FINAL
Mahoning River Total Maximum Daily Load (TMDL) for Fecal Coliform Bacteria

U.S. Environmental Protection Agency Region 5
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Appendix A: Application of the Loading Simulation Program in C++ (LSPC) to the Mahoning River Watershed, Ohio . . . . . .

ACRONYMS AND ABBREVIATIONS

AL	Aquatic life
AU	Assessment unit
cfs	Cubic feet per second
cfu	Colony forming unit
CSO	Combined sewer overflow
EPA	Environmental Protection Agency
GIS	Geographic information system
IBI	Index of Biological Integrity
ICI	Invertebrate Community Index
L	Liter
LA	Load allocations
LSPC	Loading Simulation Program in C++
MIwb	Modified Index of Well-being
MOR	Monthly Operating Report
MOS	Margin of safety
mg	Milligram
NPDES	National Pollutant Discharge Elimination System
OEPA	Ohio Environmental Protection Agency
PCS	Permit Compliance System
QAPP	Quality assurance project plan
QHEI	Quality Habitat Evaluation Index
STORET	EPA Storage and Retrieval System
STP	Sewage Treatment Plant
TMDL	Total Maximum Daily Load
WLA	Wasteload allocation
WQS	Water quality standard
WWH	Warmwater habitat
WWTP	Wastewater treatment plant

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting applicable water quality standards/guidelines or designated uses under technology-based controls. TMDLs specify the maximum amount of a pollutant which a waterbody can assimilate and still meet water quality standards. Based upon a calculation of total load of a specific pollutant that can be assimilated, TMDLs allocate pollutant loads to sources and a margin of safety (MOS). This study determines allowable limits for bacteria loadings to meet water quality standards and designated uses for the Mahoning River, Ohio. Four fecal coliform TMDLs for four separate stream segments are presented in this report. Bacteria load reduction are allocated among sources and provide a scientific basis for restoring surface water quality in this waterbody. In this way, the TMDL process links the development and implementation of control actions to the attainment and maintenance of water quality standards and designated uses.

This TMDL is a variation in approach from the traditional TMDL because it has been developed by EPA, Region 5, rather than the state of Ohio. To remain in compliance with federal regulations for the development of modeling projects, this TMDL also has a Quality Assurance Project Plan (QAPP) for the Mahoning River (USEPA, 2003) that was developed in conjunction with Tetra Tech, Inc.

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2.0 IDENTIFICATION OF WATERBODY, POLLUTANT OF CONCERN, POLLUTANT SOURCES, AND PRIORITY RANKING

2.1 Identification of Waterbody

The Mahoning River is located in northeastern Ohio near the Pennsylvania-Ohio border (Figure 2-1) and the watershed drains approximately 3,000 km^2. The Mahoning River watershed has four assessment units (AUs) listed as impaired on the Ohio 2004 Section 303(d) list (Figure 2-1 and Table 2-1). All of the AUs that make up the Mahoning River watershed have been considered in this analysis to provide for continuity in the modeling and load allocations.

Land use in the watershed is a mix of agriculture, residential, and urban. The Mahoning River flows through predominantly urban land uses in Warren and Youngstown. Pathogens are the pollutant of concern for this study, although there are also metals, sediments, nutrients, and related dissolved oxygen issues.

Mahoning River near Leavittsburg, OH

Mahoning River near Niles, OH

Mahoning River in Youngstown, OH

Mahoning River near Lowellville, OH

Table 2-1. Ohio 2004 Section 303(d) listings within the Mahoning River watershed addressed by this TMDL.

Assessment Unit	Mahoning River Segment	Significant Location or WWTP	River Mile	Assessment Category
05030103 040	Eagle Creek	None	NA	5 (Impaired/ Needs TMDL)
05030103 050*	Downstream Eagle Creek to upstream Mosquito Creek	Warren	35	3 (Impaired)
05030103 070	Downstream Mosquito Creek to upstream Mill Creek	Orion Midwest Niles, Niles, McDonald Steel, Girard, North Star Steel	29 to 23	5 (Impaired/ Needs TMDL)
05030103 080	Mill Creek to Pennsylvania border	Youngstown, Campbell, Struthers, Lowellville	19 to 12	5 (Impaired/ Needs TMDL)

NA = Not Applicable

*Assessment Unit 05030103-050 is listed in Category 3 of the 2004 Ohio Integrated Report in Appendix B.1.1 and is described as not including the Mahoning River mainstem, but AU -050 is included in the assessment. AU -050 is included both for continuity of modeling and because the Large River AU 05030103-001 in Appendix B.1.2, from Eagle Creek to the Pennsylvania border, is listed in Category 5 and is partially located in segment -050.

The purpose of this TMDL is to evaluate load reduction scenarios that will allow the pathogen water quality targets to be met. It is important to note that this TMDL does not address the issue of whether the Mahoning River achieves criteria for Warmwater Habitat (WWH), although this is also recognized to be an important issue.

