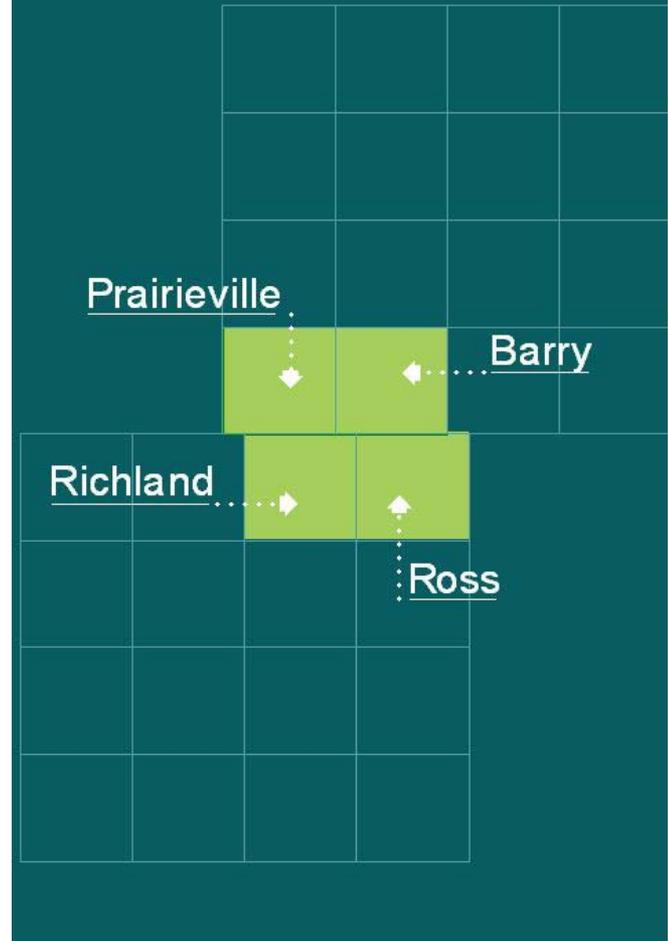


Little Long Lake Carrying Capacity Analyses

Four Township Water
Resources Council

Four Township
Water Resources
Council, Inc.



Mission

Assist with the development and implementation of land use strategies that retain the rural environment currently enjoyed by township residents, protecting lakes, streams, drinking water, agriculture, and open space.

Four Township Water Resources Council, Inc.



Recreational Carrying Capacity

- The number of boats that can be operated on a lake without compromising safe recreational use, aesthetic enjoyment, and/or environmental quality.



Environmental Carrying Capacity

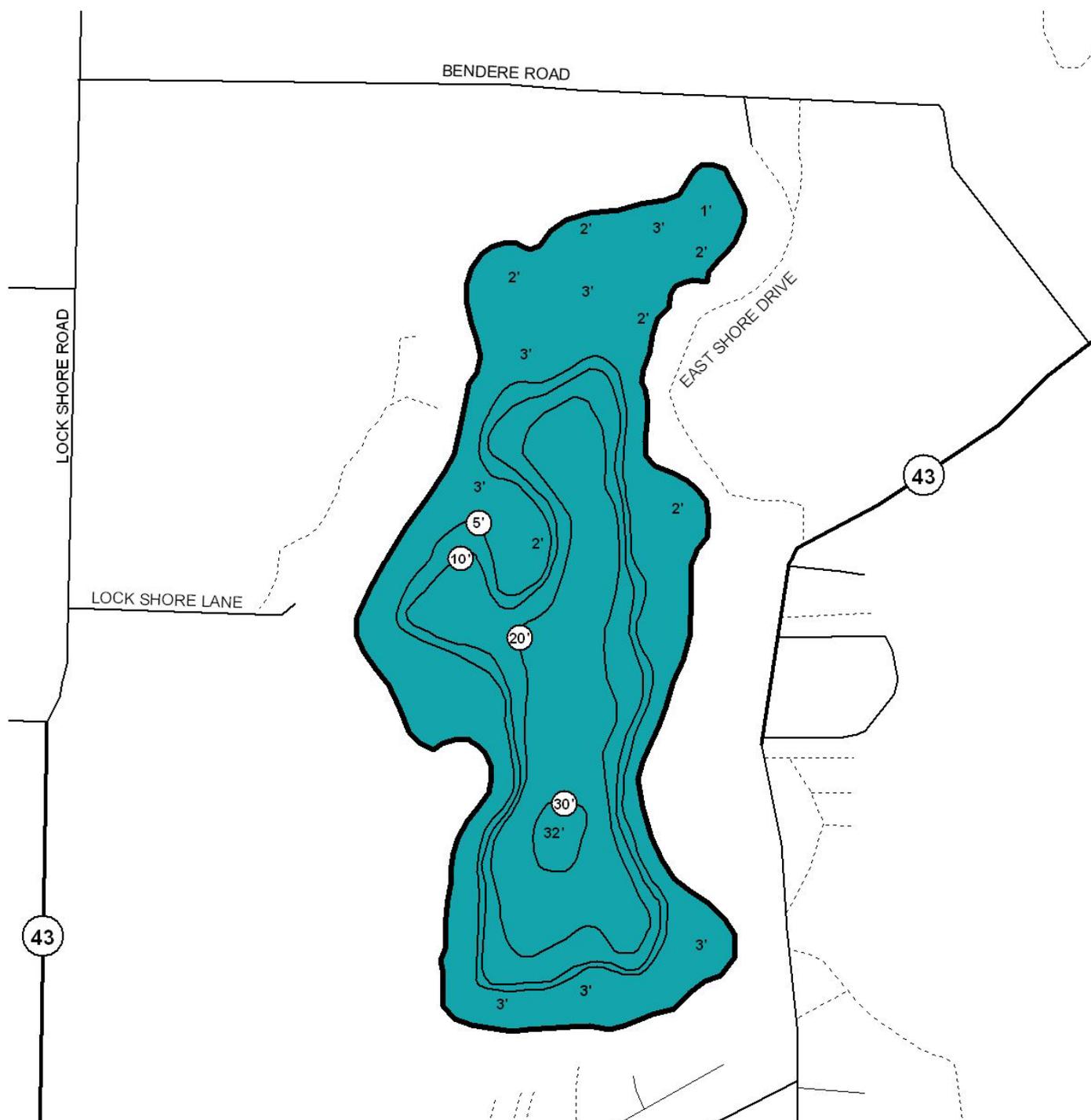
- A lake's ability to sustain pollution inputs without degrading water quality.

