Michigan Department of Environmental Quality

Water Bureau

August 2005

Total Maximum Daily Load for Nitrate for the River Raisin near Deerfield and Blissfield Lenawee County

INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations, Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting water quality standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. The TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources (NPS) to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the sources of nitrate (NO_3) standard nonattainment in the River Raisin near Deerfield and Blissfield, and to quantify reductions in these sources necessary for attainment of the standard. Figure 1 shows the River Raisin Watershed with the TMDL reach indicated, while Figure 2 shows the TMDL reach in greater detail.

The River Raisin nitrate TMDL reach is located in Lenawee County. Table 1 defines the extent and length of the reach. Note that the reach start location begins at the downstream portion of the reach, while the end location is upstream. A total of 16 river miles are addressed by the TMDL.

TABLE 1
River Raisin Nitrate TMDL Reaches

River	Reach Start	Reach End	Distance (mi.)
River Raisin	Vicinity of Deerfield (T7S, R5E, Section 12 of Lenawee County)	Vicinity of Blissfield (T7S, R5E, Section 31 of Lenawee County)	16

The River Raisin has a drainage area of approximately 681 square miles at the Deerfield Wastewater Treatment Plant (WWTP) point of discharge (Figure 2). Summer season 50 and 95 percent exceedance flows (cubic feet per second [cfs]) for the River Raisin at this location are 100 and 34 cfs, respectively. River Raisin low flows were computed from historic data collected at United States Geological Survey (USGS) River Raisin flow gages located in Adrian (041760000) and Monroe (04176500), Michigan.

PROBLEM STATEMENT

The River Raisin TMDL reach appears on the 2004 Section 303(d) list (Wolf & Wuycheck, 2004) as:

RIVER RAISIN WBID#: **061101E**

County: LENAWEE HUC: 4100002 Size: 16 M

Location: Lenawee County line (vicinity of Deerfield) upstream to Blissfield

Problem: CSO, pathogens (Rule 100); water quality exceedances for atrazine and nitrates

TMDL Year(s): 2005 RF3RchID: 4100002 11

This TMDL addresses only the nitrate standard nonattainment in the River Raisin between Blissfield and Deerfield. The TMDL will address all known sources of nitrates upstream of the Deerfield water treatment plant (WTP), which is located downstream of the Blissfield WTP. In the 2004 303(d) list, the indicated reach included a problem of atrazine exceedances. Michigan has established 3 micrograms per liter (ug/l) of atrazine as a level protective of drinking water sources under Rule 323.1057 (toxic substances) of the Part 4 WQS. Sample data show no exceedances of the 3 ug/l atrazine Rule 57 value since May of 1998, when a hit of 5 mg/l was measured at the Deerfield water treatment plant intake. Therefore, atrazine is not addressed by this TMDL.

Rule 323.1100 (designated uses) of the WQS Part 4 Rules requires that all waters of the state are to be protected for warmwater fish, other indigenous aquatic life and wildlife, agriculture, navigation, industrial water supply, public water supply at the point of intake, partial body contact recreation, and total body contact recreation from May 1 to October 31. The impaired designated use for the River Raisin addressed by this nitrate TMDL is the public water supply use.

A human non-cancer health-based ambient nitrate WQS designed to protect drinking water source waters against the risk of methemoglobinemia in infants was developed pursuant to R323.1057 of Part 4 WQS. This ambient WQS is 10 mg/l nitrate as a daily average. Raw water intake sampling data at the Blissfield and Deerfield WTPs indicate that this WQS is being met consistently in the waters of the River Raisin at the facilities.

Rule 325.10604c, promulgated under the Michigan Safe Drinking Water Act (1976 PA 399) as amended, establishes a maximum contaminant level (MCL) of 10 mg/l nitrate as nitrogen for treated drinking water. Compliance with the MCL is determined by averaging the concentrations of one sample of treated water at the point of entry to the distribution system (a "tap" sample) that has been found to exceed 10 mg/l, and a second confirmation tap sample that may or may not exceed 10 mg/l of nitrate. The confirmation sample is taken immediately after the first sample is found to exceed 10 mg/l nitrate. The MCL affords an acceptable level of human health protection from methemoglobinemia in infants due to high levels of nitrates in treated drinking water. Tables 2 and 3 show exceedances of the MCL at both the Blissfield and Deerfield WTPs' intakes, and the finished water of the Deerfield WTP.

The Blissfield WTP has treatment systems designed to remove nitrate, while the Deerfield WTP does not have any such nitrate treatment installed. The Deerfield WTP is expected to upgrade to such treatment, but not for some years in the future. Sample data from finished water of the Blissfield WTP shows no exceedances of 10 mg/l nitrate, while samples of finished water from the Deerfield WTP do show exceedances of 10 mg/l on some occasions when the River Raisin source water exceeds that level. Therefore, the target of this TMDL is a maximum nitrate level of 10 mg/l in the ambient waters of the River Raisin at the intakes of the Blissfield and Deerfield WTPs.

The best records of nitrate levels in the River Raisin TMDL reach are generated by the two drinking WTPs whose source water is provided by the River Raisin in that reach, the Blissfield and Deerfield WTPs. Both facilities monitor nitrate concentrations at their intakes for operational purposes. The facilities are required under USEPA drinking water rules to monitor daily for potentially harmful parameters, including nitrate, in their finished water. It is from these facilities' intake data that this TMDL was deemed necessary. Table 2 outlines exceedances of 10 mg/l nitrates measured in the raw intake water at the Blissfield and Deerfield WTPs by month from 2003 through 2004. Table 3 contains sample data from the facilities' finished water at the point of entry to the distribution system. Nitrate concentrations greater than 10 mg/l in the raw and finished waters are generally observed in the spring and early summer months.

TABLE 2
Blissfield and Deerfield WTPs nitrate levels - raw water **intakes**, 2003 – 2005 monthly summaries

BLISSFIELD WTP			**DEERFIELD WTP**		
Month	No. days > 10 mg/l	Max conc. > 10 mg/l	Month	No. days > 10 mg/l	Max conc. >10 mg/l
Jan-03	0	-	Jan-03	0	-
Feb-03	0	-	Feb-03	0	-
Mar-03	1	10.2	Mar-03	4	13.0
Apr-03	0	-	Apr-03	7	15.4
May-03	7	11.9	May-03	0	-
Jun-03	2	12.3	Jun-03	0	-
Jul-03	0	-	Jul-03	0	-
Aug-03	0	-	Aug-03	0	-
Sep-03	0	-	Sep-03	0	-
Oct-03	0	-	Oct-03	0	-
Nov-03	0	-	Nov-03	0	-
Dec-03	0	-	Dec-03	4	11.7
Jan-04	0	-	Jan-04	0	-
Feb-04	0	-	Feb-04	0	-
Mar-04	0	-	Mar-04	1	10.9
Apr-04	0	-	Apr-04	0	-
May-04	3	13.6	May-04	6	16.6
Jun-04	3	10.6	Jun-04	5	15.5
Jul-04	0	-	Jul-04	0	-
Aug-04	0	-	Aug-04	0	-
Sep-04	0	-	Sep-04	0	-
Oct-04	0	-	Oct-04	0	-
Nov-04	0	-	Nov-04	0	-
Dec-04	0	-	Dec-04	0	-
Jan-05	0	-	Jan-05	2	11.8
Feb-05	0	-	Feb-05	0	-
Mar-05	0	-	Mar-05	0	-

