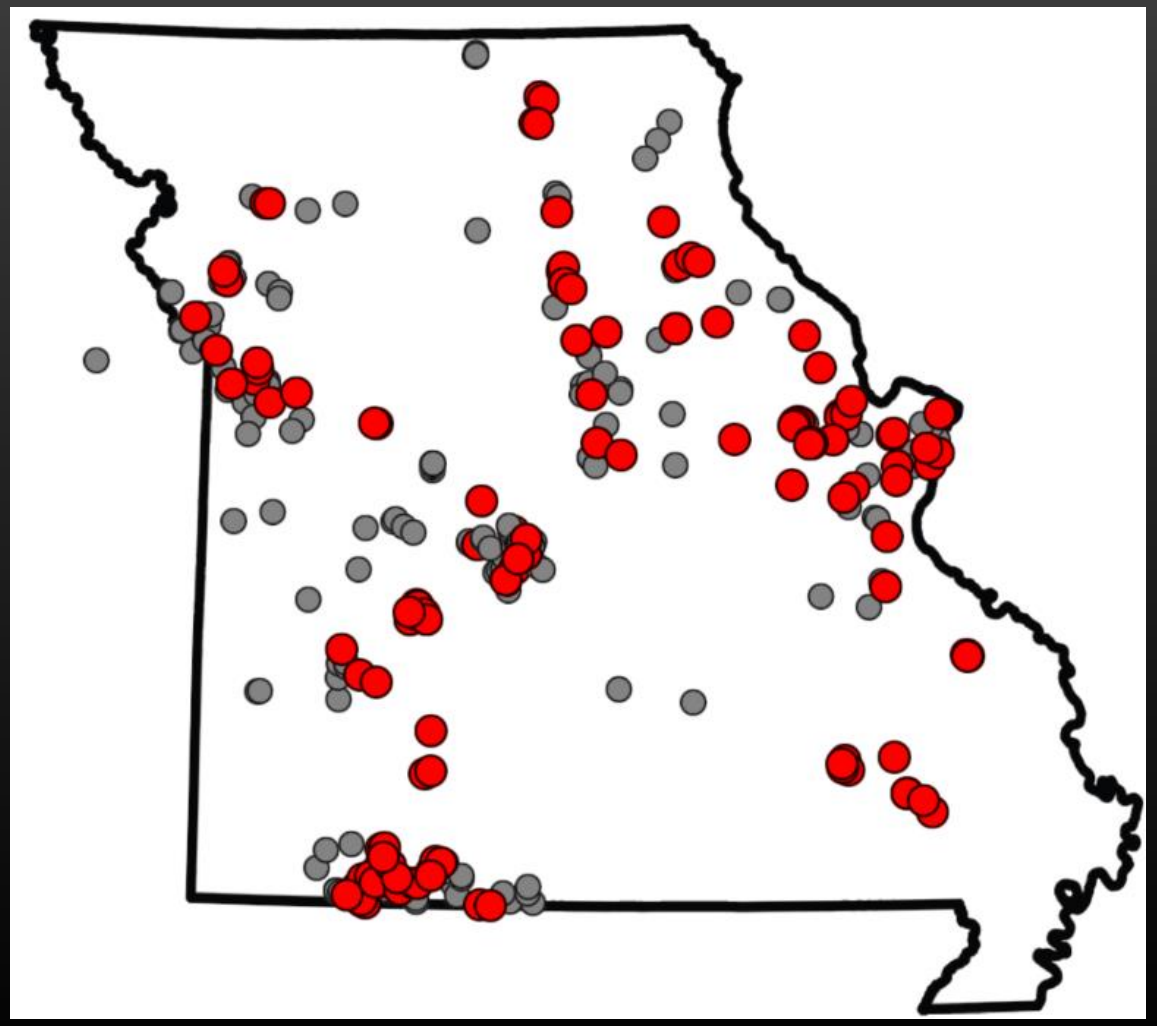
EPA 314 =>

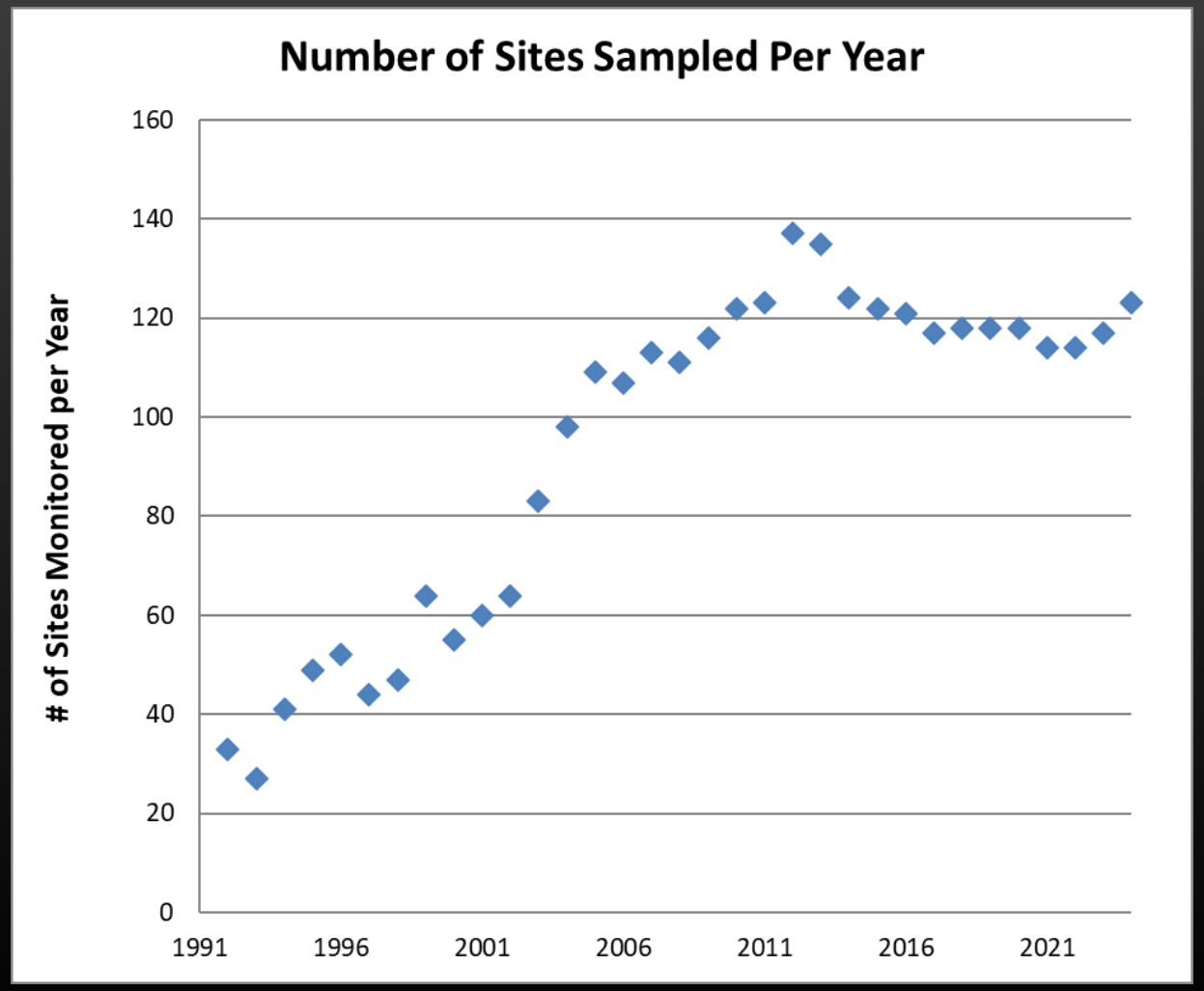
EPA 319 => Missouri Department of Natural Resources => University of Missouri (with some assistance from Missouri Department of Health and Senior Services)

Lakes of Missouri Volunteer Program

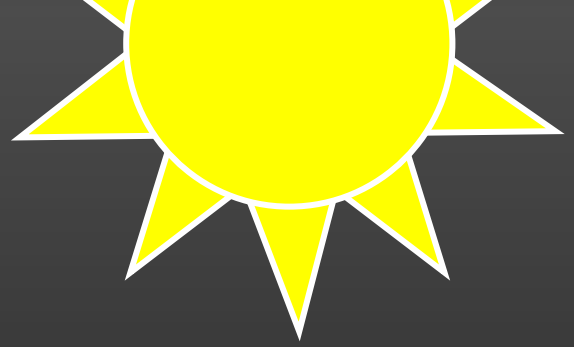
- Monitoring season is April – September
- 8 samples per season (target)
- Small ponds to 22,000+ hectare reservoirs
- Current staffing at 1.8 FTE, with ~2000 hours PT lab techs/students