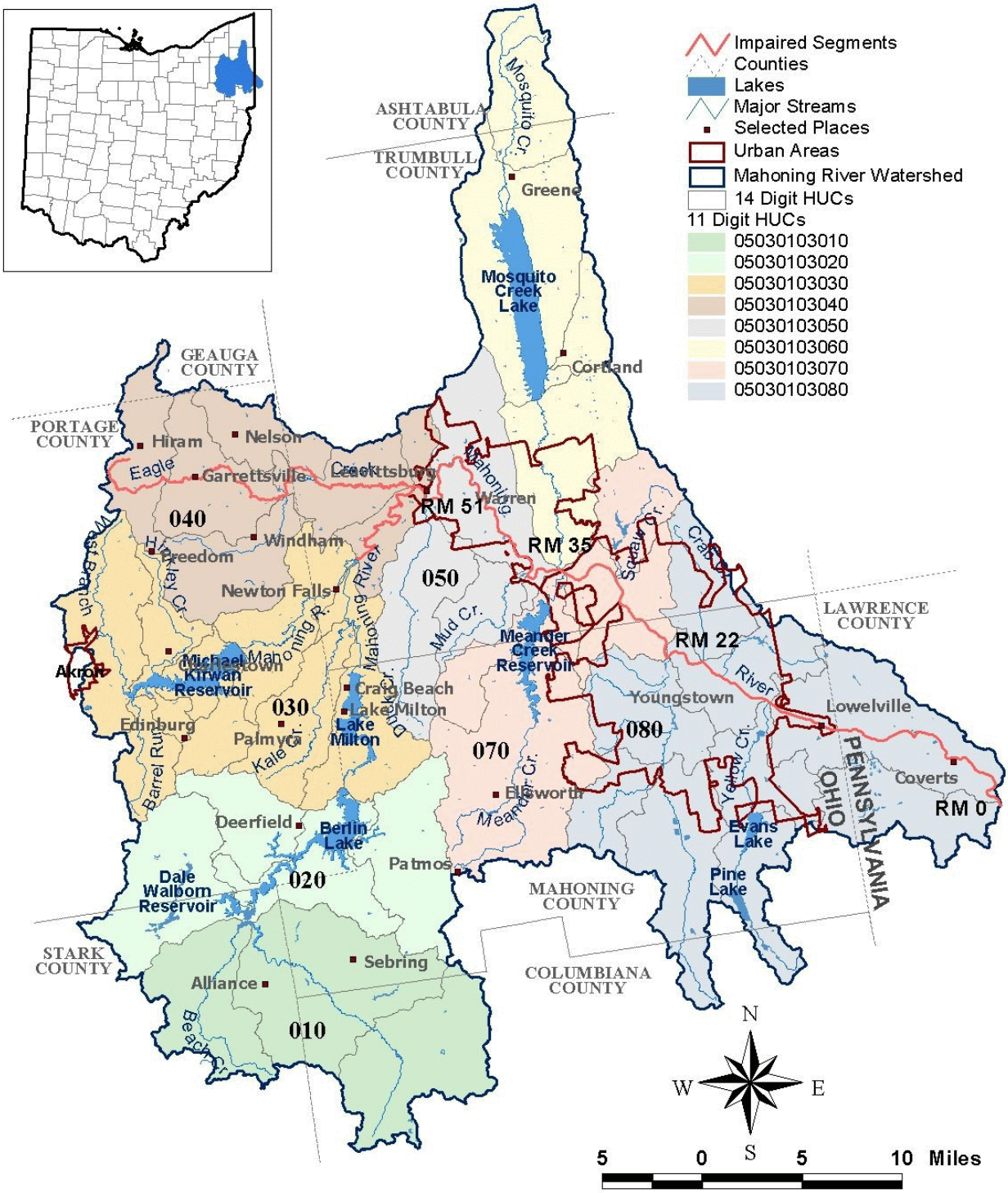

Figure 2-1. Location of the Mahoning River watershed, Ohio.

2.2 Pollutants of Concern

The TMDL addresses the pathogen loadings in the Mahoning River. Both fecal coliform and *E. coli* data are evaluated.

2.3 Pollutant Sources

The sources of the fecal coliform bacteria include unsewered areas, combined sewer overflows (CSOs), sanitary sewer overflows (SSOs), livestock, stormwater runoff, and permitted discharges. According to USEPA's Permit Compliance System (PCS), there are 84 industrial facilities and wastewater treatment plants in the Mahoning River watershed (Table 2-2).

Table 2-2. Industrial facilities and wastewater treatment plants in the Mahoning River watershed.

NPDES Permit Number	Location Name	Major Facility	NPDES Permit Number	Location Name	Major Facility
OH0023868	ALLIANCE REGIONAL STP	Yes	OH0083909	KMART DISTRIBUTION CENTER	No
OH0024325	CAMPBELL WWTP	Yes	OH0044881	LAKEVIEW MHP	No
OH0025364	GIRARD STP	Yes	OH0128872	LEAVITT ROAD ELEMENTARY SCHOOL	No
OH0037249	MAHONING CO BOARDMAN WWTP	Yes	OH0026204	LOWELLVILLE STP	No
OH0045721	MAHONING CO MEANDER CREEK WWTP	Yes	OH0043851	MAHONING CO LAKE MILTON WWTP	No
OH0026743	NILES WWTP	Yes	OH0046078	MAHONING CO PALMYRA RD	No
OH0011533	ORION MIDWEST NILES PLANT	Yes	OH0045641	MAPLE DEL MANOR MHP	No
OH0027600	STRUTHERS WWTP	Yes	OH0128571	MAPLEWOOD HIGH SCHOOL	No
OH0011363	THOMAS STEEL STRIP CORP.	Yes	OH0126250	MAPLEWOOD N ELEM SCHOOL	No
OH0043401	TRUMBULL CO MOSQUITO CREEK WWTP	Yes	OH0128490	MARATHON ALRI TRUCK PLAZA	No
OH0027987	WARREN WWTP	Yes	OH0045675	MARLINGTON LOCAL SCHOOLS	No
OH0028223	YOUNGSTOWN WWTP	Yes	OH0129089	MATHEWS HIGH SCHOOL	No
OH0011878	ALLIANCE MIDWEST TUBULAR PRODUCTS	No	OH0126225	NEMENZ FOOD MART	No
OH0107484	ARHAVEN ESTATES	No	OH0125792	NEMENZ LIL SHOPPER	No
OH0129062	BAKER ELEMENTARY SCHOOL	No	OH0022110	NEWTON FALLS STP	No
OH0128945	BAZETTA CHRISTIAN CHURCH	No	OH0126004	OBLATE SISTERS OF THE-SACRED H	No

NPDES Permit Number	Location Name	Major Facility	NPDES Permit Number	Location Name	Major Facility
OH0128937	BAZETTA ELEMENTARY SCHOOL	No	OH0037893	ODNR WEST BRANCH BEACH AREA	No
OH0024091	BELOIT WWTP	No	OH0107522	PLEASANT PARK MOBILE COURT	No
OH0107433	BLUE WATER MANOR	No	OH0044300	PM ESTATES	No
OH0129755	BP OIL STATION NO. 0592905	No	OH0117587	PONDEROSA PARK RESORTS INC	No
OH0107506	BRENTWOOD MANOR MHP	No	OH0038792	PORTAGE CO ATWATER WWTP	No
OH0129241	BUCKEYE PACKAGING COMPANY	No	OH0038539	PORTAGE CO WEST BRANCH MHP	No
OH0129682	BUDGET LODGE	No	OH0038547	PORTAGE CO WESTERN RESERVE WWT	No
OH0131326	CERTIFIED GAS STATION 410	No	OH0126365	RENT A HOME	No
OH0091901	CIRCLE RESTAURANT INC	No	OH0131474	RIDGE RANCH CAMPGROUND	No
OH0021776	COLUMBIANA WWTP	No	OH0010863	RMI TITANIUM CO NILES PLANT	No
OH0128708	COUNTRY ACRES CAMPGROUND	No	OH0128805	RODEWAY INN	No
OH0129178	CSR HYDRO CONDUIT	No	OH0087921	SCHAEFER EQUIPMENT INC	No
OH0129071	CURRIE ELEMENTARY SCHOOL	No	OH0020443	SEBRING WWTP	No
OH0129658	DAMASCUS WASTEWATER TREATMENT	No	OH0117561	SHORT STOP TRUCK PLAZA	No
OH0011193	DENMAN TIRE CORP	No	OH0038571	SOUTHEAST HIGH SCHOOL	No
OH0129038	DG AND ASSOCIATES INC.	No	OH0044113	STARK COUNTY	No
OH0123757	FAIR ACRES LTD	No	OH0092461	STONEYBROOK VILLAGE MHP	No
OH0128287	FONDERLAC INC	No	OH0128856	TRACK'S INN	No
OH0128732	GARDENBROOK PARTY CENTER	No	OH0092550	TRUMBULL CO BAZETTA NO 1	No
OH0025330	GARRETTSVILLE WWTP	No	OH0091634	TRUMBULL CO MECCA NO 1 WWTP	No
OH0064301	GCO LTD	No	OH0097993	TRUMBULL CO VIENNA NO 1 WWTP	No
OH0091740	HAMLET MHP	No	OH0023671	US CORP OF ENGINEERS MILL CREE	No
OH0025801	HIRAM STP	No	OH0128953	VALLEY MHP	No

