

## **Appendix M.**

### **Lower Sandusky River and Sandusky Bay Bacteria Watershed TMDLs**

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## M-1. Background

The lower Sandusky River and Sandusky Bay tributaries basin is comprised of the 04100011 01, 04100011 02, 04100011 10, 04100011 11, 04100011 12, 04100011 13, and 04100011 14 ten-digit hydrologic units. This basin was split into two study areas during the assessment phase, namely the lower Sandusky River basin and the Sandusky Bay tributaries basin, although the reporting of their loading analysis will be combined for the purpose of this TMDL. The overall study area covers the Wolf Creek, Muddy Creek, Muskellunge Creek, Green Creek, Pickerel Creek, Raccoon Creek, Mills Creek, and Pipe Creek watersheds along with other select tributaries of the Sandusky River. Each HUC 12 within the basin was evaluated for both aquatic life and recreation use attainment, although only bacteria impairments for recreation use will be addressed in this appendix. Sites that are on the Sandusky River mainstem are included in the TMDL for the Large River Assessment Unit (LRAU), not for the HUC 12 in which they are located.

Of the 12 sites in the Sandusky Bay tributaries study area that were evaluated for bacteria TMDLs, ten were found to be in non-attainment. Each site was sampled eight times during the recreation season (May through October 2009), with the exception of Cold Creek and Westerhouse Ditch, which were sampled five times. All of the evaluated sites can be seen in Figure M-1.

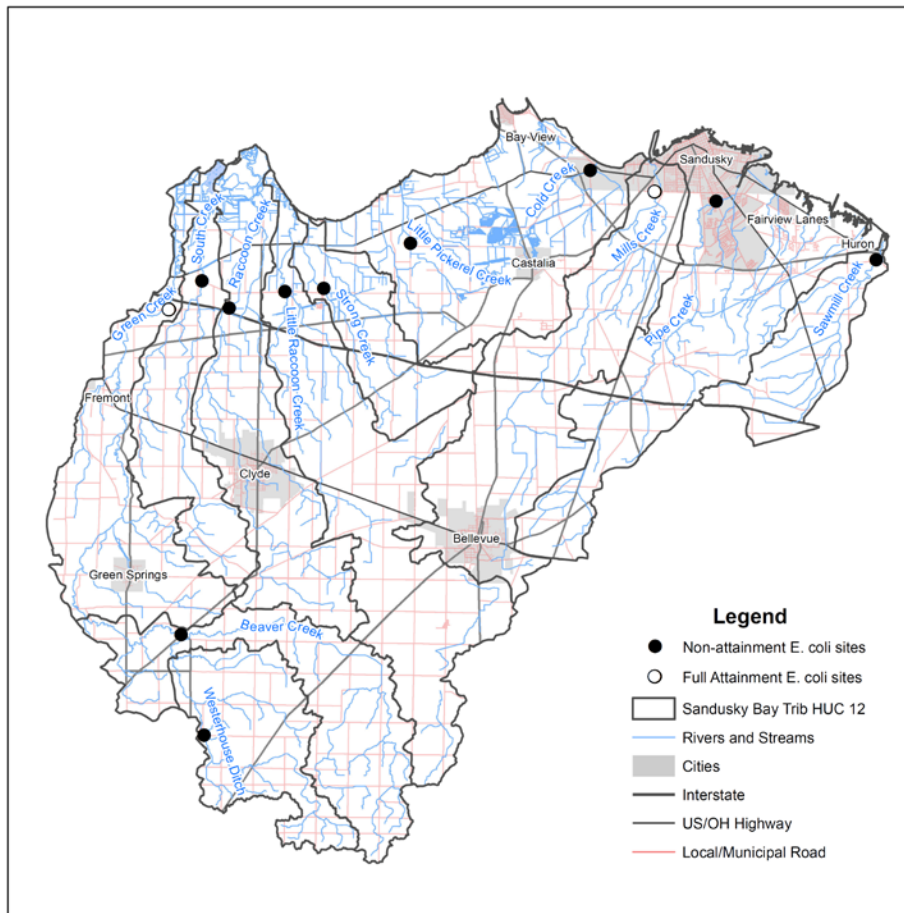
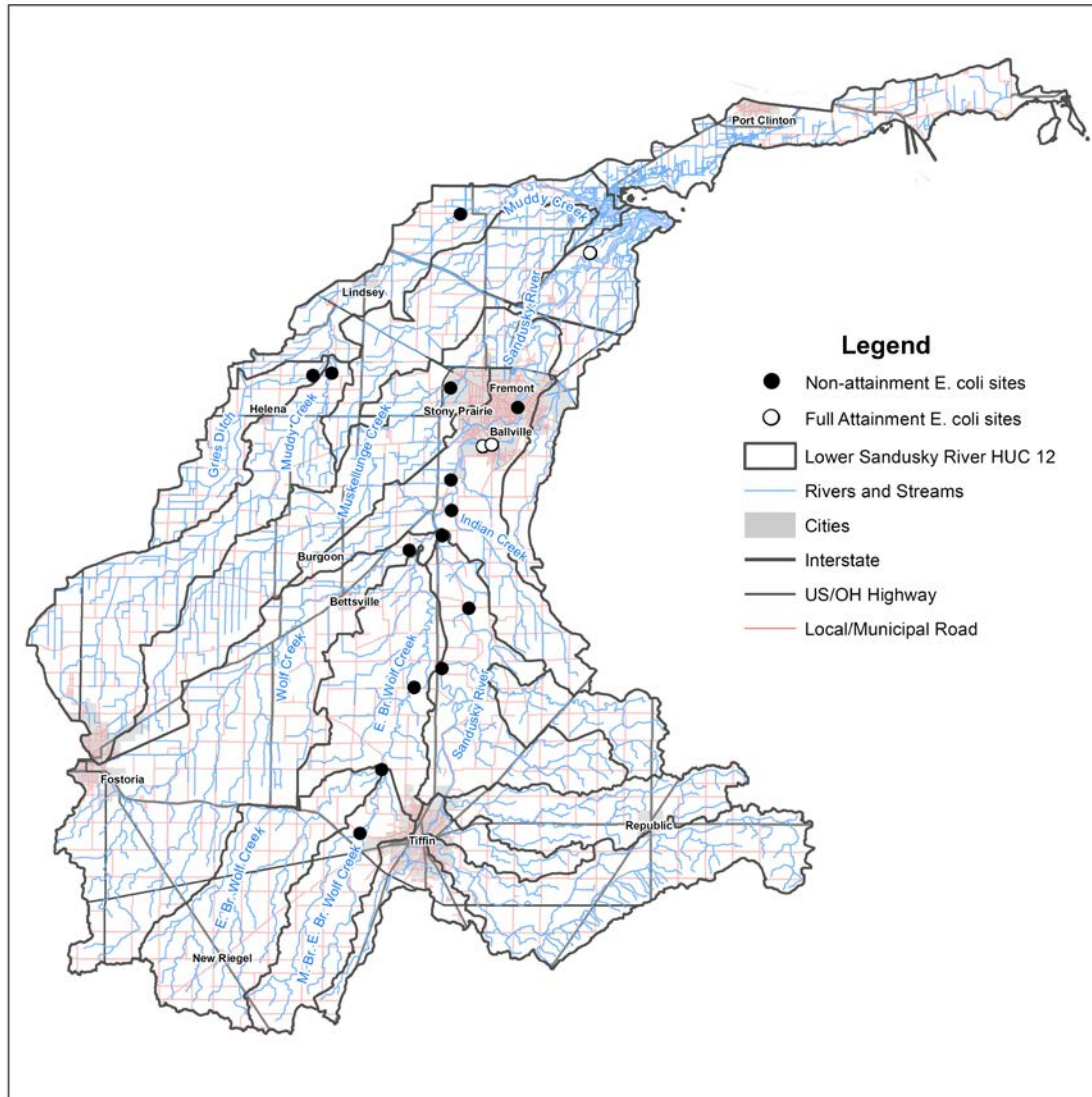


Figure M-1. E. coli sites in the Sandusky Bay tributaries basin.

Of the 17 sites in the lower Sandusky River basin that were evaluated for bacteria TMDLs, 14 were found to be in non-attainment. Each of these sites was sampled between seven and nine times during the recreation season (May through October 2009), with the exception of the sites on the Sandusky River at Tiffin Road and upstream of Ballville dam, which were sampled five times. All of the evaluated sites in this basin can be seen in Figure M-2.



**Figure M-2. *E. coli* sites in the lower Sandusky River basin.**

In many assessment units recreation use was not supported and the geometric mean did not attain the water quality standards criteria (Table M-1). A study was carried out to develop an *E. coli* total maximum daily load (TMDL) as required by Section 303(d) of the Clean Water Act and the United States Environmental Protection Agency's Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations, Part 130). This TMDL report defines in-stream bacterial conditions, potential sources, bacteria targets, and needed reductions and recommends implementation strategies as guided by bacteria load duration curves.

**Table M-1. Summary of impairment causes and actions taken for recreation uses for the lower Sandusky River and Sandusky Bay tributaries watershed.**

Assessment Unit	Narrative Description	Causes of Impairment	Method to Address
<b>Mills Creek – Frontal Lake Erie (04100011 01)</b>			
01 01 <i>Priority points = 4</i>	Sawmill Creek	E. coli (recreation use)	<i>E. coli</i> TMDL
01 02 <i>Priority points = 3</i>	Pipe Creek	E. coli (recreation use)	<i>E. coli</i> TMDL
01 03 <i>Priority points = 3</i>	Mills Creek	No impairment	<i>No action required</i>
<b>Pickerel Creek – Frontal Sandusky Bay (04100011 02)</b>			
02 01 <i>Priority points = 4</i>	Frontal South Side of Sandusky Bay	E. coli (recreation use)	<i>E. coli</i> TMDL
02 02 <i>Priority points = 1</i>	Strong Creek	E. coli (recreation use)	<i>E. coli</i> TMDL
02 03 <i>Priority points = 3</i>	Pickerel Creek	E. coli (recreation use)	<i>E. coli</i> TMDL
02 04 <i>Priority points = 3</i>	Raccoon Creek	E. coli (recreation use)	<i>E. coli</i> TMDL
02 05 <i>Priority points = 3</i>	South Creek	E. coli (recreation use)	<i>E. coli</i> TMDL
<b>Wolf Creek (04100011 10)</b>			
10 01 <i>Priority points = 3</i>	East Branch Each Branch Wolf Creek	E. coli (recreation use)	<i>E. coli</i> TMDL
10 02 <i>Priority points = 3</i>	Town of New Riegel – East Branch Wolf Creek	E. coli (recreation use)	<i>E. coli</i> TMDL
10 03 <i>Priority points = 3</i>	Snuff Creek – East Branch Wolf Creek	E. coli (recreation use)	<i>E. coli</i> TMDL
10 04 <i>Priority points = 4</i>	Wolf Creek	E. coli (recreation use)	<i>E. coli</i> TMDL
<b>Rock Creek – Sandusky River (04100011 11)</b>			
11 01 <i>Priority points =</i>	Rock Creek	Use attainment unknown	<i>No action required</i>
11 02 <i>Priority points =</i>	Morrison Creek	Use attainment unknown	<i>No action required</i>
11 03 <i>Priority points =</i>	Willow Creek – Sandusky River	Use attainment unknown	<i>No action required</i>
11 04 <i>Priority points =</i>	Sugar Creek	Use attainment unknown	<i>No action required</i>



Assessment Unit	Narrative Description	Causes of Impairment	Method to Address
11 05 <i>Priority points =</i>	Spicer Creek – Sandusky River	Use attainment unknown	<i>No action required</i>
<b>Green Creek (04100011 12)</b>			
12 01 <i>Priority points = 4</i>	Westerhouse Ditch	E. coli (recreation use)	<i>E. coli TMDL</i>
12 02 <i>Priority points = 4</i>	Beaver Creek	E. coli (recreation use)	<i>E. coli TMDL</i>
12 03 <i>Priority points = 4</i>	Green Creek	No impairment	<i>No action required</i>
<b>Muskellunge Creek – Sandusky River (04100011 13)</b>			
13 01 <i>Priority points = 4</i>	Muskellunge Creek	E. coli (recreation use)	<i>E. coli TMDL</i>
13 02 <i>Priority points = 3</i>	Indian Creek – Sandusky River	E. coli (recreation use)	<i>E. coli TMDL</i>
13 03 <i>Priority points =</i>	Mouth Sandusky River	Use attainment unknown	<i>No action required</i>
<b>Muddy Creek – Frontal Sandusky Bay (04100011 14)</b>			
14 01 <i>Priority points = 100</i>	Gries Ditch	E. coli (recreation use)	<i>E. coli TMDL</i>
14 02 <i>Priority points = 4</i>	Town of Helena – Muddy Creek	E. coli (recreation use)	<i>E. coli TMDL</i>
14 03 <i>Priority points =</i>	Little Muddy Creek	Use attainment unknown	<i>No action required</i>
14 04 <i>Priority points = 3</i>	Town of Lindsey – Muddy Creek	E. coli (recreation use)	<i>E. coli TMDL</i>
14 05 <i>Priority points =</i>	North Side Sandusky Bay Frontal	Use attainment unknown	<i>No action required</i>
<b>Sandusky River (04100011 90 01)</b>			
<i>Priority points =</i>	Tymochtee Creek to Wolf Creek	E. coli (recreation use)	<i>E. coli TMDL</i>
<b>Sandusky River (04100011 90 02)</b>			
<i>Priority points = 4</i>	Wolf Creek to Sandusky Bay	E. coli (recreation use)	<i>E. coli TMDL</i>

## M-2. Linkage Discussion

Elevated bacteria loading is the cause of recreation use impairment for many streams in the lower Sandusky River and Sandusky Bay tributaries watershed. In the assessed waters, the proportion of pathogenic organisms present is generally small compared to non-pathogenic organisms. For this reason most pathogenic organisms are difficult to isolate and identify. Additionally, pathogenic organisms are highly varied in their characteristics and type, making them difficult to measure. Nonpathogenic bacteria that are associated with pathogens transmitted by fecal contamination are more abundant and are, therefore, monitored as surrogates because of the greater ease in sampling and measuring. These bacteria are called indicator organisms. Ohio has promulgated water quality standards for the geometric mean concentration for *Escherichia coli* fecal coliform bacteria (§OAC 3745-1-07). These values serve as the targets used in the development of the TMDLs that address recreation use impairments. Therefore, the use of *E. coli* to address recreational use impairment is adequate as dictated by state law.

Excessive concentrations of the indicator bacterium—*E. coli*—exceed water quality standards throughout the watershed due to both direct and indirect sources. Many of the impairments have unidentified or unknown sources, although there have been numerous direct sources considered within the study area. Some of these sources of contamination within the lower Sandusky River watershed include Fremont combined sewer overflows (CSOs), unsewered communities (such as the village of Bascom and Bettsville), and livestock access to streams (Ohio EPA 2011). Within the Sandusky Bay tributaries basin, failing home sewage treatment systems (HSTS) and unsewered areas also contribute to standard exceedance, along with livestock access to Mills Creek and South Creek (Ohio EPA 2010). The Sandusky Bay area includes CSOs from Clyde and Sandusky and the unsewered communities of Vickery, Wightman's Grove, and Bay View (Ohio EPA 2010). Various wastewater treatment plants discharge into streams throughout the watershed, although there is an assumption that these facilities discharge at or below their NPDES permit limits, and therefore their effluent is not considered a source of impairment.

## M-3. Analysis Methods

The general approach to eliminating causes of impairment for beneficial use in the lower Sandusky River and Sandusky Bay tributaries watershed is summarized in Table M-2 below and broken down by subwatershed. As this appendix only addresses bacteria impairments to recreation use, the causes of aquatic life impairments as well as other recreation use impairments are not addressed.

**Table M-2. Summary of causes of impairment and actions taken to address them in assessment units within the 04100011 01, 04100011 02, 04100011 10, 04100011 11, 04100011 12, 04100011 13, and 04100014 12 ten-digit hydrologic units and 04100011 90 LRAU.**

Causes of Impairment	Watershed Assessment Units							
	04100011 01			04100011 02				
	01	02	03	01	02	03	04	05
<b>Recreation Use</b>								
<i>E. coli</i>	D	D		D	D	D	D	D

Causes of Impairment	Watershed Assessment Units											
	04100011 10				04100011 11					04100011 12		
	01	02	03	04	01	02	03	04	05	01	02	03
<b>Recreation Use</b>												
<i>E. coli</i>	D	D	D	D						D	D	

Causes of Impairment	Watershed Assessment Units									
	04100011 13			04100011 14					04100011 90	
	01	02	03	01	02	03	04	05	01	02
<b>Recreation Use</b>										
<i>E. coli</i>	D	D		D	D		D		D	D

D – direct

S – surrogate

N – not addressed

Blank

4B

Means that TMDLs are calculated for this parameter

Means that TMDLs are calculated for a closely related cause and actions to reduce the impact of that cause should be sufficient to address this cause. There is substantial overlap in the sources of the loading of both parameters

Means that the impairment is not addressed in this report.

Indicates that the assessment unit is not impaired for this cause.

Means that the 4B option is being used to address impairment.

### M-3.1. Load Duration Curves for *Escherichia coli*

#### M- 3.1.1 Justification of Method

The load duration curve method was chosen based on its suitability with relation to the amount of data available and the desired outcome for this project. With approximately eight data points for each sampling location, there was not enough information to develop a daily simulation model or to accurately calibrate a model with more sophisticated methods. Also, while a simulation model such as SWAT can be used to generate bacteria loads, it only handles bacteria from manure, thus not providing the range of information needed to allocate loads appropriately. In the case of load duration curves, the model can provide satisfactory results that help identify the source of impairments without additional data points.

Specifically, because they provide a visualization of the relationship between flow and loading capacity, load duration curves lend themselves well to the analysis of *E. coli* in streams. In the case of both ideal load curve conditions and instances of *E. coli* impairment, flow is a primary driver in pollutant delivery mechanisms, and other processes are a relatively insignificant part of the total loading. *E. coli* sources are distinct for each flow range, and these curves can assist in distinguishing between point and nonpoint sources that contribute to *E. coli* loading by highlighting the flow conditions under which impairments occur. At lower stream flow levels, little to no in-stream dilution of *E. coli* is occurring due to dry conditions and lack of runoff. Because of this, any point source *E. coli* contributions to the stream will result in higher concentrations of *E. coli*. If there are a high number of samples under dry weather or low flow conditions that fall above the target curve, there is a likelihood of nearby point sources of *E. coli*. Examples of bacteria point sources include CSOs, municipal separate storm sewer systems (MS4s), or wastewater treatment plants. High bacteria levels under low flow conditions may also indicate concentrated cattle grazing in the stream channel, leaking sewer lines, or failing home sewage treatment systems (HSTS).

### **M-3.1.2      Margin of Safety**

The Clean Water Act requires that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality. U.S. EPA guidance explains that the MOS may be implicit (incorporated into the TMDL through conservative assumptions in the analysis) or explicit (expressed in the TMDL as loadings set aside for the MOS).

An implicit MOS is incorporated in this method through various elements, including in the derivation of the *E. coli* water quality criterion and in not considering the die-off of pathogens as part of the TMDL calculations. Implicit MOS is also enhanced by the use of the geometric mean target (a seasonal target) to calculate daily loads. In addition, an explicit MOS has been applied as part of all of the bacteria TMDLs by reserving 20% of the allowable load, which accommodates the broad fluctuation of *E. coli* concentrations that occur in nature and the relatively low number of data points available for this analysis. The explicit MOS in each allocation is shown in the TMDL allocation tables throughout Section 4.