Since 1992: 338 Sites on 157 Lakes

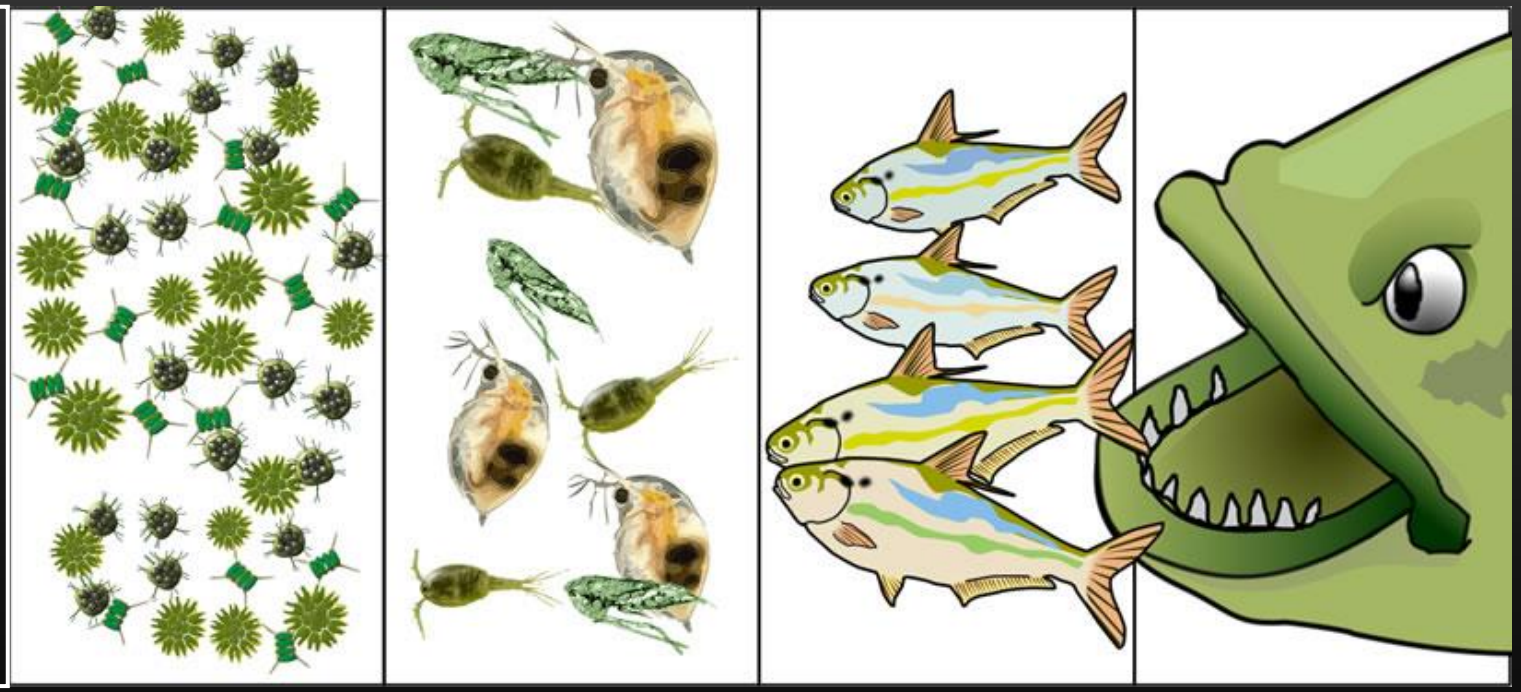




The BIG Picture



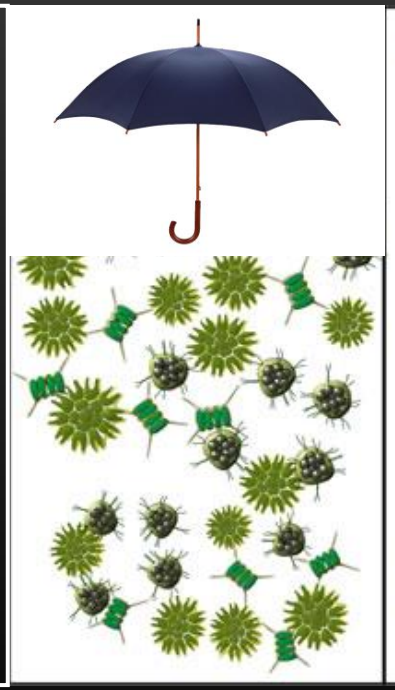
Nutrients

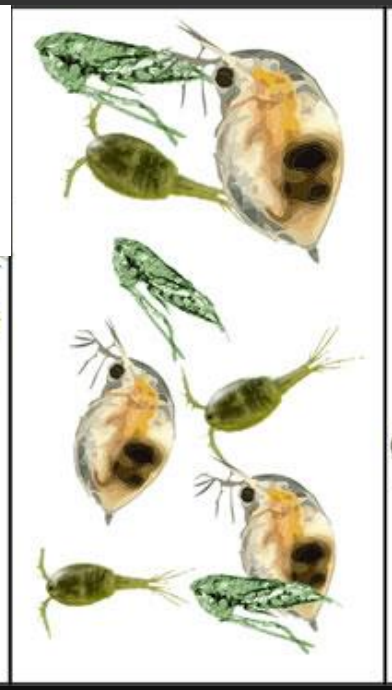


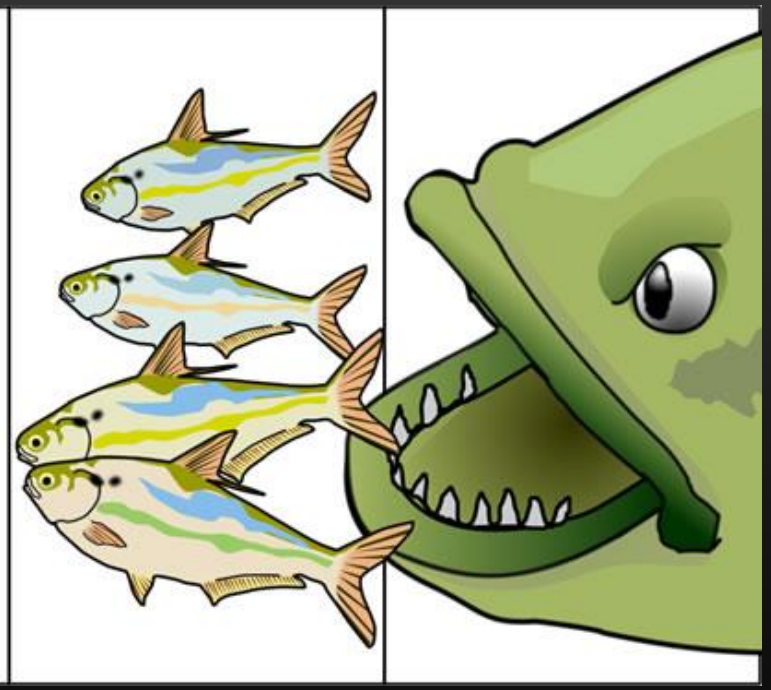
The BIG Picture

SOIL PARTICLES

Nutrients

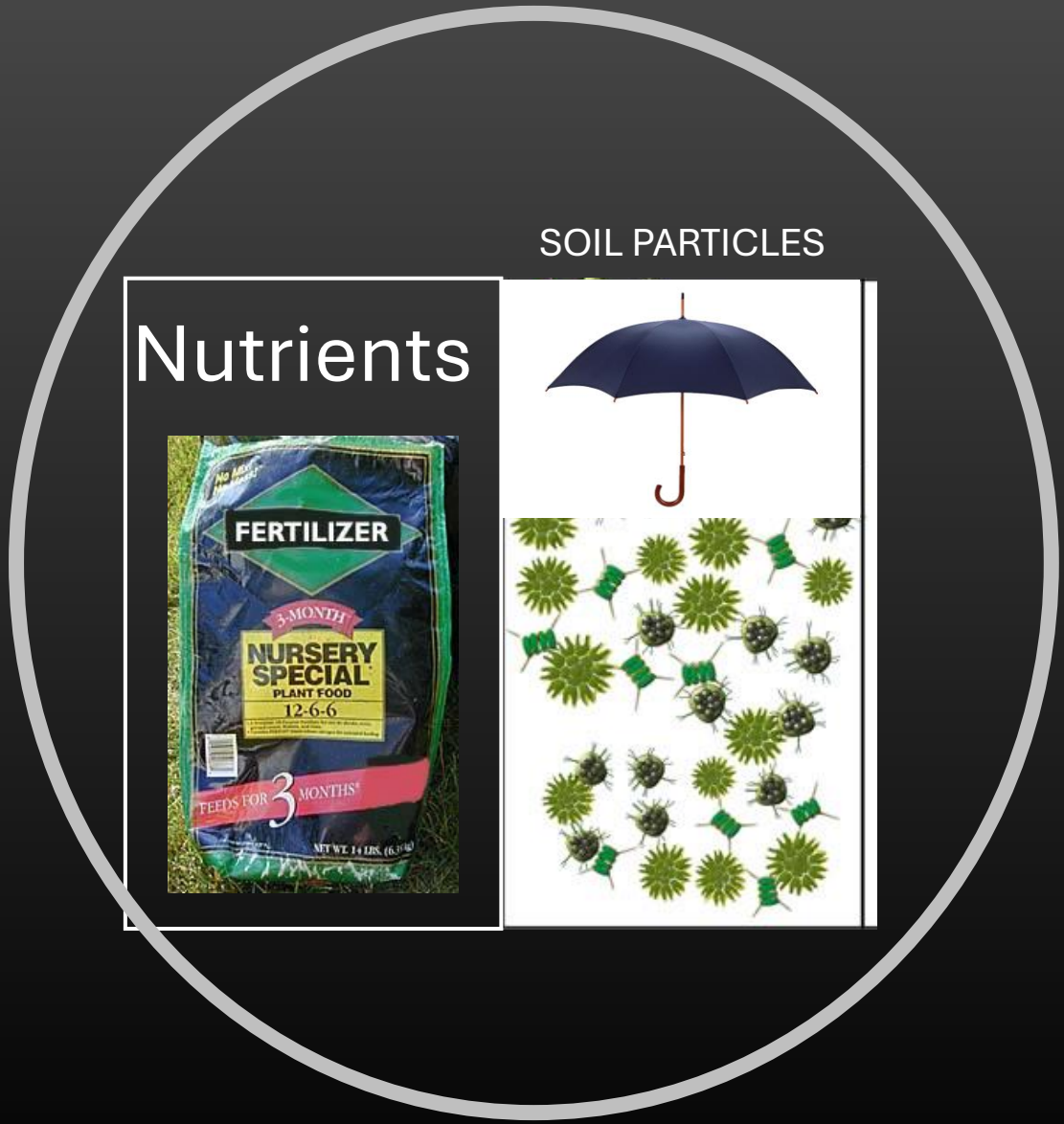






What we monitor

- Water Temperature
- Water Clarity (via Secchi Disk)
- Nutrients
  - Nitrogen (total, dissolved, NO_3, NH_4)
  - Phosphorus
- Algae (phytoplankton)
  - Chlorophyll
  - Cyanotoxins
- Suspended Sediment
- Stratification

