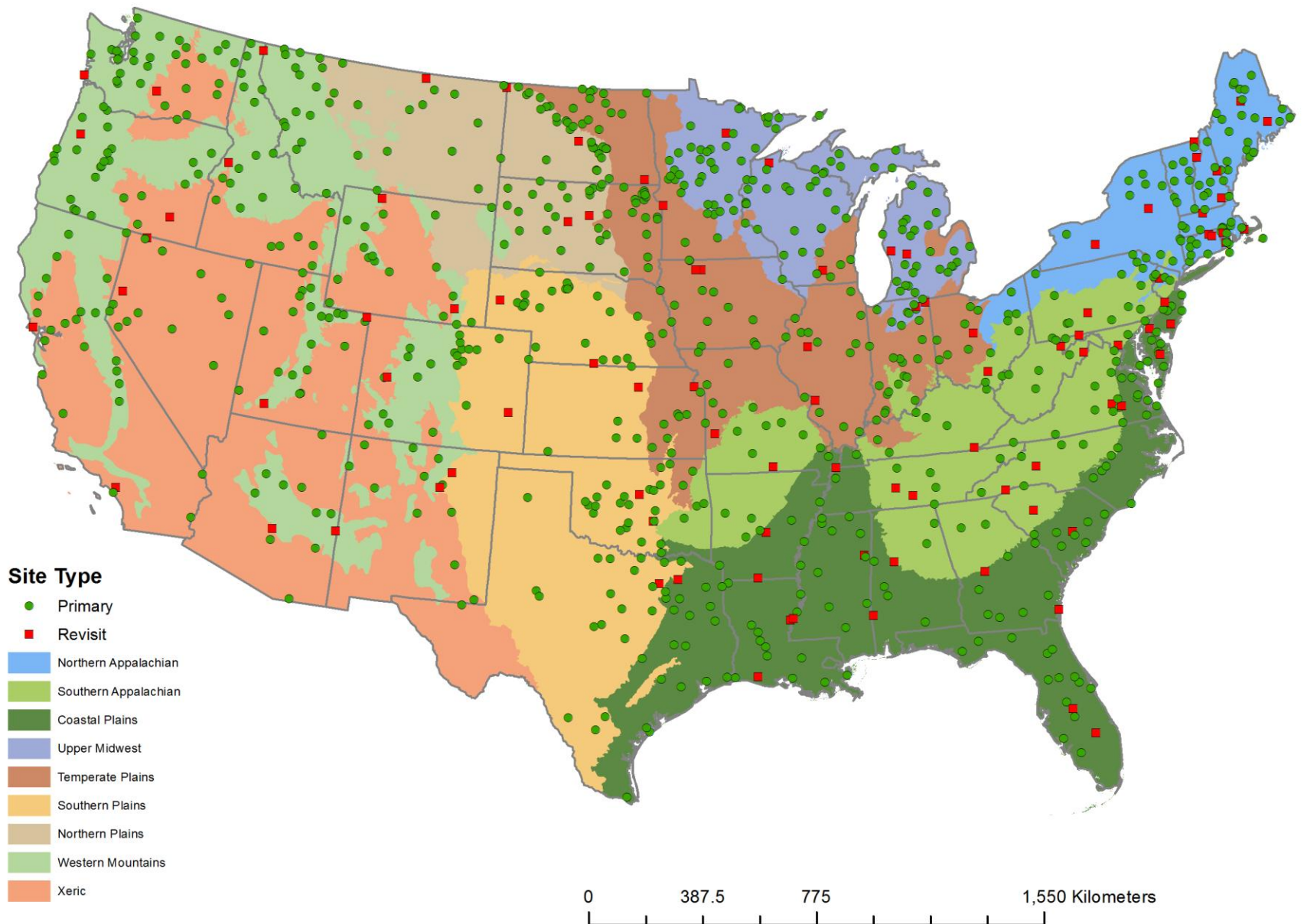
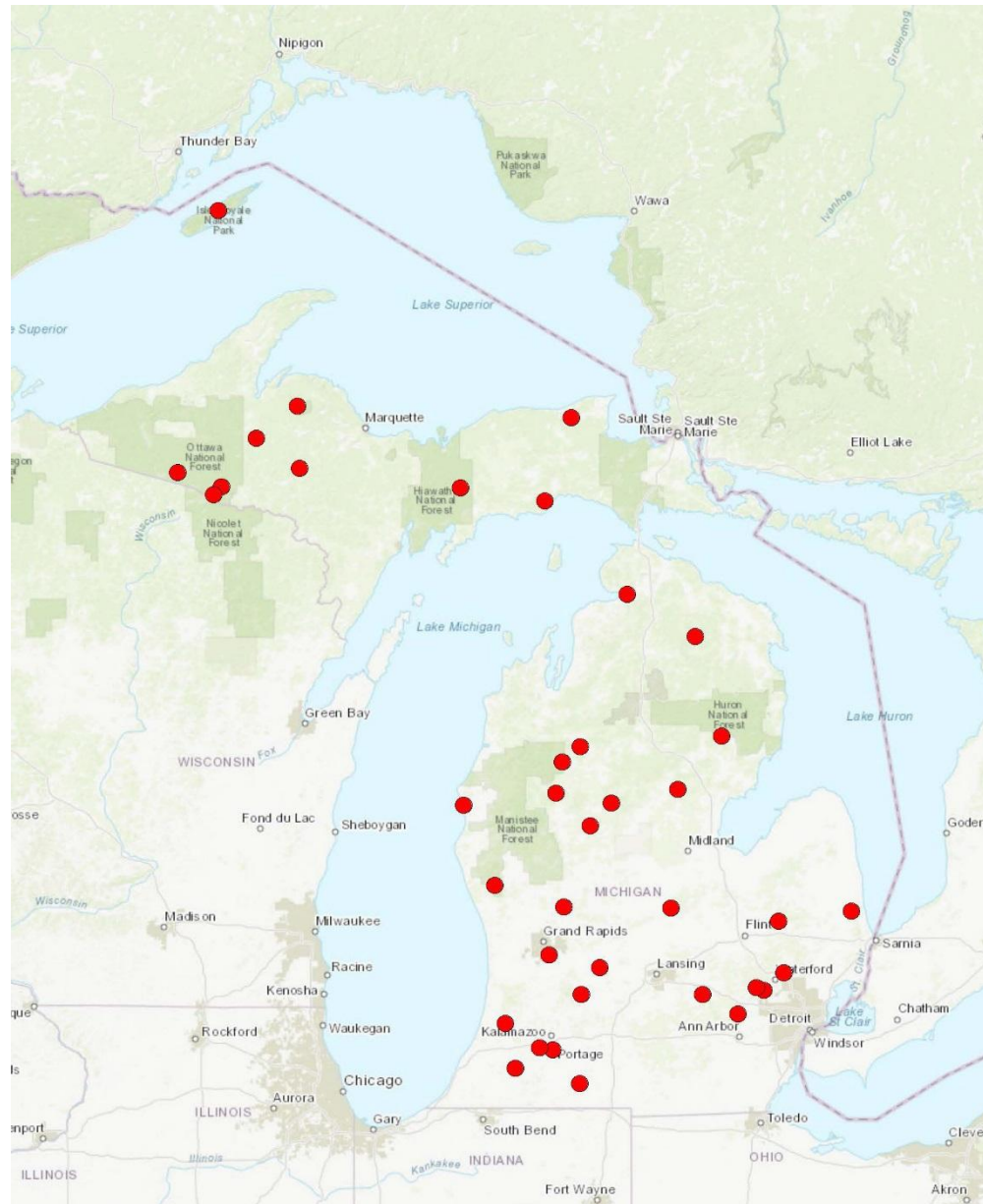


