Michigan Department of Environmental Quality

Water Division

June 2003

Total Maximum Daily Load for Dissolved Oxygen for the Grand River Jackson County

INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations, Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting water quality standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. 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 Grand, north branch Grand, and Portage Rivers near Jackson (Figure 1), and to quantify reductions in these sources necessary for attainment of the standard. The Grand, north branch Grand, and Portage Rivers near Jackson are designated as warmwater streams with a DO standard of 5 milligrams per liter (mg/l) as a minimum.

All Grand, north branch Grand, and Portage River DO TMDL reaches are located in Jackson County and are highlighted in Figure 1. Table 1 defines the extent of each TMDL reach and lists their respective lengths. Note that the reach start locations are downstream on the reaches, while the end locations are upstream. A total of 41.4 river miles are addressed by this TMDL. Approximately 16 river miles located within the city of Jackson are included in the 33.7 miles of the Grand River TMDL reach.

TABLE 1

Grand, north branch Grand, and Portage River DO TMDL reaches

River	Reach Start	Reach End	Distance (mi.)
Grand River	Tompkins Road (T1S, R2W, Section 15)	Brown Lake Road (T3S, R1W, Section 22)	33.7
N. Br. Grand River	Grand River confluence (T3S, R1E, Section 7)	Hoyer Road (T3S, R1E, Section 8)	2.6
Portage River	Grand River confluence (T2S, R1W, Section 11)	Wooster Road (T2S, R1E, Section 3)	5.1

The Grand River has a drainage area of approximately 185 square miles at the Jackson Wastewater Treatment Plant (WWTP) point of discharge (Figure 1). Summer season 50 and 95% exceedance flows (cubic feet per second [cfs]) for the Grand River at this location are 47 and 23 cfs, respectively. The north branch Grand River joins the Grand River in Section 7, T3S, R1E, of Jackson County. Summer season 50 and 95% exceedance low flows at the outlet of Center Lake are 1.7 and 0.4 cfs, respectively. The Portage River joins the Grand River in

Section 11, T2S, R1W of Jackson County, and has summer 50 and 95% exceedance low flows of 39 and 12 cfs, respectively, at M106. Grand River low flows were computed from a United States Geological Survey (USGS) Grand River flow gage (04109000) located on the property of the Jackson WWTP. North branch Grand River low flows were calculated using that gage and additional flow measurements in the north branch Grand River at the outlet of Center Lake. Portage River low flows were computed using the Grand River at Jackson gage, and additional USGS gages on the Portage River near Munith (04109500), Orchard Creek at Munith (04110000), and the Grand River at Eaton Rapids (04111000).

PROBLEM STATEMENT

The Grand and Portage River TMDL reaches appear on the 2002 Section 303(d) list as:

GRAND RIVER AND PORTAGE RIVER WBID# **082816H**
County: JACKSON HUC: 4050004 Size: 25 M
Location: Grand River from Tompkins Road upstream to the city of Jackson
and Portage River from the Grand River confluence upstream to Wooster Road.
Problem: **Untreated sewage discharge, pathogens (Rule 100); WQS exceedances for DO; Macroinvertebrate and fish communities rated poor.**
TMDL YEAR(s): 2003 RF3RchID: 4050004

This TMDL addresses only the DO standard nonattainment in the Grand and Portage Rivers near Jackson. Other TMDLs addressing the biota and pathogen concerns have been developed by the Michigan Department of Environmental Quality (MDEQ) (Alexander, 2003 and Wuycheck, 2003).

A number of water quality surveys conducted in the Grand River near Jackson have revealed significant and continuing DO standard nonattainment in reaches below the city. Intensive surveys conducted in the summers of 1962 (Water Resources Commission, 1963) and 1977 (no report published) determined that approximately ten miles of the Grand River downstream of Jackson had severely depressed levels of DO.

Continuous DO monitoring conducted at Lansing Avenue (Station 15 in Figure 1) in 1988 (Argiroff, 1999) and in 1991 (Argiroff, 1995) documented periods of standard nonattainment in dry weather. Severe DO depressions during wet weather events were also documented. From wet weather chemistry sampling conducted on the Portage River and on the Grand River upstream of the confluence with the Portage River in 1991, it was concluded that the city of Jackson Combined Sewer Overflows (CSOs) were the likely cause of the DO depressions in the Grand River and not pollutant inputs from the Portage River. The last of these Jackson CSOs was eliminated in 2000.

Continuous and instantaneous measurement of DO was conducted in the Grand, north branch Grand, and Portage Rivers in the summers of 2001 and 2002. Full details of this work are contained in Sunday (2002) and Limno-Tech (2003). The monitoring showed that periods of dry weather nonattainment and significant wet weather DO depressions continue to occur in each river in the vicinity of Jackson despite the removal of CSOs.

The 2001 and 2002 monitoring revealed there are additional reaches on the Grand and north branch Grand Rivers near Jackson, which are appropriate for inclusion in this TMDL due to DO standard nonattainment. The Grand River DO TMDL reach should be extended from Tompkins Road (Station 19) upstream through the city of Jackson to Brown Lake Road (Station 2). The north branch Grand River should be included from its confluence with the Grand River upstream to the Center Lake outlet (Station 20). Most instances of DO standard nonattainment in these reaches occurred in the early morning.

NUMERIC TARGETS

Rule 100 of the WQS Part 4 Rules requires that the TMDL reaches are to be protected for warmwater fish, other indigenous aquatic life and wildlife, agriculture, navigation, industrial water supply, public water supply at the point of intake, partial body contact recreation, and total body contact recreation from May 1 to October 31. The impaired designated use for the Grand, north branch Grand, and Portage 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 will be the target of this TMDL. The DO WQS is defined by Part 4 WQS Rule 64:

> 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 carbonaceous biochemical oxygen demand (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 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.

There are 11 individual National Pollutant Discharge Elimination System (NPDES) permitted discharges and 11 general permitted discharges to the Grand and Portage River Watersheds in the vicinity of Jackson. There are also 90 industrial storm water permitted facilities and 40 notices of coverage for construction sites. See Appendix A, Tables A.1 – A.4 for a listing of all NPDES permittees. Figure 2 indicates the location of individual, general, and storm water discharges. Of these facilities, seven are known to be relatively significant point sources of conventional pollutants in the study reaches. Three are individually permitted, continuously discharging municipal WWTPs, while the remaining four are seasonal municipal Wastewater Sewage Lagoons (WWSLs) covered under the WWSL general permit (MIG5800000).

The Jackson WWTP (MI0023256), with a design flow of 19 million gallons per day (MGD), is permitted to discharge treated municipal wastewaters to the Grand River in Section 22, T2S, R1W of Jackson County. The facility's NPDES permit requires advanced waste treatment (AWT) in the summer season. See Table B.1 of Appendix B for Jackson WWTP's NPDES permit effluent limits. This facility's summer season effluent is of a very good quality. Reported summer and fall season effluent five-day $CBOD_5$ and ammonia nitrogen levels are consistently at or below levels that the Water Division's (WD's) Surface Water Quality Assessment Section (SWQAS) typically assumes to be present in unpolluted natural streams.

The Leoni Township (Twp) WWTP (MI0045942), with a design flow of 2.6 MGD, discharges treated municipal wastewater to the Grand River via the north branch Grand River. The discharge to the north branch Grand River is located in Section 8, T3S, R1E of Jackson County, below the Center Lake spillway (Figure 1). The facility's NPDES permit requires AWT from May through November. See Table B.2 of Appendix B for Leoni Twp WWTP's NPDES permit effluent limits. Facility discharge monitoring reports (DMRs) indicate that since October 2000, the Leoni Twp WWTP has discharged only during the months of September 2001 and August 2002. During this time, the facility was undergoing conversion from a seasonally discharging WWSL to a continuously discharging mechanical WWTP.

The Leslie WWTP (MI0020796) is permitted to discharge treated municipal wastewater to the Grand River via Huntoon Creek in Section 28, T1N, R1W of Ingham County. The design flow is 0.47 MGD, and this facility's NPDES permit requires secondary treatment limits year round. See Table B.3 of Appendix B for Leslie WWTP's NPDES permit effluent limits. Huntoon Creek joins the Grand River approximately 2.7 miles downstream of this discharge. DO levels below 5 mg/l were documented in Huntoon Creek during the summer of 2002 monitoring.

The four seasonal WWSLs discharging to the Grand or Portage Rivers near Jackson are permitted to discharge only during the spring and fall months at times of high background flow in accordance with the WWSL general permit. See Table 2 for details of these WWSL discharges. Note that the WWSL general permit contains limits and associated monitoring for biochemical oxygen demand (BOD_5), total suspended solids (TSS), and DO. The MDC-SPSM-Dale Foltz WWSL has not discharged since the mid-1990s according to WD district staff.