TABLE 3
Blissfield and Deerfield WTPs nitrate levels – treated water at the **point of entry to the distribution system**, 2003 – 2005 monthly summaries

BLISSFIELD WTP			DEERFIELD WTP		
Month	No. days > 10 mg/l	Max conc. > 10 mg/l	Month	No. days > 10 mg/l	Max conc. >10 mg/l
Jan-03	0	-	Jan-03	0	-
Feb-03	0	-	Feb-03	0	-
Mar-03	0	-	Mar-03	0	-
Apr-03	0	-	Apr-03	1	10.5
May-03	0	-	May-03	0	-
Jun-03	0	-	Jun-03	0	-
Jul-03	0	-	Jul-03	0	-
Aug-03	0	-	Aug-03	0	-
Sep-03	0	-	Sep-03	0	-
Oct-03	0	-	Oct-03	0	-
Nov-03	0	-	Nov-03	0	-
Dec-03	0	-	Dec-03	0	-
Jan-04	0	-	Jan-04	0	-
Feb-04	0	-	Feb-04	0	-
Mar-04	0	-	Mar-04	0	-
Apr-04	0	-	Apr-04	0	-
May-04	0	-	May-04	4	11.4
Jun-04	0	-	Jun-04	1	11.8
Jul-04	0	-	Jul-04	0	-
Aug-04	0	-	Aug-04	0	-
Sep-04	0	-	Sep-04	0	-
Oct-04	0	-	Oct-04	0	-
Nov-04	0	-	Nov-04	0	-
Dec-04	0	-	Dec-04	0	-
Jan-05	0	-	Jan-05	0	-
Feb-05	0	-	Feb-05	0	-
Mar-05	0	-	Mar-05	0	-

NUMERIC TARGETS

The target of this TMDL is a maximum nitrate level of 10 mg/l in the ambient waters of the River Raisin at the intakes of the Blissfield and Deerfield WTPs. As the Deerfield WTP currently provides no treatment for nitrate, the raw source waters of the River Raisin must meet a level of 10 mg/l maximum nitrate in order to meet the MCL in the finished water of the Deerfield WTP. To assess water quality improvements resulting from this TMDL, nitrate levels in the raw River Raisin source water will be monitored using the intake samples taken by both facilities. Although there are no exceedances of the 10 mg/l MCL in the finished waters of the Blissfield WTP, the reach addressed by this TMDL includes the location of that facility as it was originally included in the 2004 303(d) listing.

SOURCE ASSESSMENT

Every source of nitrogen in the River Raisin Watershed, organic or inorganic, can eventually be converted to nitrate through chemical and biological processes occurring in the air, water, and soil environments. Therefore, this TMDL uses total nitrogen loads as a surrogate for nitrate loads in the River Raisin. Potential sources of nitrogen include point and NPS. Annual loads of nitrogen to the River Raisin at Deerfield were estimated using the SPAtially Referenced Regressions On Watershed Attributes (SPARROW) regression model developed by the USGS (USGS, 2005). This application relates in-stream water-quality measurements to spatially referenced characteristics of watersheds, including pollutant sources and factors influencing transport over land and in water. The model empirically estimates the origin and fate of pollutants in streams, and quantifies uncertainties in these estimates based on model coefficient error and unexplained variability in the observed data. Results from the SPARROW analysis are outlined in Table 4. The SPARROW model's estimates of nitrogen loads from other watersheds compare very favorably to load estimates calculated by the Michigan Department of Environmental Quality (MDEQ) for those watersheds (Day, 1990).

TABLE 4

Estimated sources of nitrogen to the River Raisin at Deerfield

Nitrogen source	Mean load (lbs/yr)	Percent of total load
Nonpoint sources		
Fertilizer	3,273,000	59.4
Atmospheric deposition	1,157,000	21.0
Livestock waste	603,000	10.9
Nonagricultural lands	243,000	4.4
Point sources	234,000	4.2
TOTAL ANNUAL LOAD	5,510,000	100

The SPARROW model does not differentiate between species of nitrogen in its load estimation. Data from Heidelberg College's Ohio Tributary Monitoring Program (Heidelberg College, 2003) indicate that, on average, approximately 80 percent of the total nitrogen load in the River Raisin at Deerfield exists as nitrate. Nitrogen loads estimated by the MDEQ for other watersheds dominated by agriculture show similar percentages of nitrates compared to the total nitrogen load (Day, 1990).

POINT SOURCES

There are 17 facilities in and above the TMDL reach that discharge treated wastewaters to the River Raisin or its tributaries under individual National Pollutant Discharge Elimination System (NPDES) permits. There are 18 facilities discharging wastewaters to the TMDL reach under nonstorm water general permit certificates of coverage (COCs). These discharges include secondary treatment municipal wastewater, wastewater stabilization lagoon effluent, noncontact cooling water, and hydrostatic pressure test water. See Table A.1 for details on these discharges. There are also 49 facilities covered under storm water general permit COCs (Table A.2). Note that there are no municipal separate storm sewer system (MS4) permitted communities in the watershed upstream of Deerfield.

Note that Table 4 includes a NPS nitrogen load attributed to nonagricultural lands. These lands uses include residential, commercial, forest, pasture, and grasslands. Nitrogen loads from the 53 facilities covered under industrial storm water permits (Table A.2) are included in this nonagricultural land load. In accordance with the USEPA guidelines, industrial storm water permitted facilities will be considered in the wasteload allocation (WLA) portion of this TMDL.

The Long-Term Hydrological Impact Assessment (L-THIA) Web application developed by Purdue University and the USEPA (Purdue University and USEPA, 2005) was used to estimate the relative nitrogen contributions of the residential and commercial nonagricultural land uses vs. the other nonagricultural land uses. Approximately 42 percent of nitrogen loads from nonagricultural lands can be attributed to the residential and commercial land uses, while 58 percent of the nonagricultural land load is attributed to forests, grasslands, and pasture. Table 5 allocates the total nitrogen load from nonagricultural lands appearing in Table 4 (243,000 pounds per year) into residential and commercial land use loads (to be addressed in the WLA), and loads from pasture, forest, and grasslands (to be addressed in the load allocations (LA)). It is assumed that all commercial land areas reported by L-THIA are storm water-permitted. As outlined in Table 4, nitrogen loads attributed to nonagricultural lands account for only 4.4 percent of the total annual load. There were no active construction sites with NPDES permits in the River Raisin Watershed at the time of the writing of this TMDL.

TABLE 5
River Raisin basin land use categories as percentages at Deerfield

Land use category	Mean load (lbs/yr)
Nonagricultural lands	243,000
WLA – Residential, commercial (42%)	102,000
LA - Forest, pasture, grassland (58%)	141,000

Certain farming activities, e.g. concentrated animal feeding operations (CAFOs), are addressed as point sources under the TMDL's WLA. Several CAFOs are located in the River Raisin Watershed, most upstream of the TMDL reach. Most of these are dairy cattle operations. Negative local water quality impacts (low dissolved oxygen, high nutrient loadings, and associated nuisance plant growth, etc.) have been documented as a result of livestock operations activities, many due to the over-application of manure to local fields and facilitated by drainage tiles. In some cases, manure is applied at rates exceeding possible rates of crop assimilation. Runoff from CAFO facilities and the fields to which they apply manure contribute to nitrogen loads in the River Raisin. Livestock waste from farming operations addressed under both the LA and WLA is estimated to account for approximately 11 percent of the total nitrogen load to the River Raisin TMDL reach (Table 4). Currently, one CAFO in the watershed is covered under an individual NPDES permit (Table A.1). Another CAFO has applied for a certificate of coverage under Water Bureau's (WB's) CAFO general permit.

