Enclosure 1

Michigan Department of Environmental Quality

Water Bureau

September 2004

Total Maximum Daily Load for

Dissolved Oxygen for the Belle and North Branch Belle Rivers

Lapeer and St. Clair Counties

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. 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 dissolved oxygen (DO) standard nonattainment in the Belle and North Branch Belle Rivers near Imlay City (Figure 1), and to quantify reductions in these sources necessary for attainment of the WQS. The Belle and North Branch Belle Rivers near Imlay City are designated as warmwater streams with a DO standard of 5 milligrams per liter (mg/l) as a minimum.

The Belle and North Branch Belle Rivers DO TMDL reaches are located in Lapeer and St. Clair Counties and are highlighted in Figure 1. Table 1 defines the extent and length of each reach. Note that the reach start locations begin at the downstream portion of the reaches, while the end locations are upstream. A total of 21.3 river miles are addressed by the TMDL.

Table 1. Belle and North Branch Belle Rivers DO TMDL reaches.

River	Reach Start	Reach End	Distance (mi.)
Belle River	Riley Center Road (T6N, R14E, Section 17 of St. Clair County)	Webster Road (T6N, R12E, Section 4 of Lapeer County)	17.1
N. Br. Belle River	Belle River confluence (T7N, R12E, Section 33 of Lapeer County)	Blacks Corners Road (T7N, R12E, Section 18 of Lapeer County)	4.2

The North Branch Belle River has a drainage area of approximately 17 square miles at the Imlay City Wastewater Treatment Plant (WWTP) point of discharge (Figure 1). Summer season 50% and 95% exceedance flows (cubic feet per second [cfs]) for the North Branch Belle River at this location are 2.1 cfs and 0.5 cfs, respectively. The North Branch Belle River joins the Belle River in Section 33, T7N, R12E, of Lapeer County. Summer season 50% and 95% exceedance low flows in the Belle River downstream of the confluence with the North Branch Belle River are 4.5 cfs and 1.5 cfs, respectively. The Belle River has a drainage area of approximately 132 square miles at Riley Center Road.

Belle River low flows were computed from historic data collected at a United States Geological Survey (USGS) Belle River flow gage (Gage Number 04160600) located in Memphis, Michigan.

North Branch Belle River low flows were calculated using data from a North Branch Belle River USGS gage (Gage Number 04160570) located in Imlay City.

PROBLEM STATEMENT

The Belle and North Branch Belle Rivers TMDL reaches appear on the 2004 Section 303(d) list (Wolf & Wuycheck, 2004) as:

BELLE RIVER AND N. BR. BELLE RIVER WBID# **061501G**
County: LAPEER/ST. CLAIR HUC: 4090001 Size: 21 M
Location: Riley Center Rd. u/s to Blacks Corners Rd, vicinity of Imlay City
Problem: **WQS exceedances for TDS and D.O.**
TMDL Year(s): 2004 RF3RchID: 4090001 16

This TMDL addresses only the DO standard nonattainment in the Belle and North Branch Belle Rivers near and below Imlay City.

A number of water quality surveys conducted in the Belle and North Branch Belle Rivers near Imlay City have revealed significant and continuing DO standard nonattainment in reaches in the vicinity of Imlay City. Intensive surveys conducted in the summers of 1973 and 1982, found Belle River DO levels below the present warmwater DO standard of 5 mg/l minimum. The September 1973 survey, examined 10.2 miles of the Belle and North Branch Belle Rivers near Imlay City (Water Resources Commission, 1974). Two rounds of sampling, one in the early morning and one in the late afternoon, showed that approximately 4.4 miles were in nonattainment of the (then) 4.0 mg/l minimum DO standard. The study report concluded that the very high DO diurnal variations observed in the rivers downstream of the Imlay City WWTP (greater than 8 mg/l, average minus minimum daily concentrations), were due to increased algae and macrophyte growth caused by nutrient loads from that facility.

Two 24-hour surveys of the North Branch Belle River and Belle River below Imlay City conducted in the summer and fall of 1982, documented minimum DO levels less than 4.0 mg/l (Synk and Buda, 1984). The then daily average DO standard of 5 mg/l was met throughout the study reach. Large diurnal DO variations of approximately 5 mg/l were recorded, apparently due to excessive plant growth. The 1982 surveys were used to calibrate and verify a multi-reach DO model of the Belle and North Branch Belle Rivers below Imlay City.

The North Branch Belle River DO was monitored continuously for 14 days in August 1997, approximately 0.3 miles downstream of Newark Road. Pinnacle Foods-Imlay City and the Imlay City WWTP were both discharging during the study period. Note that Pinnacle Foods-Imlay City's outfall 001 discharges to the North Branch Belle River just above its crossing with Newark Road. DO levels fell below the warmwater standard of 5.0 mg/l minimum each morning, with an average study period concentration of 4.9 mg/l, and a minimum level of 1.9 mg/l. High DO diurnal variations were also documented, with a study average value of 2.1 mg/l. The North Branch Belle River was in nonattainment of the acute DO toxicity criterion of 3.0 mg/l minimum on 9 of the 14 mornings of the study.

Continuous and instantaneous measurement of DO was conducted in the Belle and North Branch Belle Rivers in the summer of 2002. Full details of the 2002 monitoring are contained in a draft report (Limno-Tech Draft, 2003). Eight rounds of instantaneous measurements of DO, temperature, and specific conductance were taken at 13 stations along approximately 20 miles of both rivers near or below Imlay City. In addition, five stations were continuously monitored for those parameters for approximately three weeks. Sampling for total dissolved solids (TDS), carbonaceous biochemical oxygen demand$_5$ ($CBOD_5$), sulfate, chloride, total suspended solids (TSS), and nutrients was also conducted at selected stations. The monitoring showed that

periods of both dry and wet weather DO standard nonattainment continue to occur in each river near and below Imlay City. An average diurnal DO variation of approximately 4.5 mg/l was measured in the TMDL reaches.

Please see Table 1 for details on the DO TMDL reaches as delineated during the 2002 monitoring. These reaches are included in the 2004 Section 303(d) listing.

NUMERIC TARGETS

Rule 323.1100 of the Part 4. WQS 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. Regarding DO, the impaired designated use for the Belle and North Branch Belle Rivers addressed by this TMDL is the warmwater fish and other indigenous aquatic life and wildlife use. The DO standard was developed to provide protection of these designated uses. Attainment of the warmwater DO standard of 5 mg/l as a daily minimum is the target of this TMDL. The DO WQS is defined as follows:

> R 323.1064 Dissolved oxygen in Great Lakes, connecting waters, and inland streams. Rule 64. (1) A minimum of 7 milligrams per liter of dissolved oxygen in all Great Lakes and connecting waterways shall be maintained, and, except for inland lakes as prescribed in R 323.1065, a minimum of 7 milligrams per liter of dissolved oxygen shall be maintained at all times in all inland waters designated by these rules to be protected for coldwater fish. In all other waters, except for inland lakes as prescribed by R 323.1065, a minimum of 5 milligrams per liter of dissolved oxygen shall be maintained. These standards do not apply for a limited warmwater fishery use subcategory or limited coldwater fishery use subcategory established pursuant to R 323.1100(10) or during those periods when the standards specified in subrule (2) of this rule apply.
>
> …(2) Waters of the state which do not meet the standards set forth in subrule (1) of this rule shall be upgraded to meet those standards. For existing point source discharges to these waters, the Director of the Department may issue permits pursuant to R 323.2145 which establish schedules to achieve the standards set forth in subrule (1) of this rule. If existing point source dischargers demonstrate to the Director of the Department that the dissolved oxygen standards specified in subrule (1) of this rule are not attainable through further feasible and prudent reductions in their discharges or that the diurnal variation between the daily average and daily minimum dissolved oxygen concentrations in those waters exceeds 1 milligram per liter, further reductions in oxygen-consuming substances from such discharges will not be required, except as necessary to meet the interim standards specified in this subrule, until comprehensive plans to upgrade these waters to the standards specified in subrule (1) of this rule have been approved by the Director of the Department and orders, permits, or other actions necessary to implement the approved plans have been issued by the Director of the Department. In the interim, all of the following standards apply:
>
> …(b) For waters of the state designated for use for warmwater fish and other aquatic life, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 4 milligrams per liter, or below 5 milligrams per liter as a daily average, at the design flow during the warm weather season in accordance with R 323.1090(3) and (4). At the design flows during other seasonal periods as provided in R 323.1090(4), a minimum of 5 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified-in this subdivision.