NPDES Permit Number	Location Name	Major Facility	NPDES Permit Number	Location Name	Major Facility
OH0123676	HOMESTEAD MANOR MOBILE HOME	No	OH0102822	WESTWOOD HOMES INC	No
OH0107450	IMPERIAL MHP WWTP	No	OH0045462	WINDHAM WWTP	No
OH0123854	JOLLY TIME MHP	No	OH0117625	YANKEE KITCHEN RESTAURANT	No

2.4 Priority Ranking

The priority ranking for TMDL development in the Mahoning River is High on the 2002 Section 303(d) list.

3.0 DESCRIPTION OF WATER QUALITY STANDARDS, NUMERIC WATER QUALITY TARGETS, AND EXISTING WATER QUALITY

The purpose of developing a TMDL is to identify the pollutant loading that a waterbody can receive and still achieve water quality standards. Under the Clean Water Act, every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters. These standards represent a level of water quality that will support the Clean Water Act's goal of "swimmable/fishable" waters. Water quality standards consist of three components: designated uses, numeric or narrative criteria, and an antidegradation policy. Ohio's water quality standards are summarized in Table 3-1 and explained in greater detail below.

Table 3-1. Ohio water quality standards.

Component	Description
Designated Use	Designated use reflects how the water can potentially be used by humans and how well it supports a biological community. Every water in Ohio has a designated use or uses; however, not all uses apply to all waters (i.e., they are waterbody specific).*
Numeric Criteria	Chemical criteria represent the concentration of a pollutant that can be in the water and still protect the designated use of the waterbody. Biological criteria indicate the health of the in-stream biological community by using one of three indices: • Index of Biotic Integrity (IBI) (measures fish health). • Modified Index of well being (MIwb) (measures fish health). • Invertebrate Community Index (ICI) (measures benthic macroinvertebrate health).
Narrative Criteria	These are the general water quality criteria that apply to all surface waters. These criteria state that all waters must be free from sludge; floating debris; oil and scum; color- and odor-producing materials; substances that are harmful to human, animal or aquatic life; and nutrients in concentrations that may cause algal blooms.
Antidegradation Policy	This policy establishes situations under which OEPA may allow new or increased discharges of pollutants, and requires those seeking to discharge additional pollutants to demonstrate an important social or economic need. Refer to <http://www.epa.state.oh.us/dsw/wqs/wqs.html> for more information.

* According to OAC 3745-1-07(A)(1) each waterbody is assigned a designated use. However, some streams in Ohio are undesignated and receive a default Warm Water Habitat designation for chemical loadings. There is no default protection for recreational use.

3.1 Numeric Water Quality Targets

The goal of this TMDL is to identify pathogen loads to the Mahoning River and Eagle Creek that will result in achieving the designated primary contact recreational use in both waterbodies. Table 3-2 summarizes Ohio's water quality standards for fecal coliform and *E. coli* for primary contact recreation, bathing waters, and secondary contact. Only the primary contact use designation applies to the Mahoning River and Eagle Creek. Ohio's water quality standards to support recreational uses are found at OAC 3745-1-07(B)(4) and **only apply during the period May 1 to October 15.**

For most pollutants, TMDLs are expressed on a mass loading basis (e.g., pounds per day). For *E. coli*, however, mass is not necessarily an appropriate measure, and EPA allows pathogen TMDLs to be expressed in terms of organism counts (or resulting concentration). This pathogen TMDL is concentration based and the TMDL is equal to the target concentration of 126 *E. coli* per 100 ml.

Table 3-2 shows that the primary contact *E. coli* criteria of 126/100 mL is identical to the bathing water *E. coli* criteria as a geometric mean. However, this is not the case for fecal coliforms. While the primary contact fecal coliform criteria is 1,000/100 mL, the bathing water fecal coliform criteria is 200/100 mL. For this reason, *E. coli* is not used by itself to determine if there is a violation of the primary contact recreation criteria because Ohio EPA's regulations state that:

> *"For each designation at least one of the two bacteriological standards (fecal coliform or* E. coli*) must be met (OAC 3745-1-07, Table 7-13)."*

Therefore, when both fecal coliform and *E. coli* data are available from the same sample, if at least one of the two standards is met, there is not a human health violation. If only one of the two bacteria groups are available to determine violations of recreational standards, then fecal coliform should be used, not *E. coli*, because it is very rare that a fecal coliform count of 1,000/100 mL would violate the criteria and *E. coli* would not violate the 126/100 mL criteria. (No such occurrences have been observed in the existing data set). For this reason, and because many more fecal coliform data are available than *E. coli*, the TMDL for the Mahoning River is based on meeting the primary contact fecal coliform standard. Both the geometric mean and instantaneous portions of the standard are used to assess compliance with the standard.

Table 3-2. Fecal coliform and *E. coli* standards for the Mahoning River. Standards only apply for the period May 1 through October 15.

