

Michigan Department of Environmental Quality
Water Division
September 2003

Total Maximum Daily Load for *Escherichia coli* for the St. Joseph River
Berrien County

INTRODUCTION

Section 303(d) of the federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations [CFR], 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. TMDLs provide a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the allowable levels of *Escherichia coli* (*E. coli*) that will result in the attainment of the applicable WQS in the St. Joseph River located in Berrien County, Michigan. This TMDL is being developed jointly with the state of Indiana. Both the Michigan Department of Environmental Quality (MDEQ) and the Indiana Department of Environmental Management (IDEM) have the St. Joseph River listed for *E. coli* impairment on their respective 303(d) lists of impaired water bodies. The MDEQ has the St. Joseph River listed from the Lake Michigan confluence in Morrison Channel upstream to the Michigan/Indiana state line. The IDEM has the St. Joseph River listed from the Michigan/Indiana state line in Elkhart County to the Michigan/Indiana state line in St. Joseph County. The MDEQ and IDEM have been working jointly to complete TMDLs on all listed segments of the St. Joseph River.

PROBLEM STATEMENT

This TMDL listing addresses approximately 32 miles of the lower St. Joseph River from the Lake Michigan confluence in Morrison Channel upstream to Michigan/Indiana state line. The TMDL reach is on the Section 303(d) list as:

ST. JOSEPH RIVER

County: BERRIEN

HUC: 4050001

WBID#: **083204G**

Size: 32 M

Location: Lake Michigan confluence in Morrison Channel u/s to Michigan/Indiana state line.

Problem: **CSO, pathogens (Rule 100)**

TMDL YEAR(s): 2003

RF3RchID: 4050001 2

The St. Joseph River (Figure 1) was placed on the Section 303(d) list due to impairment of recreational uses as indicated by the presence of elevated levels of *E. coli* (Creal and Wuycheck, 2002). Recent monitoring data collected by MDEQ for the 2002 monitoring season documented exceedances of the WQS for *E. coli* (130 *E. coli* per 100 milliliters [ml]) as a thirty-day geometric mean at all stations sampled. St. Joseph River stations upstream of the city of Buchanan generally exhibited higher exceedances of the WQS than stations downstream, exceeding the thirty-day geometric mean WQS for a majority of the sampling period (Table 1, Figure 2). Thirty-day geometric mean *E. coli* concentrations in this segment of

the river ranged from 91 *E. coli* per 100 ml, in July, at Business US-12 (SJ-4) to 601 *E. coli* per 100 ml, in August, at Cleveland Road (SJ-1) (Figure 2). Particularly high exceedances at Cleveland (SJ-1) and Bertrand Roads (SJ-2) occurred within 24-hours of a rain event (gage located in South Bend, Indiana). Daily geometric mean *E. coli* concentrations at these two stations were greater than 7,000 *E. coli* per 100 ml on three separate occasions. The two highest daily geometric mean *E. coli* concentrations, both within 24 hours of a rain event, were found at Bertrand Road (SJ-2) – 19,626 *E. coli* per 100 ml, in August, and 10,006 *E. coli* per 100 ml, in September, respectively.

Stations downstream of Buchanan also exceeded WQS (Table 2, Figure 3), although concentrations decreased in a downstream direction with exception of the M-63 (SJ-10) site. Thirty-day geometric means ranged from 18 *E. coli* per 100 ml at Pokagon Road (SJ-7) on September 13, to 395 *E. coli* per 100 ml at M-63 (SJ-10) on August 23. The three stations immediately downstream from Buchanan, Walton Road (SJ-5), US-31 (SJ-6), and Pokagon Road (SJ-7), appear to respond to precipitation events in a similar manner as indicated by exceedances during the May/June sampling. Conversely, the same three stations met the thirty-day geometric mean in a comparable manner for the remainder of the season. Moving further downstream, the stations at US-31/Scottdale Road (SJ-8), and Napier Road (SJ-9) show less response to precipitation events. These two locations exceeded the daily geometric mean early in the sampling, but exceeded the thirty-day geometric mean on only one occasion during the sampling season. The remaining station, M-63 (SJ-10), appeared to be more responsive to precipitation events as indicated by the early season sampling. Consistent exceedances of the thirty-day geometric mean began at the end of July and continued for the remainder of the sampling season. One isolated exceedance in July documented *E. coli* concentrations greater than 2,000 *E. coli* per 100 ml after only a small amount of precipitation.

NUMERIC TARGET

The impaired designated use addressed by this TMDL is total body contact recreation. Rule 100 of the Michigan WQS requires that this water body be protected for total body contact recreation from May 1 to October 31. The target levels for this designated use are the ambient *E. coli* standards established in Rule 62 of the WQS as follows:

R 323.1062 Microorganisms.

Rule 62. (1) All waters of the state protected for total body contact recreation shall not contain more than 130 *E. coli* per 100 ml, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during five or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of three or more samples taken at representative locations within a defined sampling area. At no time shall the waters of the state protected for total body contact recreation contain more than a maximum of 300 *E. coli* per 100 ml. Compliance shall be based on the geometric mean of three or more samples taken during the same sampling event at representative locations within a defined sampling area.

In addition, sanitary wastewater discharges have an additional target:

Rule 62. (3) Discharges containing treated or untreated human sewage shall not contain more than 200 fecal coliform bacteria per 100 ml, based on the geometric mean of all five or more samples taken over a 30-day period, nor more than 400 fecal coliform bacteria per 100 ml, based on the geometric mean of all three or more samples taken during any period of discharge

not to exceed seven days. Other indicators of adequate disinfection may be utilized where approved by the Department.

Sanitary wastewater discharges are considered in compliance with the WQS of 130 *E. coli* per 100 ml if their National Pollutant Discharge Elimination System (NPDES) permit limit of 200 fecal coliforms per 100 ml as a monthly average is met. This is assumed because *E. coli* are a subset of fecal coliform (American Public Health Association, 1995). Fecal coliform is substantially higher than *E. coli* (Whitman, 2001) when the wastewater of concern is sewage. It can reasonably be assumed that there are less than 130 *E. coli* per 100 ml in the effluent when the point source discharge is meeting its limit of 200 fecal coliform per 100 ml.

The WQS of 130 per 100 ml as a 30-day geometric mean is the target level for this TMDL reach from May 1 to October 31. The 2002 monitoring data indicated exceedances of WQS at all stations sampled as previously stated.

The impaired designated use for the St. Joseph River in Indiana is for the full body contact recreational use. The recreational season is from April 1 through October 31, as stated in Indiana Rule 327 IAC 2-1.5-8(e)(2) which establishes the full body contact recreational use *E. coli* WQS for all waters in the Great Lakes system as follows:

- (2) *E. coli* bacteria, using membrane filter count, shall not exceed 125 per 100 ml as a geometric mean based on not less than five samples equally spaced over a 30-day period nor exceed 235 per 100 ml in any one sample in a 30-day period.

In addition, Indiana Rule 327 IAC 2-1.5-8(e)(2) for point source discharges involving sanitary wastewater in the Great Lakes system also include effluent limits during the recreational season, which is designated from April 1 to October 31. The Indiana *E. coli* standard of 125 *E. coli* per 100 ml varies slightly from the Michigan standard of 130 *E. coli* per 100 ml. This difference is due to significant figure rounding (Michigan rounded to two significant figures, Indiana did not). Both state standards are based on 8 illnesses per 1,000 people making it possible for each state to use their respective WQS as a target for this TMDL. It is assumed that if the water in the St. Joseph River meets Indiana's WQS, that it will be meet Michigan's WQS as well.

SOURCE ASSESSMENT

The St. Joseph River watershed covered by this TMDL is located in Berrien County, Michigan. This watershed includes a small area in Indiana which drains to the Michigan portion of the St. Joseph River via tributaries in Berrien County. The *E. coli* TMDL reach covered in this TMDL is from the Lake Michigan confluence in Morrison Channel upstream to the Michigan/Indiana state line (Figure 1). The St. Joseph River has high flows in this reach, averaging over 1,000 cubic feet per second (cfs) each month (Table 3). The Michigan TMDL watershed is defined as approximately 937 square miles and includes 64 municipalities – Berrien and Niles Township are the largest and make up approximately 8% (Figure 4). This area also includes the portion of the watershed that drains into the Indiana portion of the St. Joseph River (Figure 4 – Interstate Drainage) and is covered by Michigan's TMDL. Table 4 shows the distribution of land for each municipality.

The primary pathogen sources for this water body are typical of urban and agricultural land uses. Combined sewer overflow (CSO) discharges, point source discharges, storm water discharges, agricultural inputs, and to a lesser degree, illicit discharges are all possible sources of *E. coli* to the St. Joseph River. Historical data found exceedances of the Fecal coliform

standard, an indicator organism used prior to *E. coli*, since the 1970's (Southwestern Michigan Commission, 1990). Elevated *E. coli* concentrations, as a result of precipitation events, are well documented downstream of communities with reported CSO discharges. In 2001, the Berrien County Health Department found substantial exceedances of the *E. coli* WQS after precipitation events (Berrien County, 2001). Subsequent sampling in 2002 by the MDEQ also documented exceedances of the WQS. Particularly high concentrations of *E. coli* were found at stations immediately upstream and downstream of the Indiana/Michigan state line and in relation to precipitation events and probable CSO discharges. The persistent exceedances of *E. coli* in the St. Joseph River prompted the Berrien County Health Department to issue a "Rainfall Plus 48-Hour Health Advisory" (Berrien County, 2001). Similar advisories have been in effect for the St. Joseph River since the late 1980's (Southwestern Michigan Commission, 1990). It is important to note that effects from CSO discharges are not necessarily found at all downstream sampling locations because of time of passage. All samples from the St. Joseph River were collected on the same day but do not represent the same point in time. Water quality near the state line may therefore differ from water quality near Lake Michigan. Assuming average flow conditions, the estimated time of passage from the state line to Lake Michigan is approximately two days.

Upstream sampling conducted by IDEM during the recreational season (April 1 through October 31) documented exceedances of the Indiana WQS for *E. coli* in 1997. Additional monitoring by the cities of Elkhart, Mishawaka, and South Bend also confirmed exceedances at multiple locations on the St. Joseph River upstream of Michigan between 2000 and 2003.

Two communities, Niles and St. Joseph, have permitted CSO discharges to the St. Joseph River. During the 2002 recreational season, the Niles Wastewater Treatment Plant (WWTP) (MI0023701) reported three discharges of approximately eight million gallons of partially treated sewage. In the same year, the city of St. Joseph (MI0026735) reported 11 discharges of approximately 7 million gallons of diluted raw sewage, while Benton Harbor and Buchanan each reported Sanitary Sewer Overflows (SSO) of less than 1 million gallons. Sampling data was reviewed to determine localized effects of CSO discharges. On August 23, 2002, M-63 (SJ-10) exceeded the daily geometric mean which corresponded with a reported discharge by the city of St. Joseph. This is likely a localized problem (versus an upstream source) because the two stations immediately upstream of M-63 met WQS on that particular date.

Another possible source of pathogens to the TMDL watershed could be due to agriculture, given that 58% of the watershed is dominated by that land use (Wesley and Duffy, 1999). Surface runoff and field tile drainage are two possible mechanisms for delivering *E. coli* to the St. Joseph River. Sampling by the United States Geological Survey (USGS) in 2001, illustrate the agricultural influences found in the watershed. Atrazine, a common agricultural herbicide, was found at elevated concentrations in the St. Joseph River in May 2001 (Reeves, 2003). Peak use for Atrazine is during the spring when tile drainage and runoff are prevalent. Finding elevated concentrations of Atrazine in May indicates that products applied to land in the watershed are being found in the river via surface runoff or field tiles.

As part of an additional effort to identify possible sources of *E. coli* to the TMDL watershed, the MDEQ collected one sample for Deoxyribonucleic acid (DNA) ribotyping analysis on October 3, 2002. This is a relatively new technology that extracts DNA from *E. coli* isolates. After a complex process, the DNA is compared to a library of known source isolates. The results of the ribotyping analysis indicate that on the day of sampling, the St. Joseph River at Bertrand Road (SJ-2) contained *E. coli* of non-human origin (Table 5).

There are 178 permitted point source discharges to the St. Joseph River TMDL watershed (Tables 6 & 7, Figures 5-7). Eighty are covered by general storm water permits and 38 are active NPDES permit Notice of Coverage for construction sites in portions of Berrien, Cass, and Van Buren Counties. An additional 37 are covered by other general permits, 15 of which are noncontact cooling water discharges and 8 are discharges containing gasoline and/or related petroleum products. Eleven of the remaining 14 general permits are for wastewater stabilization lagoons and secondary treated wastewater. A lagoon discharge permit contains fecal coliform limits and allows for a seasonal discharge between March and May and October and December. Secondary treated wastewater discharges contain year-round fecal coliform limits. The remaining three of the general permits cover hydrostatic test waters.

In addition to the above permits, there are 23 individual NPDES permits in the TMDL watershed (Table 6). Nine of the discharges are WWTPs and one is a CSO that contains treated or untreated human sewage. Discharges from these ten permitted discharges may contain treated or untreated human sewage; the permits have year-round fecal coliform limits.

The remaining 13 individual permit cover treated groundwater, noncontact cooling water, hydrostatic test water, fish rearing wastewater, and storm water and are not considered to contain treated or untreated human sewage. It should be noted that the storm water portion of these discharges is not considered a source of *E. coli* because the storm water is from sources where contamination would be unlikely (e.g., roof drainage, parking lot runoff, etc.). Therefore, the above discharges are not considered to be a source of *E. coli* to the St. Joseph River TMDL watershed and the requirements of Rule 62(3) do not apply.

LINKAGE ANALYSIS

The link between the *E. coli* concentrations in the St. Joseph River and the potential sources 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 sources. This provides the basis for estimating the total assimilative capacity of the stream and any needed load reductions. A significant amount of the pathogen load for this TMDL likely enters the St. Joseph River by both wet and dry weather sources such as CSO discharges, storm water discharges, agricultural runoff, and illicit connections.

To further investigate the potential sources mentioned above, a load duration curve analysis was developed for each sampling station on the St. Joseph River, as outlined in a paper by Cleland (2002). A load duration curve is a relatively new method utilized in TMDL development and considers how flow conditions relate to a variety of pollutant sources (point and nonpoint sources). In order to develop a load duration curve, continuous flow data is required. (Note: the USGS gage (4101500) located in Niles, Michigan, was used for the development of the load duration curve analysis for the Michigan portion of the St. Joseph River TMDL). The flow data is used to create flow duration curves, which display the cumulative frequency of distribution of the daily flow of the period of record. The flow duration curve relates flow values measured at the monitoring station to the percent of time that those values are met or exceeded. Flows are ranked from extremely low flows, which are exceeded nearly 100 percent of the time, to extremely high flows, which are rarely exceeded. Flow duration curves are then transformed into load duration curves by multiplying the flow values along the curve by applicable water quality criteria values for pathogens and appropriate conversion factors. The load duration curves are conceptually similar to the flow duration curves in that the x-axis represents the flow recurrence interval. The y-axis is the *E. coli* load scale represented as number of *E. coli* per day based on actual data. The curve representing the allowable load of *E. coli* was calculated using the daily geometric mean WQS of 300 *E. coli* per 100 ml. The final step in the development of a

load duration curve is to add the water quality data to the graphs. Pollutant loads were estimated from the data as the product of the pollutant concentrations, instantaneous flows measured at the time of sample collection, and appropriate conversion factors. To identify the plotting position of each calculated load, the recurrence interval of each instantaneous flow measurement was defined. Water quality monitoring data are plotted on the same graph as the load duration curve, which provides a graphical display of the water quality conditions in the water body. The monitoring data points that plot above the target line exceed the WQS; those that fall below the target line meet WQS (Mississippi DEQ, 2002).

