MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER DIVISION
SEPTEMBER 2004

TOTAL MAXIMUM DAILY LOAD FOR PHOSPHORUS IN FORD AND BELLEVILLE LAKES

Location:

Ford and Belleville Lakes are impoundments of the Huron River, located in Washtenaw and Wayne Counties (see Figure 2 in Kosek, 1996 [attached]; and Figure 4 in Brenner and Rentschler, 1996 [attached]).

Pollutant:

Total Phosphorus.

Summary:

These lakes receive high nutrient loadings, causing severe water quality problems, most notably nuisance algae blooms. In 1991, Ford Lake suffered a September algae bloom so severe that a hazardous material response team was summoned to investigate the "green paint spill." At the September 1987 meeting of the Water Resources Commission, the state of Michigan established a goal of 30 micrograms per liter (µg/L) phosphorus concentration for Belleville Lake as part of an effort to restore designated uses of the lake. The Michigan Department of Environmental Quality (MDEQ) has determined that a 50 µg/L phosphorus concentration must be met going into Ford Lake during the period of April-September (the algae growing season) in order to achieve the 30 µg/L goal for Belleville Lake. Other impoundments along this section of the Huron River watershed are expected to benefit from the reduced phosphorus as well.

The MDEQ has developed the loading capacity for both lakes based on the phosphorus concentration goal established for Belleville Lake (Kosek, 1996). This loading capacity will be used to determine the Total Maximum Daily Load (TMDL) and associated National Pollutant Discharge Elimination System (NPDES) permit limits for all involved point source dischargers, and also to determine the magnitude of the phosphorus reductions necessary from other sources. As part of a watershed 104(b)(3) grant from the United States Environmental Protection Agency (USEPA), the local communities have been involved in the process of developing an implementation plan for these reductions (Brenner and Rentschler, 1996).

TMDL Development:

The phosphorus concentration is the critical variable in this system, since it is the limiting nutrient for algae growth in these short retention time lakes. If the total phosphorus concentration going into Ford Lake can be kept at or below 50 µg/L in April-September, then the lakes should respond by decreasing the algae growth to nonnuisance levels and Belleville Lake should meet its 30 µg/L goal. Therefore, the loading capacity is expressed as a phosphorus concentration of 50 µg/L at the Michigan Avenue bridge on the Huron River (just upstream of Ford Lake) for the months of April through September (see Table 13 in Kosek, 1996).

Phosphorus load, though related to the concentration, will vary with flow. Figure 1 shows graphically how the load varies with flow, with the monthly average loads indicated on the line. In order to decrease present loadings (represented by 1995 data in Figures 1 and 2) to the loading capacity levels, it will be necessary to reduce phosphorus loads from both point and nonpoint sources. The wasteload allocations (WLAs) and load allocations (LAs) were calculated for each month (Table 1).

Table 1. WLAs and LAs for the Ford and Belleville Lakes TMDL for Phosphorus.

	WLA/LA by Month (lb/d)					
	APR	MAY	JUN	JUL	AUG	SEP
TMDL	304	214	139	88	74	103
Ann Arbor WWTP	150	60	60	50	50	60
Chelsea WWTP	9.5	2.2	2.2	1.8	1.8	2.2
Dexter WWTP	3.0	0.9	0.9	0.8	0.8	0.9
Loch Alpine WWTP	1.5	0.6	0.6	0.5	0.5	0.6
Chrysler-Chelsea	0.5	0.3	0.3	0.3	0.3	0.3
Other Point Sources[a]	1.5	1.7	1.7	1.7	1.7	1.7
Total Point Source WLA	166	66	66	55	55	66
Nonpoint Source LA	91	100	61	29	19	37
Remaining	47	48	12	4	0	0

[a]There are 12 minor point source dischargers in the watershed area of interest. For more details, see Brenner and Rentschler, 1996.

TMDL implementation consists of reducing point and nonpoint source loads to the levels presented in Table 1. Communities would gradually implement phosphorus reduction activities over a five-year period. A Section 319 grant proposal has been submitted to provide funding for the implementation of a local information and education campaign, which has been developed. Lake and river sampling will continue in order to monitor how well the reductions are being achieved.