TABLE 2

General permitted WWSLs in the vicinity of Jackson

Facility	Receiving Water	Location	Annual Discharge Volume (MGY)
Sherman Oaks MHP WWTP (MI580274	Grand River	Section 33, T1S, R1W, Jackson County	34
MDC-Waterloo WWSL (MIG580001)	Unnamed tributary to Portage River	Section 11, T2S, R2E, Jackson County	10.95
MDC-SPSM-Wing WWSL (MIG580258)	Portage River	Section 12, T2S, R1W, Jackson County	3.0
MDC-SPSM-Dale Foltz TC WWSL (MIG580259)	Wildcat Creek (tributary to Portage River)	Section 17, T2S, R1E, Jackson County	0.5

Table 3 contains permitted annual conventional pollutant loads for the listed primary point sources. The loads are calculated from the facilities' maximum daily NPDES permit limits and design flows. Estimated loads from other unlisted individual and 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, Grand River, in Table A.5 of Appendix A (except for the Sherman Oaks WWSL which appears separately in Table 3). Loads from these facilities were estimated from the annual design flow and the following assumed discharge concentrations: $CBOD_5$, 2 mg/l; TSS, 55 mg/l; ammonia nitrogen, 0.1 mg/l; and total phosphorus (TP), 0.1 mg/l.

TABLE 3

Grand and north branch Grand River non-storm water permitted point source conventional pollutant loadings

Annual load (lbs/yr)	Jackson WWTP	Leoni Twp WWTP	Leslie WWTP	Sherman Oaks WWSLs	Other individual, non-storm water general permittees *
$CBOD_5$	584,827	100,158	35,770	8,507	8,172
TSS	1,288,800	190,170	42,922	15,603	221,988
Ammonia nitrogen	327,678	RPT	RPT	RPT	408
TP	57,838	7,915	1,431	RPT	408

RPT - facility's NPDES permit contains only a reporting requirement
* - Facilities not required to monitor for the listed parameters. Loads are estimated.

Table 4 contains estimates of Grand River TSS loads from areas that will be covered by Phase II municipal storm water permits and from existing industrial storm water permitted facilities. No such facilities discharge to the Portage River. Storm water loads in Table 4 were estimated based on land use data contained in the USEPA's BASINS 3.0 software package (USEPA, 2001a) and urban land use loading data from the Rouge River National Wet Weather Demonstration Project (Cave et al., 1994).

TABLE 4

Estimated Grand and north branch Grand Rivers conventional pollutant loads, storm water permittees

Annual load (lbs/yr)	Industrial and Phase II storm water permittees (from land use data)
BOD	1,430,000
TSS	4,590,000
Ammonia nitrogen	90,000
TP	20,000

Table 5 lists permitted loads from three general permitted WWSLs discharging to the Portage River.

TABLE 5

Portage River permitted point source conventional pollutant loadings

Annual load (lbs/yr)	MDC-Waterloo, Wing, Dale Foltz WWSLs
$CBOD_5$	3,627
TSS	6,626
Ammonia nitrogen	RPT
TP	RPT

RPT – facility's NPDES permit contains only a reporting requirement

Potential NPS of pollutants were evaluated based on land uses in the drainage basin (Table 6). north branch Grand River basin land uses are similar to those of the Grand River. Note that this land use data is approximately 25 years old, and it is possible that the urban land use proportions are in fact higher than indicated in Table 6 due to increased residential development. The WD district staff indicate no knowledge of concentrated animal feeding operations or problematic agricultural operations in the affected basins.

TABLE 6

Grand and Portage River basin land use categories as percentages

Land use category	Grand River	Portage River
Urban or built up	16	3
Agricultural	56	65
Forest	14	18
Water	3	2
Wetland	9	12
Barren land	1	0
Unclassified	0	0

The 2001 and 2002 summer DO surveys indicate that certain pollutants contribute toward DO standard nonattainment in the Grand, north branch Grand, and Portage Rivers near Jackson. Land use-related inputs cause the documented wet weather-related DO depressions in the Grand River below Jackson and likely contribute toward DO standard nonattainment through SOD (sediment loads) and plant respiration from plant growths (phosphorus loads). Estimates of land use-related annual loads of BOD ($CBOD_5$ + nitrogenous BOD), TSS, TP, and total nitrogen to the Grand and Portage Rivers near Jackson were estimated using geographic information system land use and meteorological data, and the USEPA's Simple Method approach (USEPA, 2001b). Estimates of loads to the Grand River at its confluence with the Portage River and to the Portage River at its confluence with the Grand River, appear in

Table 7. These estimates are based on non-site-specific data and represent a best approximation using literature values (Cave et al., 1994). The land use Grand River pollutant loadings in Table 7 include the estimated loads from storm water permitted facilities as described in Table 4.

TABLE 7

Estimated annual land use conventional pollutant loads, including Grand River storm water permitted facilities

Annual load (lbs/yr)	Grand River at Portage River Confluence	Portage River at Grand River Confluence
BOD	1,730,000	640,000
TSS	9,400,000	7,071,000
Total nitrogen	243,000	212,000
TP	36,000	24,000

Other estimates of sediment and nutrient loadings from sub-watersheds of the Grand River in the vicinity of Jackson are included in the Upper Grand River Watershed Management Plan (Tetra Tech MPS, DRAFT 2003), developed for the Grand River Inter-County Drainage Board (GRICDB) under a CWA Section 319 grant. The Watershed Management Plan recognizes that the urban areas in and around the city of Jackson are likely to contribute significantly more TP loads during wet weather events than areas with other land uses. This is consistent with previous studies in the Rouge River Watershed of southeast Michigan (Cave et al., 1994).

The city of Jackson and surrounding urban communities (Jackson County, the city of Jackson, and Blackman, Leoni, Napoleon, Rives, Spring Arbor, and Summit Twps), are subject to the CWA's Section 402(p)(2) Phase II storm water regulations. Urban runoff from Jackson will be considered in the wasteload allocation (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.

LINKAGE ANALYSIS

The observed DO standard nonattainment in the Grand, north branch Grand, and Portage 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 SWQAS's 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. Model input parameters were based on water quality studies and modeling guidance described in MDEQ 1995. The rate of reaeration downstream of the Jackson WWTP was estimated based on data collected in 2002. The models were calibrated to data collected in the summer of 2002.

Separate O'Connor-DiToro models (O'Connor and DiToro, 1970) of the main branch Grand, north branch Grand, and Portage Rivers were constructed. The Grand River model is an expansion of a model of Grand River reaches below the Jackson WWTP that was previously calibrated and verified based on water quality studies. That calibrated model has been used in the development of water quality-based effluent limits (WQBELs) for the Jackson WWTP. DO TMDL modeling has revealed that SOD and plant respiration are two major sinks of DO in the Grand and Portage Rivers. DO standard nonattainment in the north branch Grand River appears to be primarily due to plant respiration.

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 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.

Substrates in nonattaining reaches of the Grand River within and downstream of the city of Jackson are characterized primarily by fine sediments. In 2001, black, anoxic sludge beds, approximately 2.5 feet deep, were encountered in the Grand River at Lansing Avenue, indicating that SOD is likely a contributing factor in DO standard nonattainment in the Grand River in the vicinity of Jackson. The same is true for the Portage River from Wooster Road to its confluence with the Grand River where deep muck deposits prevail. The Grand River below Jackson and the Portage River are characterized by low channel slopes and resulting low velocities. This appears to cause deposition of sediments from the water column, exacerbating SOD. The low velocities also result in relatively low rates of reaeration.

SOD was measured in 2002 at transects at Berry Road and Lansing Avenue. SOD ranged from 0.9 to 2.3 g/m^2-d, with an overall average of 1.6 g/m^2-d. These values are near literature values of SOD for aged sediments downstream of a treated municipal sewage discharge (Chapra, 1997). City of Jackson CSOs, which previously discharged to the Grand River, likely contributed to higher levels of SOD downstream of Jackson. SOD and sediment deposits are typically highly variable spatially and temporally due to varying flow regimes affecting deposition and scour (Bowie et al., 1985).

In 2002, wet weather event chemistry sampling was conducted at three stations (Table 8). Two of these stations (Grand River at Cooper Street Prison and Portage River at M106), were sampled during the 1991 study that implicated Jackson CSOs in wet weather DO standard nonattainment below Jackson. Sampling results show that the Grand River below Jackson but upstream of the Portage River (Grand River at Cooper Street Prison, Station 13) generally contained significantly higher levels of conventional pollutants than the Portage River at M106, near its confluence with the Grand River. Significantly higher levels of TSS were found in the Grand River at the Cooper Street Prison Station as compared to TSS levels found in the Portage River at M106. These results suggest that despite the elimination of Jackson CSOs, urban runoff from the city of Jackson is a prime source of solids that may contribute to elevated SOD in the Grand River in and below the city.