Torch Lake and the National Lakes Assessment in 2017

Dennis McCauley
Great Lakes Environmental Center, Inc., Traverse City, MI

2017 NLA Design Sites





Torch Lake

- 18,770 acres (7,596 hectares),
- Max. depth of 87 meters (288 feet),
- Average depth of 111 feet,
- Michigan's deepest inland lake,
- 41 miles of shoreline,
- Approximately 2 miles wide (3.2 Km) at its widest point.
- Michigan's second largest lake; second to Houghton Lake (20,044 acres).

Torch Lake “X” Point

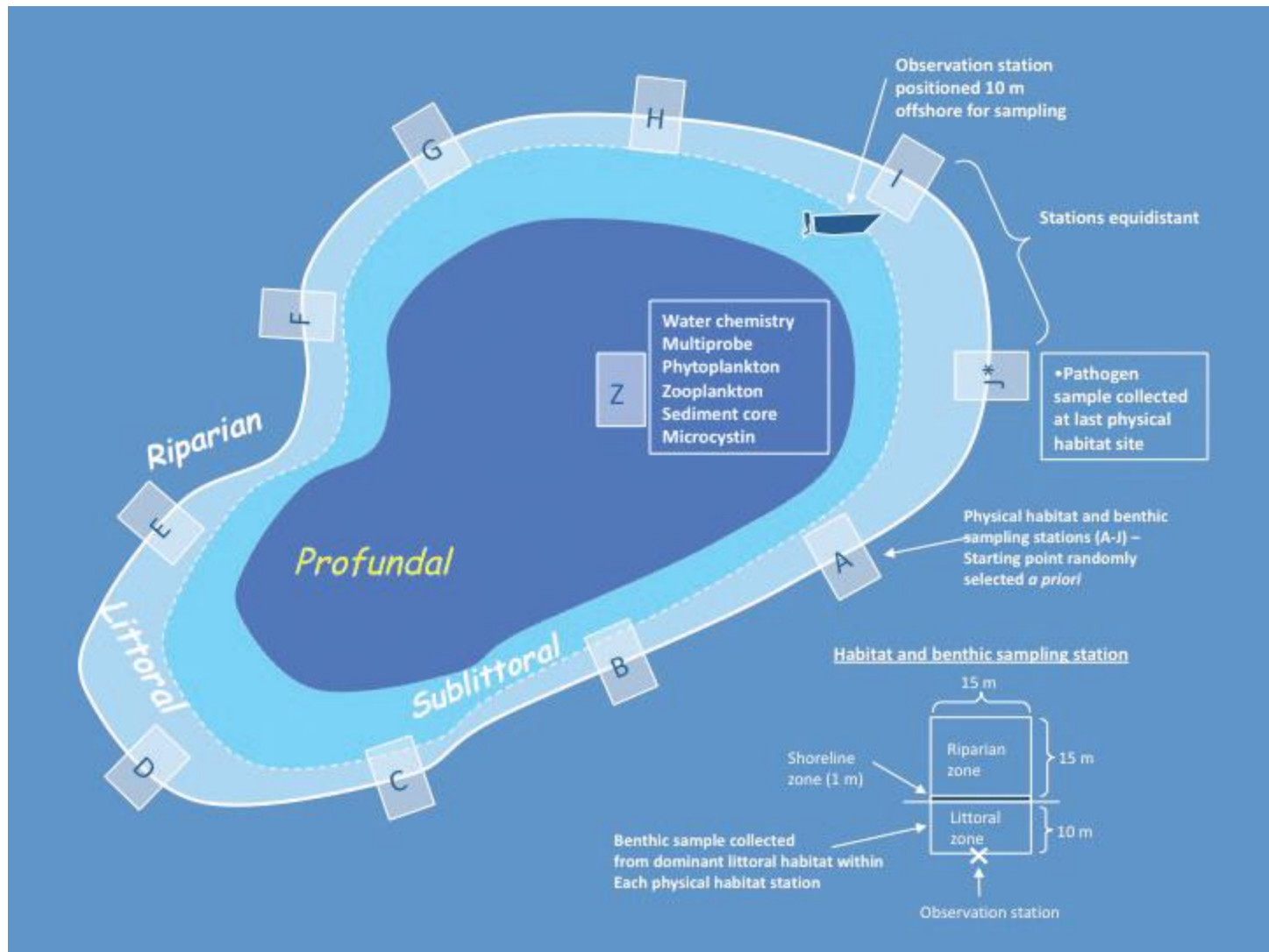
44.960000N and -85.29362W

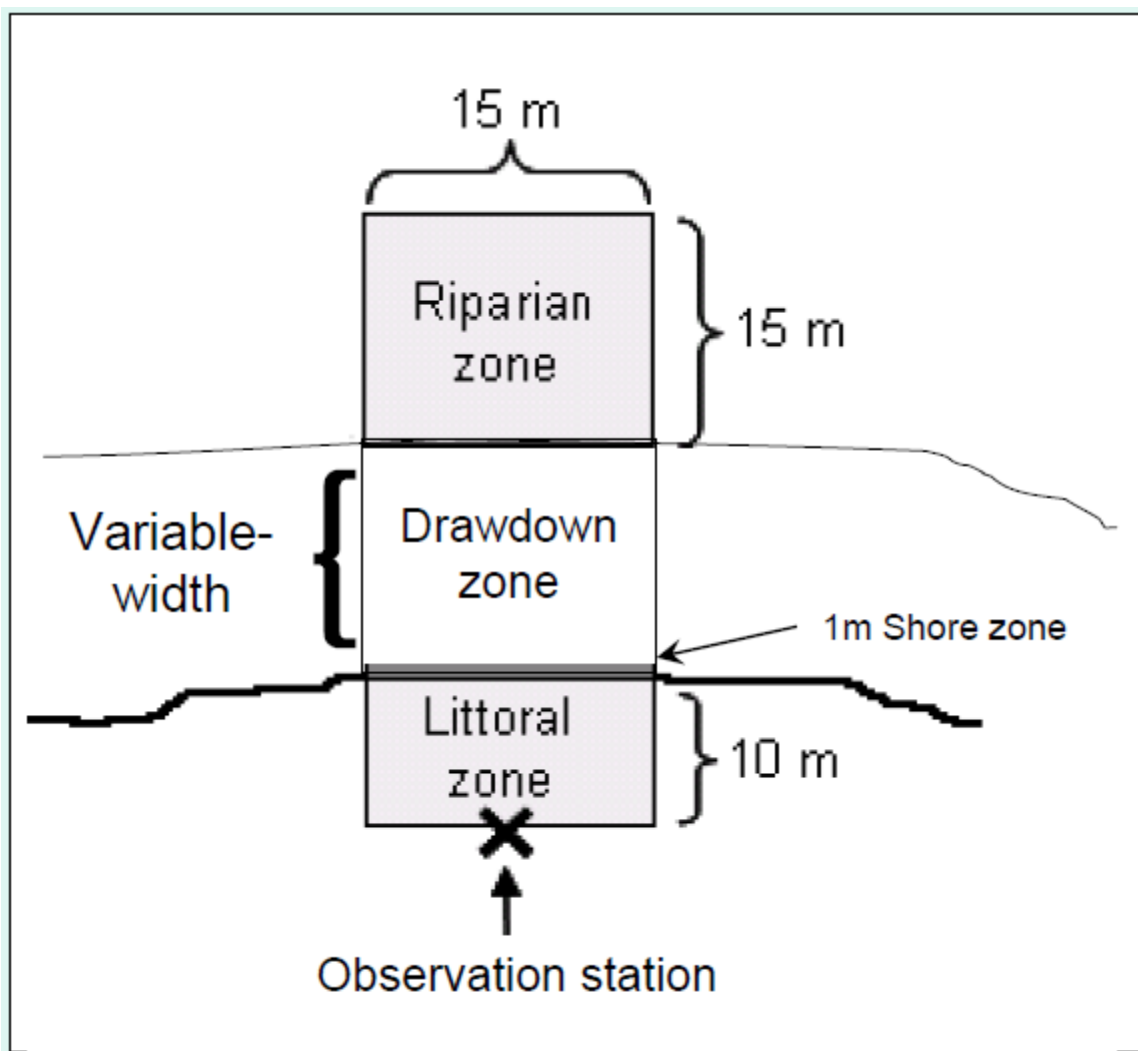
PHab_ID	LAT_DD	LONG_DD
A	44.971896	-85.282304
B	44.919366	-85.288031
C	44.864407	-85.282263
D	44.873914	-85.322731
E	44.928716	-85.322579
F	44.984969	-85.319653
G	45.037792	-85.33372
H	45.08947	-85.35299
I	45.074802	-85.321787
J	45.023989	-85.298306

