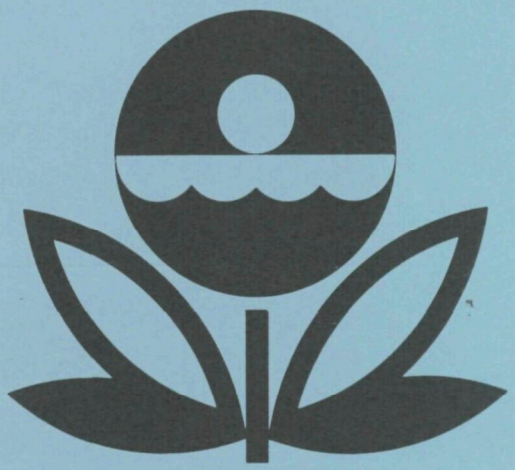
# U.S. ENVIRONMENTAL PROTECTION AGENCY
# NATIONAL EUTROPHICATION SURVEY

## WORKING PAPER SERIES



REPORT

ON

WHITE LAKE

MUSKEGON COUNTY

MICHIGAN

EPA REGION V

WORKING PAPER No. 217

**PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY**

**An Associate Laboratory of the**

**NATIONAL ENVIRONMENTAL RESEARCH CENTER - CORVALLIS, OREGON**

**and**

**NATIONAL ENVIRONMENTAL RESEARCH CENTER - LAS VEGAS, NEVADA**

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# ON
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# EPA REGION V
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**204**

WITH THE COOPERATION OF THE
MICHIGAN DEPARTMENT OF NATURAL RESOURCES
AND THE
MICHIGAN NATIONAL GUARD
MARCH, 1975

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# F O R E W O R D

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nation-wide threat of accelerated eutrophication to fresh water lakes and reservoirs.

## OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

## ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

## LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Michigan Department of Natural Resources for professional involvement and to the Michigan National Guard for conducting the tributary sampling phase of the Survey.

A. Gene Gazlay, former Director, and David H. Jenkins, Acting Director, Michigan Department of Natural Resources; and Carlos Fetterolf, Chief Environmental Scientist, and Dennis Tierney, Aquatic Biologist, Bureau of Water Management, Department of Natural Resources, provided invaluable lake documentation and counsel during the course of the Survey. John Vogt, Chief of the Bureau of Environmental Health, Michigan Department of Public Health, and his staff were most helpful in identifying point sources and soliciting municipal participation in the Survey.

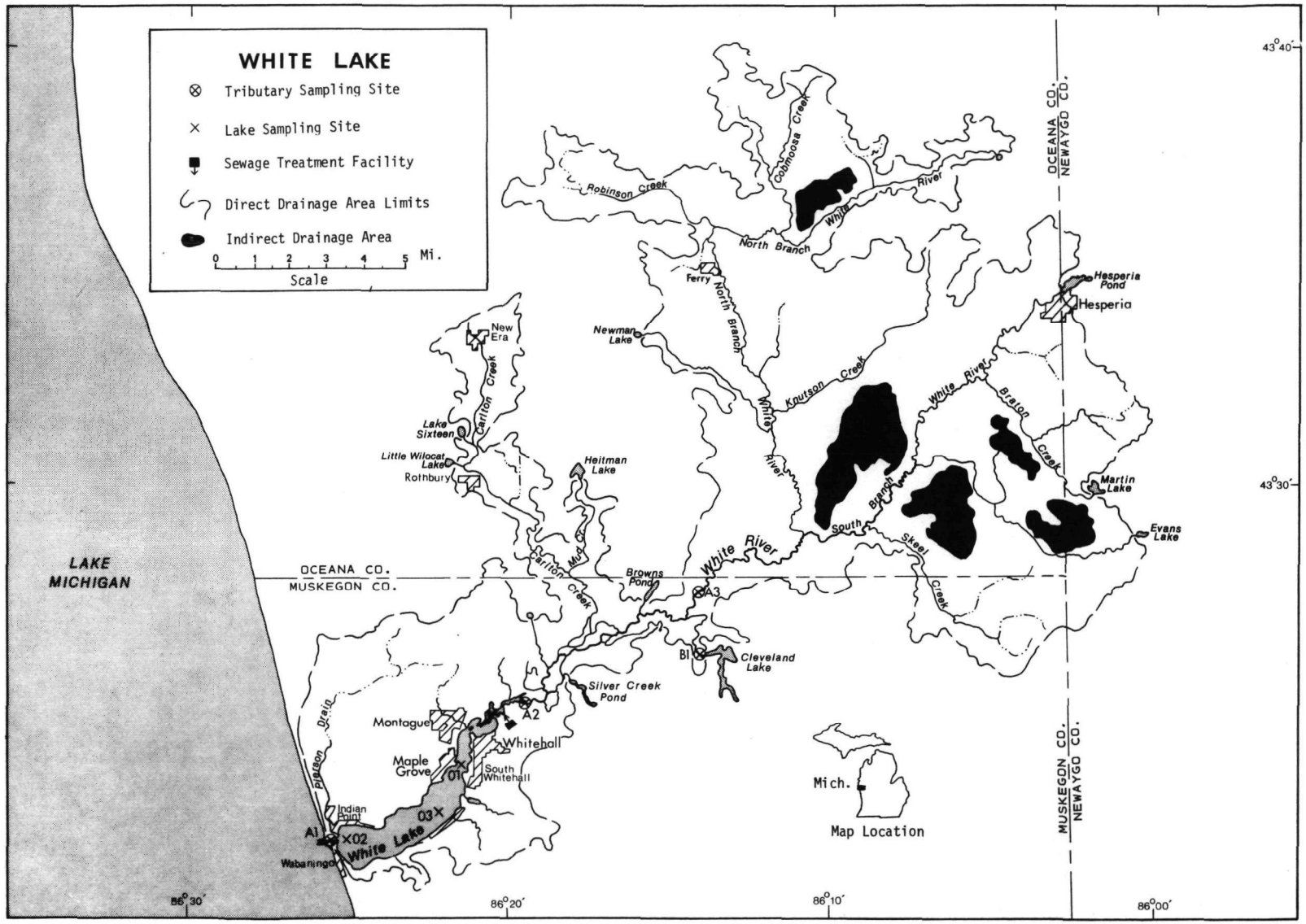
Major General Clarence A. Schnipke (Retired), then the Adjutant General of Michigan, and Project Officer Colonel Albert W. Lesky, who directed the volunteer efforts of the Michigan National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MICHIGAN

| LAKE NAME | COUNTY |
|---|---|
| Allegan Res. | Allegan |
| Barton | Kalamazoo |
| Belleville | Wayne |
| Betsie | Benzie |
| Brighton | Livingston |
| Caro Res. | Tuscola |
| Charlevoix | Charlevoix |
| Chemung | Livingston |
| Constantine Res. | St. Joseph |
| Crystal | Montcalm |
| Deer | Marquette |
| Ford | Washtenaw |
| Fremont | Newago |
| Higgins | Roscommon |
| Holloway Res. | Genesee, Lapeer |
| Houghton | Roscommon |
| Jordon | Ionia, Barry |
| Kent | Oakland |
| Long | St. Joseph |
| Macatawa | Ottawa |
| Manistee | Manistee |
| Mona | Muskegon |
| Muskegon | Muskegon |
| Pentwater | Oceana |
| Pere Marquette | Mason |
| Portage | Houghton |
| Randall | Branch |
| Rogers Pond | Mecosta |
| Ross | Gladwin |
| St. Louis Res. | Gratiot |
| Sanford | Midland |
| Strawberry | Livingston |
| Thompson | Livingston |
| Thornapple | Barry |
| Union | Branch |
| White | Muskegon |