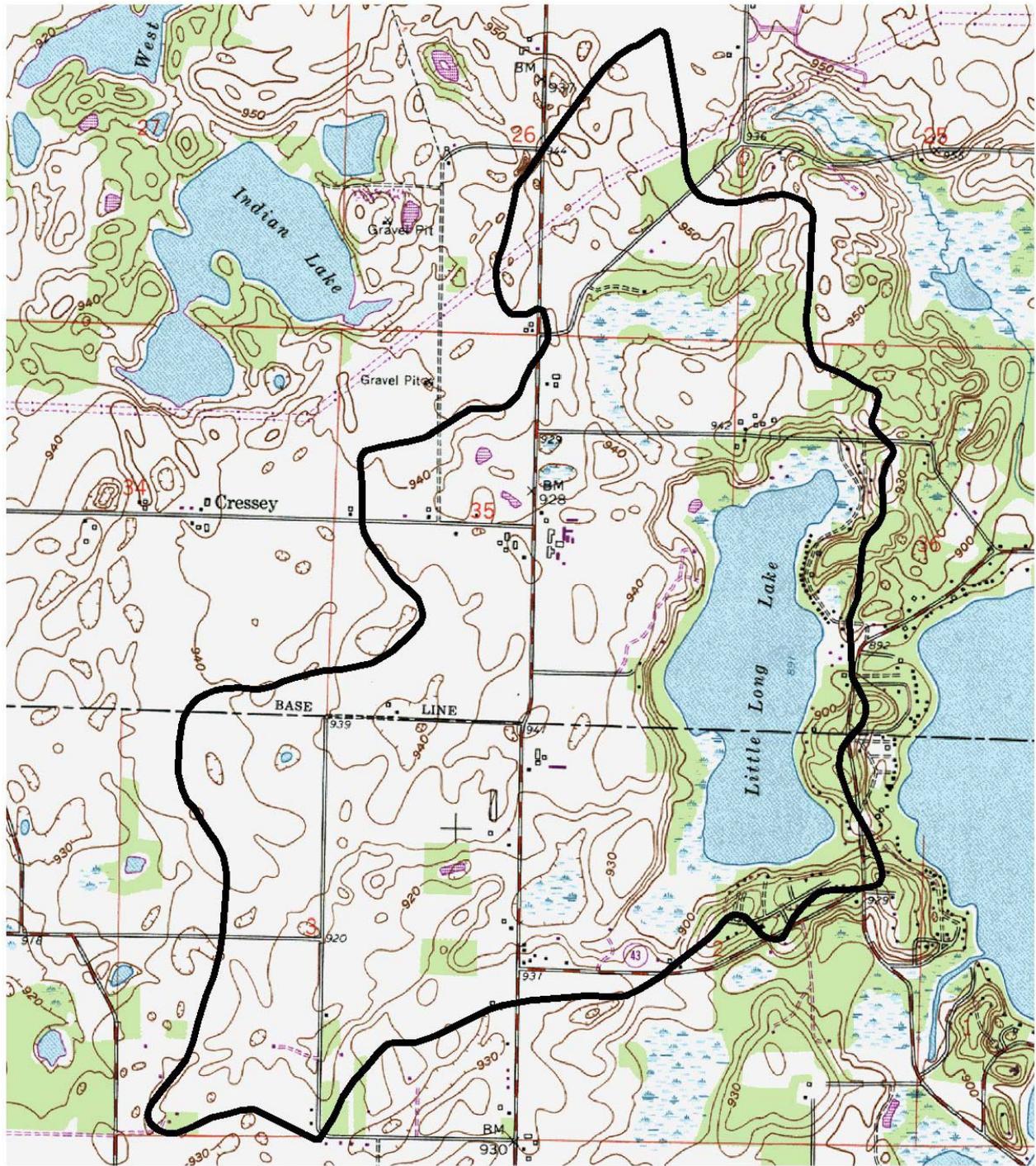


Little Long Lake

Physical Characteristics

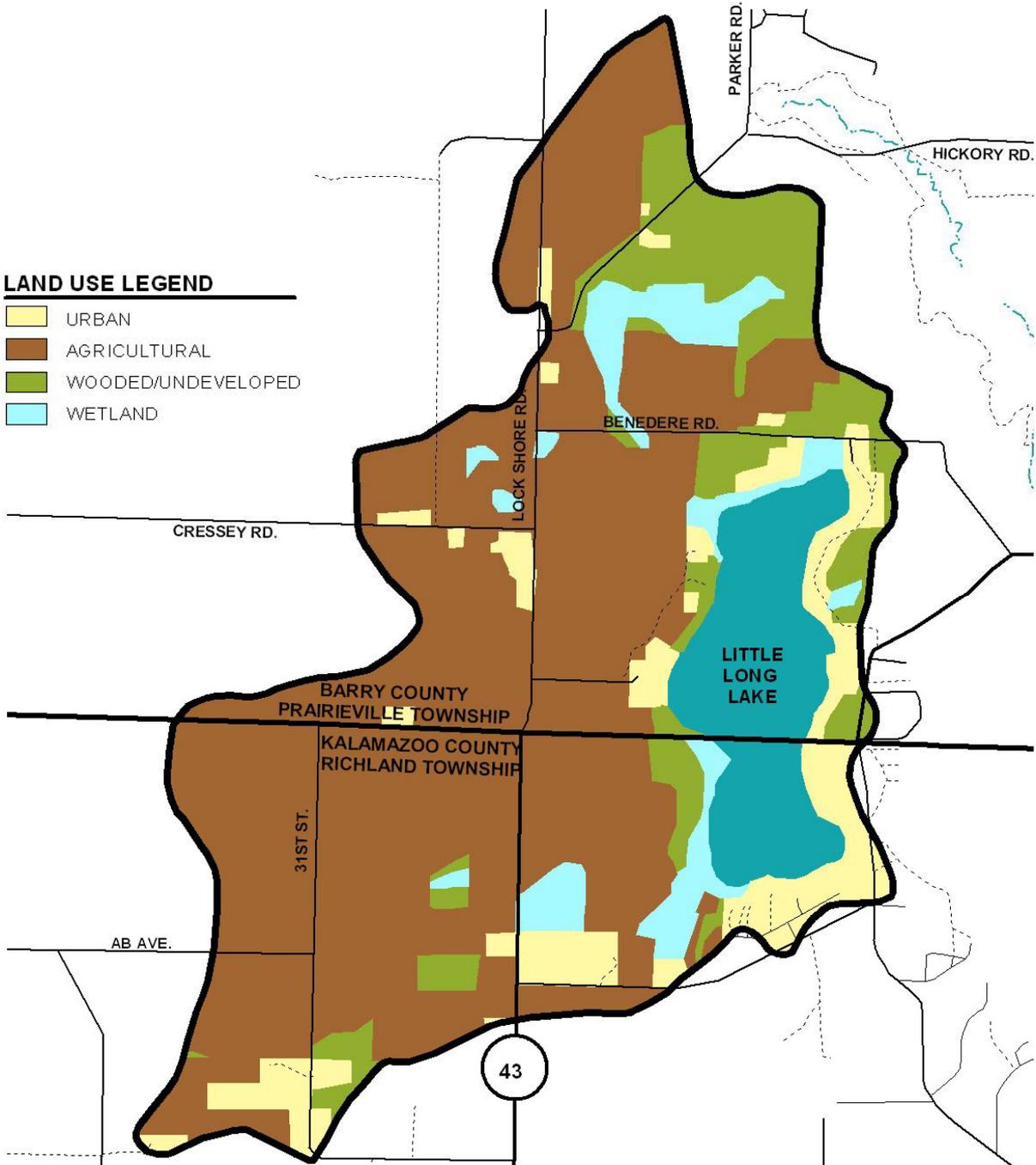
Surface Area	170 acres
Maximum Depth	32 feet
Mean Depth	10 feet
Shallowness Ratio	0.52
Lake Volume	1,704 acre-feet
Shoreline Development Factor	1.5
Lake Elevation (feet above sea level)	891
Watershed Area	1,633 Acres
Lake Area to Watershed Area Ratio	1: 9.6