TABLE 8

Summer 2002 wet weather sample data: minimum, maximum, and arithmetic average concentrations (mg/l)

Parameter	Wet Weather Event Date (Rainfall, In.)	N. Br. Grand River at Falahee Road (Station 21)	Grand River at Cooper St. Prison (Station 13)	Portage River at M106 (Station 22)
$CBOD_5$ (mg/l)	July 9-10 (0.93)	No data	2 – 17 (6.71)	3 – 4 (3.14)
	July 18-19 (0.16)	No data	3 – 6 (4.2)	2 – 2 (2)
	July 26-29 (4.93)	2 – 3 (2.39)	2 – 4 (2.71)	2 – 3 (2.25)
Total organic carbon (mg/l)	July 9-10 (0.93)	No data	8.35 – 22 (11.79)	10.3–12.7 (11.79)
	July 18-19 (0.16)	No data	9 – 15 (11.88)	9.5 – 12 (7.76)
	July 26-29 (4.93)	8.56 – 10.40 (9.36)	4.5 – 7.6 (6.29)	3.19 – 12 (7.76)
TSS (mg/l)	July 9-10 (0.93)	No data	10 – 140 (64.9)	10 – 37 (19.93)
	July 18-19 (0.16)	No data	30 – 170 (79)	11 – 26 (15.75)
	July 26-29 (4.93)	5 – 12 (8.17)	13 – 400 (175.9)	9 – 190 (59.25)
Total ammonia nitrogen (mg/l)	July 9-10 (0.93)	No data	0.03 – 0.14 (0.08)	0.04 – 0.15 (0.09)
	July 18-19 (0.16)	No data	0.1 – 0.2 (0.14)	0.03 – 0.29 (0.13)
	July 26-29 (4.93)	0.01 – 0.07 (0.03)	0.04 – 0.18 (0.09)	0.04 – 0.2 (0.08)
Nitrate + nitrite (mg/l)	July 9-10 (0.93)	No data	1.76 – 4.29 (2.9)	0.18 – 2.41 (0.61)
	July 18-19 (0.16)	No data	2.9 – 6 (4.9)	0.19 – 0.52 (0.30)
	July 26-29 (4.93)	0.07 – 0.37 (0.22)	1.41 – 4.58 (3.17)	0.24 – 3.5 (0.94)
Orthophosphate (mg/l)	July 9-10 (0.93)	No data	0.01 – 4.2 (0.72)	0.02 – 0.10 (0.04)
	July 18-19 (0.16)	No data	0.06 – 0.29 (0.21)	0.01 – 0.02 (0.02)
	July 26-29 (4.93)	0.02 – 0.09 (0.04)	0.04 – 0.3 (0.16)	0.01 – 0.11 (0.03)
TP (mg/l)	July 9-10 (0.93)	No data	0.28 – 0.65 (0.42)	0.1 – 0.19 (0.12)
	July 18-19 (0.16)	No data	0.45 – 0.72 (0.57)	0.09 – 0.12 (0.10)
	July 26-29 (4.93)	0.09 – 0.15 (0.12)	0.31 – 2.04 (0.75)	0.06 – 0.45 (0.19)

Wet weather event loads of TSS were calculated at the Grand River Cooper Street Prison Station and at the Portage River M106 Station. Much higher loads of TSS were found at the Grand River Cooper Street Prison Station (Table 9). The listed event load of 72,476 pounds (lbs) for the July 26-29 event at the Grand River Cooper Street Prison site is likely an underestimate of actual values due to incomplete flow data.

TABLE 9

Wet weather event TSS loads

	Wet Weather Event Date (Rainfall, In.)	Grand River at Cooper St. Prison	Portage River at M106
TSS (lbs/event)	July 9-10 (0.93)	30,062	4,902
	July 18-19 (0.16)	63,592	3,377
	July 26-29 (4.93)	72,476	37,397

Observations made during the 2001 and 2002 surveys, as well as observations from other surveys (Tetra Tech MPS, 2003 DRAFT), indicate that stream bank erosion contributes a substantial amount of sediments and SOD to the Grand and Portage River systems. Numerous log jams, formed from fallen riparian trees, were noted in the Grand River below Jackson. Many trees with exposed roots were documented. Soil surveys by the Soil Conservation Service indicate that poorly drained, highly erodable organic soils pervade the banks of the Portage River and the Grand River below Jackson (United States Department of Agriculture (USDA), 1981).

No wet weather event sampling has been conducted in the reaches of concern during any season other than summer. It is possible that agricultural lands in the Portage River basin may contribute much higher solids loads in other seasons, such as spring, when compared to Portage River summer TSS loads.

<u>Plant Respiration</u>: 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 Grand River. 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 to a stream.

Very dense growths of macrophytes were observed in reaches of the Grand River, especially in the north branch Grand River in 2001 and 2002. This growth results in high rates of plant photosynthesis and respiration. DO standard nonattainment in the north branch Grand River appears primarily due to plant respiration. Summer macrophyte growth in the north branch at Falahee Road was so dense that bottom substrate could often not be seen, and plant growth prohibited flow measurements with a Gurley meter. Similar growths were observed in tributaries to Center Lake, the outlet of which is the headwaters of the north branch Grand River. Diurnal DO variation at Falahee Road (average minus minimum concentration) exceeded 5 mg/l during the 2002 monitoring. This was the highest diurnal variation documented in any reach. Study period DO ranged from 0.0 (early morning) to greater than 20.0 mg/l (afternoon). The low early morning DO levels appear to cause or exacerbate DO standard nonattainment in the Grand River below its confluence with the north branch.

The dense plant growths observed in the north branch Grand River are typically found below lake outlets, especially in streams with a stable, cobble substrate, such as that of the north branch Grand River. Other factors favoring macrophyte growth, such as intermingling with a wetland area and a relatively wide, unshaded stream are present in the river (Wuycheck, 2003). Similar dense growths occur in streams connecting other lakes upstream of Center Lake (Price, Moon, Alcott, and Wolf chain of lakes). Wet weather sampling of the north branch Grand River at Falahee Road showed that TP did not exceed 0.15 mg/l. One round of dry weather chemistry sampling on November 1, 2001, showed that TP did not exceed 0.1 mg/l in the Grand, north branch Grand, or Portage Rivers (Sunday, 2002). This limited data suggests that several factors contribute to the dense plant growths in the north branch Grand River.

Plant photosynthesis and respiration influence DO levels in the Grand and Portage Rivers as evidenced by relatively high diurnal DO variations in some reaches. However, macrophyte densities matching those of the north branch Grand River were not noted in the Grand or Portage Rivers. Wet weather sample concentrations of TP and orthophosphate (Table 8) are significantly higher at the Cooper Street Prison Station (Station 13) compared to the two other sampled locations (Stations 21 and 22). One sample from the Cooper Street Prison Station during the July 26-29, 2002, event contained TP at 2.04 mg/l. This indicates that urban runoff from the city of Jackson is a significant source of TP loads to the Grand River.

Modeling calibration runs have shown that in-stream oxidation of $CBOD_5$ and ammonia nitrogen account for a relatively small amount of oxygen demand during critical conditions. Elevated levels of $CBOD_5$ and ammonia nitrogen have not been documented in the rivers at low flows. The high quality summer season effluent of the Jackson and Leoni Twp WWTPs is expected to have a minimal impact on river DO levels.

TMDL DEVELOPMENT

The TMDL represents the maximum loading of oxygen demanding substances, or other parameters that can indirectly cause oxygen demand (sediments and nutrients), 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. In general, the lowest monthly 95% exceedance flow and 90% occurrence temperature for streams are used as design conditions for conventional pollutant loadings.

Wet weather-related loadings of pollutants appear to play a significant role in the Grand River near Jackson's DO standard nonattainment. This TMDL follows a phased approach due to inherent uncertainties in estimating loadings from wet weather-related sources. 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.

DO models were used to quantify reductions in river DO sinks necessary to attain the DO standard at critical conditions. Calibration data shows that along the entire 33.7-mile length of the Grand River, on average, SOD is responsible for approximately 60% of the DO deficit at design conditions, while plant respiration is responsible for approximately 40% of the deficit. There are reaches in the Grand River where the DO deficit is due entirely to either plant respiration or to SOD. 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.

Modeling analysis indicates that approximately 80% of the DO deficit in the Portage River is due to plant respiration, while approximately 20% of the DO deficit is due to SOD. The north branch Grand River's DO standard nonattainment is assumed to be due primarily to plant respiration as per visual observations of very dense plant growth and hard or sandy bottom substrates.

In order to decrease SOD and nutrient loads, the loading of suspended sediments to the rivers must be reduced. Summer 2002 monitoring and sampling has documented that in-stream conventional pollutant loads increase significantly during wet weather events. It is likely that most nutrient inputs to the system are transported with the suspended sediment load. This is supported by the wet weather sampling data in Table 8, where except for one wet weather event, TP concentrations are significantly higher than orthophosphate concentrations. Suspended solids 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:

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

The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. 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 Grand, north branch Grand, and Portage Rivers in the vicinity of Jackson. The 50% TSS load reduction was chosen, in part, due to the results of DO modeling, which indicates that SOD and plant activity in the reaches of concern should be reduced by approximately 30 to 85%, depending on the reach 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. In addition, a wet weather event in-stream target of 80 mg/l TSS has been established in the biota TMDL for the Grand River near Jackson (Wuycheck, 2003). Monitoring indicates that in-stream TSS levels exceed this level significantly during wet weather events. The primary cause of this appears to be land use-related TSS loads rather than continuous point source discharges.

