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Lake and watershed
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WATER QUALITY INVESTIGATORS

November 1996

INDIAN LAKE EAST AND WEST, OAKLAND COUNTY, MICHIGAN

Because there are many aspects of Indian Lake that were not studied, this discussion is based on the data available. Missing information may lead to completely different conclusions than those stated below.

Indian Lake consists of two basins, a 37-acre, 63-foot-deep moderately hard, kettle, west basin and a 36-acre 10-foot-deep man-made moderately hard water man-made east basin. The lake is located in Section 31, Addison Township (T5N R11E) and Section 6, Oakland Township (T4N R11E) Oakland County, Michigan.

The west basin contains 789 acre- feet of water and has a mean depth of 21 feet. The east basin contains 149 acre-feet of water, and has a mean depth of 5 feet.

The west basin has .69 acres of islands, while the east basin has 6.37 acres of islands. The surface area of water in the west basin is 36.69 acres, while the surface area of water in the east basin is 29.66 acres.

The shoreline length of the west basin is 7264 feet, not including the island shorelines, while the shoreline length of the east basin is 9648 feet, not including the island shorelines.

The longitude of the 63-foot-deep hole in the west basin is 42° 47.934N and the latitude is 83° 12.587W. These data were not determined for the east basin.

The elevation of the lakes is 992 feet above sea level and is regulated by a dam with approximately an 11-foot head on the east side of the east basin. The lakes are shown on the Lake Orion U.S.G.S. topographic map. Water from the outlet flows into nearby Prince Lake, which is 11 feet lower than Indian Lake, then into the Graham Lakes and into the west branch of Stony Creek, which joins the Clinton River above Rochester.

TEMPERATURE AND DISSOLVED OXYGEN

In summer, the surface temperature of the west basin was 25°C. A 20-foot-thick thermocline (defined as a change in temperature of more than 1°C per meter of depth) was present from 11 to 31 feet. The lake ran out of dissolved oxygen at 20 feet and remained that way to the bottom at 63 feet. The depth area (hypsographic) graph shows only about 15 percent of the lake is deeper than 20 feet, hence about 85 percent of the lake had some dissolved oxygen present all year round.

In summer, the surface temperature of the east basin was also 25°C and because of the shallow maximum depth (10 feet) no thermocline formed. Hence this basin had adequate supplies of dissolved oxygen top to bottom through the entire lake all year round.

CHLOROPHYLL A

The chlorophyll a data indicates the west basin had a larger algal bloom in spring than in summer, while the chlorophyll a data from the east basin (which was a lot more variable) indicated little change between spring and summer.

SECCHI DISK DEPTHS

Gary Gunterman took Secchi disk readings through the summer months. Although he took readings at three stations in each basin, we averaged those readings because there was little difference in the data in each basin. The Secchi disk data shows more variation in the west basin, ranging from a low of 7 feet in May to a maximum of 16 feet in late June. In late summer they pretty much remained at eight to ten feet.

The Secchi disk data for the east basin indicates a fairly flat curve, ranging from 6 to eight feet all summer long. Because this basin is fairly shallow, it is unknown if these data are representative, or if the visibility of the disk was hindered by the aquatic plants, which were plentiful in this area.

TOTAL NITRATE NITROGEN

The nitrate nitrogen data indicates both basins of the lake were nitrogen limited in both spring and summer. This means no lawn fertilizers containing either nitrogen (which if added will cause additional problems in the lakes) or phosphorus (which because it's an element, will pretty much remain in the lakes) should be used in the near-lake areas.

TOTAL ALKALINITY

The total alkalinity data indicates both lakes are moderately hard water lakes (rather than soft water lakes).

Hard water lakes are tougher than soft water lakes and able to withstand more environmental insults.

For some (unknown) reason the water the east basin had higher alkalinities than the water in the west basin. This is unexpected, since water generally appears to flow from the west basin to the east basin before flowing out of the lakes, and since the east basin had a lot more aquatic plants than the west basin. Aquatic plants often remove carbon dioxide from the carbonates in the water (carbonates are what the alkalinity test measures) lowering the amount of carbonates, and hence the alkalinity of the water. I would expect a lower alkalinity in the east basin, when compared to the west basin, and yet the data indicated just the opposite. What may be occurring is the east basin may be receiving water from other sources. Since the shape and size of the watershed was not available, we are unable to determine if this is occurring.

pH (HYDROGEN ION CONCENTRATION)

pH values, ranging from 7.5 to 8.2, were low and normal for a southeast Michigan inland lake in both spring and summer. Given the amount of aquatic plants in the east basin, they should have been higher, especially in summer.

