Conceptual Overview of DEQ's Lake and Reservoir Eutrophication Assessment Method

Lake Conference

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Outline

- What is an Assessment Method?
- Water Quality Standards and Beneficial Uses
- Monitoring Recommendations and Requirements
- EPA Stressor Response Models
- Assessment Decision Frameworks
- Next Steps


Holter Reservoir

What is an Assessment Method?

- Required under the MT Water Quality Act and Clean Water Act
- A tool and document that provides a framework to determine whether waters are supporting their designated beneficial uses.
- Integrated Report and Impaired Waters List


Holter Reservoir

Lakes and Reservoirs in Montana

- Number of named lakes in MT ten acres or greater: 1,905
- Acres of named lakes ten acres or greater: 1,083,718


Holter Reservoir

Applicability

- Lakes and Reservoirs ten acres and greater in size.
- Reservoirs with a residence time greater than 14 days.[1]

[1] EPA Nutrient Criteria Technical Guidance Manual for Lakes and Reservoirs, 2000

Water Quality Standards

- Narrative Standard: statements that describe the desired conditions of waterbody.

- “State surface waters must be free from substances attributable to municipal, industrial, and agricultural practices or other discharges that will: (e) create conditions which produce undesirable aquatic life.” (ARM 17.30.637(1))


Avalanche Lake

Beneficial Uses

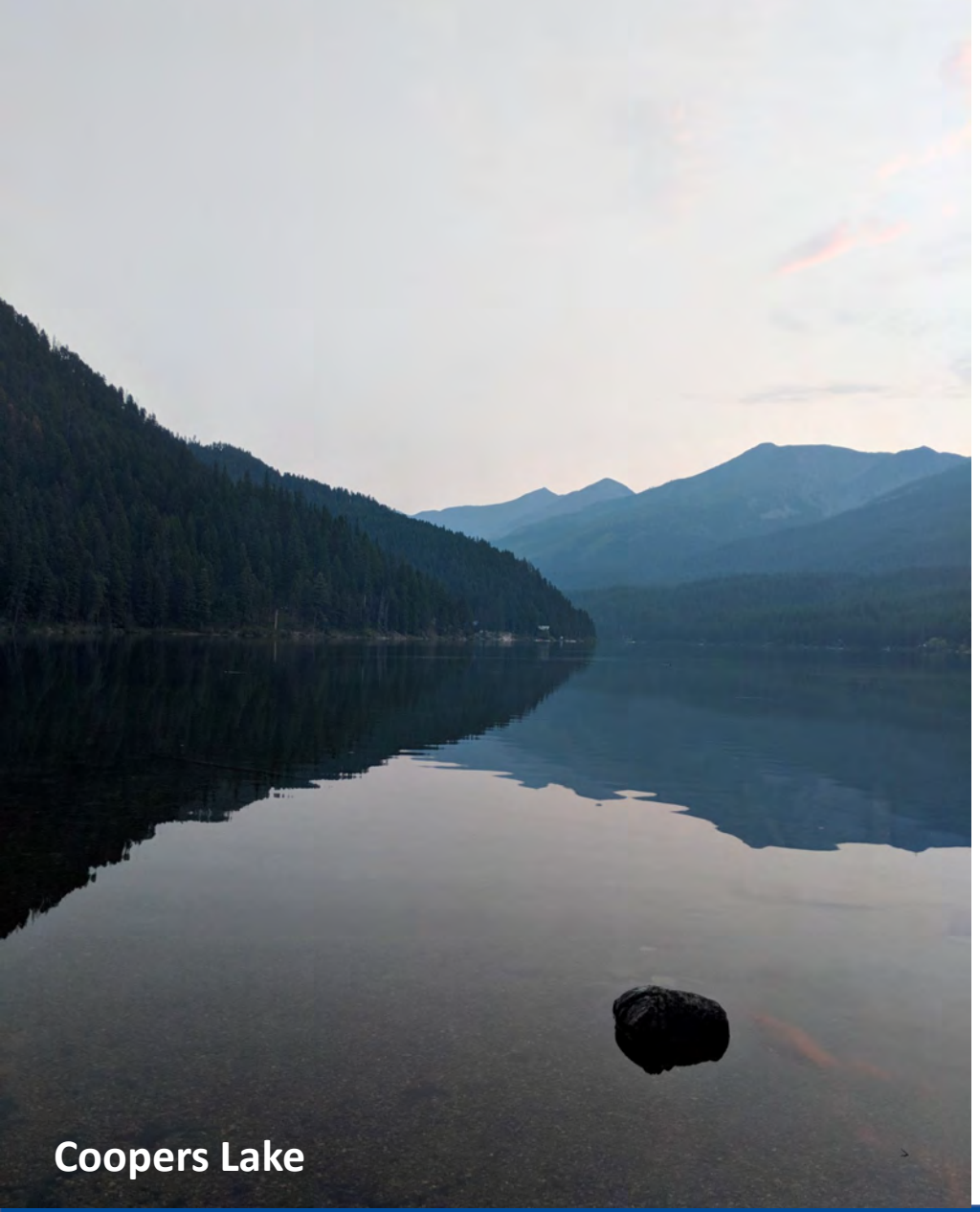
- 5 Main Categories
  - ★Aquatic Life
  - ★Recreation
    - Drinking Water
    - Agriculture
    - Industry