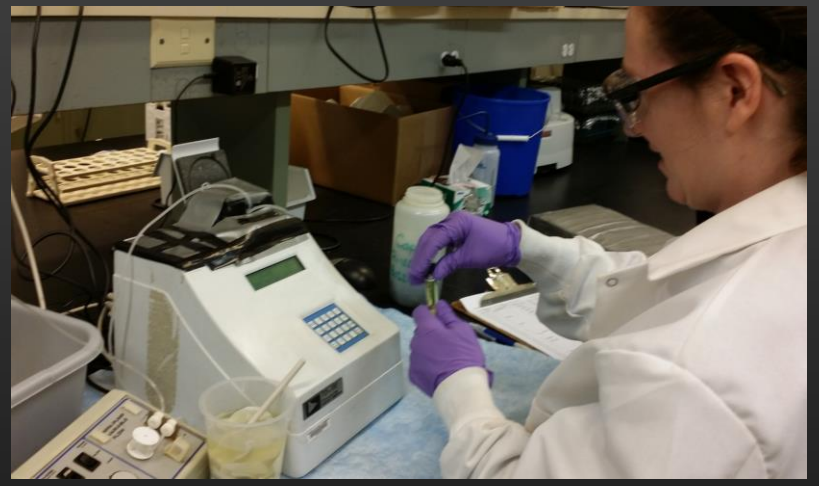


We are 2 things in one

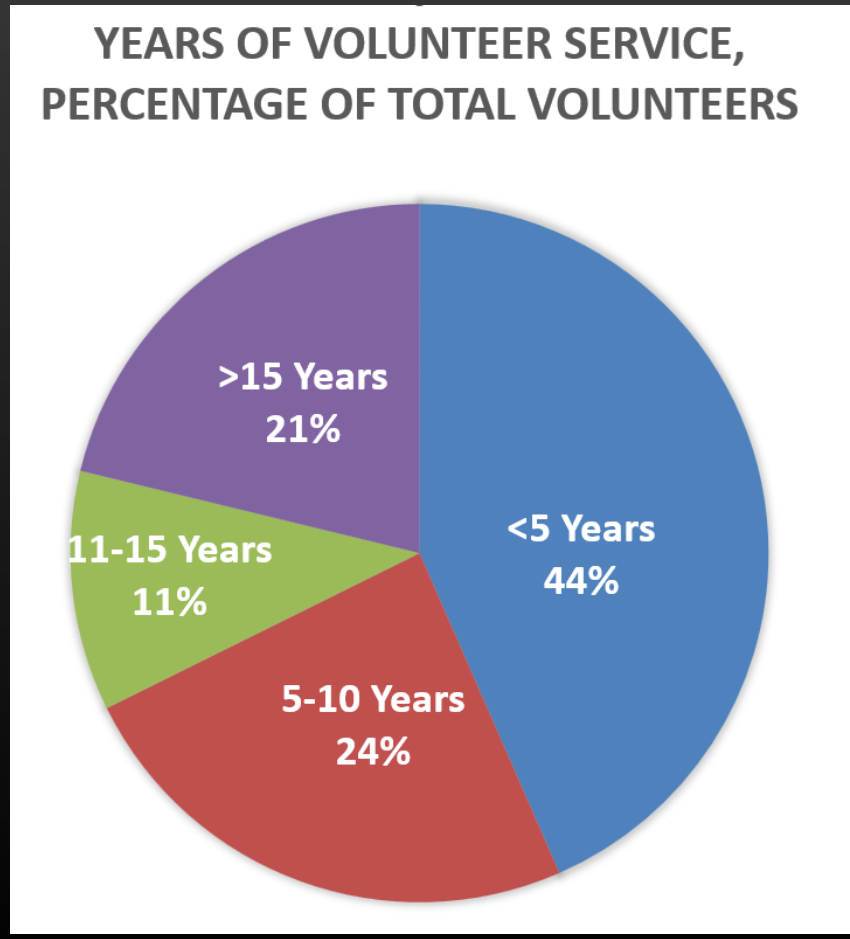
Water Quality Analysis

Volunteer Engagement

Each entity has different responsibilities to ensure quality data.



Our approach: K vs r Selection



80 Years of Sampling Experience

FIELD SHEET

1 Lake Name Blue Springs Date 4/15/92

Monitor(s) Wanda Epperson, Ron Fuhrken Time 11:15 am/pm

Public Perception Question A 2 Air Temperature 74°

Wave Conditions (circle): Calm (Rippled) Choppy Rough

Sky (circle): Clear (Hazy) Partly-Cloudy Mostly-Cloudy Overcast

2 Sample Site #1A #1B #1C

Surface temperature with hand thermometer 61° F

Secchi 3½ ft Color Reading 2

Sample Bottle 1A ✓ 1B ✓ 1C ✓

Profile

Depth Temperature

One-on-One Training

Allows opportunity to interact with volunteer, gauge strengths and weaknesses

Field Duties

1. Temperature and Secchi
2. Collect 2-liter composite sample
3. Collect 0.5-meter integrated depth sample for cyanotoxins
4. Record field observations

LMVP Data Sheet

Lake Name _____ **Site #** _____ **Date** _____ **Time** _____

Volunteers _____ **(names)**

OPTIONAL: Please provide information if available (e.g. via GPS-enabled sonar devices)
Site Depth (feet) _____ Latitude _____ Longitude _____

In The Field

(1) Water Temperature_____ F / C **(2)** Secchi Depth (inches)_____

(3) 2 Liter Water sample Collected? Y N

(4) Cyanotoxin (bluegreen algae) Sample Collected? Y N

(5) Wave Condition (circle one): Calm Rippled Choppy Rough

In The Lab

Fill in blanks with bottle/filter numbers, record filter volumes

(1) Cyanotoxin Vial# _____ * (Unfiltered lake water from tube sampler)

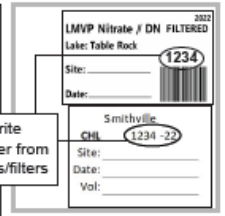
(2) Nutrient Bottle#_____ * (Unfiltered lake water)

(3) TWO TSS filters
1)#_____ * (filter number) _____ (volume)
2)#_____ * (filter number) _____ (volume)

(4) TWO CHL Filters
1)#_____ * (filter number) _____ (volume)
2)#_____ * (filter number) _____ (volume)

(5) Nitrate Bottle#_____ * (Fill with water that passed through CHL filter)

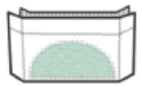
(6) Ammonium Bottle# _____ * (Fill with water that passed through CHL filter)



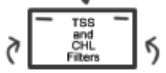
* Write number from bottles/filters

Filter Folding

Fold filter and "filter house" in half.



Fold the sides back.
Fold the top down.
Staple the corners.



Don't staple the filter!

Comments (lake condition, weather, etc.)

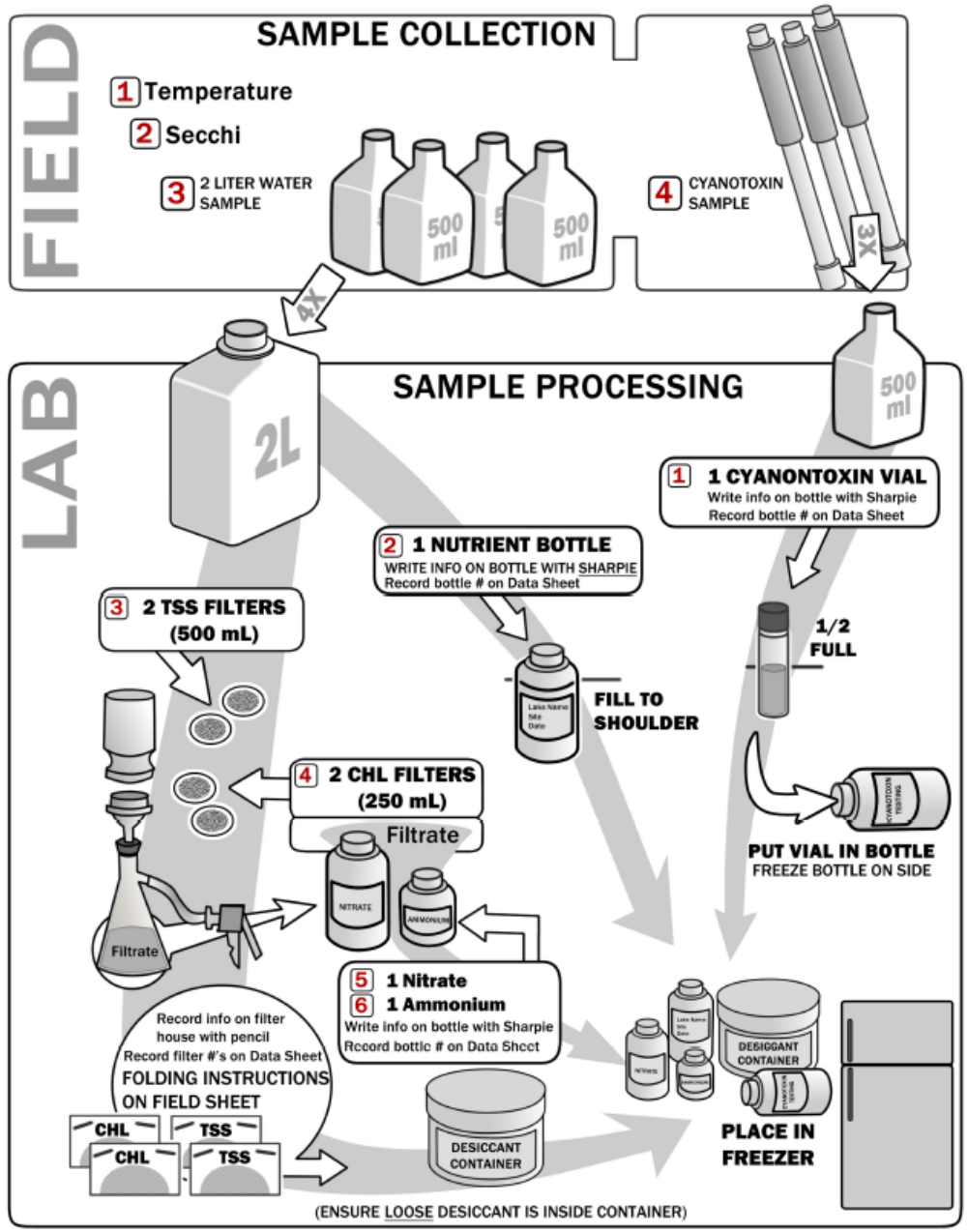
Hours and Miles (for grant requirements)