CONDUCTIVITY

Conductivity measurements, ranging from 310 to 390 μ mhos/cm in spring, and 435-460 μ mhos/cm in summer, were normal. Conductivity is a good measure of the amount of salts in the water, and these data indicated the salt concentration was about the same as most other southeast Michigan inland lakes.

TOTAL PHOSPHORUS

Spring total phosphorus concentrations in the west basin averaged 16 micrograms per liter, while they averaged 26 micrograms per liter in the east basin.

Summer total phosphorus concentrations in the west basin averaged 11 micrograms per liter, and 32 micrograms per liter in the east basin.

Again this is unusual. Because of the direction of water flow, and the large number of aquatic plants in the east basin, the phosphorus concentrations should have been lower in the east basin compared to the west basin, yet they were considerably higher. This again indicates there may be an additional source of water flowing into the lakes which we are unaware of.

Lakes don't generally go from a low phosphorus concentration to a higher phosphorus concentration, especially if the

water goes from a situation where there are few plants to one where there are lots of plants, because aquatic plants can be fairly effective at removing phosphorus from the water column, hence reducing it.

THE LAKE WATER QUALITY INDEX

The Lake Water Quality Index (LWQI), which rates the water quality of lakes about the same way professors rates students (90-100=A, and anything below 60=E) averages 88 in the west basin in spring and 87 in the east basin. Hence there is little difference in the water quality of the two basins in spring.

In summer, the LWQI averaged 90 in the west basin and 84 in the east basin. In summer the west basin has better water quality than the east basin, although the difference is not large.

THE AQUATIC PLANT COMMUNITY

The aquatic plant community of both basins included a healthy mix of aquatic plants, with essentially no monoculture. In the west basin, aquatic plants did not seem to cause serious problems with lake use, and with the exception of the south end (see map), few aquatic plant controls should be used.

The aquatic plants found in varying amounts in both basins of Indian Lake were:

Coontail (*Ceratophyllum demersum*)
Wild celery (*Vallisneria americana*)
Yellow water lily (*Nuphar variegata*)
White water lily (*Nymphaea odorata*)
Pickerelweed (*Pontederia cordata*)
Floating leaf pondweed (*Potamogeton natans*)
Illinois pondweed (*Potamogeton illinoensis*)
Bladderwort (*Utricularia vulgaris*)
Native milfoils (*Myriophyllum verticillatum* or *M. exalbescent*)
Narrow leaf pondweeds (either *Potamogeton pectinatus* or *P. filiformis*)
Cattails (*Typha* sp.)
Nitella sp. (an alga)

In the east basin, there were more aquatic plants (see map). Even so, a good portion of this shallow basin was still open and usable.

Ideally, the two basins of the lake could be used for two different purposes. The west basin could be used for activities such as power boating, swimming, water skiing, and sailing, while the east basin could be used for quieter activities such as fishing, canoeing, paddle boating, etc.

It would probably be a better use of money to enlarge the culvert between the east and west basins, which would allow easier boat access and permit these different types of uses to occur rather than try to make the east basin like the west basin.

There are a couple of reasons for this recommendation. The first is you will spend a lot of money, and the second is no matter what you do, you won't be able to make the east basin like the west basin. It's a lot easier, cheaper and more effective if you recognize the differences between the two basins, and then use of available monies to insure all residents have access to both basins.

AQUATIC PLANT CONTROL

If some aquatic plant control is desirable, here are my recommendations.

WEED HARVESTING

In my opinion, removing aquatic plants with a mechanical harvester is by far the best method of getting rid of them. This is because no chemicals (which I feel generally hurts lakes), are used and the plant mass is actually removed from the water. This helps remove some of the material which would have accumulated in the bottom sediments, causing undesirable anaerobic conditions to occur as they decompose.

Because the east basin was created by a dam, many times the area flooded is filled with stumps, preventing a weed harvester from operating. If this is the case, and if the level of the lake can be lowered, it should be lowered during the winter months, and any stumps sticking out of the ice cut off as low as possible.

AQUATIC HERBICIDES

As noted above, I generally try to discourage the use of aquatic herbicides because I feel they actually hurt lakes, in that I think the water quality and bottom sediments deteriorate with their use.