The load duration curves for each station sampled on the St. Joseph River are included in Appendix A. The data indicate that while exceedances of the WQS are observed at upstream stations during wet weather events (noted by dots above the curve on the far left side of the figure), dry weather contributions are also a source of *E. coli* to the St. Joseph River (noted by the dots above the curve on far right side of the figure). This observation is further supported by a similar analysis of data collected by IDEM (2003 St. Joseph River TMDL).

The guiding water quality management principle used to develop the TMDL was that compliance with the numeric pathogen target in the St. Joseph River depends on the control of *E. coli* from CSOs, point source discharges, storm water, illicit connections, and agriculture influences. The control of CSO discharges is currently taking place through existing elimination plans in Michigan communities and with future elimination plans for upstream sources in Indiana. Point source discharges are required to meet permit limits for fecal coliform, and storm water and illicit connection inputs will be addressed by the implementation of Phase II Storm Water Permits. Agricultural influences can be inventoried in the land use evaluation portion of the St. Joseph River Watershed Planning Project – an active 319 Grant. This activity is likely to locate areas that may be contributing nonpoint source inputs of *E. coli* to the St. Joseph River.

TMDL DEVELOPMENT

The TMDL represents the maximum loading that can be assimilated by the water body while still achieving WQS. The target for this pathogen TMDL is the WQS of 130 *E. coli* per 100 ml as indicated in the Numeric Target section. TMDL development also defines the environmental conditions that will be used when defining allowable levels concurrent with the selection of a numeric concentration endpoint. Many TMDLs are designed around the concept of a “critical condition.” 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. The critical conditions for the control of point sources in Michigan are given in R 323.1082 and R 323.1090. The lowest monthly 95% exceedance flow for streams in general is used as a critical condition for point source discharges. However, levels are restricted to a monthly average limit of 200 fecal coliform per 100 ml regardless of stream flow for pathogens in point source discharges of treated or untreated human sewage. Therefore, the design stream flow is not a critical condition for determining the allowable loading of pathogens for WWTPs. Other sources to the St. Joseph River arise from a mixture of wet and dry weather driven nonpoint sources. There is no single critical condition in Michigan WQS that is protective for all other conditions. There are a number of different allowable loads for these sources that will ensure compliance, as long as they are distributed properly throughout the watershed.

TMDLs are expressed on a mass loading basis (e.g., pounds per day) for most pollutants. However, mass is not an appropriate measure for *E. coli*. The USEPA allows pathogen TMDLs to be expressed in terms of organism counts (or resulting concentration) (USEPA, 2001). Therefore, this pathogen TMDL is concentration-based consistent with R 323.1062, and the TMDL is equal to the target concentration of 130 *E. coli* per 100 ml, as a 30-day geometric

mean, in all portions of the TMDL reach for each month of the recreational season (May through October).

ALLOCATIONS

TMDLs are comprised of the sum of individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. The TMDL must include a margin of safety (MOS), either implicitly within the WLA and/or LA or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. This definition is denoted conceptually by the equation:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. This pathogen TMDL will not be expressed on a mass loading basis, and is concentration based, consistent with USEPA regulations in 40 CFR, Section 130.2(i). The St. Joseph River upstream of the Michigan/Indiana state line is considered a source of *E. coli* to Michigan waters; however, as part of the joint TMDL development process, this TMDL will assume that IDEM will cover the upstream contributions in their TMDL and that WQS will be met when the river enters Michigan. This upstream area also includes a portion of land that drains through Indiana to the St. Joseph River and is covered by Michigan's TMDL.

WLAs

There are a total of 178 permitted point source discharges to the listed reach of the St. Joseph River as previously mentioned. Eighty are storm water permits and 38 are construction permits involving the earth disturbances. Thirty-nine of the remaining 60 permits are not permitted to treat and discharge human waste therefore, Rule 62(3) does not apply. Of the remaining 21 permits, 13 WWTPs, 1 CSO (note there are two permitted CSO discharges; only one has a separate permit), and 7 Wastewater Sewage Lagoons (WWSLs), are permitted to treat and discharge human waste. Each of these facilities has a limit for fecal coliform and, as previously stated, when the WWTPs are meeting their fecal coliform permit limit, it is assumed the *E. coli* WQS will be met in the discharge. The WWSLs are permitted to discharge during the months of March through May; and October to December. The discharge period overlaps the recreational season in May and October only, and this discharge will be considered in compliance with the WQS of 130 *E. coli* per 100 ml if their NPDES permit limit of 200 fecal coliform per 100 ml as a monthly average is met. The WLA for the above facilities, including the 80 storm water permits, 38 construction permits, and 39 individual permits that are not sources of *E. coli*, will therefore be equal to 130 *E. coli* per 100 ml during the recreation season between May 1 and October 31. The communities of St. Joseph and Niles have permitted CSO discharges to the TMDL reach of the St. Joseph River. Both communities have reported discharges during the recreational season; therefore, the WLA will be 130 *E. coli* per 100 ml for the CSOs.

LAs

The LA incorporates those pathogen sources typically associated with urban and suburban runoff, as well as illicit connections. This TMDL is concentration based. Therefore, the LA is equal to 130 *E. coli* per 100 ml. The relative responsibility for achieving the necessary reductions of bacteria and maintaining acceptable conditions will be determined by the amount of land under the jurisdiction of the various units of local government in the watershed. The amount of land per jurisdiction gives a clear indication of the relative amount of effort that will be

required by each entity to restore and maintain the total body contact designated uses in the St. Joseph River.

The government entities with the largest percent land area in the St. Joseph River TMDL watershed are Berrien (4%) and Niles Townships (4%). The second largest percentage is made up of 34 townships, which have at least 1% of the total land area. The remaining percentage is shared among 28 townships, villages, and cities. The last category, despite making up the least amount of total land area, is very important because the majority of the population in the TMDL watershed are located in cities. Sixteen of the above municipalities will be required to obtain Phase II Storm Water permits. These permits will aid in finding and eliminating nonpoint sources of *E. coli* to the St. Joseph River. Permit requirements will include the development of a public participation plan, illicit discharge elimination plan, public education plan, watershed management plan, and a storm water pollution prevention initiative. Each permit requires an annual progress report with plan updates.

In addition to the areas mentioned above, a small portion of the watershed is made up of land in Indiana that directly drains into Michigan. This TMDL assumes that Indiana will account in their TMDL for any contributions made by this direct drainage.

MOS

This section addresses the incorporation of a MOS in the TMDL analysis. 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 WLA and LA analysis through conservative assumptions) or explicit (i.e., expressed in the TMDL as a discrete portion of the loadings). This TMDL uses an implicit MOS because no rate of decay is used. The MDEQ has determined that the use of the WQS of 130 *E. coli* per 100 ml is a more conservative approach, although pathogen organisms have a limited capability of surviving outside of their hosts and a rate of decay would normally be used. Applying a rate of decay could result in a discharge limit that would be greater than the WQS, thus no rate of decay is applied in order to provide for a greater protection of water quality. Applying the WQS to be met under all flow conditions also adds to the assurance of the MOS.

SEASONALITY

Seasonality in the TMDL is addressed by expressing the TMDL in terms of a total body contact recreation season that is defined as May 1 through October 31, by R 323.1100 of the WQS. There is no total body contact during the remainder of the year primarily due to cold weather. WQS will be met regardless of flow conditions in the applicable season because this is a concentration based TMDL.

MONITORING

Pathogens were monitored by the MDEQ at nine stations from May through September 2002. Future monitoring will take place during the rotating, five-year basin monitoring. When these results indicate that the water body may be meeting WQS, sampling will be conducted at the appropriate frequency as defined by R 323.1062 to determine if the 30-day geometric mean value of 130 *E. coli* per 100 ml is being met.

In addition to the MDEQ data collected in 2002, several other monitoring projects have taken place on the St. Joseph River both in Michigan and Indiana. Recent work in Michigan on the lower St. Joseph River was conducted by the Berrien County Health Department in 2001. The

work was made possible through a Clean Michigan Initiative grant, which aimed to intensively monitor *E. coli* at the Berrien county beaches, as well as in the St. Joseph River. The monitoring by the county provided up-to-date information on the levels of *E. coli* in the St. Joseph River and area beaches. The information in turn allowed them to make better decisions with regards to possible health risks and advisories. Data were also collected by IDEM and the cities of Elkhart, Mishawaka, and South Bend at fifteen stations in Indiana in 1997, and 2000 through 2003.

REASONABLE ASSURANCE ACTIVITIES

The WWTPs and WWSLs are responsible for meeting their NPDES permit limits for fecal coliform. Compliance is based on review of discharge monitoring report data by the MDEQ. The WWTPs are presently meeting their permit limits for fecal coliform.

Niles WWTP (MI0023701) is in the process of a CSO elimination project. The goal of the project will be the elimination or adequate treatment of combined sewage discharges from seven outfalls to the St. Joseph River. The project involves the capability to treat flows based on a one-year, one-hour storm event and includes a retention basin which is permitted to discharge when flows exceed plant capacity. The basin is designed for a ten-year, one-hour storm event and the combined sewage is disinfected prior to discharge. The project is expected to be completed in 2009.

The city of St. Joseph (MI0026735) is also in the process of a CSO elimination project. The plan requires the elimination or adequate treatment of combined sewage discharges from five outfalls to the St. Joseph River. The separation program is half complete with all work to be completed by 2013.

Two facilities reported SSO events that occurred during the 2002 recreational season; the Buchanan WWTP and the city of Benton Harbor. The overflow in Buchanan was the result of a power failure and has been corrected with the installation of a secondary power supply. The city of Benton Harbor reported an overflow due to equipment failure. The equipment has been replaced.

The Phase II Storm Water permit program will affect 16 cities/townships and 1 county (Berrien) in the TMDL watershed. The cities of Buchanan, Niles, Benton Harbor, and St. Joseph, as well as Bertrand, Buchanan, Howard, Milton, Niles, Benton, Lake, Lincoln, Ontwa, Royalton, Sodus, and St. Joseph townships will all be required to obtain Phase II Storm Water permits. Permit applications were due to the MDEQ on March 10, 2003, and will become effective on December 1, 2003. Activities due in the first year of permit issuance include the development of an illicit discharge elimination plan, development of a public participation plan, and an annual progress report. Activities in year two of the permit include the development of a public education plan and watershed management plan. Years three through five include the development of a storm water pollution prevention initiative, a revised watershed management plan, and revised pollution prevention initiatives, respectively. All plans and progress reports are submitted to the MDEQ for review and are anticipated to provide valuable information to aid in reducing *E. coli* inputs to the St. Joseph River.

There are several projects in the watershed that have a direct impact on the water quality of the St. Joseph River. The Friends of the St. Joe River Association, established in 1994, is a group with 29 chapters in Michigan and Indiana. The organization is very active in local communities with clean-up projects and volunteer monitoring programs. The major goal for the group is to link numerous activities and efforts in the St. Joseph River watershed together. They

accomplish this large task through a variety of ways, one of which is an informative web site (www.fotsjr.org) providing contact information to the regulatory community and information on other activities in the watershed. The Friends of the St. Joe were awarded a Section 319 Grant in 2002. The grant consists of eight tasks which will be of considerable benefit to the watershed. Two tasks, public education/participation and the development of a Watershed Management Plan, will be instrumental in identifying potential problems in the watershed at the local level. Other key activities, such as drainage basin characterization, will identify land uses in the watershed for future planning and decision-making with water quality issues a main goal. Finally, the creation of a web site (www.stjoeriver.net) will serve as a centralized source of information for this large watershed. The web site will provide the latest progress of the group on the defined tasks and serve as a means of sharing information with other partners in the watershed.

The Dowagiac River Group has one project currently underway titled Meeting the Ecological and Agricultural Needs within the Dowagiac River System (MEANDRS). The Dowagiac River is a tributary to the St. Joseph River. The MEANDRS project is a pilot river channel restoration project seeking to restore the natural flows and riparian zones in the river. The Dowagiac River Watershed Project, now complete, focused on preserving the hydrology and water quality in the watershed by implementing institutional and long-term mechanisms to guide land use decisions. The project provided one-on-one opportunities with local communities in the watershed regarding planning issues. Work by both groups has led to better decisions in master plans and zoning ordinances and increased public awareness on water quality issues.

Both the states of Indiana and Michigan are working cooperatively on a TMDL for the lower St. Joseph River. IDEM has focused their efforts from the city of Elkhart downstream to the Indiana/Michigan state line; the MDEQ has concentrated on the remaining 32 miles prior to the confluence with Lake Michigan. The IDEM's efforts to address CSO discharges in five municipalities are critical in controlling wet-weather WQS exceedances in the St. Joseph River in both Indiana and Michigan. These municipalities are developing Long-Term Control Plans (LTCPs) for CSOs with a goal to meet WQS. These plans must be approved by the IDEM and the USEPA before they are considered final. All the LTCPs for the affected cities in Indiana should be approved by early 2006. The combined efforts of the two state agencies have resulted in a partnership that will ultimately reduce and/or eliminate the major sources of *E. coli* to the St. Joseph River.