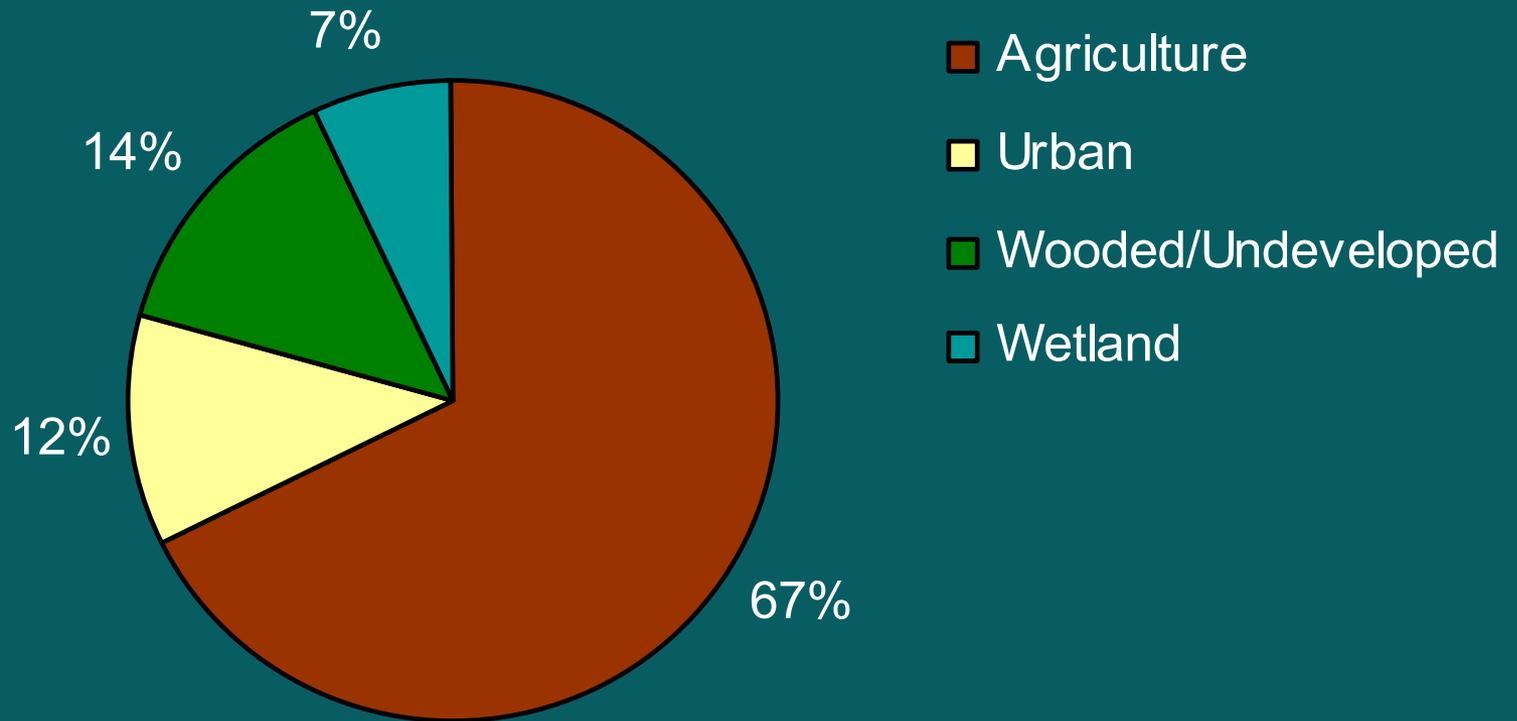


LAND USE LEGEND

-  URBAN
-  AGRICULTURAL
-  WOODED/UNDEVELOPED
-  WETLAND

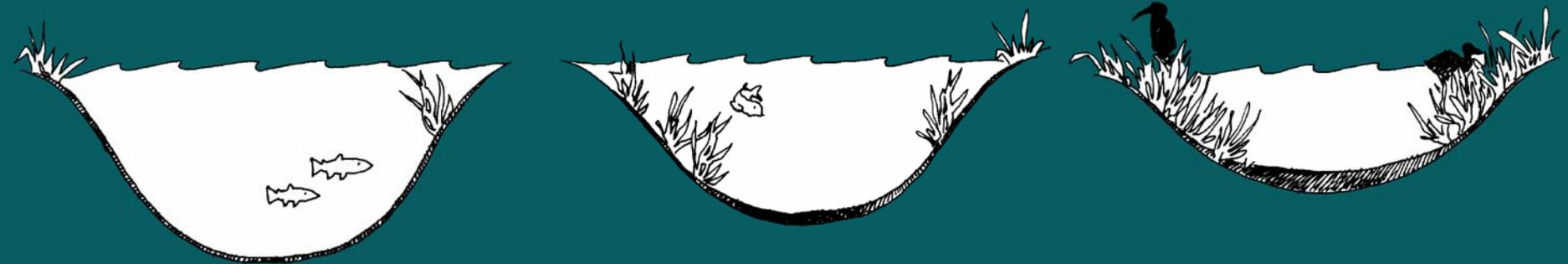


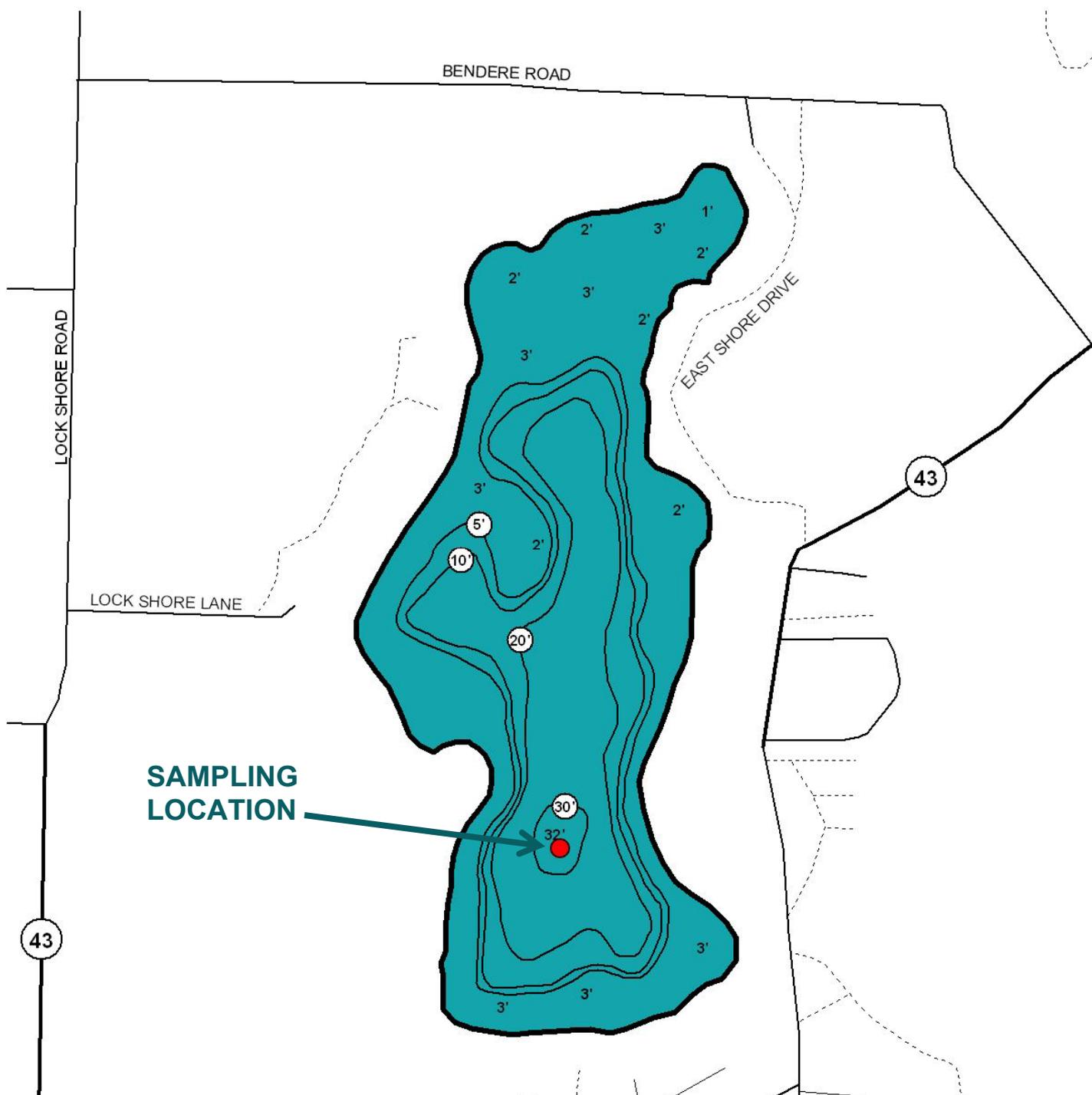
Watershed Land Cover



Lake Classification Criteria

Lake Classification	Total Phosphorus ($\mu\text{g/L}$)	Chlorophyll-a ($\mu\text{g/L}$)	Secchi Transparency (feet)
Oligotrophic	Less than 10	Less than 2.2	Greater than 15.0
Mesotrophic	10 to 20	2.2 to 6.0	7.5 to 15.0
Eutrophic	Greater than 20	Greater than 6.0	Less than 7.5