NONPOINT SOURCES

Land use-based NPS of nitrogen can include commercial fertilizers, soil organic matter, crop residues, and animal manures. Each nitrogenous compound, organic or inorganic, can eventually be converted to nitrate through biological and chemical processes occurring in the soil environment. Nitrate is completely soluble in water and is not attracted to negatively charged soil particles and soil organic matter. Nitrate can be lost from soils through leaching, a physical process where nitrate moves with soil water below the root zone and enters groundwater, or surface water via drainage tiles (University of Minnesota Extension Service, 2005). Seventy percent of the nitrogen contribution to and upstream of the River Raisin TMDL reach comes from commercial fertilizers and animal manure (Table 4).

Commercial fertilizers are estimated to account for approximately 59 percent of the total nitrogen load to the River Raisin, the largest contributor of all sources of nitrogen. In some cases, commercial fertilizers are likely applied in amounts greater than needed at farms throughout the River Raisin Watershed, based on idealized yield potentials. Some farms may apply nitrogen at a rate suited for the maximum possible yield, when climate and other factors make the realization of the maximum yield unlikely. Fertilizer nitrogen not utilized by crops is then free to enter surface waters. Many, if not most, agricultural lands in the River Raisin Watershed are under-tiled, so that water in and on the fields during wet weather events and/or during thaws is rapidly discharged to adjacent surface waters

Atmospheric deposition is the second largest source of nitrogen to the River Raisin TMDL reaches (Table 4). Dissolved nitrate and ammonia are present in precipitation and are delivered to the ground and surface waters during precipitation events. Atmospheric nitrogen has natural and anthropogenic sources. Lightning causes molecular nitrogen gas (N_2) to combine with oxygen to form nitrogen oxides (NO_x), which are converted to nitrate which then dissolves in water vapor. Soil bacteria release gaseous nitrous oxide (N_2O) which can also be converted to dissolved nitrate. In the United States, 90 percent of atmospheric nitrogen oxides arise from anthropogenic combustion processes. Approximately 80 percent of ammonia emissions arise from livestock waste and applications of commercial fertilizers (National Atmospheric Deposition Program (NADP), 2000). Atmospheric sources of nitrogen are considered to be beyond the scope of this TMDL, as airborne nitrogen loads can travel from distant sources and arise, in part, out of uncontrollable processes.

In addition to the point source CAFOs, smaller animal feeding operations (AFOs) and many small farms with livestock are distributed throughout the watershed. Runoff from some of these operations will contribute nitrogen in the form of livestock waste.

Table 6 describes land uses present in the River Raisin Watershed at Deerfield, expressed as percentages of the total basin area. These land use percentages were estimated with the L-THIA application. Note that the dominant land use is agriculture, comprising approximately 58 percent of the TMDL reach drainage area. Commercial fertilizers and animal manure are associated primarily with agriculture. Note that nitrate levels greater than 10 mg/l in the River Raisin and in the Deerfield WTP's finished water generally occur in the spring and early summer months (Tables 2 and 3), concurrent with spring rains and snow melt. It is very likely that the exceedances are due to nitrogen losses from agricultural lands after fertilizer and manure applications.

TABLE 6
River Raisin basin land use categories as percentages at Deerfield

Land use category	Percent land use category
Water / wetlands	6.0
Commercial / industrial	0.5
Agriculture	58.1
High density residential	0.2
Low density residential	1.4
Grass / pasture	17.3
Forest	16.4

Literature values (Cave et al., 1994; Purdue University and USEPA, 2005) of estimated loadings of nitrogen species to surface waters from certain land uses consistently rank agricultural land uses as the highest contributors. These estimates are often expressed as annual loading factors (pounds per year) or event mean concentrations (EMCs, mg/l), which are used to compute annual loading factors. Table 7 outlines a typical event mean concentration range from different land uses for total Kjeldahl nitrogen (TKN; organic nitrogen + ammonia) and nitrate + nitrite ($NO_3 + NO_2$) (Cave et al., 1994). A total nitrogen EMC is calculated in Table 7 by summing these two parameters' EMCs. The agriculture/pasture land use has the highest EMC for total nitrogen at 5.98 mg/l. Note again that agriculture accounts for approximately 58 percent of the land use in the TMDL reach drainage area (Table 6). The land use with the second highest EMC for total nitrogen (5.15 mg/l), the low density residential land use, accounts for 1.4 percent of the TMDL reach drainage area. The land use with the third highest EMC (3.97 mg/l), the industrial land use, accounts for less than 0.5 percent of drained lands. The EMCs are calculated as flow weighted averages; therefore, none of the values in Table 7 exceeds 10 mg/l.

TABLE 7
Estimated event mean concentrations of nitrogen species per land use category

	Event mean concentration (mg/l N)		
Land use category	TKN	$NO_3 + NO_2$	Total N
Forest	0.94	0.80	1.74
Urban open	0.94	0.80	1.74
Agriculture / pasture	**1.92**	**4.06**	**5.98**
Low density residential	3.32	1.83	5.15
High density residential	1.17	2.12	3.29
Commercial	1.74	1.23	2.97
Industrial	2.08	1.89	3.97
Highways	1.82	0.83	2.65
Water / wetlands	0.79	0.59	1.38

Using data from the Natural Resources Conservation Service (NRCS, 1996), the National Agricultural Statistics Service (NASS, 2005), and the Michigan State University Extension Service (MSUE, 2005), it is estimated that approximately 20,000,000 pounds per year of total nitrogen are applied to crops in Lenawee County alone. The majority of this nitrogen, approximately 15,400,000 pounds per year, is applied to corn.

A partnership of the MDEQ, the Michigan Association of Conservation Districts (MACD), and the NRCS, has estimated nitrate losses from soils in the River Raisin Watershed using the land use-based event mean concentration method (Cave et al, 1994). The method was refined in order to account for tile-drained fields, resulting in higher nitrate loss estimates from such areas (Richards, 1999). The results of the analysis were published in the River Raisin GeoBook (Pacific Meridian Resources, 2000), a watershed planning tool employed by local governments. Table 8 lists the 36 River Raisin subbasins and their associated rank of nitrate contributions to surface waters as contained in the River Raisin GeoBook analysis. Note that some of the subbasins with higher nitrate intensity drain into the River Raisin near the intakes at Blissfield and Deerfield. For example, Black Creek enters the Raisin within five miles of the Blissfield WTP intake, and a concentrated load of nitrates from that subbasin may cause a more apparent spike of nitrate at the intake due to its proximity. Nitrate loads from other subbasins would be more attenuated at the intake due to diffusion and dilution by other flows into the River Raisin.