### **M-3.1.3      Critical Conditions and Seasonality**

The critical condition can be thought of as the “worst case” scenario of environmental conditions in the waterbody for which the loading expressed in the TMDL will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g. flow, temperature, etc.) that result in attaining and maintaining the water quality criterion and have an acceptably low frequency of occurrence.

The critical condition for pathogens is the summer dry period when flows are lowest, and thus the potential for dilution is the lowest. Growth rates are higher and mortality rates lower in the warmer months further making this a critical time of the year for bacteria contamination. Likewise, summer is the period when the probability of recreational contact is the highest. For these reasons recreational use designations are only applicable in the period May through the end of October, and only flow and data from the same time frame are used in the calculations to address seasonal variation. Pathogen TMDLs are developed for this period in consideration of the critical condition, and for agreement with this use criterion.

### **M-3.1.4      Allowance for Future Growth**

The lower Sandusky River and Sandusky Bay tributaries basin includes portions of Sandusky, Erie, and Seneca counties. Of these three counties, Erie is the only one with projected population growth (1.2% from 2010 to 2020) (ODD 2003). Both Sandusky and Seneca counties are expected to see a decline in overall population (-3.4% and -4.4% respectively) (ODD 2003). Because averaging these rates will produce a negative rate of growth, an assumed allowance for future growth (AFG) of 1% is reserved from the TMDL load as a conservative estimate.

## **M-3.2.      Description of Method**

In order to determine the magnitude of bacteria impairment and differentiate between types of bacteria sources contributing to impairment, load duration curves (LDCs) were calculated for analyzed sites following the methods described in U.S. EPA’s *An Approach for Using Load Duration Curves in the Development of TMDLs* (U.S. EPA 2007). It is important to note that the load duration curve method does

not enable one to attribute impairment to any particular source; instead it is a tool used to determine the flow conditions under which impairment occurs and the probable types of sources contributing to that impairment. For examples of probable sources, refer to Table M-3 below.

**Table M-3. Load duration curve flow zones and typical contributing sources.**

Contributing Source Area	Duration Curve Zone				
	High	Moist	Mid-Range	Dry	Low
Point source				M	H
Livestock direct access to streams				M	H
Home sewage treatment systems	M	M-H	H	H	H
Riparian areas		H	H	M	
Storm water: Impervious		H	H	H	
Combined sewer overflow (CSO)	H	H	H		
Storm water: Upland	H	H	M		
Field drainage: Natural condition	H	M			
Field drainage: Tile system	H	H	M-H	L-M	
Bank erosion	H	M			

\* H = high influence; M = moderate influence; L = low influence

In the Sandusky Bay tributaries basin 10 sites received LDC TMDLs for *E. coli*. These were the most downstream assessment sites impaired for recreational use within each subwatershed. All sites with TMDLs in the Sandusky Bay tributaries basin were considered Class B streams (*E. coli* limit of 161 cfu/100 ml) for the purpose of this analysis. Table M-4 shows these sites with a brief summary of the conditions at each.

**Table M-4. Sandusky Bay Tributaries LDC *E. coli* TMDL sites.**

12-Digit HUC	Stream Name	Station ID	Class	River Mile	Drainage Area (Sq. mi.)	Geomean	Sentinel
04100011 01 01	Sawmill Creek	K01K21	B	1.1	13.5	302	N
04100011 01 02	Pipe Creek	U05K15	B	2.3	22.8	238	Y
04100011 02 01	Cold Creek	300670	B	0.3	3.0	317	N
04100011 02 01	Little Pickerel Creek	201385	B	2.1	5.9	395	N
04100011 02 02	Strong Creek	U05K11	B	2	4.6	602	N
04100011 02 03	Pickerel Creek	U05S04	B	3.3	29	569	Y
04100011 02 04	Raccoon Creek	U05W17	B	5.45	22.5	726	Y
04100011 02 05	South Creek	U05K05	B	4	18.1	293	N
04100011 12 01	Westerhouse Ditch	U04K05	B	3.25	9.6	542	N
04100011 12 02	Beaver Creek	U04G25	B	3.48	43.4	310	Y

Eleven sites received LDC TMDLs for *E. coli* in the lower Sandusky River basin. Most sites within this basin were classified as Class B, with the exception of the sites on the Sandusky River and all sites within five river miles of the mainstem, which were evaluated as Class A (*E. coli* limit of 126 cfu/100 ml). The site on Gries Ditch—classified as a secondary contact recreation use—was located within five river miles of Muddy Creek, so it was evaluated as Class B for *E. coli*. Table M-5 shows the lower Sandusky River sites with a brief summary of the conditions at each.

Table M-5. Lower Sandusky River LDC E. coli TMDL sites.

12-Digit HUC	Stream Name	Station ID	Class	River Mile	Drainage Area (Sq. mi.)	Geomean	Sentinel
04100011 10 01	M. Br. E. Br. Wolf Creek	U04G14	B	0.46	11.3	473	N
04100011 10 02	E Br Wolf Creek	U04G15	B	13.63	33	437	N
04100011 10 03	E Br Wolf Creek	201338	B	9	68	426	Y
04100011 10 04	Wolf Creek	U04G07	A*	1.58	71.8	234	Y
04100011 13 01	Muskellunge Creek	201332	B	5.4	37	183	Y
04100011 13 02	Indian Creek	500950	A*	0.62	11.2	1252	N
04100011 14 01	Gries Ditch	U04Q16	B*	0.9	16.3	179	N
04100011 14 02	Muddy Creek	201410	B	21.1	44	346	N
04100011 14 04	Muddy Creek	U04S01	B	9.79	74	719	Y
04100011 90 01	Sandusky River	U04Q06	A	23	1073	301	N
04100011 90 02	Sandusky River	U04W11	A	15.4	1260	441	N

\*Evaluated as a higher recreation use class to protect downstream use (< 5 miles)

The development of LDCs begins with the calculation of long-term flow records for each impaired site. In order to determine this record for each LDC, stream flows are either extrapolated to a USGS gage via the drainage area yield method or are calculated via regression, depending on whether flows were measured at each site. The sites with measured flows are called sentinel sites, meaning they are selected in advance as having characteristics representative of the basin and being accessible for longer-term monitoring. Sites in the Sandusky Bay tributaries and lower Sandusky River basin whose flows were estimated via regression were all sentinel sites where measured flows and flows estimated via BWSE (bridge-to-water surface elevation) were mapped to long-term gage measurements. Those estimated via the drainage area yield method used historical flow records multiplied by a drainage area ratio ( $DA_{site}/DA_{gage}$ ) to determine the record for the particular site. Notes on how each method was used by site can be found in Tables D-6 and D-7 below.

Table M-6. Summary of flow calculation methods for Sandusky Bay LDC sites.

12-Digit HUC	Stream Name	Method	Gage	Notes
04100011 01 01	Sawmill Creek	Drainage Area (DA)	Rock Creek at Tiffin OH	The DA yield method used with DA ratio of 0.390
04100011 01 02	Pipe Creek	Regression	Rock Creek at Tiffin OH	Calculated based on a regression relationship between measured and BWSE estimated flows and historic gage data
04100011 02 01	Cold Creek	Drainage Area (DA)	Rock Creek at Tiffin OH	The DA yield method used with DA ratio of 0.087
04100011 02 01	Little Pickerel Creek	Drainage Area (DA)	Rock Creek at Tiffin OH	The DA yield method used with DA ratio of 0.171

04100011 02 02	Strong Creek	Drainage Area (DA)	Rock Creek at Tiffin OH	The DA yield method used with DA ratio of 0.133
04100011 02 03	Pickrel Creek	Regression	Rock Creek at Tiffin OH	Calculated based on a regression relationship between measured and BWSE estimated flows and historic gage data
04100011 02 04	Raccoon Creek	Regression	Rock Creek at Tiffin OH	Calculated based on a regression relationship between measured and BWSE estimated flows and historic gage data
04100011 02 05	South Creek	Drainage Area (DA)	Rock Creek at Tiffin OH	The DA yield method used with DA ratio of 0.523 + NPDES average flow of 0.0008 cfs
04100011 12 01	Westerhouse Ditch	Drainage Area (DA)	Rock Creek at Tiffin OH	The DA yield method used with DA ratio of 0.277
04100011 12 02	Beaver Creek	Regression	Rock Creek at Tiffin OH	Calculated based on a regression relationship between measured and BWSE estimated flows and historic gage data

Table M-7. Summary of flow calculation methods for lower Sandusky River LDC sites.

12-Digit HUC	Stream Name	Method	Gage	Notes
04100011 10 01	M. Br. E. Br. Wolf Creek	Drainage Area (DA)	Rock Creek at Tiffin OH	The DA yield method used with DA ratio of 0.327
04100011 10 02	E Br Wolf Creek	Drainage Area (DA)	Rock Creek at Tiffin OH	The DA yield method used with DA ratio of 0.954
04100011 10 03	E Br Wolf Creek	Regression	Rock Creek at Tiffin OH	Calculated based on a regression relationship between measured and BWSE estimated flows and historic gage data
04100011 10 04	Wolf Creek	Regression	Rock Creek at Tiffin OH	Calculated based on a regression relationship between measured and BWSE estimated flows and historic gage data
04100011 13 01	Muskellunge Creek	Regression	Rock Creek at Tiffin OH	Calculated based on a regression relationship between measured and BWSE estimated flows and historic gage data
04100011 13 02	Indian Creek	Drainage Area (DA)	Rock Creek at Tiffin OH	The DA yield method used with DA ratio of 0.324
04100011 14 01	Gries Ditch	Drainage Area (DA)	Rock Creek at Tiffin OH	The DA yield method used with DA ratio of 0.471
04100011 14 02	Muddy Creek	Drainage Area (DA)	Rock Creek at Tiffin OH	The DA yield method used with DA ratio of 1.272



12-Digit HUC	Stream Name	Method	Gage	Notes
04100011 14 04	Muddy Creek	Regression	Rock Creek at Tiffin OH	Calculated based on a regression relationship between measured and BWSE estimated flows and historic gage data
04100011 90 01	Sandusky River	Drainage Area (DA)	Sandusky River at Fremont, OH	The DA yield method used with DA ratio of 0.858
04100011 90 02	Sandusky River	Drainage Area (DA)	Sandusky River at Fremont, OH	The DA yield method used with DA ratio of 1.007

Once flow records were completed, the flow duration for each TMDL site was determined. This involves calculating the flow expected for the full range of exceedance percentile. Exceedance percentile stream flows are the probability that a given flow magnitude is exceeded. This normalizes the flows to a range of natural occurrences from extremely high flows (zero exceedance percentile) to extremely low flows (100 exceedance percentile). Since this beneficial use is only applicable to the recreation season (May through October), the stream flows used to calculate this range of exceedance percentile are only those occurring in May through October of each year. The flow curve is then converted into a load duration curve by taking the product of each flow value, the water quality geometric mean standard, and a conversion factor. These values, in *E. coli* counts per day, are the TMDL for each flow condition. The resulting points are plotted to create the load duration curve.

The water quality samples for each impaired site are converted into loads by taking the product of the *E. coli* sample result, the flow at the time the sample was collected, and a conversion factor. Each calculated load is shown as a point on the LDC plot and is then compared to the water quality TMDL load. Points that plot above the LDC represent deviations from the water quality standard and the daily allowable load. Points that plot below the curve represent samples in compliance with standards and the daily allowable load.

Water quality samples on the LDCs are drawn as diamonds. Samples taken when storm flow is greater than 50% of the stream's overall flow are noted as diamonds filled with orange (noted as ">50% storm" in the figure's legend). This flow condition is determined using the sliding-interval method for streamflow hydrograph separation contained in the USGS HYSEP program (Sloto 1996).

The load duration curves are grouped into five flow regimes noted with vertical lines and labels. These regimes are defined as follows:

<i>High flow zone:</i>	Stream flows in the 0 to 5 exceedance percentile range; these are related to flood flows.
<i>Wet weather zone:</i>	Flows in the 5 to 40 exceedance percentile range; these are flows in wet weather conditions.
<i>Normal range zone:</i>	Flows in the 40 to 80 exceedance percentile range; these are the median stream flow conditions.
<i>Dry weather zone:</i>	Flows in the 80 to 95 exceedance percentile range; these are related to dry weather flows.



*Low flow zone:* Flows in the 95 to 100 exceedance percentile range; related to drought conditions.

Box plots are shown for each flow regime with observed data. The center line of these boxes represents the median *E. coli* load for that flow regime. The top and bottom of the boxes represents the 75<sup>th</sup> and 25<sup>th</sup> percentiles respectively, and the middle and lower vertical bar tails are the maximum and minimum observed loads respectively.

All of the area beneath the TMDL curve is considered the *E. coli* loading capacity of the stream. The difference between this area and the area representing the current loading conditions is the load that must be reduced to meet water quality standards/targets.

The final step in creating an LDC is to determine where reductions need to occur. Samples in exceedance at the right side of the graph occur during low flow conditions, and significant sources might include wastewater treatment plants, malfunctioning home sewage treatment systems, illicit sewer connections, or animals depositing waste directly to the stream. Any exceedance on the left side of the graph occurs during higher flow events and potential sources are likely related to land use or management practices such as manure spreading or livestock production. These supply bacteria that are washed off upland areas by runoff. The LDC approach helps determine which implementation practices are most effective for reducing loads.

Along with each load curve is a “TMDL table,” which details the information that is graphically presented in the LDC figure. Each table contains the following information for each hydrologic regime:

- number of samples
- median sample *E. coli* load
- total maximum daily load (TMDL)
- wasteload allocation (WLA) for each point source
- nonpoint load allocation (LA)
- margin of safety (MOS) load
- allowance for future growth (AFG) load
- nonpoint (LA) % load reduction required

See Figure M-3 and Table M-8 for examples of a typical load curve and associated table.

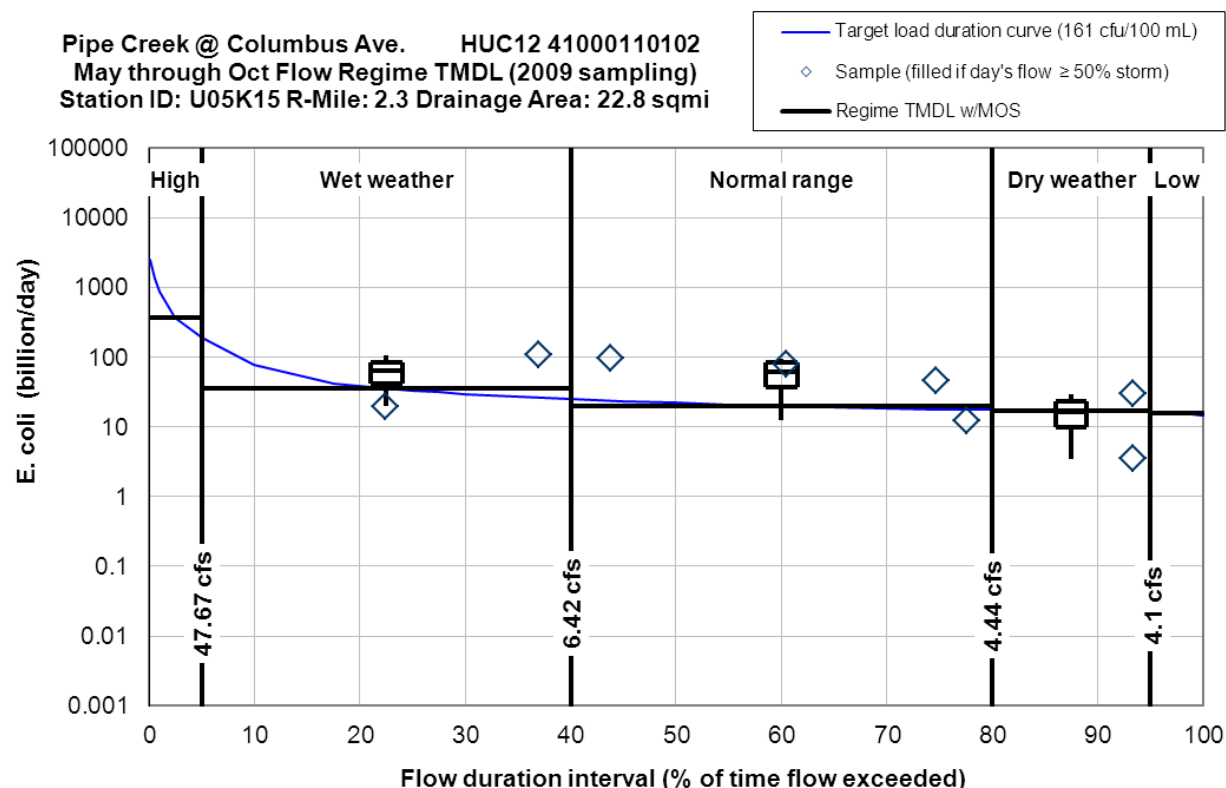


Figure M-3. Example load duration curve.

Table M-8. Example TMDL table calculations (from above load duration curve).

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
Samples Per Regime		2	4	2	
Median Sample load		83	86.82	28.04	
Total Load Reduction Required	No Data	60.1%	76.5%	30.3%	No Data
Total Maximum Daily Load	380.39	41.91	25.84	22.73	21.51
Margin of Safety: 20%	76.08	8.38	5.17	2.95	1.94
Allowance for future growth: 1%	3.80	0.42	0.26	0.23	0.22
Load Allocation	266.28	13.06	1.04	0.21	0.03
Wasteload Allocation Total	34.22	20.05	19.38	19.33	19.32
MS4 - Sandusky	14.90	0.73	0.06	0.01	0.00
Hanson Aggregates Midwest 21J00021	19.32	19.32	19.32	19.32	19.32
Norfolk Southern Bellevue 21T00010	0.00	0.00	0.00	0.00	0.00

### M-3.2.1 Target and Existing Deviation

For a given impaired site, each hydrologic condition (high flows, moist conditions, mid-range conditions, dry conditions, or low flows) was assigned a target bacteria loading rate (cfu/day) by multiplying the median flow of each hydrologic class at that site by the Class B standard (161 cfu/100 ml) and a unit conversion constant. This was achieved by the following formula:

$$T = Q_m * S * C$$

$T$  = target bacteria load

$Q_m$  = median flow for a specific hydrologic class

$S$  = water quality standard

$C$  = conversion constant (cubic feet per second to milliliters per day)

After incorporating a margin of safety and allowance for future growth, median observed bacteria loads in each hydrologic condition were compared to the median target value in that condition in order to quantify needed reductions.

### M-3.2.2 Wasteload Allocation

Once load curves are completed, each discharger in the watershed is assigned a wasteload allocation (WLA) given by the product of its design flow, the water quality standard applicable to its receiving water, and a conversion factor. The water quality standard for a facility is dependent on the class of the waterbody into which it discharges and its proximity to stream reaches of a higher standard as discussed in Tables D-4 and D-5. These WLAs are listed in the TMDL table that corresponds with each sampling site.

Because a given facility typically operates at some fraction of its design flow, the WLA for each facility includes an amount of reserve capacity up to the design flow of the facility. Since these facilities operate independent of stream flow with an unchanging design flow, their WLA is the same for all five flow regimes. For one LDC site—Raccoon Creek—using the design flow to establish WLA created negative load allocations, which are not allowed within a TMDL. Negative allocations arise when there is not sufficient flow to allow for all of the NPDES wasteload allocation *and* the margin of safety and allowance for future growth loads in the lowest flow regimes. To address this problem, adjustments had to be made to both the flow records and the explicit and implicit margins of safety.