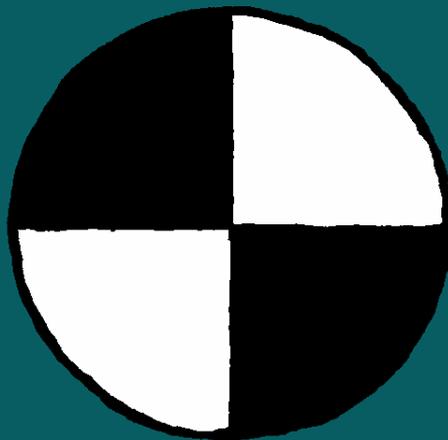


Deep Basin Water Quality Data

<u>Date</u>	<u>Depth (ft)</u>	<u>Temperature (°F)</u>	<u>Dissolved Oxygen (mg/L)</u>	<u>Total Phosphorus (µg/L)</u>
8-Apr-04	1	50	11	7
8-Apr-04	15	48	11	10
8-Apr-04	28	47	11	17
22-Jul-04	1	81	7	6
22-Jul-04	15	74	7	6
22-Jul-04	29	61	1	460

Surface Water Quality Data

<u>Date</u>	Secchi Transparency (feet)	Chlorophyll-a ($\mu\text{g/L}$)
8-Apr-04	24.5	0.5
22-Jul-04	6.5	0.5



Marl Deposits

MICHIGAN DEPARTMENT OF CONSERVATION LONG LAKE

AREA 169 ACRES

BARRY COUNTY T. 1 N., R. 10 W., SECS., 35, 36
KALAMAZOO COUNTY T. 1 S., R. 10 W., SEC., 2
SURVEY AND SOUNDINGS JAN. 21, -JAN. 23, 1964

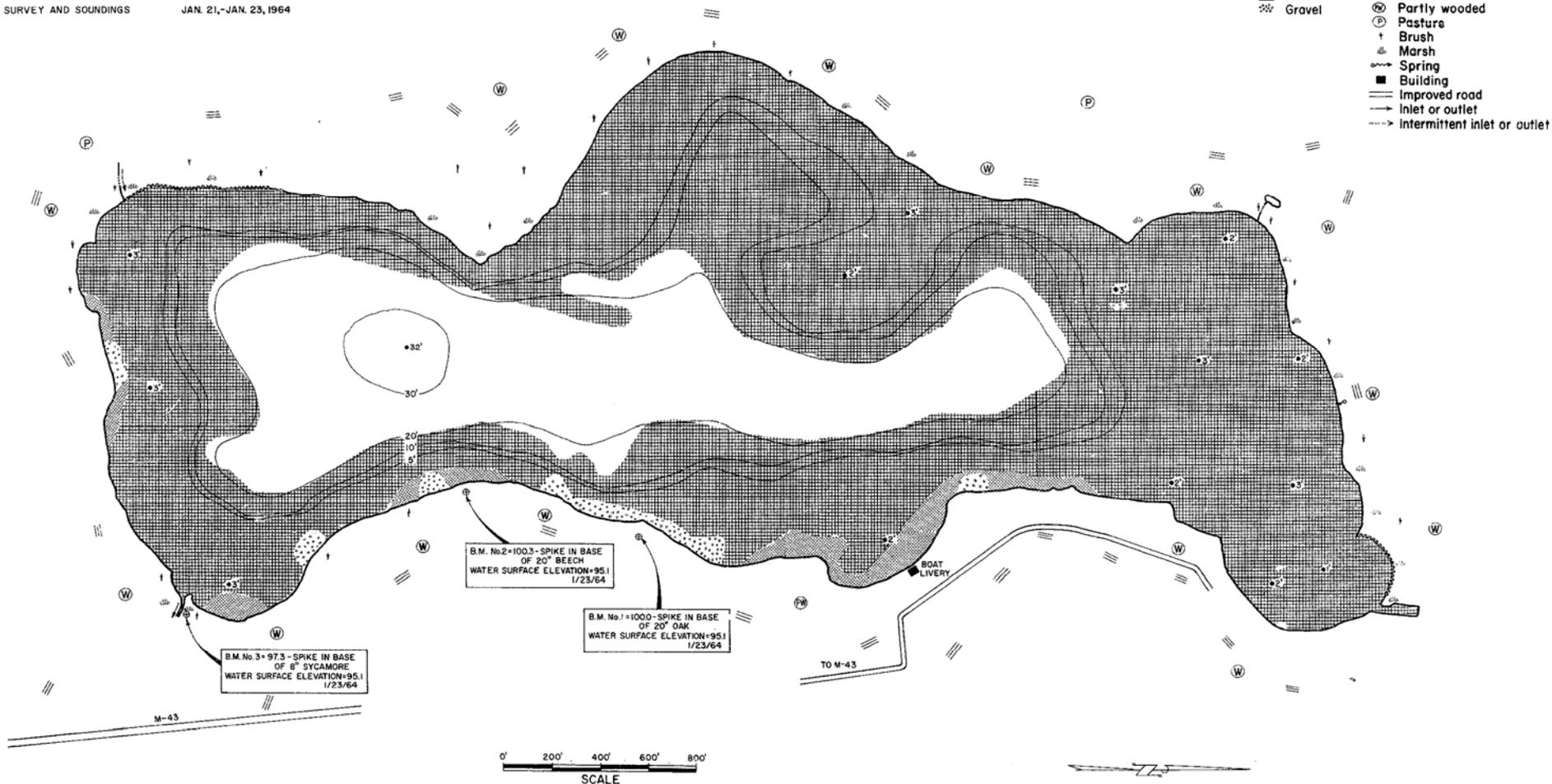
LEGEND

BOTTOM

-  Sand
-  Organic
-  Marl
-  Gravel

SHORE FEATURES

-  Encroaching shore
-  Steep slope
-  Wooded
-  Partly wooded
-  Pasture
-  Brush
-  Marsh
-  Spring
-  Building
-  Improved road
-  Inlet or outlet
-  Intermittent inlet or outlet



Recreational Carrying Capacity Considerations

- Use Characteristics
- Environmental Impacts
- Useable Lake Area
- Boating Density
- Lake Use Rate



Use Characteristics

BOAT COUNT DATA

July 22, 2004

Boats with Motors Greater Than 25 HP	65	37%
Boats with Motors Less Than or Equal to 25 HP	21	12%
Personal Watercraft	7	4%
Sailboats	8	5%
<u>Non-Motorized Boats</u>	<u>76</u>	<u>42%</u>
Total	177	100%