However, if aquatic herbicides are used, they should be used in minimum amounts to do the job you want them to do, and applied a person knowledgeable in their use. Someone in your association might consider taking the test and becoming a licensed applicator. If you do this, you'll cut your costs by about two thirds, and you'll have a better handle on applications and costs. This is because the more herbicides the herbicide applicators apply, the more money they make, so in my opinion there is little incentive to use the smallest amounts necessary.

I do not recommend the use of copper compounds to control algal blooms, which often occur after herbicide applications. There are several reasons for this. First, the improvement in water clarity is very short, generally less than a week, and then the algae comes back even worse than before. The reason for this is when the algae die, they settle to the bottom, but the nutrients they contained are released into the water. Since the light can now penetrate further down in the water than it did before, you'll get more algae than you had before copper compounds were used.

Second, the copper does not decompose. It stays in the bottom sediments. If in the future you want to dredge the lake, the copper compounds will be considered a hazardous material, and so the expenses involving the disposal of dredge spoils will skyrocket.

Third, based on experiments here in the lab, water with algae treated with copper compounds remains turbid even after six months, with no zooplankters, and the sand bottom sediments are black and anaerobic a half inch below the surface. The control, although covered with a floating algal layer, remains clear underneath with many zooplankton swimming about; and the bottom sediments look good,

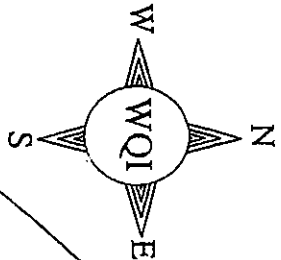
Fourth, copper compounds are toxic to many forms of aquatic life, including mollusks and fish.

THE GRASS CARP

If (or when) the grass carp, a fish that eats aquatic plants, is approved for use in Michigan (as it has in at least 34 other states) its use to control aquatic plants in Indian Lake is recommended.

ADDITIONAL RECOMMENDATIONS

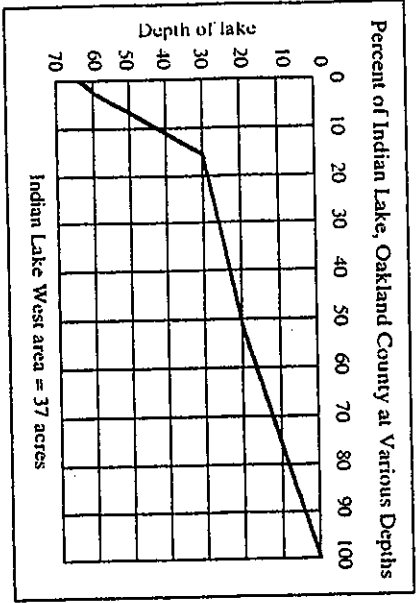
- Indian Lake should continue to take Secchi disk readings through the summer months every year. In the future, these data will prove extremely useful.
- Indian Lake should have at least two more years of water quality testing to provide a reasonable data set against which future data can be compared.
- The watershed of Indian Lake needs to be mapped.
- The bottom sediments of both basins should be analyzed to determine the amount of organic material in them. That was supposed to be done this year, but was not.
- If herbicides are used to kill aquatic plants, samples for algal determination should be collected 2-3 weeks after the herbicides are applied.