TABLE 8

Nitrate loss intensity from soils per River Raisin subbasin

VERY HIGH:	LOW (cont.):
East Bear Creek	Lower River Raisin 3
Lower Black Creek 2	South Br River Raisin 2
Upper Br Nile Ditch	South Br River Raisin 3
	South Br River Raisin 4
HIGH:	Stoney Lk Drain
Lower River Raisin 4	Upper Beaver Creek
Nile Ditch	Upper Goose Creek
Upper Black Creek 2	Upper River Raisin 2
	Upper River Raisin 3
MODERATE:	Upper River Raisin 4
Black Creek	Upper West Bear Creek
Lower Black Creek 1	Wolf Creek
Lower River Raisin 5	
South Br River Raisin 1	VERY LOW:
Upper Black Creek 1	Dillingham Creek
West Bear Creek	Iron Creek
	Kedron Drain
LOW:	Lower Goose Creek
Beaver Creek	Lower River Raisin 2
Evans Creek	Norvell-Manchester Drain
Hazen Creek	Sweezy Lake Drain
Lower River Raisin 1	Upper River Raisin 1

It is estimated that approximately 42,000 pounds per year of nitrogen enter the River Raisin drainage basin through failed septic tanks (MDEQ, 2001). This is based on a septic system density of 23 systems per square mile, a failure rate of 10 percent, and a discharge rate of 220 gallons per day. This is a very liberal estimate, assuming that all failed septic effluent reaches surface waters. The 42,000 pounds per year nitrogen contribution accounts for approximately 0.8 percent of the estimated total load of 5,510,000 pounds per year of nitrogen into the TMDL reach. If 50 percent of all septic systems draining to the TMDL reach were assumed to be failing, the estimated nitrogen contribution rises to approximately 209,000 pounds per year, still a small portion (3.8 percent) of the total present annual load.

The application of lawn fertilizers to residential and commercial properties, including golf courses, is another potential source of nitrogen in the River Raisin basin. However, recent research indicates that lawn fertilization, while greatly increasing phosphorus levels in lawn runoff, has little effect on runoff nitrogen concentrations compared to nonfertilized lawns (USGS, 2002). Nitrogen loads resulting from septic tank failure and lawn fertilization are accounted for in the SPARROW model's nonagricultural land load classification.

LINKAGE ANALYSIS

The link between the nitrate concentration in the River Raisin and the identified sources to the river and its tributaries is the basis for the development of the TMDL. The linkage is defined as the cause and effect relationship between the selected indicators and the identified sources. This provides the basis for estimating the total assimilative capacity of the river and any needed load reductions. For this TMDL, the presence of elevated nitrate levels in the River Raisin and the large confirmed and estimated loadings of nitrogen from point and NPS is the inherent link. The large quantities of nitrogen applied to farm fields and lost in animal manure in various forms can eventually be converted to soluble nitrate which is easily lost to surface waters.

TMDL DEVELOPMENT

The TMDL represents the maximum loading of nitrogen that can be assimilated by the water body while still achieving WQS. As indicated in the Numeric Target section, the target for this nitrate TMDL is the MCL of 10 mg/l nitrate as a maximum. The TMDL development also defines the environmental conditions that will be used when defining allowable levels of pollutants. The "critical condition" is defined as the set of environmental conditions that, if controls are designed to protect, will ensure attainment of objectives for all other conditions. For example, the critical conditions for the control of point sources in Michigan are given in R 323.1082 (mixing zones) and R 323.1090 (applicability of WQS). In general, the lowest monthly 95 percent exceedance flow and 90 percent occurrence temperature for streams are used as design conditions for conventional pollutant loadings.

For this TMDL, the critical condition is considered the spring and early summer wet weather (snow melt and rain) season. It is at this time that newly applied fertilizers and manure have the greatest potential for runoff from fields to surface waters where they may cause exceedances of the 10 mg/l MCL. During other times of the year, fertilizer and manure application rates are lower or nonexistent, and rainfall less, resulting in lower nitrate loadings and ambient river concentrations below 10 mg/l (Tables 2 and 3).

The NPS loadings of pollutants play a significant role in the River Raisin near Deerfield's nitrate standard nonattainment. This TMDL follows a phased approach due to inherent uncertainties in estimating loadings from NPS. Under the phased approach, LAs and WLAs are calculated using the best available data and information, recognizing the need for additional monitoring data to determine if the load reductions required by the TMDL result in WQS attainment. The phased approach provides for the implementation of the TMDL while additional data are collected, if necessary, to reduce uncertainty (USEPA, 1991).

ALLOCATIONS

TMDLs are comprised of the sum of individual WLAs for point sources and LAs for NPS and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. The overall loading capacity is subsequently allocated into the TMDL components of WLAs for point sources, LAs for NPS, and the MOS. Table 9 contains total estimated existing and TMDL target nitrogen loads to the River Raisin at Deerfield.

LA

Agricultural sources (commercial fertilizer and animal manure) are the largest estimated controllable sources of nitrogen to the River Raisin (Table 4). Sampling data shows that nitrate MCL nonattainment of the Deerfield WTP's finished water occurs most often in the spring and early summer months, coinciding with increased precipitation, snow melt, and agricultural applications of manure and fertilizer. Therefore, this TMDL will target the fertilizer and livestock waste nitrogen sources for reductions. Reducing the application of nitrogenous fertilizers and manure to agronomical rates, combined with managing the timing of nitrogen applications, should greatly reduce nitrogen loads to the River Raisin.

Table 2 shows that the maximum concentration of nitrate found at either the Blissfield or Deerfield WTPs' intakes in 2003 and 2004 were 16.6 mg/l. In order to reduce this concentration to a maximum of 10 mg/l to meet the nitrate MCL in the Deerfield WTP's finished water, an instream nitrate reduction of 40 percent is required. Assuming that the reduction of annual nitrogen load will result in a similar reduction of River Raisin nitrate levels, a 40 percent reduction of total annual nitrogen loads would achieve this goal. Watershed studies (Blomquist & Fisher, 1994) have shown that basins high in agricultural activity such as the Raisin have the highest yields of in-stream nitrate for a given amount of nitrogen applied in the drainage area. This is especially true where commercial fertilizers are used. The relationship between total nitrogen inputs and nitrate loadings is complex and cannot always be predicted. This TMDL's total nitrogen reduction goals may be reevaluated under the phased approach depending on the results of future monitoring. A tributary-specific strategy for nitrogen reduction, as suggested by Blomquist and Fisher, may be appropriate.

Animal manure and fertilizers are estimated to account for 70 percent of annual nitrogen loads to the TMDL reach. To achieve an overall reduction of 40 percent in river nitrate levels, fertilizer and manure loads would have to be reduced by 57 percent while all other loads remained the same. A margin of safety of 10 percent will be incorporated by further reducing manure and fertilizer nitrogen loads by an additional 10 percent, for an overall reduction of 61 percent in fertilizer and livestock waste nitrogen loads. With the margin of safety included, the overall annual nitrogen load to the TMDL reach will be reduced by 43 percent, from the current estimate of 5,510,000 pounds per year to 3,134,000 pounds per year.

See Table 9 for River Raisin at Deerfield nitrate source allocations and numeric targets. Fertilizer and livestock waste loadings have been reduced by 61 percent in the LA as compared to existing loads. All other nitrogen loads remain equal to the current load under this TMDL.

TABLE 9
Annual nitrogen load source allocations and numeric targets River Raisin at Deerfield

Water Body	Current Annual Nitrogen Load (lbs)	Annual Nitrogen Load Numeric Target (lbs)	WLA Annual Nitrogen Load (lbs)	LA Annual Nitrogen Load (lbs)
RIVER RAISIN :				
Fertilizer	3,273,000	1,267,000	-	1,267,000
Atmospheric deposition	1,157,000	1,157,000	-	1,157,000
Livestock waste	603,000	233,000	-	233,000
Nonagricultural land uses (WLA) *	102,000	102,000	102,000	-
Nonagricultural land uses (LA) **	141,000	141,000	-	141,000
Point sources ***	234,000	234,000	234,000	-
Totals:	5,510,000			
Annual Nitrogen Load Numeric Target To TMDL Reach	-	3,134,000	336,000	2,798,000

* - Attributed to industrial and commercial land uses in the TMDL reach drainage basin. Includes loads from industrial storm water permittees.
** - Attributed to forest, grassland, and pasture nonagricultural lands.
*** - Includes all the NPDES permitted facilities except industrial storm water permittees.