…(3) The Director of the Department may cause a comprehensive plan to be prepared to upgrade waters to the standards specified in subrule (1) of this rule taking into consideration all factors affecting dissolved oxygen in these waters and the cost effectiveness of control measures to upgrade these waters and, after notice and hearing, approve the plan. After notice and hearing, the Director of the Department may amend a comprehensive plan for cause. In undertaking the comprehensive planning effort the Director of the Department shall provide for and encourage participation by interested and impacted persons in the affected area. Persons directly or indirectly discharging substances which contribute towards these waters not meeting the standards specified in subrule (1) of this rule may be required after notice and order to provide necessary information to assist in the development or amendment of the comprehensive plan. Upon notice and order, permit, or other action of the Director of the Department, persons directly or indirectly discharging substances which contribute toward these waters not meeting the standards specified in subrule (1) of this rule shall take the necessary actions consistent with the approved comprehensive plan to control these discharges to upgrade these waters to the standards specified in subrule (1) of this rule.

This TMDL will be considered the Comprehensive Plan for this water body referred to in Rule 64(3).

SOURCE ASSESSMENT

Potential sources of DO demanding pollutants, such as CBOD, ammonia nitrogen, sediments, and nutrients include point and NPS. CBOD and ammonia can be oxidized in the water column, depleting levels of DO. Decay of deposited organic sediments can also negatively affect in-stream DO concentrations. This decay process is known as sediment oxygen demand (SOD). Nutrients such as phosphorus and nitrogen can stimulate plant growths, which in turn can reduce DO levels through respiration. These nutrients are often adsorbed onto solids, which can enter waterways during wet weather events.

There are four individual National Pollutant Discharge Elimination System (NPDES) permitted discharges and five non-storm water general permitted discharges to the Belle and North Branch Belle Rivers watershed in the vicinity of Imlay City. There are also 11 industrial storm water permitted facilities in the drainage area. There are a total of 73 notices of coverage for construction sites in Lapeer and St. Clair Counties. See Appendix A, Tables A.1 through A.4 for a listing of all NPDES permittees. Figure 2 indicates the location of individual, general, and storm water discharges. Of all of these facilities, five are known to be relatively significant point sources of conventional pollutants in the study reaches. Two of these five facilities (Imlay City WWTP and Meadowbrook Estates WWTP) are individually permitted WWTPs continuously discharging treated sanitary wastewaters. Two facilities are seasonal municipal Wastewater Sewage Lagoon (WWSL) discharges, one covered under the WWSL general permit (Capac WWSL), and the other with an individual NPDES permit (Dryden WWSL). The remaining facility is an individually permitted continuous food processing discharge (Pinnacle Foods-Imlay City). Of all of these facilities, the Imlay City WWTP and Pinnacle Foods-Imlay City are the most significant sources of conventional pollutant loadings, based on NPDES permit and discharge monitoring report (DMR) load values.

The Imlay City WWTP (MI0023167), with a design flow of 0.9 million gallons per day (MGD), is permitted to discharge treated municipal wastewaters from outfall 001 to the North Branch Belle River in Section 16, T7N, R12E of Lapeer County. The facility's current NPDES permit requires advanced waste treatment (AWT) in the summer and fall seasons. AWT limits are treatment technology-based effluent limits (TTBELs) and are the most restrictive conventional pollutant limits imposed on sanitary wastewater facilities employing biological treatment. See Table B.1 of Appendix B for Imlay City WWTP's NPDES permit effluent limits. During the summer of

2002, the Imlay City WWTP effluent had average $CBOD_5$ and ammonia concentrations of 2.5 mg/l and 0.2 mg/l, respectively, according to facility DMRs. Daily maximum $CBOD_5$ and ammonia concentrations were 4.1 mg/l and 1.3 mg/l.

Pinnacle Foods-Imlay City (MI0001708) is permitted to discharge 1.555 MGD of process water, noncontact cooling water, and storm water to the North Branch Belle River from outfall 001 located in Section 21, T7N, R12E of Lapeer County. The facility's NPDES permit requires AWT in the months of May through November. See Table B.2 of Appendix B for Pinnacle Foods-Imlay City's NPDES permit limits. The facility's previously existing outfall 002 to the North Branch Belle River ceased discharge in June 30, 2001. During the summer of 2002, Pinnacle Foods-Imlay City 001 effluent had average $CBOD_5$ and ammonia concentrations of 0.1 mg/l and 0.0 mg/l, respectively, according to facility DMRs. Daily maximum summer $CBOD_5$ and ammonia concentrations were 3 mg/l and 0.6 mg/l.

Three other facilities in the vicinity of Imlay City contribute smaller loads of oxygen-demanding wastes to the Belle River. Meadowbrook Estates MHP (MI0055999) is authorized to discharge 0.094 MGD of treated sanitary wastewater continuously to Dryden Drain, a tributary to the Belle River, upstream of the Belle River's confluence with the North Branch Belle River. The discharge is located in Section 12, T6N, R11E of Lapeer County. The facility's NPDES permit requires AWT limits in the summer, fall, and winter seasons (May through March). This facility's complete NPDES permit limits are contained in Table B.3.

The Dryden WWSL (MI0035637) is currently permitted to discharge 36.5 million gallons per year (MGY) of treated sanitary wastewaters seasonally to Dryden Drain in Section 12, T6N, R11E of Lapeer County, approximately 1500 feet upstream of the Meadowbrook Estates MHP discharge. In June 2001, the Michigan Department of Environmental Quality (MDEQ), Surface Water Assessment Section (SWAS) developed water quality-based effluent limits (WQBELs) for a proposed 0.19 MGD continuous discharge from the Dryden WWTP facility. AWT limits were recommended for the summer season (May through September). As of the date of this report, the Dryden WWSL remains a seasonal WWSL discharge. This facility's NPDES permit limits are contained in Table B.4.

The Capac WWSL (MIG580271) discharges 76 MGY seasonally to Lemon Drain in Section 27, T7N, R13E of St. Clair County. Lemon Drain is tributary to Doty Drain, which joins the Belle River in Section 12, T6N, R13E of St. Clair County. Note that the WWSL general permit under which the Capac WWSL discharges has identical effluent limits as the Dryden WWSL permit, except that there is only a reporting requirement for total phosphorus instead of the 1 mg/l monthly average limit (Table B.4). The Dryden WWSL, Meadowbrook Estates MHP, and Capac WWSL did not need to be included in the most recent waste load allocation (WLA) for the Imlay City WWTP and Pinnacle Foods-Imlay City effluent limit development due to their seasonal discharges and relatively small pollutant load contributions.

Four other facilities discharge wastewaters to the TMDL reaches under non-storm water general permit certificates of coverage in addition to the Capac WWSL. These include construction sand and gravel, noncontact cooling water, and swimming pool discharges. See Table A.1 under General Permits for details on these discharges.

Table 2 contains permitted annual conventional pollutant loads for the listed primary point sources. The loads are calculated from the facilities' monthly NPDES permit load limits. For parameters not limited by load, annual loads were estimated from concentration limits or estimates, and the facility design flows. Note that the facilities may, in fact, be discharging significantly lower loads of these pollutants than they are permitted to discharge. Estimated loads from other unlisted non-storm water general permittees, which are not required to monitor for the indicated parameters, are included. These estimated loads are from the facilities listed

under General NPDES Permits in Table A.1 of Appendix A (except for the Capac WWSL, which is listed separately in Table 2). Loads from these facilities were estimated from the annual design flow and the following assumed discharge concentrations (typical of unpolluted ambient surface waters (MDEQ, 1995; Wuycheck, 2003)): $CBOD_5$, 2 mg/l; TSS, 30 mg/l; ammonia nitrogen, 0.1 mg/l; and total phosphorus, 0.1 mg/l.