Avalanche Lake

Required Parameters for Assessment

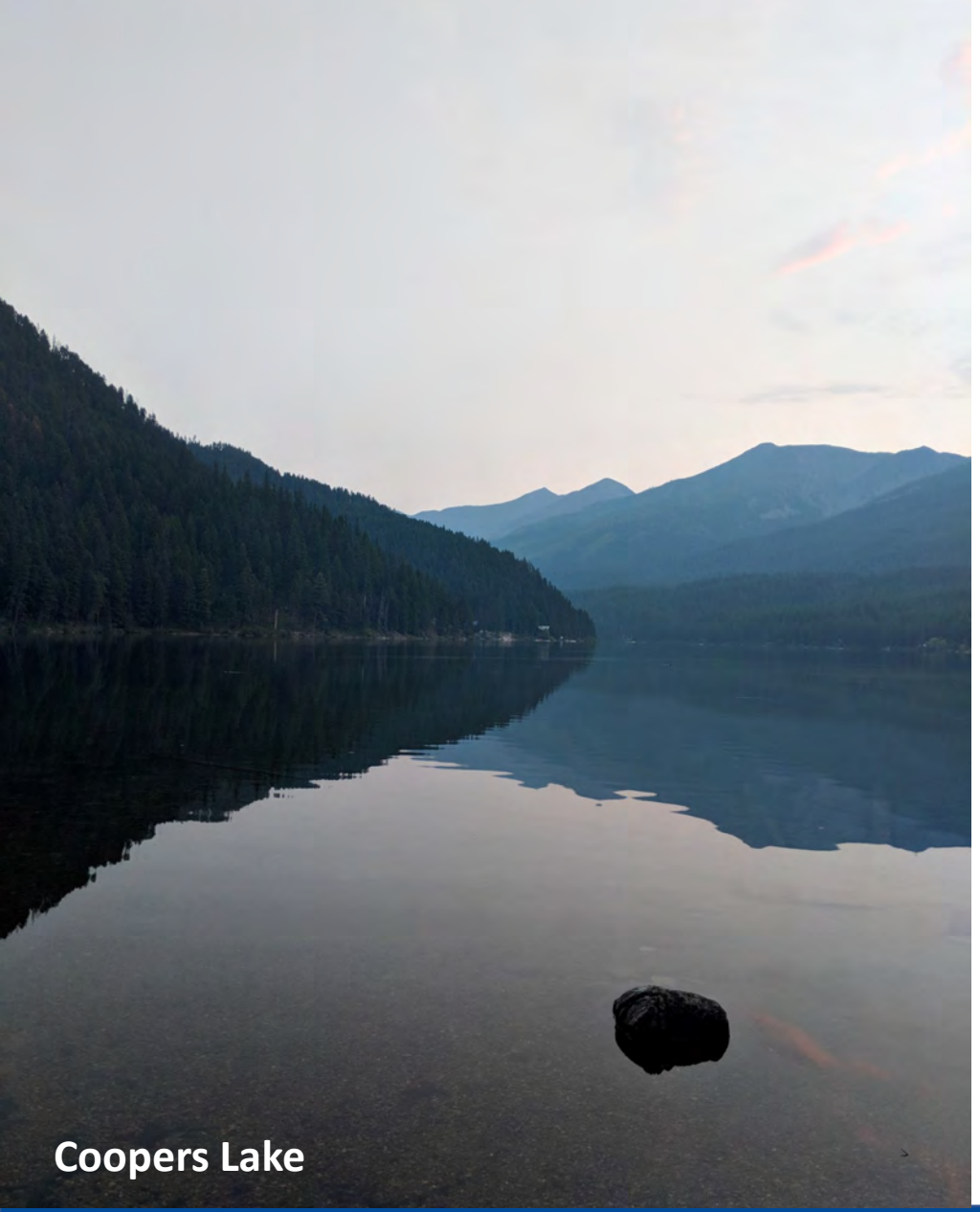
Response Variable Parameters	Causal Parameters	Model Inputs
Chlorophyll a (Chla)	Total Nitrogen (TN)	Dissolved Organic Carbon (DOC)
Secchi Depth (SD)	Total Phosphorus (TP)	Temperature Profile*