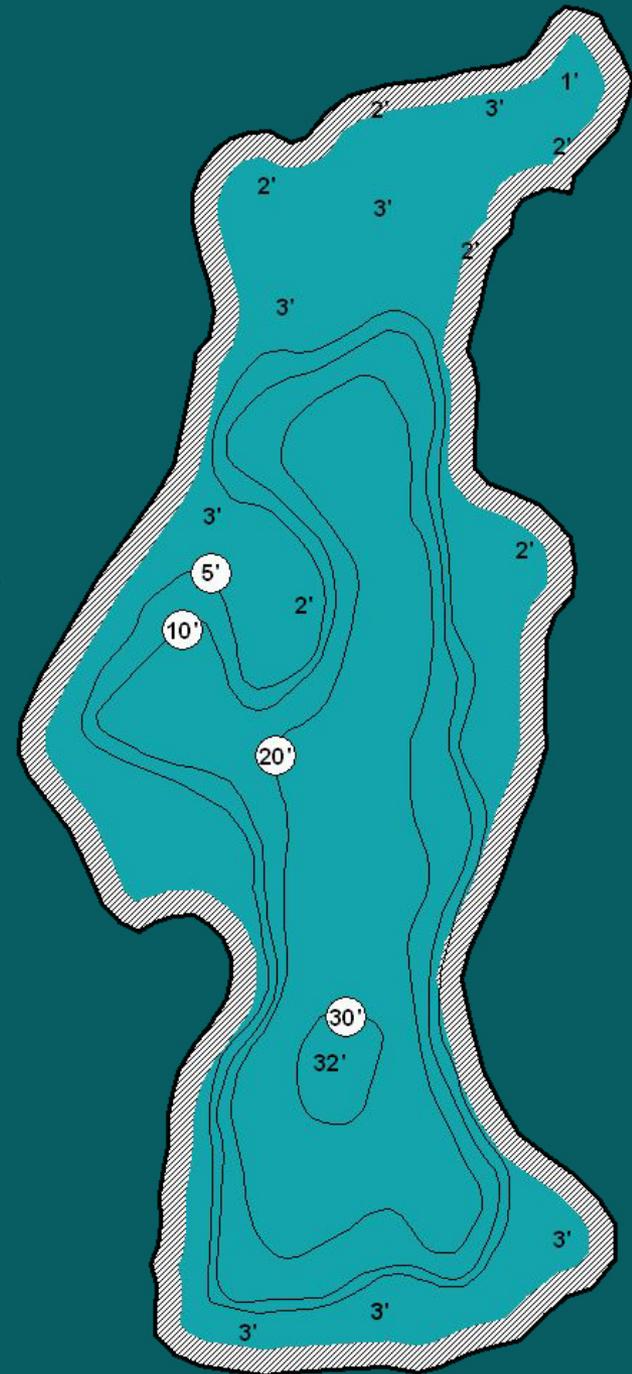
Environmental Impacts

- Fuel emissions
- Sediment suspension
- Reduced transparency
- Fish and wildlife impacts



Useable Lake Area

- 100-foot safety and environmental protection zone: 34 acres of Long Lake
- Long Lake useable lake area: 136 acres



Boating Density

<u>Source</u>	<u>Suggested Density (acres/boat)</u>	<u>Boating Uses</u>
Ashton (1971)	5 to 9	All uses combined in Cass Lake
	4 to 9	All uses combined in Orchard Lake
	6 to 11	All uses combined in Union Lake
Kusler (1972)	40	Waterskiing - All uses combined
	20	Waterskiing
	15	Coordinated waterskiing
Jaakson et al. (1989)	20	Waterskiing and motorboat cruising
	10	Fishing
	8	Canoeing, kayaking, sailing
	10	All uses combined
Wagner (1991)	25	All recreational activities
Warbach et al. (1994)	30	All motorized (>5 HP) uses

Boating Density

- Little Long Lake: 10 acres/boat as aggregate density for all lake uses



Lake Use Rate

- 10% of moored boats (during peak use)
- Little Long Lake: $10\% \times 177 = 17.7$ boats

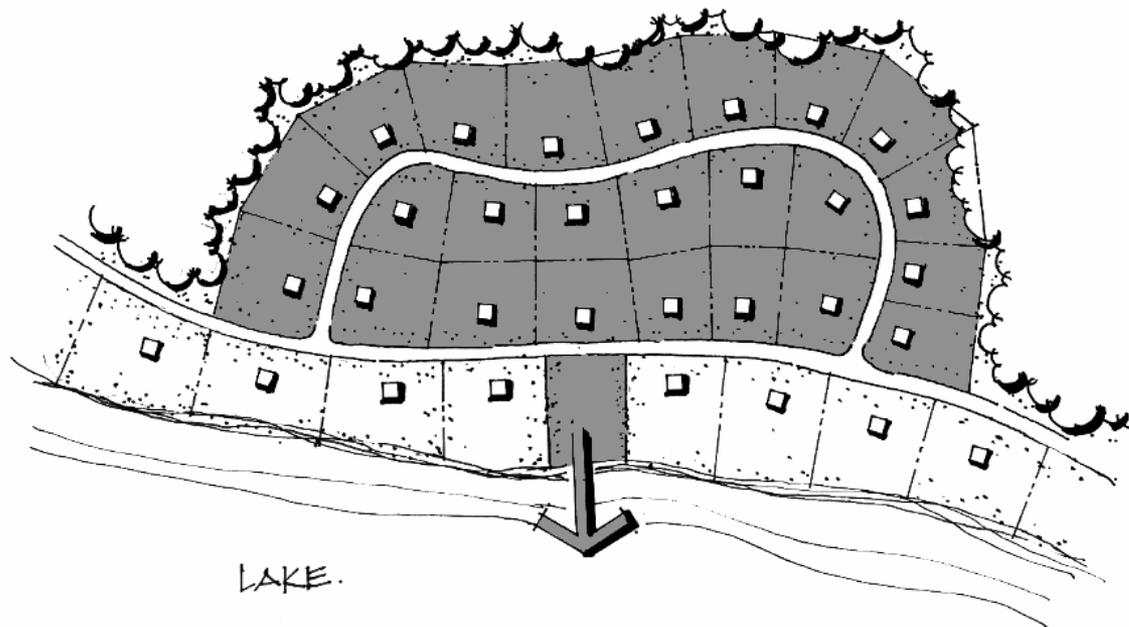


Little Long Lake Recreational Carrying Capacity

- 136 acres of useable lake area \div 10 acres per boat = 13.6 boats
- Estimated number of boats during peak use periods = 17.7 boats
- 132% of Little Long Lake's carrying capacity
- Potential for congestion, unsafe boating conditions, and/or adverse environmental impacts

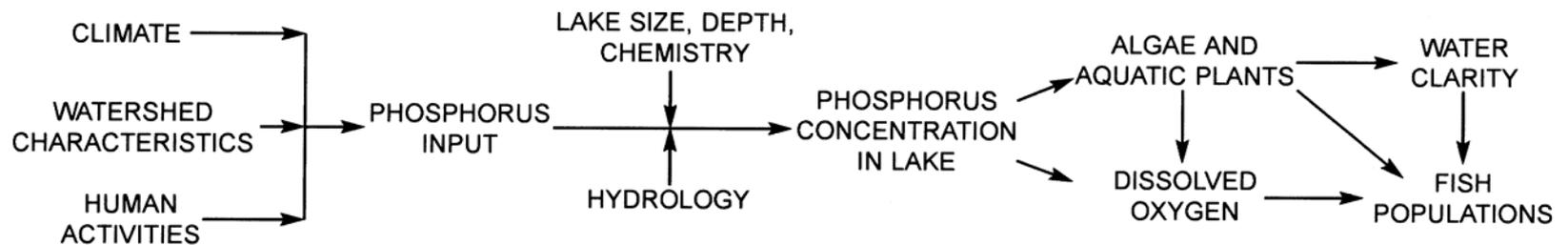
Recommendations: Recreational Carrying Capacity

- Keyhole or funnel development controls
- Watercraft control ordinances
- Information and education