Table 2. Belle and North Branch Belle Rivers non-storm water permitted point source conventional pollutant loadings.

Annual load (lbs/yr)	Imlay City WWTP	Pinnacle Foods-Imlay City	Meadowbrook Estates MHP	Dryden WWSL	Capac WWSL
$CBOD_5$	11,000	37,000	3,000	9,000	19,000
TSS	55,000	383,000	6,000	17,000	35,000
Ammonia nitrogen	22,000	8,000	1,000	5,000	10,000
Total phosphorus	3,000	5,000	200	300	600

Table 2 (cont.) Belle and North Branch Belle Rivers non-storm water permitted point source conventional pollutant loadings.

Annual load (lbs/yr)	Other non-storm water general permittees *
$CBOD_5$	15,000
TSS	225,000
Ammonia nitrogen	800
Total phosphorus	800

* - Facilities not required to monitor for the listed parameters. Loads are estimated.

Table 3 contains estimates of Belle and North Branch Belle Rivers TSS loads from existing industrial storm water permitted facilities (Table A.2). Storm water loads in Table 3 were estimated based on commercial land use data contained in the Long-Term Hydrologic Impact Assessment (L-THIA) web-based software created and maintained by Purdue University and the USEPA (Purdue University and USEPA, 2001). This geographic information system-based application uses the event mean concentration (EMC) and curve number (CN) procedures to calculate annual pollutant loads based on land use, soil type, and meteorological data. The L-THIA application is supported by staff of the USEPA, Region 5.

Table 3. Estimated Belle and North Branch Belle Rivers conventional pollutant loads, storm water permittees.

Annual load (lbs/yr)	Industrial storm water permittees (from land use data)
BOD	45,000
TSS	108,000
Total Nitrogen	3,000
Total Phosphorus	600

Potential NPS of pollutants were evaluated based on land uses in the drainage basin (Table 4). Land use proportions were derived using the L-THIA application. It is possible that the urban land use proportions (e.g., commercial and residential) are in fact higher than indicated in Table 4 due to increased residential development. Note that Water Bureau (WB) district staff indicate no knowledge of concentrated animal feeding operations or problematic agricultural operations in the affected basins.

Table 4. Belle and North Branch Belle Rivers basin land use categories as percentages at Riley Center Road.

Land use category	Percent land use category
Water	7.2
Commercial	0.9
Agriculture	57.1
High density residential	0.2
Low density residential	1.0
Grass / pasture	16.2
Forest	17.4

The 2002 summer DO surveys indicate that certain pollutants contribute toward DO standard nonattainment in the Belle and North Branch Belle Rivers near Imlay City. Land use-related inputs of various oxygen demanding pollutants appear to cause the documented wet weather-related DO depressions in the Belle River below Imlay City, and likely contribute toward DO standard nonattainment through SOD, and especially respiration from very abundant plant growths.

Estimates of land use-related annual loads of BOD ($CBOD_5$ + nitrogenous BOD), TSS, total phosphorus (TP), and total nitrogen to the Belle and North Branch Belle Rivers near Imlay City were estimated using the L-THIA application. Estimates of loads to the Belle River at Riley Center Road appear in Table 5. These loads include those to the North Branch Belle River and all Belle River tributaries. These estimates are based on non-site-specific data and represent a best approximation using software default EMC and CN values. These estimates include construction site contributions based on commercial land use. Note that the land use-based Belle River pollutant loadings in Table 5 include the estimated loads from storm water permitted facilities contained in Table 3.

Table 5. Estimated annual land use conventional pollutant loads at Riley Center Road, including Belle River storm water permitted facilities.

Pollutant	Annual load (lbs/yr)
BOD	189,000
TSS	3,569,000
Total nitrogen	149,000
TP	43,000

In accordance with USEPA guidelines, urban runoff from Imlay City will be considered in the WLA portion of this TMDL. Industrial storm water permitted facilities and construction sites with certificates of coverage will also be considered in the WLA portion of the TMDL. Industrial NPDES stormwater permittees in the vicinity of Imlay city are listed in Table A.2. Tables A.3 and A.4 list active NPDES certificates of coverage for construction sites in Lapeer and St. Clair Counties, respectively. Note that there are no municipalities in the drainage area of concern that are subject to Phase II storm water permits.

LINKAGE ANALYSIS

The observed DO standard nonattainment in the Belle and North Branch Belle Rivers can be attributed to a number of factors. These factors were assessed using mathematical DO models of the reaches of concern. The model chosen was the O'Connor-DiToro multireach, steady-state DO model (O'Connor and DiToro, 1970), based on the modified Streeter-Phelps equation. This model has the capability of simulating diurnal DO variation resulting from plant

photosynthesis and respiration. The respiration term includes DO depletion due to SOD. The O'Connor-DiToro model is considered appropriate for use in the TMDL as it can represent the system without being unnecessarily complex or too data-intensive. The model is based on a calibrated and verified model of the Belle and North Branch Belle Rivers developed in 1983, using data from the 1982 surveys (MDNR, 1984). Modeling was conducted in accordance with guidance described in the Great Lakes and Environmental Assessment Section (GLEAS), Procedure 80 (MDEQ, 1995). The models were calibrated to data collected in the summer of 2002.

An O'Connor-DiToro model of the Belle and North Branch Belle Rivers was constructed. Modeling of reaches below the Imlay City WWTP was based on an existing model of the Belle and North Branch Belle Rivers that was calibrated and verified based on water quality studies. That calibrated and verified model has been used in the development of WQBELs for the Imlay City WWTP. River surveys and DO modeling have revealed that plant respiration is the major sink of DO in the Belle and North Branch Belle Rivers. SOD plays a less significant role in the DO problem in the TMDL reaches.

Plant Respiration: The presence of aquatic plants in a water body can have a very significant affect on levels of DO. Plants, such as rooted macrophytes and algae, use photosynthesis during daylight hours to convert carbon dioxide and water into glucose, a process that releases oxygen. The oxygen is released to the surrounding water increasing levels of DO. Throughout the day and night, plants also respire aerobically. This process removes DO from the water column. DO concentrations vary throughout the day in response to photosynthesis and respiration. Since the photosynthetic contribution of DO occurs only with sunlight, and respiration is relatively constant, levels of DO are most often lowest just before sunrise. Plant growth can be encouraged by the addition of nutrients, such as phosphorus, to a water body. This increased growth causes increases in photosynthesis and respiration rates, resulting in exaggerated daytime DO concentration peaks and potentially problematic early morning lows.

Phosphorus is an important nutrient of concern in aquatic systems, such as the Belle and North Branch Belle Rivers. Phosphorus can exist in dissolved and particulate forms. When dissolved, some of the phosphorus is available for use by aquatic plants and increased growth can result. Phosphorus, in the particulate form in river sediments, can be released to the water column as dissolved phosphorus under certain conditions, contributing to increased plant growth. Solids that run off of land into water bodies or that are discharged directly to a stream typically have particulate phosphorus associated with them. Substantial loads of TSS can therefore result in substantial inputs of phosphorus available for plant use in a stream.

Prolific growth of rooted and detached macrophytes was noted in the North Branch Belle River during the summer of 2002 (Limno-Tech Draft, 2003). Field crews indicated that during the summer 2002 monitoring, growth was so dense at Newark Road (Station 8) that nearly 100% of the river surface was covered by floating (rooted or detached) macrophytes. The plant growth appeared to have the effect of slowing the movement of the water at the surface of the river, while it was apparent that the river below the surface was moving. The water surface appeared stagnant at low flows. The Belle River at Bowman Road (Station 3) showed similarly dense growths of macrophytes. The Belle and North Branch Belle Rivers are largely unshaded down to Bowman Road (Station 3), a condition that encourages plant growth. Suspended algae was consistently observed at each station monitored in 2002 (Figure 1). During routine maintenance visits to deployed monitoring instruments, DO sensors were found to be fouled with relatively heavy algal biofilm growths. This heavy plant growth results in high rates of photosynthesis and respiration. Based on the 2002 (and past) river surveys and DO modeling, DO standard nonattainment in both the Belle and North Branch Belle Rivers appears primarily due to plant respiration. Very high DO diurnal variations were measured in 2002, and early morning DO standard nonattainment was common throughout the TMDL reaches (Limno-Tech Draft, 2003).