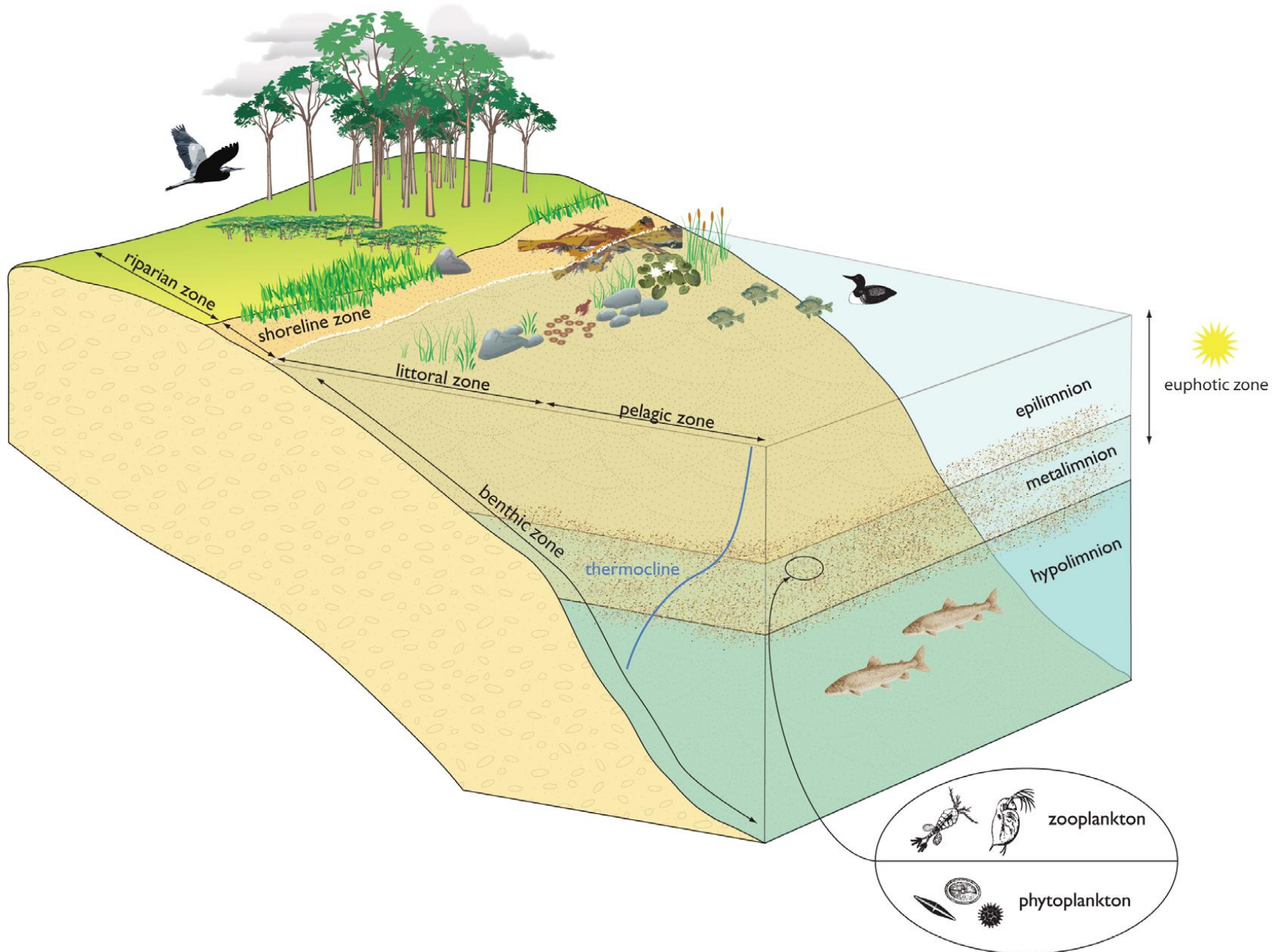
Torch Lake



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community







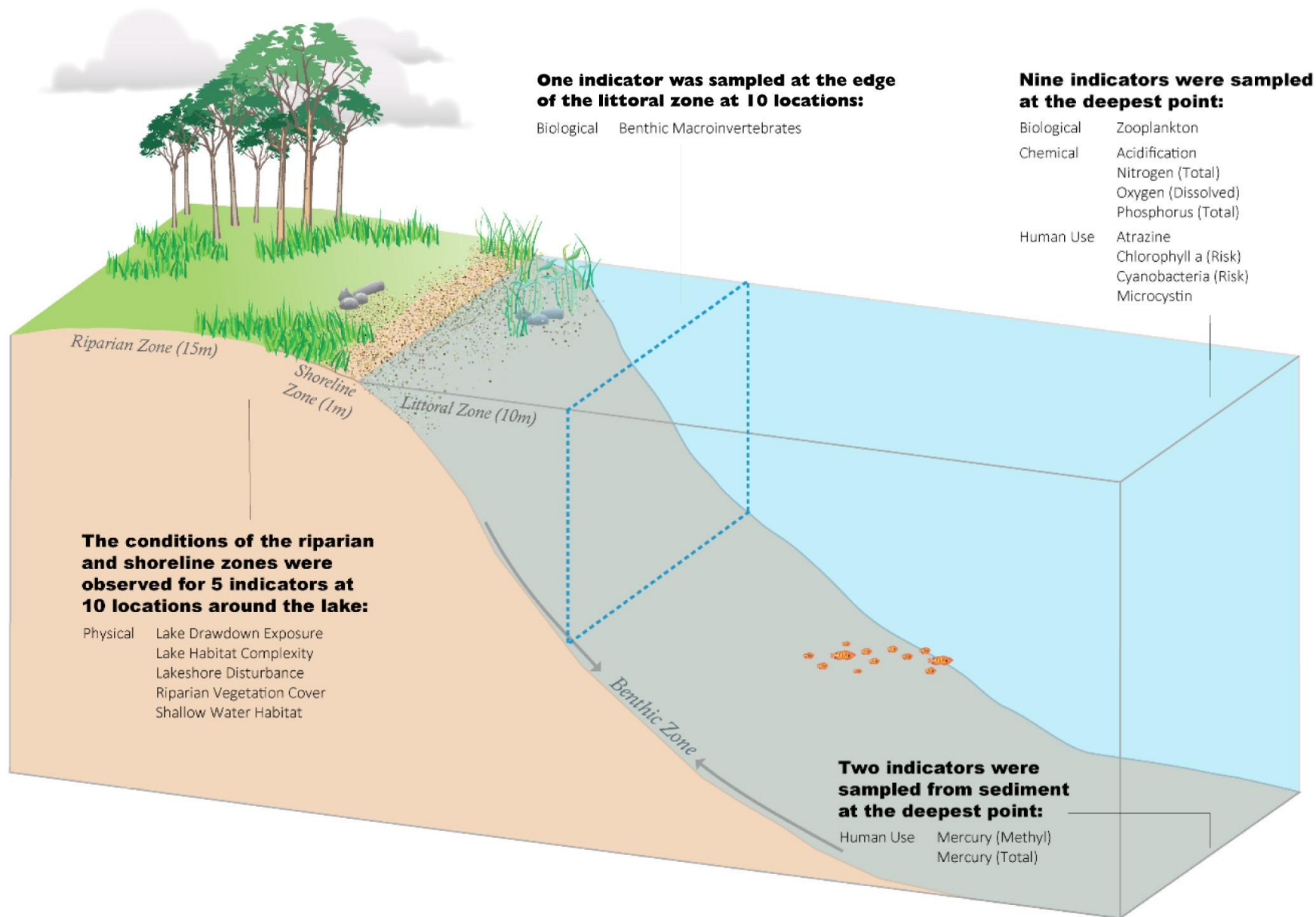


Table 1. Least-disturbed Reference Screening Filter Thresholds for NLA 2012 (Upper Midwest Ecoregion is labeled as UMW in the following table)