Table 10 outlines townships that have lands contributing nitrogen loads to the River Raisin TMDL reach.

TABLE 10
Townships in the TMDL reach drainage basin

Hillsdale County:	Lenawee County cont.:
Somerset	Ogden
	Palmyra
Jackson County:	Raisin
Columbia	Riga
Grass Lake	Rollin
Napoleon	Rome
Norvell	Seneca
	Tecumseh
Lenawee County:	Woodstock
Adrian	
Blissfield	Washtenaw County:
Cambridge	Bridgewater
Clinton	Freedom
Deerfield	Manchester
Fairfield	Pittsfield
Franklin	Saline
Hudson	Sharon
Madison	
Medina	

WLA

No nitrogen load reductions are proposed under this TMDL's WLA. All point sources, including industrial storm water permittees, will be unaffected by this TMDL. After a 61 percent reduction in fertilizer and livestock waste nitrogen loads, nitrogen sources under the WLA still account for approximately just 10 percent of the total annual load.

MOS

The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can be either implicit (i.e., incorporated into the TMDL analysis through conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an explicit MOS with the additional 10 percent target load reduction from fertilizer and animal manure nitrogen sources. This results in a fertilizer and manure load reduction target of 61 percent, over and above the computed necessary 57 percent load reduction from those sources.

SEASONALITY

Sample data from the intakes at the Blissfield and Deerfield WTPs from 2003 through 2004 show that nitrate has exceeded the 10 mg/l nitrate MCL during the months of December, March, April, May, and June (Table 2) at one or both facilities. These months correspond to times of wet weather and high streamflow, and also correspond to periods of fertilizer and manure application on agricultural lands. A decrease in the application of nitrogen (commercial fertilizers and manure) to agricultural lands, along with the management of nitrogen application timing, will reduce the likelihood of River Raisin nitrate standard exceedances in the spring and early summer, as well as any other month less likely to see nitrate standard exceedances.

MONITORING

This TMDL's phased approach requires that future monitoring be conducted to assess whether activities implemented under the TMDL result in water quality improvements. The Deerfield and Blissfield WTPs will continue to monitor for nitrates in both the raw intake water from the River Raisin and their finished water on a daily basis as long as they continue to operate. These data will be used to determine whether the recommendations outlined in the TMDL for nitrogen reductions are effective in meeting the TMDL goal.

Monitoring will be conducted by the WB to further delineate nitrogen sources as resources allow. Typically, the WB monitors watersheds in accordance with the five-year NPDES permit review process. The River Raisin will be reevaluated in 2008, when the River Raisin basin is next scheduled for monitoring. Limited nitrate monitoring may be conducted in the meantime.

Nitrate standard attainment will result in the water bodies being removed from the Section 303(d) list, while continued nonattainment will result in further evaluation under the TMDL process.

REASONABLE ASSURANCE ACTIVITIES

Under the NPDES permit program, point sources in and above the TMDL reach are responsible for meeting their effluent limits for nitrogenous substances. Compliance is determined based on review of Discharge Monitoring Report (DMR) data by the MDEQ. Existing DMR data reviewed by the MDEQ indicates these facilities are meeting those permit limits, including limits for ammonia nitrogen. No point sources are known to analyze their effluents for nitrate. Typically, municipal WWTPs will be subject to ammonia limits under their NPDES permits, and these WWTPs typically have effluent nitrate levels near 10 mg/l.

The NRCS and the MSUE provide technical assistance along with educational materials and training on nitrogen management. The NRCS also has cost-share available to assist producers with nutrient management practices and for vegetative practices such as cover crops. In addition to the NRCS and the MSUE, one of the components of the Michigan Agriculture Environmental Assurance Program (MAEAP) is the cropping systems component. One key aspect of the cropping system is proper nitrogen management practices. The MAEAP is a proactive, voluntary program that works with producers to implement pollution prevention practices and ensure compliance with environmental regulations.

The River Raisin Watershed Council is currently developing a watershed management plan and is applying for a grant under Section 319 of the Clean Water Act. The group plans on monitoring water quality as part of their efforts. Land use issues, including agricultural nutrient management practices, will be addressed in the plan. The plan must be approved by the WB before Section 319 funds can be released for any activities under the plan.

As discussed in the Source Identification section of this TMDL, the MDEQ, the MACD, and the NRCS have collaborated to produce the River Raisin GeoBook watershed management and planning tool. These agencies realize the impact of agricultural practices on the River Raisin, especially in light of that resource's use as a source of drinking water. Local governments have access to the GeoBook analyses and the resources of the partnered agencies in making decisions that may affect nitrate loadings to the Raisin.

The USEPA's Great Lakes National Program Office, the WB, and others are involved in River Raisin water quality issues through their involvement in the Lake Erie Lakewide Area Management Plan (LaMP). As part of the LaMP, nutrient inputs to Lake Erie have been studied and associated impacts assessed. Farming and land use planning is currently being evaluated throughout the Lake Erie basin, and recommendations for reducing nutrient loads will be included in their evaluation.

The Southeast Michigan Council of Governments (SEMCOG) is involved in River Raisin water quality through the Water Quality Management Plan for Southeast Michigan released in 1999. The SEMCOG is the Areawide Water Quality Planning Agency designated under CWA. The plan contains water quality management policies on a broad range of issues including infrastructure, monitoring, management, NPS pollution, storm water, pollution prevention, and public education. These policies are directed to various agencies and organizations that have a role in the stewardship of the region's water resources (SEMCOG, 2000). The Water Quality Management Plan Task Force includes county drain commissioners and planning authorities, city and township officials, university professors, and private environmental firms. The SEMCOG coordinates with and acts as an information clearinghouse to agencies outside its jurisdiction.

All parties involved with River Raisin water quality activities recognize the importance of managing the application of nitrogen to farmlands. All will work to reduce manure and fertilizer use to agronomic rates. Soil testing prior to fertilizer application in order to determine how much nitrogen is needed for a given crop is encouraged and will be further promoted. The economic benefits of such practices to the farmer will also be stressed. Managing the timing of fertilizer and manure applications, the use of cover crops, split applications, and nitrification inhibitors, the proper accounting for manure, organic matter, and legume nitrogen credits, and the application of realistic yield goals, can all contribute to nitrogen load reductions in the watershed. Tile in-line control structures can also reduce nitrogen loads while aiding in field moisture retention.

The WB has conducted escalated enforcement actions against some of the larger CAFOs in Lenawee and Hillsdale Counties. Settlements were reached out of court with the owner of two of the largest CAFOs in both counties, outside the River Raisin Watershed. The settlement requires improved techniques for manure application. The mandated measures resulting from these actions will reduce nitrates loads originating from animal manure sources. Presently, the WB is engaged in negotiations with two more Lenawee County facilities in the River Raisin Watershed. Further nitrate load reductions can be expected as the WB implements the NPDES CAFO Permit Program and pursues enforcement actions where necessary to achieve compliance.