One round of dry weather chemistry sampling on August 13, 2002, showed that TP concentrations exceeded 0.1 mg/l in only three (Stations 3, 11, and 12) of the ten sampled locations on the Belle and North Branch Belle Rivers (Limno-Tech Draft, 2003).

SOD: Solids present in the water column of a flowing water body can settle to the stream bed, forming layers of sediments with variable depths and compositions. Organic solids on the surface layer of the bottom deposit in direct contact with the water can undergo aerobic decomposition. This process causes diffusion of DO from the water column into the sediment layer, depleting DO levels in the overlying river water. High levels of TSS in a water body can potentially cause high SOD rates if the solids settle to the bottom and decompose.

River substrates in the TMDL reaches were observed to be varied during the summer 2002 monitoring (Limno-Tech Draft, 2003). At the furthest upstream continuously monitored station on the North Branch Belle River at Imlay City Road (Station 1), the river bottom was mostly sandy with heavy growths of rooted macrophytes. Progressing downstream, the North Branch Belle and Belle Rivers' substrates became more silty until approximately Riley Center Road (station 5), which was dominated by clays with cobbles and boulders present. Cobbles were also observed at Berville Road (station 4). It is possible that some of the silty deposits result from point source discharges to the Belle and North Branch Belle Rivers. Such deposits may also be due to urban runoff, which is generally high in TSS concentrations (Cave et al., 1994; Sunday, 2003). The WB district staff have indicated that sanitary sewer overflows (SSOs) discharged to the North Branch Belle River in Imlay City during 2000, due to grease build up in sanitary sewers. No details of the SSO events, such as volume and duration, are known. Such SSO discharges can contribute significant amounts of SOD to receiving waters. SOD and sediment deposits are typically highly variable spatially and temporally due to varying flow regimes affecting deposition and scour (Bowie et al., 1985). Note that SOD has not been measured in the Belle or North Branch Belle Rivers, and no site specific data on that parameter is available.

TMDL DEVELOPMENT

The TMDL represents the maximum loading of oxygen demanding substances (e.g., sediments and nutrients), or other parameters that can indirectly cause oxygen demand, that can be assimilated by the water body while still achieving WQS. As indicated in the Numeric Target section, the target for this DO TMDL is the WQS of 5 mg/l minimum DO. TMDL development also defines the environmental conditions that will be used when defining allowable levels.

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 and R 323.1090 of the Michigan WQS. In general, the lowest monthly 95% exceedance flow and 90% occurrence temperature for streams are used as design conditions for oxygen-demanding pollutant loads (CBOD and ammonia nitrogen).

NPS loadings of pollutants appear to play a significant role in the Belle River near Imlay City's DO standard nonattainment. This TMDL follows a phased approach due to inherent uncertainties in estimating loadings from NPS. Under the phased approach, load allocations (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 to reduce uncertainty (USEPA, 1991).

DO models were used to quantify reductions in river DO sinks necessary to attain the DO standard at critical conditions. Calibration data show that along the entire 21.3 mile DO TMDL reaches of the Belle and North Branch Belle Rivers, on average, SOD is responsible for approximately 30% of the DO deficit at design conditions, while plant respiration is responsible for approximately 70% of the deficit. The calculated relative contributions to the DO deficit from plant respiration and SOD will vary depending on the conditions to which the models are calibrated.

In order to decrease SOD and nutrient loads, the loading of suspended sediments to the rivers must be reduced. Summer 2002, and past Belle and North Branch Belle Rivers monitoring has documented significant DO sags during wet weather events. It is likely that most nutrient inputs to the system are transported with the suspended sediment loads likely to accompany runoff. This is supported by wet weather water chemistry sampling conducted in other watersheds similar to the Belle and North Branch Belle Rivers basins. Wet weather sampling conducted in development of the Grand River at Jackson DO TMDL (Sunday, 2003) showed that except for one wet weather event, TP concentrations are significantly higher than orthophosphate concentrations. These data indicate that most phosphorus loads are adsorbed to solids rather than being in a dissolved form. TSS reduction is therefore the best overall strategy to improve DO in the stream.

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.

This phased approach DO TMDL will target a 50% reduction in land use-related TSS loads to the Belle and North Branch Belle Rivers in the vicinity of and below Imlay City. The 50% TSS load reduction was chosen, in part, due to the results of DO modeling, which indicates that plant respiration and SOD in the reaches of concern should be reduced by approximately 30% to 75%, depending on the reaches under consideration, in order to achieve the DO standard. According to the modeling with its inherent uncertainties in parameter estimation, some (and likely most) reaches will attain the DO standard after an overall 50% reduction of TSS loads, while other reaches may not achieve standard attainment. Overall, however, the TMDL water body segment is expected to meet WQS with this reduction. The existence of further uncertainties that make it difficult to quantify the effects of TSS loads on in-stream DO levels make the proposed 50% reduction a reasonable objective for the initial phase of the TMDL. Subsequent phases of the TMDL may lead to changes in this target, and additional attention may be directed towards any reaches that remain in nonattainment.

Table 6 contains total estimated existing TSS loads to the Belle and North Branch Belle Rivers at Riley Center Road (4,290,000 lbs/yr TSS). The initial phase of this TMDL will focus on land use TSS load reductions, as monitoring data and load estimates indicate that land use-related pollution is the primary cause of DO standard nonattainment in the affected reaches. Land use TSS loads include those from industrial storm water permittees, which will be treated as point sources in the WLA. Industrial storm water discharges were assumed to comprise 100% of the commercial land uses in the Belle and North Branch Belle Rivers basins at Riley Center Road

(0.9% of the total Belle River basin land cover at that point), in order to compute land use-related TSS loads. As outlined in Table 6, the final total TSS load target of this TMDL is 2,506,000 lbs/yr TSS.

WLAs

DO standard nonattainment in the relevant water bodies has been documented during the summer months only. During the summer months (May through September), the two most significant point sources of oxygen demanding substances to nonattaining reaches, the Imlay City WWTP and Pinnacle Foods-Imlay City, are required by their NPDES permits to treat their effluent at AWT limits. These effluent limits are the most restrictive limits that the state of Michigan imposes on municipal wastewater treatment facilities, and effluent of this quality is considered to exert no oxygen demand in-stream (stable effluent). Further reductions in conventional parameters ($CBOD_5$, ammonia nitrogen, and TSS) from these facilities will not impact DO levels in the critical summer months. The high levels of treatment required by the Imlay City and Pinnacle Foods-Imlay City lead to high conventional pollutant removal rates throughout the year.

See Table 6 for proposed WLAs and LAs for the Belle and North Branch Belle Rivers. No reductions in municipal wastewater treatment facility (WWTP or WWSL) point source loadings are proposed for this DO TMDL's WLA for the individual NPDES permit or non-storm water general permitted facilities. TSS loads from these facilities are allocated as described in Appendix A, Table A.5.

All land use-related loads have been reduced by 50% in both the WLA (industrial storm water permittee loads, attributed to commercial land uses) and the LA (all non-commercial land use loads) as compared to existing loads outlined in Table 6.

Table 6. Annual TSS load source allocations and numeric targets - Belle and North Branch Belle Rivers at Riley Center Road.

Water Body	Current Annual TSS Load (lbs)	Annual TSS Load Numeric Target (lbs)	WLA Annual TSS Load (lbs)	LA Annual TSS Load (lbs)
BELLE AND NORTH BRANCH BELLE RIVERS:				
Industrial Storm Water Permitted Outfalls*	108,000	54,000	54,000	-
Other Land Use Related Sources**	3,461,000	1,731,000	-	1,731,000
Existing Individual/General NPDES Permitted Facilities	721,000	721,000	721,000	-
Totals:	4,290,000			
Annual TSS Load Numeric Target To DO TMDL Reach	-	2,506,000	775,000	1,731,000

* Primarily attributed to urban or built-up land uses in the city of Imlay City; ** Attributed to non-commercial land uses in the townships of Almont, Attica, Berlin, Brockway, Dryden, Emmet, Goodland, Imlay, Mussey, and Riley.