Miles driven/boated _____ (round trip)

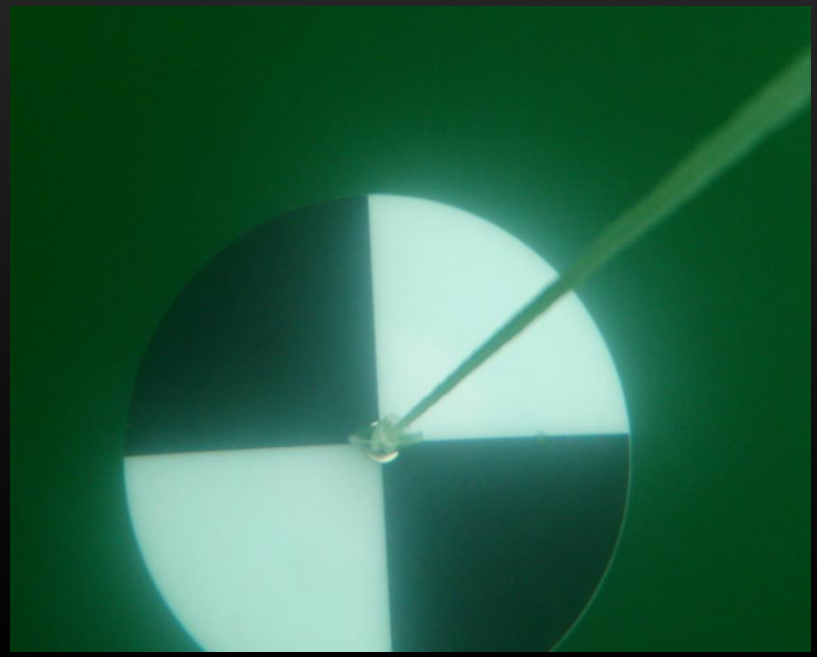
_____ (# of hours) X _____ (# of volunteers) = _____ (Total hours)

LAKES of MISSOURI VOLUNTEER PROGRAM

WATER MONITORING PROCEDURE



Secchi – a measure of water clarity

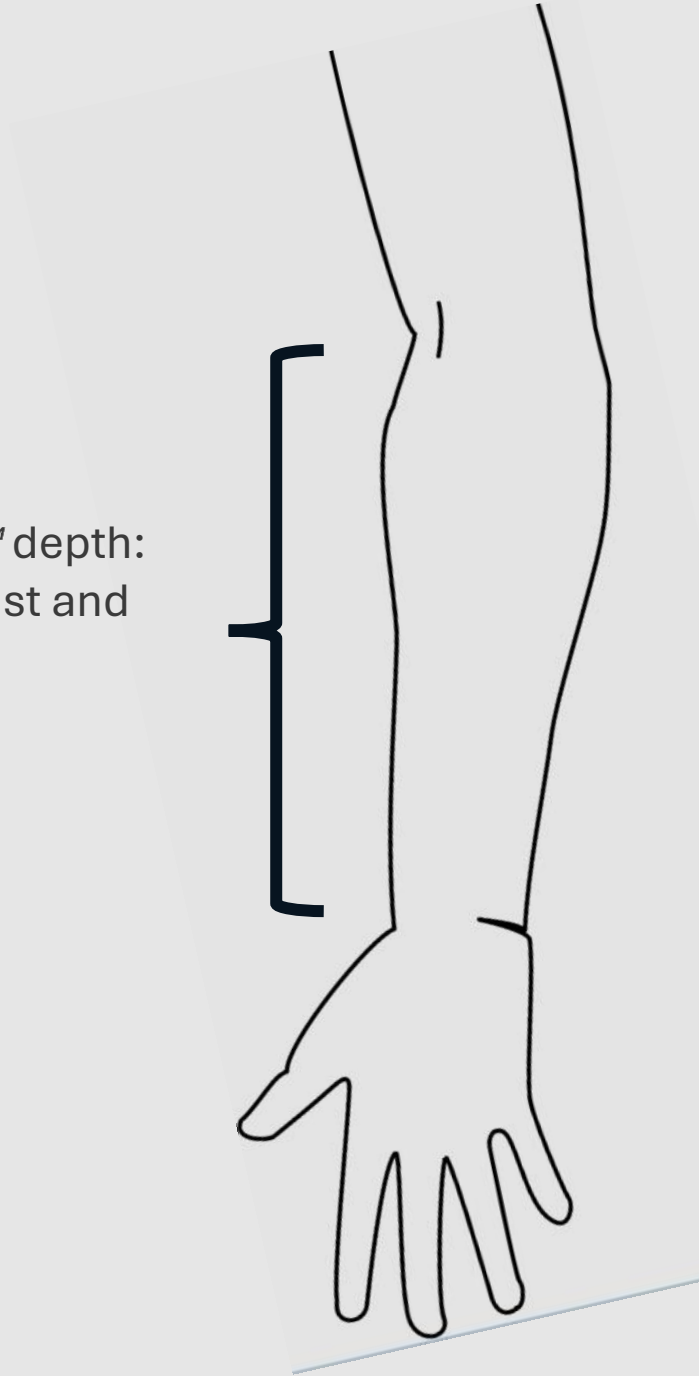


Water sample collection

Surface grab

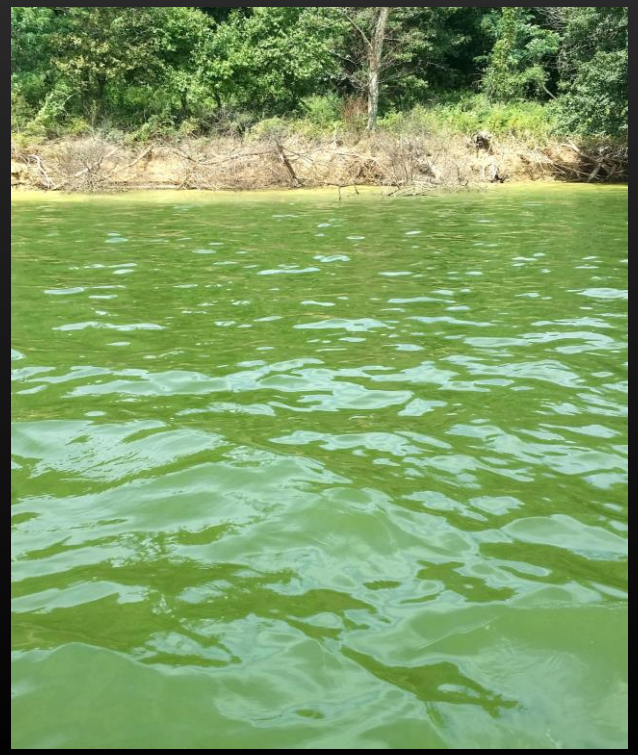
- at “intra-ulnar” depth
- Three to four composited samples in a 2-liter bottle