○ Sample stations

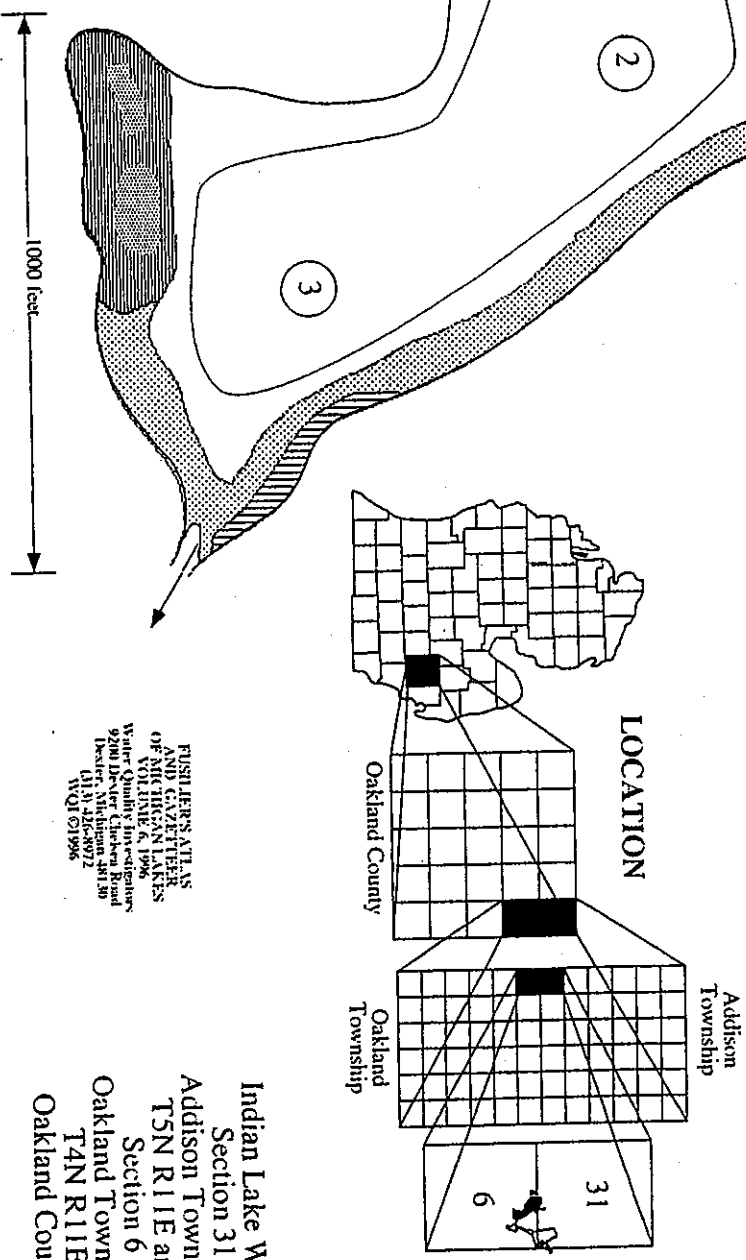
Hydrographic map
(Contours for limnological purposes only)

Islands

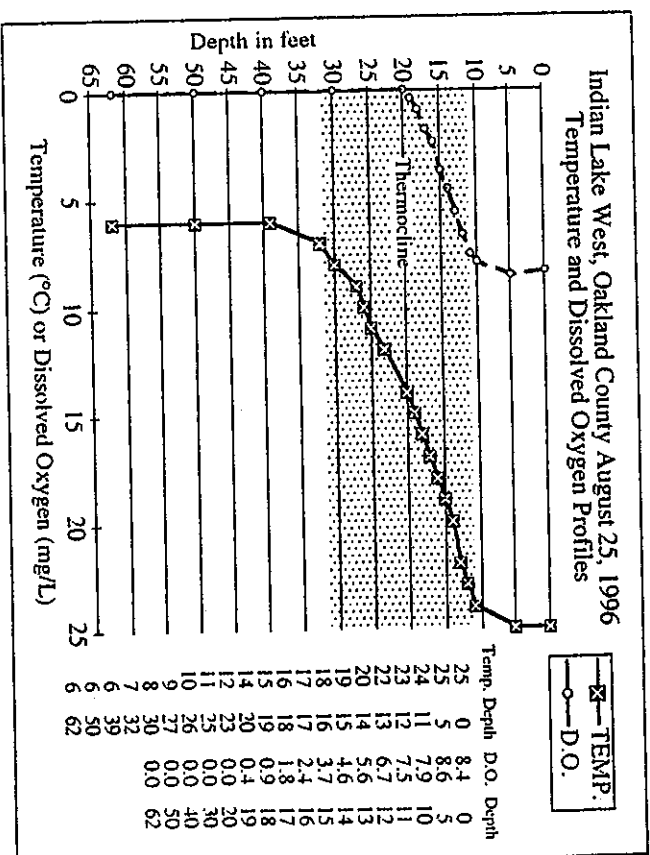
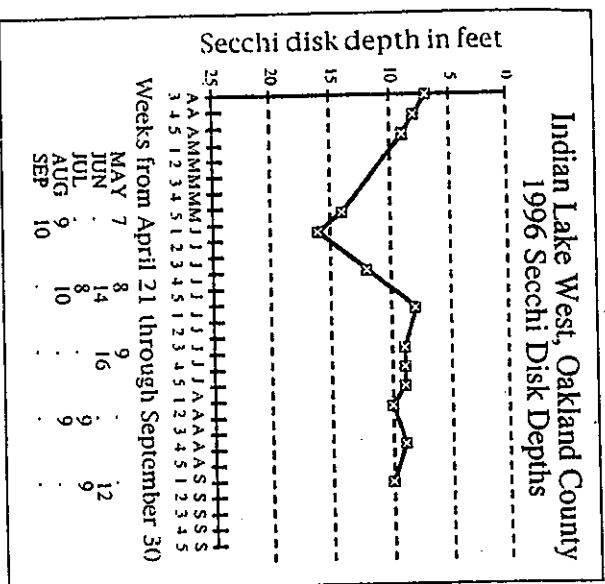