LAs

TSS inputs resulting from land use-related sediment loads will be the primary targets for reduction in the Belle and North Branch Belle Rivers in this TMDL. Table 6 lists the land use source LAs for the Belle and North Branch Belle Rivers. The LA values in Table 6 do not include land use loadings due to industrial storm water permittees discharging to the rivers, as those loads are addressed in the WLA. The target LA values in Table 6 represent 50% of the loads of the existing estimated TSS loads contributed by those land uses classified as nonurban and not covered under storm water permits. Lands contributing TSS loads to the Belle and North Branch Belle Rivers are located in the Townships of Almont, Attica, Berlin, Brockway, Dryden, Emmet, Goodland, Imlay, Mussey, and Riley.

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 implicit MOS with conservative assumptions incorporated in DO modeling. Background flows and tributary inflows are represented at the 95% exceedance summer low flow as determined by the MDEQ, Land and Water Management Division. The summer 95% exceedance flow is a stream flow that would be expected only during periods of severe drought. Stream flows would be expected to be this low for only 5% or less of the time during the summer season. Michigan WQS (R 323.1090), specify that WQS apply at all flows equal to or exceeding the 12-month 95% exceedance low flow. This is the stream flow employed in the modeling of the critical summer season, the very minimum flow at which WQS are to be applied. Similarly, river temperatures are represented at the highest monthly 90% occurrence temperature for the summer season as defined in the SWAS effluent limit coordination Procedure 15. This temperature would be expected to be exceeded only 10% of the time during the summer months. This design temperature is derived from R 323.1075 of the WQS. Such high temperatures result in lower DO saturation concentrations and increased rates of in-stream oxygen utilization. The conservative assumptions regarding stream flow and water temperature are the same as those employed in the determination of WQBELs in NPDES WLAs at critical design conditions.

SEASONALITY

Monitoring and modeling indicates that design conditions occurring during the summer season represents the most critical conditions for DO standard attainment in the Belle and North Branch Belle Rivers. Modeling of the Belle and North Branch Belle Rivers in other seasons using appropriate 95% exceedance low flows and 90% occurrence temperatures shows no predicted instances of DO standard nonattainment.

The very large diurnal variations documented in the North Branch Belle River are likely to persist into the fall season, possibly leading to early morning DO standard nonattainment. Preliminary modeling shows fall season nonattainment, though there is uncertainty regarding the magnitude of photosynthesis and respiration rates in that season. The reduction in TSS loads and resulting reduction in phosphorus loads recommended in this TMDL should result in decreased plant activity and DO diurnal variations in the North Branch Belle River during all seasons.

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. This monitoring

will be conducted as resources allow. Typically, the WB monitors watersheds in accordance with the five-year NPDES permit review process. The WB will give priority to TMDL reaches when conducting monitoring under this five-year cycle. The Belle and North Branch Belle Rivers will be reevaluated in 2007, when the Belle River basin is next scheduled for monitoring. Limited DO monitoring (instantaneous measurements similar to those of the 2002 survey) may be conducted in the meantime.

Future monitoring should be conducted after recommendations outlined in this TMDL are implemented. DO 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. Monitoring during the fall season may be included to assess standard attainment during that season. Wet weather pollutant load sampling may aid in directing future efforts toward specific areas contributing significant NPS loads.

REASONABLE ASSURANCE ACTIVITIES

Under the NPDES permit program, point sources in the vicinity of Imlay City are responsible for meeting their effluent limits for oxygen demanding substances. Compliance is determined based on review of DMR data by the MDEQ. Existing DMR data reviewed by the MDEQ indicates these facilities are meeting those permit limits.

The Southeast Michigan Council of Governments is involved in Belle River water quality through the Macomb-St. Clair Intercounty Watershed Advisory Group. The activities of this group focus on improving water quality in Lake St. Clair by improving water quality in streams tributary to the lake. The group's initiatives include the development of watershed management plans, sedimentation reduction, and minimization of land use impacts through storm water control.

The St. Clair County Drain Commissioner and Health Department have received state funds to conduct surveys for the identification and elimination of sanitary sewer and other illicit connections in the Belle River and other watersheds draining to the St. Clair River and Lake Huron. The goal of the project is to reduce nutrient and bacteria inflows into the Belle River and other affected rivers. This effort is funded by grants from the State of Michigan under the Clean Michigan Initiative-Clean Water Fund (CMI-CWF, Grant #2002-0222 and #2002-0223). Activities conducted under these grants will be reviewed and approved by the SWAS staff.

The TMDL reaches are designated as an intercounty drain, managed by an intercounty drainage board. The drain commissioners of Lapeer and St. Clair Counties, and the Michigan Department of Agriculture, manage the Belle River for water quantity and, to a limited extent, for water quality issues.

Both Lapeer and St. Clair Counties administer the National Resources and Environmental Protection Act's Part 91, Soil Erosion and Sedimentation Control program (SESC). This program aims to reduce sedimentation in rivers, lakes, and streams by controlling sediments in runoff from construction sites greater than 1 acre in area, or those located within 500 feet of a water of the state. Temporary (silt fences) and permanent control measures (such as fully vegetation buffer strips) are employed. The MDEQ, WB oversees the counties' programs to ensure that they are effectively enforcing SESC regulations.

Prepared by: Erik Sunday
Surface Water Assessment Section
Water Bureau
Michigan Department of Environmental Quality
December 21, 2004

REFERENCES

Bowie, B.L., W.B. Mills, D.B. Porcella, C.L. Campbell, J.R. Pagenkoph, G.L. Rupp, K.M. Johnson, P.W.H. Chan, S.A. Gherini, and C.E. Chamberlin. Rates, Constants, and Kinetic Formulations in Surface Water Quality Modeling. USEPA, ORD, Athens, GA, ERL, EPA/600/3-85/040.

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.

Limno-Tech, Inc. 2003. DRAFT Dissolved Oxygen and Total Dissolved Solids Study, Belle River and North Branch Belle River, June 21 – August 13, 2002.

MDEQ. 1995. Great Lakes and Environmental Assessment Section. Procedures Manual, Vol. II. Procedure 80: Guidance on WQBEL Recommendations for Oxygen Demanding Substances. WD, MDEQ.

O'Connor, D.J. and D.M. DiToro. 1970. Photosynthesis and Oxygen Balance in Streams. Journal of the Sanitary Engineering Division, ASCE 96(2): 547-571.

Purdue University and USEPA. 2001. Long Term Hydrological Impact Assessments (L-THIA) Web site, November 12, 2003. https://engineering.purdue.edu/~lthia/

Sunday, Erik. 2003. Total Maximum Daily Load for Dissolved Oxygen for the Grand River, Jackson County. MDEQ, WD.

Synk, M. M. and S. G. Buda. 1984. Belle River Study Below Imlay City, Sept 7-8, 1982. MDNR, Report #025035.

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

Water Resources Commission. 1974. Belle River Study Below Imlay City, Sept 11-12, 1973. MDNR, Report #025020.

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/WD-04/029.

Wuycheck, J. February 12, 2003. Personal Conversation.

APPENDIX A - PERMITTED OUTFALLS TO THE BELLE AND NORTH BRANCH BELLE RIVERS IN THE VICINITY OF IMLAY CITY

Table A.1. Individual and general (non-storm water) NPDES permitted outfalls to the Belle and North Branch Belle Rivers in the vicinity of Imlay City. Source: MDEQ/WD NPDES Permit Management System (NMS)

PERMIT NUMBER	FACILITY	RECEIVING WATER	DESIGN FLOW (MGY)	LAT	LONG
Individual NPDES Permits:					
MI0023167	Imlay City WWTP	NB Belle via storm drain	328.50	43.023055	-83.070277
MI0001708	Pinnacle Foods-Imlay City	NB Belle	567.58	43.008333	-83.058333
MI0035637	Dryden WWTP	Dryden Drain	69.35	42.950833	-83.118055
MI0055999	Meadowbrook Estates MHP	Dryden Drain	34.31	42.950000	-83.125000
	Total Design Discharge (MGY):		999.74		
General Permits:					
MIG580271	Capac WWSL	Lemon Drain	76	43.004166	-83.879166
MIG250382	Imlay City Plastics	unnamed trib of NB Belle	54.75	43.083333	-83.072222
MIG760004	Lapeer CPR-Gen Sqier Co Park	SB Belle	0.08	42.916666	-83.125000
MIG490249	Lindys Pre-pak Carrots-Imlay	Hunt Dr	839.5	43.059722	-83.066388
MIG250077	VRD	unnamed trib Belle	6.205	42.980555	-83.054166
	Total Design Discharge (MGY):		976.535		

Table A.2. NPDES permitted industrial stormwater outfalls to the Belle and North Branch Belle Rivers in the vicinity of Imlay City.