Although this is a sentinel site whose flows were calculated via regression, it cannot be assumed that all upstream facilities were discharging at full capacity during wading flow measurements. By adding the difference between each facility's design flow and average flow to all daily flow records, an allowance for fluctuations in discharge was created that slightly improves negative allocations. But, because this did not completely alleviate the problem, both margin of safety and allowance for future growth were also decreased. For Raccoon Creek, MOS was reduced to 9% and 0% for dry weather and low flow respectively and AFG was reduced to 0% for low flow conditions in order to meet the TMDL.

Apart from NPDES point source facilities, WLA also includes the allocation provided to municipal separate storm sewer systems (MS4). Although MS4 runoff is a nonpoint source and varies by regime, it is regulated by Ohio EPA and thus considered part of the WLA. The calculation of MS4 allocations is carried out by multiplying the ratio of the MS4 area to the total drainage area at a site with the remaining *E. coli* load after allocating MOS, AFG, and NPDES point source loads. Within the Sandusky Bay tributaries basin, the Sandusky urbanized area is the only MS4, and its allocations are identified on the

affected bacteria TMDL tables. MS4s within the lower Sandusky River basin include Fostoria, Tiffin, Bucyrus, and Galion, which are presented both separately and collectively in each relevant table.

### M-3.2.3 Load Allocation

Other than MS4 contributors, all nonpoint source contributors and natural background conditions are included within the calculation of load allocations (LA). Unlike wasteload allocations, LAs vary greatly by flow regime as they are heavily dependent on the presence of runoff. These allocations constitute the remainder of the total load after removal of MOS, AFG, and WLA. In the Sandusky Bay tributaries and lower Sandusky River basin, all site loads are dominated by LAs, thus placing the largest burden for reduction on these nonpoint sources.

## M-4. Results

This section summarizes TMDL results.

### M-4.1. Sandusky Bay Tributaries Public Recreation Results

A summary of the bacteria TMDLs, wasteload allocation, load allocation, margin of safety, and allowance for future growth at each hydrologic condition is presented in Table M-9 below.

**Table M-9. Sandusky Bay tributaries TMDL summary table (E. coli loads in billions of organisms per day).**

Hydrologic Condition	High flows	Wet weather	Normal range	Dry weather	Low flows
<b>Flow Duration Interval</b>	0-5%	5-40%	40-80%	80-95%	95-100%
<b>Sawmill Ck @ Boos Rd. HUC12: 04100011 01 01</b>					
Total Maximum Daily Load	213.81	13.39	3.86	2.01	1.30
Wasteload Allocation	0.00	0.00	0.00	0.00	0.00
Load Allocation	168.91	10.58	3.05	1.59	1.03
Margin of Safety	42.76	2.68	0.77	0.40	0.26
Allowance for future growth	2.14	0.13	0.04	0.02	0.01
Total load reduction required	No Data	NA	76.2%	28.0%	No Data
<b>Pipe Creek @ Columbus Ave. HUC12: 04100011 01 02</b>					
Total Maximum Daily Load	374.68	36.20	20.09	16.98	15.76
Wasteload Allocation	15.69	1.52	0.84	0.71	0.66
Load Allocation	280.31	27.08	15.03	12.70	11.79
Margin of Safety	74.94	7.24	4.02	3.40	3.15
Allowance for future growth	3.75	0.36	0.20	0.17	0.16
Total load reduction required	No Data	55.3%	74.6%	18.9%	No Data
<b>Cold Creek @ Bardshar Rd. HUC12: 04100011 02 01</b>					
Total Maximum Daily Load	47.54	2.99	0.87	0.47	0.32
Wasteload Allocation	4.71	0.30	0.09	0.05	0.03
Load Allocation	32.85	2.07	0.60	0.33	0.22
Margin of Safety	9.51	0.60	0.17	0.09	0.06
Allowance for future growth	0.48	0.03	0.01	0.00	0.00
Total load reduction required	No Data	90.3%	93.0%	NA	No Data

Hydrologic Condition	High flows	Wet weather	Normal range	Dry weather	Low flows
<b>Little Pickerel Creek @ Stocker Rd. HUC12: 04100011 02 01</b>					
Total Maximum Daily Load	93.43	5.87	1.69	0.91	0.59
Wasteload Allocation	0.00	0.00	0.00	0.00	0.00
Load Allocation	73.81	4.64	1.34	0.72	0.47
Margin of Safety	18.69	1.17	0.34	0.18	0.12
Allowance for future growth	0.93	0.06	0.02	0.01	0.01
Total load reduction required	No Data	86.6%	70.9%	57.8%	No Data
<b>Strong Creek at Vickery @ TR 268 HUC12: 04100011 02 02</b>					
Total Maximum Daily Load	72.87	4.57	1.34	0.71	0.47
Wasteload Allocation	0.00	0.00	0.00	0.00	0.00
Load Allocation	57.57	3.61	1.06	0.56	0.37
Margin of Safety	14.57	0.91	0.27	0.14	0.09
Allowance for future growth	0.73	0.05	0.01	0.01	0.00
Total load reduction required	No Data	75.3%	79.5%	90.5%	No Data
<b>Pickerel Creek @ TR 247 HUC12: 04100011 02 03</b>					
Total Maximum Daily Load	251.98	30.02	12.25	8.04	6.18
Wasteload Allocation	0.91	0.91	0.91	0.91	0.91
Load Allocation	198.15	22.80	8.76	5.43	3.97
Margin of Safety	50.40	6.00	2.45	1.61	1.24
Allowance for future growth	2.52	0.30	0.12	0.08	0.06
Total load reduction required	No Data	97.3%	84.2%	49.7%	No Data
<b>Raccoon Creek @ TR 244 HUC12: 04100011 02 04</b>					
Total Maximum Daily Load	176.78	30.05	16.27	13.00	11.58
Wasteload Allocation	11.58	11.58	11.58	11.58	11.58
Load Allocation	128.08	12.16	1.27	0.12	0.00
Margin of Safety	35.36	6.01	3.25	1.17	0.00
Allowance for future growth	1.77	0.30	0.16	0.13	0.00
Total load reduction required	No Data	92.6%	86.0%	71.9%	No Data
<b>South Creek @ Whitmore (TR 247) HUC12: 04100011 02 05</b>					
Total Maximum Daily Load	286.64	17.96	5.16	2.72	1.73
Wasteload Allocation	0.01	0.01	0.01	0.01	0.01
Load Allocation	226.43	14.18	4.06	2.13	1.36
Margin of Safety	57.33	3.59	1.03	0.54	0.35
Allowance for future growth	2.87	0.18	0.05	0.03	0.02
Total load reduction required	No Data	78.4%	76.1%	88.8%	No Data
<b>Westerhouse Ditch @ Snavely HUC12: 04100011 12 01</b>					
Total Maximum Daily Load	152.04	9.53	2.76	1.46	0.95
Wasteload Allocation	0.00	0.00	0.00	0.00	0.00
Load Allocation	120.12	7.53	2.18	1.15	0.75
Margin of Safety	30.41	1.91	0.55	0.29	0.19
Allowance for future growth	1.52	0.10	0.03	0.01	0.01
Total load reduction required	No Data	65.9%	67.3%	No Data	No Data
<b>Beaver Creek @ SR 101 HUC12: 04100011 12 02</b>					
Total Maximum Daily Load	1935.26	21.90	2.17	0.39	0.08
Wasteload Allocation	0.06	0.06	0.06	0.06	0.06
Load Allocation	1528.80	17.24	1.65	0.25	0.00
Margin of Safety	387.05	4.38	0.43	0.08	0.02
Allowance for future growth	19.35	0.22	0.02	0.00	0.00
Total load reduction required	No Data	89.1%	82.1%	92.2%	18.7%

In the sequence of figures and tables below, the load duration curve for each site (Figures D-4 through D-13) is shown followed by the TMDL table for that site. Values in table format have been adjusted for rounding.

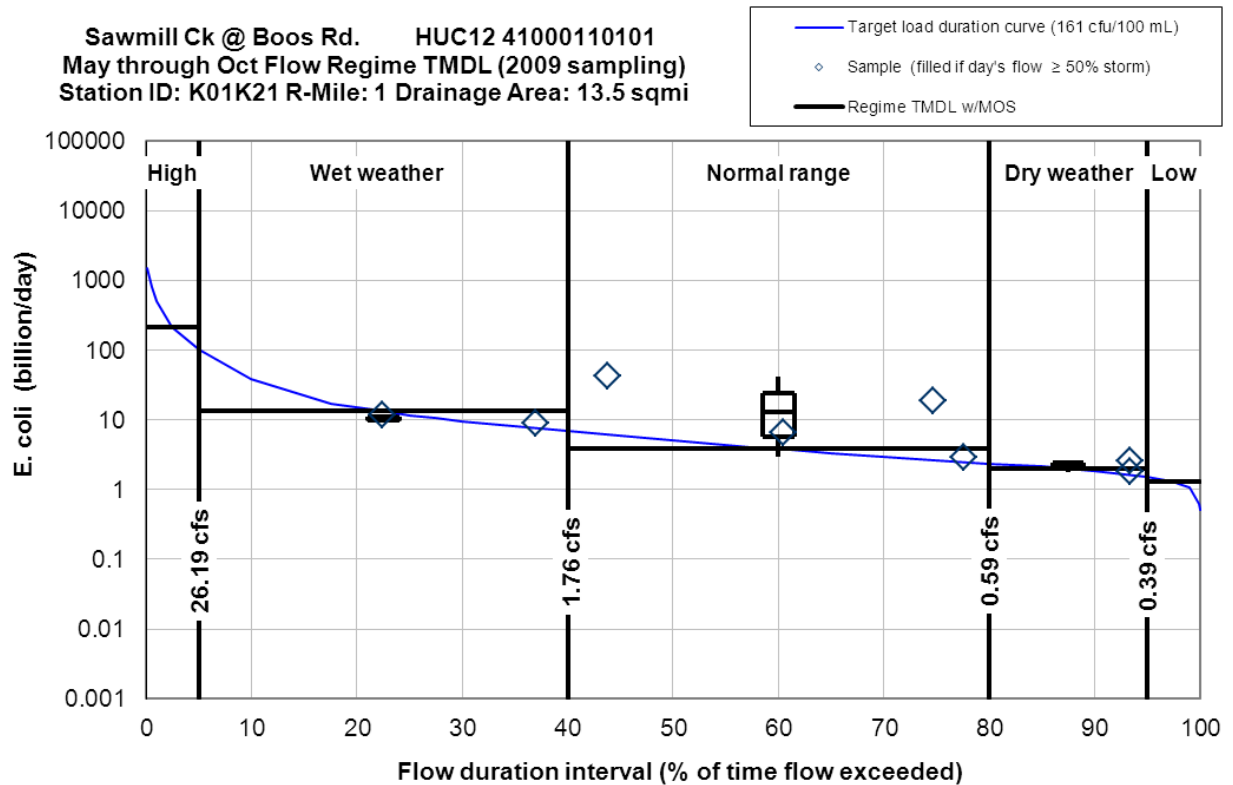


Figure M-4. Load duration curve for site on Sawmill Creek at Boos Rd.

Table M-10. TMDL table for site on Sawmill Creek at Boos Rd.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
Samples Per Regime		2	4	2	
Median Sample load		10	12.79	2.21	
Total Load Reduction Required	No Data	NA	76.2%	28.0%	No Data
Total Maximum Daily Load	213.81	13.39	3.86	2.01	1.30
Margin of Safety: 20%	42.76	2.68	0.77	0.40	0.26
Allowance for future growth: 1%	2.14	0.13	0.04	0.02	0.01
Load Allocation	168.91	10.58	3.05	1.59	1.03
Wasteload Allocation Total	0.00	0.00	0.00	0.00	0.00
MS4	0.00	0.00	0.00	0.00	0.00
NASA Plum Brook (Stn. 1 & 5) 2IO00002	0.00	0.00	0.00	0.00	0.00

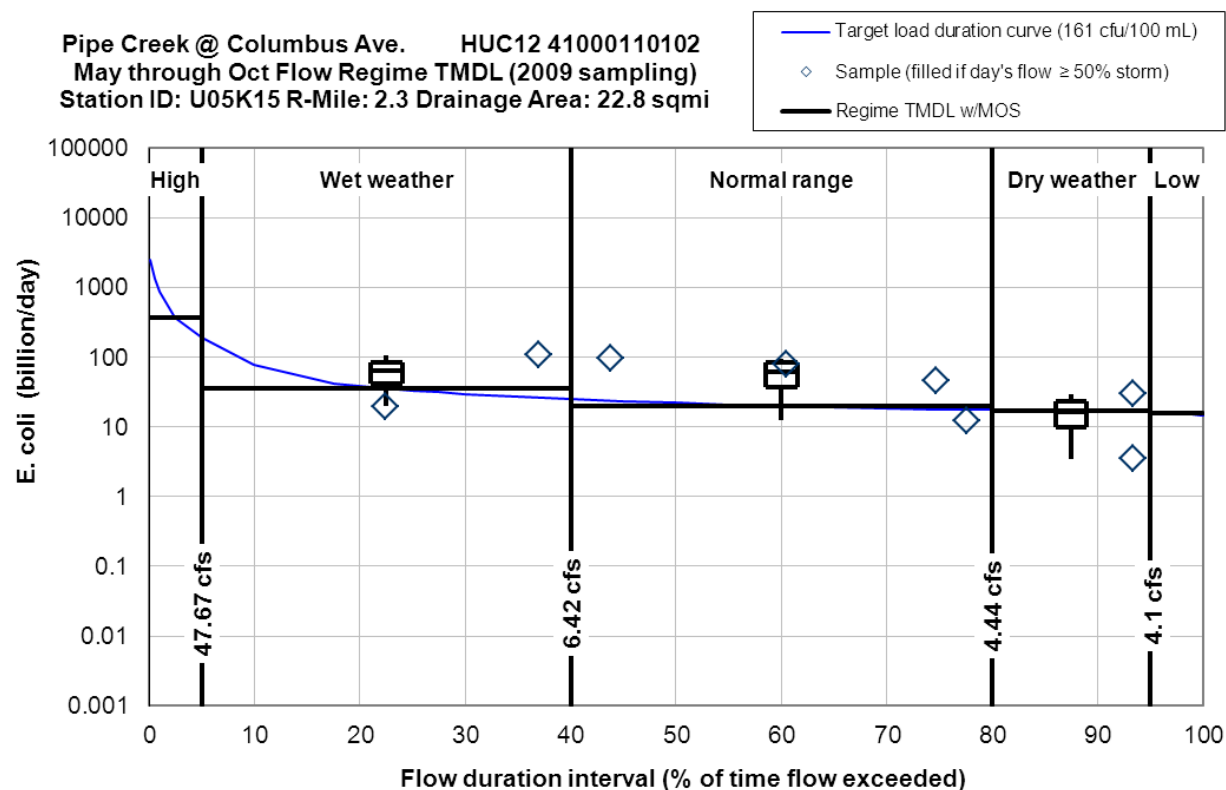


Figure M-5. Load duration curve for site on Pipe Creek at Columbus Ave.

Table M-11. TMDL table for site on Pipe Creek at Columbus Ave.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
Samples Per Regime		2	4	2	
Median Sample load		64	62.59	16.55	
Total Load Reduction Required	No Data	55.3%	74.6%	18.9%	No Data
Total Maximum Daily Load	374.68	36.20	20.09	16.98	15.76
Margin of Safety: 20%	74.94	7.24	4.02	3.40	3.15
Allowance for future growth: 1%	3.75	0.36	0.20	0.17	0.16
Load Allocation	280.31	27.08	15.03	12.70	11.79
Wasteload Allocation Total	15.69	1.52	0.84	0.71	0.66
MS4 - Sandusky	15.69	1.52	0.84	0.71	0.66
Hanson Aggregates Midwest 21J00021	0.00	0.00	0.00	0.00	0.00
Norfolk Southern Bellevue 21T00010	0.00	0.00	0.00	0.00	0.00

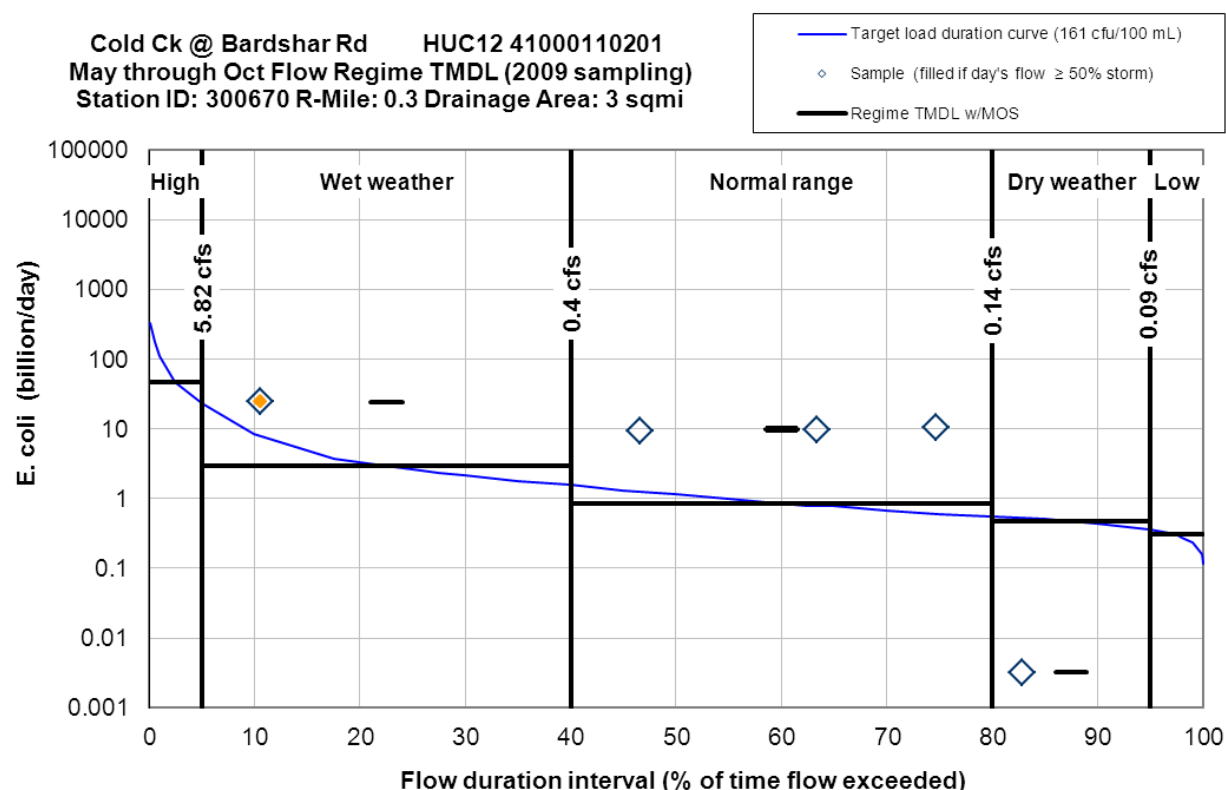


Figure M-6. Load duration curve for site on Cold Creek at Bardshar Rd.