Table 10 contains total estimated existing TSS loads to the Grand (including the north branch Grand) and Portage Rivers at their confluences with each other. The total load for the Grand River includes point source loads from the Leslie WWTP and Sherman Oaks WWSL, both of which actually discharge to the Grand River below its confluence with the Portage River. 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 Phase II municipal and industrial storm water permittees, which will be treated as point sources in the WLA. Phase II municipal and industrial storm water discharges were assumed to comprise 100% of the urban or built-up land uses in the Grand River basin at its confluence with the Portage River (16% of the total Grand River basin land cover at that point) in order to compute land use-related TSS loads.

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 Jackson and Leoni Twp WWTPs, are required by their NPDES permits to treat their effluent at AWT limits. These effluent limits are the most restrictive limits, which 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) will not impact DO levels in the critical summer months. The high levels of treatment required by the Jackson and Leoni Twp WWTPs lead to high conventional pollutant removal rates throughout the year. The Leoni Twp WWTP also has AWT limits in the fall season, while the Jackson WWTP's limits are near AWT (Appendix B).

See Table 10 for proposed WLAs and LAs for the Grand (including the north branch Grand) and Portage Rivers. No reductions in municipal wastewater treatment facility (WWTP or WWSL) point source loadings are proposed for this DO TMDL's WLA, nor are reductions proposed for 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 (Phase II municipal and industrial storm water permittee loads, attributed to urban land uses) and the LA (all nonurban land use loads) as compared to existing loads outlined in Table 10. No permitted storm water dischargers are known to exist in the Portage River Watershed, so the Portage River WLA is the currently permitted annual TSS load from the three WWSLs.

TABLE 10

Annual TSS load source allocations and numeric targets

Water Body	Current Annual TSS Load (million lbs)	Annual TSS Load Numeric Target (million lbs)	WLA Annual TSS Load (million lbs)	LA Annual TSS Load (million lbs)
GRAND RIVER:				
Industrial/Municipal Storm Water Permitted Outfalls*	4.59	2.30	2.30	-
Other Land Use Related Sources**	4.81	2.41	-	2.41
Existing Ind./Gen NPDES Permitted Facilities	1.76	1.76	1.76	-
Grand River Total Annual Loads	11.16	6.47	4.06	2.41
PORTAGE RIVER:				
Land Use Related Sources***	7.07	3.54	-	3.54
Existing Ind./Gen NPDES Permitted Facilities	0.01	0.01	0.01	-
Portage River Total Annual Loads	7.08	3.55	0.01	3.54
Total:	18.24			
Annual TSS Load Numeric Target To Biota TMDL Reach	-	10.02	4.07	5.95

* Primarily attributed to urban or built-up land uses in the city of Jackson; ** Attributed to nonurbanized/built-up land uses in the townships of Leoni, Blackman, and Summit; *** Attributed to nonurban or built-up land uses in the Portage River basin.

<u>LAs</u>

TSS inputs resulting from land use-related sediment loads will be the primary targets for reduction in the Grand, north branch Grand, and Portage Rivers in this TMDL. Table 10 lists the land use source LAs for the Grand (including the north branch Grand) and Portage Rivers. The LA values in Table 10 do not include land use loadings due to industrial and municipal Phase II storm water permittees discharging to the Grand River, which are addressed in the WLA. The target LA values in Table 10 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 Grand River are located in Leoni, Blackman, and Summit Twps. Lands in Leoni, Henrietta, and Waterloo Twps contribute TSS loads to the Portage River.

<u>MOS</u>

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 thorough 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, Geological and Land 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 water quality rules (Rule 90) 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 SWQAS 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 protective water quality rules (Rule 1075). 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.

Note again that the large, continuous point source discharges during the critical summer period are required to treat effluent to AWT standards, a level of treatment considered by the WD to exert little, if any, in-stream oxygen demand.

SEASONALITY

Monitoring and modeling indicates that design conditions occurring during the summer season represents the most critical conditions for DO standard attainment in the Grand, north branch Grand, and Portage Rivers. Modeling of the Grand and Portage 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 Grand 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 Grand 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 WD monitors watersheds in accordance with the five-year NPDES permit review process. The Grand, north branch Grand, and Portage Rivers will be reevaluated in 2006, when the Grand River basin is next scheduled for monitoring. Limited DO monitoring (instantaneous measurements similar to those of the 2001 and 2002 surveys) 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.

REASONABLE ASSURANCE ACTIVITIES

Under the NPDES permit program, point sources in the vicinity of Jackson 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. Under the Phase II, Storm Water Regulations, the city of Jackson will be required to evaluate and implement best management practices to reduce urban land use pollutant loadings to the Grand, north branch Grand, and Portage Rivers, regardless of the findings of this TMDL. Compliance with these regulations will be overseen by the MDEQ.

The GRICDB has developed and published the draft regional Upper Grand River Watershed Management Plan under a CWA Section 319 grant. Planning efforts have included the development of geographical information system tools for the analysis of land use, and the development of specific management recommendations for six tributary or sub-basins under the regional, umbrella watershed plan. The plan includes provisions for the development of a regional watershed information and education campaign, including Adopt-A-Stream volunteer monitoring and stewardship activities. Ultimately, the watershed planning process will result in the creation of a stable organization for the planning and management of watershed activities, such as a watershed council (Tetra Tech MPS, 2003).

The Upper Grand River Watershed Planning Initiative Steering Committee, advising GRICDB on the development of the plan, includes representatives of numerous local agencies and stakeholder groups. The WD will work with these entities to ensure effective implementation of the TMDL. Efforts to reduce land use loads in the Grand River should focus on the city of Jackson and associated urban areas in accordance with the findings of the 2002 wet weather sampling.

DO standard nonattainment in the north branch Grand River is apparently primarily due to plant growths, which may result in part from nutrient enrichment. Subsequent phases of this TMDL will examine whether point source loads of nutrients to the north branch Grand River from the Leoni WWTP are in need of reduction.

The summer 2002 DO survey documented DO concentrations below 5 mg/l in Huntoon Creek near its confluence with the Grand River. WQBELs for the Leslie WWTP, which discharges to Huntoon Creek, will be reevaluated using site-specific DO modeling data when this facility's NPDES permit is to be reissued. The Leslie WWTP's effect on Grand River DO levels is insignificant according to past WQBEL modeling.

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REFERENCES

Alexander, C. 2003. Pathogen TMDL for the Grand River near Jackson. MDEQ, WD, Draft Report.

Argiroff, P. 1999. Report on Continuous DO monitoring of the Grand River Downstream of the City of Jackson. MDEQ, Surface Water Quality Division (SWQD), Report #MI/DEQ/SWQ-99/153.

Argiroff, P. 1995. Wet Weather Survey on the Grand River Downstream of Jackson, August – September 1991. MDEQ, SWQD, Report #MI/DEQ/SWQ-95/045.

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.

Chapra, S.C. 1997. Surface Water Quality Modeling. McGraw-Hill. New York.

Creal, W. and J. Wuycheck. 2002. Federal CWA Section 303(d) List – Michigan's Submittal for Year 2002. MDEQ, SWQD, Report #MI/DEQ/SWQ-02/013.

Limno-Tech, Inc. 2003. DRAFT DO, Total Dissolved Solids (TDS), and Water Chemistry Study on the Grand River, Vicinity of Jackson, Jackson County, Michigan, June 22 – August 27, 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.

Sunday, E. 2002. DO, TDS, and Water Chemistry Study on the Grand River, Vicinity of Jackson, Jackson County, Michigan, June 22 - July 27, 2001. MDEQ, SWQD, Report #MI/DEQ/SWQ-02/031.

Tetra Tech MPS. 2003. DRAFT Upper Grand River Watershed Management Plan.

USDA. 1981. Soil Survey of Jackson County, Michigan. Soil Conservation Service.

USEPA. 2001a. BASINS 3.0 User's Manual. EPA 823-B-01-001. USEPA, Office of Water, Washington, DC.