- Aquatic plants**
- Water lilies & pondweeds
 - Coonail, pondweeds & native milfoil
 - Cattails
 - Pondweeds, nitella & pickerel weed
 - Native milfoil, bladderwort, pondweeds, nitella, water lilies & bladderwort

Indian Lake West Contour Areas And Volumes	
Area of various contours	Volume in Acre feet
Lake area = 37.38 acres	559
Island area = .69 acres	126
Surface area = 36.69 acres	50
20 feet = 19.25 acres	33
30 feet = 5.87 acres	19
40 feet = 4.03 acres	2
50 feet = 2.59 acres	
60-63 feet = 1.26 acres	
Lake volume = 789 acre feet	



FUSHER'S ATLAS
AND GAZETTEER
OF MICHIGAN LAKES
OF VOLUME 6, 1996
Water Quality Institute
9200 Lakeview Drive
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WQI ©1996



FISHER'S ATLAS
AND GAZETTEER
OF MICHIGAN LAKES
VOLUME 6, 1996
Water Quality Investigations
9200 Dexter Clineken Road
Denver, Michigan 48130
(313) 426-8972
WQI 6/1996

Indian Lake West
Section 31
Addison Township
T5N R11E and
Section 6
Oakland Township
T4N R11E
Oakland County

TABLE OF LAKE DATA

Lake name:	Indian Lake West
County:	Oakland
U.S.G.S. Map:	Lake Orion
Type of lake:	Natural with dam
River basin:	Clinton
Lake area (acres):	37
Maximum depth (feet):	63
Mean depth (feet):	21
Lake volume (acre feet):	789
Shoreline length (feet):	7264
Watershed area (acres):	Unknown
Drainage area (acres):	Unknown
Watershed to lake ratio:	Unknown
Flushing rate:	Unknown
Elevation:	992
Longest dimension (feet):	2271
Ice out date:	Unknown
Dike like mixed:	Unknown
Spring LWQI:	87.88
Summer LWQI:	91.90
Bottom Sediments, % mineral:	Unknown
Latitude:	42° 47.934'N
Longitude:	83° 12.587'W
Official lake monitor:	Gary Gunterman

Surface Lake Water Quality Data

Date	Sample Station Number	Temperature (°C)	Dissolved Oxygen (mg/L)	Chlorophyll a (µg/L)	Secchi Disk Depth (feet)	Total Nitrate (mg/L)	Ammonia Nitrate (mg/L)	pH	Conductivity (µmhos/cm at 25°C)	Total Phosphorus (µg/L)	Lake Water Quality Index	Grade
4/21/96	1	---	---	4.4	7	46	117	7.7	370	13	87	B
4/21/96	2	---	---	3.4	7	35	126	7.5	370	16	88	B
4/21/96	3	---	---	3.4	7	35	126	7.6	390	20	88	B
8/25/96	1	25	8.4	1.3	8	5	139	8.2	460	11	91	A
8/25/96	2	25	8.6	2.3	9	4	136	8.2	450	11	90	A
8/25/96	3	25	8.6	102	---	4	165	7.6	460	14	---	A
8/25/96	Inlet	---	---	---	---	---	---	---	---	---	---	---

A drainage area map does not exist.
Long term Secchi disk data does not exist.