Table M-12. TMDL table for site on Cold Creek at Bardshar Rd.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
<b>Samples Per Regime</b>		1	3	1	
<b>Median Sample load</b>		24	9.76	0.00	
<b>Total Load Reduction Required</b>	No Data	90.3%	93.0%	NA	No Data
<b>Total Maximum Daily Load</b>	47.54	2.99	0.87	0.47	0.32
<b>Margin of Safety: 20%</b>	9.51	0.60	0.17	0.09	0.06
<b>Allowance for future growth: 1%</b>	0.48	0.03	0.01	0.00	0.00
<b>Load Allocation</b>	32.85	2.07	0.60	0.33	0.22
<b>Wasteload Allocation Total</b>	4.71	0.30	0.09	0.05	0.03
<b>MS4 - Sandusky</b>	4.71	0.30	0.09	0.05	0.03
<b>Castalia Trout Farms 2IN00049</b>	0.00	0.00	0.00	0.00	0.00



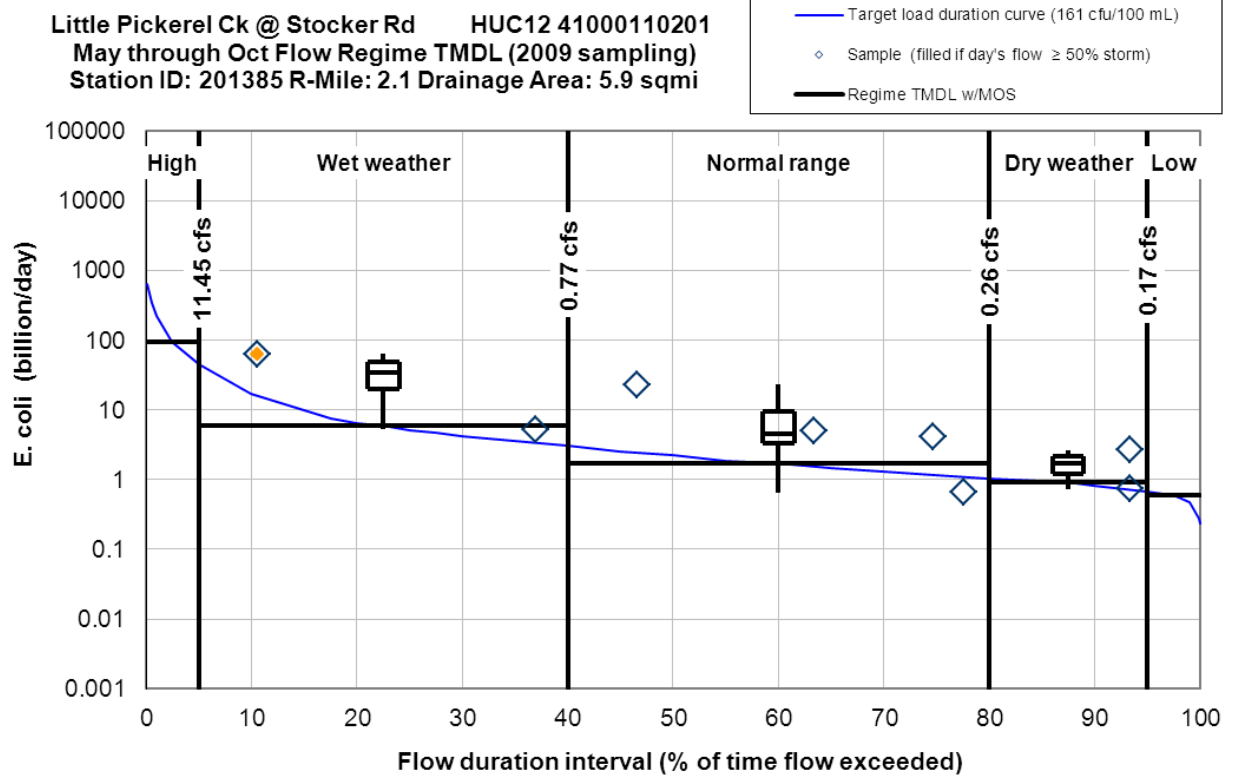


Figure M-7. Load duration curve for site on Little Pickerel Creek at Stocker Rd.

Table M-13. TMDL table for site on Little Pickerel Creek at Stocker Rd.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
Samples Per Regime		2	4	2	
Median Sample load		35	4.60	1.70	
Total Load Reduction Required	No Data	86.6%	70.9%	57.8%	No Data
Total Maximum Daily Load	93.43	5.87	1.69	0.91	0.59
Margin of Safety: 20%	18.69	1.17	0.34	0.18	0.12
Allowance for future growth: 1%	0.93	0.06	0.02	0.01	0.01
Load Allocation	73.81	4.64	1.34	0.72	0.47
Wasteload Allocation Total	0.00	0.00	0.00	0.00	0.00
MS4	0.00	0.00	0.00	0.00	0.00

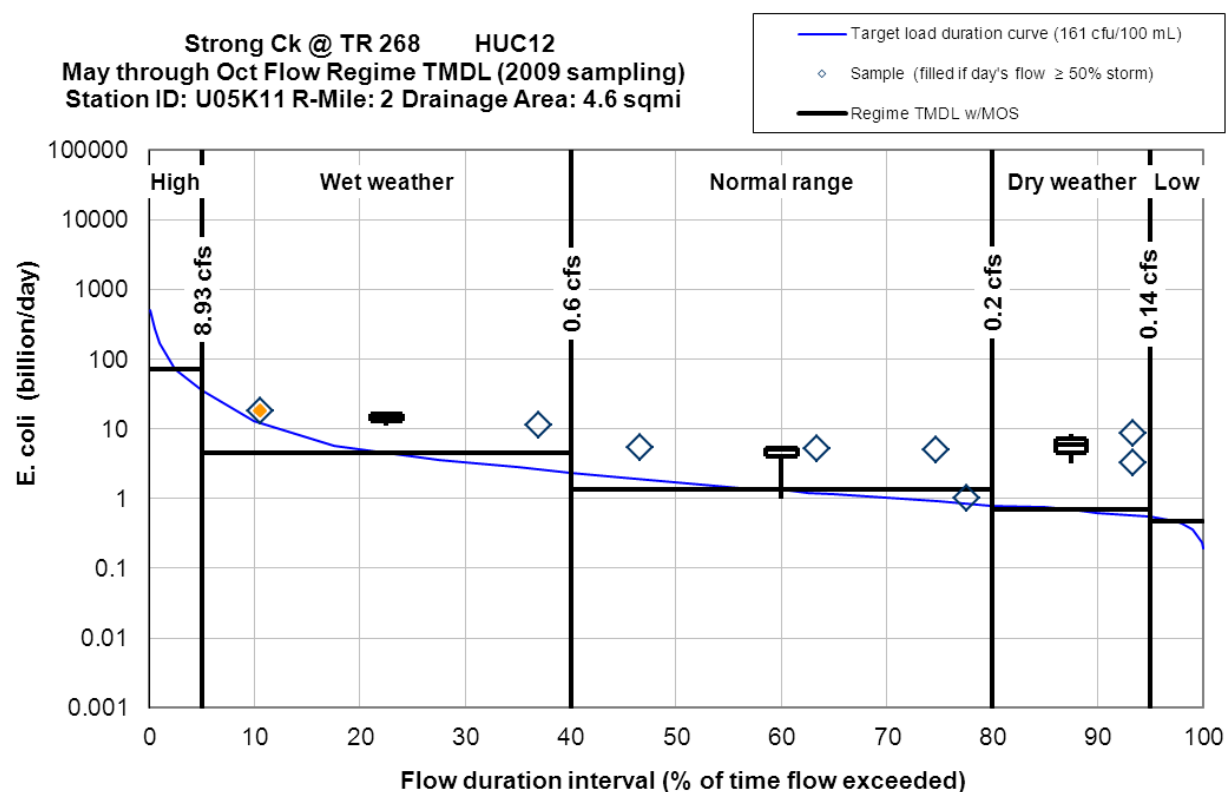


Figure M-8. Load duration curve for site on Strong Creek at TR 268.

Table M-14. TMDL table for site on Strong Creek at TR 268.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
<b>Samples Per Regime</b>		2	4	2	
<b>Median Sample load</b>		15	5.17	5.92	
<b>Total Load Reduction Required</b>	No Data	75.3%	79.5%	90.5%	No Data
<b>Total Maximum Daily Load</b>	72.87	4.57	1.34	0.71	0.47
<b>Margin of Safety: 20%</b>	14.57	0.91	0.27	0.14	0.09
<b>Allowance for future growth: 1%</b>	0.73	0.05	0.01	0.01	0.00
<b>Load Allocation</b>	57.57	3.61	1.06	0.56	0.37
<b>Wasteload Allocation Total</b>	0.00	0.00	0.00	0.00	0.00
<b>MS4</b>	0.00	0.00	0.00	0.00	0.00

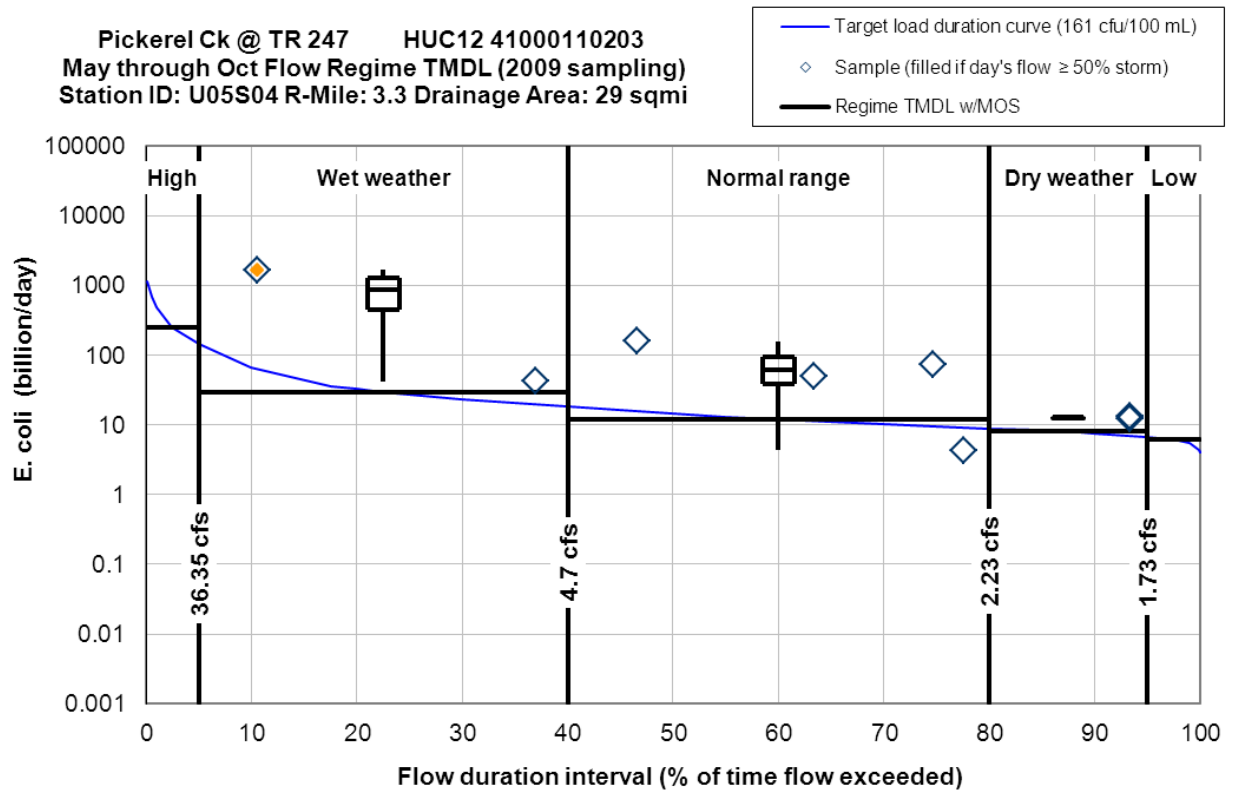


Figure M-9. Load duration curve for site on Pickereel Creek at TR 247.

Table M-15. TMDL table for site on Pickereel Creek at TR 247.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
Samples Per Regime		2	4	2	
Median Sample load		866	61.42	12.61	
Total Load Reduction Required	No Data	97.3%	84.2%	49.7%	No Data
Total Maximum Daily Load	251.98	30.02	12.25	8.04	6.18
Margin of Safety: 20%	50.40	6.00	2.45	1.61	1.24
Allowance for future growth: 1%	2.52	0.30	0.12	0.08	0.06
Load Allocation	198.15	22.80	8.76	5.43	3.97
Wasteload Allocation Total	0.91	0.91	0.91	0.91	0.91
MS4	0.00	0.00	0.00	0.00	0.00
Ohio Tnpke Com.: Erie Islands WWTP 2PQ00001	0.91	0.91	0.91	0.91	0.91

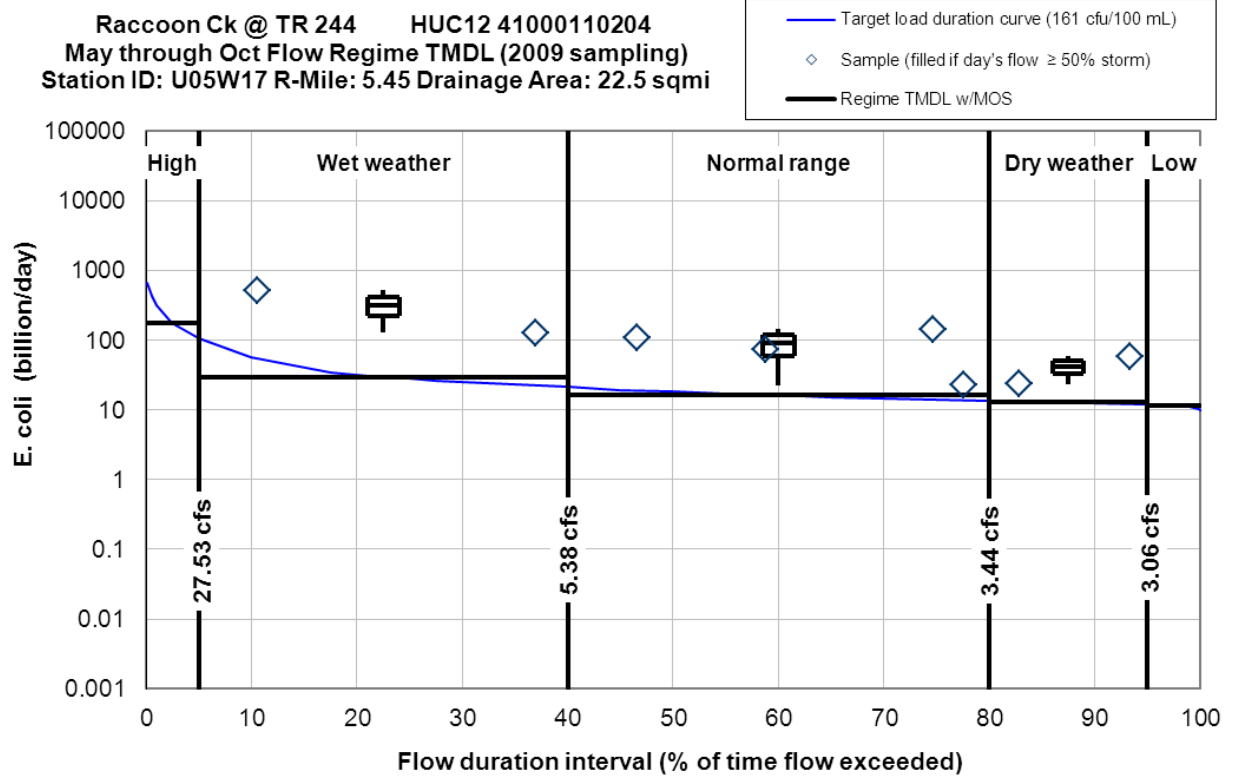


Figure M-10. Load duration curve for site on Raccoon Creek at TR 244.

Table M-16. TMDL table for site on Raccoon Creek at TR 244.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
<b>Samples Per Regime</b>		2	4	2	
<b>Median Sample load</b>		323	91.75	41.60	
<b>Total Load Reduction Required</b>	No Data	92.6%	86.0%	71.9%	No Data
<b>Total Maximum Daily Load</b>	176.78	30.05	16.27	13.00	11.58
<b>Margin of Safety: 20%*</b>	35.36	6.01	3.25	1.17	0.00
<b>Allowance for future growth: 1%*</b>	1.77	0.30	0.16	0.13	0.00
<b>Load Allocation</b>	128.08	12.16	1.27	0.12	0.00
<b>Wasteload Allocation Total</b>	11.58	11.58	11.58	11.58	11.58
<b>MS4</b>	0.00	0.00	0.00	0.00	0.00
<b>Clyde WWTP 2PD00004</b>	11.58	11.58	11.58	11.58	11.58
<b>Clyde WTP No 1 2IW00050</b>	0.00	0.00	0.00	0.00	0.00

\*MOS and AFG were adjusted to accommodate a low TMDL magnitude in the lower two flow regimes

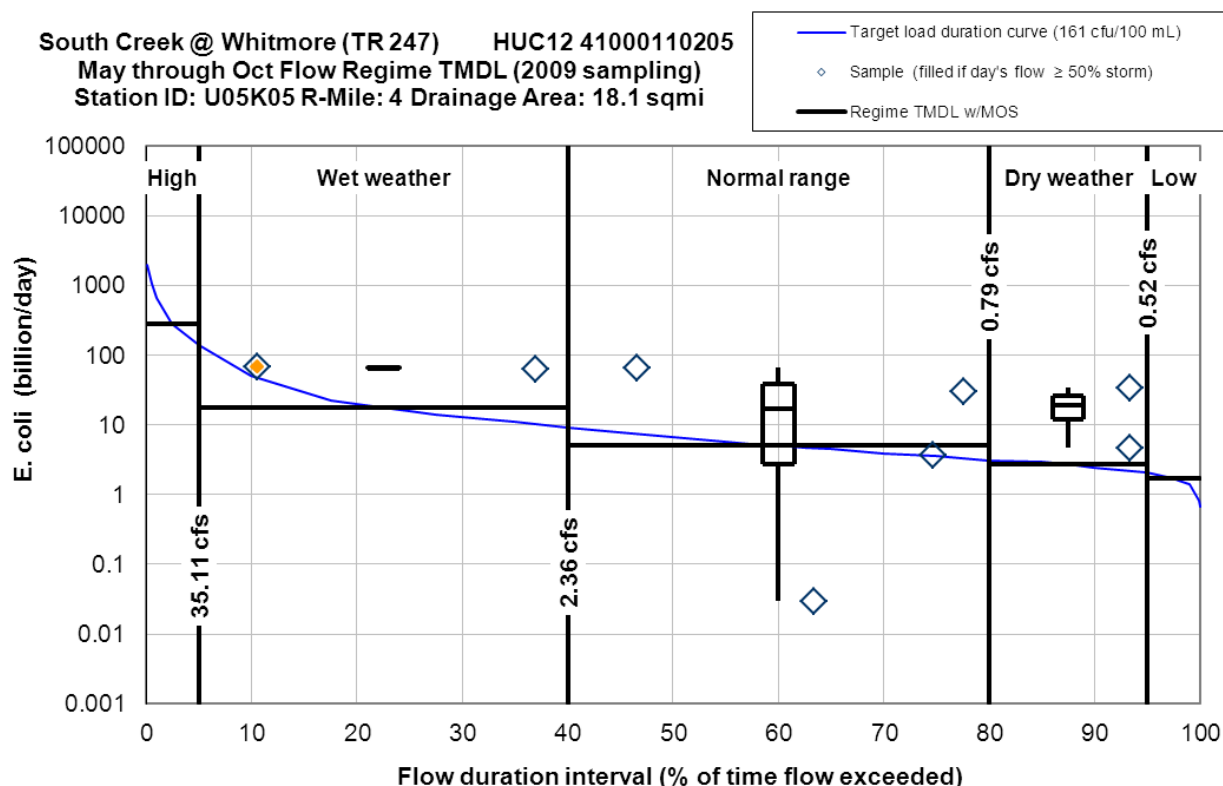


Figure M-11. Load duration curve for site on South Creek at Whitmore at TR 247.