PERMIT NUMBER	FACILITY	TYPE	LAT	LONG
MIS111148	Venture-Almont-4641 Van Dyke	Industrial Stormwater Only	42.93111	-83.05139
MIS111149	Venture-Almont-4701 Van Dyke	Industrial Stormwater Only	42.92917	-83.04917
MIS410097	Thor-Champion Bus-Imlay City	Industrial Stormwater Only	43.01556	-83.00500
MIS410099	Hydraulic Tubes & Fittings Inc	Industrial Stormwater Only	42.95722	-83.05889
MIS410105	World Waste Services-Almont	Industrial Stormwater Only	42.94972	-83.05417
MIS410106	OMS Co-Scott Hyponex Corp	Industrial Stormwater Only	43.01111	-83.01000
MIS410125	Mold Masters Co-Imlay City	Industrial Stormwater Only	43.18889	-83.07472
MIS410126	Imlay City Concrete	Industrial Stormwater Only	43.02222	-83.07472
MIS410481	Toyo Seat USA Corp	Industrial Stormwater Only	42.99472	-83.07306
MIS410499	Die Tech Tool-Imlay City	Industrial Stormwater Only	43.01250	-83.06917
MIS410487	Kurtz Gravel Co-Capac	Industrial Stormwater Only	43.01000	-82.92833

Table A.3. Active NPDES permit notice of coverage for construction sites in Lapeer County.

PERMIT NUMBER	EFFECTIVE DATE	SITE_NAME	DESCRIPTION	TWP	RANGE	SECTION
MIR103687	04/14/1999	River Ridge Mobile Home Park	Saginaw Rd, Lapeer	T8N	R10E	28
MIR103647	03/18/1999	Trade Center Way	I-69 & Lake Nepessing Rd, Lapeer			
MIR103942	08/05/1999	Hunters Creek-Commercial Bldg/Rd	Btw Sutton Rd Hunters Creek Rd E Of Wilder			
MIR105136	02/28/2001	Imlay Place Condominiums	Almont Ave And Newark Rd	T7N	R12E	20
MIR106446	11/05/2002	Weber Sand & Gravel Inc	M-24 And White Rd, Lapeer	T9N	R10E	28
MIR104946	11/28/2000	Mitch Krane	M-24, Lapeer S Of I-69	T7N	R10E	17
MIR105654	11/09/2001	Andrew's River Estates No 2	Saginaw St between Peppermill & Imlay City Rd	T7N	R10E	4
MIR106853	05/23/2003	Devonshire Retirement Village	Davison Rd, Lapeer	T7N	R9E	1
MIR106693	04/07/2003	Wal-Mart Sc Relocation Store #1987-03	521 Imlay City Rd, Lapeer	T7N	R10E	4
MIR106714	04/15/2003	Pine Crest	M-53 Van Dyke Ave	T6N	R12E	33
MIR106782	05/01/2003	Brown City Missionary Church	Burns Line Rd, Brown City	T9N	R12E	12
MIR106983	07/07/2003	Dupont Lapeer Airport	1232 Rood Lake Rd, Lapeer	T8N	R10E	34
MIR107312	12/04/2003	Pratt Drive & Nepessing Lakeside Condo	Pratt Drive	T7N	R9E	14
MIR107225	10/06/2003	Rubber Enterprises, Inc.	Reek Rd., Imlay City	T7N	R12E	28, 29
MIR107187	09/29/2003	Almont Middle School	4624 Kidder Rd between Tubspring & Almont Rd	T6N	R12E	22

Table A.4. Active NPDES permit notice of coverage for construction sites in St. Clair County.

PERMIT NUMBER	EFFECTIVE DATE	SITE_NAME	DESCRIPTION	TWP	RANGE	SECTION
MIR103573	02/26/1999	Andrews Corporate Park Phase I	Marine City Hwy And County Line Rd,	T3N	R15E	6
MIR103668	04/06/1999	Wadhams Road Development	Wadhams And Lapeer Rds	T6N	R16E	2
MIR103832	06/10/1999	River Terrace South	Btw Sutton Rd Hunters Creek Rd E Of Wilder	T4N	R17E	7
MIR103964	08/03/1999	Golfside Development Phase Iv	Pug Rd, St Clair	T5N	R17E	19
MIR103989	08/19/1999	Stocks Creek Mhp	3807 Lapeer Rd, Port Huron	T6N	R17E	5, 8
MIR103971	08/10/1999	Hidden Pine Lake	Lapeer Rd W Of Bartlett Rd	T6N	R16E	3
MIR104020	08/31/1999	Hunters Crossing	Saginaw St Between Peppermill & Imlay City Rd	T7N	R13E	27
MIR104058	09/15/1999	Ravenwood Farms Subdivision	Behind 4416 & 4424 Ravenwood Rd	T6N	R17E	19
MIR104177	12/01/1999	Castlewood Phase Ii	West Water East Of Allen	T6N	R16E	1
MIR104243	01/19/2000	Emerald Forest	Cuttle Rd, Marysville	T5N	R17E	6
MIR104228	01/11/2000	Koula Estates	905 Delware Ave, Marysville	T6N	R17E	
MIR104221	01/03/2000	Vector Pipeline Project	3.5 Mi Pipeline Btw Posts 100.0-265.2 & 324.0-327.7	T4N	R16E	7, 10, 12-15, 18
MIR104337	03/08/2000	Pratt Drive & Nepessing Lakeside Condo	W Of I-94	T6N	R16E	13, 24
MIR105001	12/27/2000	Whispering Winds Phase Ii, Iii, Iv	Griswold	T6N	R16E	10
MIR104466	04/28/2000	Macdonald Elementary School	5201 County Line, Casco	T4N	R15E	
MIR104610	06/23/2000	The Village Of Mercy Health Senior Cntr	4170 24th Ave, E Of 24th Ave & N Of Krafft Rd	T7N	R17E	22
MIR104607	06/20/2000	Blue Water Bridge Maintenace Facility	I-94, Port Huron Twp	T6N	R17E	5

Table A.4. Continued.