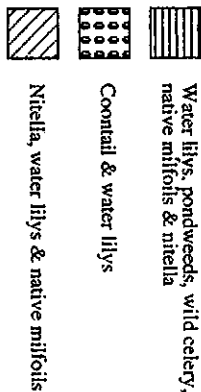
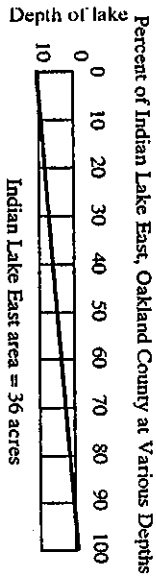
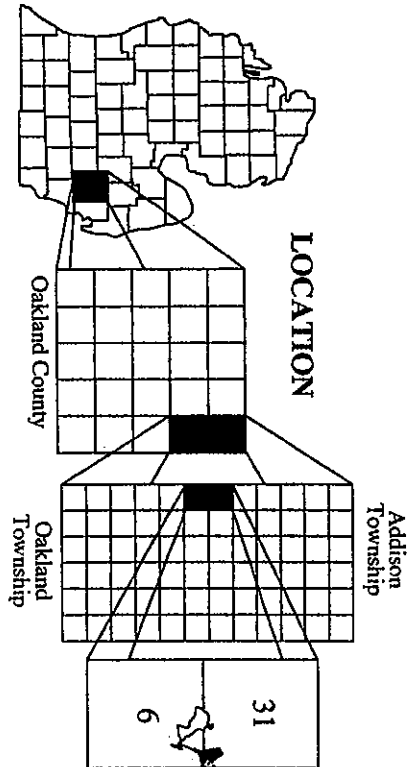
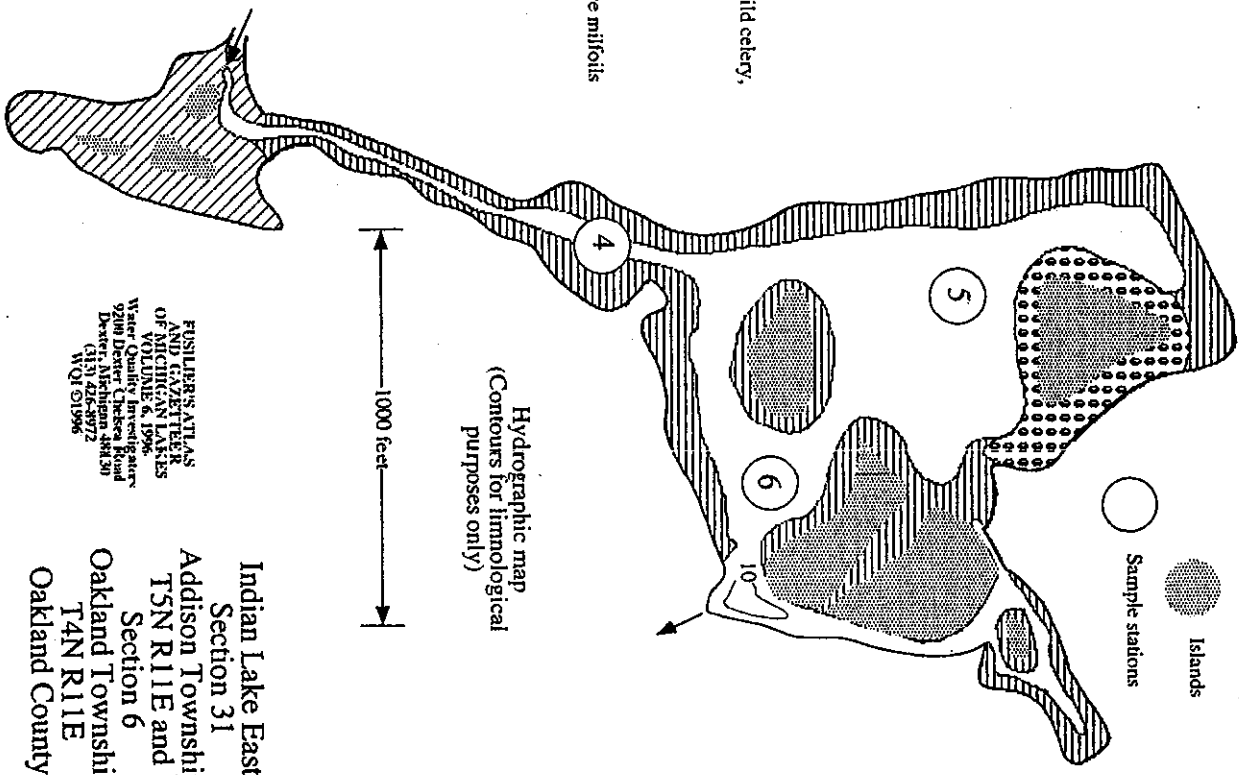