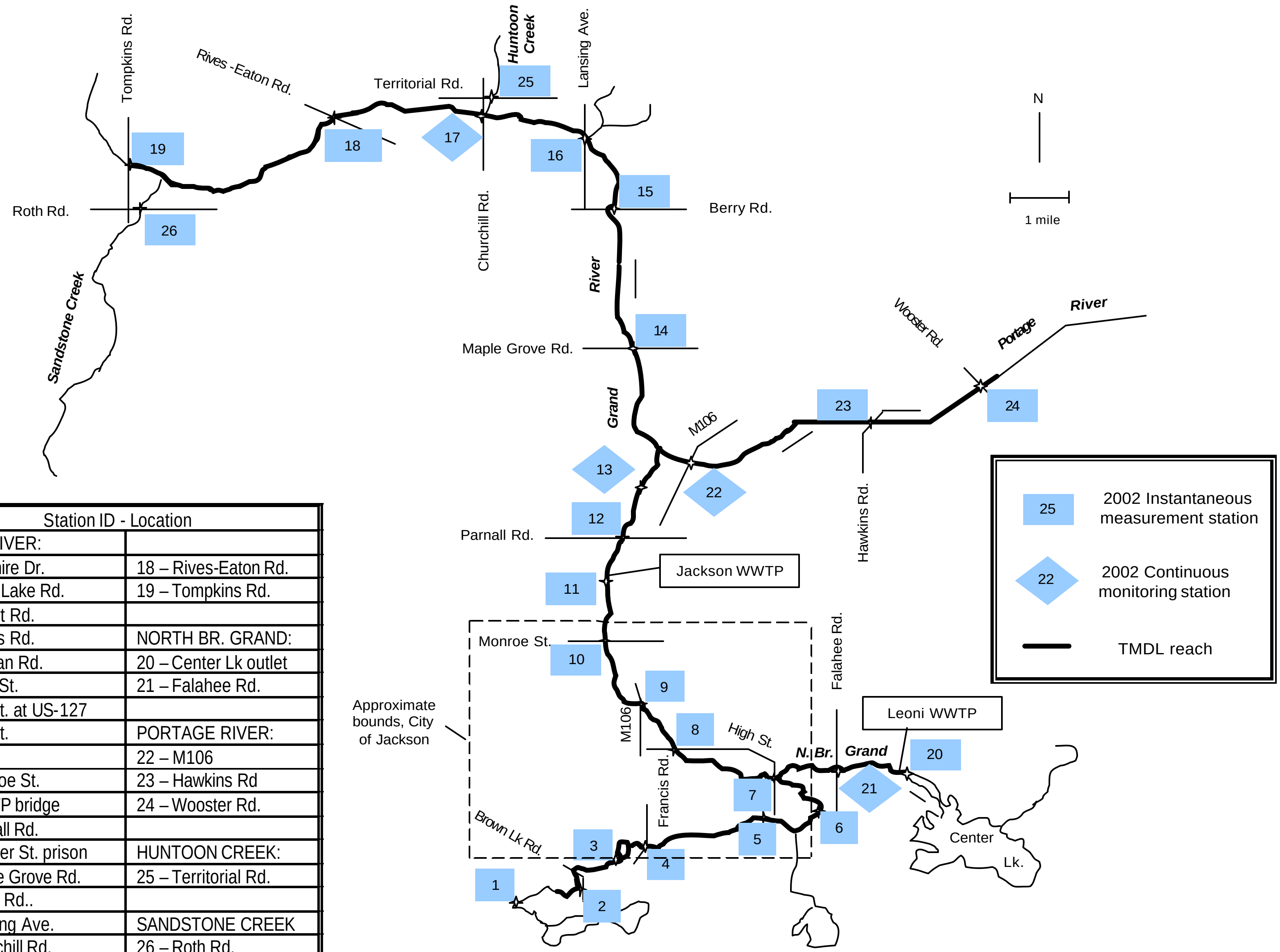
USEPA. 2001b. PLOAD Version 3.0 User's Manual. USEPA, Assessment and Watershed Protection Division, Washington, DC.

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. 1963. Report on Oxygen Relationships of Grand River Below Jackson 1962 Survey. State of Michigan.

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

Wuycheck, J. 2003. Biota TMDL for the Grand River near Jackson, Draft Report.



Station ID - Location	
GRAND RIVER:	
1 – Glenshire Dr.	18 – Rives-Eaton Rd.
2 – Brown Lake Rd.	19 – Tompkins Rd.
3 – Probert Rd.	
4 – Francis Rd.	NORTH BR. GRAND:
5 – Meridian Rd.	20 – Center Lk outlet
6 – South St.	21 – Falahee Rd.
7 – High St. at US-127	
8 – High St.	PORTAGE RIVER:
9 – M106	22 – M106
10 – Monroe St.	23 – Hawkins Rd
11 – WWTP bridge	24 – Wooster Rd.
12 – Parnall Rd.	
13 – Cooper St. prison	HUNTOON CREEK:
14 – Maple Grove Rd.	25 – Territorial Rd.
15 – Berry Rd..	
16 – Lansing Ave.	SANDSTONE CREEK
17 – Churchill Rd.	26 – Roth Rd.

FIGURE 1 – Grand River study sampling stations

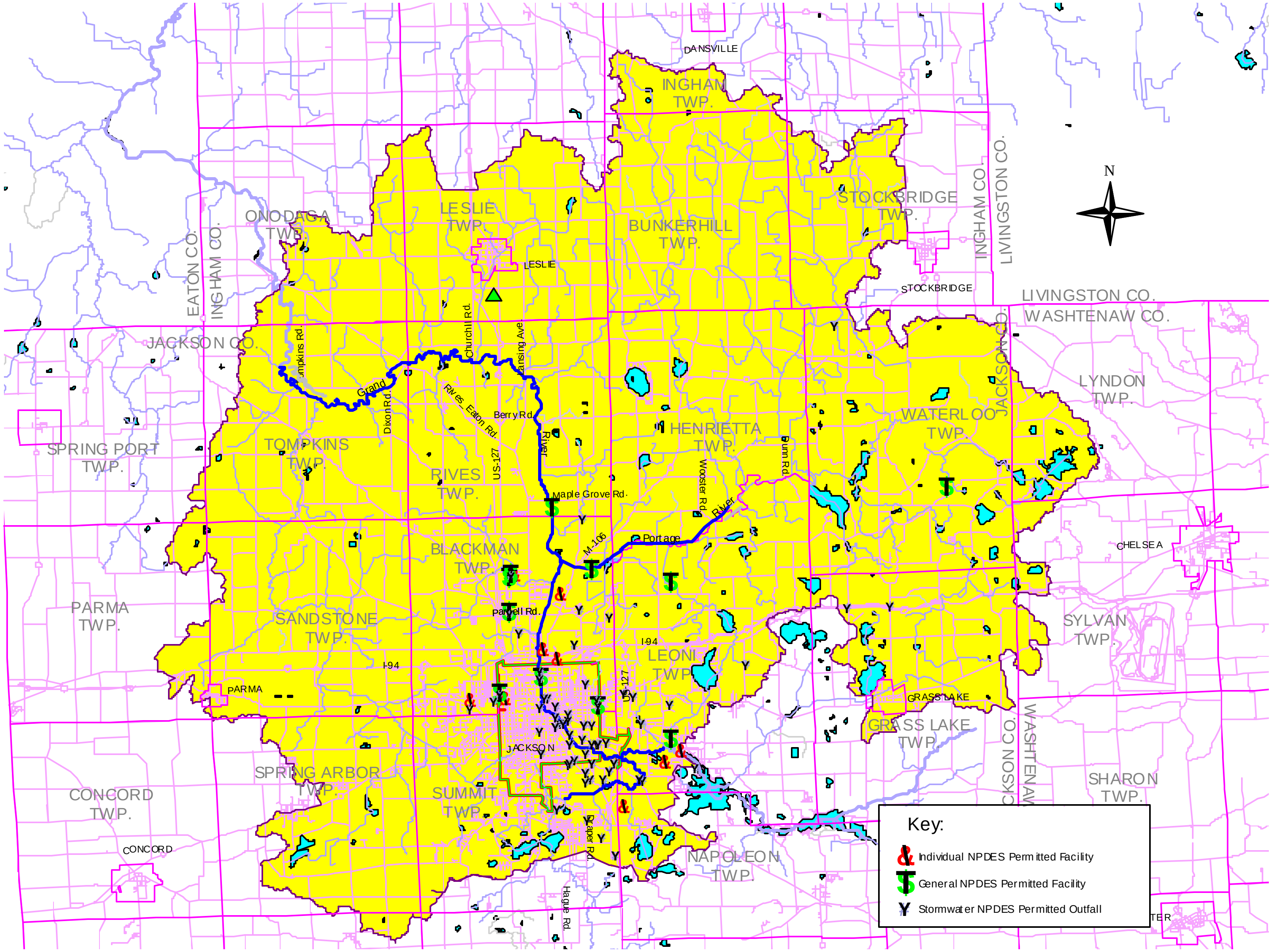


FIGURE 2 – Grand River DO TMDL drainage area and point source discharges

APPENDIX A – PERMITTED OUTFALLS TO THE GRAND AND PORTAGE RIVER WATERSHEDS IN THE VICINITY OF JACKSON

TABLE A.1

Individual and general NPDES permitted outfalls to the Grand River and Portage River watersheds in the vicinity of Jackson. Source: MDEQ/WD's NPDES Permit Management System (NMS); *MGY = million gallons per year.