WHITE LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Direct Drainage Area Limits
Indirect Drainage Area
0 1 2 3 4 5 Mi.
Scale
LAKE MICHIGAN
OCEANA CO.
MUSKEGON CO.
OCEANA CO.
NEWAYGO CO.
MUSKEGON CO.
NEWAYGO CO.
43°40′
43°30′
86°30′
86°20′
86°10′
86°00′
Robinson Creek
Cobmoosa Creek
White River
North Branch
Ferry
North Branch
White River
Hesperia Pond
Hesperia
New Era
Carlton Creek
Newman Lake
Lake Sixteen
Little Wilocat Lake
Rothbury
Heitman Lake
Knutson Creek
White River
Braton Creek
Martin Lake
Evans Lake
South Branch
Skeel Creek
Mud Creek
Carlton Creek
Browns Pond
White River
A3
B1
Cleveland Lake
Silver Creek Pond
A2
Montague
Whitehall
Maple Grove
South Whitehall
01
Indian Point
03
A1
02
White Lake
Wabaningo
Pigeon Creek
Mich.
Map Location

WHITE LAKE

STORET NO. 2688

# I. CONCLUSIONS

## A. Trophic Condition:

Survey data and the records of others (Robinson et al., 1967) show that White Lake is eutrophic. Of the 35 Michigan lakes sampled in November when essentially all were well-mixed, nine had less mean total phosphorus, 12 had less mean dissolved phosphorus, and 11 had less mean inorganic nitrogen; of all 41 lakes sampled, six had greater Secchi disc transparency, and eight had less mean chlorophyll a*. Marked depression of dissolved oxygen at and below 27 feet occurred at stations 2 and 3 in September, 1972.

Ketelle and Uttormark (1971) reported that excessive algal and aquatic weed growths occur regularly in White Lake.

## B. Rate-Limiting Nutrient:

There was a significant loss of phosphorus in the algal assay sample, and the results are not representative of conditions in the lake at the time the sample was taken. The lake data indicate nitrogen limitation in June and September but phosphorus limitation in November.

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* See Appendix A.

C. Nutrient Controllability:

1. Point sources--During the sampling year, White Lake received a total phosphorus load at a rate about 1.5 times the rate proposed by Vollenweider (in press) as "dangerous"; i.e., a eutrophic rate (see page 11). However, White Lake has a relatively short mean hydraulic retention time of 56 days, and Vollenweider's model may not be applicable.

The City of Whitehall no longer impacts White Lake, and the other point sources considered in this report either have or soon will terminate their discharges (Bastian, 1974).

It is calculated that elimination of these discharges will reduce the phosphorus loading rate to 14.6 lbs/acre/yr or 1.64 $g/m^2/yr$. While this rate will still exceed the eutrophic rate, in view of the short hydraulic retention time and the questionable applicability of Vollenweider's model, it is believed the lower loading rate will at least reduce the incidence and severity of nuisance algal blooms as well as provide additional protection for Lake Michigan.

2. Non-point sources (see page 11)--During the sampling year, the phosphorus export of the White River was somewhat high as compared to the exports of Michigan streams studied elsewhere. This relatively high export and the export N/P ratio indicate a possible point source in the drainage beyond the 25-mile limit of the Survey*.

* See Working Paper No. 1, "Survey Methods, 1972".

## II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

### A. Lake Morphometry†:

1. Surface area: 2,571 acres.
2. Mean depth: 22.5 feet.
3. Maximum depth: 70+ feet.
4. Volume: 57,940 acre-feet.
5. Mean hydraulic retention time: 56 days.

### B. Tributary and Outlet:
(See Appendix B for flow data)

1. Tributaries -

| Name | Drainage area* | Mean flow* |
|---|---|---|
| White River | 481.0 $mi^2$ | 495.1 cfs |
| Minor tributaries & immediate drainage - | 24.0 $mi^2$ | 27.2 cfs |
| Totals | 505.0 $mi^2$ | 522.3 cfs |

2. Outlet -

| | | |
|---|---|---|
| White River | 509.0 $mi^2$** | 522.3 cfs |

### C. Precipitation***:

1. Year of sampling: 31.0 inches.
2. Mean annual: 31.4 inches.

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† Robinson, Cosens, & Mills, 1967.
* Drainage areas are accurate within ±5%; mean daily flows for 74% of the drainage areas are accurate within ±25% and the remaining sites up to ±40%; and mean monthly flows, normalized mean monthly flows, and mean annual flows are slightly more accurate than mean daily flows.
** Includes area of lake.
*** See Working Paper No. 1, "Survey Methods, 1972".

## III. LAKE WATER QUALITY SUMMARY

White Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from two or more depths at each station (see map, page v). During each visit, a single depth-integrated (15 feet to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the second visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 21 feet at station 1, 54 feet at station 2, and 34 feet at station 3.

The results obtained are presented in full in Appendix C, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix C.

A. Physical and chemical characteristics:

| Parameter | Minimum | Mean | Median | Maximum |
|---|---|---|---|---|
| | | FALL VALUES (11/14/72) | | |
| Temperature (Cent.) | 6.9 | 7.0 | 7.0 | 7.1 |
| Dissolved oxygen (mg/l) | 10.2 | 10.3 | 10.4 | 10.4 |
| Conductivity (μmhos) | 460 | 471 | 470 | 480 |
| pH (units) | 7.8 | 7.9 | 7.9 | 7.9 |
| Alkalinity (mg/l) | 131 | 135 | 135 | 138 |
| Total P (mg/l) | 0.026 | 0.027 | 0.027 | 0.031 |
| Dissolved P (mg/l) | 0.018 | 0.019 | 0.019 | 0.021 |
| $NO_2$ + $NO_3$ (mg/l) | 0.130 | 0.141 | 0.140 | 0.160 |
| Ammonia (mg/l) | 0.210 | 0.226 | 0.230 | 0.230 |
| | | ALL VALUES | | |
| Secchi disc (inches) | 60 | 82 | 72 | 108 |

B. Biological characteristics:

1. Phytoplankton* -

| Sampling Date | Dominant Genera | Number per ml |
|---|---|---|
| 09/18/72 | 1. Fragilaria | 1,135 |
| | 2. Melosira | 961 |
| | 3. Anabaena | 376 |
| | 4. Flagellates | 202 |
| | 5. Microcystis | 103 |
| | Other genera | 629 |
| | Total | 3,406 |
| 11/14/72 | 1. Melosira | 1,092 |
| | 2. Fragilaria | 678 |
| | 3. Synedra | 527 |
| | 4. Aphanothece | 282 |
| | 5. Cyclotella | 282 |
| | Other genera | 1,715 |
| | Total | 4,576 |

* The June sample was lost in shipment.