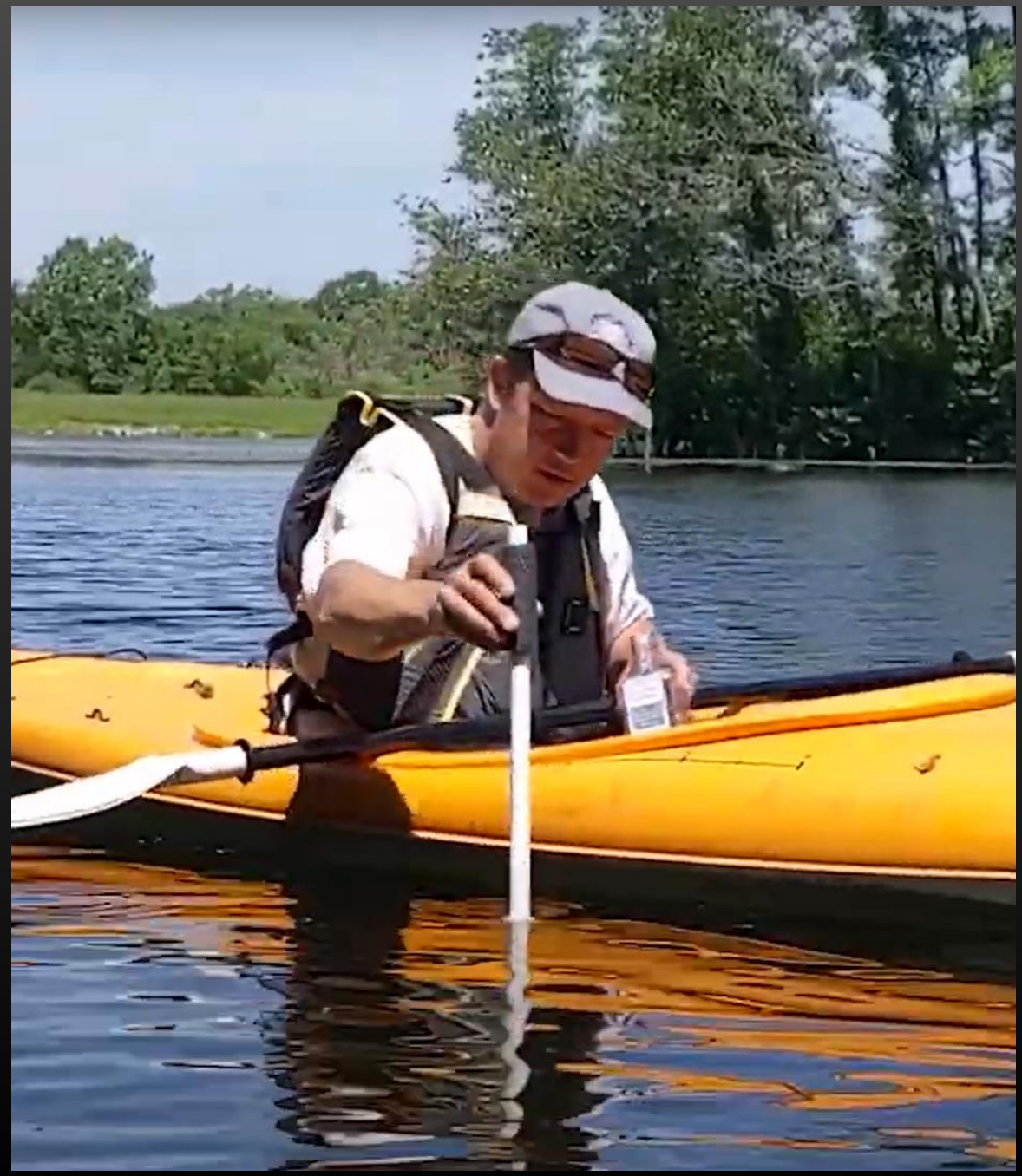
Intra-ulnar™ depth: Between wrist and elbow deep



Cyanotoxin sampling

- 0.5-meter integrated sample





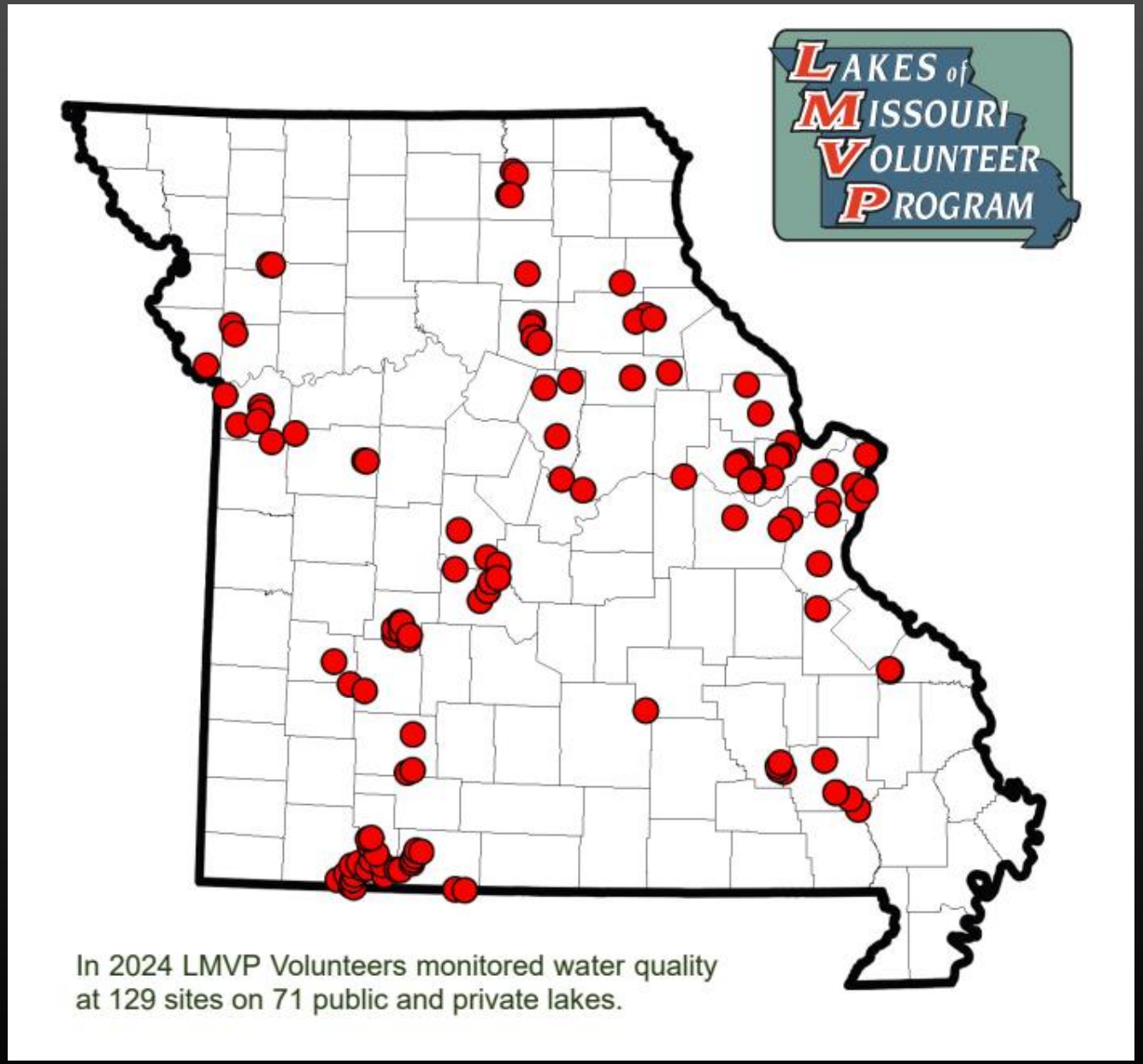
Sample Processing

- Cyanotoxin subsample
- 2 TSS filters (934-AH)
- 2 Chlorophyll filters (GF/F)
- Whole water (60 ml)
- Filtrate (60ml, 30 ml)

Samples stored frozen, filters in desiccant.

Sample Retrieval

Samples are retrieved by LMVP staff 2-3 times each season.

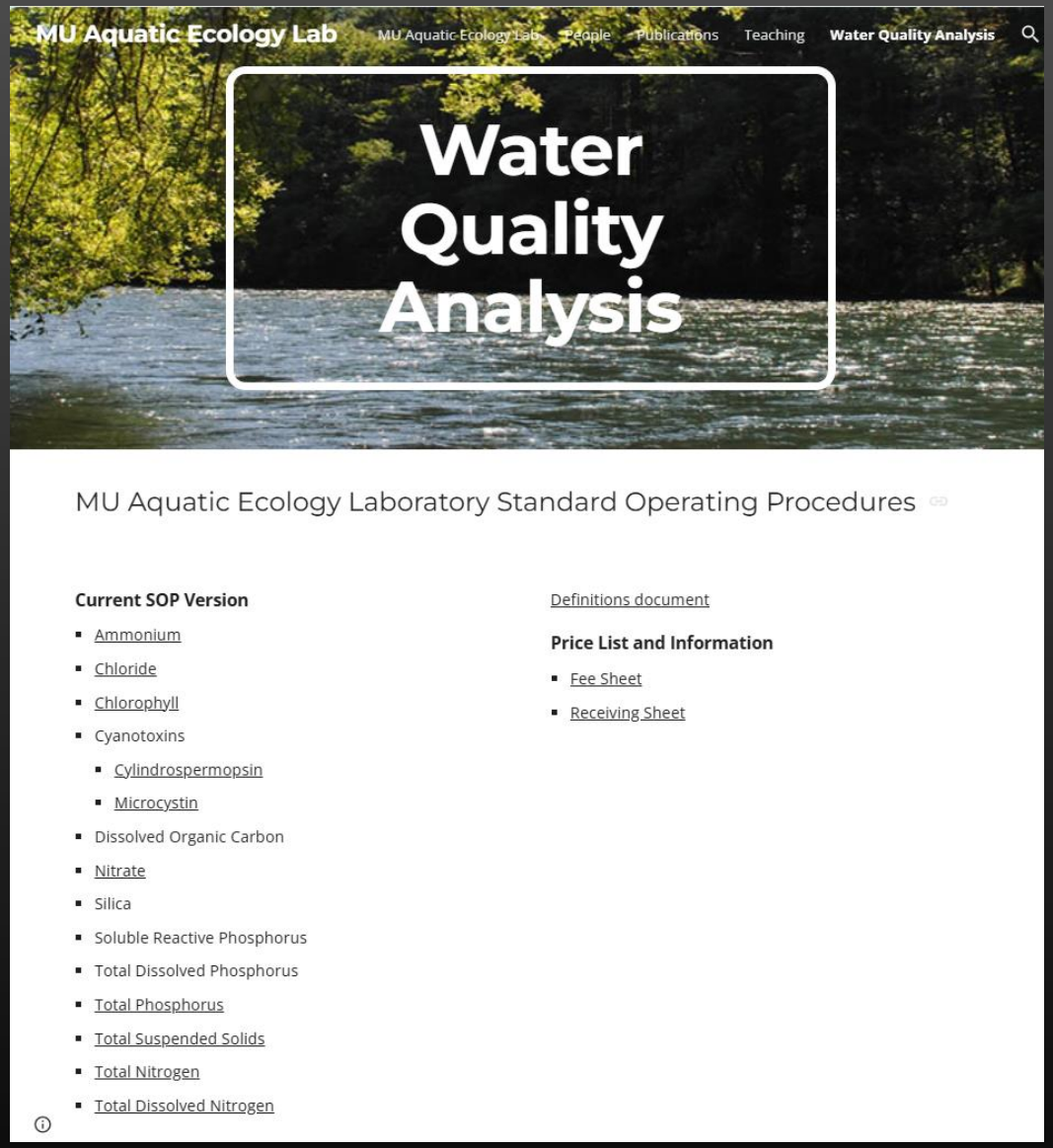


Sample Analysis

Samples are analyzed at the University of Missouri's Aquatic Ecology Laboratory. Our SOPs can be found on the lab's website.