* Temperature profile is only required for aquatic life beneficial use assessment.


Coopers Lake

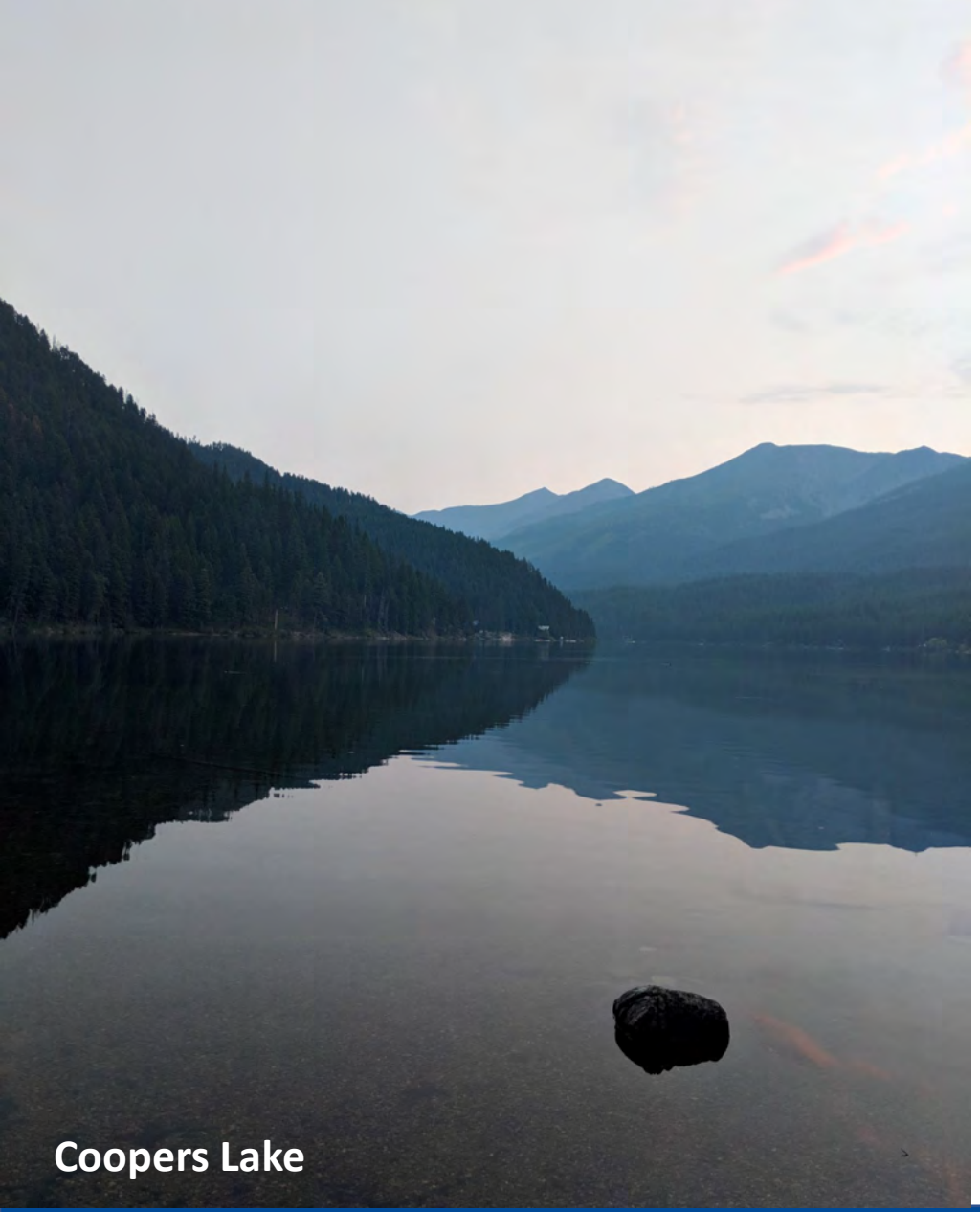
Required Parameters for Assessment - Recreation