Parameter	Bathing Waters		Primary Contact		Secondary Contact
	Geometric Mean[1]	Instantaneous[2]	Geometric Mean[1]	Instantaneous[2]	Instantaneous[2]
Fecal Coliform	200/100 mL	400/100 mL	1,000/100 mL	2,000/100 mL	5,000/100 mL
E. coli	126/100 mL	235/100 mL	126/100 mL	298/100 mL	576/100 mL

[1] Geometric mean fecal coliform content should not exceed this standard based on not less than five samples within a thirty-day period.
[2] Fecal coliform content should not exceed this standard in more than ten percent of the samples taken in any thirty-day period.

3.2 Existing Water Quality

This section of the document summarizes the available pathogen water quality data for the Mahoning River watershed. Fecal coliform data are available from OEPA, USGS, and the local wastewater treatment plants, while *E. coli* data are only available from the USGS and OEPA.

Table 3-3 provides a summary of the available fecal coliform data for the stations with the most data. The stations in Leavittsburg and Lowellville have been sampled most frequently. The Leavittsburg station is located upstream of the urbanized Warren/Youngstown area and the Lowellville station is located downstream. Average fecal coliform concentrations exceed the 1,000/100 mL criterion (May 1 to October 15) at both stations, but there is a significant increase moving downstream. Other stations with average fecal coliform counts above the 1,000/100 mL criterion include at the Struthers WWTP, the Niles WWTP, the Campbell WWTP, and the Youngstown WWTP.

Table 3-3. Period of record and summary statistics for fecal coliform data in the Mahoning River watershed.

Station Name	First Date	Last Date	Number of Samples	Minimum (#/100 mL)	Average (#/100 mL)	Maximum (#/100 mL)
Mahoning River at Leavittsburg	2/13/1975	11/6/2002	166	17	1,239	10,000
Mahoning River at Lowellville	2/13/1975	11/6/2002	189	100	16,340	240,000
Upstream Struthers WWTP	5/4/1995	10/22/2002	76	100	2,922	16,600
Downstream Struthers WWTP	5/4/1995	10/22/2002	81	50	2,463	18,100
Upstream Niles WWTP	5/4/1995	10/17/2002	86	1	2,321	12,000
Downstream Niles WWTP	5/4/1995	10/17/2002	87	1	2,767	15,000
Upstream Trumbull Co Commissioners Mosquito Creek WWTP	5/3/1995	10/11/2002	75	39	539	6,100
Downstream Trumbull Co Commissioners Mosquito Creek WWTP	5/3/1995	10/10/2002	72	70	446	4,400
Downstream Warren STP	5/3/1995	10/7/2002	88	1	579	11,100
Downstream Girard STP	5/3/1995	10/7/2002	86	4	442	10,050
Upstream Girard STP	5/16/1997	10/7/2002	33	70	566	2,940
Upstream Warren STP	5/3/1995	10/7/2002	88	1	676	9,000
Downstream Campbell WWTP	5/3/1995	10/2/2002	81	20	3,602	20,000
Upstream Campbell WWTP	5/3/1995	10/2/2002	72	100	2,536	20,000
Downstream Youngstown WWTP	5/2/1995	10/1/2002	83	20	2,426	58,000
Upstream Mahoning Co Commissioners Boardman WWTP	5/3/1995	10/1/2002	68	25	1,768	17,200
Downstream Mahoning Co Commissioners Boardman WWTP	5/3/1995	10/1/2002	67	33	1,172	13,400
Downstream Mahoning Co Bd of Comm Meander Creek WWTP	5/4/1995	10/1/2002	66	1	4,262	70,500
Upstream Youngstown WWTP	5/2/1995	10/1/2002	83	8	818	7,750
Upstream Mahoning Co Bd of Comm Meander Creek WWTP	5/11/1995	9/3/2002	53	1	371	4,600
Downstream Garrettsville WWTP	5/3/1995	8/27/2002	34	50	380	2,780

Station Name	First Date	Last Date	Number of Samples	Minimum (#/100 mL)	Average (#/100 mL)	Maximum (#/100 mL)
Upstream Garrettsville WWTP	5/3/1995	8/27/2002	34	70	416	2,890
Upstream Lowellville STP	5/3/1995	8/21/2002	27	150	1,574	4,950
Upstream Windham WWTP	5/23/1995	8/14/2002	27	50	779	4,000
Downstream Windham WWTP	5/23/1995	8/14/2002	28	80	644	4,000
Downstream Lowellville STP	5/3/1995	6/5/2002	28	50	1,369	4,150

All of the fecal coliform data for the Mahoning River at Leavittsburg are shown in Figure 3-1. They indicate that fecal coliform counts have occasionally exceeded the instantaneous 2,000/100 mL criterion (May 1 to October 15) since the mid-1970s, although most samples are below the criterion.

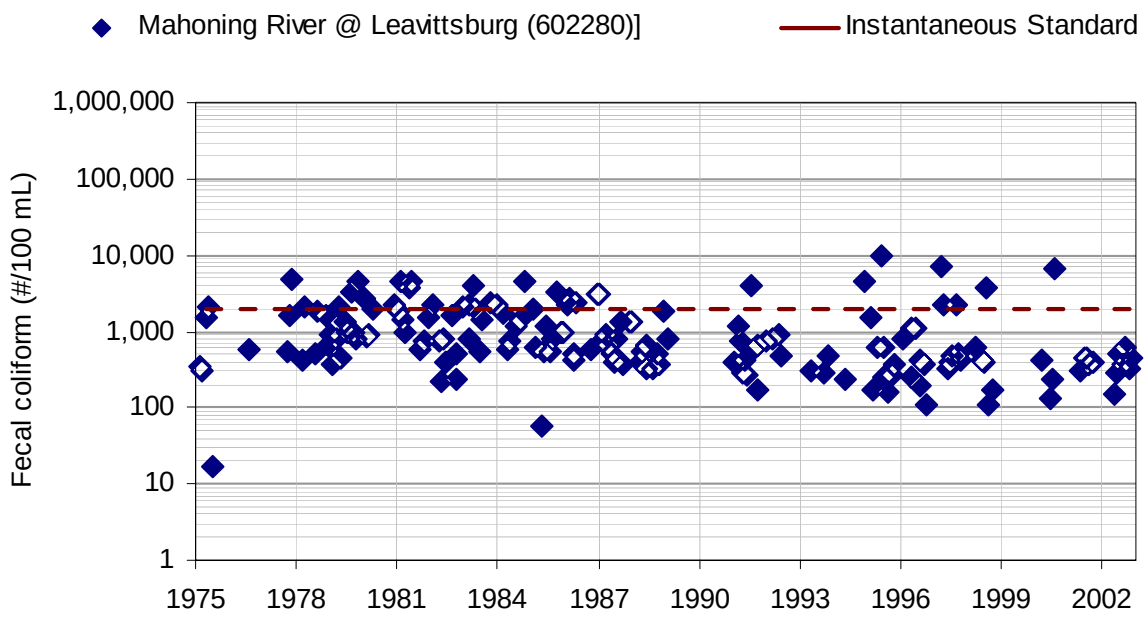

Figure 3-1. All observed fecal coliform data for the Mahoning River at Leavittsburg.