TABLE OF LAKE DATA

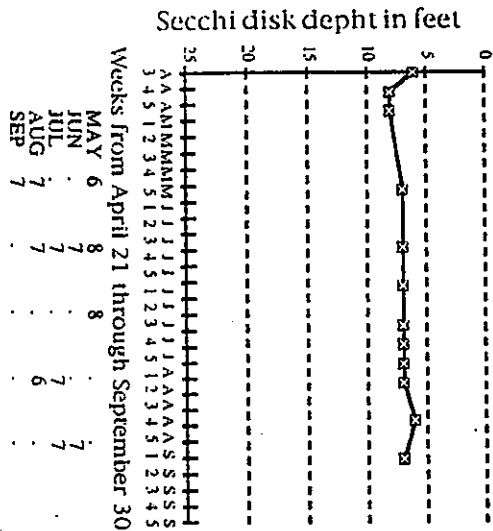
Lake name	Indian Lake East
County	Oakland
U.S.G.S. Map	Lake Oton
Type of lake	Natural with dam
River basin	Clinton
Lake area (acres)	36
Maximum depth (feet)	10
Mean depth (feet)	5
Lake volume (acre feet)	149
Shoreline length (feet)	9648
Watershed area (acres)	Unknown
Drainage area (acres)	Unknown
Watershed to lake ratio	Unknown
Flushing rate	Unknown
Elevation	992
Longest dimension (feet)	3141
Ice out date	Unknown
Date lake mixed	Unknown
Spring LWOL	85 88 89
Summer LWOL	86 88 86
Bottom Sediments, % mineral	Unknown
Latitude	42° 47.934N
Longitude	83° 12.587W
Official lake monitor	Gary Gunterman

Indian Lake Contour Areas And Volumes

Area of various contours	Volume in Acre Feet
East basin area = 36.03 acres	
Islands = 6.37 acres	
Surface area = 29.66 acres	149
10 feet = .19 acres	
East basin volume = 149 acre feet	



Indian Lake East, Oakland County 1996 Secchi Disk Depths



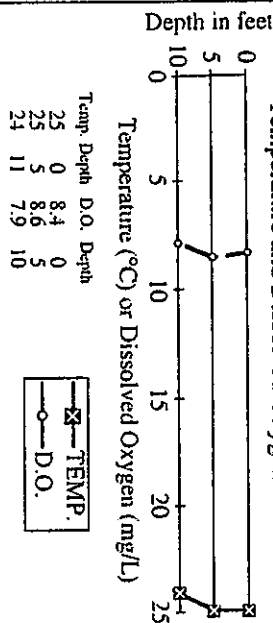
A drainage area map does not exist.

Long term Secchi disk data does not exist.

Indian Lake East
Section 31
Addison Township
T5N R11E and
Section 6
Oakland Township
T4N R11E
Oakland County

FOOTPRINTS ATLAS
AND INTERVIEW
OF RESIDENTS IN LAKES
OF VOLUNTARY 6, 1996
Water Quality Investigations
9200 Dexter Chertea Road
Dexter, Michigan 48130
G13 426-8072
M01 01596

Indian Lake East, Oakland County August 25, 1996 Temperature and Dissolved Oxygen Profiles



Surface Lake Water Quality Data

Date	Sample Station Number	Temperature °C	Dissolved Oxygen (mg/L)	Percent Saturation	Chlorophyll a (µg/L)	Secchi Depth (feet)	Total Nitrogen (µg/L)	Alkalinity (mg/L)	pH	Conductivity (µmhos/cm)	Total Phosphorus (µg/L)	Lake Water Quality Index	Grade
4/21/96	4	---	---	---	3.4	6	7	104	7.8	320	40	85	B
4/21/96	5	---	---	---	2.6	5	5	102	7.8	310	17	88	B
4/21/96	6	---	---	---	2.6	6	5	108	7.9	340	20	89	B
8/25/96	4	27	8.7	109	1.6	6	8	140	8.0	435	30	86	B
8/25/96	5	26	10.1	123	5.1	6	4	143	8.1	440	33	80	B
8/25/96	6	26	8.1	99	2.8	7	4	143	8.0	440	33	86	B