PERMIT NUMBER	EFFECTIVE DATE	SITE_NAME	DESCRIPTION	TWP	RANGE	SECTION
MIR104875	10/19/2000	Woodlands Sub	N Side Of St Clair Hwy W Of Indian Trail	T4N	R16E	2
MIR104914	11/06/2000	Marysville Plant	2700 Willis M -29 And Davis Rd	T5N	R17E	7
MIR104937	11/21/2000	Greenwood Energy Center	7000 Kilgore Rd, Avoca	T8N	R15E	22
MIR104968	12/05/2000	I-94 Business Loop Improvements	Military St/Electric Ave	T6N	R17E	21, 22
MIR104982	12/11/2000	Woodland Estates No 2	Carney Dr N Of Clinton Ave			
MIR105475	08/08/2001	New Anchor Bay High School	6319 County Line Rd, Fairhaven	T3N	R15E	6
MIR105432	07/23/2001	Woodward Energy - Peaker Power Fac	Remer Rd & M-29	T4N	R17E	18
MIR106385	10/10/2002	Dorchester Court	Amy Lane S Of Michigan Rd	T6N	R17E	8
MIR105850	03/11/2002	Clay Twp Retail Center	Pte Tremble Rd, Clay Twp	T2N	R16E	
MIR105800	02/11/2002	Hidden Pine Lake Ii	Hidden Lake Dr, Kimball	T6N	R16E	3
MIR105748	01/14/2002	16" Dte East China Lateral	S Of St Clair W Of M-29 Off Puttygut Rd	T4N	R16E	7, 18
MIR105761	01/22/2002	Art Van Furniture	1234 32 Nd St, Port Huron			
MIR106163	07/16/2002	Preserve At Boulder Pond Ph I	M-29 N Of Puttygut Rd, East China	T4N	R17E	7
MIR106213	08/02/2002	I-94 Under Range Rd		T6N	R16W	
MIR106232	08/07/2002	Boulder Creek Ph Ii		T4N	R17E	7
MIR106233	08/08/2002	Preserve @ Boulder Pond Ph I	M-29 S Of Puttygut Rd	T4N	R17E	7
MIR106383	10/08/2002	Villas Of Black Forest	S End Of Aberdeen Court	T7N	R17E	33
MIR106433	11/13/2002	Lake Huron Woods	In Back Of 5235 Lakeshore Rd	T7N	R17E	9
MIR106454	11/18/2002	Sawmill Village Iii	Ravenswood	T6N	R16E	24
MIR106522	01/17/2003	Quail Woods		T6N	R16E	3
MIR106797	05/07/2003	M-29 Reconstruction	Broadway To Francis St	T3N	R16E	
MIR106564	02/04/2003	Desmond Landing	3rd, 4th Oak To Court St, Port Huron	T6N	R7E	10, 15
MIR106569	02/05/2003	M-29 St Clair	Fracis St N To Riverside Dr	T4N	R17E	30
MIR106570	02/05/2003	Old M-21	Cade Rd E To M-19			
MIR106639	03/17/2003	4th St Area Sewer Seperation		T6N	R17E	
MIR106689	04/03/2003	Desmond Landings, Southside		T6N	R17E	15
MIR106694	04/07/2003	Palmer Court Area Sewer Separation		T7N	R17E	
MIR106711	04/09/2003	Ravenswood Farms No 3	N End Of Quain Lane	T6N	R17E	19
MIR106730	04/18/2003	Rural Area Sewer Separation Proj		T7N	R17E	34
MIR106737	04/22/2003	11th Ave Sewer Separation		T6N	R17E	
MIR106765	04/29/2003	Belle River Woods Condo Ph I	Belle River Rd	T4N	R17E	25
MIR106806	05/12/2003	Hancock St Reconstruction	Hancock St, Port Huron	T7N	R17E	34
MIR106838	05/22/2003	St Clair County Sheriff's Office	1170 Michigan Rd	T6N	R17E	20
MIR106925	06/16/2003	River Woods Estates	Mach Ave, Marysville			
MIR107132	09/08/2003	I-94	I-94 Bridge / I-94 Over Gtw Rr & Griswold Rd			
MIR107156	10/01/2003	Fort Gratiot Landfill	3290 Keewahdin Rd	T7N	R17E	16
MIR107183	09/29/2003	Preserve At Boulder Pond Ph Ii	M-29 S Of Puttygut Rd	T4N	R17E	7
MIR107246	10/07/2003	Tunnel St Area Sewer Separation		T6N	R17E	15
MIR107227	10/09/2003	Hawthorn Hollow	1046 Mayer Rd, Columbus	T5N	R15E	13
MIR107228	10/09/2003	Big Hand Rd Development		T5N	R16E	30
MIR107306	11/14/2003	Acheson Office Building	Port Huron	T6N	R17E	10, 1

Table A.5. Individual and general (non-storm water) NPDES permitted outfalls to the Belle and North Branch Belle Rivers in the vicinity of Imlay City with estimated TSS loads.

PERMIT NUMBER	FACILITY	RECEIVING WATER	DESIGN FLOW (MGY*)	Max. Monthly TSS Limit (mg/l)	Annual TSS Loading (lbs)
Individual NPDES Permits:					
MI0023167	Imlay City WWTP	NB Belle via storm drain	328.50	20	*55,000*
MI0001708	Pinnacle Foods-Imlay City	NB Belle	567.58	30 **	*383,000*
MI0035637	Dryden WWTP	Dryden Drain	69.35	40 and 70 *	*17,000*
MI0055999	Meadowbrook Estates MHP	Dryden Drain	34.31	20 and 30 *	*6,000*
		Total Design Discharge:	999.74		461,000
General NPDES Permits:					
MIG580271	Capac WWSL	Lemon Drain	76	40 and 70 *	*35,000*
MIG250382	Imlay City Plastics	Unnamed trib of NBB	54.75	30 **	*14,000*
MIG760004	Lapeer CPR-Gen Sqier Co Park	SB Belle	0.08	30 **	*20*
MIG490249	Lindys Pre-pak Carrots-Imlay	Hunt Drain	839.5	30 **	*210,000*
MIG250077	VRD	Unnamed trib Belle	6.205	30 **	*1,500*
		Total Design Discharge:	976.535		260,520

* Seasonal limits, spring and fall.

** Not limited but assumed maximum monthly TSS concentration.

APPENDIX B – IMLAY CITY WWTP, PINNACLE FOODS CORP-IMLAY CITY, MEADOWBROOK ESTATES MHP, AND DRYDEN WWSL CONVENTIONAL PARAMETER NPDES PERMIT LIMITS

Table B.1. Imlay City WWTP NPDES conventional parameter permit limits (design flow 0.9 MGD).

Parameter	Period	Maximum loading (lbs/d)		Maximum concentration (mg/l)		
		Monthly	7-day	Monthly	7-day	Daily
$CBOD_5$ (mg/l)	Year-round	30	75	4.0	-	10
TSS (mg/l)	Year-round	150	225	20	30	-
Ammonia Nitrogen (mg/l)	May – Oct	-	-	0.5	-	2.0
	Nov	-	-	(report)	-	12
	Dec – Apr	-	-	(report)	-	(report)
TP (mg/l)	Year-round	7.5	-	1.0	-	-
DO (min., mg/l)	May – Nov	-	-	-	-	7.0
	Dec – Apr	-	-	-	-	6.0

Table B.2. Pinnacle Foods Corp-Imlay City NPDES conventional parameter permit limits (design flow 1.555 MGD)

Parameter	Period	Maximum loading (lbs/d)		Maximum concentration (mg/l)		
		Monthly	7-day	Monthly	7-day	Daily
$CBOD_5$ (mg/l)	May – Nov	52	130	4.0	-	10
	Dec – Apr	(report)	169	(report)	-	13
TSS (mg/l)	Year-round	1050	1460	(report)	-	(report)
Ammonia Nitrogen (mg/l)	May – Nov	6.5	26	0.5	-	2.0
	Dec – Mar	(report)	49	(report)	-	3.8
	April	(report)	36	(report)	-	2.8
TP (mg/l)	Year-round	13	-	1.0	-	-
DO (min., mg/l)	May – Nov	-	-	-	-	6.0
	Dec – Apr	-	-	-	-	5.0

Table B.3. Meadowbrook Estates MHP NPDES conventional parameter permit limits (design flow 0.094 MGD)

Parameter	Period	Maximum loading (lbs/d)		Maximum concentration (mg/l)		
		Monthly	7-day	Monthly	7-day	Daily
$CBOD_5$ (mg/l)	Mar – Nov	3.1	7.8	4.0	-	10
	Dec – Feb	20	31	25	40	-
TSS (mg/l)	Mar – Nov	16	23	20	30	-
	Dec – Feb	23	35	30	45	-
Ammonia Nitrogen (mg/l)	Mar – Nov	0.39	1.6	0.5	-	2.0
	Dec	-	11	-	-	14
TP (mg/l)	May – Sept	0.16	-	0.2	-	-
	Oct – Apr	0.78	-	1.0	-	-
DO (min., mg/l)	Mar – Nov	-	-	-	-	7.0
	Dec. – Feb.	-	-	-	-	3.0

Table B.4. Dryden WWSL NPDES conventional parameter permit limits (design flow 36.5 MGY)

Parameter	Period	Maximum loading (lbs/d)		Maximum concentration (mg/l)		
		Monthly	7-day	Monthly	7-day	Daily
$CBOD_5$ (mg/l)	Mar – May Oct – Dec	-	-	30	45	-
TSS (mg/l)	Mar – May	-	-	70	100	
	Oct – Dec	-	-	40	45	-
Ammonia Nitrogem (mg/l)	Mar – May Oct – Dec	-	-	(report)	-	-
TP (mg/l)	Mar – May Oct – Dec	-	-	1	-	-
DO (min., mg/l)	Mar – May Oct – Dec	-	-	5.0	-	-