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

| Sampling Date | Station Number | Chlorophyll a (µg/l) |
|---|---|---|
| 06/13/72 | 01 | 15.5 |
| | 02 | 18.9 |
| | 03 | 14.8 |
| 09/18/72 | 01 | 6.9 |
| | 02 | 16.0 |
| | 03 | 7.2 |
| 11/14/72 | 01 | 1.2 |
| | 02 | 1.2 |
| | 03 | 1.2 |

C. Limiting Nutrient Study:

More than half of the dissolved phosphorus in the algal assay sample was lost between the time of collection and the beginning of the assay, and the results are not representative of conditions in the lake at the time the sample was collected (09/18/72).

The lake data indicate nitrogen limitation in June and September (N/P ratios were 10/1) but phosphorus limitation in November (N/P = 19/1).

## IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the Michigan National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the months of April and June, when two samples were collected, and November when samples were omitted. Sampling was begun in October, 1972, and was completed in September, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Michigan District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for the White River were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the mean concentrations in Cleveland Creek at station B-1 and the mean ZZ flow.

The operation of the Whitehall primary wastewater treatment plant was discontinued in July, 1973, when the Whitehall/Montague land disposal system became operative; however, only two effluent samples were submitted for analysis during the 10-month operating period of the plant. Therefore, the nutrient loads attributed to the Whitehall STP

* See Working Paper No. 1.

were estimated at 2.5 lbs P and 7.5 lbs N/capita/year and were adjusted for the ten months of operation during the sampling year.

The Whitehall Leather Company and Hooker Chemical Company continued discharging to White Lake throughout the sampling year. Reportedly (Robinson, Cosens, & Mills, 1967), the Whitehall Leather Company discharges about three pounds of total phosphorus and 193 pounds of inorganic nitrogen daily, while the Hooker Chemical Company discharges about one pound of total phosphorus per day and essentially no inorganic nitrogen. These values were used to estimate the annual loads from these sources.

A. Waste Sources:

1. Known municipal† -

| Name | Pop. Served | Treatment | Mean Flow (mgd) | Receiving Water |
|---|---|---|---|---|
| Whitehall | 3,017* | land disp. | 0.431** | None |

2. Known industrial*** -

| Name | Product | Treatment | Mean Flow (mgd) | Receiving Water |
|---|---|---|---|---|
| Hooker Chem. Co. | chems. | ? | 9.200 | White Lake |
| Whitehall Leather Co. | leather | ? | 1.190 | White Lake |

* 1970 Census.
** Based on limited flow data provided by operator.
*** Robinson, Cosens, & Mills, 1967.
† Wetzel, 1973.

B. Annual Total Phosphorus Loading - Sampling Year:

1. Inputs -

| Source | lbs P/ yr | % of total |
|---|---|---|
| a. Tributaries (non-point load) - | | |
| White River | 36,520 | 80.5 |
| b. Minor tributaries & immediate drainage (non-point load) - | 480 | 1.1 |
| c. Known municipal STP's - | | |
| Whitehall (10 mos.) | 6,290 | 13.9 |
| d. Septic tanks* - | 230 | 0.5 |
| e. Known industrial - | | |
| Hooker Chemical Company | 360 | 0.8 |
| Whitehall Leather Company | 1,100 | 2.4 |
| f. Direct precipitation** - | 400 | 0.8 |
| Total | 45,380 | 100.0 |

2. Outputs -

Lake outlet - White River 35,230

3. Net annual P accumulation - 10,150 pounds

* Estimate based on 375 lakeshore dwellings; see Working Paper No. 1.
** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Sampling Year:

1. Inputs -

| Source | lbs N/ yr | % of total |
|---|---|---|
| a. Tributaries (non-point load) - | | |
| White River | 851,020 | 83.7 |
| b. Minor tributaries & immediate drainage (non-point load) - | 35,390 | 6.4 |
| c. Known municipal STP's - | | |
| Whitehall (10 mos.) | 18,860 | 1.5 |
| d. Septic tanks* - | 8,810 | 0.7 |
| e. Known industrial - | | |
| Hooker Chemical Company | - | - |
| Whitehall Leather Company | 70,440 | 5.7 |
| f. Direct precipitation** - | 24,770 | 2.0 |
| Total | 1,009,290 | 100.0 |

2. Outputs -

Lake outlet - White River 802,730

3. Net annual N accumulation - 206,560 pounds

* Estimate based on 375 lakeshore dwellings; see Working Paper No. 1.
** See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

| Tributary | lbs P/mi$^2$/yr | lbs N/mi$^2$/yr |
|---|---|---|
| White River | 76 | 1,769 |

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with very short hydraulic retention times.

| | Total Phosphorus | | Total Nitrogen | |
|---|---|---|---|---|
| Units | Total | Accumulated | Total | Accumulated |
| lbs/acre/yr | 17.7 | 3.9 | 392.6 | 80.3 |
| grams/m$^2$/yr | 1.98 | 0.44 | 44.0 | 9.0 |

Vollenweider loading rates for phosphorus (g/m$^2$/yr) based on mean depth and mean hydraulic retention time of White Lake:

| | |
|---|---|
| "Dangerous" (eutrophic rate) | 1.28 |
| "Permissible" (oligotrophic rate) | 0.64 |

## V. LITERATURE REVIEWED

Bastian, Robert K., 1974. Personal communication (Muskegon County wastewater management systems). EPA Proj. Support Off., Muskegon.

Ketelle, Martha J., and Paul D. Uttormark, 1971. Problem lakes of the United States. EPA Water Poll. Contr. Res. Ser., Proj. 16010 EHR.

Robinson, John, John Cosens, and Blanchard Mills; 1967. White Lake nutrient survey, Muskegon County. MI Dept. Nat. Resources, Lansing.

Vollenweider, Richard A. (in press). Input-output models. Schweiz. Z. Hydrol.

Wetzel, Michael, 1973. Treatment plant questionnaire (Whitehall STP). MI Dept. Nat. Resources, Lansing.