Monthly fecal coliform counts at the Leavittsburg station are shown in Figure 3-2. The figure indicates that average values are typically below the 2,000/100 mL (May 1 to October 15) instantaneous standard (although it is recognized that this is not a direct comparison to the standard). Counts are highest in the winter months (November, December, and January) due to greater stormwater runoff, although the standard does not apply during these months. Counts are least during the summer months (June, July, and August).

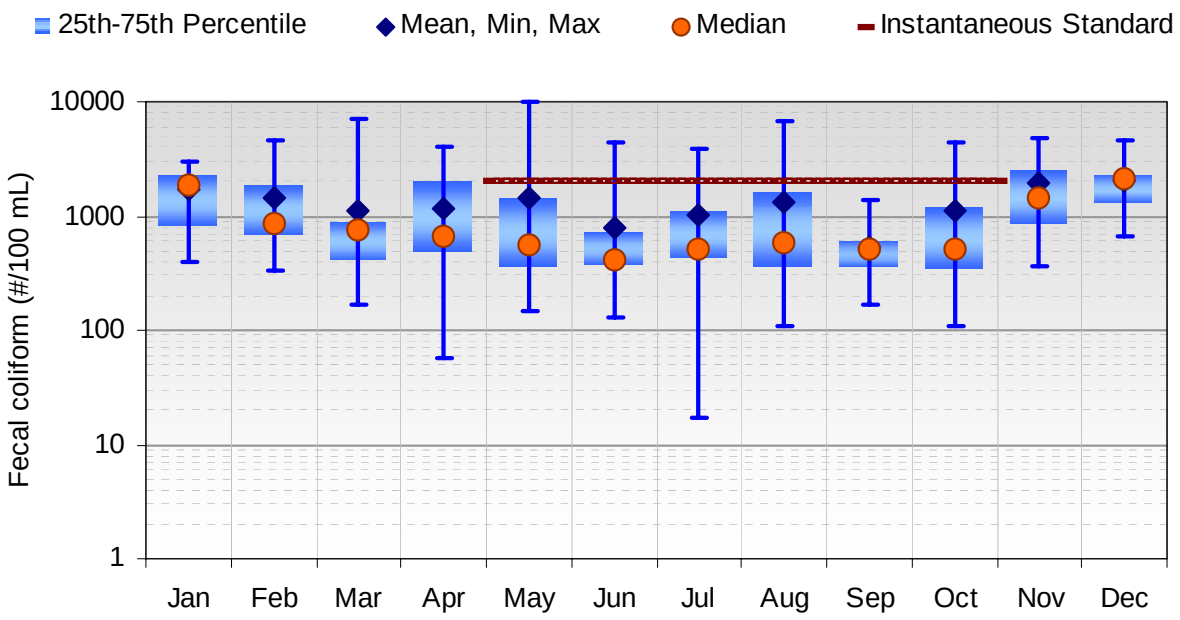

Figure 3-2. Monthly average observed fecal coliform counts for the Mahoning River at Leavittsburg (data cover the period 1975 to 2002).

All of the fecal coliform data for the Mahoning River at Lowellville are shown in Figure 3-3. They indicate that fecal coliform counts have routinely exceeded the 2,000/100 mL criterion (May 1 to October 15) since the mid-1970s, although there appears to be a slight decreasing trend. All recent data (2002) were below the criterion

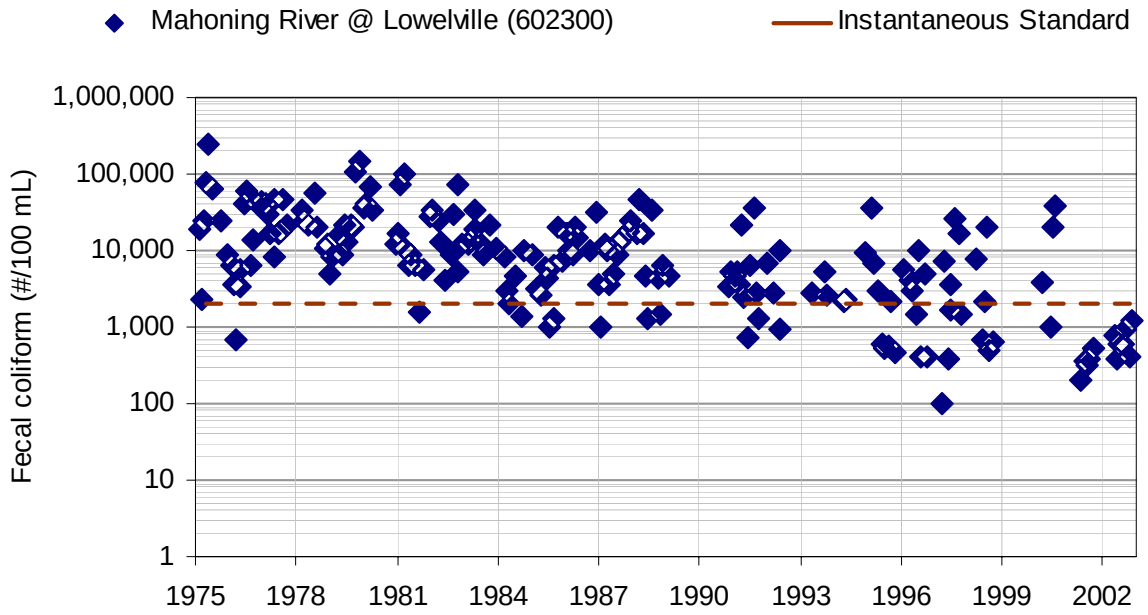

Figure 3-3. All observed fecal coliform data for the Mahoning River at Lowellville.

Monthly fecal coliform counts at the Lowellville station are shown in Figure 3-4. The figure indicates that average values are above the 2,000/100 mL instantaneous standard for all months. As with Leavittsburg, counts are highest in the winter months (November, December, and January) due to greater stormwater runoff and least during the summer months (June, July, and August).