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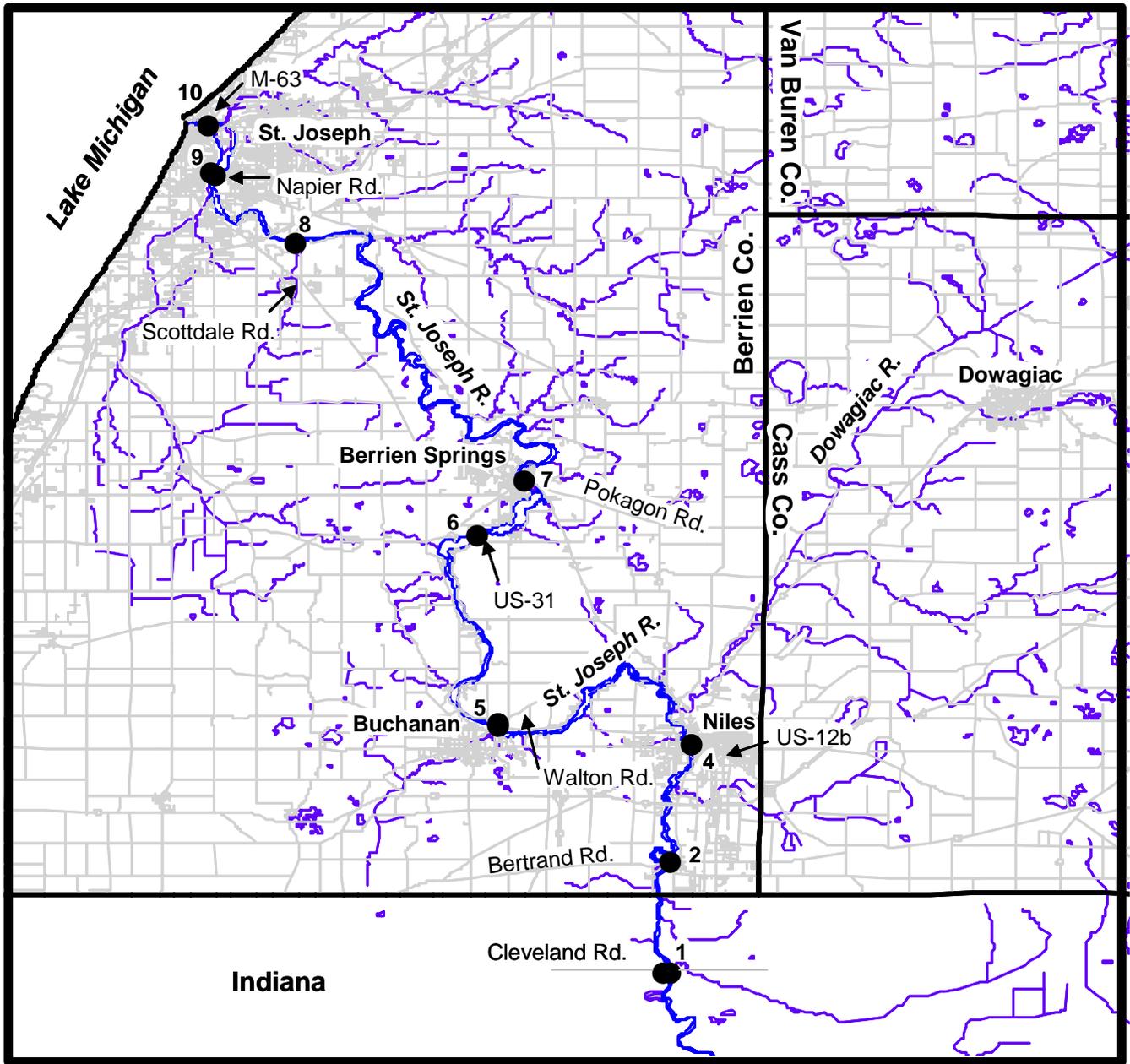


Figure 1. The St. Joseph River *E. coli* sampling locations, vicinity of Berrien County, Michigan, 2002.

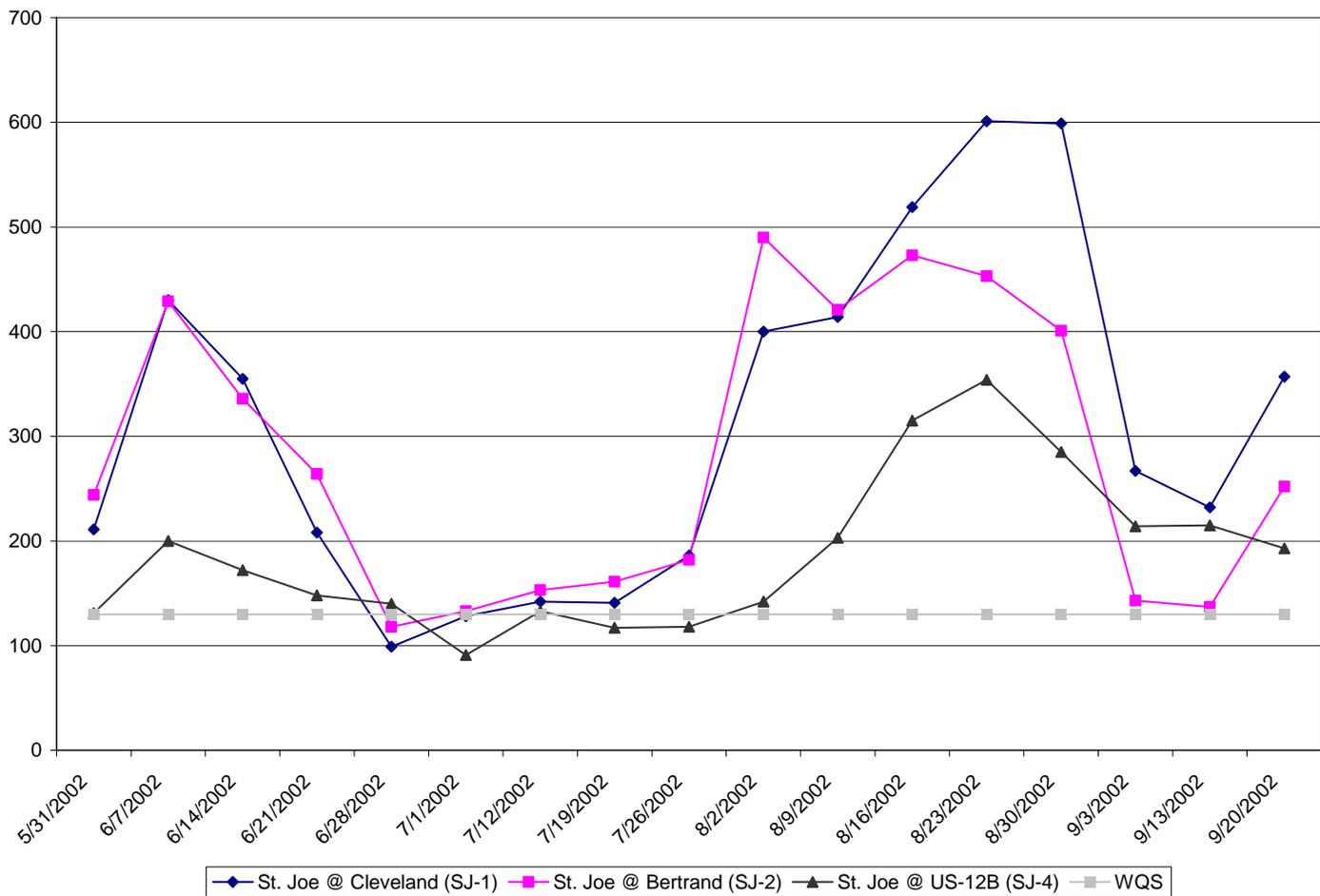


Figure 2. Thirty-day geometric mean for *E. coli* in the St. Joseph River, upstream of Buchanan, Michigan, 2002.

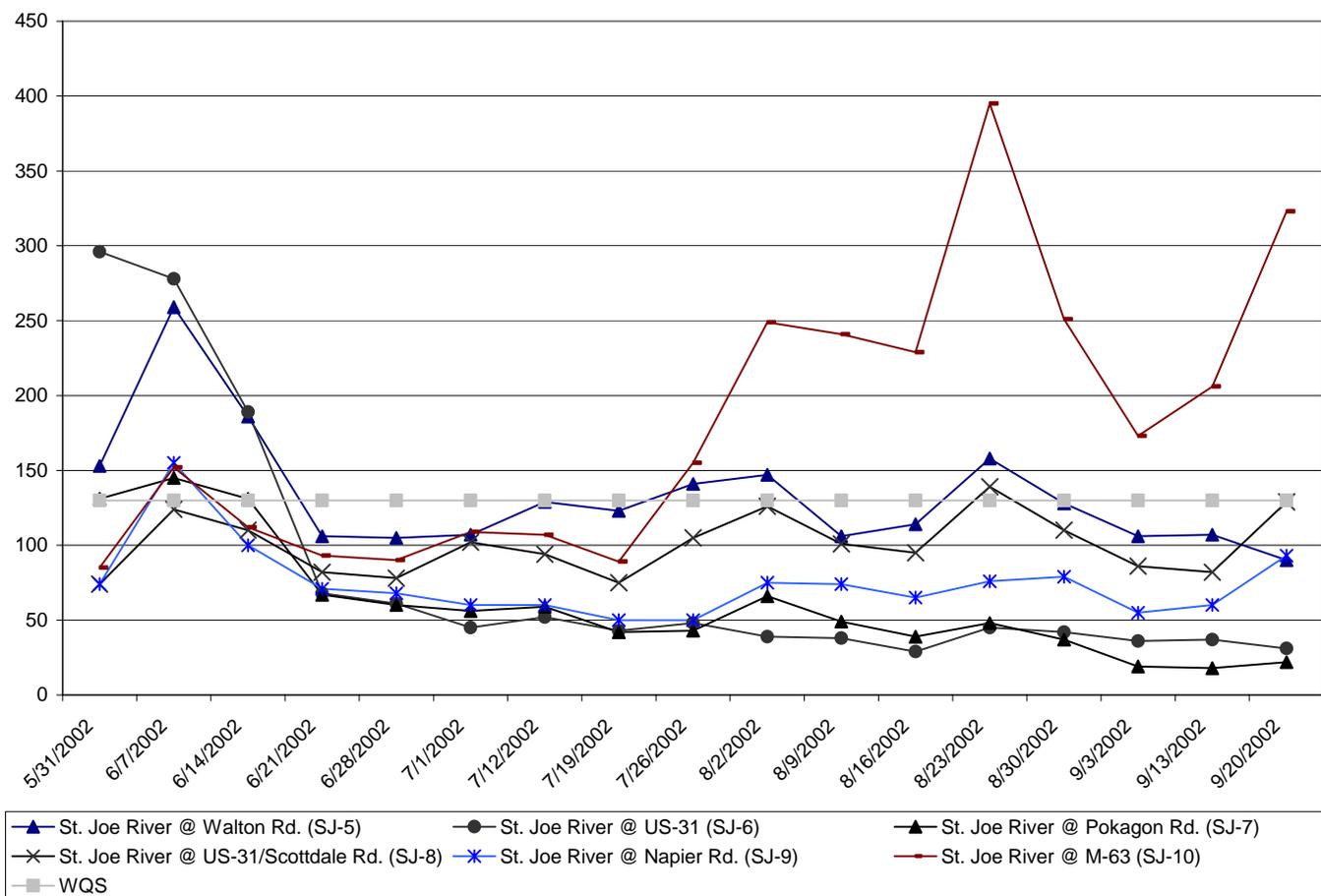


Figure 3. Thirty-day geometric mean *E. coli* concentrations downstream of Buchanan, Michigan, 2002.

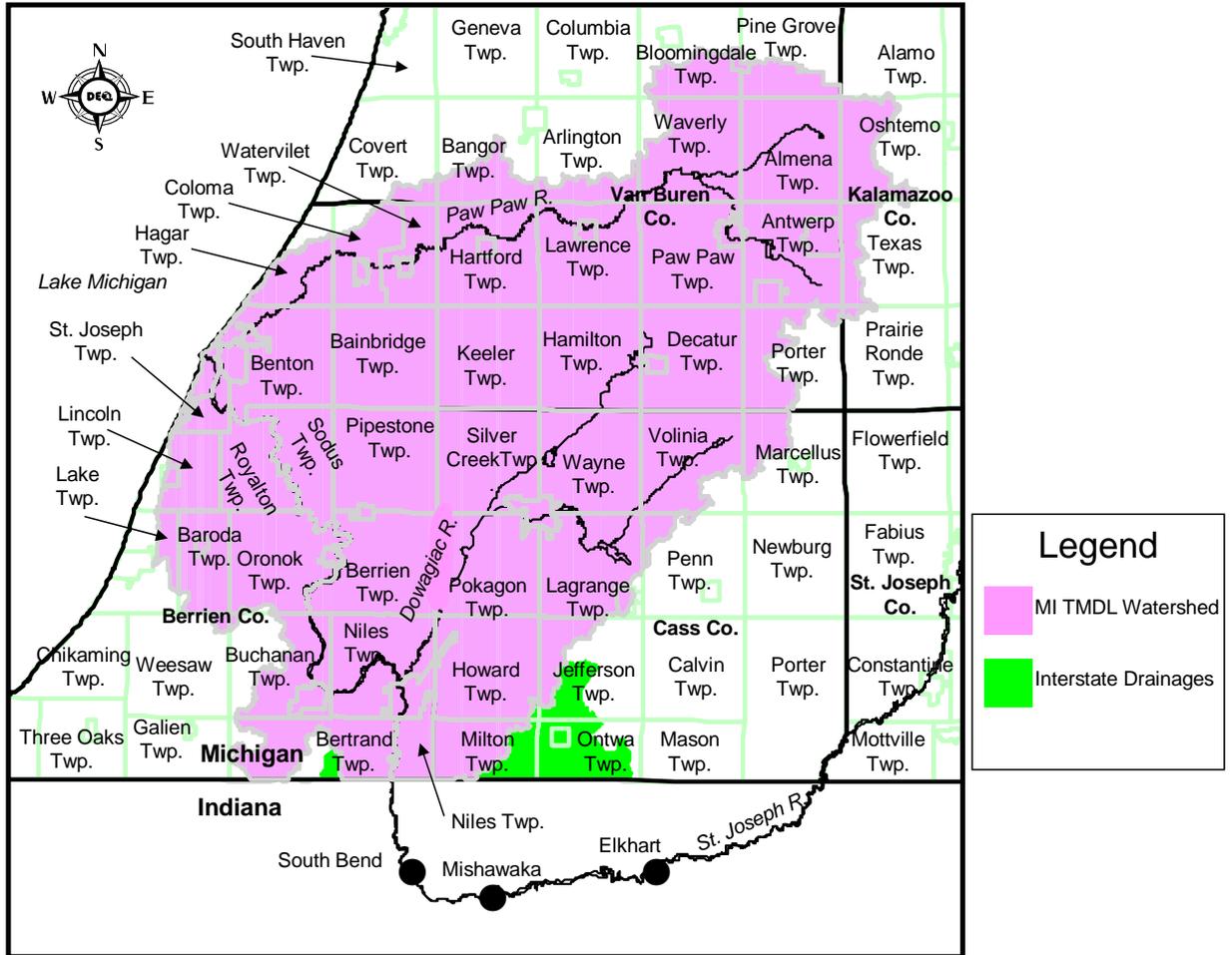


Figure 4. Shaded areas represent municipalities in the St. Joseph River TMDL watershed.