¹ WMT = Western Mountains; ² XER = western Xeric, ³ NPL = Northern Plains, ⁴ SPL = Southern Plains, ⁵ TPL = Temperate Plains, ⁶ UMW = Upper Midwest, ⁷ Central Plains, ⁸ Southern Appalachians, ⁹ NAP = Northern Appalachians, ¹⁰ Lakeshore Physical Habitat disturbances; non-agricultural,

¹¹ Lakeshore Physical Habitat disturbances; agricultural, ¹² Sum of agricultural/residential/industrial human disturbances

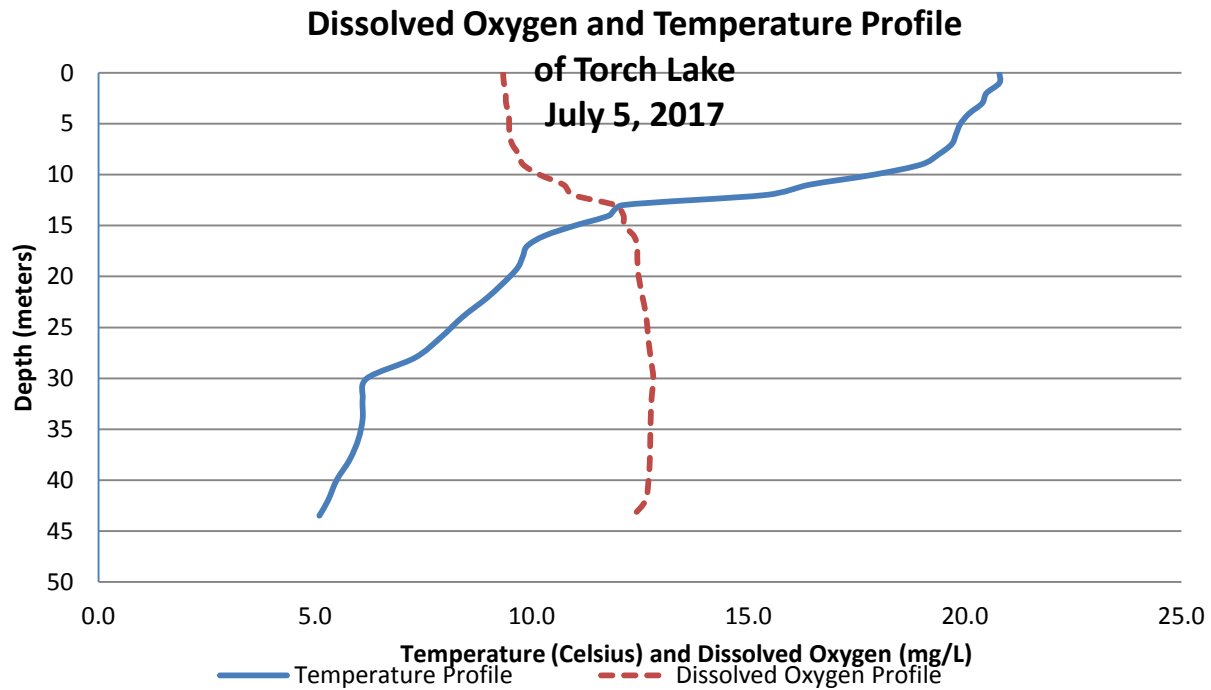
	TP (ug/L)	TN (ug/L)	Cl (ueq/L)	SO4 (ueq/L)	Turbidity (NTU)	Hii-NonAg ¹⁰	Hii- Ag ¹¹	Assessment (Ag/Res/Ind) ¹²
WMT ¹	>30@	>400	>100#	>200	>3	>0.6	>0	> 5/5/5
XER ²	>100	>1000	>500	>1000	>5	>1.5	>0.2	> 5/5/5
NPL ³	>150	>2000	>1000	---	>5	>1.5	>0.5	> 10/6/6
SPL ⁴	>150*	>2000*	>1000	---	>5	>1.5	>0.5	> 10/6/6
TPL ⁵	>120	>2000	>1000	>5000	>5.5	>1.7	>0.15	> 9/9/9
UMW⁶	>40	>1200	>200	>200	>5	>0.6	>0	> 5/5/5
CPL ⁷	>50	>1200	>1000	>400	>5	>1.0	>0	> 6/10/6
SAP ⁸	>35	>800	>125	>300	>5	>0.9	>0	> 6/6/6
NAP ⁹	>30	>600	>100#	>300	>5	>0.6	>0	> 6/6/6