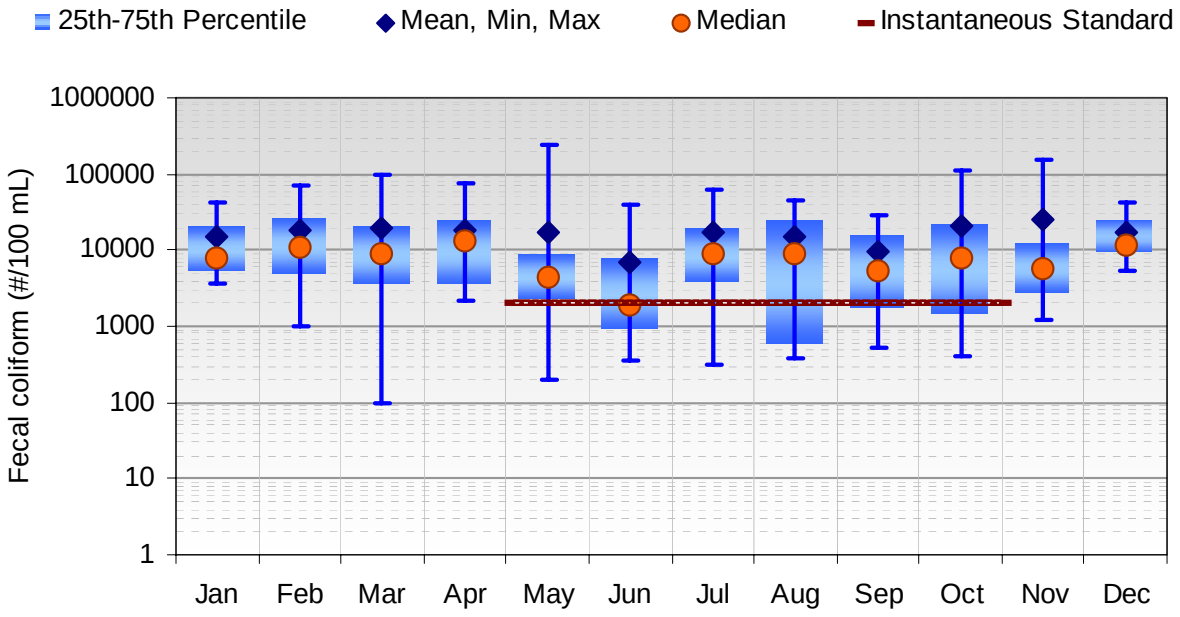

Figure 3-4. Monthly average observed fecal coliform counts for the Mahoning River at Lowellville (1975 to 2002).

Table 3-4 summarizes the monthly fecal coliform data at the Lowellville station and presents information regarding the proportion of samples that exceed the 2,000/100 mL criterion (May 1 to October 15). The table indicates that all applicable months experience significant numbers of violations, ranging from 50 percent of all samples to 78 percent.

Table 3-4. Summary of exceedances of 2,000/100 mL fecal coliform criterion (May 1 to October 15) in the Mahoning River at Lowellville.

Month	Mean (#/100 mL)	Median (#/100 mL)	Min (#/100 mL)	Max (#/100 mL)	25th (#/100 mL)	75th (#/100 mL)	XS:Count	XS%
Jan	15475	7850	3700	42000	5450	21250	NA	NA
Feb	18729	11000	1000	73000	4875	26350	NA	NA
Mar	19761	8700	100	100000	3700	21000	NA	NA
Apr	18642	13000	2200	76000	3700	24500	NA	NA
May	17296	4500	200	240000	2300	9000	16:21	76%
Jun	6873	1900	360	40000	948	7775	9:18	50%
Jul	16776	8800	320	63000	3800	19500	14:18	78%
Aug	14851	8700	390	46000	600	26000	10:17	59%
Sep	9391	5200	520	29000	1800	16000	11:15	73%
Oct	20370	7900	400	110000	1450	22000	5:7	71%
Nov	24563	5750	1200	150000	2850	12750	NA	NA
Dec	17175	12000	5400	43000	9300	25750	NA	NA

XS = Exceedance; NA = Not Applicable

Table 3-5 provides a summary of the available *E. coli* data for the Mahoning River. The most data have been collected at Lowellville and in Youngstown. Average values are well above the 126/100 mL primary contact criterion at all stations. As discussed previously, the TMDL for the Mahoning River is based on an evaluation of fecal coliform due to the nature of Ohio's water quality standards.

Table 3-5. Period of record and summary statistics for *E. coli* data in the Mahoning River watershed.

Station Name	First Date	Last Date	Number of Samples	XS%	Min (#/100 mL)	Avg (#/100 mL)	Max (#/100 mL)
Mahoning River at Youngstown (USGS)	5/6/1999	10/8/2000	24	54%	17	1,209	8,100
Mahoning River below West Ave at Youngstown (USGS)	5/6/1999	10/8/2000	24	67%	48	3,327	38,000
Mahoning River at Lowellville (USGS)	5/5/1999	10/8/2000	24	100%	210	5,074	28,000
Mahoning River at Center St. at Youngstown (USGS)	7/8/1999	10/8/2000	19	89%	93	5,037	55,000
Mahoning River at Leavittsburg (OEPA)	3/22/2000	11/6/2002	16	56%	51	674	5,800
Mahoning River at Lowellville (OEPA)	3/22/2000	11/6/2002	16	69%	170	2,095	20,000

XS = Exceedance

4.0 LOADING CAPACITY

To meet the objectives defined for the Mahoning River TMDL, it was determined that development of a comprehensive watershed model was necessary to represent the watershed. A watershed model is essentially a series of algorithms applied to watershed characteristics and meteorological data to simulate naturally occurring land-based processes and anthropogenic activities over an extended period of time, including hydrology and pollutant transport. Many watershed models are also capable of simulating in-stream processes using the land-based calculations as input. The reasons that a comprehensive watershed model were determined to be necessary for this project including the following:

- Land use in the Mahoning River watershed includes row crop agriculture, older urban areas, and suburban areas. Different potential sources of pathogens are associated with each of these land use types (e.g., cattle, manure application, failing septic systems, combined sewer overflows, wastewater treatment plants) and each land use also has affected the natural hydrology of the watershed. The model must therefore be able to address a mixed land use watershed.
- Rainfall intensity and volume play an important role in pathogen loadings. The model must provide adequate time-step estimation of flow and not over-simplify storm events by only predicting monthly or seasonal output. It should provide accurate representation of rainfall events and resulting peak runoff.
- Different sources influence receiving waters in different ways and at different times (through different transport mechanisms). For example, surface runoff impacts waterbodies differently than direct stream contributions. The model must therefore be capable of simulating these transport mechanisms.
- Representation of the potential impacts from combined sewer overflows during significant rainfall events, and associated loads to the Mahoning River, had to be addressed.
- The selected model had to be capable of simulating daily pathogen counts so that applicable averaging periods and peak levels can be determined and compared to numeric targets. The selected model had to also be able to address seasonal variations in hydrology and water quality and critical conditions (i.e., periods when pathogen counts are at their highest) as required by TMDL regulations.