Existing CAFOs which are not under the WB escalated enforcement are subject to the CAFO general permit (MIG44000). This permit contains the following provisions regarding the CAFOs and land-applied fields:

- land application of nitrogen must be limited to that utilized by crops in one year
- no discharges that cause or contribute to a violation of WQS are allowed
- the containment of all contaminated runoff at the production area is required

- applications to frozen or snow-covered ground are limited to fields with a low risk of runoff
- buffers or equivalent practices at both production areas and land application areas that are sufficient to prevent the discharge of pollutants are required

Beginning in the fall of 2005, the WB will add new requirements to the CAFO general permit and individual NPDES permits issued to CAFOS. These new permit requirements will apply to all new CAFOs and any existing CAFOs that seek to renew coverage under the CAFO general permit. Some additional requirements to the above requirements are:

- field-by-field analyses to show application of nutrients at an agronomic rate must be conducted
- manure applications must be injected or incorporated within 24 hours (with some exceptions)
- manure applications are prohibited if half inch or more of rain is predicted within 24 hours
- certain setbacks are required for land application

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REFERENCES

Blomquist, J. D., and Fisher, G. T., 1994, Nitrogen sources and nitrate loads in major watersheds of the Upper Potomac River Basin: EOS, Transactions of the American Geophysical Union, v. 75, n. 16, p. 165, Supplement with abstracts for the 1994 Spring Meeting, Baltimore, Md.

Cave, K., T. Quarsebarth, and E. Harold. 1994. Selection of storm water pollutant loading factors. Rouge River National Wet Weather Demonstration Project Technical Memorandum RPO-MOD-TM34.00. Detroit, Michigan.

Day, R. 1990. Estimated Loadings from seven Michigan tributaries and recommendations for tributary sampling strategies. Michigan Department of Natural Resources, Surface Water Quality Division. Report No. MI/DNR/SWQ-90/010.

Heidelberg College. 2003. Reports from the Ohio Tributary Monitoring Program Annual Loads of Sediment, Nutrients, and Chloride.

MDEQ. 2001. The Status Of The On-Site Wastewater Industry In Michigan Year 2001. Drinking Water and Radiological Protection Division, Environmental Health Section.

MSUE. Soils & Soil Management - Fertilizer – 06039714 07/10/97. Nitrogen Recommendations for Corn. April 3, 2005. http://web1.msue.msu.edu/msue/imp/modf1/06039714.html

NADP. 2000. Nitrogen in the Nation's Rain. NADP Brochure 2000-01b (revised). 4M—2000—99-2975. March 29, 2005. http://nadp.sws.uiuc.edu/lib/brochures/nitrogen.pdf

NASS. FedStats. National Agricultural Statistics Service web site. February 7, 2005. http://www.fedstats.gov/key_stats/NASSkey.html

NRCS. RCA III Nutrient use in cropland agriculture (Commercial fertilizer and manure): nitrogen and phosphorus. Working paper No. 14. February 1996.

Pacific Meridian Resources. 2000. River Raisin Watershed GeoBook CD-ROM. Ann Arbor, Michigan.

Purdue University and USEPA. Long Term Hydrological Impact Assessments (L-THIA) Web Site, February 3, 2005. <http://www.ecn.purdue.edu/runoff/lthianew>

Richards, P.L. 1999. Agricultural tile drainage in Southeast Michigan: extent, impact, and simulation in hydrological models. Unpublished manuscript.

SEMCOG. 1999. Water Quality Management Plan for Southeast Michigan.

USDA. National Agriculture Statistics Service. Quick Stats: Agricultural statistics database. March 3, 2005. <http://www.nass.usda.gov/QuickStats/ >

USEPA. 1991. Guidance for Water Quality-Based Decisions: The TMDL Process. EPA 440/4-91-001. USEPA, Assessment and Watershed Protection Division, Washington, DC.

USGS. Effects of Lawn Fertilizer on Nutrient Concentration in Runoff from Lakeshore Lawns, Lauderdale Lakes, Wisconsin. Water-Resources Investigations Report 02–4130, July 2002. <http://wi.water.usgs.gov/pubs/wrir-02-4130/wrir-02-4130.pdf>

USGS. SPARROW-SPAtially Referenced Regressions On Watershed Attributes web utility, March 11, 2005. <http://water.er.usgs.gov/nawqa/sparrow/index.html>

University of Minnesota Extension Service, Understanding Nitrogen in Soils web site, March 20, 2005. <http://www.extension.umn.edu/distribution/cropsystems/DC3770.html>

Wolf, S. and J. Wuycheck. 2004. Water Quality and Pollution Control in Michigan: Sections 303(d) and 305(b) Integrated Reports. MDEQ, SWQD, Report #MI/DEQ/WB-04/029.