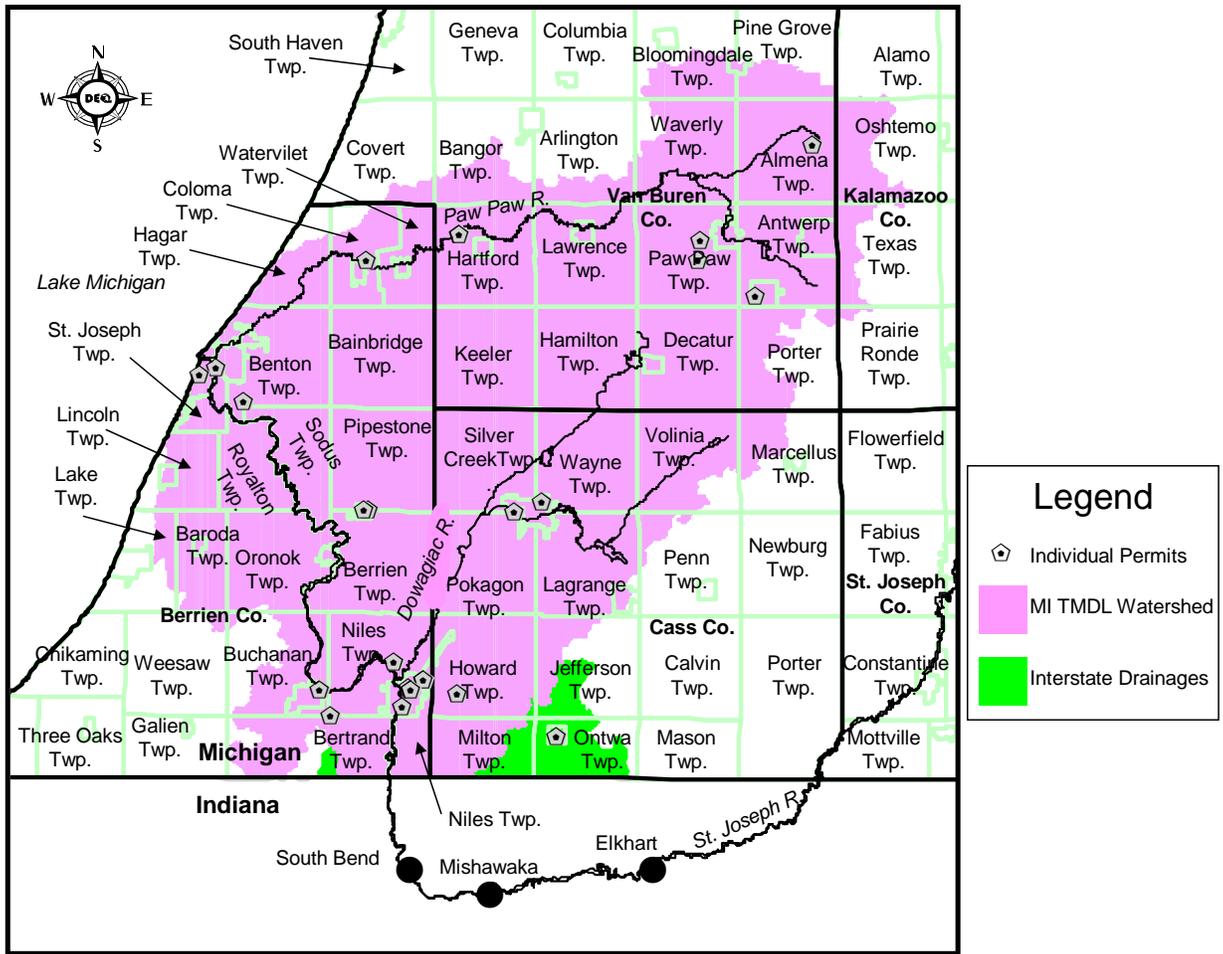


Figure 5. Individual NPDES permitted discharges in the St. Joseph River TMDL watershed.

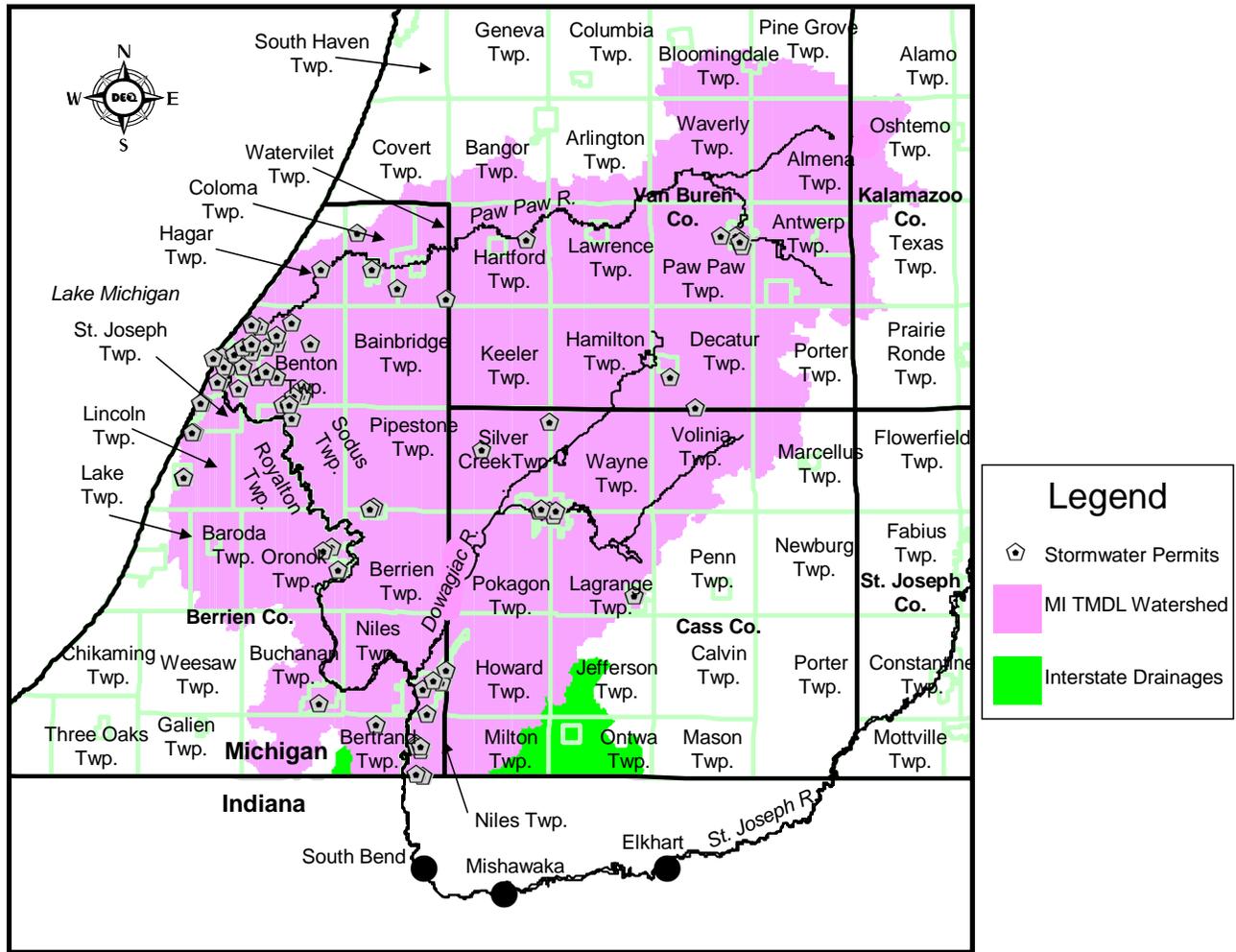


Figure 6. NPDES storm water permitted discharges in the St. Joseph River TMDL watershed.

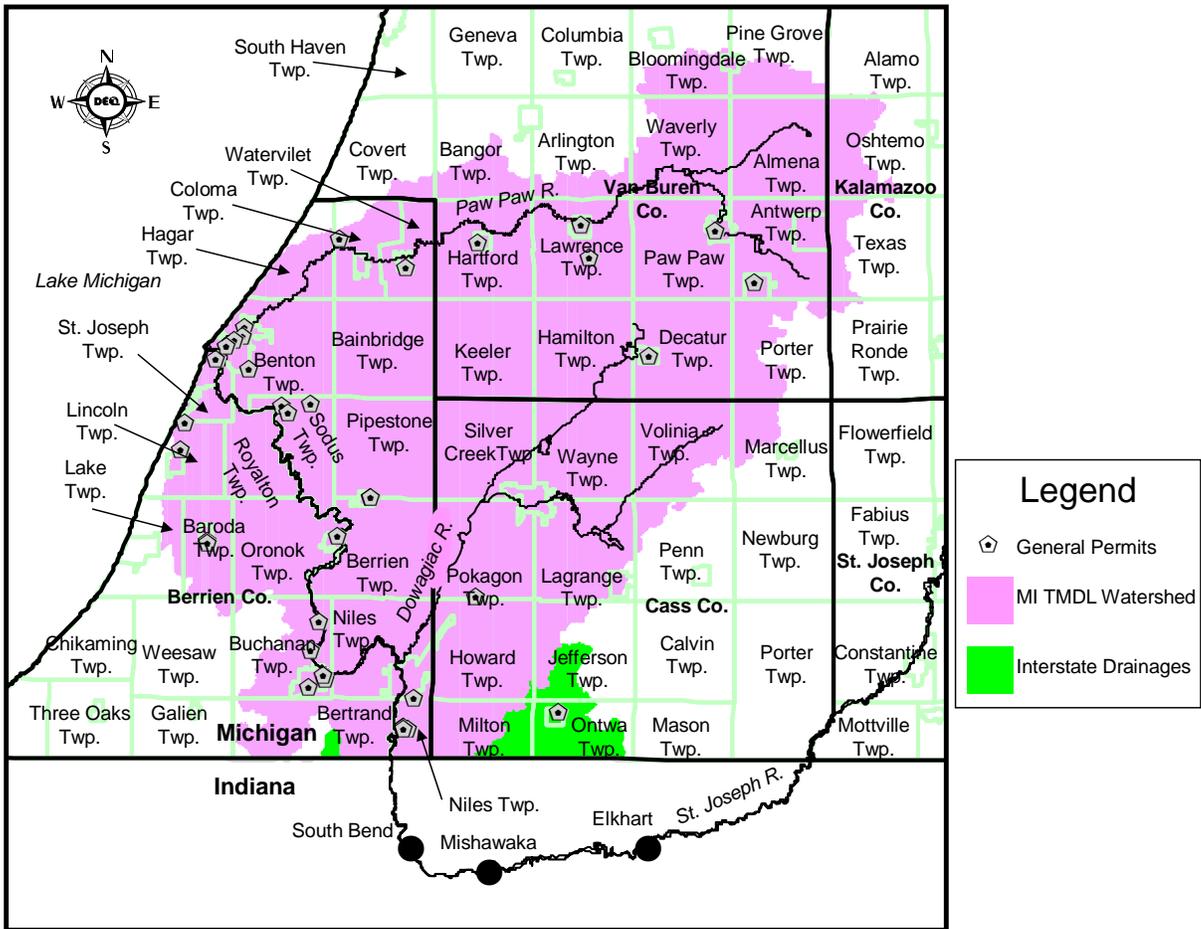


Figure 7. General NPDES permitted discharges in the St. Joseph River TMDL watershed.

Table 1. MDEQ 2002 *E. coli* monitoring data for the St. Joseph River upstream of Buchanan (*E. coli*/100 ml). Shaded areas indicate exceedances of the Water Quality Standard. Data are presented upstream to downstream.

	St. Joe River @ Cleveland Rd. (IN) (SJ-1)			St. Joe River @ Bertrand Rd. (SJ-2)			St. Joe River @ Business US-12 (SJ-4)			
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	Weather data
5/3/2002	8	5	---	2	8	---	12	7	---	sunny, 50°
	2			14			2			
	8			18			14			
5/10/2002	400	400	---	400	400	---	400	400	---	sunny, 45°
	400			400			400			
	400			400			400			
5/13/2002	660	837	---	290	357	---	430	377	---	clear, 45°
	1200			460			430			
	740			340			290			
5/24/2002	9600	8639	---	9200	7699	---	290	215	---	sunny, 60°
	9200			12400			180			
	7300			4000			190			
5/31/2002	60	29	211	100	99	244	90	168	131	sunny, 80°
	40			140			240			
	10			70			220			
6/7/2002	350	176	430	200	133	429	10	59	200	sunny, 80°
	120			130			160			
	130			90			130			
6/14/2002	200	154	355	60	117	336	260	186	172	cloudy, 65°
	140			150			190			
	130			180			130			
6/21/2002	180	58	208	140	108	264	140	177	148	humid, 80°
	110			90			210			
	10			100			190			

Table 1. continued (*E. coli*/100 ml).

DATE	St. Joe River @ Cleveland Rd. (IN) (SJ-1)			St. Joe River @ Bertrand Rd. (SJ-2)			St. Joe River @ Business US-12 (SJ-4)			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
6/28/2002	190	209	99	150	139	118	220	167	140	clear, 75°
	200			100			150			
	240			180			140			
7/1/2002	110	103	128	100	178	133	10	19	91	clear, 85°
	90			710		70				
	110			80		10				
7/12/2002	460	295	142	300	269	153	430	396	133	clear, 75°
	200		240	380						
	280		270	380						
7/19/2002	170	149	141	100	152	161	80	99	117	overcast, 80°
	150		500	80						
	130		70	150						
7/26/2002	180	235	186	310	198	182	110	187	118	partly cloudy, 75°
	240		180	260						
	300		140	230						
8/2/2002	10000	9587	400	14000	19626	490	430	414	142	clear, 80°
	9900			27000			350			
	8900			20000			470			
8/9/2002	110	123	414	130	83	421	300	114	203	clear, 75°
	80		40	50						
	210		110	100						
8/16/2002	1800	912	519	310	483	473	3100	3543	315	rain, 75°
	740			280			4100			
	570			1300			3500			

Table 1. continued (*E. coli*/100 ml).

DATE	St. Joe River @ Cleveland Rd. (IN) (SJ-1)			St. Joe River @ Bertrand Rd. (SJ-2)			St. Joe River @ Business US-12 (SJ-4)			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
8/23/2002	350	311	601	90	122	453	230	177	354	rain, 65°
	220			170			160			
	390			120			150			
8/30/2002	270	231	599	120	107	401	60	63	285	sunny, 80°
	170			170			60			
	270			60			70			
9/3/2002	120	168	267	100	115	143	120	99	214	partly cloudy, 70°
	110			140			80			
	360			110			100			
9/13/2002	40	61	232	60	66	137	150	118	215	clear, 65°
	80			70			110			
	70			70			100			
9/20/2002	7300	7885	357	9900	10006	252	1300	2060	193	clear, 70°
	7900			9200			2400			
	8500			11000			2800			

Table 2. MDEQ 2002 *E. coli* monitoring data for the St. Joseph River downstream of Buchanan (*E. coli*/100 ml). Shaded areas indicate exceedances of the Water Quality Standard. Data are presented upstream to downstream.

DATE	St. Joe River @ Walton Rd. (SJ-5)			St. Joe River @ US-31 (SJ-6)			St. Joe River @ Pokagon Rd. (SJ-7)			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
5/3/2002	8	9	---	100	119	---	38	27	---	sunny, 50°
	8			120			20			
	10			140			26			
5/10/2002	400	400	---	400	400	---	400	205	---	sunny, 45°
	400			400			400			
	400			400			54			
5/13/2002	1100	1334	---	5000	4127	---	690	909	---	clear, 45°
	1800			3800			990			
	1200			3700			1100			
5/24/2002	160	158	---	110	117	---	80	82	---	sunny, 60°
	130			60			70			
	190			240			100			
5/31/2002	60	115	153	110	100	296	160	92	131	sunny, 80°
	120			100			70			
	210			90			70			
6/7/2002	140	121	259	110	87	278	130	45	145	sunny, 80°
	140			60			10			
	90			100			70			
6/14/2002	90	77	186	60	58	189	180	124	131	cloudy, 65°
	50			80			70			
	100			40			150			
6/21/2002	110	81	106	80	25	68	30	31	67	humid, 80°
	80			20			100			
	60			10			10			

Table 2. continued (*E. coli*/100 ml).