Based on these considerations EPA and its consultant selected the Hydrologic Simulation Program - FORTRAN (HSPF) to be used to support TMDL development in the Mahoning River watershed. HSPF is a comprehensive watershed and receiving water quality modeling framework that was originally developed in the mid-1970's. During the past several years it has been used to develop hundreds of USEPA-approved TMDLs and it is generally considered the most advanced hydrologic and watershed loading model available. USEPA has recently upgraded the coding of the HSPF model to increase its speed and flexibility. The new version of the model is called the Loading Simulation Program in C++ (LSPC). LSPC integrates a geographical information system (GIS), comprehensive data storage and management capabilities, the original HSPF algorithms, and a data analysis/post-processing system into a convenient PC-based windows interface that dictates no software requirements. LSPC was used for this project because it best matches the required criteria described above.

4.1 Strengths and Weaknesses

There are several strengths associated with using LSPC to determine the loading capacity of the Mahoning River. These including the following:

- can simulate the time-varying nature of deposition on land surfaces and transport to receiving waters.

- can incorporate seasonal effects on the production and fate of fecal coliform.
- is well-suited for urban watersheds.
- provides daily output to allow for direct comparison to the water quality targets (daily output is required because the fecal coliform bacteria standard has a 30-day geometric mean component).
- provides post-processing and analytical tools designed specifically to support TMDL development and reporting requirement (including a TMDL calculator).
- contains an archival mechanism for saving each and every model run (critical to support the administrative record for TMDL development and for model transfer between users)
- includes a customized GIS interface that does not require user-purchased software (critical for the public participation process/stakeholder input).
- has been used elsewhere for pathogen TMDL development (e.g., Hurricane Creek, Alabama; Hawksbill Creek, Virginia; Cane Creek/Swan Creek, Tennessee).

There are also several weaknesses associated with using LSPC, such as:

- The model is fairly intensive in terms of data needs and complexity, resulting in a longer schedule than would have been required with a simpler approach.
- The model's instream capabilities (i.e., ability to simulate pollutant fate and transport within the Mahoning River) is not as advanced as some other receiving water models, such as the Water Quality Analysis Simulation Program (WASP).

These two shortcomings are not believed to be significant weaknesses for this project and it is believed that the LSPC model is acceptable for development of the TMDL. Appendix A provides a full description of the application of the LSPC model.

4.2 Critical Conditions

The highest concentrations of pathogens are observed in the Mahoning River during winter months when primary contact recreation is unlikely to occur. The critical conditions for the TMDL are therefore the summer recreational months (May 1 to October 15) when the primary contact recreation standard applies.

4.3 Loading Capacity

A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs can be expressed in terms of mass per time or by other appropriate measures. TMDLs are composed of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this is defined by the equation:

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

To develop TMDLs for the Mahoning River watershed, the following approach was taken:

- Simulate baseline conditions
- Assess source loading alternatives
- Determine the TMDL and source allocations

The calibrated model provided the basis for performing the allocation analysis and was first used to project baseline conditions. Baseline conditions represent existing nonpoint source loading conditions

and permitted point source discharge conditions (i.e., point sources discharging constantly at their permit limits). The baseline conditions allow for an evaluation of in-stream water quality under the "worst currently allowable" scenario.

Simulation of baseline conditions provided the basis for evaluating stream response to variations in source contributions. The simulations revealed that the major sources varied by assessment unit and meteorologic conditions. The primary sources during dry weather conditions are WWTP facilities, straight pipe connections in unsewered areas, wildlife, and livestock. The primary sources during wet weather periods are CSOs and stormwater runoff from rural and urban areas. These results facilitated developing an effective allocation strategy.

The calibrated LSPC model was used to determine the allowable loads of fecal coliform for the Mahoning River watershed. The model was run with existing loads from the various sources reduced until both the instantaneous and geometric mean parts of the water quality standard were met. The assessment period was from 1993 to 2002 which covers both wet, dry, and average rainfall years.

A top-down methodology was followed to develop the TMDLs and allocate loads to sources. Impaired headwaters were analyzed first, because their impact had an effect on downstream water quality. Loads were reduced from applicable sources for these waterbodies, and TMDLs were developed. Model results from the selected successful scenarios were then routed through downstream waterbodies. Therefore, when TMDLs were developed for downstream impaired waterbodies, upstream loads were representing conditions meeting water quality criteria.

The results of the TMDL analysis are presented in Table 4-1 and Figures 4-1 to 4-4. The data plotted in Figure 4-1 to 4-4 are the simulated results from the model for existing and allocation conditions. The TMDL loads are presented for the critical summer conditions (April 1 to October 31) and represent the allowable load at the most downstream point of each assessment unit. Several observations can be made from Table 4-1 and Figures 4-1 to 4-4:

- Fecal coliform counts typically increase moving from upstream to downstream. However, counts are somewhat diluted in AU 070 due to the influence of Mosquito and Meander Creeks.
- Reducing loads to meet the instantaneous part of the fecal coliform standard typically results in fecal coliform values well below the geometric mean part of the standard.
- Reducing upstream loads has a significant impact on downstream allocations. The predicted allocation conditions for AU 080 are therefore well below both parts of the standard.

Table 4-1. Fecal coliform TMDL summary for the Mahoning River Watershed.