~800 samples each season

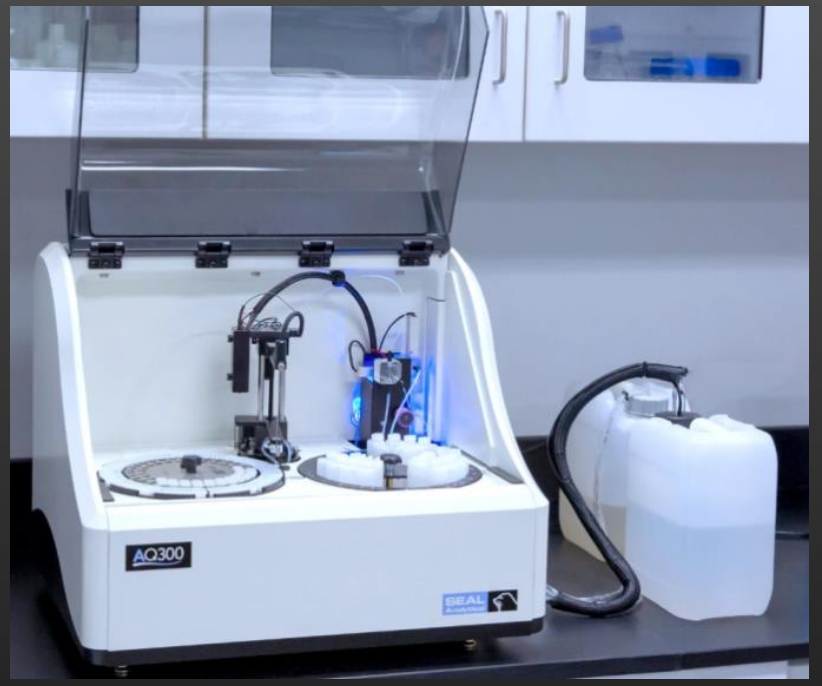
Each analyte run in duplicate or triplicate



A link can be found at the bottom of any page of the LMVP Website

Sample Analysis

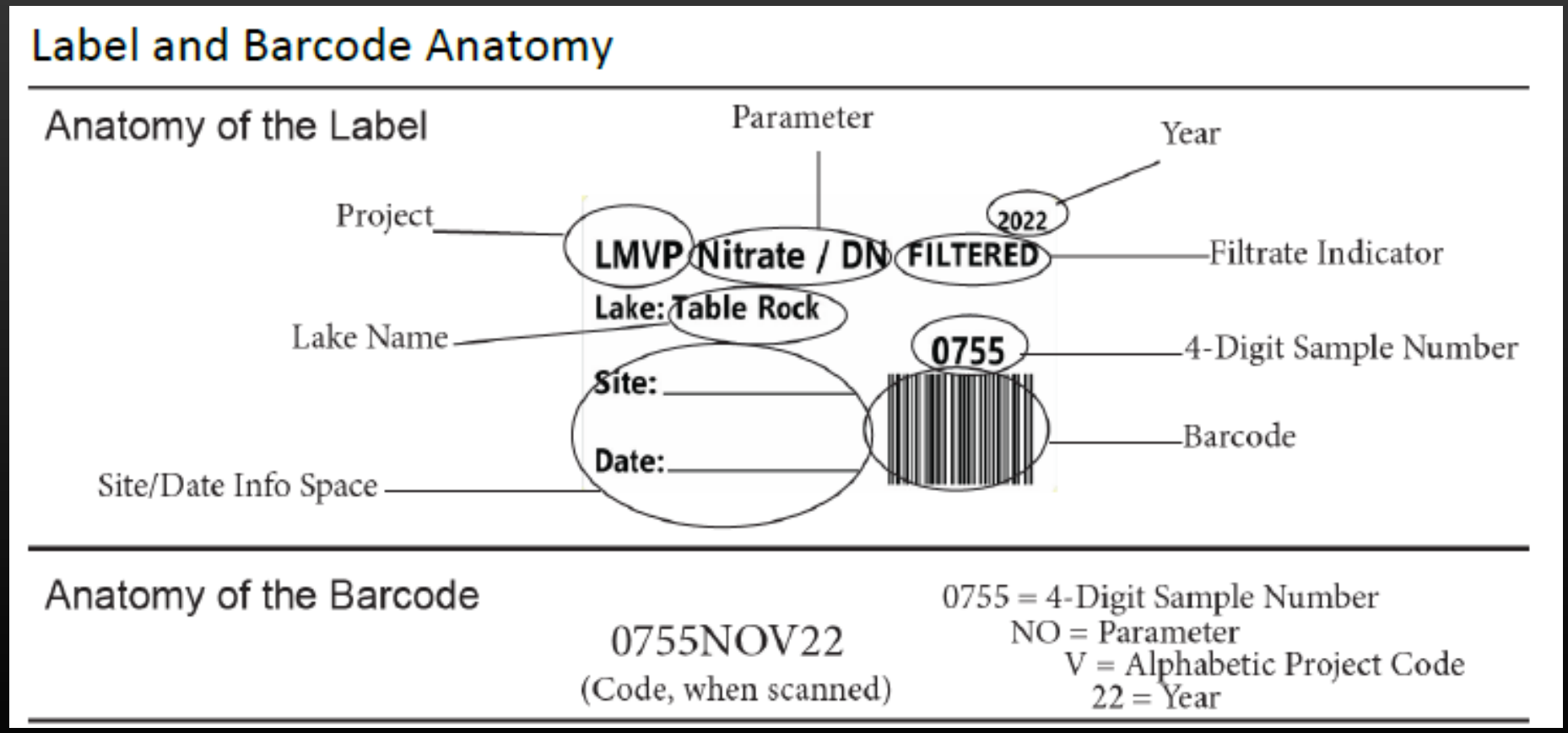
- Total phosphorus, total nitrogen, dissolved total nitrogen
    - Spectrophotometers: Agilent Cary 60, Genysis 2
- Nitrate, ammonium
    - SEAL Analytical AQ300
- Chlorophyll a
    - Fluorometer: Turner Trilogy
- Total suspended solids
- Microcystin, cylindrospermopsin
    - ELISA: Abraxis/Chromate 4303 microplate reader



Barcodes

Significantly fewer transcription errors

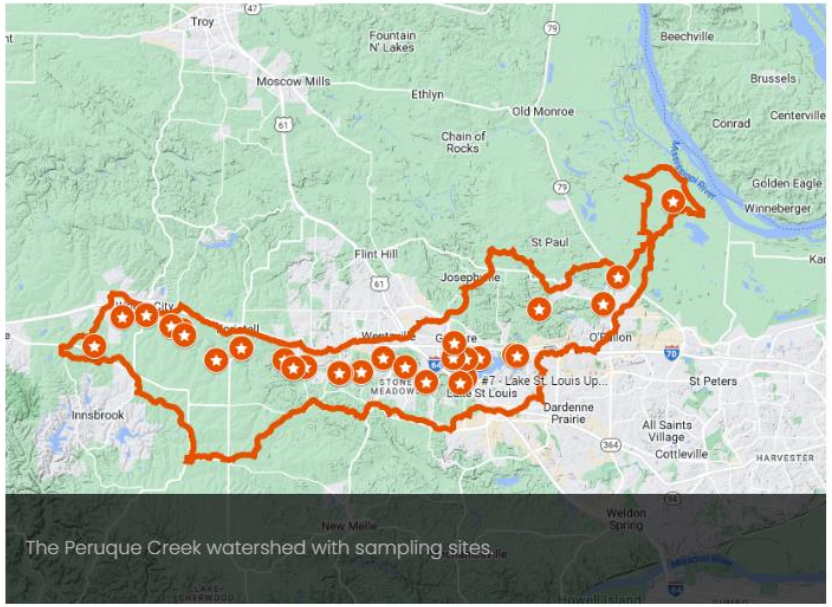
Speeds up data QA/QC and database entry



Other Activities

Peruque Creek Watershed Sampling

On August 14, 2024, the LMVP conducted a watershed-wide sampling of Peruque Creek in Warren and St. Charles counties. With the help of volunteers from the Lake St. Louis community, the city of Wentzville, and Missouri Stream Team, we sampled 28 sites in the watershed. You can view the map and see photos of the sampling sites on our Google Map.



The Peruque Creek watershed with sampling sites.