# VI. APPENDICES

## APPENDIX A

## LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

| LAKE CODE | LAKE NAME | FALL VALUES: MEAN TOTAL P | FALL VALUES: MEAN DISS P | FALL VALUES: MEAN INORG N | ALL VALUES: 500- MEAN SEC | ALL VALUES: MEAN CHLORA | ALL VALUES: 15- MIN DO |
|---|---|---|---|---|---|---|---|
| 26A0 | HOLLOWAY RESERVOIR | 0.062 | 0.043 | 1.461 | 439.375 | 10.678 | 9.200 |
| 26A1 | CARO RESERVOIR | 0.117 | 0.022 | 3.835 | 473.000 | 11.967 | 9.500 |
| 26A2 | BOARDMAN HYDRO POND | 0.006 | 0.005 | 0.358 | 363.500 | 1.267 | 6.600 |
| 2603 | ALLEGAN LAKE | 0.123 | 0.057 | 1.168 | 470.222 | 20.311 | 12.600 |
| 2606 | BARTON LAKE | 0.121 | 0.086 | 1.489 | 456.167 | 27.800 | 14.850 |
| 2609 | BELLEVILLE LAKE | 0.118 | 0.048 | 1.420 | 465.250 | 28.262 | 8.200 |
| 2610 | BETSIE LAKE | 0.025 | 0.008 | 0.273 | 461.667 | 4.567 | 7.400 |
| 2613 | BRIGHTON LAKE | 0.109 | 0.073 | 1.015 | 456.000 | 44.233 | 7.500 |
| 2617 | LAKE CHARLEVOIX | 0.007 | 0.006 | 0.230 | 351.250 | 3.008 | 9.240 |
| 2618 | LAKE CHEMUNG | 0.044 | 0.014 | 0.132 | 404.333 | 13.483 | 14.800 |
| 2621 | CONSTANTINE RESERVOIR | 0.027 | 0.008 | 0.910 | 456.167 | 39.317 | 7.500 |
| 2629 | FORD LAKE | 0.105 | 0.058 | 1.536 | 456.167 | 14.733 | 14.000 |
| 2631 | FREMONT LAKE | 0.372 | 0.342 | 1.406 | 441.667 | 28.500 | 14.800 |
| 2640 | JORDAN LAKE | 0.180 | 0.144 | 1.998 | 427.667 | 20.517 | 14.900 |
| 2643 | KENT LAKE | 0.040 | 0.015 | 0.417 | 455.000 | 33.944 | 13.000 |
| 2648 | LAKE MACATAWA | 0.197 | 0.120 | 2.358 | 477.600 | 25.600 | 12.200 |
| 2649 | MANISTEE LAKE | 0.018 | 0.010 | 0.304 | 451.333 | 6.317 | 11.380 |
| 2659 | MUSKEGON LAKE | 0.087 | 0.043 | 0.469 | 436.444 | 9.511 | 14.800 |
| 2665 | PENTWATER LAKE | 0.027 | 0.017 | 0.496 | 430.667 | 16.083 | 14.800 |
| 2671 | RANDALL LAKE | 0.246 | 0.183 | 0.818 | 457.333 | 27.217 | 8.020 |
| 2672 | ROGERS POND | 0.026 | 0.015 | 0.183 | 435.500 | 8.133 | 9.600 |
| 2673 | ROSS RESERVOIR | 0.034 | 0.021 | 0.460 | 465.333 | 10.383 | 8.200 |
| 2674 | SANFORD LAKE | 0.016 | 0.008 | 0.307 | 458.750 | 13.791 | 8.300 |
| 2683 | THORNAPPLE LAKE | 0.042 | 0.032 | 1.737 | 442.833 | 14.650 | 10.800 |
| 2685 | UNION LAKE | 0.083 | 0.064 | 1.252 | 455.500 | 15.667 | 8.200 |
| 2688 | WHITE LAKE | 0.027 | 0.019 | 0.367 | 417.778 | 9.211 | 13.400 |
| 2691 | MONA LAKE | 0.307 | 0.241 | 0.963 | 451.667 | 27.783 | 14.100 |
| 2692 | LONG LAKE | 0.163 | 0.148 | 0.749 | 418.400 | 10.067 | 13.600 |

LAKE DATA TO BE USED IN RANKINGS

| LAKE CODE | LAKE NAME | FALL VALUES: MEAN TOTAL P | FALL VALUES: MEAN DISS P | FALL VALUES: MEAN INORG N | ALL VALUES: 500-MEAN SEC | ALL VALUES: MEAN CHLORA | ALL VALUES: 15-MIN DO |
|---|---|---|---|---|---|---|---|
| 2693 | ST LOUIS RESERVOIR | 0.134 | 0.093 | 1.227 | 462.667 | 5.583 | 8.420 |
| 2694 | CRYSTAL LAKE | 0.009 | 0.006 | 0.164 | 380.000 | 2.986 | 13.000 |
| 2695 | HIGGINS LAKE | 0.007 | 0.005 | 0.058 | 268.500 | 1.043 | 9.400 |
| 2696 | HOUGHTON LAKE | 0.018 | 0.008 | 0.136 | 420.833 | 9.217 | 8.200 |
| 2697 | THOMPSON LAKE | 0.043 | 0.029 | 0.436 | 407.889 | 11.967 | 14.800 |
| 2698 | PERE MARQUETTE LAKE | 0.032 | 0.024 | 0.346 | 448.667 | 11.833 | 8.600 |
| 2699 | STRAWBERRY LAKE | 0.069 | 0.050 | 0.567 | 419.800 | 11.117 | 13.600 |