Calculations:

LA:

Due to the highly variable nature of nonpoint source loads, the development of the LA was complex. The general concept used to develop the LA for the nonpoint sources was to subtract the amount of reduction from watershed-specific best management practices from the current nonpoint source loads. A detailed land use study was performed to determine the maximum reductions possible through extensive use of best management practices tailored to the land uses in the middle Huron River watershed. Best management practices based on the specific area and type of land use in each subwatershed basin would reduce the nonpoint source load by as much as 58% (Brenner and Rentschler, 1996). The maximum usage of the most effective best management practices is recommended.

Since the TMDL corresponds to a constant concentration at various flows, allowable loads are best expressed as a linear equation (Figure 1). The average flows for the period of record for each month were used to calculate the TMDL loads by month. Several of the critical months in 1995 deviated from the average flows for the period of record. Rather than use the unusually high or low loadings that were calculated for these months in 1995, "expected" nonpoint source loads under current point and nonpoint source management practices were calculated for each month (except April) based on the average flow for the period of record. These calculations were based on a linear regression of the measured loads and flow conditions for each month in 1995 (Figure 2). A summary of the nonpoint source load calculations is presented in Table 2. Current "expected" conditions are highlighted in bold in Table 2.

The nonpoint source load allocations are equal to a 57% reduction from current "expected" nonpoint source loads in April and a 58% reduction from current "expected" nonpoint source loads in May-September.

WLA:

Phosphorus load restrictions are not needed to protect these lakes during the months of October through March, since algae growth does not occur at those times and the water will be flushed out of the lakes before the algae growing season starts. The limit of 1 milligram per liter (mg/L) would be retained in the point source permits during the months of October through March for the purposes of Great Lakes protection.

The critical algae growing season begins in May. Therefore, allowing some time of passage and cycling of phosphorus through the system, reductions in the phosphorus loadings need to begin in April. The point sources will be expected to operate in such a manner so as not to exceed the allocated waste loads. Options to meeting the allocated waste loads will include permit requirements to 1) meet the individual WLA in Table 1; 2) meet the aggregate total point source WLA in Table 1; or 3) enter into a Cooperative Agreement to meet the point source WLA in Table 1 for phosphorus. It is left to each facility to determine the exact dynamics of the concentration and flow rates used to meet these loadings at the respective plants.

Late snowmelt and spring rains usually cause high flow conditions in April, so the phosphorus concentrations remain relatively low despite higher loading rates. Therefore, the point source WLA for April incorporates larger loadings (166 lb/d) and serves as a transitional period between the unrestricted winter loads and the stringent summer loads. The loading rate of 166 lb/d approximates concentrations of 0.6 mg/L phosphorus at the design flows of the point sources. For the months of May, June, and September, the WLA among the point sources drops to 66 lb/d (Table 2), which approximates concentrations of 0.4 mg/L phosphorus at the current flows of the wastewater treatment plants. For the months of July and August, the WLA among the point sources is reduced to 55 lb/d (Table 2). Please note that the loads for July and August are less than those proposed in the phosphorus reduction strategy developed by the local stakeholders (see Table 14 in Brenner and Rentschler, 1996).

Table 2. Information Used to Calculate WLAs and LAs.

	LA by Month (lb/d)					
	APR	MAY	JUN	JUL	AUG	SEP
TMDL	304	214	139	88	74	103
1995 Total Load	246	319	244	211	331	85
"Expected" Load	304	336	223	145	123	168
1995 Point Sources	92	97	77	78	86	80
Ann Arbor WWTP	150	60	60	50	50	60
Chelsea WWTP	9.5	2.2	2.2	1.8	1.8	2.2
Dexter WWTP	3.0	0.9	0.9	0.8	0.8	0.9
Loch Alpine WWTP	1.5	0.6	0.6	0.5	0.5	0.6
Chrysler-Chelsea	0.5	0.3	0.3	0.3	0.3	0.3
Other Point Sources[a]	1.5	1.7	1.7	1.7	1.7	1.7
Total Point Source WLA	166	66	66	55	55	66
1995 Nonpoint Sources	155	223	159	99	122	46
"Expected" Nonpoint Sources[b]	212	239	146	68	46	87
Nonpoint Source LA	91	100	61	29	19	38
Remaining	47	48	12	4	0	0

[a]There are 12 minor dischargers in the watershed area of interest. For more details, see Brenner and Rentschler, 1996.