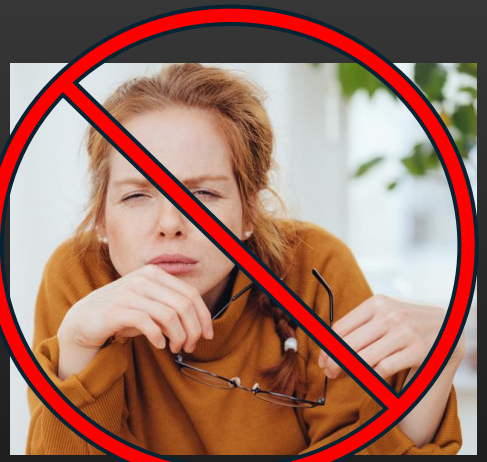
Niangua Watershed Sampling Event

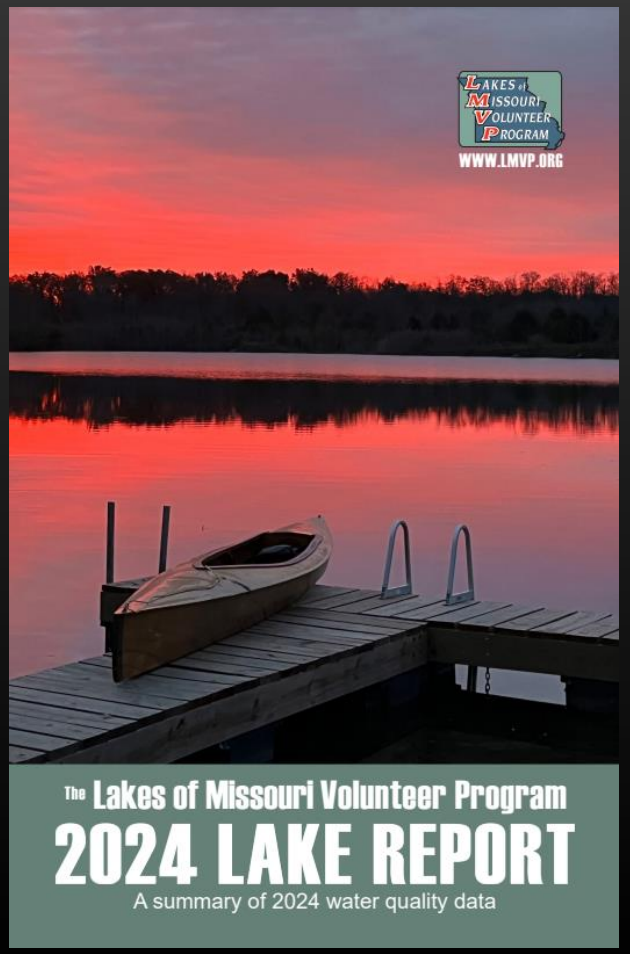
May 7, 2011

The Little Niangua River

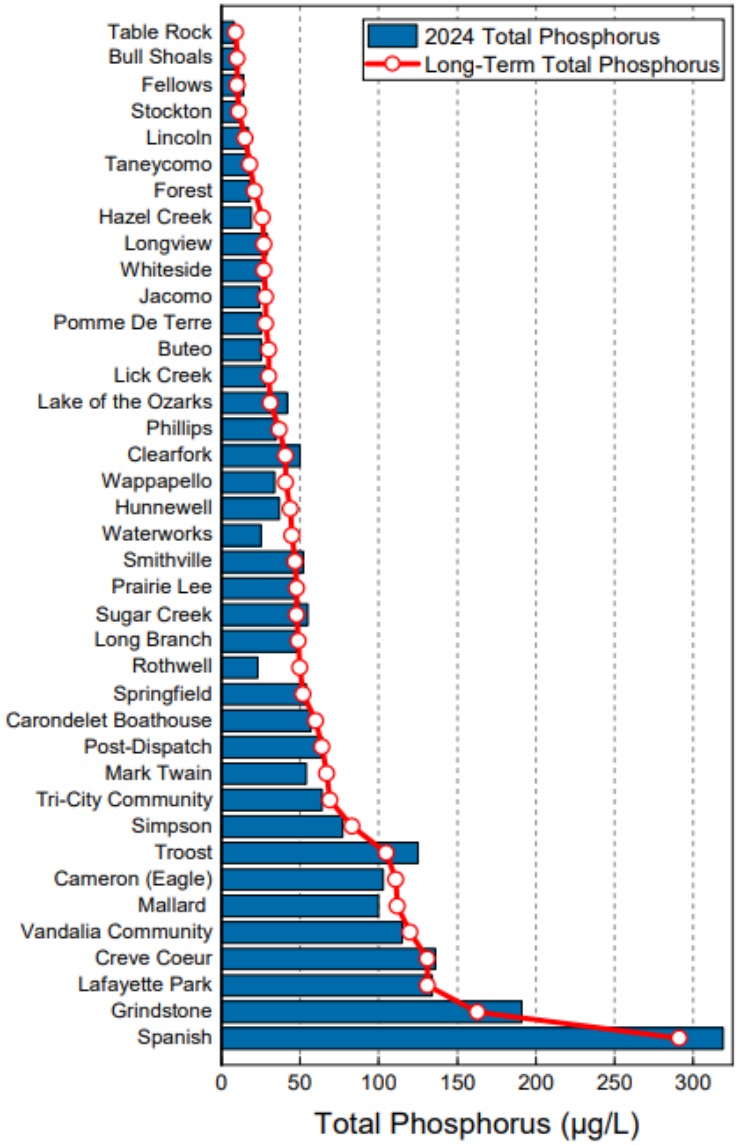
The 125-mile long Niangua River meanders northward from the town of Marshfield on I-44 to the Lake of the Ozarks. Its watershed covers more than 658,000 acres and includes the Little Niangua River, Macks Creek, and the interestingly named Greasy Creek. Several springs feed the Niangua River, including the popular trout-fishing destination, Bennett Spring.

Data Reporting





Average total phosphorus values for 39 public lakes monitored (at or near the dam) by LMVP volunteers in 2024 (bars). Long-term lake values shown in red.



Data Reporting

Summary Report for Smithville 4

2024 Data Table

	4/29	5/17	6/10	6/27	7/18	8/9	8/30	9/20	Mean
Temperature (F)	63	72	78	84	84	82	82	77	78
Secchi (feet)	2.6	2.6	2.6	2.3	2.0	2.0	2.0	1.6	2.2
Phosphorus (µg/L)	30	51	53	73	70	58	43	54	54
Nitrogen (µg/L)	950	2187	1540	1020	1035	1033	900	910	1197
Ammonium (µg/L)	<10	74	10	<10	<10	54	<10	<10	20
Nitrate (µg/L)	347	1582	599	12	<5	15	13	13	323
Chlorophyll (µg/L)	8.8	36.5	38.9	62.8	51.2	44.2	47.4	51.4	42.7
Susp. Sediment (mg/L)	2.0	3.4	2.8	2.3	4.2	2.2	2.1	2.5	2.7
Microcystin (µg/L)	<0.10	<0.10	0.34	0.29	0.29	0.15	0.13	0.16	0.18
Cylindrospermopsin (µg/L)	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04

Trophic State: Based on the mean phosphorus concentration, this lake site is Eutrophic

Interpreting the Data

Trophic State Categories

Oligotrophic: (Phosphorus <10 µg/L) Low productivity (measured by phytoplankton biomass and nutrients), clear water.
Mesotrophic: (Phosphorus 10-24 µg/L) Moderate productivity, water often slightly greenish.
Eutrophic: (Phosphorus 25-99 µg/L) High productivity, water green or brown.
Hypereutrophic: (Phosphorus >100 µg/L) Extreme productivity, water very green or brown. Aquatic life may struggle to survive.

Description of Measured Parameters

Temperature: Water temperature, degrees Fahrenheit.
Secchi: Measure of water clarity, feet.
Phosphorus and Nitrogen: Nutrients required for phytoplankton growth, µg/L or parts per billion.
Ammonium and Nitrate: Forms of dissolved nitrogen favored by phytoplankton, µg/L or parts per billion.
Chlorophyll: Photosynthetic pigment in phytoplankton used to estimate biomass, µg/L or parts per billion.
Suspended Sediment: Particulate inorganic matter suspended in water column, mg/L or parts per million.
Microcystin and Cylindrospermopsin: Cyanotoxins produced by cyanobacteria, µg/L or parts per billion.

Limit of Detection Values

This table shows our limit of detection values for each laboratory-measured parameter. If results are below the limit of detection, graphs will show 1/2 the limit of detection, rounded up.

Limit of Detection Values

Parameter	Detection Limit
Phosphorus (µg/L)	1
Nitrogen (µg/L)	35
Ammonium (µg/L)	10
Nitrate (µg/L)	5
Chlorophyll (µg/L)	0.1
Suspended Sediment (mg/L)	0.1
Microcystin (µg/L)	0.10
Cylindrospermopsin (µg/L)	0.04

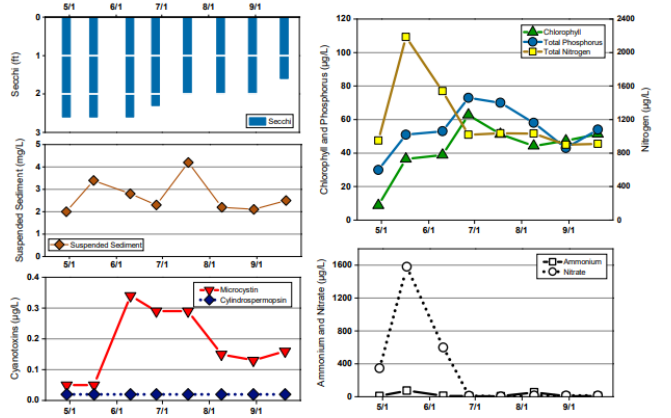
EPA Health Advisories for Cyanotoxins

The table below shows EPA health advisories for cyanotoxin exposure.