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

| LAKE CODE | LAKE NAME | FALL VALUES: MEAN TOTAL P | FALL VALUES: MEAN DISS P | FALL VALUES: MEAN INORG N | ALL VALUES: 500- MEAN SEC | ALL VALUES: MEAN CHLORA | ALL VALUES: 15- MIN DO | INDEX NO |
|---|---|---|---|---|---|---|---|---|
| 26A0 | HOLLOWAY RESERVOIR | 46 ( 16) | 43 ( 15) | 17 ( 6) | 57 ( 20) | 60 ( 21) | 63 ( 22) | 286 |
| 26A1 | CARO RESERVOIR | 29 ( 10) | 54 ( 19) | 0 ( 0) | 3 ( 1) | 49 ( 17) | 54 ( 19) | 189 |
| 26A2 | BOARDMAN HYDRO POND | 97 ( 34) | 97 ( 34) | 69 ( 24) | 91 ( 32) | 94 ( 33) | 97 ( 34) | 545 |
| 2603 | ALLEGAN LAKE | 20 ( 7) | 31 ( 11) | 31 ( 11) | 6 ( 2) | 29 ( 10) | 40 ( 14) | 157 |
| 2606 | BARTON LAKE | 23 ( 8) | 20 ( 7) | 14 ( 5) | 29 ( 9) | 14 ( 5) | 3 ( 1) | 103 |
| 2609 | BELLEVILLE LAKE | 26 ( 9) | 37 ( 13) | 20 ( 7) | 11 ( 4) | 11 ( 4) | 79 ( 26) | 184 |
| 2610 | BETSIE LAKE | 77 ( 27) | 77 ( 27) | 80 ( 28) | 17 ( 6) | 86 ( 30) | 94 ( 33) | 431 |
| 2613 | BRIGHTON LAKE | 31 ( 11) | 23 ( 8) | 34 ( 12) | 34 ( 12) | 0 ( 0) | 90 ( 31) | 212 |
| 2617 | LAKE CHARLEVOIX | 91 ( 32) | 91 ( 32) | 83 ( 29) | 94 ( 33) | 89 ( 31) | 60 ( 21) | 508 |
| 2618 | LAKE CHEMUNG | 49 ( 17) | 71 ( 25) | 94 ( 33) | 86 ( 30) | 46 ( 16) | 11 ( 2) | 357 |
| 2621 | CONSTANTINE RESERVOIR | 71 ( 25) | 83 ( 29) | 40 ( 14) | 29 ( 9) | 3 ( 1) | 90 ( 31) | 316 |
| 2629 | FORD LAKE | 34 ( 12) | 29 ( 10) | 11 ( 4) | 29 ( 9) | 37 ( 13) | 23 ( 8) | 163 |
| 2631 | FREMONT LAKE | 0 ( 0) | 0 ( 0) | 23 ( 8) | 54 ( 19) | 9 ( 3) | 11 ( 2) | 97 |
| 2640 | JORDAN LAKE | 11 ( 4) | 11 ( 4) | 6 ( 2) | 69 ( 24) | 26 ( 9) | 0 ( 0) | 123 |
| 2643 | KENT LAKE | 57 ( 20) | 69 ( 24) | 63 ( 22) | 40 ( 14) | 6 ( 2) | 36 ( 12) | 271 |
| 2648 | LAKE MACATAWA | 9 ( 3) | 14 ( 5) | 3 ( 1) | 0 ( 0) | 23 ( 8) | 43 ( 15) | 92 |
| 2649 | MANISTEE LAKE | 80 ( 28) | 74 ( 26) | 77 ( 27) | 46 ( 16) | 80 ( 28) | 46 ( 16) | 403 |
| 2659 | MUSKEGON LAKE | 37 ( 13) | 40 ( 14) | 54 ( 19) | 60 ( 21) | 69 ( 24) | 11 ( 2) | 271 |
| 2665 | PENTWATER LAKE | 69 ( 24) | 63 ( 22) | 51 ( 18) | 66 ( 23) | 31 ( 11) | 11 ( 2) | 291 |
| 2671 | RANDALL LAKE | 6 ( 2) | 6 ( 2) | 43 ( 15) | 23 ( 8) | 20 ( 7) | 86 ( 30) | 184 |
| 2672 | ROGERS POND | 74 ( 26) | 66 ( 23) | 86 ( 30) | 63 ( 22) | 77 ( 27) | 51 ( 18) | 417 |
| 2673 | ROSS RESERVOIR | 60 ( 21) | 57 ( 20) | 57 ( 20) | 9 ( 3) | 63 ( 22) | 79 ( 26) | 325 |
| 2674 | SANFORD LAKE | 86 ( 30) | 80 ( 28) | 74 ( 26) | 20 ( 7) | 43 ( 15) | 71 ( 25) | 374 |
| 2683 | THORNAPPLE LAKE | 54 ( 19) | 46 ( 16) | 9 ( 3) | 51 ( 18) | 40 ( 14) | 49 ( 17) | 249 |
| 2685 | UNION LAKE | 40 ( 14) | 26 ( 9) | 26 ( 9) | 37 ( 13) | 34 ( 12) | 79 ( 26) | 242 |
| 2688 | WHITE LAKE | 66 ( 23) | 60 ( 21) | 66 ( 23) | 80 ( 28) | 74 ( 26) | 31 ( 11) | 377 |
| 2691 | MONA LAKE | 3 ( 1) | 3 ( 1) | 37 ( 13) | 43 ( 15) | 17 ( 6) | 20 ( 7) | 123 |
| 2692 | LONG LAKE | 14 ( 5) | 9 ( 3) | 46 ( 16) | 77 ( 27) | 66 ( 23) | 27 ( 9) | 239 |

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

| LAKE CODE | LAKE NAME | FALL VALUES: MEAN TOTAL P | FALL VALUES: MEAN DISS P | FALL VALUES: MEAN INORG N | ALL VALUES: 500-MEAN SEC | ALL VALUES: MEAN CHLORA | ALL VALUES: 15-MIN DO | INDEX NO |
|---|---|---|---|---|---|---|---|---|
| 2693 | ST LOUIS RESERVOIR | 17 ( 6) | 17 ( 6) | 29 ( 10) | 14 ( 5) | 83 ( 29) | 69 ( 24) | 229 |
| 2694 | CRYSTAL LAKE | 89 ( 31) | 89 ( 31) | 89 ( 31) | 89 ( 31) | 91 ( 32) | 36 ( 12) | 483 |
| 2695 | HIGGINS LAKE | 94 ( 33) | 94 ( 33) | 97 ( 34) | 97 ( 34) | 97 ( 34) | 57 ( 20) | 536 |
| 2696 | HOUGHTON LAKE | 83 ( 29) | 86 ( 30) | 91 ( 32) | 71 ( 25) | 71 ( 25) | 79 ( 26) | 481 |
| 2697 | THOMPSON LAKE | 51 ( 18) | 49 ( 17) | 60 ( 21) | 83 ( 29) | 51 ( 18) | 11 ( 2) | 305 |
| 2698 | PERE MARQUETTE LAKE | 63 ( 22) | 51 ( 18) | 71 ( 25) | 49 ( 17) | 54 ( 19) | 66 ( 23) | 354 |
| 2699 | STRAWBERRY LAKE | 43 ( 15) | 34 ( 12) | 49 ( 17) | 74 ( 26) | 57 ( 20) | 27 ( 9) | 284 |

# APPENDIX B

# TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MICHIGAN 2/3/75

LAKE CODE 2688 WHITE LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ MI) 509.00

| TRIBUTARY | SUB-DRAINAGE AREA(SQ MI) | NORMALIZED FLOWS(CFS) JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2688A1 | 509.00 | 502.41 | 502.41 | 712.25 | 879.72 | 623.46 | 449.95 | 354.10 | 359.15 | 412.62 | 430.78 | 533.68 | 510.48 | 522.24 |
| 2688A2 | 481.00 | 472.00 | 472.00 | 669.00 | 827.00 | 585.00 | 423.00 | 333.00 | 338.00 | 387.00 | 405.00 | 502.00 | 531.00 | 495.09 |
| 2688ZZ | 28.00 | 26.00 | 26.00 | 37.00 | 45.00 | 33.00 | 23.00 | 18.00 | 18.00 | 22.00 | 22.00 | 27.00 | 29.00 | 27.15 |