- Harmful Algal Bloom (HAB)
  - Cyanotoxins (Microcystin, Anatoxin-a, & Cylindrospermospin)
  - Cyanobacterial Cell Count
  - Documented, visible, and pervasive cyanobacteria blooms


Coopers Lake

Recommended Monitoring Timeframe for Aquatic Life

- Collected July – September
- At least once per month
- At least 14 days apart


Coopers Lake

Recommended Monitoring Timeframe for Recreation

- Collected June – September
- At least once per month
- At least 14 days apart

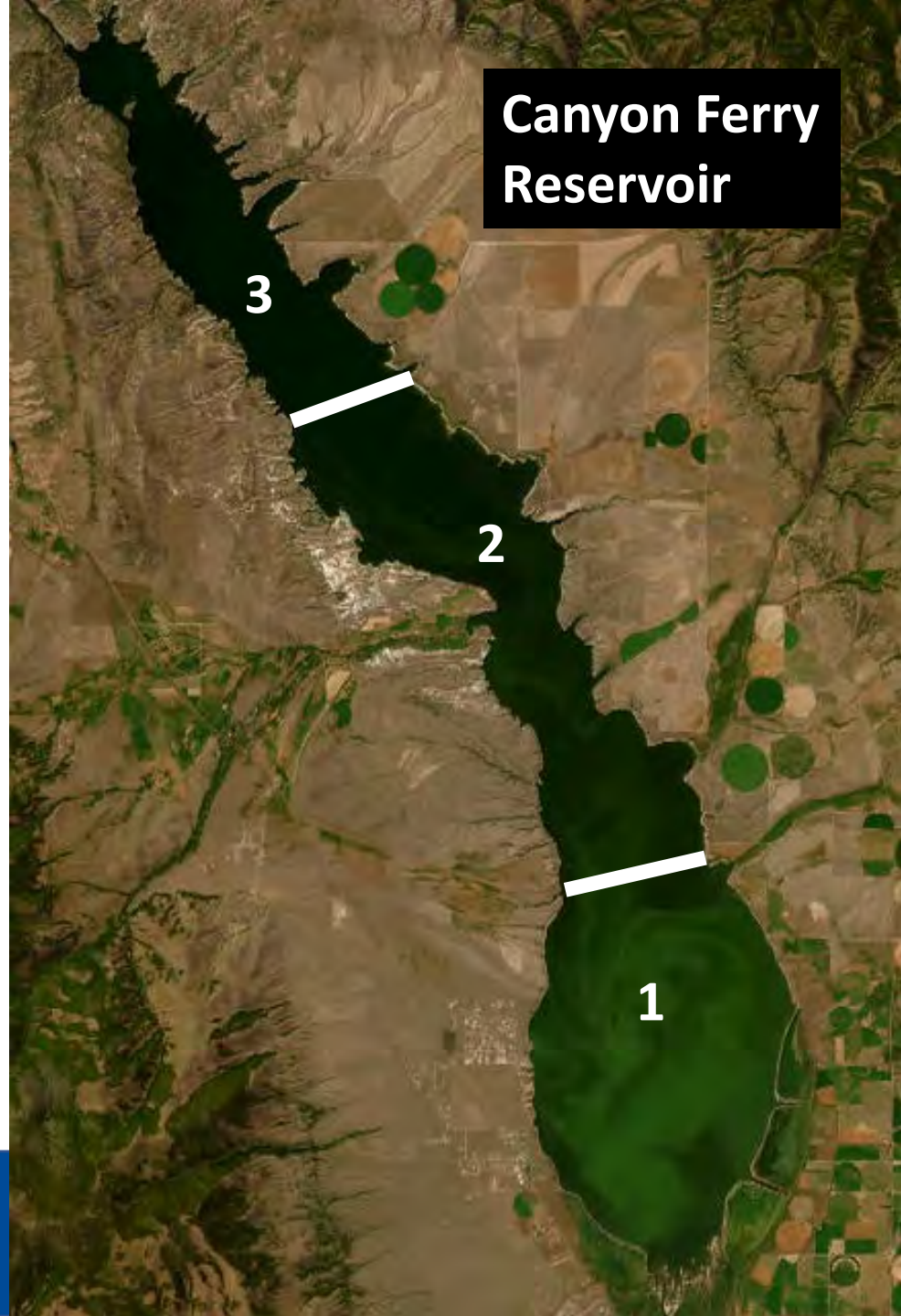
Monitoring Locations

- Assessment Unit
- Assessment Zones
  - Larger lakes and reservoirs segmented into distinct bays or zones.


Cooney Reservoir

Example of Assessment Zones

1. Inflow
2. Transitional
3. Near-Dam



Nutrient Monitoring Locations

- Deepest point or midpoint
- Within the epilimnion


Cooney Reservoir

Response Variable Monitoring Locations