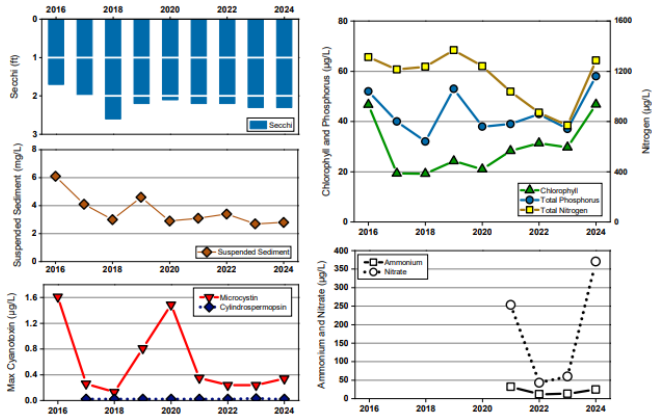
	Drinking Water Guidelines		Recreational Guidelines
	Bottle-fed infants and pre-school children	School-age children and adults	
Microcystin	0.3 µg/L	1.6 µg/L	8.0 µg/L
Cylindropsermopsin	0.7 µg/L	3.0 µg/L	15.0 µg/L

Summary Report for Smithville 4

2024 Data for Smithville 4



Trend Data for Smithville 4

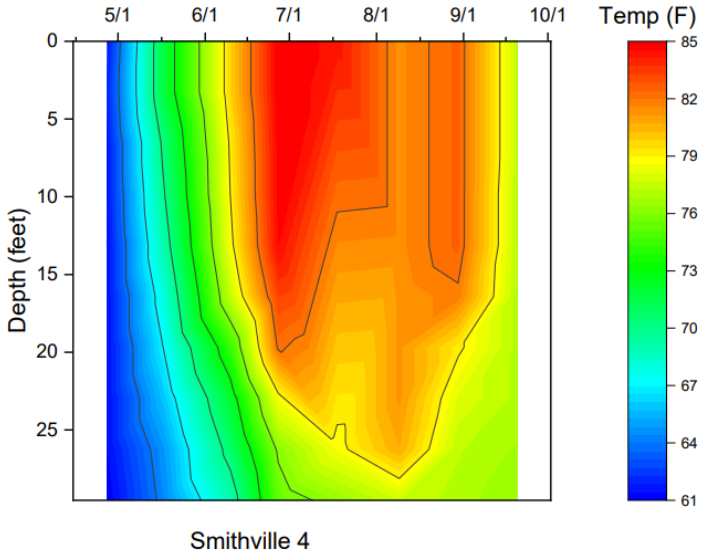


Trend data graphs show annual arithmetic means from May 15 through September 15.
Cyanotoxin graph shows maximum seasonal values, not arithmetic means.

Smithville 4
2024 Temperature/Depth Profile

To see the surface temperature throughout the season, follow the top of the graph from left to right and notice the color changes. You can follow the same procedure for any depth.

Another way to view the graph is to pick a date on the top axis and look down to see where the color changes occur.



Smithville 4

QA/QC

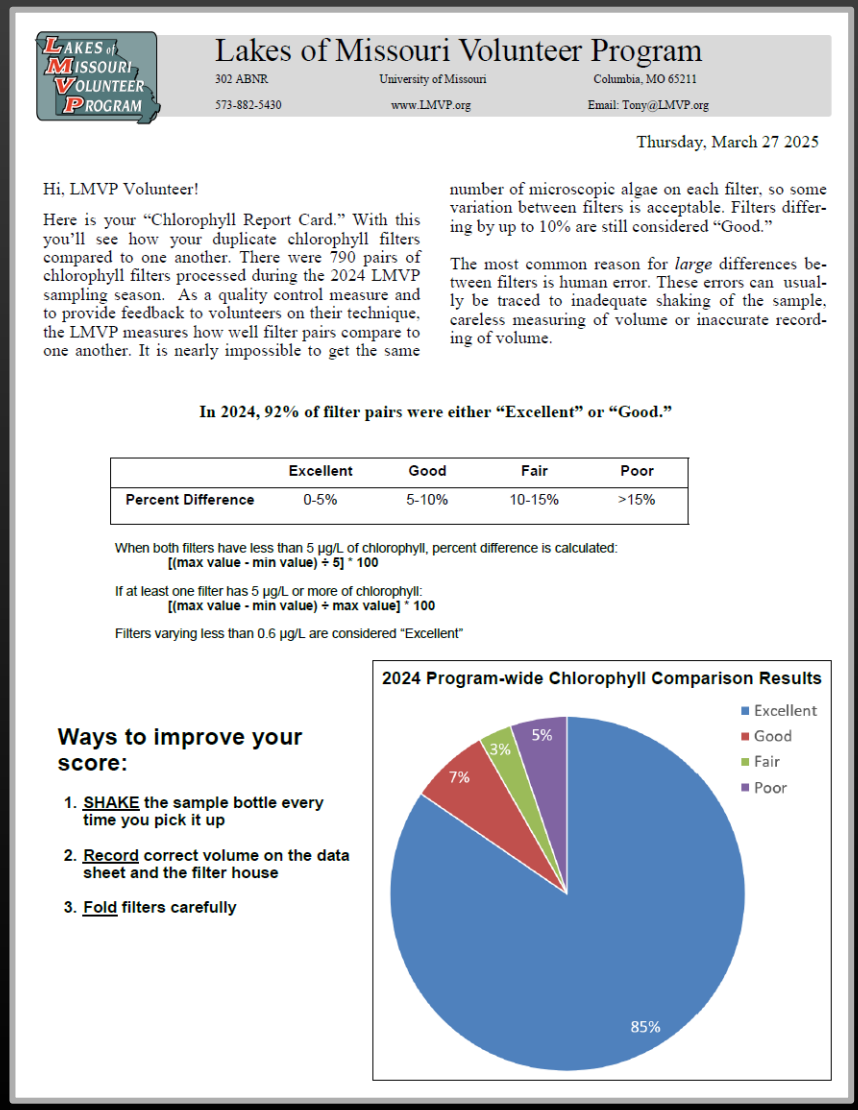
- Annual proficiency testing
- Split samples
- Annual QAPP review
- Chlorophyll grade cards (filter replicate comparison)

Chlorophyll Grade Cards

Gordon Julich

E=Excellent; G=Good; F=Fair; P=Poor

	Date	Filter 1	Filter 2	Rating
Jacomo 1	4/24/2024	8.2	8.9	G
Jacomo 1	5/15/2024	7.9	9.4	P
Jacomo 1	6/5/2024	8.9	9.4	E
Jacomo 1	6/26/2024	11.0	11.2	E
Jacomo 1	7/18/2024	23.6	24.4	E
Jacomo 1	8/6/2024	29.9	31.5	G
Jacomo 1	8/28/2024	20.4	21.2	E
Jacomo 1	9/17/2024	21.3	22.0	E



Lakes of Missouri Volunteer Program

302 ABNR University of Missouri Columbia, MO 65211

573-882-5430 www.LMVP.org Email: Tony@LMVP.org

Thursday, March 27 2025

Hi, LMVP Volunteer!

Here is your "Chlorophyll Report Card." With this you'll see how your duplicate chlorophyll filters compared to one another. There were 790 pairs of chlorophyll filters processed during the 2024 LMVP sampling season. As a quality control measure and to provide feedback to volunteers on their technique, the LMVP measures how well filter pairs compare to one another. It is nearly impossible to get the same number of microscopic algae on each filter, so some variation between filters is acceptable. Filters differing by up to 10% are still considered "Good."

The most common reason for *large* differences between filters is human error. These errors can usually be traced to inadequate shaking of the sample, careless measuring of volume or inaccurate recording of volume.

In 2024, 92% of filter pairs were either "Excellent" or "Good."

	Excellent	Good	Fair	Poor
Percent Difference	0-5%	5-10%	10-15%	>15%

When both filters have less than 5 µg/L of chlorophyll, percent difference is calculated:
[(max value - min value) ÷ 5] * 100

If at least one filter has 5 µg/L or more of chlorophyll:
[(max value - min value) ÷ max value] * 100

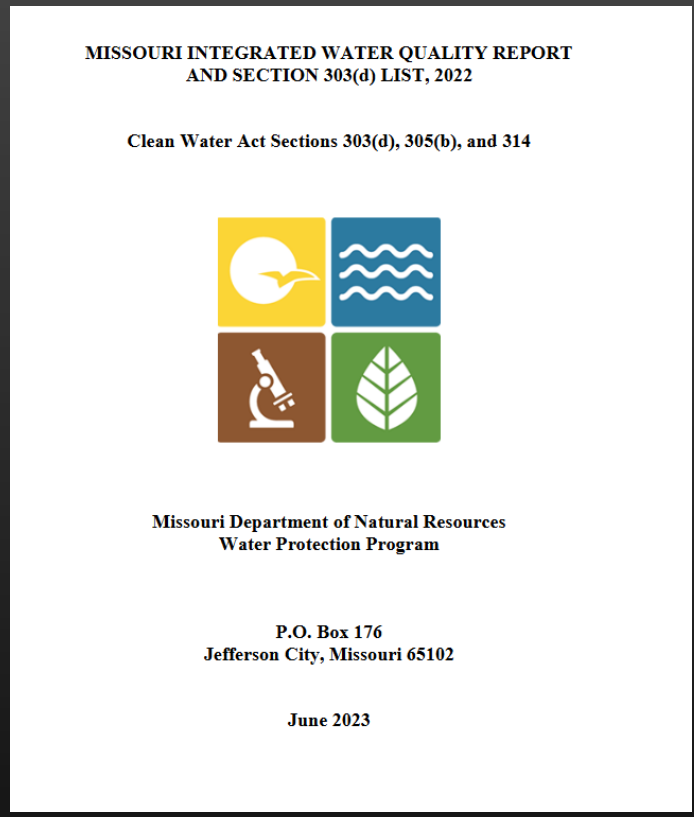
Filters varying less than 0.6 µg/L are considered "Excellent"

Ways to improve your score:

1. **SHAKE the sample bottle every time you pick it up**
2. **Record correct volume on the data sheet and the filter house**
3. **Fold filters carefully**

Data Use

- LMVP data featured in development of Numeric Nutrient Criteria
- Data submitted directly to state regulatory agency
  - 303d listings/de-listings, 305b reporting
- Journal Publications
- EDI Datasets



MISSOURI INTEGRATED WATER QUALITY REPORT
AND SECTION 303(d) LIST, 2022

Clean Water Act Sections 303(d), 305(b), and 314

Missouri Department of Natural Resources
Water Protection Program

P.O. Box 176
Jefferson City, Missouri 65102

June 2023

Primary EDI Dataset: Search “Lakes of Missouri Volunteer” for the full list

Thank you!