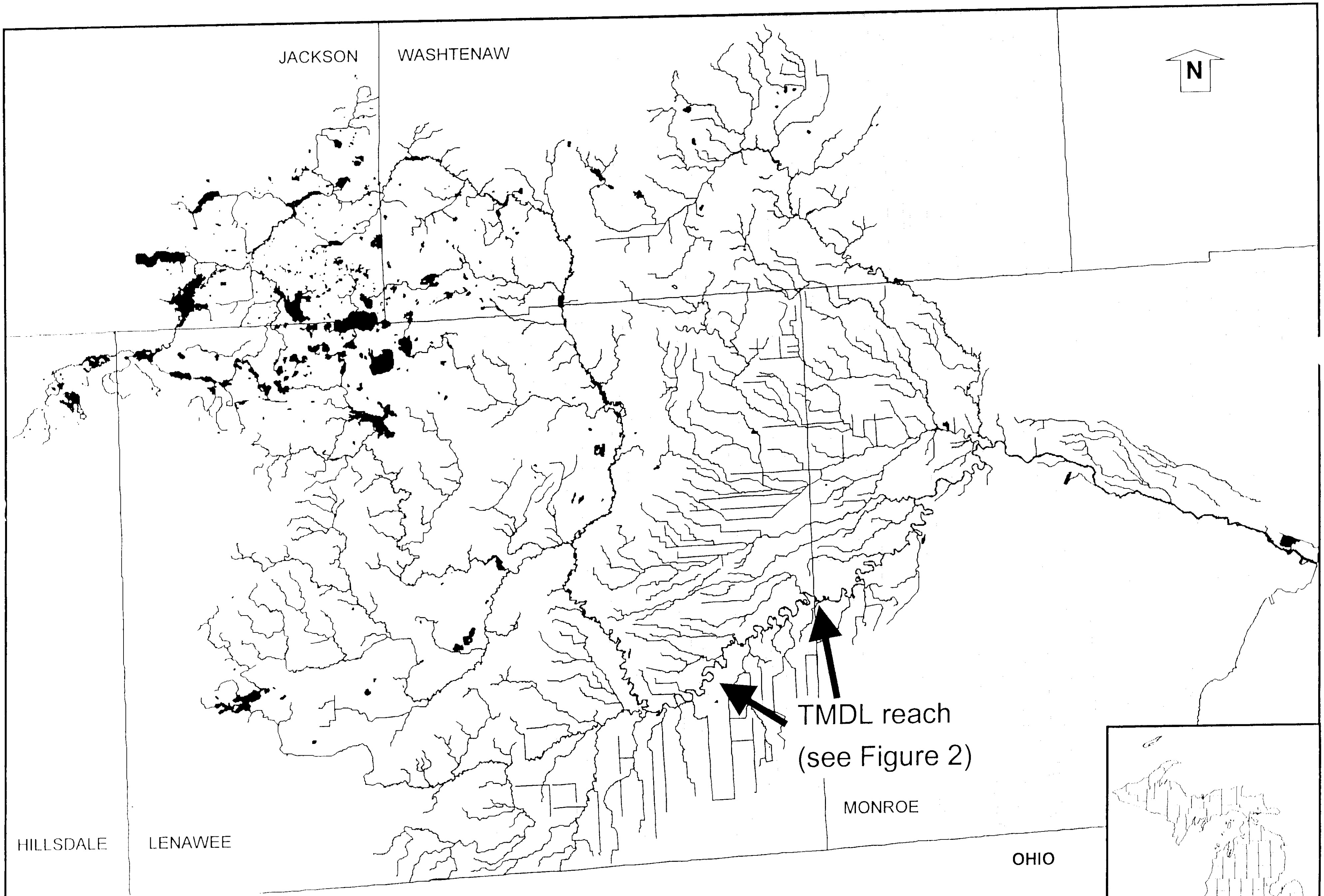

Figure 1 - River Raisin watershed (HUC 04100002), Hillsdale, Jackson, Lenawee, Monroe, and Washtenaw Counties.

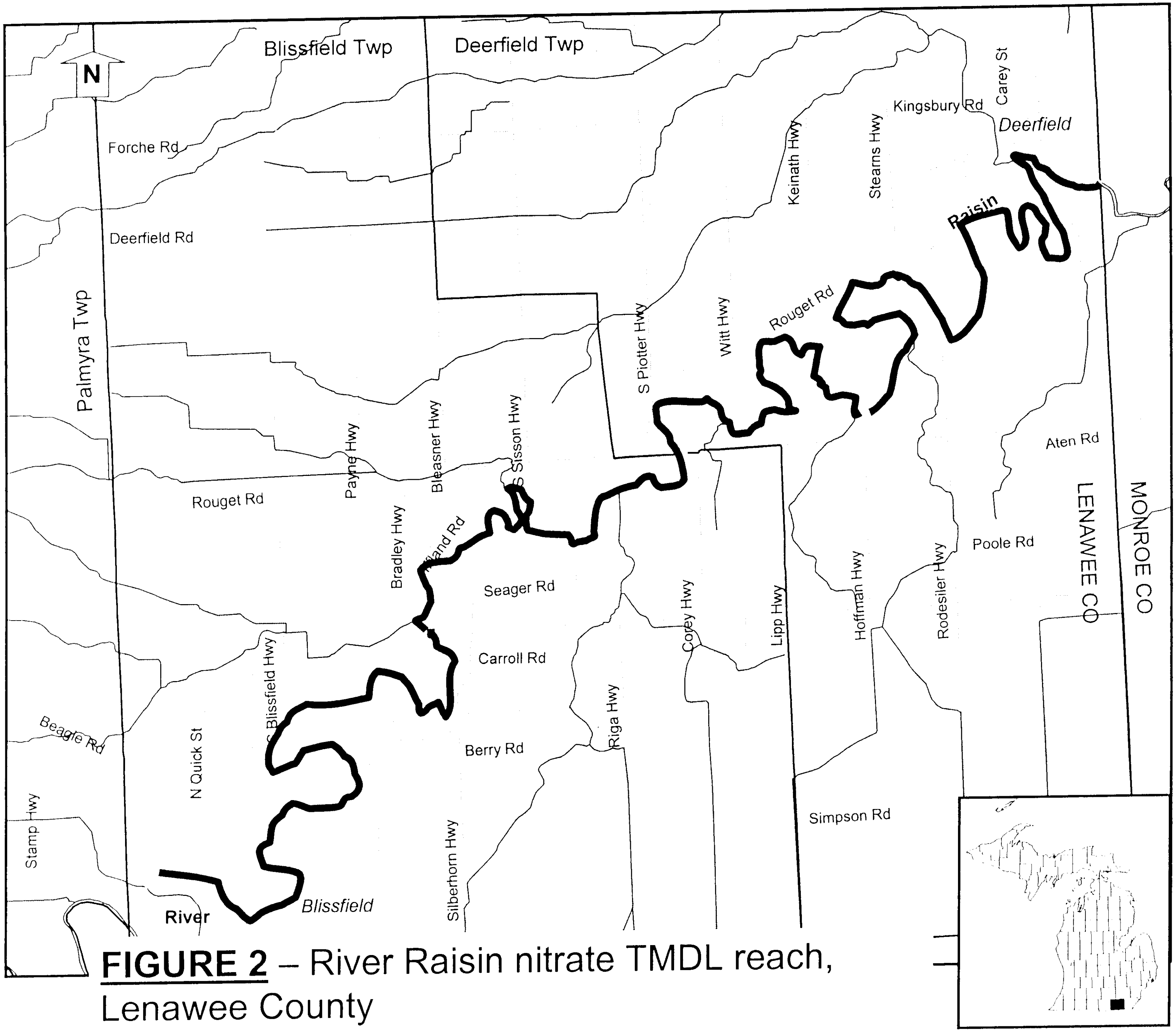

FIGURE 2 – River Raisin nitrate TMDL reach, Lenawee County

APPENDIX A - PERMITTED OUTFALLS TO THE RIVER RAISIN ABOVE DEERFIELD

TABLE A.1
Individual and general (non-stormwater) NPDES permitted outfalls to the River Raisin above Deerfield
Source: MDEQ/WD NPDES Permit Management System (NMS)