Aquatic Life

- Chl*a* and Secchi Depth
  - Deepest point or midpoint
  - Within the epilimnion


Cooney Reservoir

Response Variable Monitoring Locations

Recreation

- Chl*a* and Secchi Depth
  - Deepest point or midpoint
    - Within the epilimnion
  - Shoreline


Cooney Reservoir

HAB Monitoring Locations

- Where cyanobacteria occur.
- Where contact recreation occurs.


Cooney Reservoir

Minimum Data Requirements

Nutrients, Chl*a*, & Secchi Depth

- Collected during two separate years.
- Minimum of 8 individual samples

HAB Data

- Collected during two separate years.
- Minimum of 3 individual samples


Cooney Reservoir


Holter Reservoir

EPA Lake & Reservoir Stressor Response Models

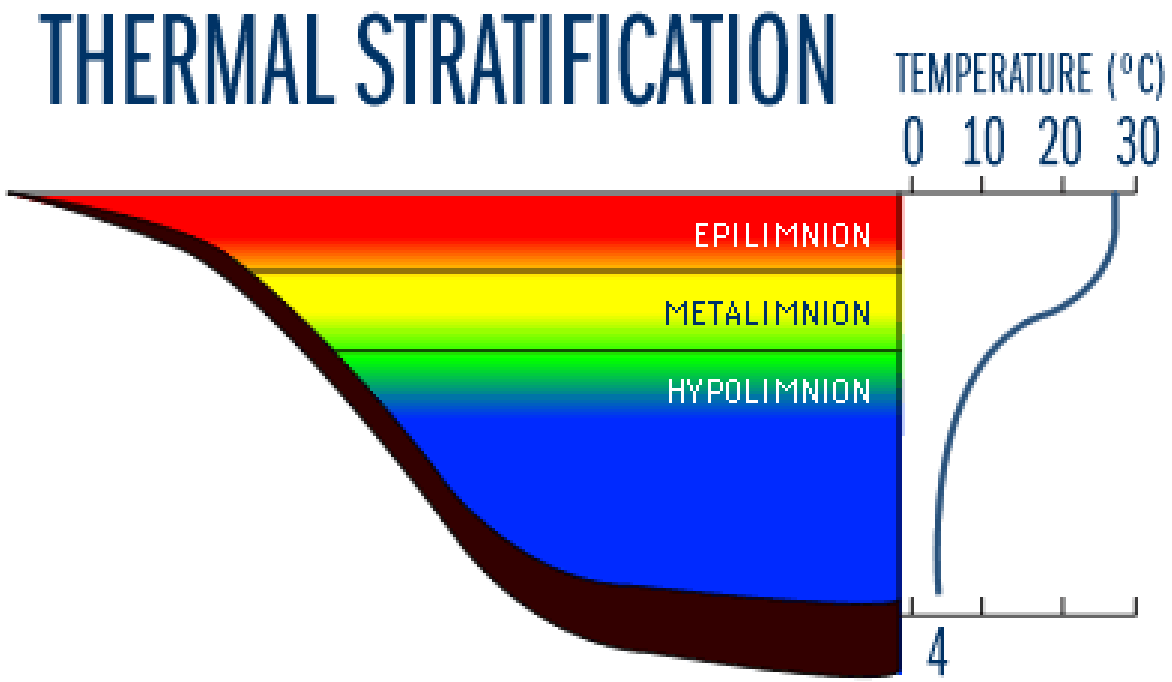
- Tools to derive site specific thresholds that reflect local conditions.
- Two model options
- Output: Chlorophyll a Threshold