PERMIT NUMBER	FACILITY	RECEIVING WATERS	DESIGN FLOW (MGY*)	LATDD	LONGDD
Individual NPDES Permits:					
MI0023256	Jackson WWTP	Grand River	6935.00	42.27611	-84.40611
MI0028461	Quanex Corp-Mac Steel Division	Grand River via wetland and Akerson Drain	55.00	42.20556	-84.36222
MI0041998	Mich Center School District	Murray Lake	0.12	42.22444	-84.33694
MI0045403	Marathon Ashland Petro-Jacks	Grand River via Tobin Snyder Drain	39.00	42.31028	-84.42361
MI0045942	Leoni Twp WWTP	Grand River at Center Lake outlet	949.00	42.23860	-84.25750
MI0046809	Citgo Corp-Jackson	Grand River via Tobin Snyder Drain	171.00	42.30889	-84.42250
MI0051683	Mechanical Products	Grand River via storm sewer	33.00	42.27167	-84.39861
MI0054976	MDC-SPSM-GWCU	Grand River	26.00	42.30000	-84.39583
MI0055042	Plastigage Corp	Hurd Marvin Drain via storm sewer	64.00	42.25417	-84.45000
MI0056006	TRW Inc-Jackson	Grand River	18.30	42.25417	-84.42917
MI0020796	Leslie WWTP	Huntoon Creek	171.60	42.44305	-84.42861
		Total Design Discharge (mgy):	**8462**		
General Permits:					
MIG080265	Wolverine Pipeline Co-Jackson	Tobin Snyder Drain	10.50	42.30722	-84.42528
MIG250042	Industrial Steel Treating Co	Grand River	100.40	42.25583	-84.43194
MIG250355	ADCO Products Inc	Grand River	27.40	42.23417	-84.33389
MIG250360	Lefere Forge & Machine	Grand River	4.40	42.25000	-84.37500
MIG250365	Mid-American Products	Grand River	21.90	42.26250	-84.40833
MIG250396	B & H Machine Inc	Tobin Snyder Drain	18.30	42.29167	-84.42556
MIG580001	MDC-Waterloo WWSL	unnamed trib. to Portage River	10.95	42.34361	-84.17000
MIG580258	MDC-SPSM-Wing WWSL	Portage River	3.00	42.30972	-84.37778
MIG580259	MDC-SPSM-Dale Foltz TC WWSL	Wildcat Creek	0.50	42.30417	-84.33194
MIG580274	Sherman Oaks MHP WWSL	Grand River	34.00	42.33750	-84.40000
MIG670278	Equilon Enterprises-Jackson	Rives-Blackman Drain	307.00	42.30861	-84.42444
		Total Design Discharge (mgy):	**538**		

TABLE A.2
NPDES permitted industrial storm water outfalls to the Grand River and/or Portage River watersheds in the vicinity of Jackson.

PERMIT NUMBER	FACILITY	TYPE	LATDD	LONGDD
Storm Water NPDES Permits:				
MIR0 11159	Eaton Hydraulics Inc	Industrial Storm Water Only	42.20000	-84.38333
MIR011220	Wolverine Vinyl Siding	Industrial Storm Water Only	42.24417	-84.39250
MIR011324	Jackson County Airport	Industrial Storm Water Only	42.25972	-84.45917
MIR011327	Thompson-McCully Co -Jackson	Industrial Storm Water Only	42.27722	-84.38833
MIR011332	Legends Mfg Inc	Standard	42.25389	-84.47583
MIR011338	Tenneco Auto Grass Lk	Industrial Storm Water Only	42.29167	-84.22917
MIR011339	Midbrook Inc	Industrial Storm Water Only	42.22444	-84.39306
MIR011340	Camshaft Machine Co	Industrial Storm Water Only	42.28306	-84.41972
MIR011341	Fourway Machine	Industrial Storm Water Only	42.25528	-84.36028
MIR011342	Hydraulic Systems Inc	Industrial Storm Water Only	42.22611	-84.38917
MIR011343	USF Holland Inc-Jackson	Industrial Storm Water Only	42.25222	-84.47833
MIR011344	C & K Box Company	Industrial Storm Water Only	42.25306	-84.43528
MIR011345	Production Engr Inc	Industrial Storm Water Only	42.21778	-84.38083
MIR011347	Worthington Specialty Proc	Industrial Storm Water Only	42.19167	-84.37500
MIR011348	Mich Auto Compressor Inc	Industrial Storm Water Only	42.26722	-84.54167
MIR011350	Blu-Surf Inc	Industrial Storm Water Only	42.25833	-84.55000
MIR011351	Pioneer Foundry Co Inc	Industrial Storm Water Only	42.24278	-84.39750
MIR011352	O' Briens Trading Post	Industrial Storm Water Only	42.22139	-84.31944
MIR011353	Edscha Jackson	Industrial Storm Water Only	42.25306	-84.37611
MIR011405	UPS-Jackson	Industrial Storm Water Only	42.21667	-84.38333
MIR011418	United Metal Technology Inc	Industrial Storm Water Only	42.26750	-84.28861
MIR011419	Willbee Transit Mix	Industrial Storm Water Only	42.25417	-84.50833
MIR011441	Crankshaft Machine Group	Industrial Storm Water Only	42.24972	-84.40833
MIR011445	Michner Plating-Angling Road	Industrial Storm Water Only	42.22917	-84.38333
MIR011447	Elm Plating Co Plt 2	Industrial Storm Water Only	42.23333	-84.37639
MIR011448	Elm Plating Co-Plt 1	Industrial Storm Water Only	42.22500	-84.39167
MIR011449	H & M Welding & Fab	Industrial Storm Water Only	42.24167	-84.35000
MIR011450	McGill Road Landfill	Industrial Storm Water Only	42.28944	-84.36750
MIR011451	Jackson Co Dalton Road LF	Industrial Storm Water Only	42.29306	-84.38472
MIR011452	Jackson Co RRF	Industrial Storm Water Only	42.29306	-84.38472
MIR011453	Conway Central Express-XJA	Industrial Storm Water Only	42.25000	-84.33333
MIR011455	Mich ARNG Jack Armory OMS12	Industrial Storm Water Only	42.25000	-84.40000
MIR011456	American Tooling Center Inc	Industrial Storm Water Only	42.29167	-84.20417
MIR011457	Miller Tool & Die Co	Industrial Storm Water Only	42.23333	-84.39167
MIR011458	Clarklake Machine Inc	Industrial Storm Water Only	42.18333	-84.36667
MIR011459	Allied Chucker & Engr Co	Industrial Storm Water Only	42.27500	-84.48750

TABLE A.2. (cont.)

PERMIT NUMBER	FACILITY	TYPE	LATDD	LONGDD
MIR011460	Way Bakery Div	Industrial Storm Water Only	42.23333	-84.37083
MIR011461	Dawn Food Products	Industrial Storm Water Only	42.22500	-84.36667
MIR011462	Advance Packaging Corp-Jac	Industrial Storm Water Only	42.23333	-84.37500
MIR011464	Michner Plating-N Mechanic	Industrial Storm Water Only	42.25417	-84.40417
MIR011465	Worthington Steel	Industrial Storm Water Only	42.24167	-84.38333
MIR011466	TAC Manufacturing	Industrial Storm Water Only	42.27500	-84.47917
MIR011467	Wolverine Metal Specialties	Standard	42.25417	-84.48333
MIR011468	Dawlen Corp	Industrial Storm Water Only	42.22500	-84.36667
MIR011469	John Crowley Inc	Industrial Storm Water Only	42.24167	-84.40000
MIR011470	Mich Extruded Aluminum	Industrial Storm Water Only	42.25417	-84.35417
MIR011471	C & H Stamping Inc	Industrial Storm Water Only	42.41667	-84.23333
MIR011472	Storey Stone Co	Industrial Storm Water Only	42.20417	-84.40000
MIR011473	Michigan Seat Co	Industrial Storm Water Only	42.22083	-84.38333
MIR011474	Chemical Technologies	Industrial Storm Water Only	42.23333	-84.37917
MIR011475	Liberty Environmentalists	Industrial Storm Water Only	42.18333	-84.36667
MIR011476	Jackson Iron & Metal #1	Industrial Storm Water Only	42.24167	-84.37917
MIR011477	Jackson Iron & Metal #2	Industrial Storm Water Only	42.23750	-84.39167
MIR011478	Andys Airport Auto Parts	Industrial Storm Water Only	42.25000	-84.45000
MIR011482	Miller Truck & Storage	Industrial Storm Water Only	42.24167	-84.38333
MIR011483	Boone's Welding & Fab	Industrial Storm Water Only	42.22917	-84.40833
MIR011484	Mag-Tec Casting Corp	Industrial Storm Water Only	42.21667	-84.35000
MIR011485	Norfolk Southern Jackson	Industrial Storm Water Only	42.24583	-84.40000
MIR011486	Jackson Auto Salvage	Industrial Storm Water Only	42.25417	-84.50000
MIR011491	International Foam & Trim	Industrial Storm Water Only	42.25000	-84.47917
MIR011512	Riverside Grinding Co	Industrial Storm Water Only	42.22472	-84.37917
MIR011513	Specialty Castings Inc	Standard	42.37500	-84.69583
MIR011520	Lefere Forge & Machine	Standard	42.25000	-84.37500
MIR011526	B & H Machine Inc	Standard	42.29167	-84.42556
MIR011527	Mid-American Products	Standard	42.26250	-84.40833
MIR011563	Jackson Iron & Metal-Elm Div	Industrial Storm Water Only	42.23556	-84.38417
MIR011609	Orbitform	Industrial Storm Water Only	42.22139	-84.36861
MIR011610	South Street Automotive	Industrial Storm Water Only	42.21778	-84.35250
MIR011617	Emmons Service Inc	Industrial Storm Water Only	42.23972	-84.40972
MIR011618	Linear Automatic Systems	Industrial Storm Water Only	42.25389	-84.40639
MIR011619	Industrial Steel Treating Co	Standard	42.25583	-84.43194
MIR011641	Bailey Sand & Gravel Co	Industrial Storm Water Only	42.25000	-84.51278
MIR011659	Sams Iron & Metal Co	Industrial Storm Water Only	42.26583	-84.40833
MIR011673	Kaneka Texas Corp	Industrial Storm Water Only	42.27417	-84.48056
MIR011710	Eaton Aeroquip Inc	Industrial Storm Water Only	42.24694	-84.39250