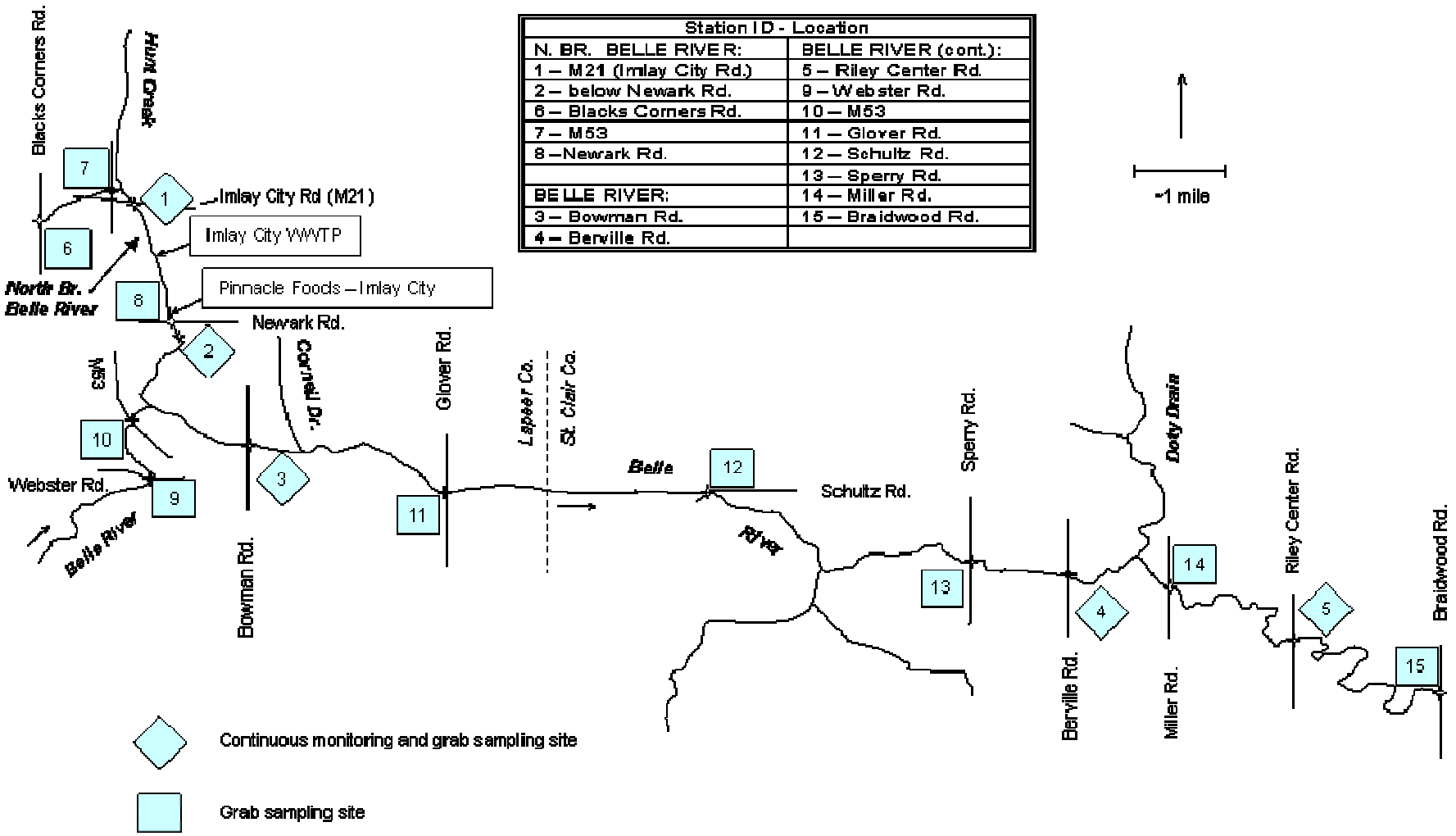

Figure 1. Belle and North Branch Belle River study sampling sites
Summer 2002 DO/TDS TMDL scoping monitoring.

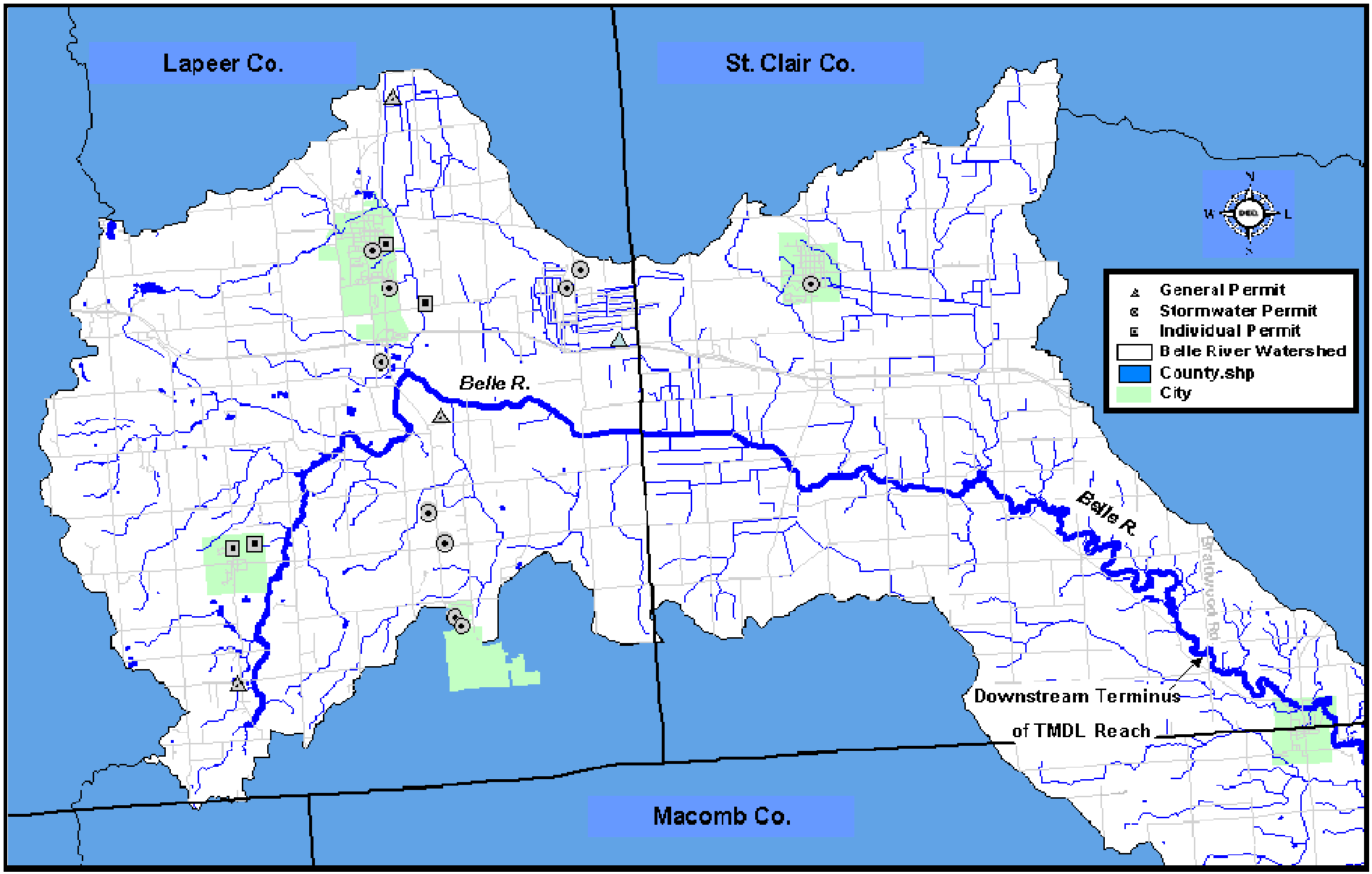

Figure 2. TMDL crairage area and point source discharges.