EPA Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs, 2021

EPA Lake & Reservoir Stressor Response Models – Aquatic Life

Hypoxia Model

- Seasonal stratification
- Protecting cold and cool water fish.

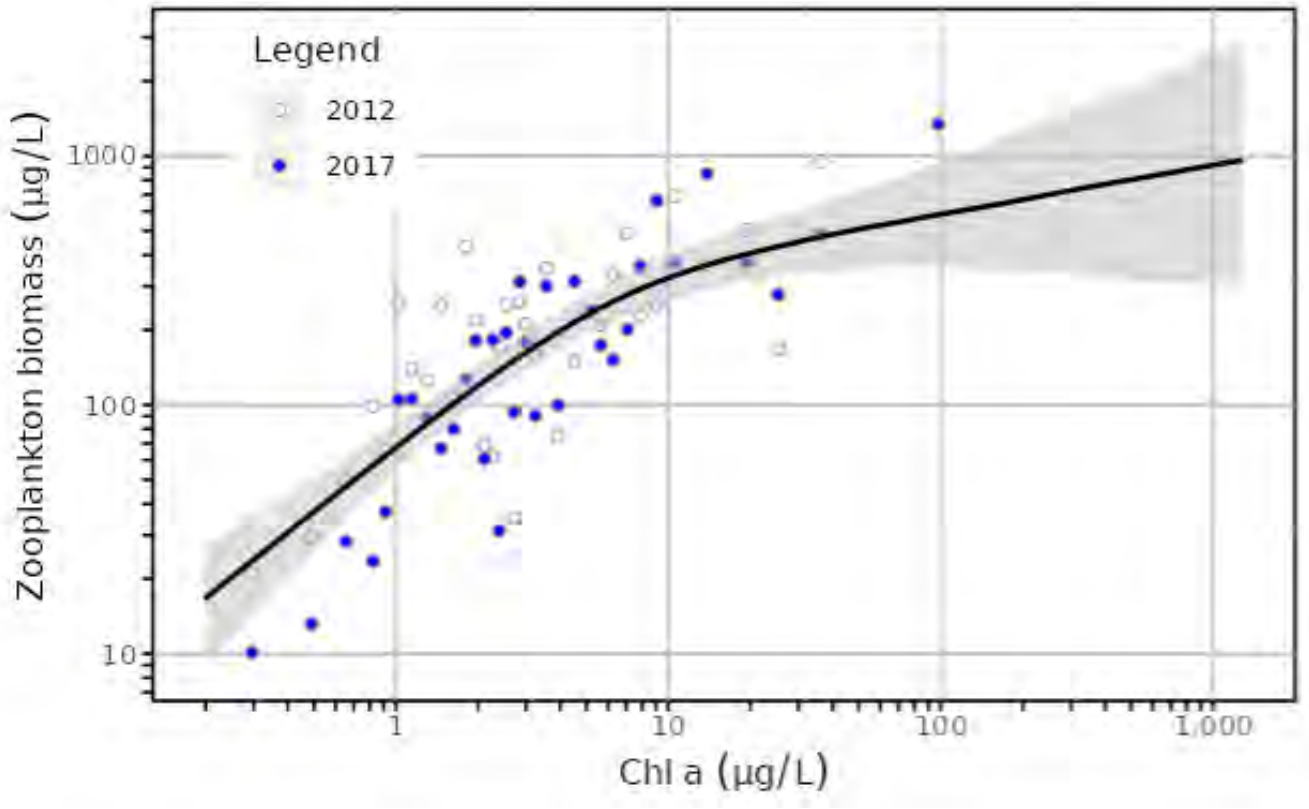


https://nsteps.epa.gov/apps/chl-hypoxia/

EPA Lake & Reservoir Stressor Response Models – Aquatic Life

Zooplankton Model

- Meso- to hypereutrophic lakes
- Relationship between phytoplankton and zooplankton.



https://nsteps.epa.gov/apps/chl-zooplankton/

Aquatic Life Decision Framework

Prepare data for assessment.