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 509.00
SUM OF SUB-DRAINAGE AREAS = 509.00
TOTAL FLOW IN = 6270.00
TOTAL FLOW OUT = 6271.00

MEAN MONTHLY FLOWS AND DAILY FLOWS(CFS)

| TRIBUTARY | MONTH | YEAR | MEAN FLOW | DAY | FLOW | DAY | FLOW | DAY | FLOW |
|---|---|---|---|---|---|---|---|---|---|
| 2688A1 | 10 | 72 | 478.00 | 29 | 728.00 | | | | |
| | 11 | 72 | 497.00 | | | | | | |
| | 12 | 72 | 500.00 | 3 | 458.00 | | | | |
| | 1 | 73 | 859.00 | 7 | 697.00 | | | | |
| | 2 | 73 | 623.00 | 4 | 807.00 | | | | |
| | 3 | 73 | 872.00 | 4 | 1070.00 | | | | |
| | 4 | 73 | 760.00 | 4 | 839.00 | 26 | 838.00 | | |
| | 5 | 73 | 823.00 | 10 | 1180.00 | | | | |
| | 6 | 73 | 582.00 | 5 | 749.00 | 24 | 442.00 | | |
| | 7 | 73 | 377.00 | 10 | 364.00 | 22 | 334.00 | | |
| | 8 | 73 | 343.00 | 25 | 338.00 | | | | |
| | 9 | 73 | 322.00 | 27 | 334.00 | | | | |
| 2688A2 | 10 | 72 | 453.00 | 29 | 690.00 | | | | |
| | 11 | 72 | 471.00 | | | | | | |
| | 12 | 72 | 474.00 | 3 | 434.00 | | | | |
| | 1 | 73 | 814.00 | 7 | 660.00 | | | | |
| | 2 | 73 | 591.00 | 4 | 765.00 | | | | |
| | 3 | 73 | 827.00 | 4 | 1020.00 | | | | |
| | 4 | 73 | 720.00 | 4 | 795.00 | 26 | 794.00 | | |
| | 5 | 73 | 780.00 | 10 | 1120.00 | | | | |
| | 6 | 73 | 551.00 | 5 | 710.00 | 24 | 419.00 | | |
| | 7 | 73 | 357.00 | 10 | 345.00 | 22 | 316.00 | | |
| | 8 | 73 | 325.00 | 25 | 320.00 | | | | |
| | 9 | 73 | 305.00 | 27 | 316.00 | | | | |
| 2688ZZ | 10 | 72 | 25.00 | | | | | | |
| | 11 | 72 | 26.00 | | | | | | |
| | 12 | 72 | 26.00 | | | | | | |
| | 1 | 73 | 45.00 | | | | | | |
| | 2 | 73 | 32.00 | | | | | | |
| | 3 | 73 | 45.00 | | | | | | |
| | 4 | 73 | 40.00 | | | | | | |
| | 5 | 73 | 43.00 | | | | | | |
| | 6 | 73 | 31.00 | | | | | | |
| | 7 | 73 | 20.00 | | | | | | |
| | 8 | 73 | 18.00 | | | | | | |
| | 9 | 73 | 17.00 | | | | | | |

# APPENDIX C

# PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/02/04

268801
43 24 00.0 086 21 30.0
WHITE LAKE
26 MICHIGAN

11EPALES 2111202
5 0020 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00610 NH3-N TOTAL MG/L | 00665 PHOS-TOT MG/L P | 00666 PHOS-DIS MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 72/06/13 | 16 | 35 0000 | 19.4 | 10.7 | 60 | 500 | 8.50 | 147 | 0.050 | 0.110 | 0.044 | 0.031 |
| | 16 | 35 0015 | 18.3 | 9.8 | | 500 | 8.55 | 147 | 0.040 | 0.060 | 0.027 | 0.017 |
| 72/09/18 | 15 | 05 0000 | | | 60 | 400 | 8.90 | 129 | 0.070 | 0.090 | 0.025 | 0.016 |
| | 15 | 05 0004 | 21.2 | 10.4 | | 400 | 8.90 | 128 | 0.060 | 0.060 | 0.025 | 0.012 |
| | 15 | 05 0015 | 19.6 | 7.2 | | 380 | 8.30 | 134 | 0.140 | 0.190 | 0.030 | 0.014 |
| 72/11/14 | 11 | 10 0000 | | | 108 | 480 | 7.90 | 136 | 0.160 | 0.220 | 0.028 | 0.020 |
| | 11 | 10 0004 | 6.9 | 10.2 | | 480 | 7.90 | 136 | 0.160 | 0.230 | 0.027 | 0.021 |
| | 11 | 10 0015 | 6.9 | 10.4 | | 480 | 7.90 | 135 | 0.150 | 0.220 | 0.028 | 0.021 |
| | 11 | 10 0021 | 6.9 | 10.2 | | 480 | 7.90 | 134 | 0.150 | 0.210 | 0.031 | 0.020 |

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 32217 CHLRPHYL A UG/L |
|---|---|---|---|
| 72/06/13 | 16 | 35 0000 | 15.5J |
| 72/09/18 | 15 | 05 0000 | 6.9J |
| 72/11/14 | 11 | 10 0000 | 1.2J |