Table M-17. TMDL table for site on South Creek at Whitmore at TR 247.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
<b>Samples Per Regime</b>		2	4	2	
<b>Median Sample load</b>		66	17.09	19.24	
<b>Total Load Reduction Required</b>	No Data	78.4%	76.1%	88.8%	No Data
<b>Total Maximum Daily Load</b>	286.64	17.96	5.16	2.72	1.73
<b>Margin of Safety: 20%</b>	57.33	3.59	1.03	0.54	0.35
<b>Allowance for future growth: 1%</b>	2.87	0.18	0.05	0.03	0.02
<b>Load Allocation</b>	226.43	14.18	4.06	2.13	1.36
<b>Wasteload Allocation Total</b>	0.01	0.01	0.01	0.01	0.01
<b>MS4</b>	0.00	0.00	0.00	0.00	0.00
<b>Club Rog WWTP 2PR00170</b>	0.01	0.01	0.01	0.01	0.01

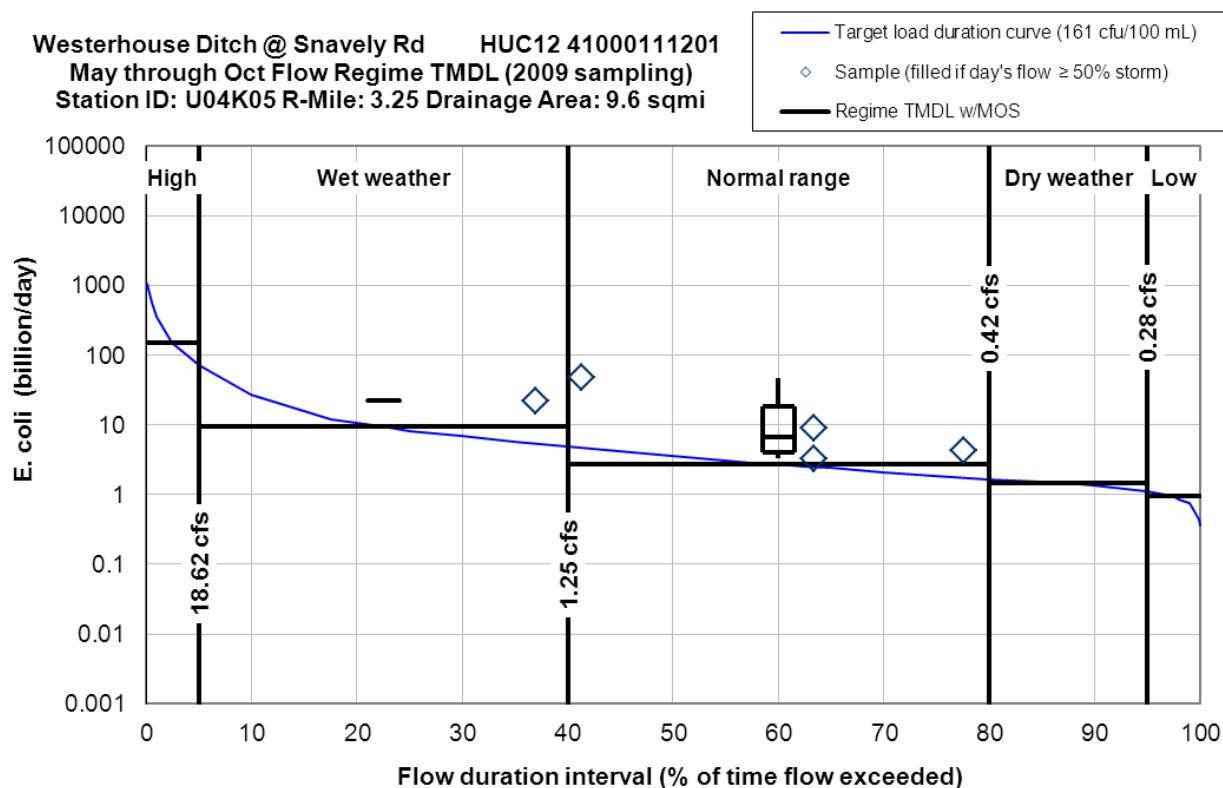


Figure M-12. Load duration curve for site on Westerhouse Ditch at Snavelly Rd.

Table M-18. TMDL table for site on Westerhouse Ditch at Snavelly Rd.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
Samples Per Regime		1	4		
Median Sample load		22	6.66		
Total Load Reduction Required	No Data	65.9%	67.3%	No Data	No Data
Total Maximum Daily Load	152.04	9.53	2.76	1.46	0.95
Margin of Safety: 20%	30.41	1.91	0.55	0.29	0.19
Allowance for future growth: 1%	1.52	0.10	0.03	0.01	0.01
Load Allocation	120.12	7.53	2.18	1.15	0.75
Wasteload Allocation Total	0.00	0.00	0.00	0.00	0.00
MS4	0.00	0.00	0.00	0.00	0.00

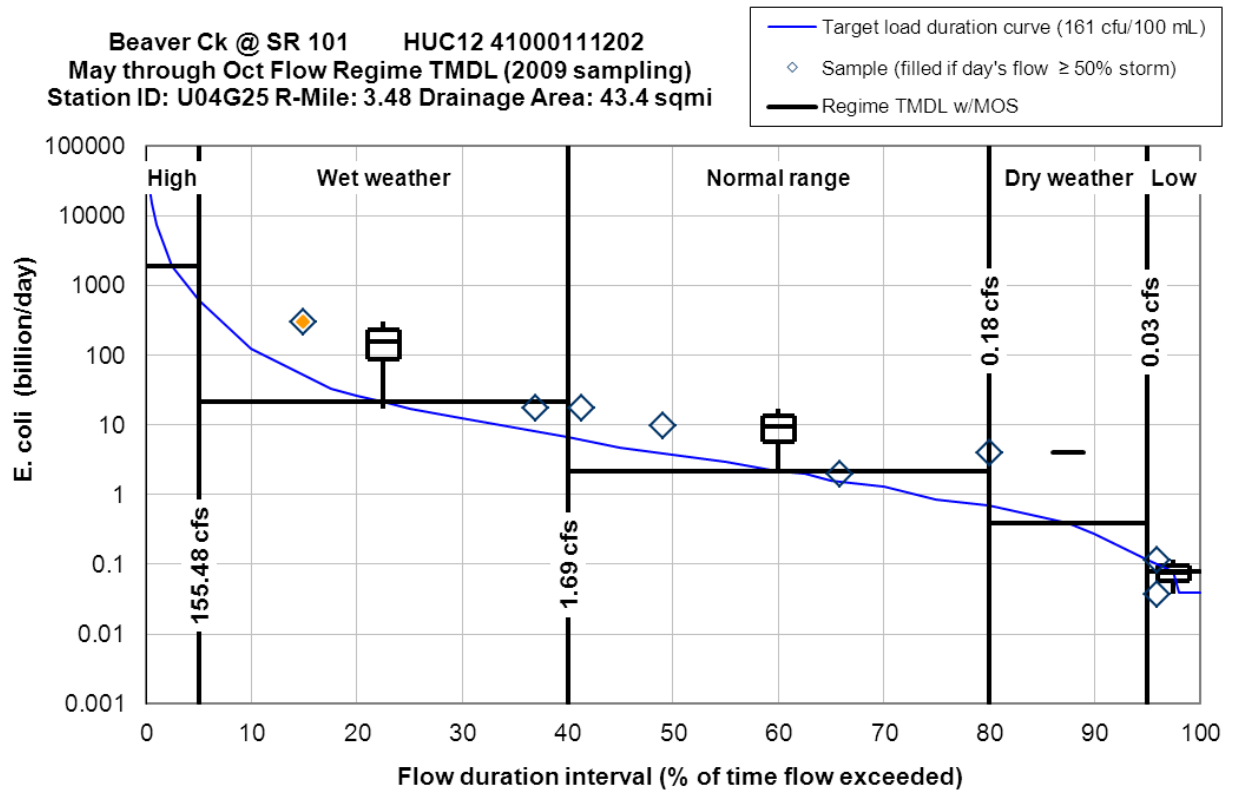


Figure M-13. Load duration curve for site on Beaver Creek at SR 101.

Table M-19. TMDL table for site on Beaver Creek at SR 101.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
Samples Per Regime		2	3	1	2
Median Sample load		159	9.57	3.99	0.08
Total Load Reduction Required	No Data	89.1%	82.1%	92.2%	18.7%
Total Maximum Daily Load	1935.26	21.90	2.17	0.39	0.08
Margin of Safety: 20%	387.05	4.38	0.43	0.08	0.02
Allowance for future growth: 1%	19.35	0.22	0.02	0.00	0.00
Load Allocation	1528.80	17.24	1.65	0.25	0.00
Wasteload Allocation Total	0.06	0.06	0.06	0.06	0.06
MS4	0.00	0.00	0.00	0.00	0.00
Leafy Oaks RV Park 2PR00147	0.06	0.06	0.06	0.06	0.06

## M-4.2. Lower Sandusky River Public Recreation Results

A summary of the bacteria TMDLs, wasteload allocation, load allocation, margin of safety, and allowance for future growth at each hydrologic condition is presented in Table M-20 below.

**Table M-20. Lower Sandusky River TMDL summary table (E. coli loads in billions of organisms per day).**

Hydrologic Condition	High flows	Wet weather	Normal range	Dry weather	Low flows
Flow Duration Interval	0-5%	5-40%	40-80%	80-95%	95-100%
<b>M. Br. E. Br. Wolf Creek @ CR 26</b> <b>HUC12: 04100011 10 01</b>					
Total Maximum Daily Load	178.95	11.23	3.23	1.69	1.10
Wasteload Allocation	3.82	0.24	0.07	0.04	0.02
Load Allocation	137.55	8.63	2.48	1.30	0.85
Margin of Safety	35.79	2.25	0.65	0.34	0.22
Allowance for future growth	1.79	0.11	0.03	0.02	0.01
Total load reduction required	No Data	87.5%	72.3%	59.7%	No Data
<b>E. Br. Wolf Creek @ TR 132</b> <b>HUC12: 04100011 10 02</b>					
Total Maximum Daily Load	522.66	32.77	9.45	4.96	3.19
Wasteload Allocation	5.66	1.02	0.80	0.75	0.74
Load Allocation	407.24	24.87	6.67	3.17	1.78
Margin of Safety	104.53	6.55	1.89	0.99	0.64
Allowance for future growth	5.23	0.33	0.09	0.05	0.03
Total load reduction required	No Data	87.8%	50.4%	48.8%	No Data
<b>E. Br. Wolf Creek @ TR 150</b> <b>HUC12: 04100011 10 03</b>					
Total Maximum Daily Load	599.47	66.81	17.84	7.29	3.82
Wasteload Allocation	16.38	2.49	1.22	0.94	0.85
Load Allocation	457.21	50.28	12.88	4.82	2.17
Margin of Safety	119.89	13.36	3.57	1.46	0.76
Allowance for future growth	5.99	0.67	0.18	0.07	0.04
Total load reduction required	No Data	83.9%	65.9%	49.3%	No Data
<b>Wolf Creek @ Twp Line Rd. (72B/728)</b> <b>HUC12: 04100011 10 04</b>					
Total Maximum Daily Load	245.75	56.94	16.00	8.32	5.33
Wasteload Allocation	8.68	3.02	1.79	1.56	1.47
Load Allocation	185.46	41.96	10.85	5.02	2.75
Margin of Safety	49.15	11.39	3.20	1.66	1.07
Allowance for future growth	2.46	0.57	0.16	0.08	0.05
Total load reduction required	No Data	79.8%	50.1%	No Data	93.7%
<b>Muskellunge Ck @ Speildenner</b> <b>HUC12: 04100011 13 01</b>					
Total Maximum Daily Load	594.55	45.30	19.18	14.14	12.13
Wasteload Allocation	1.30	0.44	0.40	0.39	0.38
Load Allocation	468.39	35.35	14.76	10.78	9.20
Margin of Safety	118.91	9.06	3.84	2.83	2.43
Allowance for future growth	5.95	0.45	0.19	0.14	0.12
Total load reduction required	No Data	59.7%	50.3%	NA	No Data
<b>Indian Ck @ Hurdick</b> <b>HUC12: 04100011 13 02</b>					
Total Maximum Daily Load	139.06	8.94	2.74	1.54	1.08
Wasteload Allocation	0.00	0.00	0.00	0.00	0.00



Hydrologic Condition	High flows	Wet weather	Normal range	Dry weather	Low flows
Flow Duration Interval	0-5%	5-40%	40-80%	80-95%	95-100%
Load Allocation	109.86	7.06	2.17	1.22	0.85
Margin of Safety	27.81	1.79	0.55	0.31	0.22
Allowance for future growth	1.39	0.09	0.03	0.02	0.01
Total load reduction required	No Data	89.4%	95.1%	85.9%	No Data
<b>Gries Ditch @ Staff Rd. HUC12: 04100011 14 01</b>					
Total Maximum Daily Load	258.12	16.15	4.65	2.44	1.58
Wasteload Allocation	0.00	0.00	0.00	0.00	0.00
Load Allocation	203.92	12.76	3.67	1.93	1.24
Margin of Safety	51.62	3.23	0.93	0.49	0.32
Allowance for future growth	2.58	0.16	0.05	0.02	0.02
Total load reduction required	No Data	5.9%	59.8%	NA	No Data
<b>Muddy Ck @TR 55 HUC12: 04100011 14 02</b>					
Total Maximum Daily Load	708.31	55.11	24.07	18.04	15.68
Wasteload Allocation	35.71	3.20	1.65	1.35	1.24
Load Allocation	523.85	40.33	17.36	12.90	11.15
Margin of Safety	141.66	11.02	4.81	3.61	3.14
Allowance for future growth	7.08	0.55	0.24	0.18	0.16
Total load reduction required	No Data	58.9%	69.7%	32.3%	No Data
<b>Muddy Ck @ CR 153 HUC12: 04100011 14 04</b>					
Total Maximum Daily Load	1172.79	110.92	22.85	6.14	2.28
Wasteload Allocation	37.86	5.15	2.43	1.92	1.80
Load Allocation	888.65	82.48	15.62	2.94	0.01
Margin of Safety	234.56	22.18	4.57	1.23	0.46
Allowance for future growth	11.73	1.11	0.23	0.06	0.02
Total load reduction required	No Data	64.8%	80.0%	89.2%	No Data
<b>Sandusky River upst. Fremont, upst. Wolf Ck HUC12: 04100011 90 01</b>					
Total Maximum Daily Load	14149.19	1911.73	485.99	229.51	181.91
Wasteload Allocation	228.62	89.50	73.29	71.07	70.39
Load Allocation	10949.23	1420.76	310.64	158.44	111.52
Margin of Safety	2829.84	382.35	97.20	0.00	0.00
Allowance for future growth	141.49	19.12	4.86	0.00	0.00
Total load reduction required	No Data	87.3%	60.9%	No Data	No Data
<b>Sandusky River @ Fremont, State St. HUC12: 04100011 90 02</b>					
Total Maximum Daily Load	16610.13	2239.97	565.77	264.59	208.70
Wasteload Allocation	282.47	98.52	77.09	73.23	72.52
Load Allocation	12839.53	1671.06	369.87	135.79	92.35
Margin of Safety	3322.03	447.99	113.15	52.92	41.74
Allowance for future growth	166.10	22.40	5.66	2.65	2.09
Total load reduction required	No Data	89.7%	73.0%	No Data	No Data

In the sequence of figures and tables below, the load duration curve for each site (Figures D-14 through D-24) is shown followed by the TMDL table for that site. Values in table format have been adjusted for rounding.

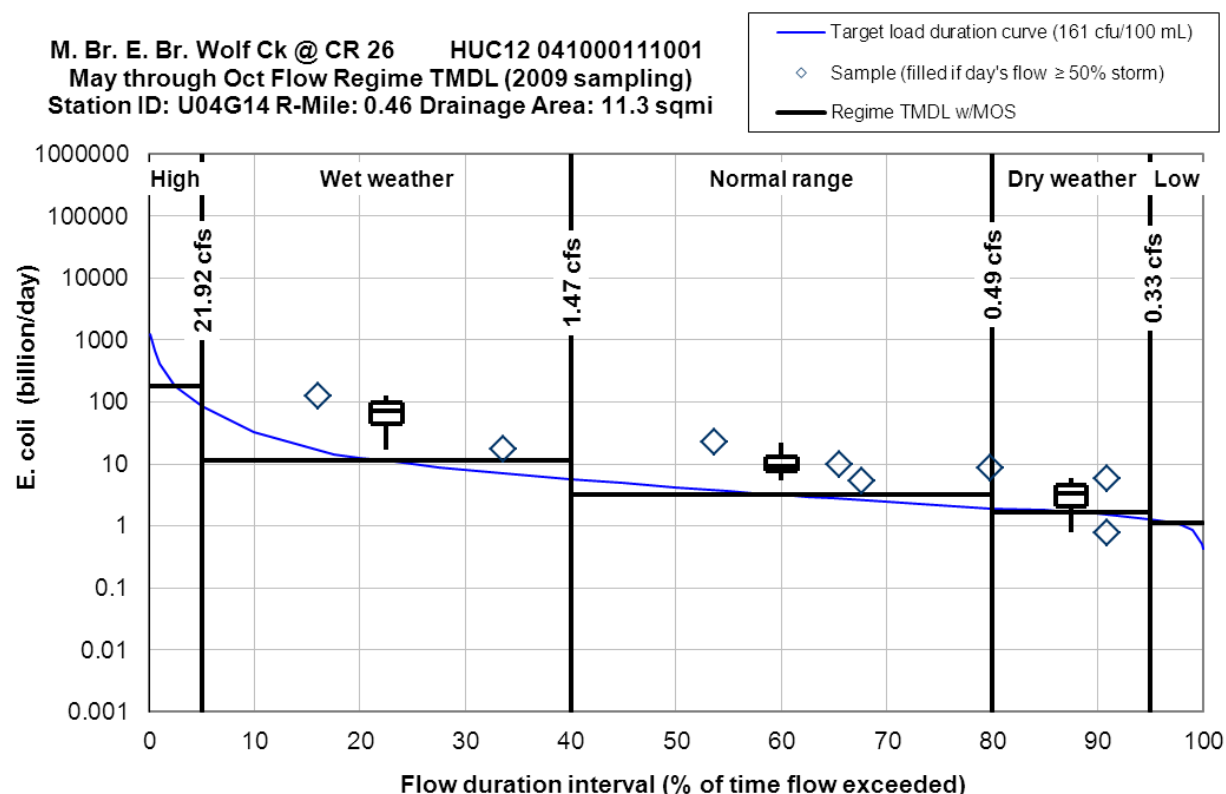


Figure M-14. Load duration curve for site on M Br E Br Wolf Creek at CR 26.