Environmental Carrying Capacity

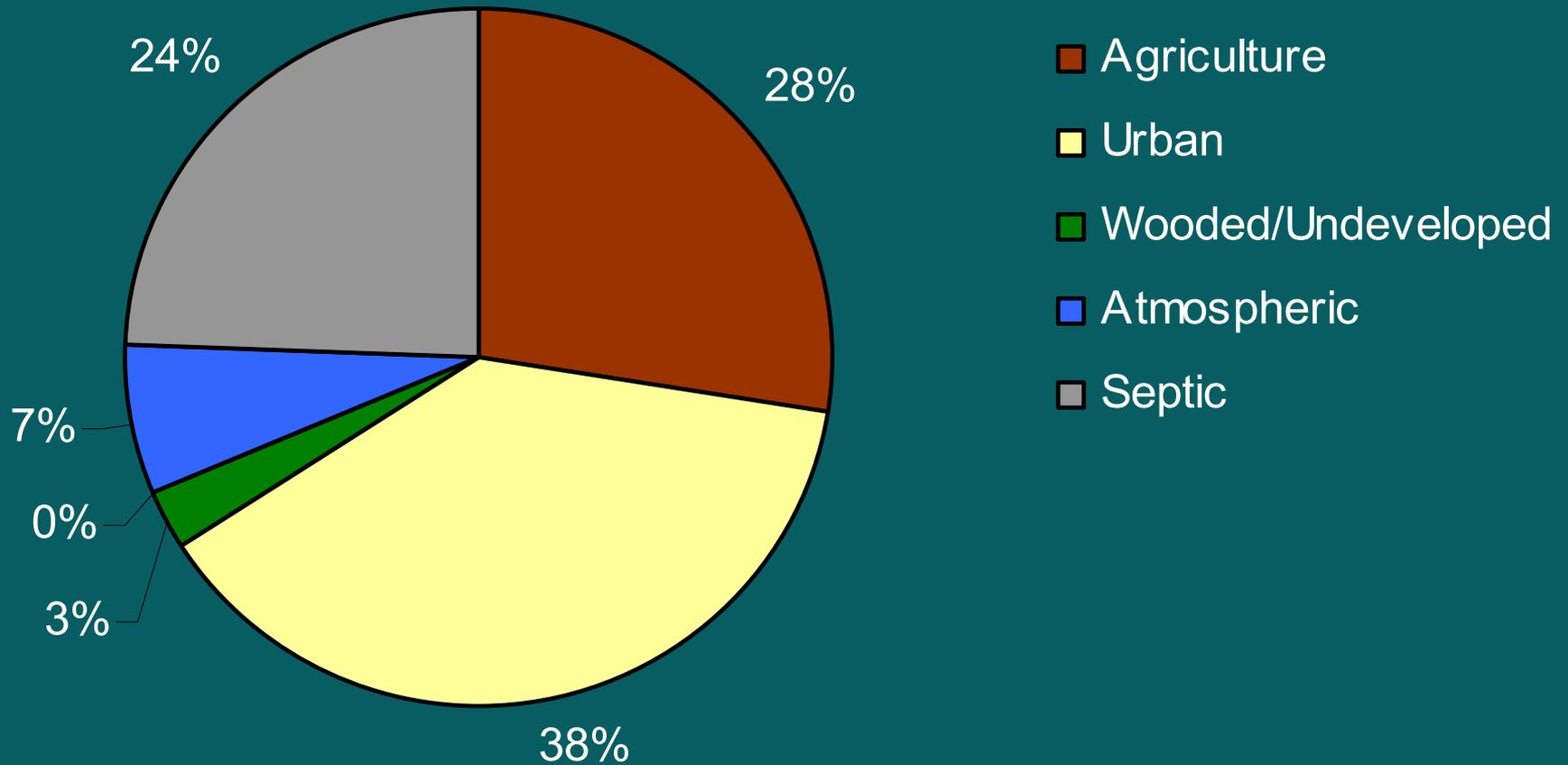
- Phosphorus is the nutrient that most often stimulates excessive growth of aquatic plants and algae, leading to a variety of problems collectively known as eutrophication



Little Long Lake Environmental Carrying Capacity

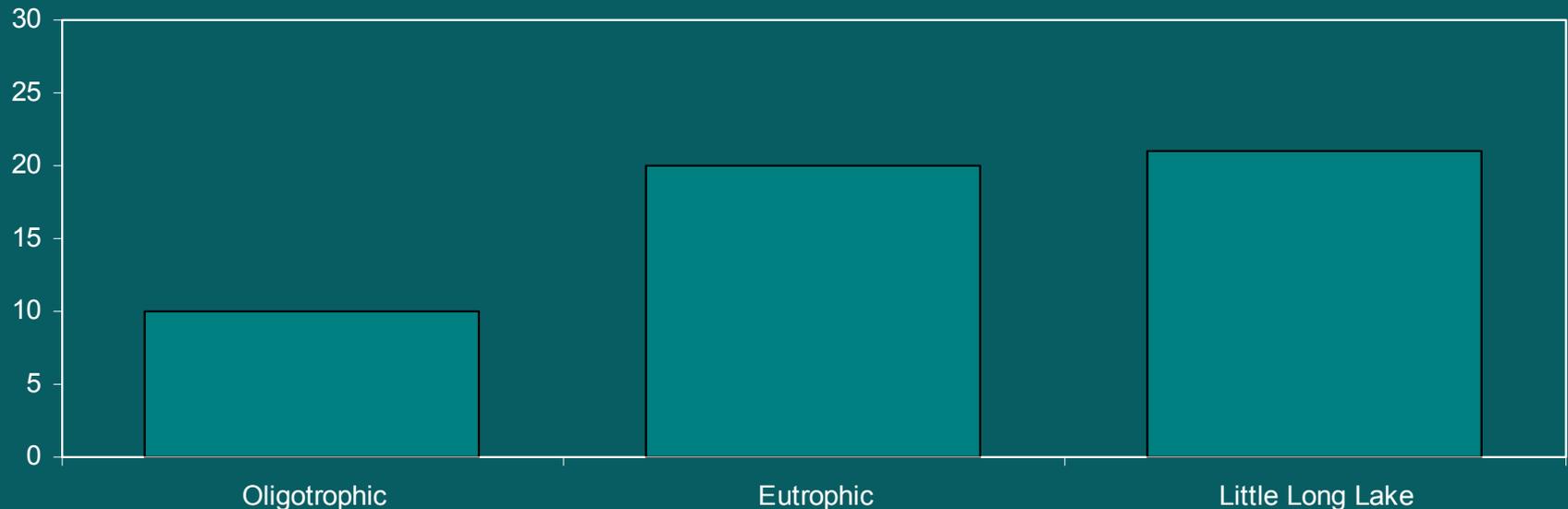
Source	Area (acre)	Phosphorus Loading Values (lbs/acre/yr)	Phosph. Load (lbs/yr)	% of Total Load
Agriculture	1,101	0.1	110	28%
Residential	192	0.8	154	38%
Wooded/Undeveloped	225	0.05	11	3%
Wetland	115	0	0	0%
Atmospheric	170	0.165	28	7%
<u>Septic</u>			97	24%
Total	1,633		400	100%