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 75/02/04

268802
43 22 30.0 085 25 00.0
WHITE LAKE
26 MICHIGAN

11EPALES 2111202
5 0040 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00610 NH3-N TOTAL MG/L | 00665 PHOS-TOT MG/L P | 00666 PHOS-DIS MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 72/06/13 | 17 00 | 0000 | 18.3 | 9.6 | 80 | 470 | 8.55 | 146 | 0.070 | 0.090 | 0.023 | 0.015 |
| | 17 00 | 0015 | 17.6 | 9.7 | | 420 | 8.55 | 146 | 0.050 | 0.080 | 0.017 | 0.010 |
| | 17 00 | 0030 | 12.3 | 6.3 | | 440 | 8.10 | 140 | 0.120 | 0.220 | 0.020 | 0.016 |
| 72/09/18 | 15 45 | 0000 | | | 72 | 400 | 8.90 | 128 | 0.020 | 0.040 | 0.021 | 0.013 |
| | 15 45 | 0004 | 19.3 | 9.4 | | 400 | 8.90 | 128 | 0.020 | 0.030 | 0.019 | 0.012 |
| | 15 45 | 0015 | 19.1 | 8.0 | | 410 | 8.70 | 128 | 0.030 | 0.050 | 0.021 | 0.012 |
| | 15 45 | 0020 | 19.0 | 7.6 | | 420 | 8.65 | 127 | 0.030 | 0.070 | 0.020 | 0.011 |
| | 15 45 | 0026 | 18.9 | 7.4 | | 400 | 8.60 | 125 | 0.040 | 0.100 | 0.022 | 0.014 |
| | 15 45 | 0033 | 17.3 | 2.2 | | 430 | 7.95 | 126 | 0.070 | 0.410 | 0.064 | 0.051 |
| | 15 45 | 0040 | 16.5 | 2.8 | | 400 | 8.00 | 126 | 0.070 | 0.370 | 0.057 | 0.047 |
| | 15 45 | 0047 | 16.4 | 1.6 | | 425 | 7.90 | 126 | 0.070 | 0.430 | 0.097 | 0.061 |
| 72/11/14 | 10 20 | 0000 | | | 108 | 470 | 7.90 | 133 | 0.140 | 0.230 | 0.026 | 0.019 |
| | 10 20 | 0004 | 7.0 | 10.4 | | 470 | 7.90 | 135 | 0.140 | 0.230 | 0.027 | 0.018 |
| | 10 20 | 0015 | 7.0 | 10.4 | | 470 | 7.90 | 135 | 0.140 | 0.220 | 0.028 | 0.018 |
| | 10 20 | 0025 | 7.0 | 10.3 | | 470 | 7.90 | 136 | 0.140 | 0.220 | 0.028 | 0.018 |
| | 10 20 | 0040 | 7.0 | 10.3 | | 480 | 7.90 | 138 | 0.140 | 0.230 | 0.026 | 0.020 |
| | 10 20 | 0054 | 6.9 | 10.4 | | 480 | 7.90 | 138 | 0.140 | 0.230 | 0.028 | 0.018 |

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 32217 CHLRPHYL A UG/L |
|---|---|---|---|
| 72/06/13 | 17 00 | 0000 | 18.9J |
| 72/09/18 | 15 45 | 0000 | 16.0J |
| 72/11/14 | 10 20 | 0000 | 1.2J |

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 75/02/04

268803
43 23 00.0 086 22 00.0
WHITE LAKE
26 MICHIGAN

11EPALES 2111202
5 0025 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00010 WATER TEMP CENT | 00300 DO MG/L | 00077 TRANSP SECCHI INCHES | 00094 CNDUCTVY FIELD MICROMHO | 00400 PH SU | 00410 T ALK CACO3 MG/L | 00630 NO2&NO3 N-TOTAL MG/L | 00610 NH3-N TOTAL MG/L | 00665 PHOS-TOT MG/L P | 00666 PHOS-DIS MG/L P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 72/06/13 | 17 40 | 0000 | 19.4 | 10.5 | 72 | 440 | 8.60 | 145 | 0.040 | 0.060 | 0.028 | 0.016 |
| | 17 40 | 0015 | 16.8 | 8.9 | | 460 | 8.50 | 145 | 0.060 | 0.110 | 0.022 | 0.015 |
| 72/09/18 | 15 25 | 0000 | | | 72 | 415 | 8.83 | 124 | 0.040 | 0.050 | 0.020 | 0.012 |
| | 15 25 | 0004 | 19.9 | 9.3 | | 405 | 8.85 | 125 | 0.040 | 0.050 | 0.024 | 0.012 |
| | 15 25 | 0015 | 19.1 | 7.5 | | 410 | 8.60 | 125 | 0.060 | 0.110 | 0.025 | 0.013 |
| | 15 25 | 0020 | 18.9 | 7.3 | | 430 | 8.55 | 125 | 0.040 | 0.110 | 0.025 | 0.015 |
| | 15 25 | 0027 | 18.2 | 3.9 | | 420 | 8.10 | 124 | 0.050 | 0.280 | 0.052 | 0.030 |
| | 15 25 | 0034 | 17.4 | 3.7 | | 420 | 8.10 | 124 | 0.050 | 0.300 | 0.050 | 0.031 |
| 72/11/14 | 10 50 | 0000 | | | 108 | 460 | 7.80 | 133 | 0.130 | 0.230 | 0.026 | 0.019 |
| | 10 50 | 0004 | 7.1 | 10.4 | | 460 | 7.90 | 133 | 0.130 | 0.230 | 0.027 | 0.018 |
| | 10 50 | 0015 | 7.1 | 10.4 | | 460 | 7.90 | 132 | 0.130 | 0.230 | 0.028 | 0.020 |
| | 10 50 | 0020 | 7.1 | 10.4 | | 460 | 7.90 | 131 | 0.130 | 0.230 | 0.026 | 0.019 |

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 32217 CHLRPHYL A UG/L |
|---|---|---|---|
| 72/06/13 | 17 40 | 0000 | 14.8J |
| 72/09/18 | 15 25 | 0000 | 7.2J |
| 72/11/14 | 10 50 | 0000 | 1.2J |

J VALUE KNOWN TO BE IN ERROR

# APPENDIX D

## TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/02/04

2688A1 LS2688A1
43 22 30.0 086 25 30.0
WHITE RIVER
26 15 MONTAGUE
0/WHITE RIVER
SAMPLE OUTLT CHANL N EDGE OF WABANINGO
11EPALES 2111204
4 0000 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 72/10/29 | | | 0.130 | 0.500 | 0.176 | 0.016 | 0.035 |
| 72/12/03 | 10 45 | | 0.270 | 0.850 | 0.075 | 0.011 | 0.024 |
| 73/01/07 | 15 30 | | 0.310 | 0.960 | 0.086 | 0.011 | 0.025 |
| 73/02/04 | 10 45 | | 0.330 | 0.330 | 0.072 | 0.016 | 0.030 |
| 73/04/04 | 18 10 | | 0.231 | 0.540 | 0.126 | 0.005K | 0.030 |
| 73/04/26 | 07 45 | | 0.105 | 0.540 | 0.014 | 0.005K | 0.020 |
| 73/05/10 | 09 15 | | 0.147 | 0.540 | 0.017 | 0.005K | 0.035 |
| 73/06/05 | 18 20 | | 0.056 | 0.480 | 0.039 | 0.006 | 0.030 |
| 73/06/24 | 13 10 | | 0.023 | 0.460 | 0.028 | 0.010 | 0.030 |
| 73/07/10 | 14 30 | | 0.040 | 0.800 | 0.066 | 0.012 | 0.050 |
| 73/07/22 | 07 00 | | 0.017 | 1.050 | 0.009 | 0.012 | 0.060 |
| 73/08/25 | 10 00 | | 0.084 | 0.580 | 0.011 | 0.009 | 0.035 |
| 73/09/27 | 18 30 | | 0.105 | 0.640 | 0.080 | 0.009 | 0.040 |