	St. Joe River @ Walton Rd. (SJ-5)			St. Joe River @ US-31 (SJ-6)			St. Joe River @ Pokagon Rd. (SJ-7)			
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	Weather data
6/28/2002	180	148	105	80	70	61	110	48	60	clear, 75°
	200			60			50			
	90			70			20			
7/1/2002	60	126	107	40	20	45	50	65	56	clear, 85°
	100			10			70			
	330			20			80			
7/12/2002	400	312	129	320	184	52	60	59	59	clear, 75°
	190			140			170			
	400			140			20			
7/19/2002	80	60	123	20	22	43	10	22	42	overcast, 80°
	30			50			20			
	90			10			50			
7/26/2002	250	161	141	30	44	48	70	38	43	partly cloudy, 75°
	140			10			20			
	120			290			40			
8/2/2002	130	182	147	50	27	39	200	385	66	clear, 80°
	140			20			130			
	330			20			2200			
8/9/2002	30	25	106	10	16	38	10	14	49	clear, 75°
	50			10			10			
	10			40			30			
8/16/2002	540	436	114	50	46	29	10	20	39	rain, 75°
	300			50			10			
	510			40			80			

Table 2. continued (*E. coli*/100 ml).

	St. Joe River @ Walton Rd. (SJ-5)			St. Joe River @ US-31 (SJ-6)			St. Joe River @ Pokagon Rd. (SJ-7)			
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	Weather data
8/23/2002	300	314	158	200	210	45	150	61	48	rain, 65°
	240			200			30			
	430			230			50			
8/30/2002	40	56	128	20	30	42	10	10	37	sunny, 80°
	150			130			10			
	30			10			10			
9/3/2002	50	70	106	10	13	36	10	16	19	partly cloudy, 70°
	70			20			40			
	100			10			10			
9/13/2002	10	25	107	20	20	37	10	10	18	clear, 65°
	20			20			10			
	80			20			10			
9/20/2002	110	191	90	10	17	31	50	53	22	clear, 70°
	300			50			60			
	210			10			50			

Table 2. continued (*E. coli*/100 ml).

	St. Joe River @ US-31 (Scottsdale Rd.) (SJ-8)			St. Joe River @ Napier Rd. (SJ-9)			St. Joe River @ M-63 (SJ-10)			
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	Weather data
5/3/2002	6	7	---	10	3	---	8	7	---	sunny, 50°
	4			2			6			
	16			2			6			
5/10/2002	400	201	---	400	400	---	400	400	---	sunny, 45°
	51			400			400			
	400			400			400			
5/13/2002	320	307	---	350	402	---	420	339	---	clear, 45°
	360			370			250			
	250			500			370			
5/24/2002	360	133	---	130	80	---	90	99	---	sunny, 60°
	130			40			180			
	50			100			60			
5/31/2002	140	38	74	70	52	74	300	49	85	sunny, 80°
	40			50			20			
	10			40			20			
6/7/2002	60	94	124	170	134	155	130	123	152	sunny, 80°
	70			140			90			
	200			100			160			
6/14/2002	170	111	110	20	46	100	50	86	112	cloudy, 65°
	100			60			90			
	80			80			140			
6/21/2002	130	68	82	40	71	71	110	134	93	humid, 80°
	30			90			100			
	80			100			220			

Table 2. continued (*E. coli*/100 ml).

	St. Joe River @ US-31 (Scottsdale Rd.) (SJ-8)			St. Joe River @ Napier Rd. (SJ-9)			St. Joe River @ M-63 (SJ-10)			
DATE	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	Weather data
6/28/2002	210	105	78	60	62	68	100	87	90	clear, 75°
	50			40			50			
	110			100			130			
7/1/2002	90	148	102	30	29	60	100	126	109	clear, 85°
	90			10			90			
	400			80			220			
7/12/2002	40	63	94	130	133	60	100	111	107	clear, 75°
	40			120			90			
	160			150			150			
7/19/2002	80	36	75	10	18	50	20	34	89	overcast, 80°
	20			20			20			
	30			30			100			
7/26/2002	800	364	105	70	72	50	700	2187	155	partly cloudy, 75°
	110			60			1800			
	550			90			8300			
8/2/2002	240	256	126	390	468	75	940	919	249	clear, 80°
	270			280			970			
	260			940			850			
8/9/2002	40	49	101	10	27	74	110	107	241	clear, 75°
	100			50			110			
	30			40			100			
8/16/2002	10	47	95	220	68	65	360	87	229	rain, 75°
	150			140			10			
	70			10			180			

Table 2. continued (*E. coli*/100 ml).

DATE	St. Joe River @ US-31 (Scottsdale Rd.) (SJ-8)			St. Joe River @ Napier Rd. (SJ-9)			St. Joe River @ M-63 (SJ-10)			Weather data
	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	SAMPLE RESULTS	DAILY G. MEAN	30-day G. MEAN	
8/23/2002	100	239	139	60	42	76	570	519	395	rain, 65°
	980		60	500						
	140		20	490						
8/30/2002	150	115	110	410	87	79	70	229	251	sunny, 80°
	60			20			180			
	170			80			950			
9/3/2002	150	75	86	120	78	55	80	141	173	partly cloudy, 70°
	70			50			100			
	40			80			350			
9/13/2002	40	39	82	50	39	60	220	258	206	clear, 65°
	50			40			290			
	30			30			270			
9/20/2002	400	444	129	720	623	93	700	812	323	clear, 70°
	300			560			920			
	730			600			830			

Table 3. The St. Joseph River average flows (cfs) at Niles, Berrien County, Michigan.

May	June	July	August	September	October
4060	2970	2270	2000	1860	2060

Table 4. Distribution of land for each municipality in the TMDL watershed.

Municipality	Percent
Berrien Township	4
Niles Township	4
Almena Township	3
Antwerp Township	3
Bainbridge Township	3
Benton Township	3
Bertrand Township	3
Decatur Township	3
Hamilton Township	3
Hartford Township	3
Howard Township	3
Keeler Township	3
Lagrange Township	3
Lawrence Township	3
Oronok Township	3
Paw Paw Township	3
Pipestone Township	3
Pokagon Township	3
Silver Creek Township	3
Volinia Township	3
Waverly Township	3
Wayne Township	3
Baroda Township	2
Buchanan Township	2
Coloma Township	2
Oshtemo Township	2
Porter Township	2
Royalton Township	2
Sodus Township	2
Bangor Township	1
Bloomington Township	1
Hagar Township	1
Lincoln Township	1
Milton Township	1
Ontwa Township	1
Watervliet Township	1
TOTAL (%)	89

Table 4. continued

- *Alamo Township
- *Arlington Township
- *Baroda
- *Benton Harbor
- *Berrien Springs
- *Buchanan
- *Cassopolis
- *Coloma
- *Covert Township
- *Decatur
- *Dowagiac
- *Eau Claire
- *Gobles
- *Hartford
- *Jefferson Township
- *Lake Township
- *Lawrence
- *Lawton
- *Marcellus Township
- *Mattawan
- *Niles
- *Paw Paw
- *Penn Township
- *Pine Grove Township
- *Prairie Ronde Township
- *St. Joseph
- *St. Joseph Township
- *Texas Township

*represents municipalities with less than one percent of the total TMDL watershed area of approximately 937 square miles.

Table 5. Discriminant Analysis of Ribotype Profiles of *E. coli* isolates from St. Joseph River water sample collected on October 3, 2002.

Sample number Fecal coliform mpn/100 ml ²	<i>E. coli</i> isolate number	Probability value per source ¹	
		non-human	human
SJ-2A mpn = 43	1	100	0
	2	100	0
	3	100	0
	4	100	0
	5	100	0

*The probability value equals % probability of true sources

¹Ribotyping analysis was performed by the method of Salina et al. 1998. Briefly, chromosomal DNA was extracted from *E. coli* isolates and digested with *Hind*III. Fragments were separated by agarose electrophoresis. The DNA was then transferred and fixed to a Zeta-probe membrane. A cDNA probe complimentary to the *E. coli* 16S and 23S rDNA was labeled with digoxigenin-dUTP and was used to probe the membranes. The resulting genetic fingerprint was translated to a binary code based on the presence and absence of predetermined bands. The resulting binary code was then analyzed by discriminate analysis using SAS (registered) software against a vast library of known source isolates.

²Standard methods for the Examination of Water and Wastewater method 9223 (APAHA. 1998).

Table 6. Permitted discharges to the St. Joseph River TMDL watershed.
Source: MDEQ/WD's NPDES Permit Management System (NMS); *MGD = million gallons per day.

Permit Number	Facility	Design Flow (MGD*)	Latdd	Longdd
Individual NPDES permits				
MI0000434	Hermel Die Casting Corp	0.16	41.986111	-86.297222
MI0000833	Simplicity Pattern Co Inc	0.80	41.835555	-86.249166
MI0003069	National Copper Products	2.16	41.993888	-86.098888
MI0003093	French Paper Co	1.75	41.819166	-86.258055
MI0021741	Paw Paw WWTP	1.70	42.197222	-85.923055
MI0022322	Benton Harbor-St Joseph WWTP	15.30	42.103888	-86.470000
MI0022489	Buchanan WWTP	1.50	41.833333	-86.350000
MI0022837	Dowagiac WWTP	2.50	41.984444	-86.131666
MI0023094	Hartford WWTP	0.35	42.218330	-86.193060
MI0023701	Niles WWTP	5.80	41.857222	-86.266666
MI0023779	Paw Paw Lake Area WWTP	2.20	42.195833	-86.298611
MI0026735	St Joseph CSO	---	42.100000	-86.488333
MI0027596	Nat Standard-Lake St	1.20	41.843888	-86.234444
MI0035734	MDNR-Wolf Lake Fish Hatchery	5.76	42.291666	-85.791666
MI0039179	Nat Standard-City Complex	0.13	41.834444	-86.247777
MI0043141	MDEQ-RRD-Aviex SF	0.40	41.830555	-86.196388
MI0045551	Gast Mfg Inc-Benton Harbor	0.02	42.075833	-86.437777
MI0051764	MDEQ-ERD-Edwardsburg	0.69	41.794722	-86.083888
MI0052329	Southeast Berrien Co Landfill	0.29	41.811710	-86.338480
MI0055514	Lawton WWTP	0.20	42.166111	-85.857777
MI0056367	Minute Maid Co-Paw Paw	0.70	42.212222	-85.921111
MI0056626	Alcoa Inc	0.03	41.985000	-86.299722
General NPDES Permits				
MIG080077	Connie Ketcham Property	0.04	42.026388	-86.515277
MIG080088	Amoco Oil Company-Lawrence	0.01	42.193611	-86.042222
MIG080170	Amoco Oil Co-Watervliet	0.04	42.183333	-86.255555
MIG080606	Crystal Flash LP-Hartford	0.29	42.205555	-86.171388
MIG080854	Westgate Oil Co-Pokagon	0.04	41.900000	-86.175000
MIG080855	Service Oil Co-Edwardsburg	0.08	41.799722	-86.078055
MIG080963	Citgo Corp-Niles	0.01	41.787500	-86.257222
MIG080969	Shell Oil Products-Niles	0.15	41.785300	-86.252300
MIG250145	St Julian Wine Company Inc	0.17	42.215277	-85.895555

Table 6. continued

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Permit Number	Facility	Design Flow (MGD*)	Latdd	Longdd
MIG250149	Niles Precision Co	0.13	41.812500	-86.245833
MIG250285	Bowater NuWay Inc	0.01	42.131111	-86.443055
MIG250340	Buchanan Metal Forming Inc	0.06	41.820833	-86.366666
MIG250345	Robert Bosch Corp-St Joseph	0.30	42.050000	-86.512500
MIG250353	Sodus Hard Chrome Co	0.04	42.063888	-86.400000
MIG250354	Clark Engineering Services	0.15	41.828611	-86.347777
MIG250357	Hanson Cold Storage-Sodus	0.02	42.066666	-86.366666
MIG250362	Sumitec Inc-Benton Harbor	0.03	42.125000	-86.445833
MIG250364	Jack-Post Corp	0.06	41.833055	-86.351111
MIG250366	Vail Rubber Works Inc	0.12	42.104166	-86.475000
MIG250368	New Products Corp	0.11	42.120833	-86.454166
MIG250369	Whirlpool-Benton Harbor Div	0.35	42.114722	-86.464722
MIG250385	Welch Foods Inc	1.00	42.170833	-85.850833
MIG250393	Nat Zinc Processors	0.00	42.095833	-86.437500
MIG570104	Hills Haven MHP WWTP	0.02	41.877777	-86.355555
MIG570105	Ravine View Estates	0.03	42.208333	-86.333333
MIG570106	Riverside Estates MH WWTP	0.01	41.852777	-86.365277
MIG570204	Berrien Springs WWTP	0.75	41.951111	-86.333055
MIG580107	Lawrence WWSL	16.00	42.222222	-86.051944
MIG580108	Baroda WWSL	46.00	41.947222	-86.485555
MIG580109	Meadow Streams Estates	9.70	42.058333	-86.391666
MIG580110	Camp Rosenthal	2.00	41.986111	-86.297222
MIG580309	Shawnee Mobile Home Park WWSL	10.00	41.946388	-86.484722
MIG580314	Decatur WWSL	70.00	42.108055	-85.974166
MIG580386	Eau Claire WWSL	16.00	41.986111	-86.297222
MIG670010	Citgo Corp-Niles	0.30	41.787500	-86.257222
MIG670280	Shell Oil Products-Niles	1.20	41.785300	-86.252300
MIG670281	Marathon Ashland-Niles	2.52	41.785277	-86.256111
Storm Water NPDES Permits				
MIR011593	Tobian Metals Inc		42.138333	-86.435555
MIR011553	Collins & Aikman-St Joseph		42.075000	-86.500000
MIR011592	The Alloy Foundry Company		42.125000	-86.416666
MIR011542	Eau Claire Fruit Exchange		42.112500	-86.466666
MIR011596	Wolverine Metal Stamping		42.050000	-86.508333
MIR011681	McCoy Docking Inc		42.112500	-86.473611