PERMIT NUMBER	FACILITY	RECEIVING WATER	DESIGN FLOW (MGD)	LATDD	LONGDD	WLA % N load reduction
Individual NPDES Permits						
MI0002011	Sorenson Paperboard Corp	River Raisin	0.25	41.900	-84.100	0 %
MI0020583	Tecumseh WWTP	River Raisin	1.61	42.002	-83.932	0 %
MI0021661	Clinton WWTP	River Raisin	0.45	42.064	-83.976	0 %
MI0021695	Blissfield WWTP	Raisin River	0.57	41.838	-83.850	0 %
MI0022152	Adrian WWTP	Raisin River South Branch	7.0	41.921	-84.021	0 %
MI0023442	Deerfield WWTP	River Raisin	0.14	41.885	-83.769	0 %
MI0023507	Manchester WWTP	River Raisin	0.55	42.150	-84.025	0 %
MI0026034	Wacker Chem Corp	River Raisin	0.25	41.943	-83.947	0 %
MI0028304	Onsted WWTP	Wolf Creek	1.5	41.996	-84.165	0 %
MI0043974	Travis Pointe-Lodi Twp WWTP	Rouse Drain	0.06	42.213	-83.786	0 %
MI0048232	Adrian LF	River Raisin	0.06	41.892	-83.992	0 %
MI0053848	Lenawee Co-Loch Erin WWTP	Evans Creek	24 MGY	42.042	-84.125	0 %
MI0055387	Cement City MHP	Reeds Lake	0.80	42.956	-85.621	0 %
MI0056308	Palmyra Twp WWTP	unnamed trib of Honey Creek	0.4	42.281	-83.806	0 %
MI0056375	Britton Estates MHP	Coats Drain	0.072	41.980	-83.822	0 %
MI0057189	Clinton Twp WWTP	River Raisin	0.05	42.042	-83.958	0 %
MI0057536 (CAFO)	Hartland Farms	tributaries to the River Raisin	9 MGY	41.894	-84.274	0 %
General Permits:						
MIG250045	PlasTechs Inc	Wood Outlet Drain	0.002	42.183	-83.750	0 %
MIG250410	Blissfield Mfg Co	Raisin River	0.04	41.824	-83.861	0 %
MIG250411	Dura Convert Sys E Beecher	Raisin River South Branch	0.01	41.891	-84.015	0 %
MIG250412	Aget Mfg Co	Raisin River South Branch	0.003	41.896	-84.017	0 %
MIG250413	PPG Industries Inc	Savage Drain	0.02	41.875	-84.017	0 %
MIG250425	Diehl Inc-Adrian Plant	Raisin River South Branch	0.5	41.900	-84.033	0 %
MIG490235	Jude Stonequarry	Austin Drain No. 1	0.025	42.162	-84.236	0 %
MIG490262	Sylvester Material-Clinton	wetland tributary to Iron Creek	2.0	42.101	-83.988	0 %
MIG580319	Clayton WWSL	South Branch Raisin River	12.6 MGY	41.875	-84.250	0 %
MIG580323	Fairfield Twp WWSL-Jasper	Black Creek	37 MGY	41.792	-84.025	0 %
MIG580323	Fairfield Twp-Weston Sec WWSL	Black Creek	19 MGY	41.750	-84.125	0 %
MIG580348	Britton/Ridgeway WWSL	Schreeder Brook	35 MGY	41.992	-83.818	0 %
MIG580360	Westlake MHP	unnamed tributary to the River Rais	17.6 MGY	42.075	-83.996	0 %
MIG580391	Mooreville WWSL	Turtle Creek	2.9 MGY	43.465	-82.978	0 %
MIG580392	Lenawee CDC-Wamplers Lk WWSL	Evans Creek	105 MGY	42.042	-84.125	0 %
MIG640209	Madison Charter Twp-WTP	unnamed tributary to the South Bra	0.045	41.867	-84.050	0 %
MIG640210	Brooklyn WTP	Raisin River	0.029	42.111	-84.246	0 %
MIG640224	Adrian WTP	Wolf Creek	31 MGY	41.983	-84.117	0 %

TABLE A.2

NPDES permitted industrial stormwater outfalls to the River Raisin above Deerfield

PERMIT NUMBER	FACILITY	TYPE	LATDD	LONGDD	WLA % N load reduction
MIS310144	Collins & Aikman-Manchester	Industrial Stormwater Only	43.895	-85.269	
MIS310176	Con-Way Central Express-Ypsi	Industrial Stormwater Only	42.299	-85.086	0 %
MIS410543	Martinrea-Manchester Div	Industrial Stormwater Only	43.871	-85.497	0 %
MIS510065	UPS-Adrian	Industrial Stormwater Only	46.758	-88.458	0 %
MIS510068	B & U Corp-Adrian	Industrial Stormwater Only	44.722	-85.842	0 %
MIS510069	Great Lakes Insulspan	Industrial Stormwater Only	43.980	-86.441	0 %
MIS510070	Riverbend Timber Framing	Industrial Stormwater Only	42.278	-83.131	0 %
MIS510073	Adrian Asphalt Company	Industrial Stormwater Only	42.424	-84.365	0 %
MIS510079	Roto Plastics Corp	Industrial Stormwater Only	43.689	-84.760	0 %
MIS510088	Tecumseh Corrugated Box Co	Industrial Stormwater Only	43.094	-85.174	0 %
MIS510125	Adrian Fabricators	Industrial Stormwater Only	42.424	-84.365	0 %
MIS510127	Pilkington-Clinton	Industrial Stormwater Only	43.838	-83.288	0 %
MIS510138	Foster Auto Sales	Industrial Stormwater Only	46.270	-87.445	0 %
MIS510147	Nagys Auto Sales #1	Industrial Stormwater Only	43.219	-86.336	0 %
MIS510148	Johnsons Used Cars & Parts	Industrial Stormwater Only	43.951	-86.219	0 %
MIS510175	Uniloy Milacron Inc	Industrial Stormwater Only	42.279	-83.738	0 %
MIS510185	Metalforming Technologies Inc	Industrial Stormwater Only	42.464	-83.800	0 %
MIS510187	Delphi-Adrian	Industrial Stormwater Only	42.931	-85.731	0 %
MIS510188	Dura Convert Sys W Beecher	Industrial Stormwater Only	41.891	-84.015	0 %
MIS510189	Faraday LLC	Industrial Stormwater Only	44.242	-85.088	0 %
MIS510190	Inergy Automotive Systems Inc	Industrial Stormwater Only	42.254	-84.428	0 %
MIS510191	Merillat Industries-Adrian	Industrial Stormwater Only	45.104	-87.618	0 %
MIS510192	Hydro Aluminum Adrian Inc	Industrial Stormwater Only	43.430	-82.546	0 %
MIS510196	Biolab Inc-Adrian	Industrial Stormwater Only	43.853	-84.303	0 %
MIS510197	Tecumseh Products Co	Industrial Stormwater Only	43.094	-85.174	0 %
MIS510215	Adrian Steel Company	Industrial Stormwater Only	41.892	-83.992	0 %
MIS510216	Jebco Mfg Inc	Industrial Stormwater Only	42.276	-84.406	0 %
MIS510218	Redi-Mix Concrete-Adrian	Industrial Stormwater Only	42.092	-83.365	0 %
MIS510219	Pallox Inc	Industrial Stormwater Only	42.281	-83.806	0 %
MIS510220	Hardwoods of Michigan-Clinton	Industrial Stormwater Only	45.157	-84.644	0 %
MIS510222	Silbond Corp	Industrial Stormwater Only	43.873	-85.500	0 %
MIS510224	Dusseau Auto Parts-Adrian	Industrial Stormwater Only	42.946	-84.033	0 %
MIS510225	Jackson Iron & Metal-Adrian	Industrial Stormwater Only	41.833	-86.351	0 %
MIS510226	Countryside Auto Recyclers	Industrial Stormwater Only	42.786	-84.679	0 %
MIS510227	Nagys Auto Sales #2	Industrial Stormwater Only	43.219	-86.336	0 %
MIS510228	Ervin-Ama Steel Div-Adrian	Industrial Stormwater Only	42.238	-83.313	0 %
MIS510229	Oliver Instrument Co-Adrian	Industrial Stormwater Only	43.650	-84.330	0 %
MIS510248	Kuhlman Concrete Inc-Adrian	Industrial Stormwater Only	42.646	-86.127	0 %
MIS510441	C & J Pallets Inc	Industrial Stormwater Only	42.838	-83.954	0 %
MIS510485	Royster-Clark Inc-Blissfield	Industrial Stormwater Only	43.689	-84.760	0 %
MIS510593	Cyltec LLC	Industrial Stormwater Only	43.951	-86.209	0 %
MIS510599	L&W Engineering Plt4	Industrial Stormwater Only	45.131	-87.616	0 %
MIS510620	Lenawee Stamping-Tecumseh	Industrial Stormwater Only	42.042	-84.125	0 %
MIS510635	CTE Sand & Gravel-Tecumseh	Industrial Stormwater Only	44.514	-86.002	0 %
MIS520020	PPG Industries Inc-Adrian	Industrial Stormwater Only	41.875	-84.017	0 %
MIS520023	Anderson Development Co-Adrian	Industrial Stormwater Only	42.746	-82.713	0 %