Table M-21. TMDL table for site on M Br E Br Wolf Creek at CR 26.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
<b>Samples Per Regime</b>		2	4	2	
<b>Median Sample load</b>		71	9.20	3.32	
<b>Total Load Reduction Required</b>	No Data	87.5%	72.3%	59.7%	No Data
<b>Total Maximum Daily Load</b>	178.95	11.23	3.23	1.69	1.10
<b>Margin of Safety: 20%</b>	35.79	2.25	0.65	0.34	0.22
<b>Allowance for future growth: 1%</b>	1.79	0.11	0.03	0.02	0.01
<b>Load Allocation</b>	137.55	8.63	2.48	1.30	0.85
<b>Wasteload Allocation Total</b>	3.82	0.24	0.07	0.04	0.02
<b>MS4 - Tiffin</b>	3.82	0.24	0.07	0.04	0.02

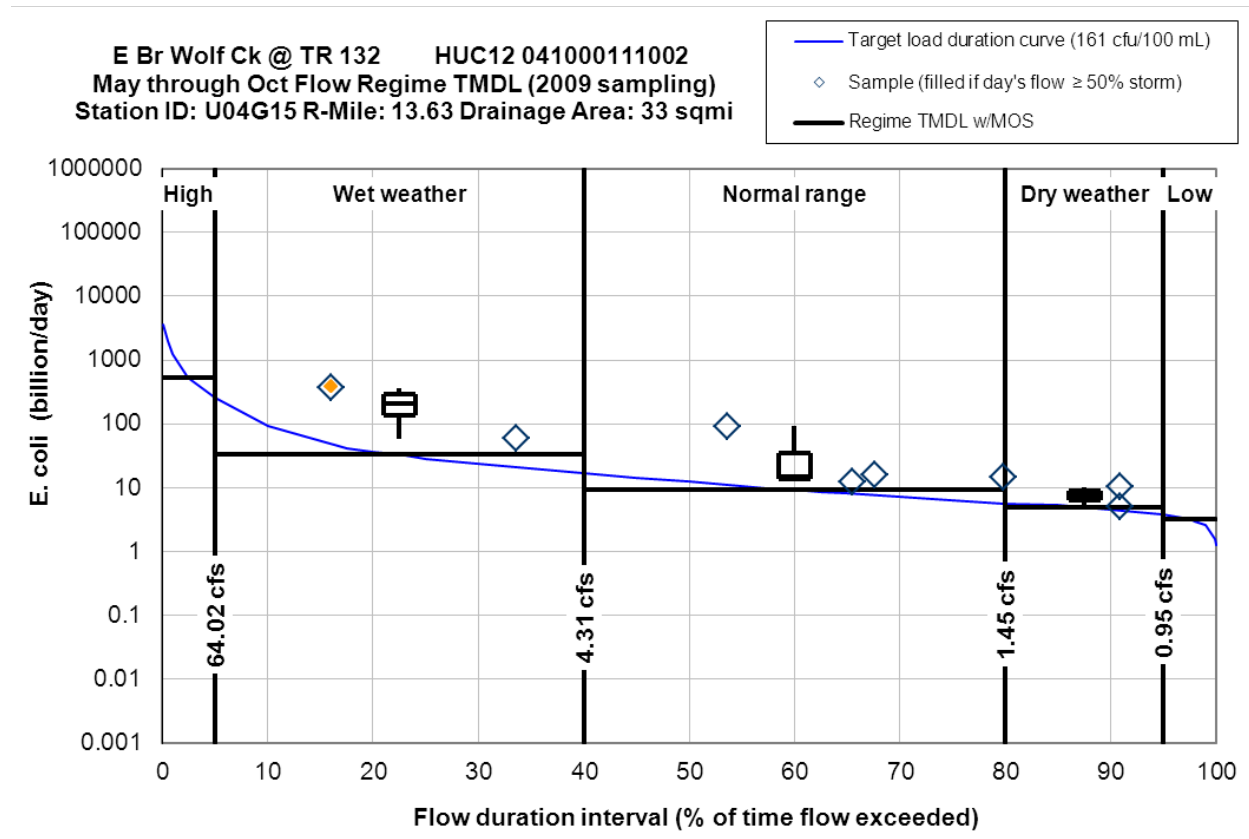


Figure M-15. Load duration curve for site on E Br Wolf Creek at TR 132.

Table M-22. TMDL table for site on E Br Wolf Creek at TR 132.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
<b>Samples Per Regime</b>		2	4	2	
<b>Median Sample load</b>		212	15.05	7.65	
<b>Total Load Reduction Required</b>	No Data	87.8%	50.4%	48.8%	No Data
<b>Total Maximum Daily Load</b>	522.66	32.77	9.45	4.96	3.19
<b>Margin of Safety: 20%</b>	104.53	6.55	1.89	0.99	0.64
<b>Allowance for future growth: 1%</b>	5.23	0.33	0.09	0.05	0.03
<b>Load Allocation</b>	407.24	24.87	6.67	3.17	1.78
<b>Wasteload Allocation Total</b>	5.66	1.02	0.80	0.75	0.74
<b>MS4 - Tiffin</b>	4.95	0.30	0.08	0.04	0.02
<b>Bascom WWTP 2PG00118</b>	0.49	0.49	0.49	0.49	0.49
<b>Snakesters 2PR00114</b>	0.01	0.01	0.01	0.01	0.01
<b>Meadowbrook Park 2PR00142</b>	0.06	0.06	0.06	0.06	0.06
<b>Hopewell Loudon School 2PT00044</b>	0.15	0.15	0.15	0.15	0.15

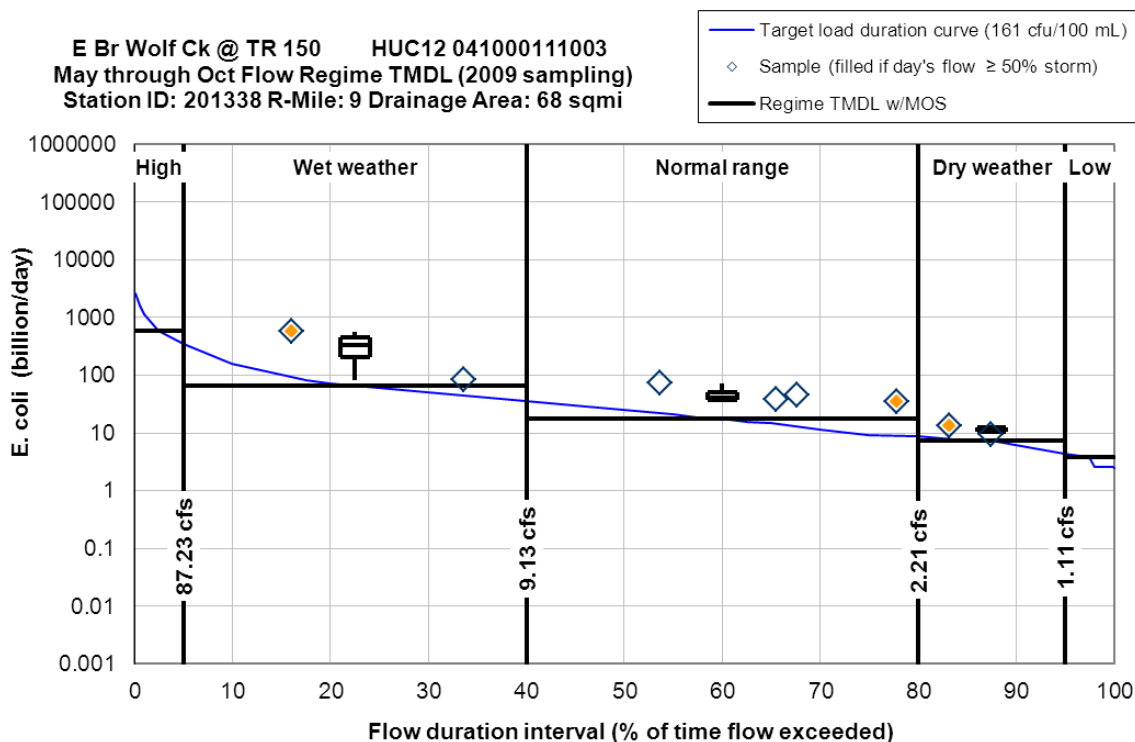


Figure M-16. Load duration curve for site on E Br Wolf Creek at TR 150.

Table M-23. TMDL table for site on E Br Wolf Creek at TR 150.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
<b>Samples Per Regime</b>		2	4	2	
<b>Median Sample load</b>		328	41.29	11.35	
<b>Total Load Reduction Required</b>	No Data	83.9%	65.9%	49.3%	No Data
<b>Total Maximum Daily Load</b>	599.47	66.81	17.84	7.29	3.82
<b>Margin of Safety: 20%</b>	119.89	13.36	3.57	1.46	0.76
<b>Allowance for future growth: 1%</b>	5.99	0.67	0.18	0.07	0.04
<b>Load Allocation</b>	457.21	50.28	12.88	4.82	2.17
<b>Wasteload Allocation Total</b>	16.38	2.49	1.22	0.94	0.85
<b>MS4 - Tiffin</b>	15.60	1.72	0.44	0.16	0.07
<b>Bascom WWTP 2PG00118</b>	0.49	0.49	0.49	0.49	0.49
<b>Snakesters 2PR00114</b>	0.01	0.01	0.01	0.01	0.01
<b>Meadowbrook Park 2PR00142</b>	0.06	0.06	0.06	0.06	0.06
<b>Hopewell Loudon School 2PT00044</b>	0.15	0.15	0.15	0.15	0.15
<b>Atlas Ind, Inc. 2IS00017</b>	0.00	0.00	0.00	0.00	0.00
<b>Buckeye Tiffin Terminal 2IN00209</b>	0.00	0.00	0.00	0.00	0.00
<b>Webster Industries, Inc. 2IS00035</b>	0.00	0.00	0.00	0.00	0.00
<b>Brook Park Estates MHP 2PY00034</b>	0.06	0.06	0.06	0.06	0.06

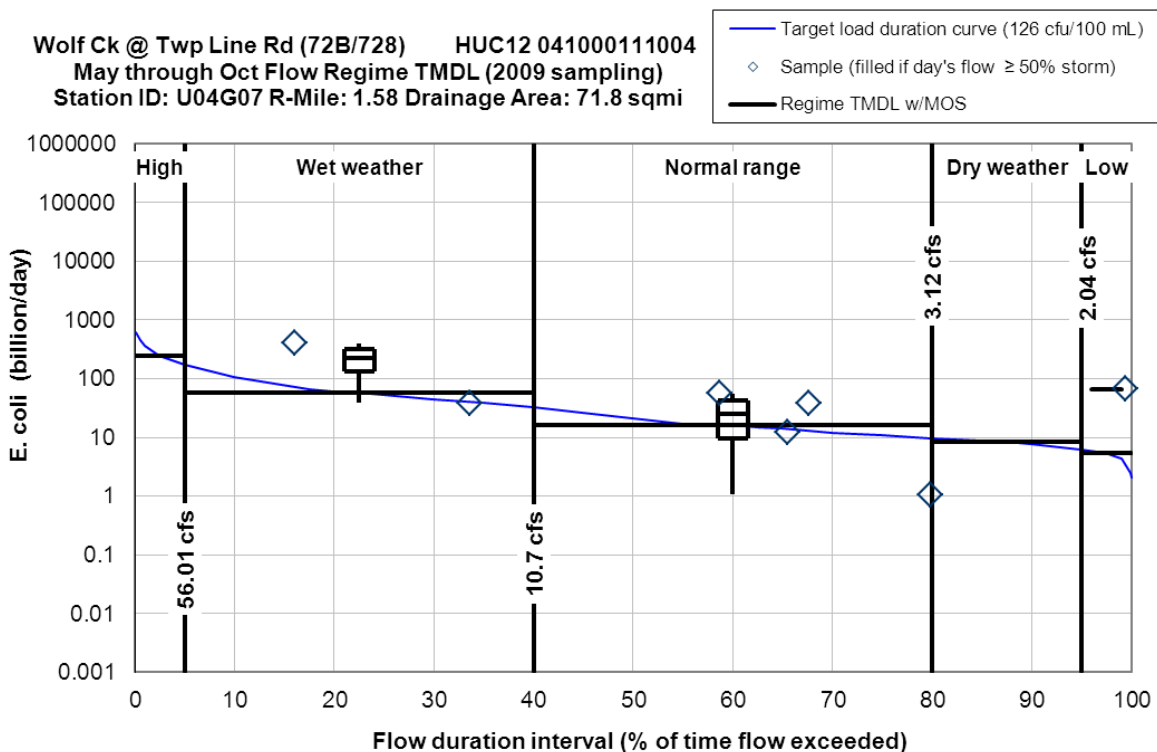


Figure M-17. Load duration curve for site on Wolf Creek at Township Line Rd.

Table M-24. TMDL table for site on Wolf Creek at Township Line Rd.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
Samples Per Regime		2	4		1
Median Sample load		223	25.33		66.83
Total Load Reduction Required	No Data	79.8%	50.1%	No Data	93.7%
Total Maximum Daily Load	245.75	56.94	16.00	8.32	5.33
Margin of Safety: 20%	49.15	11.39	3.20	1.66	1.07
Allowance for future growth: 1%	2.46	0.57	0.16	0.08	0.05
Load Allocation	185.46	41.96	10.85	5.02	2.75
Wasteload Allocation Total	8.68	3.02	1.79	1.56	1.47
MS4	7.33	1.66	0.43	0.20	0.11
Fostoria	7.13	1.61	0.42	0.19	0.11
Tiffin	0.19	0.04	0.01	0.01	0.00
Hopewell Estates MHP 2PY00006	0.10	0.10	0.10	0.10	0.10
Poplar Village 2PY00032	0.01	0.01	0.01	0.01	0.01
Hammer-Heinsman STP 2PG00011	0.18	0.18	0.18	0.18	0.18
Bettsville WWTP (Burgoon) 2PA00072	1.07	1.07	1.07	1.07	1.07
IAR Land-Fostoria 2IN00211	0.00	0.00	0.00	0.00	0.00
Sunny Farms Landfill LLC 2IN00136	0.00	0.00	0.00	0.00	0.00

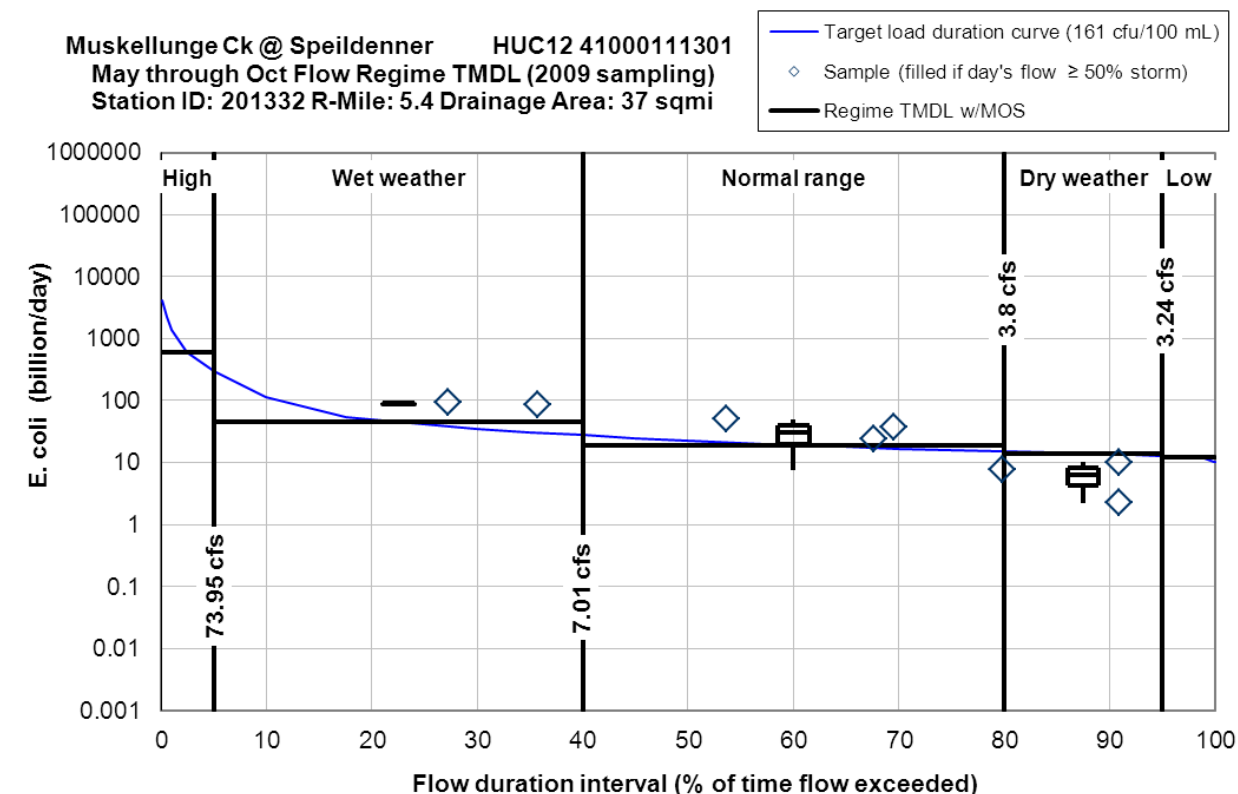


Figure M-18. Load duration curve for site on Muskellunge Creek at Speildenner.