Table 6. continued

Permit Number	Facility	Design Flow (MGD*)	Latdd	Longdd
MIR020019	Knouse Foods Coop Inc-Paw Paw		42.206666	-85.888611
MIR011680	Ameriwood Furniture Div		41.983333	-86.108333
MIR011437	Mobile Facility Engineering		41.912500	-86.012500
MIR011585	Premier Tool Die Cast		41.933333	-86.345833
MIR011598	R A Imus Inc		42.212500	-85.891666
MIR011539	Coloma Frozen Foods		42.187500	-86.366666
MIR011701	B&R Oil Co Inc		41.761666	-86.249722
MIR020017	Harbor Isle Marina		42.108333	-86.470833
MIR011591	Technisand Inc		41.762500	-86.257500
MIR011597	Hanson Cold Storage-Hartford		42.212500	-86.133333
MIR011666	Anstey Foundry Co		42.012500	-86.520833
MIR011685	Ray's Auto Sales-Berrien Spr		41.954166	-86.354166
MIS310337	Brenner Transportation-Niles		41.783333	-86.252500
MIS310391	Hofmann Ind-Mich Tube Div		41.987780	-86.304440
MIS310005	Whirlpool Tech Center		42.114440	-86.478890
MIS310006	Jerry Tyler Memorial-Niles		41.838888	-86.227777
MIS310009	Brutsche Concrete-Benton Hbr		42.095560	-86.416666
MIS310027	Consumers Asphalt Co		42.072777	-86.407777
MIS310035	Leco-Pier 33-St Joseph		42.104166	-86.470833
MIS310062	Leco-Michigan Ceramics Div		42.087500	-86.387500
MIS310061	St Julian Wine Company Inc		42.215277	-85.895555
MIS310060	United Fixtures Co-Niles		41.833333	-86.250000
MIS310058	Dean Foods-Benton Harbor		42.112500	-86.458333
MIS310055	Niles Precision Co		41.812500	-86.245833
MIS310069	Nat Zinc Processors		42.095833	-86.437500
MIS310071	Reliable Disposal-Stevensvill		42.012500	-86.520833
MIS310072	Inverness Casting Group		41.985000	-86.120277
MIS310078	Southwest Mich Reg Airport		42.120833	-86.429166
MIS310105	VanDenbos Inc		42.216666	-85.912500
MIS310106	GM-Brass-Aluminum Foundry-BH		42.112500	-86.458333
MIS310109	ABC Precision Machining		42.079166	-86.387500
MIS310111	Pier 1000 Marina LLC		42.087500	-86.458333
MIS310114	Mono Ceramics-Benton Harbor		42.062500	-86.400000
MIS310115	Orchard Hill LF-Watervliet		42.170833	-86.279166
MIS310118	Worthington Armstrong Venture		42.140000	-86.444166

Table 6. continued

Permit Number	Facility	Design Flow (MGD*)	Latdd	Longdd
MIS320004	Citgo Corp-Niles		41.787500	-86.257222
MIS310124	Five Corners Garage Inc		41.985833	-86.310555
MIS310126	Contech Div SPX Corp		42.070833	-85.941666
MIS310127	Atlantic Automotive Component		42.131944	-86.417500
MIS310128	Vail Rubber Works Inc		42.104166	-86.475000
MIS320001	New Products Corp		42.120833	-86.454166
MIS310131	K-O Products Co		42.095555	-86.437777
MIS310119	Atlantic Auto-Territorial		42.116666	-86.454166
MIS310150	Whirlpool-Benton Harbor Div		42.114722	-86.464722
MIS310153	Mennel Milling Co of Michigan		41.980555	-86.101944
MIS310154	Shawnee Specialties Inc		42.141666	-86.400000
MIS310157	Midway Recreation Inc		42.036111	-86.184444
MIS310164	Mich ARNG-Dowagiac-OMS 15		41.983333	-86.100000
MIS310174	Vertis-Printco Incorporated		41.850000	-86.225000
MIS310177	West Michigan Railroad Co		42.210277	-85.891666
MIS310201	Keenes Auto Sales-Dowagiac		42.058333	-86.108333
MIS310204	Old Europe Cheese Inc		42.100555	-86.427222
MIS310203	Andrews University Airport		41.950000	-86.362500
MIS310227	Pilkington-Niles		41.803333	-86.303611
MIS320012	Marathon Ashland-Niles		41.785277	-86.256111
MIS310237	Menasha Packaging Co-Coloma		42.187500	-86.308333
MIS310242	Max Casting Co-Benton Harbor		42.116666	-86.445833
MIS310248	Robert Bosch Corp-St Joseph		42.050000	-86.512500
MIS310250	Paw Paw Sports & Marina		42.216666	-86.325000
MIS310255	Sandvik Steel Co-Benton Harbo		42.080000	-86.396666
MIS310265	Shepherd Caster Corp-St Josep		42.075000	-86.501388
MIS310266	August Pohl Auto Wreckers		42.125000	-86.379166
MIS310325	Eagle Point Harbor-St Joseph		42.091666	-86.483333
MIS310329	Certified Metal Finishing		42.104166	-86.454166
MIS310330	Brians Marine Service		42.112500	-86.487500
MIS310348	Consumers Concrete-Niles		41.841666	-86.237500
MIS310333	Ausco Products-St Joseph		42.072777	-86.401388
MIS320013	Shell Oil Products-Niles		41.785300	-86.252300
MIS310343	Modern Plastics Corp		42.120833	-86.454166
MIS310349	Norm & Sons Auto Salvage		42.162500	-86.225000
MIS310355	Special-Lite-Decatur		42.095833	-85.970833

Table 6. continued

Permit Number	Facility	Design Flow (MGD*)	Latdd	Longdd
MIS310362	Internet Corp-Stevensville		42.011111	-86.520555
MIS310322	Lyons Ind-Heddon Div		41.986666	-86.116111
MIS310382	Buchanan Metal Forming Inc		41.820833	-86.366666
MIS310396	Sumitec Inc-Benton Harbor		42.125000	-86.445833

Table 7. Active NPDES permit Notices of Coverage for construction sites in the St. Joseph TMDL Watershed.

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Permit Number	Facility	Location	Twp.	Range	Section	Effective Date
Berrien County						
MIR103568	ANR-E BRIDGMAN LOOP SUPPLY LNK	NILES, BUCANAN, WEESAW TWPS				02/17/1999
MIR106470	WHITTAKER WOODS	12578 WILSON RD, NEW BUFFALO	T8S	R21W	20,21	12/10/2002
MIR103595	MDOT-US31 RELOC RIVER TO NAOMI	ORONKO AND SODUS TWP				03/11/1999
MIR106303	ML-LUTHERAN HERITAGE VILLAGE	MARQUETTE WOODS RD, ST. JOSEPH	T5S	R18W	18	08/30/2002
MIR106687	CHELSIE CORP-ROLLING PRAIRIE 2	MARQUETTE WOOD RD, ST JOSEPH	T5S	R18W	17	04/07/2003
MIR103948	PARTNERS-CROWNPOINTE VLLG CNTR	4232 RED ARROW HWY				07/30/1999
MIR102393	MDOT-M140-M62 TO NAPIER RD					06/04/1997
MIR106774	WAL-MART SUPERCENTER EXP-NILES	2107 S 11TH ST, NILES	T8S	R17W	11	05/06/2003
MIR102337	STONECREEK-THE SANTUARY SEC 1	W SIDE OF COPP RD., MI/IN LINE, NILES				05/12/1997
MIR104966	MDOT-US-31	N OF SNYDER RD TO N OF NAPIER RD	T5S	R18W	35, 26	12/05/2000
MIR105856	MDOT- M63 DOZER TO HICKORY	DOZER DR TO HICKORY CREEK	T5N	R19W	1,2	03/11/2002
MIR102832	RIVERLAND-PINE RIDGE SUBD	3490 BACON SCHOOL RD, ST JOSEPH				02/23/1998
MIR105960	FINE-RIVER RUN EST. DEV	3284 & 3294 WYNDWICKE DR	T5S	R18W	6	04/23/2002
MIR105317	MARZKE ISLAND POINTE MARINA	ANCHORS WAY, ST. JOSEPH, MI	T4S	R19W	25	05/25/2001
MIR106581	CHELSIE-WYNDSTONE ESTATES	STEVENSVILLE	T5S	R19W	27	02/12/2003
MIR104608	MDOT-US31 RELOCATION	FROM NAOMI RD TO SNYDER RD	T5S	R18W	2,3,10,11	06/20/2000
MIR102608	JPA-FAIRPLAIN PLACE	M-139, BENTON HARBOR				08/25/1997
MIR106677	BENTON TWP-WOODRIDGE PLACE	ENTERPRISE WAY	T4S	R18W	7	04/01/2003
MIR103492	STONECREEK-SANCTUARY PH 2	COPP RD, NILES	T8S	R17W	S21&22	12/14/1998
MIR102582	MDOT-RANGELINE OVER US31					08/12/1997
MIR102591	RED ARROW SPORTS GOLF COURSE	RED ARROW HWY, BRIDGMAN				08/18/1997
MIR105784	MDOT/I-94,BERRIEN	FROM ST JOSEPH RIVER TO I-196				01/31/2002
MIR106651	WAL-MART SC EXPANSION #2062	1400 MALL DR, BENTON HARBOR	T4S	R18W	32	03/25/2003
MIR103385	TRUMPETER BAY CONDO AND MARINA	BETWEEN I - 94 & OLD M -139, ST JOSEPH				10/30/1998
MIR104851	FURTHER PT-STOCKBRIDGE EST.	MARQUETTE WOODS RD AND BACON SCHOOL RD	T5S	R18W	21	10/04/2000
MIR105857	MDOT- US31 RELOCATION	OLD US-31 TO NAPIER AVE	T6S	R18W		03/11/2002
MIR105909	MDMB-STATE POLICE POST CMLPX	SILVERBROOK AVE NEAR MAIN ST, NILES				04/02/2002
MIR105457	POKAGON BAND-GRADING & STORM	WILSON RD, NEW BUFFALO	T8S	R21W	11,13,14,15	08/06/2001
Cass County						
MIR105421	ADAMS ROAD DEVELOPMENT CORP	RESERVE @ KNOLLWOOD PHASE III	T8S	R16W	19,20	07/18/2001
MIR105565	CASS COUNTY	CASS CO-LAW & COURTS BLDG	T6S	R15W	26	09/21/2001
MIR106100	CASS COUNTY ROAD COMMISSION	CASS CO-ADM BLDG RENOVATIONS	T6S	R15W	25	06/17/2002

Table 7. continued

Permit Number	Facility	Location	Twp.	Range	Section	Effective Date
Van Buren County						
MIR105693	STONE & WEBSTER-TEMP LAYDOWN	26000 47TH ST, COVERT	T2S	R17W	4	11/30/2001
MIR105283	COVERT GENERATING COMPANY	26000 77TH STREET	T2S	R17W	4	05/15/2001
MIR106318	SHAMEE-VILLAGE VIEW	VILLAGE VIEW	T3	R14	13	09/09/2002
MIR106524	MDOT-M51 DECATUR	M-51, DECATUR	T4S	R14W		01/16/2003
MIR103566	MINUTE MAID-SPRAY IRRGTN EXPAN	SRAY IRRIGATION FIELD EXPANSION	T3S	R14W	15	02/18/1999
MIR106201	MINUTE MAID FORCEMAN	RED ARROW HWY, PAW PAW	T3	R14	4,9,10,15	07/31/2002
MIR105910	CONSUMERS-COVERT PIPELINE PROJ	EASTWARD N OF 28TH AVE	T2S	R18W	1,2,3,4	04/03/2002

APPENDIX A

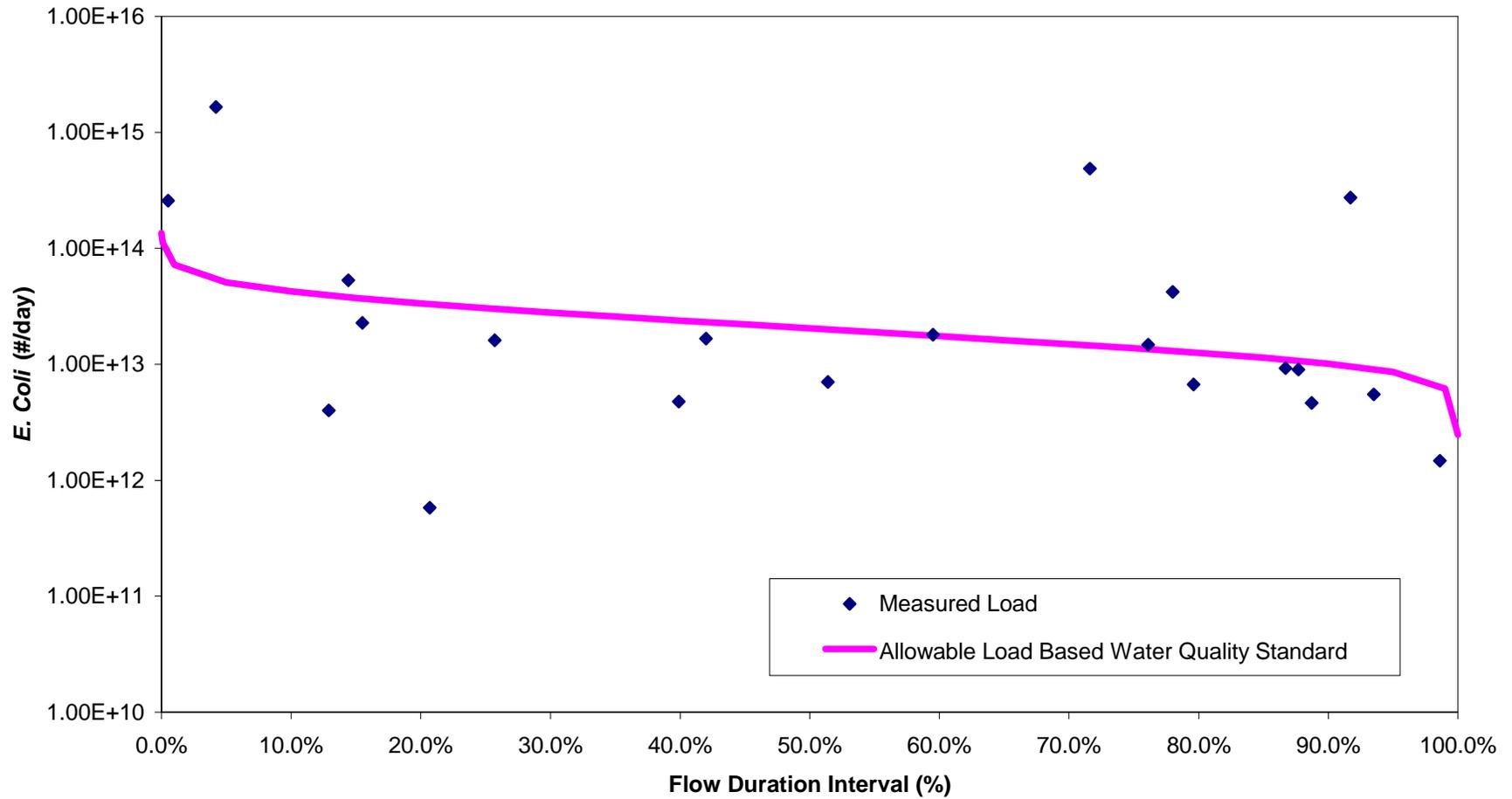


Figure A-1. St. Joseph River at Niles. Load Duration Curve based on Daily Geometric Mean. Site: Cleveland Road (Indiana) SJ-1.