Estimated Total Phosphorus Loadings to Little Long Lake



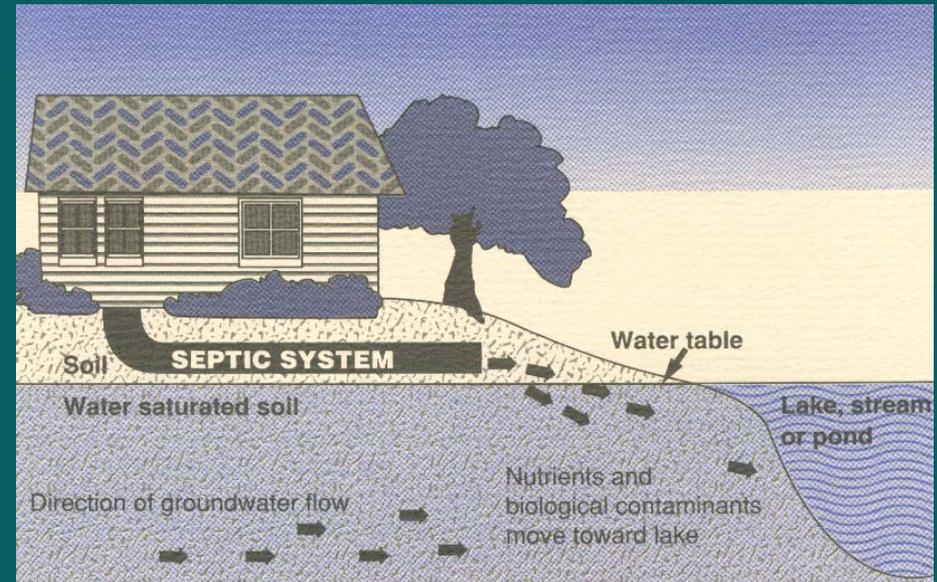
Lake Sensitivity

- Based on an annual phosphorus input of 400 pounds, the projected in-lake phosphorus concentration is 21 parts per billion—a concentration slightly above the eutrophic threshold concentration of 20 parts per billion.



Recommendations: Environmental Carrying Capacity

- Existing development: Lakeside landscaping and septic system maintenance

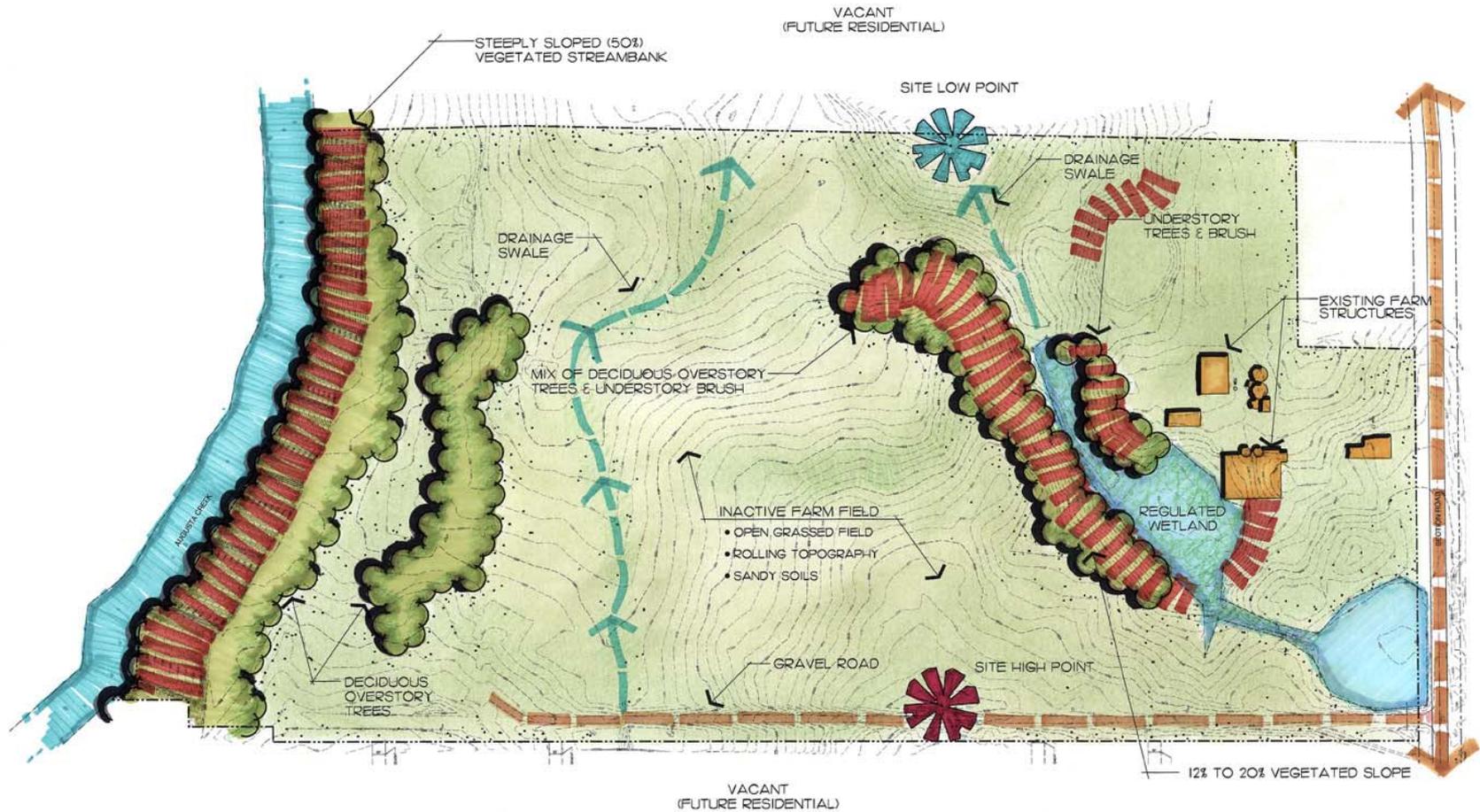


Recommendations: Environmental Carrying Capacity

- Future development:
 - Wetland protection
 - Shoreland overlay zoning
 - Open space development
 - Low impact development