Table M-25. TMDL table for site on Muskellunge Creek at Speildenner.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
<b>Samples Per Regime</b>		2	4	2	
<b>Median Sample load</b>		89	30.48	6.20	
<b>Total Load Reduction Required</b>	No Data	59.7%	50.3%	NA	No Data
<b>Total Maximum Daily Load</b>	594.55	45.30	19.18	14.14	12.13
<b>Margin of Safety: 20%</b>	118.91	9.06	3.84	2.83	2.43
<b>Allowance for future growth: 1%</b>	5.95	0.45	0.19	0.14	0.12
<b>Load Allocation</b>	468.39	35.35	14.76	10.78	9.20
<b>Wasteload Allocation Total</b>	1.30	0.44	0.40	0.39	0.38
<b>MS4 - Fostoria</b>	0.94	0.07	0.03	0.02	0.02
<b>Adam's Acres Sub. 2PG00082</b>	0.21	0.21	0.21	0.21	0.21
<b>Sycamore Hills Clubhouse 2PR00193</b>	0.05	0.05	0.05	0.05	0.05
<b>Brush Wellman 2IE00000</b>	0.00	0.00	0.00	0.00	0.00
<b>Poet Biorefining (Fostoria Ethanol) 2IF00026</b>	0.00	0.00	0.00	0.00	0.00
<b>Westwood Acres Sub. 2PG00023</b>	0.11	0.11	0.11	0.11	0.11
<b>Precision Aggregates 2IJ00094</b>	0.00	0.00	0.00	0.00	0.00

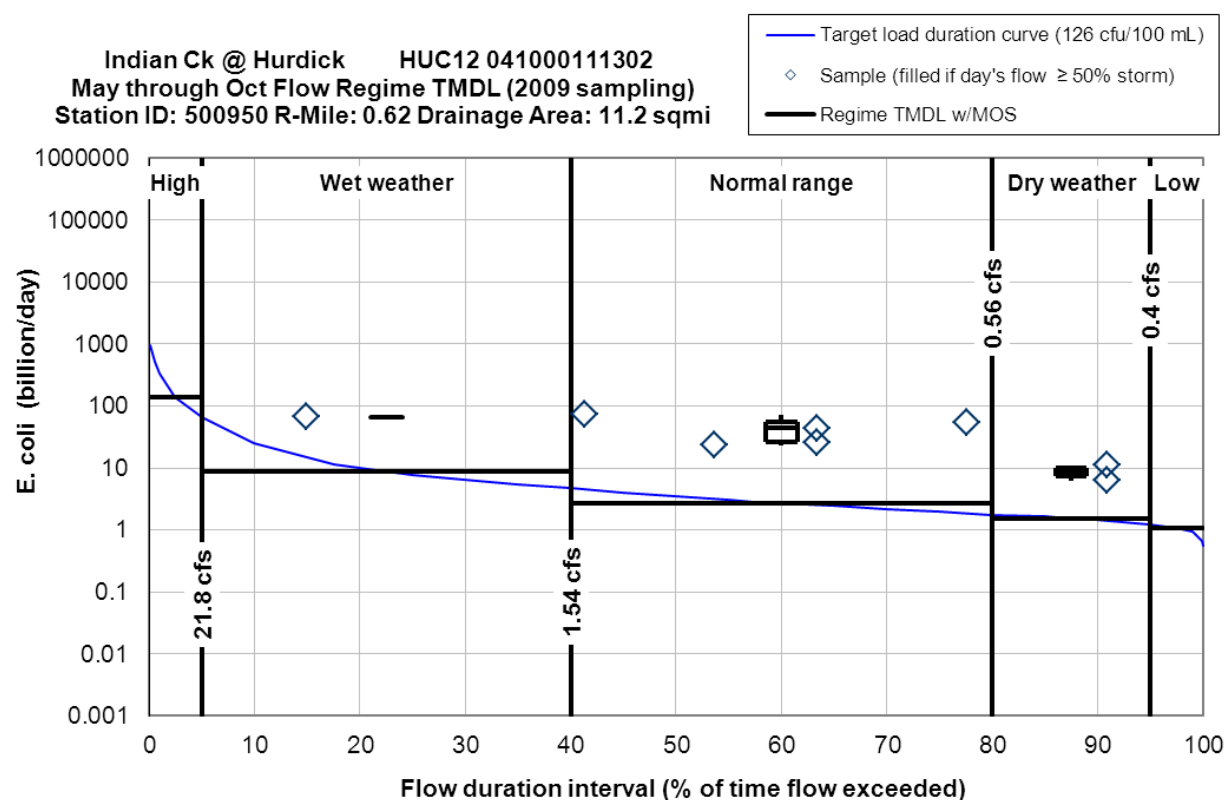


Figure M-19. Load duration curve for site on Indian Creek at Hurdick.

Table M-26. TMDL table for site on Indian Creek at Hurdick.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
Samples Per Regime		1	5	2	
Median Sample load		66	44.08	8.66	
Total Load Reduction Required	No Data	89.4%	95.1%	85.9%	No Data
Total Maximum Daily Load	139.06	8.94	2.74	1.54	1.08
Margin of Safety: 20%	27.81	1.79	0.55	0.31	0.22
Allowance for future growth: 1%	1.39	0.09	0.03	0.02	0.01
Load Allocation	109.86	7.06	2.17	1.22	0.85
Wasteload Allocation Total	0.00	0.00	0.00	0.00	0.00
MS4	0.00	0.00	0.00	0.00	0.00
Church & Dwight Co. 2IE00011	0.00	0.00	0.00	0.00	0.00

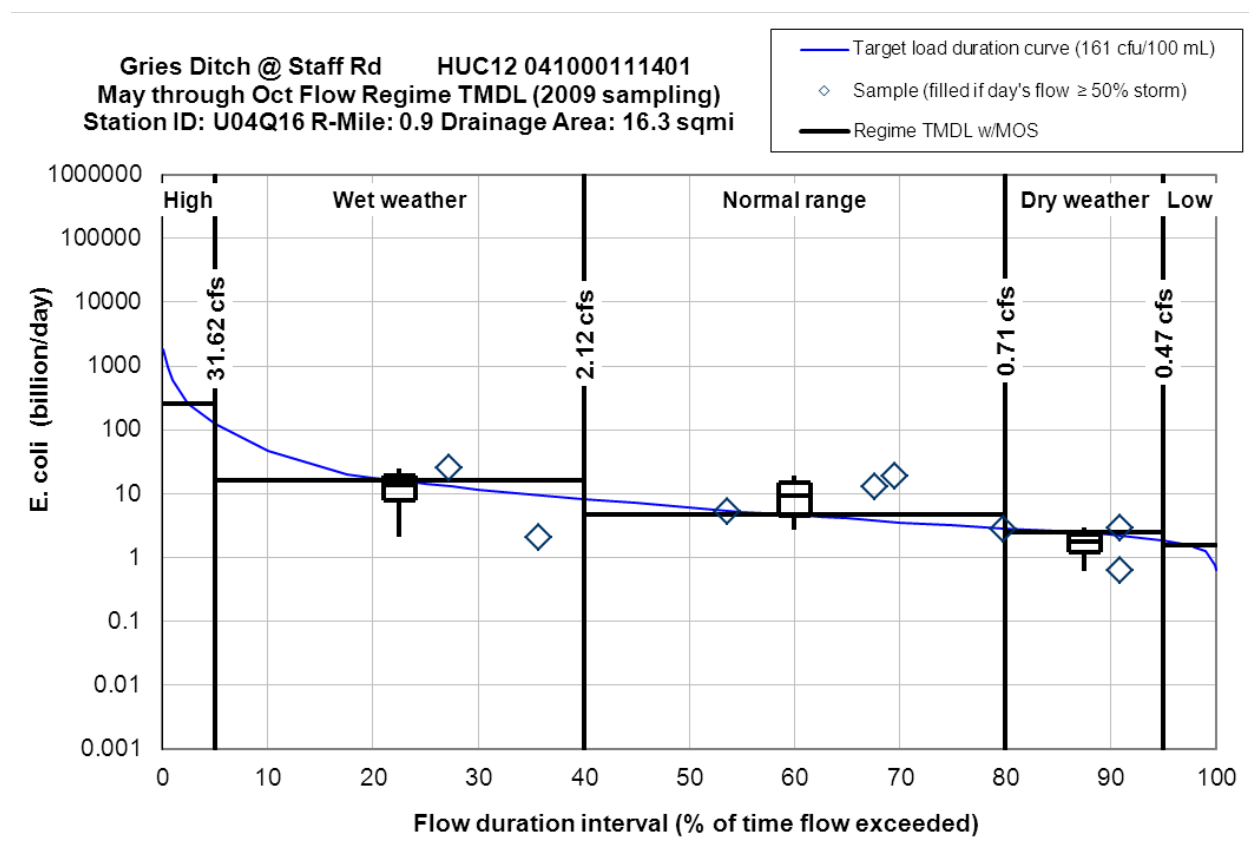


Figure M-20. Load duration curve for site on Gries Ditch at Staff Rd.

Table M-27. TMDL table for site on Gries Ditch at Staff Rd.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
<b>Samples Per Regime</b>		2	4	2	
<b>Median Sample load</b>		14	9.13	1.76	
<b>Total Load Reduction Required</b>	No Data	5.9%	59.8%	NA	No Data
<b>Total Maximum Daily Load</b>	258.12	16.15	4.65	2.44	1.58
<b>Margin of Safety: 20%</b>	51.62	3.23	0.93	0.49	0.32
<b>Allowance for future growth: 1%</b>	2.58	0.16	0.05	0.02	0.02
<b>Load Allocation</b>	203.92	12.76	3.67	1.93	1.24
<b>Wasteload Allocation Total</b>	0.00	0.00	0.00	0.00	0.00
<b>MS4</b>	0.00	0.00	0.00	0.00	0.00



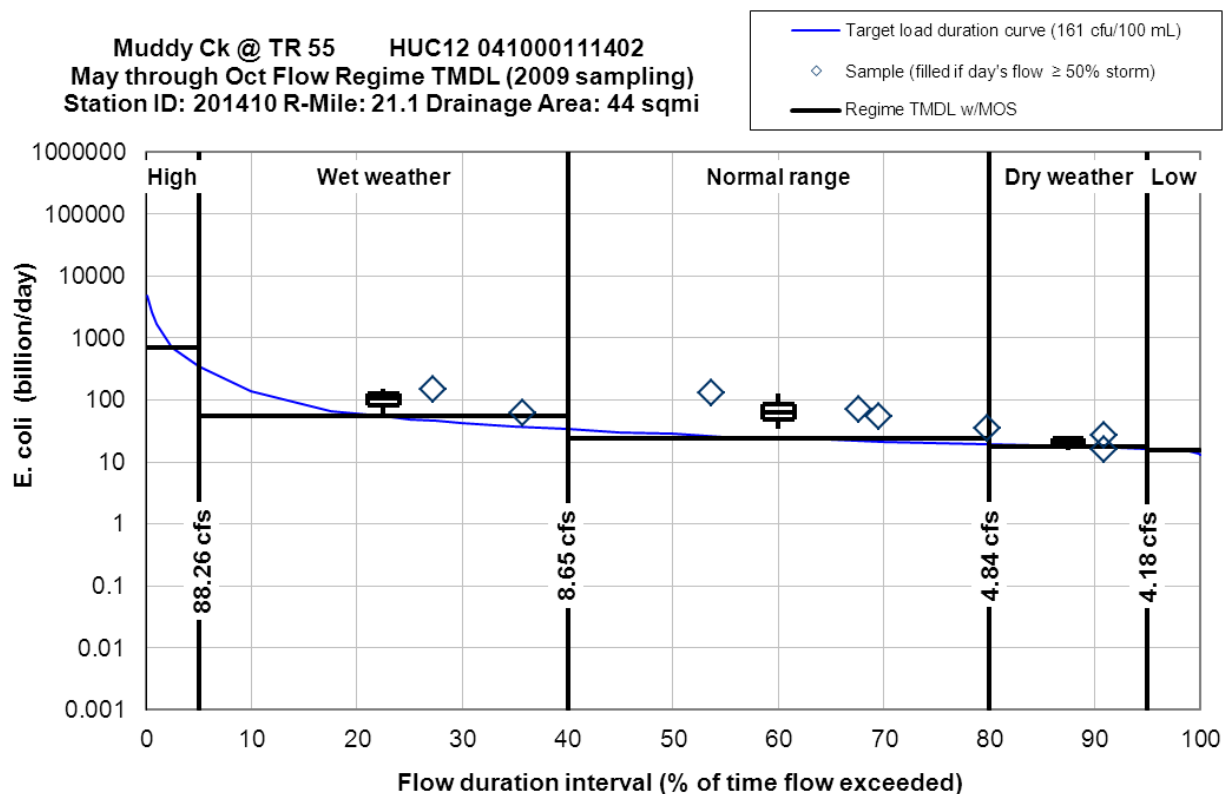


Figure M-21. Load duration curve for site on Muddy Creek at TR 55.

Table M-28. TMDL table for site on Muddy Creek at TR 55.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
<b>Samples Per Regime</b>		2	4	2	
<b>Median Sample load</b>		106	62.71	21.05	
<b>Total Load Reduction Required</b>	No Data	58.9%	69.7%	32.3%	No Data
<b>Total Maximum Daily Load</b>	708.31	55.11	24.07	18.04	15.68
<b>Margin of Safety: 20%</b>	141.66	11.02	4.81	3.61	3.14
<b>Allowance for future growth: 1%</b>	7.08	0.55	0.24	0.18	0.16
<b>Load Allocation</b>	523.85	40.33	17.36	12.90	11.15
<b>Wasteload Allocation Total</b>	35.71	3.20	1.65	1.35	1.24
<b>MS4 - Fostoria</b>	35.22	2.71	1.17	0.87	0.75
<b>Fostoria MHP 2PY00055</b>	0.12	0.12	0.12	0.12	0.12
<b>Helena Migrant Head Start 2PT00032</b>	0.00	0.00	0.00	0.00	0.00
<b>Lakota High School 2PT00053</b>	0.12	0.12	0.12	0.12	0.12
<b>Carmeuse Lime, Inc 2IJ00032</b>	0.00	0.00	0.00	0.00	0.00
<b>Helena WWTP 2PA00097</b>	0.24	0.24	0.24	0.24	0.24

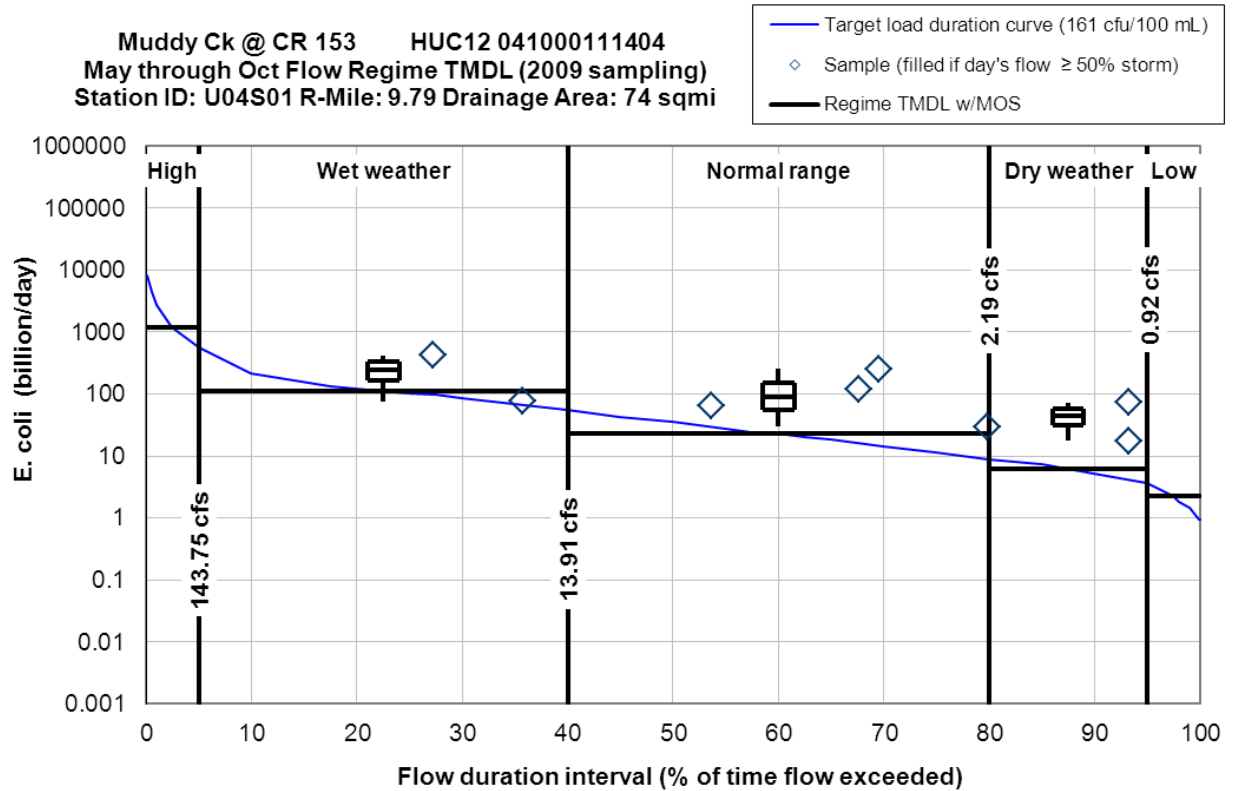


Figure M-22. Load duration curve for site on Muddy Creek at CR 153.

Table M-29. TMDL table for site on Muddy Creek at CR 153.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
<b>Samples Per Regime</b>		2	4	2	
<b>Median Sample load</b>		249	90.43	45.12	
<b>Total Load Reduction Required</b>	No Data	64.8%	80.0%	89.2%	No Data
<b>Total Maximum Daily Load</b>	1172.79	110.92	22.85	6.14	2.28
<b>Margin of Safety: 20%</b>	234.56	22.18	4.57	1.23	0.46
<b>Allowance for future growth: 1%</b>	11.73	1.11	0.23	0.06	0.02
<b>Load Allocation</b>	888.65	82.48	15.62	2.94	0.01
<b>Wasteload Allocation Total</b>	37.86	5.15	2.43	1.92	1.80
<b>MS4 - Fostoria</b>	36.06	3.35	0.63	0.12	0.00
<b>Lindsey WWTP 2PA00024</b>	1.31	1.31	1.31	1.31	1.31
<b>Fostoria MHP 2PY00055</b>	0.12	0.12	0.12	0.12	0.12
<b>Helena Migrant Head Start 2PT00032</b>	0.00	0.00	0.00	0.00	0.00
<b>Lakota High School 2PT00053</b>	0.12	0.12	0.12	0.12	0.12
<b>Carmeuse Lime, Inc 2IJ00032</b>	0.00	0.00	0.00	0.00	0.00
<b>Helena WWTP 2PA00097</b>	0.24	0.24	0.24	0.24	0.24

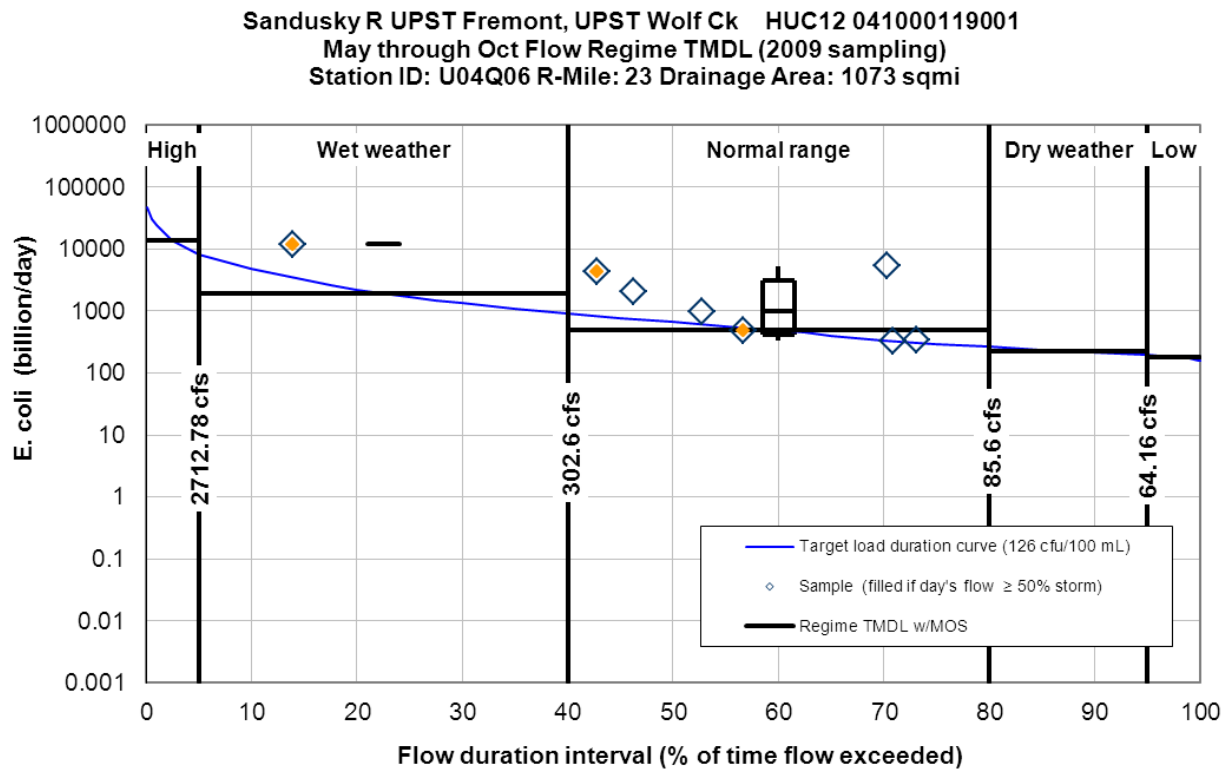


Figure M-23. Load duration curve for site on Sandusky River upstream of Fremont.