[b]For April-June, using respective 1995 point source loads. For July-September, using 77 lb/d point source load. For all months, using "expected" loads as totals.

References:

Kosek, S. 1996. A Phosphorus Loading Analysis and Proposed TMDL for Ford and Belleville Lakes, Washtenaw and Wayne Counties, December 1994-November 1995. MDEQ Report No. MI/DEQ/SWQ-96/005.

Brenner, A. and P. Rentschler. 1996. The Middle Huron Initiative: A Total Maximum Daily Load Analysis for the Middle Portion of the Huron River Watershed. Huron River Watershed Council.

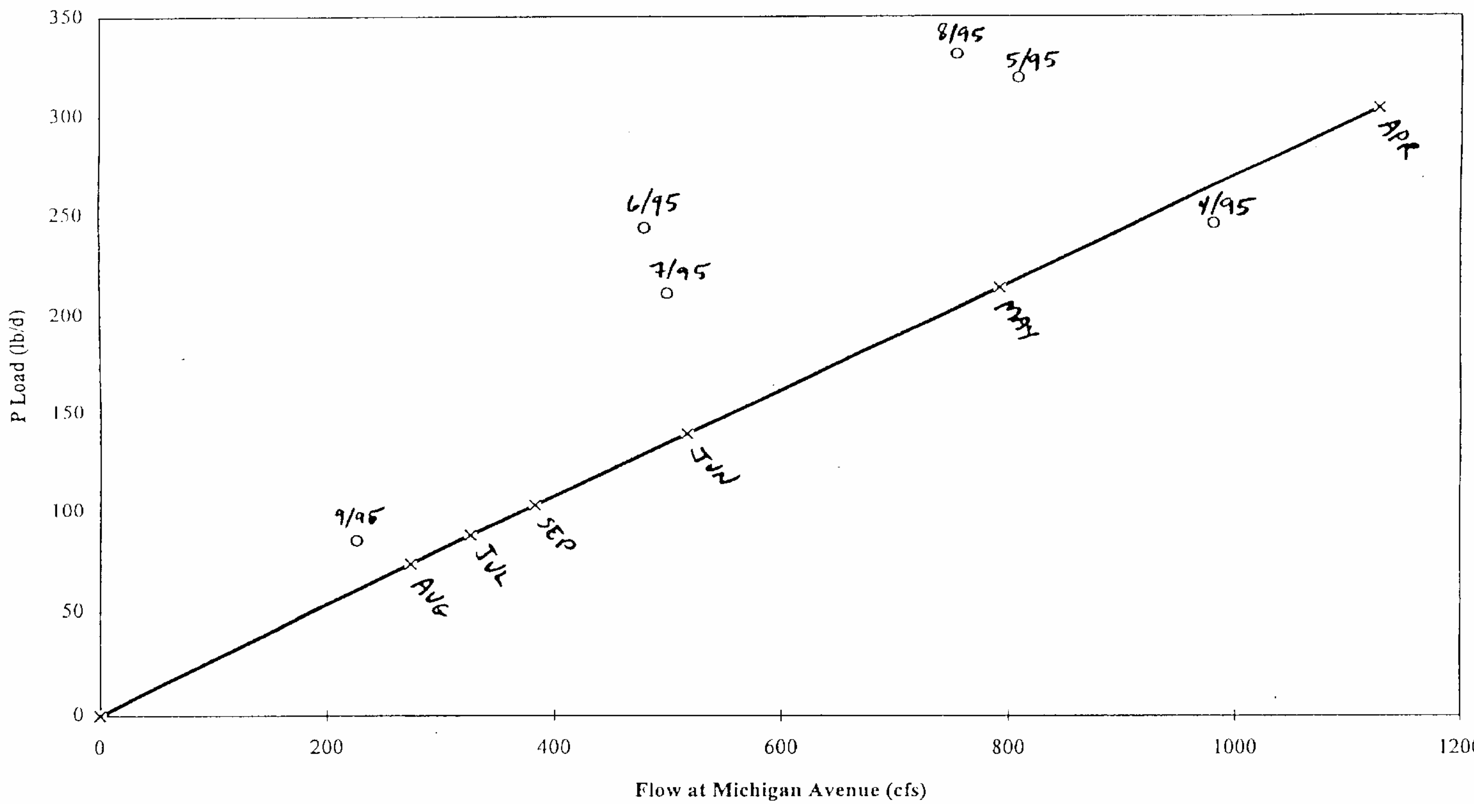

Figure 1: HRWI TMDL and 1995 data relative to average flow.