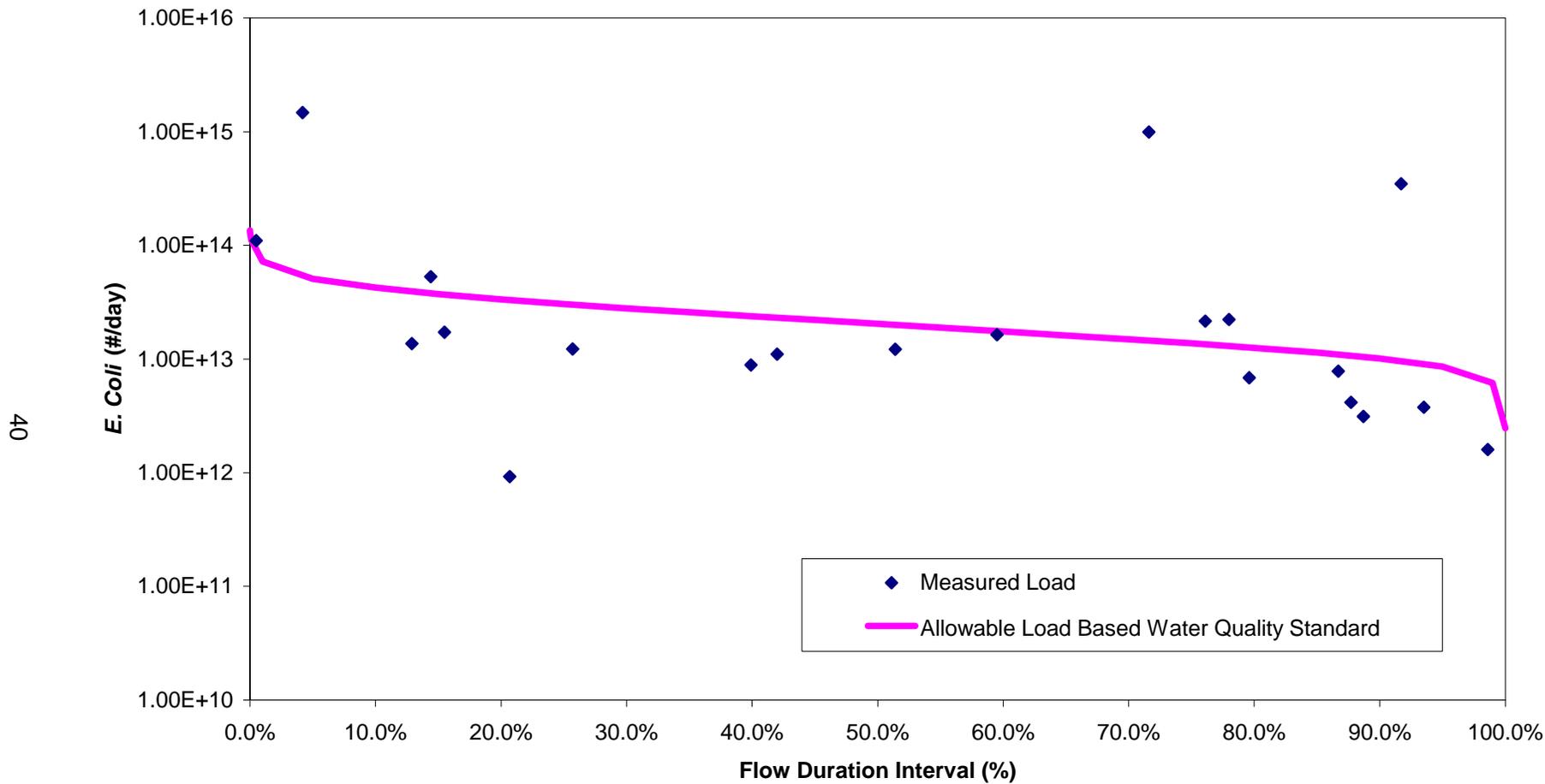


Figure A-2. St. Joseph River. Load Duration Curve based on Daily Geometric Mean Site: Bertrand Road (SJ-2).

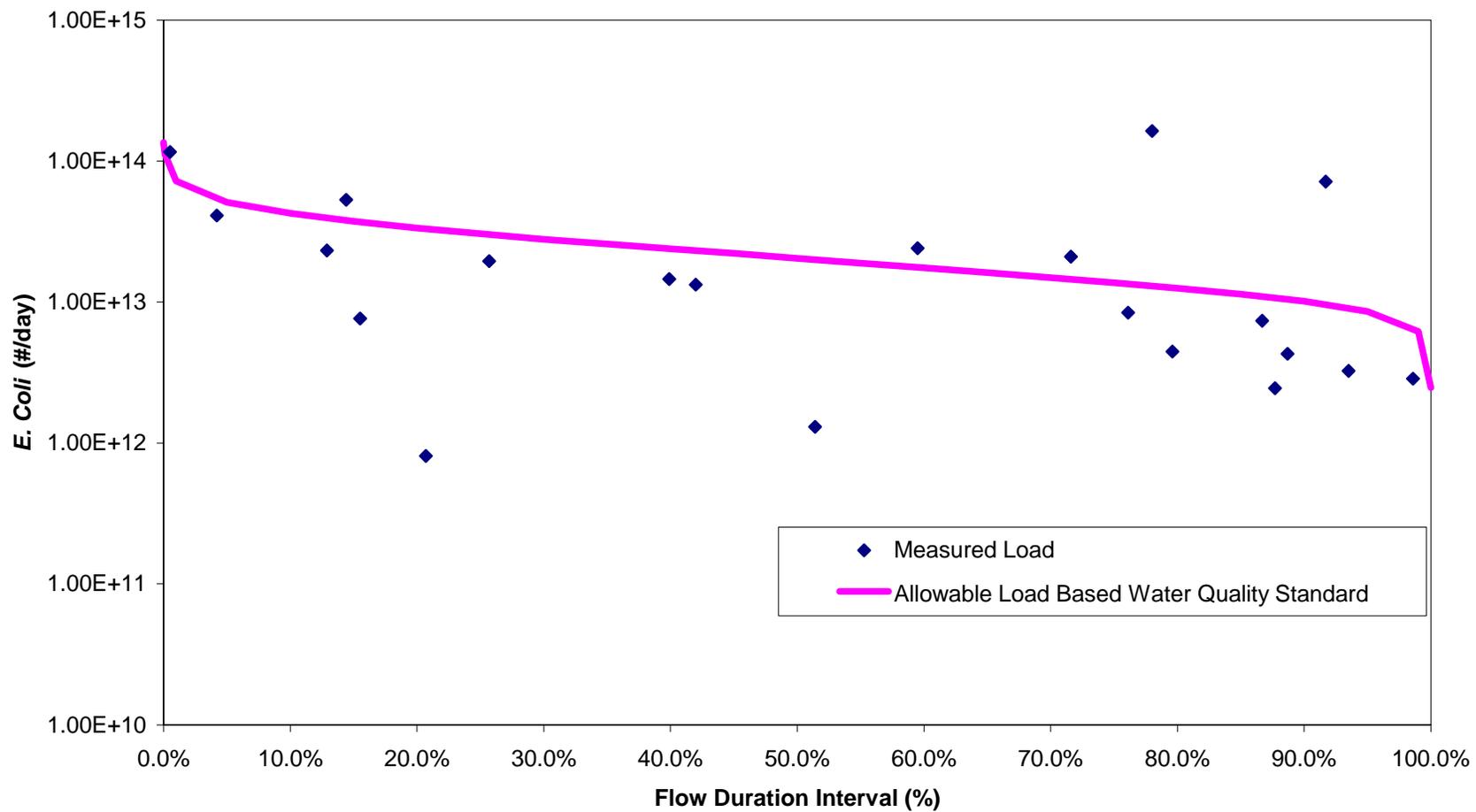


Figure A-3. St. Joseph River. Load Duration Curve based on Daily Geometric Mean
Site: Business US-12 (SJ-4).

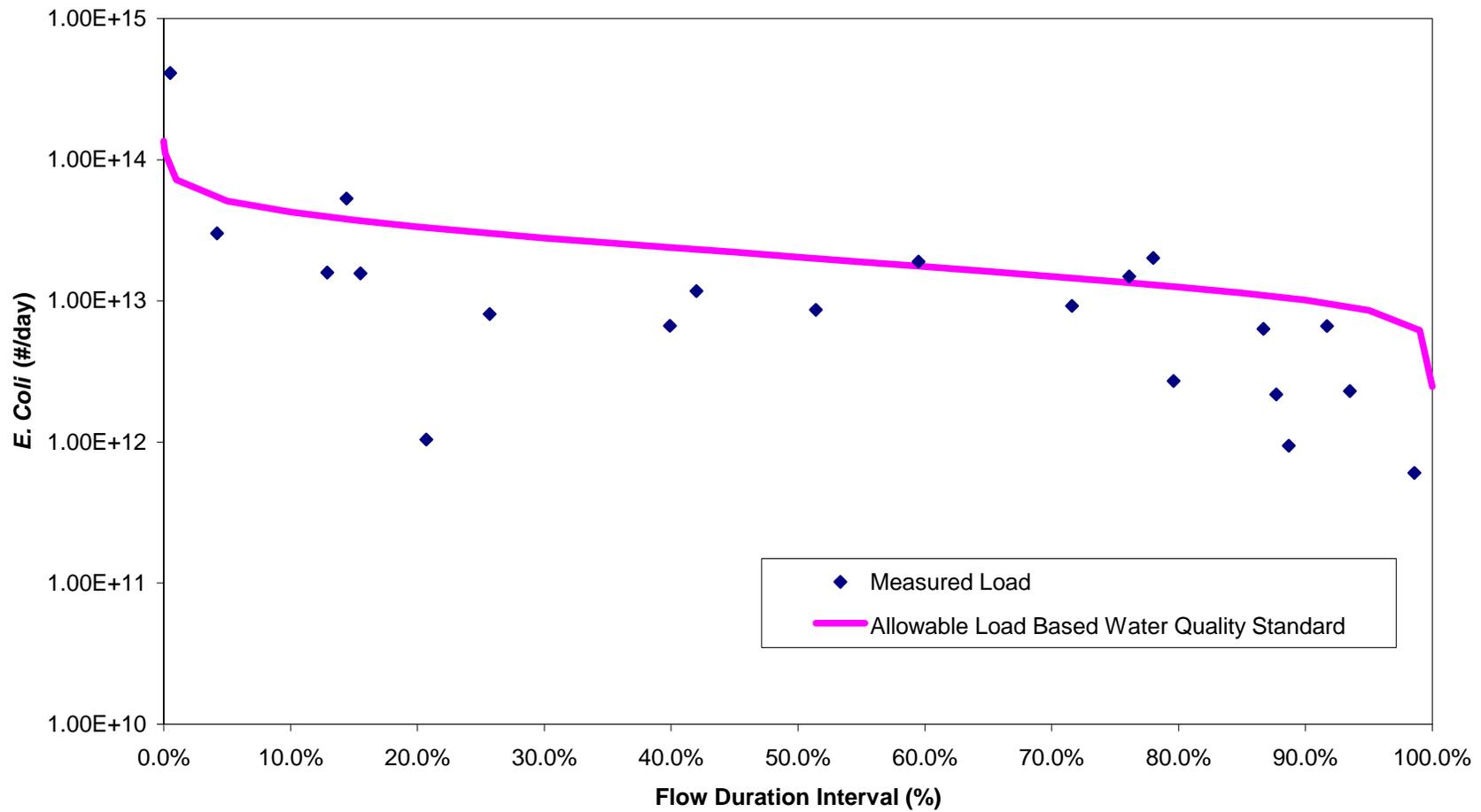


Figure A-4. St. Joseph River. Load Duration Curve based on Daily Geometric Mean
Site: Walton Road (SJ-5).

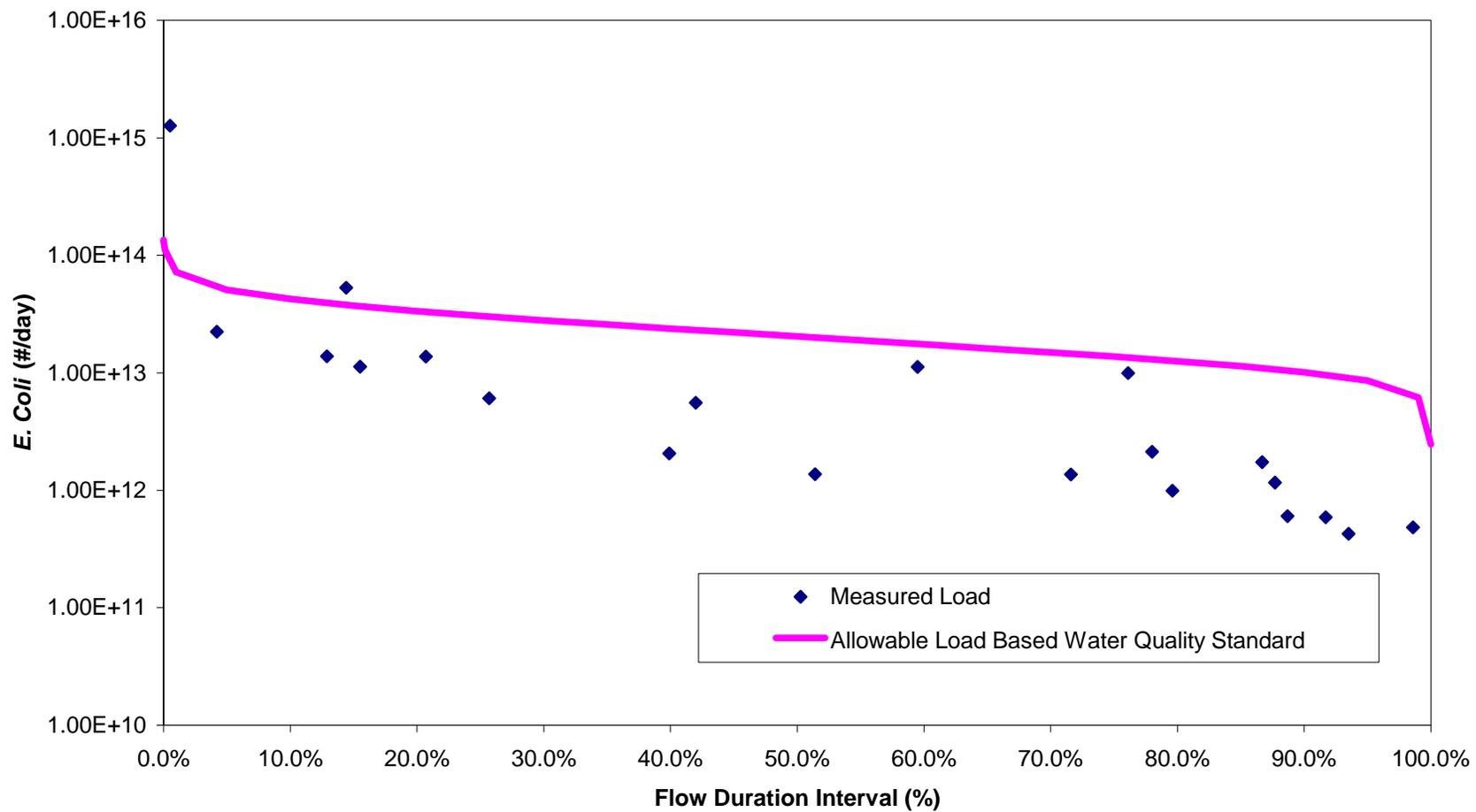


Figure A-5. St. Joseph River. Load Duration Curve based on Daily Geometric Mean.
Site: US-31 (SJ-6).