Table M-30. TMDL table for site on Sandusky River upstream of Fremont.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95- 100%
<b>Samples Per Regime</b>		1	7		
<b>Median Sample load</b>		11931	981.19		
<b>Total Load Reduction Required</b>	No Data	87.3%	60.9%	No Data	No Data
<b>Total Maximum Daily Load</b>	14149.19	1911.73	485.99	229.51	181.91
<b>Margin of Safety: 20%</b>	2829.84	382.35	97.20	0.00	0.00
<b>Allowance for future growth: 1%</b>	141.49	19.12	4.86	0.00	0.00
<b>Load Allocation</b>	10949.23	1420.76	310.64	158.44	111.52
<b>Wasteload Allocation Total</b>	228.62	89.50	73.29	71.07	70.39
<b>MS4</b>	159.87	20.74	4.54	2.31	1.63
<b>Tiffin</b>	73.98	9.60	2.10	1.07	0.75
<b>Bucyrus</b>	46.51	6.04	1.32	0.67	0.47
<b>Galion</b>	39.38	5.11	1.12	0.57	0.40
<b>The Timken Co Bucyrus Bearing Plant 2IC00046</b>	0.00	0.00	0.00	0.00	0.00
<b>Pittsburgh Glass Works LLC 2IE00004</b>	0.91	0.91	0.91	0.91	0.91

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95- 100%
Church and Dwight Co Inc 2IE00011	0.00	0.00	0.00	0.00	0.00
The Andersons Inc Crestline Ethanol Facility 2IF00024	0.00	0.00	0.00	0.00	0.00
Concerted Manufacturing of Nevada, Ohio LLC 2IH00088	0.98	0.98	0.98	0.98	0.98
New Eezy Gro Inc 2II00109	0.00	0.00	0.00	0.00	0.00
National Lime & Stone Co Carey Plant 2IJ00008	0.00	0.00	0.00	0.00	0.00
Hanson Aggregates Midwest Inc Bloomville Stone Plant 2IJ00016	0.00	0.00	0.00	0.00	0.00
National Lime and Stone Co - Bucyrus Plant 2IJ00020	0.00	0.00	0.00	0.00	0.00
Shelly Materials Tri-Co Quarry 2IJ00045	0.00	0.00	0.00	0.00	0.00
The Olen Corporation Plt No 6 2IJ00067	0.00	0.00	0.00	0.00	0.00
Wyandot Dolomite Inc Carey Plant 2IJ00068	0.00	0.00	0.00	0.00	0.00
Kalmbach Feeds Inc 2IN00110	0.00	0.00	0.00	0.00	0.00
County Environmental of Wyandot Landfill 2IN00121	0.00	0.00	0.00	0.00	0.00
Crawford County Sanitary Landfill 2IN00127	0.00	0.00	0.00	0.00	0.00
BP Amoco Oil Corp Bulk Plant Upper Sandusky 2IN00169	0.00	0.00	0.00	0.00	0.00
BP Amoco Oil Corp Bulk Plant Bucyrus 2IN00172	0.00	0.00	0.00	0.00	0.00
Beck Suppliers Attica Bulk Plant 2IN00188	0.00	0.00	0.00	0.00	0.00
PSD Partners LLC - MPK Complex 2IN00223	0.00	0.00	0.00	0.00	0.00
Tiffin Landfill 2IN00227	0.00	0.00	0.00	0.00	0.00
National Machinery LLC 2IS00009	0.00	0.00	0.00	0.00	0.00
Sycamore WTP 2IV00102	0.00	0.00	0.00	0.00	0.00
Attica WTP No 2 2IV00113	0.00	0.00	0.00	0.00	0.00
Upper Sandusky WTP No 2 2IV00120	0.00	0.00	0.00	0.00	0.00
Bucyrus WTP 2IW00020	0.00	0.00	0.00	0.00	0.00
Ohio American Water Co Tiffin Facility 2IW00235	0.00	0.00	0.00	0.00	0.00
Nevada STP 2PA00070	0.55	0.55	0.55	0.55	0.55
Republic WWTP 2PA00087	0.73	0.73	0.73	0.73	0.73
Sycamore WWTP 2PB00000	0.76	0.76	0.76	0.76	0.76
Attica STP 2PB00001	1.22	1.22	1.22	1.22	1.22
Bloomville WWTP 2PB00053	0.79	0.79	0.79	0.79	0.79
New Washington WWTP 2PB00060	0.91	0.91	0.91	0.91	0.91
Crestline WWTP 2PC00006	5.79	5.79	5.79	5.79	5.79
Bucyrus WWTP 2PD00021	20.72	20.72	20.72	20.72	20.72
Tiffin WWTP 2PD00025	19.08	19.08	19.08	19.08	19.08
Carey WWTP 2PD00038	5.55	5.55	5.55	5.55	5.55
Upper Sandusky WWTP 2PD00039	9.54	9.54	9.54	9.54	9.54
Bumford Road WWTP SD 6A 2PG00030	0.04	0.04	0.04	0.04	0.04
Linlare SSD No 2 2PG00089	0.15	0.15	0.15	0.15	0.15

<b>TMDL and duration intervals</b>	<b>High 0-5%</b>	<b>Wet weather 5-40%</b>	<b>Normal range 40-80%</b>	<b>Dry weather 80-95%</b>	<b>Low 95- 100%</b>
<b>Morton Subdiv WWTP 2PG00115</b>	0.06	0.06	0.06	0.06	0.06
<b>ODOT Dist 1 Park No 1-29 2PP00020</b>	0.04	0.04	0.04	0.04	0.04
<b>ODOT Dist 1 Park No 1-30 2PP00021</b>	0.04	0.04	0.04	0.04	0.04
<b>ODOT Rest Area US Rte 30 2PP00048</b>	0.12	0.12	0.12	0.12	0.12
<b>Honey Creek Village 2PR00107</b>	0.24	0.24	0.24	0.24	0.24
<b>Alloway Melmore Laboratory 2PR00177</b>	0.01	0.01	0.01	0.01	0.01
<b>Foxfire Family Fun Park 2PR00201</b>	0.05	0.05	0.05	0.05	0.05
<b>Camp Glen 2PR00215</b>	0.02	0.02	0.02	0.02	0.02
<b>Rocky's Truck and Trailer Service 2PR00225</b>	0.01	0.01	0.01	0.01	0.01
<b>Tee Pee Campground 2PR00241</b>	0.03	0.03	0.03	0.03	0.03
<b>Island View Campground 2PR00251</b>	0.02	0.02	0.02	0.02	0.02
<b>Northwest Ohio Christian Youth Camp 2PR00261</b>	0.05	0.05	0.05	0.05	0.05
<b>Richmond Elementary School 2PT00012</b>	0.02	0.02	0.02	0.02	0.02
<b>Mohawk High School 2PT00014</b>	0.11	0.11	0.11	0.11	0.11
<b>Sentinel Vocational Center 2PT00017</b>	0.06	0.06	0.06	0.06	0.06
<b>Wynford HS &amp; Elem Sch 2PT00028</b>	0.15	0.15	0.15	0.15	0.15

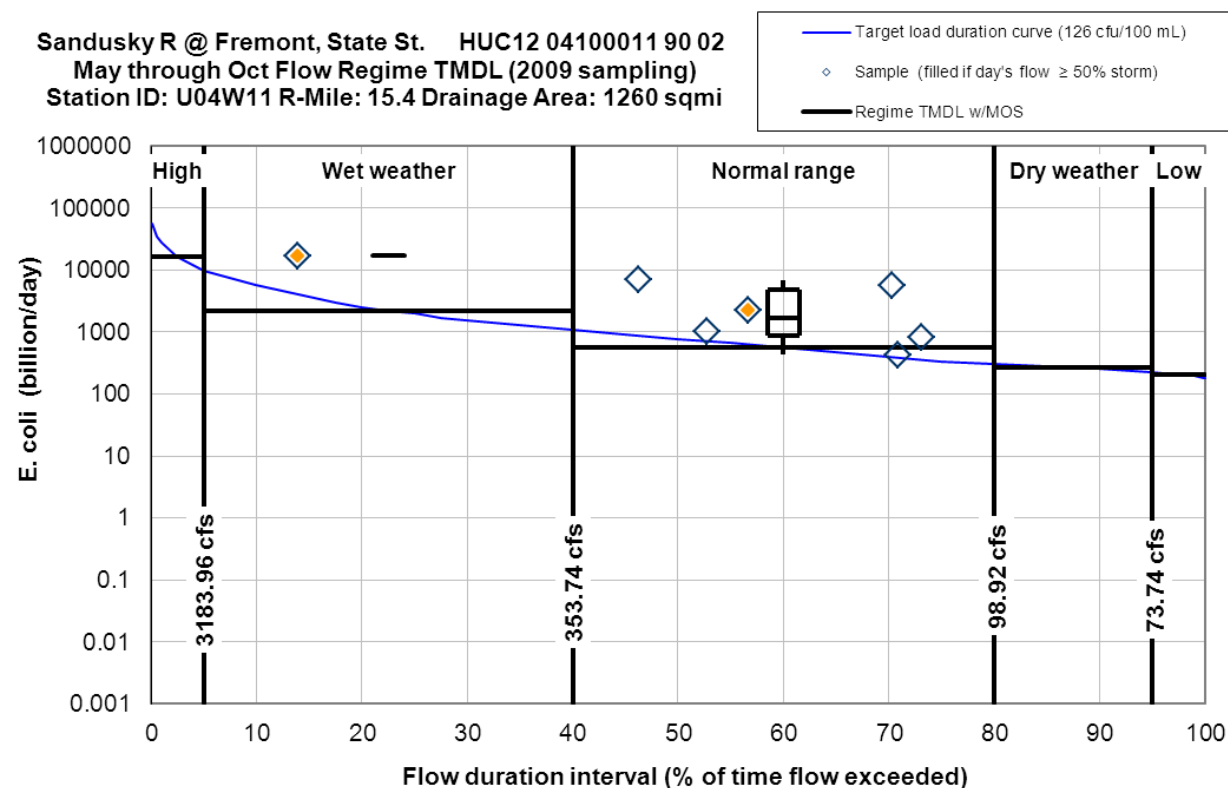


Figure M-24. Load duration curve for site on Sandusky River at Fremont.

Table M-31. TMDL table for site on Sandusky River at Fremont.

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
<b>Samples Per Regime</b>		1	6		
<b>Median Sample load</b>		17155	1654.39		
<b>Total Load Reduction Required</b>	No Data	89.7%	73.0%	No Data	No Data
<b>Total Maximum Daily Load</b>	16610.13	2239.97	565.77	264.59	208.70
<b>Margin of Safety: 20%</b>	3322.03	447.99	113.15	52.92	41.74
<b>Allowance for future growth: 1%</b>	166.10	22.40	5.66	2.65	2.09
<b>Load Allocation</b>	12839.53	1671.06	369.87	135.79	92.35
<b>Wasteload Allocation Total</b>	282.47	98.52	77.09	73.23	72.52
<b>MS4</b>	208.82	27.18	6.02	2.21	1.50
<b>Fostoria</b>	27.94	3.64	0.80	0.30	0.20
<b>Tiffin</b>	97.77	12.72	2.82	1.03	0.70
<b>Bucyrus</b>	46.44	6.04	1.34	0.49	0.33
<b>Galion</b>	39.32	5.12	1.13	0.42	0.28
<b>The Timken Co Bucyrus Bearing Plant 2IC00046</b>	0.00	0.00	0.00	0.00	0.00

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
Pittsburgh Glass Works LLC 2IE00004	0.91	0.91	0.91	0.91	0.91
Church and Dwight Co Inc 2IE00011	0.00	0.00	0.00	0.00	0.00
The Andersons Inc Crestline Ethanol Facility 2IF00024	0.00	0.00	0.00	0.00	0.00
Concerted Mfg of Nevada Ohio LLC 2IH00088	0.98	0.98	0.98	0.98	0.98
New Eezy Gro Inc 2II00109	0.00	0.00	0.00	0.00	0.00
National Lime & Stone Co Carey Plant 2IJ00008	0.00	0.00	0.00	0.00	0.00
Hanson Aggregates Midwest Inc Bloomville Stone Plant 2IJ00016	0.00	0.00	0.00	0.00	0.00
National Lime & Stone Co 2IJ00020	0.00	0.00	0.00	0.00	0.00
Shelly Materials Inc - Tri-County Quarry 2IJ00045	0.00	0.00	0.00	0.00	0.00
The Olen Corporation 2IJ00067	0.00	0.00	0.00	0.00	0.00
Wyandot Dolomite Inc Carey Plant 2IJ00068	0.00	0.00	0.00	0.00	0.00
MGQ Inc 2IJ00099	0.00	0.00	0.00	0.00	0.00
Carmeuse Lime Inc Maple Grove 2IN00051	0.00	0.00	0.00	0.00	0.00
Culligan Water Conditioning-Fremont 2IN00084	0.00	0.00	0.00	0.00	0.00
Kalmbach Feeds Inc 2IN00110	0.00	0.00	0.00	0.00	0.00
County Environmental of Wyandot Landfill 2IN00121	0.00	0.00	0.00	0.00	0.00
Crawford County Sanitary Landfill 2IN00127	0.00	0.00	0.00	0.00	0.00
Sunny Farms Landfill LLC 2IN00136	0.00	0.00	0.00	0.00	0.00
Automated Petroleum Upper Sandusky Bulk Plant 2IN00169	0.00	0.00	0.00	0.00	0.00
Central Ohio Farmer's Co-Op (Bucyrus Bulk Plant) 2IN00172	0.00	0.00	0.00	0.00	0.00
Beck Suppliers Attica Bulk Plant 2IN00188	0.00	0.00	0.00	0.00	0.00
Buckeye Terminals LLC - Buckeye Tiffin Terminal 2IN00209	0.00	0.00	0.00	0.00	0.00
IAR Land-Fostoria LLC 2IN00211	0.00	0.00	0.00	0.00	0.00
PSD Partners LLC - MPK Complex 2IN00223	0.00	0.00	0.00	0.00	0.00
Tiffin Landfill 2IN00227	0.00	0.00	0.00	0.00	0.00
National Machinery LLC 2IS00009	0.00	0.00	0.00	0.00	0.00
Atlas Ind Inc 2IS00017	0.00	0.00	0.00	0.00	0.00
Webster Industries Inc 2IS00035	0.00	0.00	0.00	0.00	0.00
Sycamore WTP 2IV00102	0.00	0.00	0.00	0.00	0.00
Attica WTP No 2 2IV00113	0.00	0.00	0.00	0.00	0.00
Upper Sandusky WTP No 2 2IV00120	0.00	0.00	0.00	0.00	0.00
Bucyrus WTP 2IW00020	0.00	0.00	0.00	0.00	0.00
Aqua Ohio Water Co - Tiffin WTP 2IW00235	0.00	0.00	0.00	0.00	0.00
Nevada WWTP 2PA00070	0.55	0.55	0.55	0.55	0.55
Bettsville WWTP 2PA00072	1.07	1.07	1.07	1.07	1.07
Republic WWTP 2PA00087	0.73	0.73	0.73	0.73	0.73
Sycamore WWTP 2PB00000	0.76	0.76	0.76	0.76	0.76

<b>TMDL and duration intervals</b>	<b>High 0-5%</b>	<b>Wet weather 5-40%</b>	<b>Normal range 40-80%</b>	<b>Dry weather 80-95%</b>	<b>Low 95-100%</b>
<b>Attica STP 2PB00001</b>	1.22	1.22	1.22	1.22	1.22
<b>Bloomville WWTP 2PB00053</b>	0.79	0.79	0.79	0.79	0.79
<b>New Washington WWTP 2PB00060</b>	0.91	0.91	0.91	0.91	0.91
<b>Crestline WWTP 2PC00006</b>	5.79	5.79	5.79	5.79	5.79
<b>Bucyrus WWTP 2PD00021</b>	20.72	20.72	20.72	20.72	20.72
<b>Tiffin WWTP 2PD00025</b>	19.08	19.08	19.08	19.08	19.08
<b>Carey WWTP 2PD00038</b>	5.55	5.55	5.55	5.55	5.55
<b>Upper Sandusky WWTP 2PD00039</b>	9.54	9.54	9.54	9.54	9.54
<b>Hammer Heinsman WWTP 2PG00011</b>	0.18	0.18	0.18	0.18	0.18
<b>Bumford Road WWTP SD 6A 2PG00030</b>	0.04	0.04	0.04	0.04	0.04
<b>Linlare SSD No 2 2PG00089</b>	0.15	0.15	0.15	0.15	0.15
<b>Morton Subdiv WWTP 2PG00115</b>	0.06	0.06	0.06	0.06	0.06
<b>Bascom WWTP 2PG00118</b>	0.49	0.49	0.49	0.49	0.49
<b>ODOT Dist 1 Park No 1-29 2PP00020</b>	0.04	0.04	0.04	0.04	0.04
<b>ODOT Dist 1 Park No 1-30 2PP00021</b>	0.04	0.04	0.04	0.04	0.04
<b>ODOT Rest Area US Rte 30 2PP00048</b>	0.12	0.12	0.12	0.12	0.12
<b>Honey Creek Village 2PR00107</b>	0.24	0.24	0.24	0.24	0.24
<b>PJ's Brickhouse 2PR00114</b>	0.01	0.01	0.01	0.01	0.01
<b>Meadowbrook Park WWTP 2PR00142</b>	0.12	0.12	0.12	0.12	0.12
<b>Sensible Solar and Wind - Melmore Facility 2PR00177</b>	0.01	0.01	0.01	0.01	0.01
<b>Foxfire Campground WWTP 2PR00201</b>	0.05	0.05	0.05	0.05	0.05
<b>Camp Glen 2PR00215</b>	0.02	0.02	0.02	0.02	0.02
<b>M &amp; D Real Estate Invest - Rocky's Truck and Trailer 2PR00225</b>	0.01	0.01	0.01	0.01	0.01
<b>Tee Pee Campground 2PR00241</b>	0.03	0.03	0.03	0.03	0.03
<b>Island View Campground 2PR00251</b>	0.02	0.02	0.02	0.02	0.02
<b>Northwest Ohio Christian Youth Camp 2PR00261</b>	0.05	0.05	0.05	0.05	0.05
<b>Richmond Elem Sch 2PT00012</b>	0.02	0.02	0.02	0.02	0.02
<b>Mohawk High School 2PT00014</b>	0.11	0.11	0.11	0.11	0.11
<b>Sentinel Vocational Center 2PT00017</b>	0.06	0.06	0.06	0.06	0.06
<b>Wynford HS &amp; Elem Sch 2PT00028</b>	0.15	0.15	0.15	0.15	0.15
<b>Hopewell Loudon School 2PT00044</b>	0.15	0.15	0.15	0.15	0.15
<b>Hopewell Estates MHP 2PY00006</b>	0.10	0.10	0.10	0.10	0.10
<b>Poplar Village MHP 2PY00032</b>	0.11	0.11	0.11	0.11	0.11



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