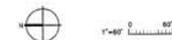


Site Analysis



SITE ANALYSIS PLAN

LOW IMPACT DEVELOPMENT PLANNING

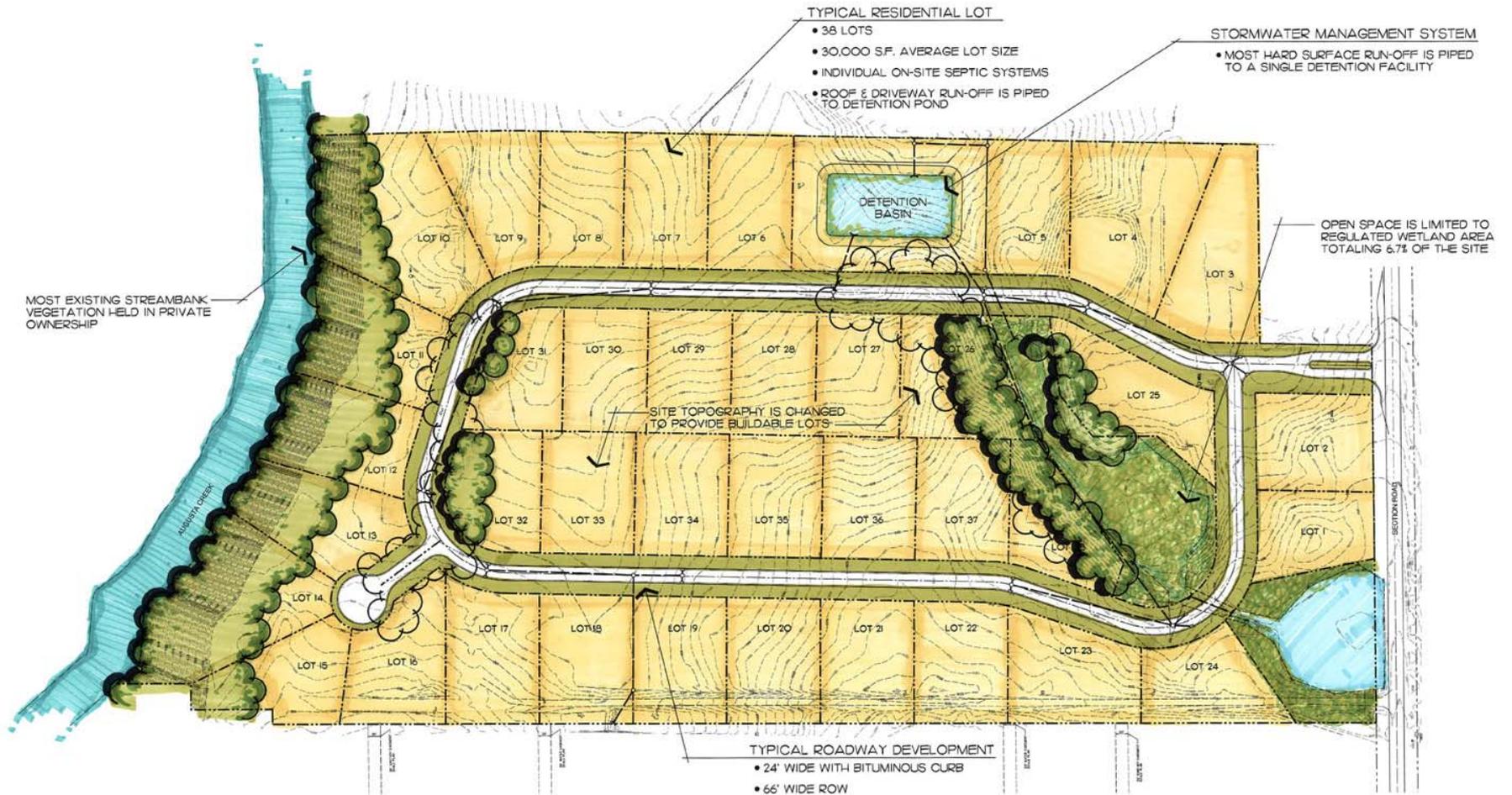


ProgressiveAE

LSI
Landscape
Institute
of
Savannah, Inc.



Conventional Development



CONVENTIONAL PLAN

LOW IMPACT DEVELOPMENT PLANNING



ProgressiveAE

LSI
Landscape
Spatial
Innovations, Inc.



Low Impact Development



LOW IMPACT DEVELOPMENT PLAN

LOW IMPACT DEVELOPMENT PLANNING



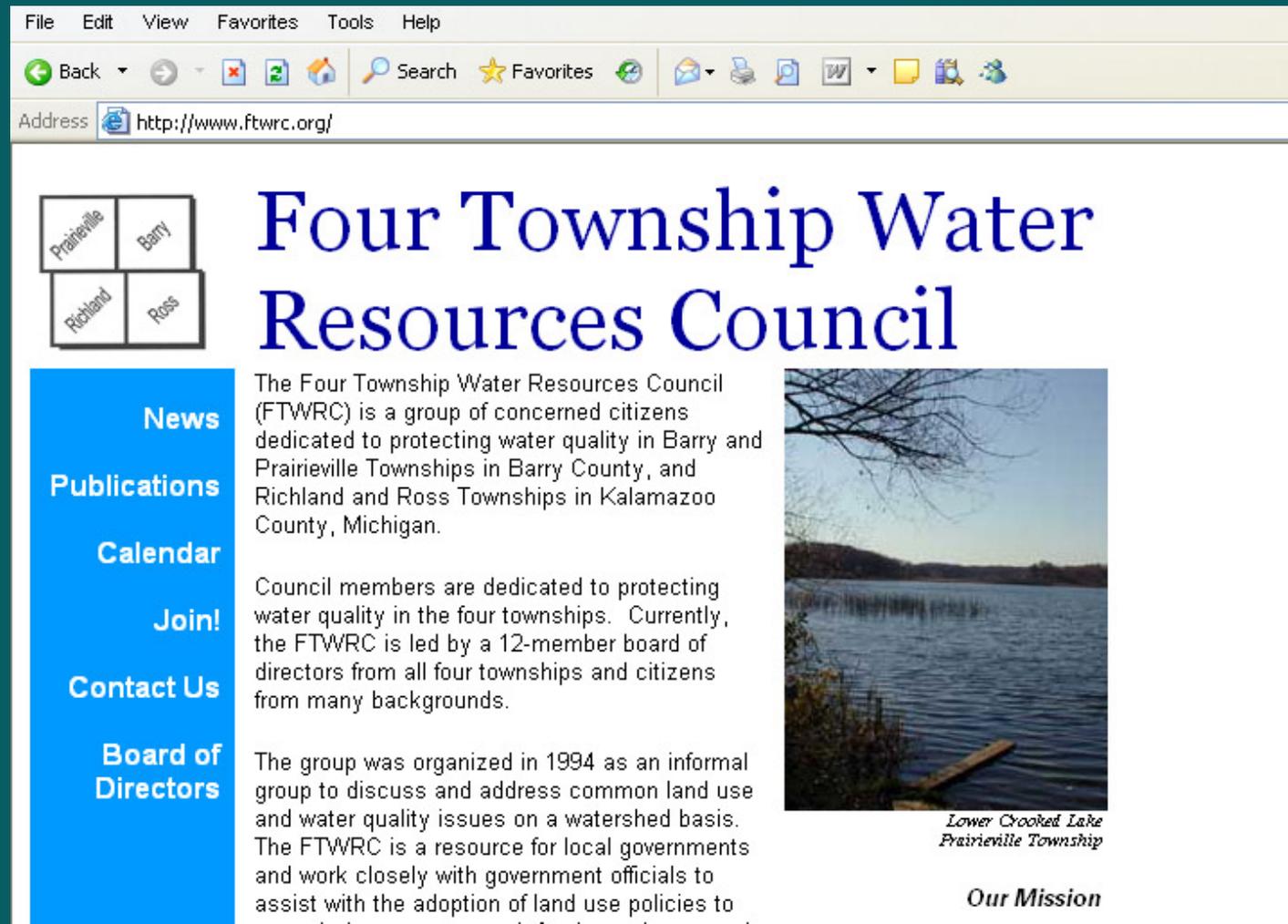
Conventional vs. Low Impact Development

	<u>Conventional Layout</u>	<u>LID Layout</u>	<u>% Change</u>
Impervious Surface:			
Road Area (s.f.):	93,706	97,952	
Roof Area (s.f.):	60,800	0*	↓
Total Area (s.f.):	154,506	97,952	↓ 36.6%
Stormwater Management Infrastructure:			
Storm Sewer Pipe (l.f.):	3,753	1,486	↓ 60.4%
Drainage Structures:	39	13	↓ 66.7%
Open Space Preservation:	6.7%	32.7%	↑ ~5X

*No roof top runoff is calculated since it is conveyed to infiltration trenches at the rear of the properties.

For More Information . . .

- Visit the Council's web site: www.ftwrc.org



The screenshot shows a web browser window with the address bar displaying <http://www.ftwrc.org/>. The website features a navigation menu on the left with links for News, Publications, Calendar, Join!, Contact Us, and Board of Directors. The main content area includes a logo for the Four Township Water Resources Council, a description of the council's mission, and a photograph of Lower Crooked Lake in Prairieville Township.

Four Township Water Resources Council

The Four Township Water Resources Council (FTWRC) is a group of concerned citizens dedicated to protecting water quality in Barry and Prairieville Townships in Barry County, and Richland and Ross Townships in Kalamazoo County, Michigan.

Council members are dedicated to protecting water quality in the four townships. Currently, the FTWRC is led by a 12-member board of directors from all four townships and citizens from many backgrounds.

The group was organized in 1994 as an informal group to discuss and address common land use and water quality issues on a watershed basis. The FTWRC is a resource for local governments and work closely with government officials to assist with the adoption of land use policies to

*Lower Crooked Lake
Prairieville Township*

Our Mission