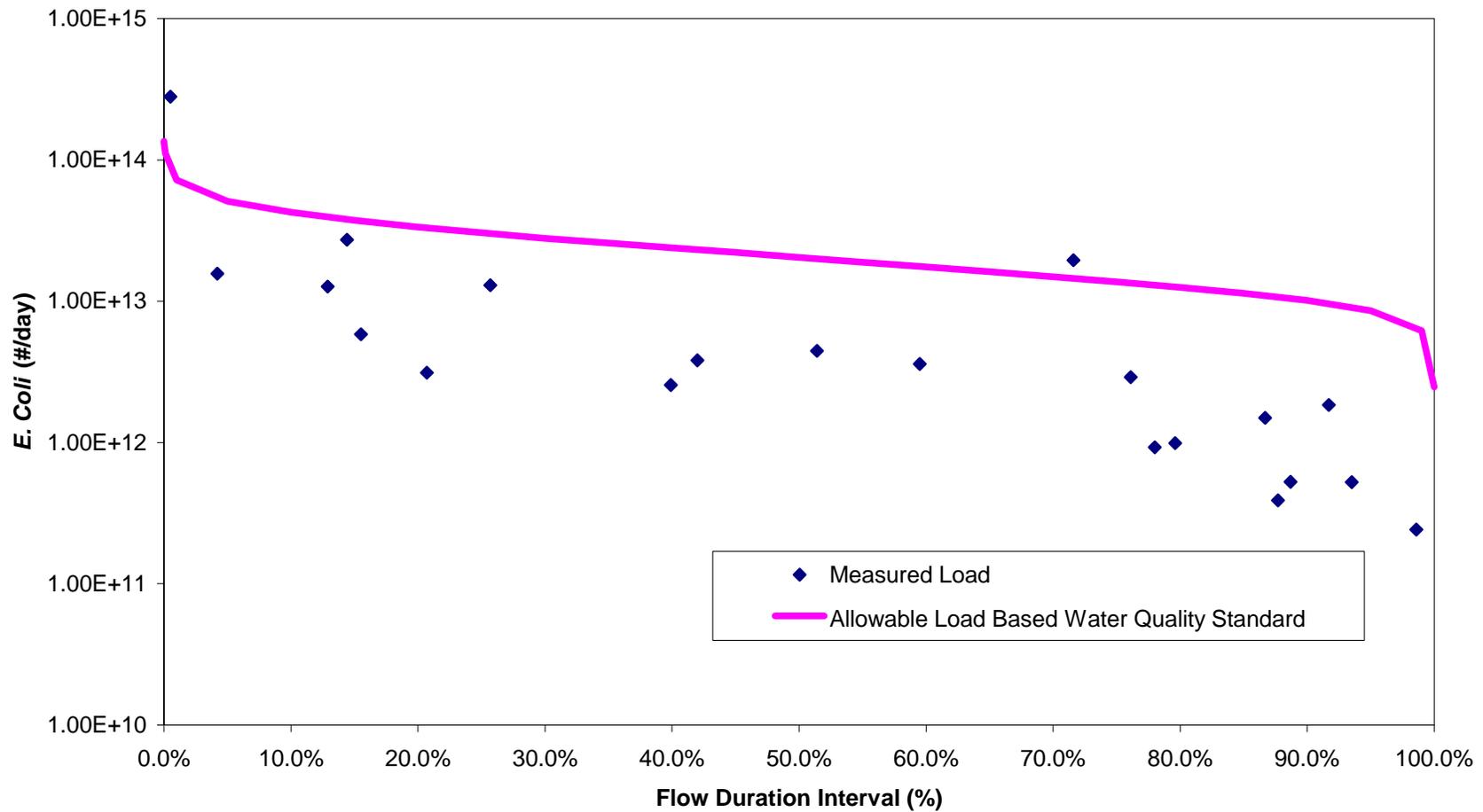


Figure A-6. St. Joseph River. Load Duration Curve based on Daily Geometric Mean.
Site: Pokagon Road (SJ-7).

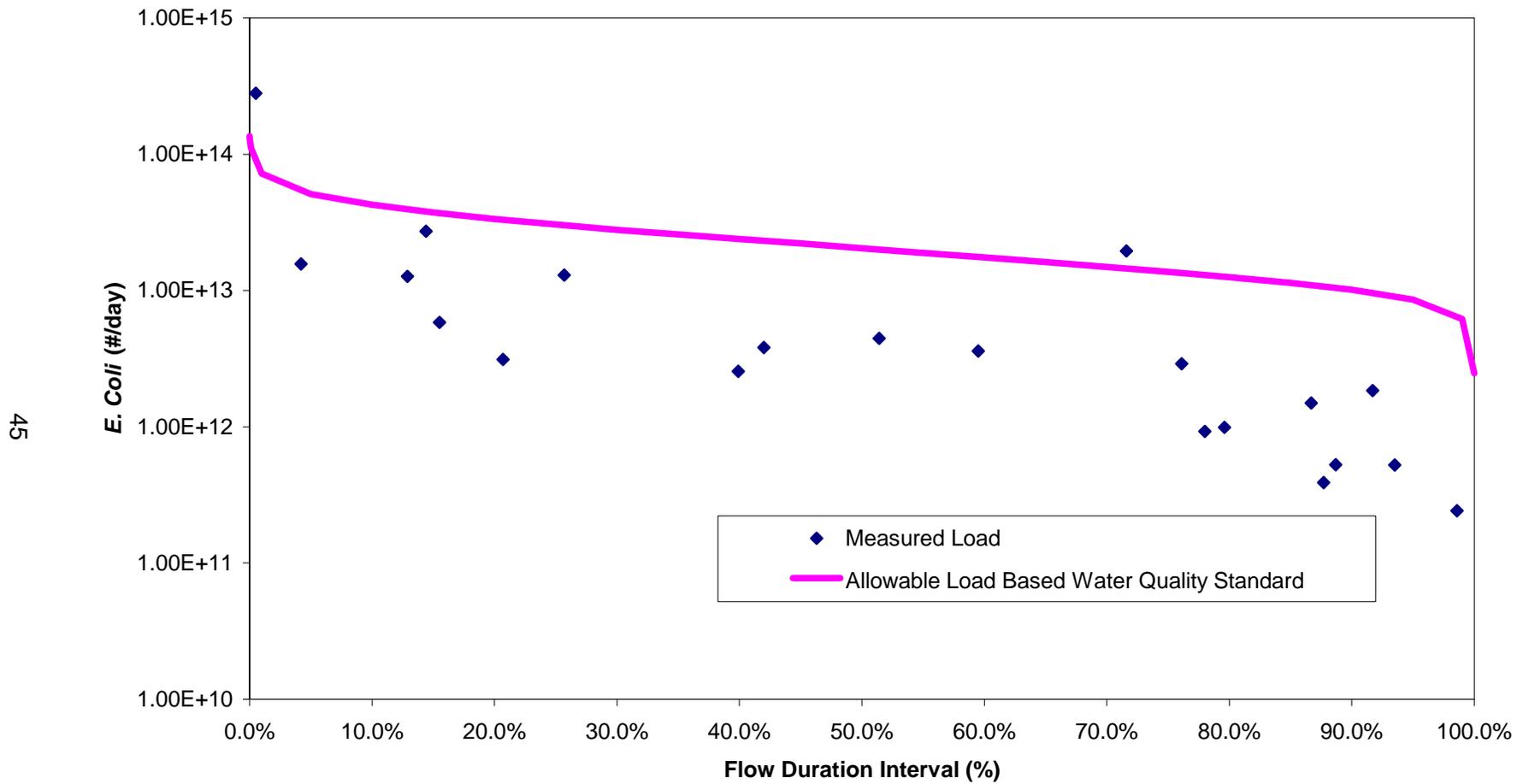


Figure A-7. St. Joseph River. Load Duration Curve based on Daily Geometric Mean. Site: US-31 (Scottdale Road) (SJ-8).

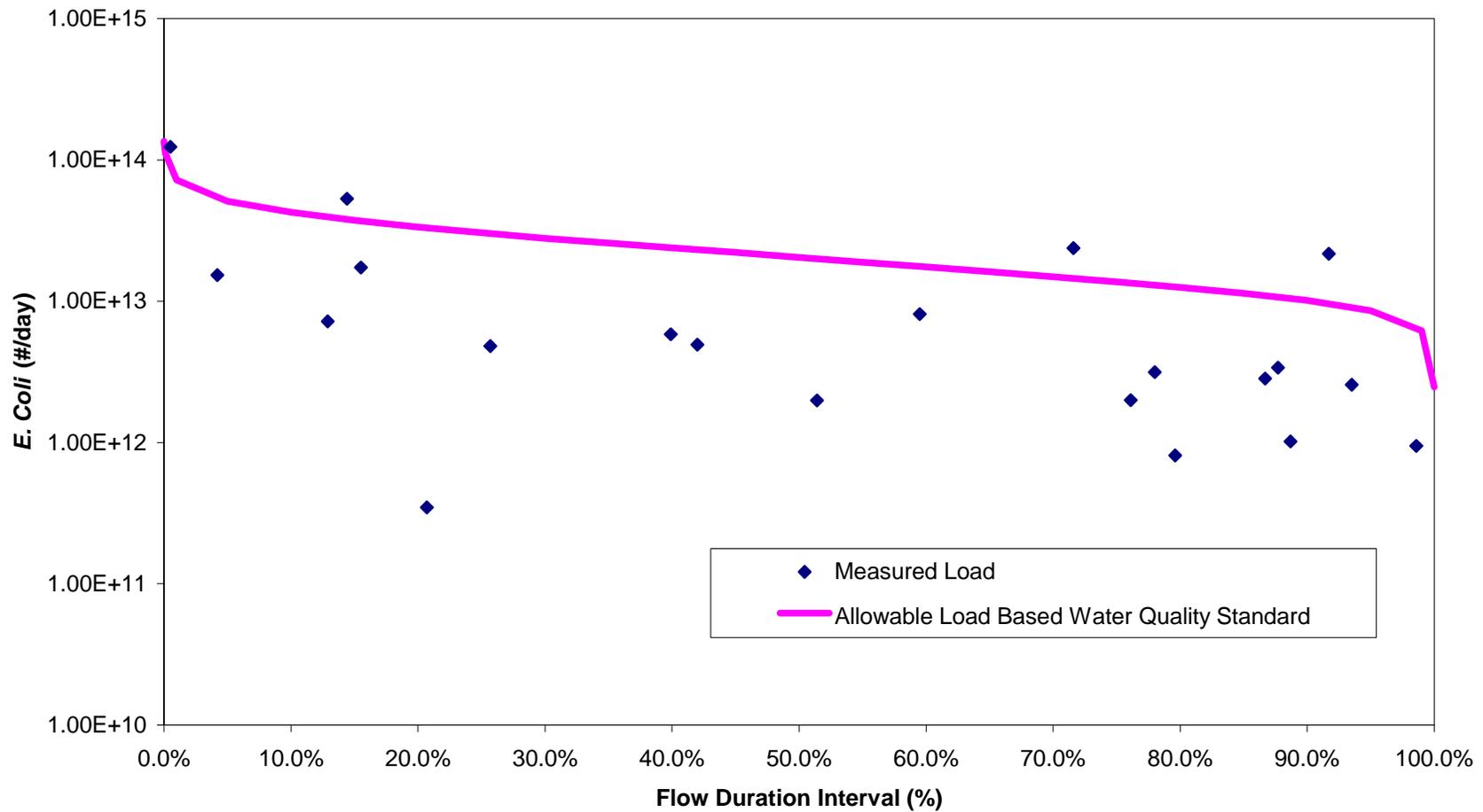


Figure A-8. St. Joseph River. Load Duration Curve based on Daily Geometric Mean.
Site: Napier Road (SJ-9).

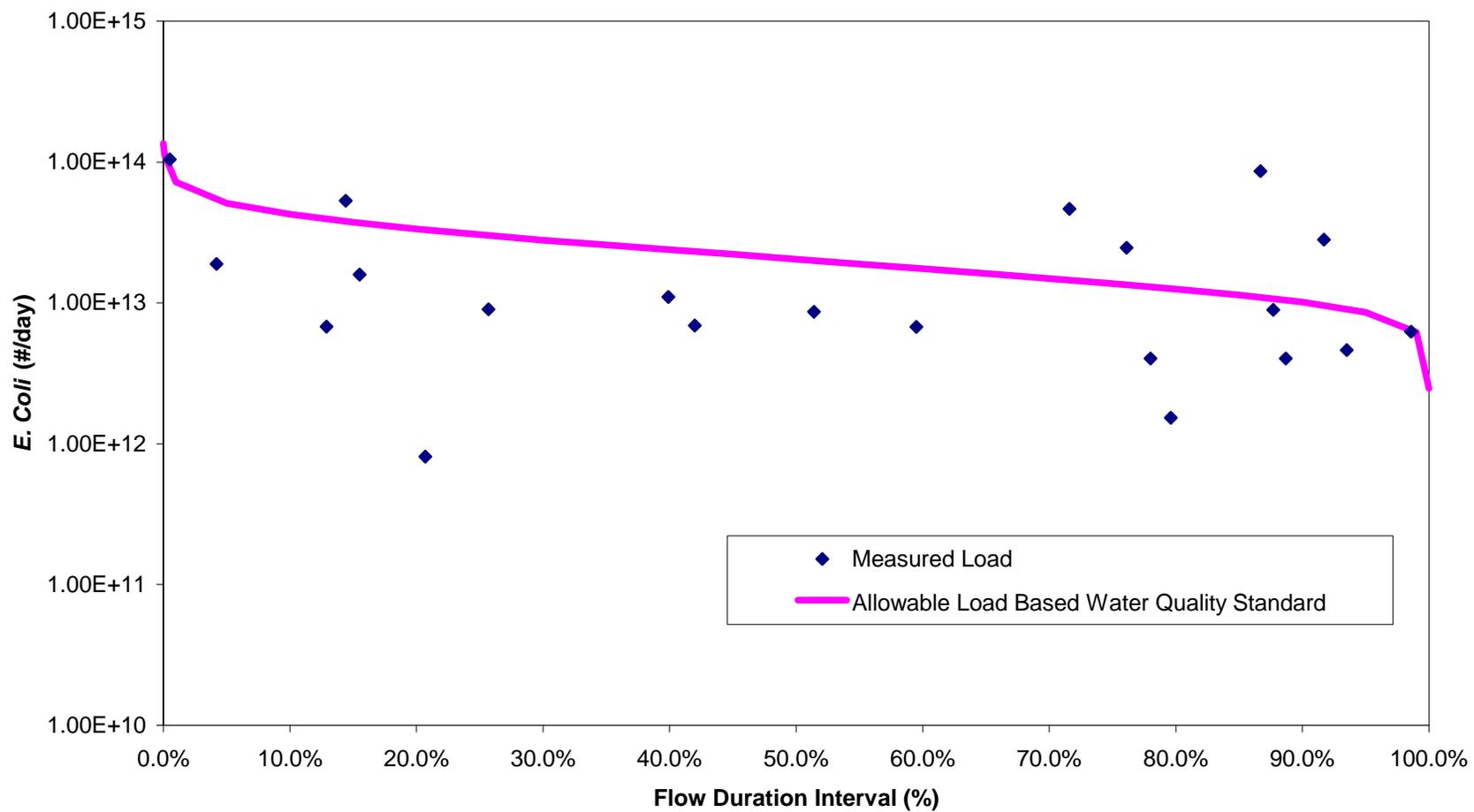


Figure A-9. St. Joseph River. Load Duration Curve based on Daily Geometric Mean.
Site: M-63 (SJ-10).