Select and run the appropriate stressor-response model to determine a Chl*a* threshold.

Parameter	Region	Threshold
Secchi Depth	Level III Mountain Ecoregions	≤ 2 m
	Level III Plains Ecoregions	≤ 1 m

Carlson 1977

Step 1: Compare monthly averages to the Chla threshold and secchi depth threshold.

> 1 Chla exceedance and/or	≤ 1 Chl*a* exceedance and/or
> 1 Secchi depth exceedance	≤ 1 Secchi depth exceedance

Impaired for excess algal growth.

Fully supporting aquatic life.

Step 2: Nutrient impairment determination is to be determined.

Recreation Decision Framework

Prepare data for assessment.

Step 1: Compare monthly averages to the Chl*a* and secchi depth ecoregional percentiles.

>67th percentile Chl*a* and/or	≤67th percentile Chl*a* and/or
<33rd percentile Secchi Depth	≥33rd percentile Secchi Depth

Parameter	Ecoregion	Threshold
Chl*a* (67th percentile)	Northern Rockies and Idaho Batholith	1.1 µg/L
	Northwestern Great Plains	10.7 µg/L

Parameter	Ecoregion	Threshold
Secchi Depth (33rd percentile)	Northern Rockies and Idaho Batholith	4.8 m
	Northwestern Great Plains	2.4 m

Recreation Decision Framework

Prepare data for assessment.

Step 1: Compare monthly averages to the Chl*a* and secchi depth ecoregional percentiles.

>67th percentile Chl*a* and/or

<33rd percentile Secchi Depth

≤67th percentile Chl*a* and/or

≥33rd percentile Secchi Depth

Step 2: Compare monthly averages to the ecoregional thresholds based on literature values.

Fully supporting recreation.

Recreation Decision Framework

Step 2: Compare monthly averages to the ecoregional thresholds based on literature values.

> 1 Chla exceedance and/or	≤ 1 Chl*a* exceedance and/or
> 1 Secchi depth exceedance	≤ 1 Secchi depth exceedance

Impaired for excess algal growth.

Fully supporting recreation.

Step 3: Nutrient impairment determination is to be determined.

Heiskary & Walker Jr 1988 and Smeltzer & Heiskary 2009

Parameter	Ecoregion	Threshold
Secchi Depth	Northern Rockies and Idaho Batholith	3.5 m
	Northwestern Great Plains (>4.5 m)	0.9 m

Parameter	Ecoregion	Threshold
Chl*a*	Northern Rockies and Idaho Batholith	8.0 µg/L
	Northwestern Great Plains (>4.5 m)	22 µg/L

HAB Thresholds

Parameter	Threshold
Microcystin[1]	8 ug/L
Anatoxin-a[2]	20 ug/L
Cylindrospermopsin[1]	15 ug/L
Cyanobacterial Cell Count[2]	> 100,000 cells/mL
Documented, visible, pervasive cyanobacteria bloom	> 14 days loss in the recreational season per year

[1] EPA Recommendations for Cyanobacteria and Cyanotoxin Monitoring in Recreational Waters, 2019

[2] Harmful Algal Bloom Guidance Document for Montana, 2021

HAB Decision Framework

Prepare data for assessment.

Compare individual cyanobacteria concentrations, cyanobacterial cell counts and document HABs samples to HAB thresholds.

> 1 Cyanotoxin exceedance and/or	≤ 1 Cyanotoxin exceedance
> 1 Cell count exceedance and/or	≤ 1 Cell count exceedance
> 1 Document HABs exceedance	≤ 1 Document HABs exceedance

Impaired for harmful algal blooms.

Fully supporting recreation.

Next Steps

- Public Comment Period
- Final Assessment Method
- Assess selected lakes for the 2022-2024 Integrated Report


Avalanche Lake

Connect with us!

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Questions?

Upper Red Rock Lake

Thank you!

Holland Lake