Table 3. Water and Sediment Quality Analysis: Torch Lake 2017

NLA Indicators		Torch Lake Results
Sample Type	Analyses	
Water chemistry	pH	8.24
nutrients	TOTAL PHOSPHORUS	<0.0007
nutrients	TKN	0.458 mg/L
	Chlorophyll a	0.00033 mg/L
Bacteria	E.coli	<1 (MPN)
Bacteria	Total Coliforms	5.2 (MPN)
Algal Toxin	Microcystin	0.001 µg/L
Sediment	Total Organic Carbon	3.8%
Sediment	grain size	Clay: 26.1%, Sand: 35.0%, Silt: 29.1%
Sediment	Chlorinated Pesticides	<1 ng/dry gram (<mdl)
Sediment	Total PCBs	<1 ng/dry gram (<mdl)
Sediment	Total PAHs	14.0 ng/dry gram
Sediment	Percent Solids	73.8%
Sediment	Metals (µg/L) : Aluminum	3249/3640
	Antimony	0/0
	Arsenic	4.16/4.12
	Cadmium	0/0
	Chromium	5.9/6.2
	Copper	5.9/7.6
	Iron	5665/5667
	Lead	1.7/1.7
	Manganese	179/178
	Mercury	0.0053/0.0046
	Nickel	3.4/3.4
	Selenium	0.091/0.112
	Silver	0/0
	Tin	0.45/0.52
	Vanadium	10.7/10.9
	Zinc	8.2
Triazine Pesticides (water)	Atrazine Screen	0 µg/L



**Table 5. Comparison of Selected Water Quality and Physical Habitat Indices (Rating Over Index Value)
From Two Northern Michigan Lakes and Torch Lake**

Lake	Trophic Status	DO ¹	Chl. ² @	Draw-down	LitCvr ³	LitRipCvr ⁴	RDIS ⁵	RVeg. ⁶	Total Phosphorus (mg/L)	Secchi Depth (m)
Torch	Oligotrophic	High	Good (0.00033)	small	Poor (2.91)	Poor (1.5)	Poor (0.427)	Poor (0.11)	<0.0007	11.5
Clear	Oligotrophic	High	Good	Med.	Poor (0.071)	Poor (0.305)	Fair (0.487)	Poor (0.447)	21	8.8
Glenn	Oligotrophic	High	Good	Small	Poor (0.217)	Poor (0.424)	Poor (0.753)	Fair (0.560)	23	--

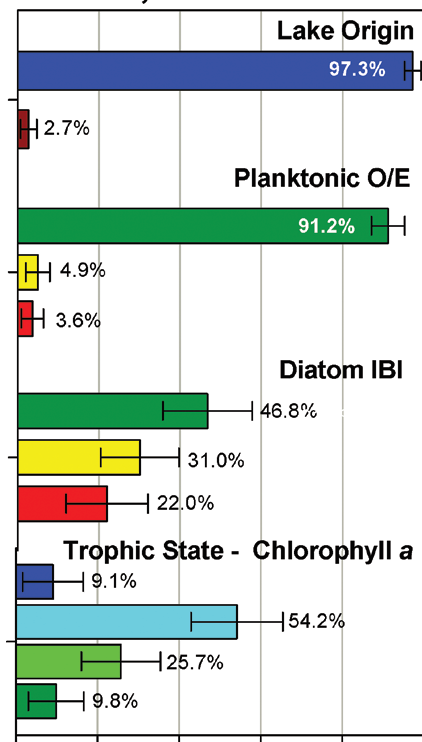
¹ Dissolved Oxygen, ² Chlorophyll @, ³ Littoral Cover, ⁴ Avg. Littoral and Riparian Cover, ⁵ Anthropogenic Disturbance, ⁶ Riparian Cover Complexity

Table 6. Comparison of the Least Disturbed Condition in the Upper Midwest EcoRegion to Torch Lake (2017)

	TP (ug/L)	TN (ug/L)	Cl (ueq/L)	SO4 (ueq/L)	Turbidity (NTU)
UMW	>40	>1200	>200	>200	>5
Torch	<7	458			>5



Upper Midwest 15,562 Lakes



Percentage of Lakes

For Lake Origin:

Blue: Natural, Red: Man-Made

For Plankton O/E

Green: < 20% Taxa Loss, Yellow: 20-40% Taxa Loss, Red: > 40% Taxa Loss

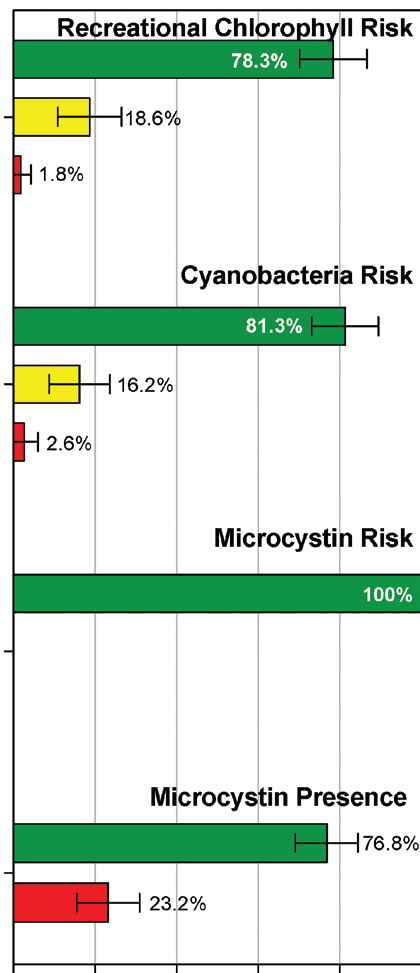
For Diatom IBI:

Green: Good, Yellow: Fair, Red: Poor

For Trophic State - Chlorophyll a

Blue: Oligotrophic (<= 2 ug/L), Light Blue: Mesotrophic (>2-7 ug/L)

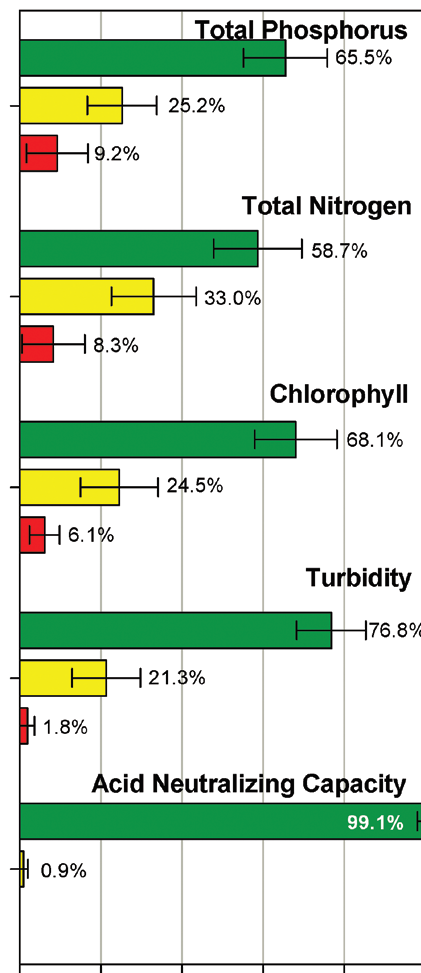
Green: Eutrophic (>7 to 30 mg/L), Dark Green: Hypereutrophic (> 30 ug/L)



Percentage of Lakes

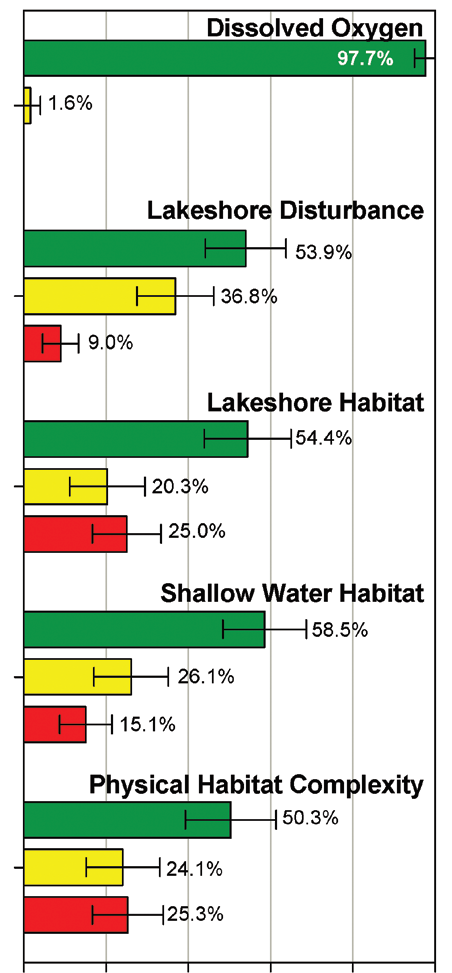
Green: Low Risk, Yellow: Moderate Risk, Red: High Risk

Red: Present, Green: Absent



Percentage of Lakes

Green: Good, Yellow: Fair, Red: Poor



Percentage of Lakes

Green: Good, Yellow: Fair, Red: Poor

“Given these indicators and similar scoring, Torch Lake would also likely rank in the “Good” category nationally.”