TABLE A.2 (cont.)

PERMIT NUMBER	FACILITY	TYPE	LATDD	LONGDD
MIR011712	Miller Industrial Products	Industrial Storm Water Only	42.24278	-84.39583
MIR011718	Professional Assembly Corp	Industrial Storm Water Only	42.21750	-84.37333
MIR011727	D-CO Limestone LLC	Industrial Storm Water Only	42.33292	-84.38182
MIR020005	Equilon Enterprises-Jackson	Standard	42.30861	-84.42444
MIR020014	Koch Materials Co -Jackson	Industrial Storm Water Only	42.24583	-84.40000
MIR020032	Jackson Power Facility	Industrial Storm Water Only	42.26022	-84.38192
MIS310004	Allied Chucker & Engr Co	Industrial Storm Water Only	42.27500	-84.48750
MIS310007	International Foam & Trim	Industrial Storm Water Only	42.25000	-84.47917
MIS310010	Miller Tool & Die Co	Industrial Storm Water Only	42.23333	-84.39167
MIS310012	Riverside Grinding Co	Industrial Storm Water Only	42.22472	-84.37917
MIS310013	Orbitform	Industrial Storm Water Only	42.22139	-84.36861
MIS310022	Willbee Transit Mix	Industrial Storm Water Only	42.25417	-84.50833
MIS310023	Jackson Auto Salvage	Industrial Storm Water Only	42.25417	-84.50000
MIS310030	Thompson-McCully Co -Jackson	Industrial Storm Water Only	42.27722	-84.38833
MIS310032	John Crowley Inc	Industrial Storm Water Only	42.24167	-84.40000
MIS310033	Michigan Seat Co	Industrial Storm Water Only	42.22083	-84.38333

TABLE A.3
Active NPDES permit notice of coverage for construction site in Jackson County, Michigan.

PERMIT NUMBER	FACILITY	LOCATION	TWP.	RANGE	SECTION	DATE RECEIVED	EFFECTIVE DATE
MIR102805	SCHOTT-HICKORY HILLS GOLF CLUB	2540 PAR VIEW DR, JACKSON				01/30/1998	01/30/1998
MIR102912	MDOT-M60-JACKSON COUNTY	SPRING ARBOR, SUMMT, AND BLACKMAN TWPS				03/24/1998	03/24/1998
MIR103006	IPL TOLEDO-HANNAWALD STRG YD	M-52, WATERLOO	T1S	R2E	1	05/11/1998	05/11/1998
MIR103095	WATERLOO GOLF COURSE EXPANSION	11800 TRIST RD, GRASS LAKE	T1S	R2E	33	06/17/1998	06/17/1998
MIR103498	KARVOL-TIMS LAKE PRESERVE	KNIGHT RD - MT HOPE RD, GRASS LAKE	T2S	R2E	21	12/15/1998	12/15/1998
MIR103980	GILLESPIE-GALLERY PLACE	PARNALL RD, NE CORNER OF PARNALL AND LANSING RD	T2S	R1W	15	08/11/1999	08/11/1999
MIR104072	STERLING-ASHTON RIDGE APTS	2905 BLAKE RD, JACKSON BETWEEN N ELM AND DETTMAN RD	T2S	R1W	25	09/28/1999	09/28/1999
MIR104174	JMK-ART MOEHN CHEVROLET/HONDA	SEYMOUR RD N OR I-94				11/29/1999	11/29/1999
MIR104208	NORFOLK-SUMMIT GLEN/RIDGE CNDO	BETWEEN MC CAIN AND MORRELL ST NEAR ROBINSON	T3S	R1E	5	11/17/1999	12/29/1999
MIR104362	JCRC-BOARDMAN ROAD EXTENSION	LONGFELLOW TO MAYNARD TO AIRPORT RD				03/08/2000	03/20/2000
MIR104382	JCRC-WILDWOOD/GANSON RECONST	MICHIGAN AVE TO BROWN	T2S	R1W	32,33	03/24/2000	03/24/2000
MIR104492	SUMMIT GLEN/SUMMIT RIDGE	MCCAIN RD, JACKSON	T3S	R1E	5	04/19/2000	05/15/2000
MIR104558	COLBROOK-COLBROOK MEADOWS	JEFFERSON RD AND TIFFANY RD	T4S	R1E	24	06/05/2000	06/05/2000
MIR104644	MOLTON GROUP-CORONADO	NAPOLEON RD & DORRELL RD	T3S	R1E	14	07/07/2000	07/11/2000
MIR104814	BULLINGER/WANDERING CK CONDO	S JACKSON RD S OF FERGUSON	T3S	R1W	21	09/19/2000	09/19/2000
MIR104943	KIRK MERCER	8049 S JACKSON RD	T4S	R1W	3	11/17/2000	11/29/2000
MIR105057	KINDER MORGAN-ORION PLANT	2219 CHAPIN ST, JACKSON	T3S	R1W	36	01/22/2001	01/22/2001
MIR105198	JACKSON CON ENRGY HEADQUARTER	BETWEEN FRANCIS ST ON AIRLINE DR	T3S	R1W	2	03/28/2001	03/28/2001
MIR105197	PENMARK GOODYR TIRE DEMOLITION	1304 PAGE ST, JACKSON	T2S	R1W	36	03/28/2001	03/28/2001
MIR105238	ECCLESIA RIDGE VIEW ESTATES	MICHIGAN AVE, MT. HOPE ROAD, GRASS LAKE TWP	T2S	R2E	33	04/24/2001	04/24/2001
MIR105297	MDOT CS 38111	JN 55900A				05/17/2001	05/17/2001
MIR105301	SCENIC HILLS	SCENIC HILLS DRIVE	T2S	R1E	29	05/18/2001	05/21/2001
MIR105498	DRS-MYSTIC HILLS-GRANDE GOLF	FLOYD RD NEAR US-127			24, 25	07/30/2001	08/24/2001
MIR105566	GANTON'S-TERRACE HILLS 1A & 1B	ROBINSON & SPRING ARBOR RD, JACKSON	T3S	R1W	7	09/21/2001	09/21/2001
MIR105586	LEFERE-SPEEDWAY-KART TRACK	PAGE AVE, JACKSON	T3S	R1E	6	09/17/2001	10/03/2001
MIR105614	MDOT-US127 RECONSTRUCTION		T3S	R1E		10/17/2001	10/17/2001
MIR105665	SUN COMM-WINDHAM HILLS	COUNTY FARM RD, JACKSON	T2S	R1W	19	11/20/2001	11/20/2001
MIR105695	JACKSON CO-FRANCIS ST RECONST	FRANCIS ST MCDEVITT TO SOUTH ST, JACKSON	T3S	R1W	10,11,14,22,23	11/26/2001	12/04/2001
MIR105704	TAC-MFG PLANT ADDITION	4111 COUNTY FARM RD	T2S	R1W	30	11/30/2001	12/07/2001
MIR105886	MJ FARMS-GREENBRIAR PH 2	KING RD, SPRING ARBOR	T3S	R2W	9	03/25/2002	03/25/2002
MIR105925	MDOT-M50 / US127 BL	NORTH ST TO BOARDMAN RD	T2S	R1W	27,28,33,4	04/05/2002	04/05/2002
MIR105996	VISTA GRANDE VILLA EXPANSION	2251 SPRINGPORT RD	T20S	R1W	28	05/08/2002	05/08/2002
MIR106096	HOME DEPOT-INSTALLMENTS	1400 W MONROE ST	T2N	R1W	28	06/14/2002	06/14/2002
MIR106113	SD-ARBORS @ THE WOODS	DETLMAN & AMOS, JACKSON	T2S	R1W	36	06/19/2002	06/19/2002
MIR106173	HOME DEPOT STORE 2770-JACKSON	NW CORNER OF MONROE & WISNER ST	T2N	R1W	28	07/18/2002	07/18/2002
MIR106172	NORFOLK-SUMMIT GLEN/OAK GROVE	BARRINGTON CIRCLE, JACKSON	T3S	R1E	5	07/18/2002	07/18/2002
MIR106194	SANCTUARY OF BRILLS LK PH 2	3650 WHIPPLE RD, JACKSON	T2S	R1E	22	07/30/2002	07/30/2002
MIR106265	WELLHOFF-BRENDAN ESTATES	M-50, NAPOLEON	T4S	R1E	1	08/21/2002	08/21/2002
MIR106529	MDOT-US127, JACKSON		T4S	R1W	13	01/16/2003	01/16/2003