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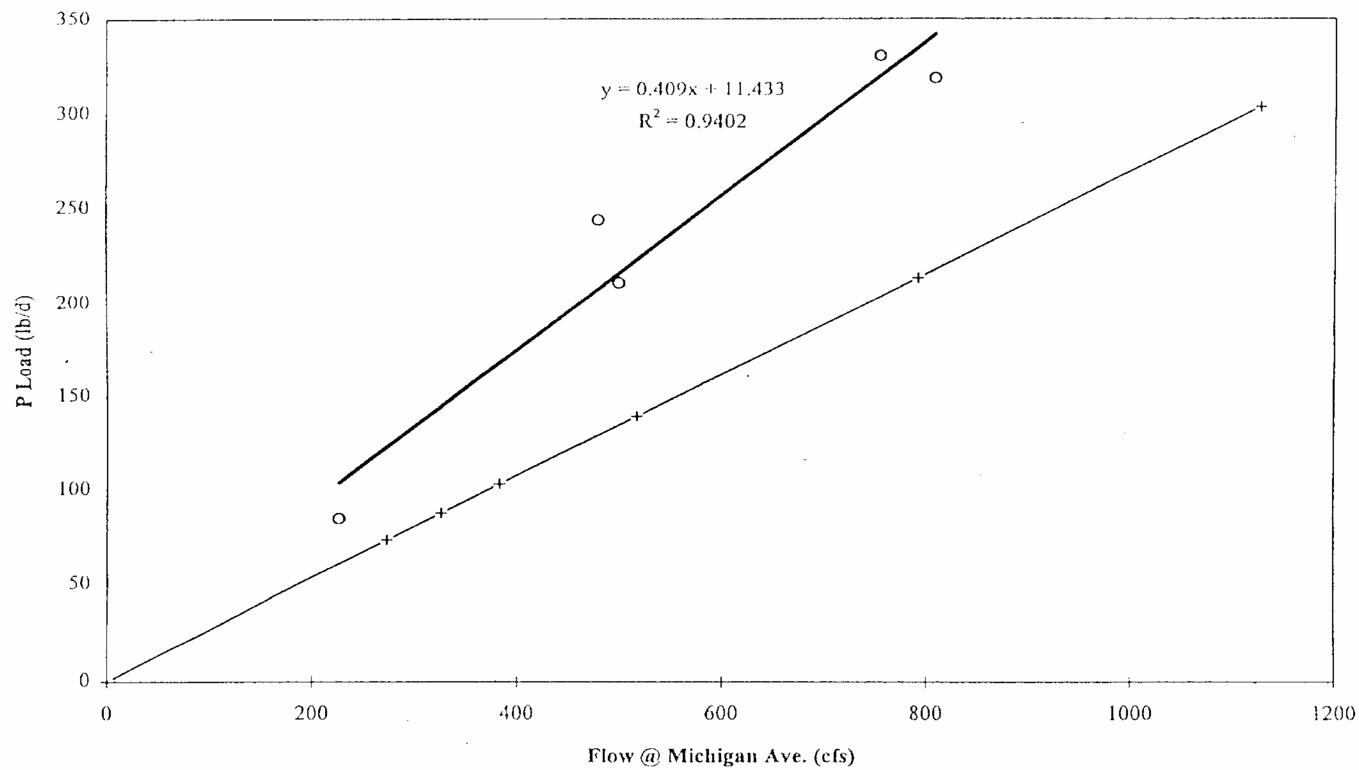

Figure 2: Huron River TMDL and 1995 data relative to average flow. Linear regression line and equation for calculation of "expected" total load.

TMDL 1 (50 ug/L) | 1995 | Linear (1995)

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