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/04

2686A2 LS2688A2
43 25 30.0 086 19 30.0
WHITE RIVER
26 15 MONTAGUE
I/WHITE LAKE
BRDG ON US31 NE WHITEHALL
11EPALES 2111204
4 0000 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 72/10/29 | 11 05 | | 0.068 | 1.600 | 0.160 | 0.012 | 0.029 |
| 72/12/03 | 10 00 | | 0.280 | 0.910 | 0.078 | 0.011 | 0.018 |
| 73/01/07 | 15 00 | | 0.260 | 0.630 | 0.027 | 0.010 | 0.022 |
| 73/02/04 | 10 15 | | 0.320 | 0.310 | 0.024 | 0.010 | 0.030 |
| 73/03/04 | 09 40 | | 0.399 | 0.500 | 0.052 | 0.014 | 0.035 |
| 73/04/04 | 17 30 | | 0.063 | 0.420 | 0.046 | 0.010 | 0.025 |
| 73/04/26 | 06 00 | | 0.025 | 0.880 | 0.048 | 0.011 | 0.025 |
| 73/05/10 | 08 45 | | 0.022 | 0.700 | 0.044 | 0.012 | 0.035 |
| 73/06/05 | 19 25 | | 0.080 | 0.600 | 0.042 | 0.027 | 0.060 |
| 73/06/24 | 11 50 | | 0.010K | 0.500 | 0.036 | 0.032 | 0.077 |
| 73/07/10 | 12 00 | | 0.168 | 0.340 | 0.034 | 0.018 | 0.050 |
| 73/07/22 | 07 30 | | 0.093 | 1.980 | 0.198 | 0.016 | 0.030 |
| 73/08/25 | 10 15 | | 0.168 | 0.390 | 0.032 | 0.022 | 0.045 |
| 73/09/27 | 17 30 | | 0.105 | 0.340 | 0.089 | 0.016 | 0.040 |

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/04

2688A3 LS2688A3
43 28 00.0 086 14 00.0
WHITE RIVER
26 15 TWIN LAKE
T/WHITE LAKE
CO RD BRDG 1 MI NW BIG BLUELAKE
11EPALES 2111204
4 0000 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 72/10/29 | 10 30 | | 0.117 | 1.600 | 0.105 | 0.012 | 0.028 |
| 72/12/03 | 09 35 | | 0.280 | 0.360 | 0.026 | 0.010 | 0.017 |
| 73/01/07 | 14 30 | | 0.300 | 0.990 | 0.056 | 0.011 | 0.021 |
| 73/02/04 | 09 45 | | 0.340 | 0.440 | 0.063 | 0.012 | 0.025 |
| 73/03/04 | 09 15 | | 0.490 | 0.800 | 0.138 | 0.020 | 0.060 |
| 73/04/04 | 17 25 | | 0.176 | 0.340 | 0.036 | 0.009 | 0.020 |
| 73/04/26 | 08 45 | | 0.098 | 0.600 | 0.025 | 0.016 | 0.040 |
| 73/05/10 | 08 00 | | 0.100 | 0.320 | 0.058 | 0.018 | 0.047 |
| 73/06/05 | 18 55 | | 0.176 | 0.520 | 0.032 | 0.027 | 0.065 |
| 73/06/24 | 12 10 | | 0.240 | 0.520 | 0.046 | 0.030 | 0.075 |
| 73/07/10 | 12 35 | | 0.189 | 1.980 | 0.084 | 0.015 | 0.050 |
| 73/07/22 | 07 45 | | 0.120 | 1.380 | 0.050 | 0.012 | 0.030 |
| 73/08/25 | 10 30 | | 0.220 | 0.460 | 0.026 | 0.019 | 0.050 |
| 73/09/27 | 17 10 | | 0.110 | 0.210 | 0.038 | 0.010 | 0.025 |

STORET RETRIEVAL DATE 75/02/04

268881 LS268881
43 26 30.0 086 14 00.0
CLEVELAND CREEK
26 15 TWIN LAKE
T/WHITE LAKE
CO RD BRDG 4 MI N OF LAKEWOOD
11EPALES 2111204
4 0000 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P |
|---|---|---|---|---|---|---|---|
| 72/10/29 | 10 40 | | 0.087 | 1.650 | 0.120 | 0.005K | 0.007 |
| 72/12/03 | 09 30 | | 0.020 | 2.000 | 0.067 | 0.005K | 0.009 |
| 73/01/07 | 14 30 | | 0.072 | 0.580 | 0.032 | 0.005K | 0.008 |
| 73/02/04 | 09 15 | | 0.026 | 0.100K | 0.015 | 0.005K | 0.005K |
| 73/03/04 | 08 45 | | 0.035 | 0.190 | 0.029 | 0.006 | 0.010 |
| 73/04/04 | 17 20 | | 0.019 | 0.100K | 0.014 | 0.005K | 0.010 |
| 73/04/26 | 08 30 | | 0.010K | 0.240 | 0.011 | 0.005K | 0.005K |
| 73/05/10 | 07 30 | | 0.013 | 1.150 | 0.018 | 0.005K | 0.015 |
| 73/06/05 | 19 10 | | 0.013 | 0.660 | 0.017 | 0.005K | 0.015 |
| 73/06/24 | 12 20 | | 0.015 | 0.520 | 0.022 | 0.005K | 0.010 |
| 73/07/10 | 12 50 | | 0.018 | 0.230 | 0.028 | 0.005K | 0.010 |
| 73/07/22 | 08 00 | | 0.034 | 0.770 | 0.032 | | 0.005K |
| 73/08/25 | 10 50 | | 0.010K | 0.340 | 0.024 | 0.008 | 0.010 |
| 73/09/27 | 17 00 | | 0.023 | 0.330 | 0.054 | 0.006 | 0.010 |

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/04

268850 PR268850 P003017
43 25 00.0 086 20 00.0
WHITEHALL
26 15 MONTAGUE
D/WHITE LAKE
WHITE LAKE
11EPALES 2141204
4 0000 FEET DEPTH

| DATE FROM TO | TIME OF DAY | DEPTH FEET | 00630 NO2&NO3 N-TOTAL MG/L | 00625 TOT KJEL N MG/L | 00610 NH3-N TOTAL MG/L | 00671 PHOS-DIS ORTHO MG/L P | 00665 PHOS-TOT MG/L P | 50051 FLOW RATE INST MGD | 50053 CONDUIT FLOW-MGD MONTHLY |
|---|---|---|---|---|---|---|---|---|---|
| 73/02/12 | 00 00 | | | | | | | | |
| CP(T)- | | | 2.750 | 19.000 | 0.880 | 2.700 | 7.300 | 0.478 | 0.456 |
| 73/02/12 | 08 00 | | | | | | | | |
| 73/03/27 | 08 00 | | | | | | | | |
| CP(T)- | | | 1.200 | 15.400 | 0.098 | 4.500 | 6.400 | 0.483 | 0.406 |
| 73/03/27 | 16 00 | | | | | | | | |