TABLE A.4
City of Jackson identified municipal storm water outfall locations to the Grand River.
Provided as part of Phase II MS4 storm water permit program.

OUTFALL LOCATION DESCRIPTION	LATDD	LONGDD
E. of N. Blackstone St.	42.26925	-84.40983
E. Monroe St. (W. Price St.)	42.26576	-84.40851
W. Monroe St.	42.26495	-84.41011
Adams St. (W)	42.26243	-84.40997
Myrtle St. (W)	42.26102	-84.40969
North St. (NE)	42.25913	-84.40813
North St. (NW)	42.25892	-84.40859
North St. (SE)	42.25840	-84.40767
Mongomery St.	42.25739	-84.41426
Gauson St. (NE)	42.25475	-84.40725
Gauson St. (NW)	42.25460	-84.40771
W. Trail St. (NW)	42.25247	-84.40813
W. Trail St. (NE)	42.25268	-84.40754
N. Jackson St. (N of RR)	42.25040	-84.40822
Oak St. (N of Detroit St.)	42.24978	-84.40448
Mechanic St. (E) (N of Mich. Ave.	42.24806	-84.40541
Francis St. (@ W. Cortland Ave.)	42.24692	-84.40323
S. Airline Dr. (S. Louis Glick Hw	42.24630	-84.40134
Hupp Ave. (N)	42.24711	-84.40001
Hupp Ave. (S)	42.24396	-84.39608
Amur St.	42.24182	-84.39538
Bridge St. (NW)	42.24075	-84.39502
Bridge St. (NE)	42.24096	-84.39437
Mitchell St. (ext. W)	42.23854	-84.39040
Louis St. (SW)	42.23630	-84.39188
Louis St. (NE)	42.23692	-84.39105
High St. (W)	42.23320	-84.38994
High St. (SW)	42.23293	-84.38745
High St. (SE)	42.23282	-84.38615
S. Elm Ave.	42.23245	-84.38435
Losey Ave. (N)	42.23238	-84.38089
Losey Ave. (S)	42.23117	-84.38089
Gorham St.	42.23221	-84.37946
Clara St. (N)	42.23117	-84.37794
Clara St. (S)	42.22962	-84.37803
Research Ave. (NW)	42.23042	-84.37355
Research Ave. (SE)	42.23004	-84.37290
E. High St. (S)	42.23162	-84.37078
Dirlam Dr.	42.22856	-84.36653
Goodrich St. & W. South St. (S)	42.22515	-84.41094
S. Jackson St. & W. South St. (S)	42.22504	-84.40915
Oakwood Dr. (E) at Colfax St.	42.22270	-84.41288

TABLE A.5
Individual and non-storm water general NPDES permitted facilities in the upper Grand River watershed, with estimated TSS loadings.

Permit Number	Permitted Facility Name	Design Flow (mgy)	Maximum Monthly Limit TSS (mg/l)	Annual TSS Loadings (lbs)
Individual NPDES Permits, Grand River:				
MI0023256	Jackson WWTP	6935	20 and 25	1288800*
MI0028461	Quanex Corp-Mac Steel Div	55	25	11415
MI0041998	Michigan Center School Dist	0.1	30**	30
MI0045403	Marathon Ashland Petro-Jackson	39	30**	9758
MI0045942	Leoni Twp WWTP	949	20 and 30	190170*
MI0046809	Citgo Corp-Jackson	171	30**	42784
MI0051683	Mechanical Products	33	30**	8257
MI0054976	MDC-SPSM-GWCU	26	30**	6505
MI0055042	Plastigage Corp	64	30**	16013
MI0056006	TRW Inc-Jackson	18.3	30**	4579
MI0020796	Leslie WWTP	172	30	42922
	Total individual permittees:	**8462**		**1621233**
General NPDES Permits, Grand River:				
MIG080265	Wolverine Pipeline Co-Jackson	10.5	30**	2629
MIG250042	Industrial Steel Treating Co	100.4	30**	25135
MIG250355	ADCO Products Inc	27.4	30**	6860
MIG250360	Lefere Forge & Machine	4.4	30**	1102
MIG250365	Mid-American Products	21.9	30**	5483
MIG250396	B & H Machine Inc	18.3	30**	4581
MIG670278	Equilon Enterprises-Jackson	307	30**	76857
MIG580274	Sherman Oaks MHP WWSL	34	40 and 70	15603***
General NPDES Permits, Portage River:				
MIG580001	MDC-Waterloo WWSL	11	40 and 70	5049***
MIG580258	MDC-SPSM-Wing WWSL	3	40 and 70	1375***
MIG580259	MDC-SPSM-Dale Foltz TC WWSL	0.5	40 and 70	229***
	Total general permittees:	**538**		**144801**
			Overall Total:	**1,766,034**

- Total TSS loadings estimates for 5/1 to 11/30 plus 12/1 to 4/30; ** Not limited but assumed maximum monthly TSS concentration;
  *** Combined total TSS loadings for permitted discharge periods 3/1 to 5/31 and 10/1 to 12/31 .

APPENDIX B – JACKSON, LEONI TWP, AND LESLIE WWTPs CONVENTIONAL PARAMETER NPDES PERMIT LIMITS

TABLE B.1
Jackson WWTP NPDES conventional parameter permit limits (design flow 19 MGD)

		Maximum loading (lbs/d)		Maximum concentration (mg/l)		
Parameter	Period	Monthly	7-day	Monthly	7-day	Daily
$CBOD_5$ (mg/l)	6/1 – 9/30	630	1600	4	-	10
	10/1 – 11/30	1100	1600	7	-	10
	12/1 – 4/30	-	2700	-	-	17
	5/1 – 5/31	1100	1600	7	-	10
TSS (mg/l)	5/1 – 11/30	3200	4800	20	30	-
	12/1 – 4/30	4000	6300	25	40	-
Ammonia Nitrogen (mg/l)	6/1 – 9/30	79	320	0.5	-	2
	10/1 – 11/30	-	560	-	-	3.5
	12/1 – 4/30	1700	2400	10.6	-	15
	5/1 – 5/31	-	890	-	-	5.6
TP (mg/l)	Year round	-	-	1.0	-	-
DO (min., mg/l)	Year round	-	-	-	-	6.0

TABLE B.2
Leoni Twp WWTP NPDES conventional parameter permit limits (design flow 2.6 MGD)

		Maximum loading (lbs/d)		Maximum concentration (mg/l)		
Parameter	Period	Monthly	7-day	Monthly	7-day	Daily
$CBOD_5$ (mg/l)	5/1 – 11/30	87	220	4	-	10
	12/1 – 4/30	540	870	25	40	-
TSS (mg/l)	5/1 – 11/30	430	650	20	30	-
	12/1 – 4/30	650	980	30	45	-
Ammonia Nitrogen (mg/l)	5/1 – 11/30	11	43	0.5	-	2
	12/1 – 4/30	-	-	(report)	-	-
TP (mg/l)	Year round	-	-	1.0	-	-
DO (min., mg/l)	5/1 – 11/30	-	-	-	-	7.0
	12/1 – 4/30	-	-	-	-	5.0

TABLE B.3
Leslie WWTP NPDES conventional parameter permit limits (design flow 0.47 MGD)

		Maximum loading (lbs/d)		Maximum concentration (mg/l)		
Parameter	Period	Monthly	7-day	Monthly	7-day	Daily
$CBOD_5$ (mg/l)	Year round	98	160	25	40	-
TSS (mg/l)	Year round	120	180	30	45	-
Ammonia Nitrogen (mg/l)	Year round	(report)	-	(report)	-	-
TP (mg/l)	Year round	-	-	1.0	-	-
DO (min., mg/l)	Year round	-	-	-	-	5.0