Assessment Unit	Tributary	WLA (cfu/rec. season)	LA (cfu/rec. season)	MOS	TMDL (cfu/rec. season)
05030101-040	Eagle Creek	6.96E+12	7.79E+14	10%	7.02E+14
05030101-050	Mahoning River Above Duck Creek and Below Eagle Creek	4.73E+13	1.18E+15	10%	1.10E+15
	Duck Creek	8.75E+10	2.11E+13	10%	1.91E+13
05030103-070	Mosquito Creek	3.07E+13	2.20E+14	10%	2.26E+14
	Mud Creek	3.30E+10	4.00E+13	10%	3.60E+13
	Meander Creek	2.39E+12	1.59E+13	10%	1.65E+13
	Squaw Creek	6.92E+11	2.21E+13	10%	2.05E+13
05030103-080	Mill Creek	4.21E+13	1.95E+14	10%	2.13E+14
	Crab Creek	2.26E+11	2.86E+15	10%	2.57E+15
	Yellow Creek	1.02E+13	9.22E+13	10%	9.22E+13

cfu = colony forming units

Figure 4-1 displays the modeling results for the Eagle Creek subwatershed (AU 040). The lines labeled "existing" represent the daily fecal coliform count predicted by the calibrated model. The top graph 4-1 A indicates there is seasonal variation of fecal coliform counts above the instantaneous standard of 2000 counts/100ml, which is indicated by the dark horizontal line. These increases occur from approximately April to November in most years, as is to be expected due to the SSOs, CSOs, stormwater runoff and unsewered areas that would contribute to the fecal coliform load during these months. The lighter bottom plot of the instantaneous graph shows the modeled allocation of fecal coliform that the stream could assimilate and not exceed the instantaneous standard. The cyclic nature of the inputs due to the hydrology are maintained by the model, but values are smaller and have decreased variation. The middle graph 4-1 B of the geometric mean standard is similar in nature, and shows the existing fecal coliform in the top plot, with the annual cyclic influxes of fecal coliform into the system above the geometric mean standard of 1000 counts/ml, shown by the horizontal line. The bottom plot of the geometric mean standard shows the modeled allocated amount of fecal coliform that the stream could assimilate and not exceed the geometric mean standard. The bottom graph 4-1 C is a composite of the top two, with modeled allocations falling below both the instantaneous and geometric mean lines.

Figure 4-2 is similar to Figure 4-1 except that the existing conditions exceed the instantaneous standards in the top plot 4-2 A only occasionally and overall the values are smaller. The duration and magnitude of exceedances is also smaller in the geometric mean plots B. These values were mentioned previously as being smaller due to dilution from Meander and Mosquito Creeks. In the final composite plot 4-2 C, the standards are easily met as both the instantaneous and geometric mean allocations are well below both standards.

Figure 4-3 is similar to Figure 4-2 again in both the duration and magnitude of exceedences, and in the ability to meet standards. In the final Figure 4-4 A at location (AU 080 downstream from Youngstown) the top plots of exceedances of the instantaneous standards have greater magnitude. Note the scale on the y-axis is 100,000 counts/100 mL fecal coliform. The modeled allocations at the downstream locations show that predicted fecal coliform counts will be below both standards. As mentioned previously, when headwater allocations are addressed through the top-down modeling methodology, then routed

downstream, the downstream locations meet standards. Contributions from downstream can also be allocated more equitably.

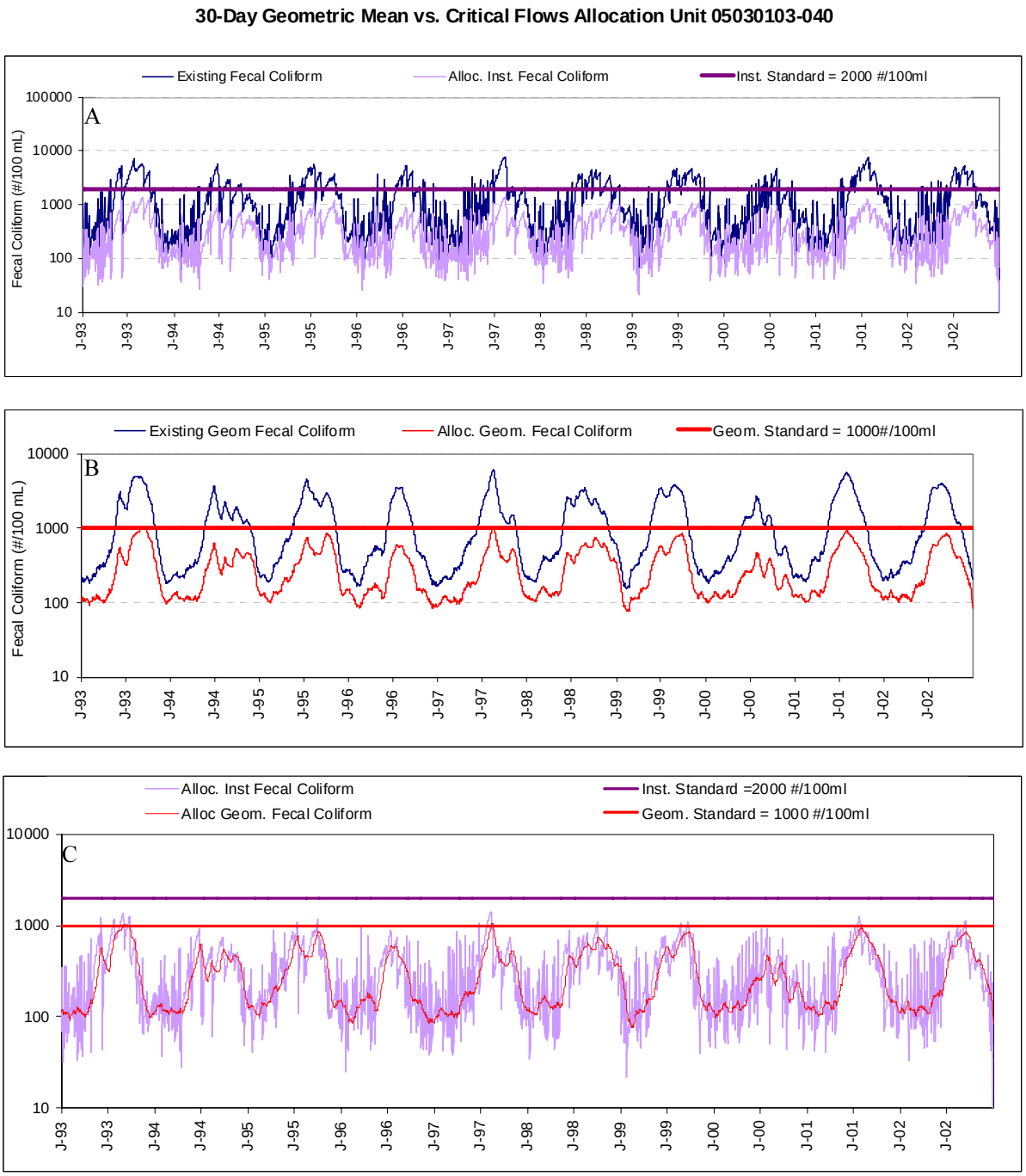

Figure 4-1. TMDL evaluation for assessment unit 05030103-040. Top graph A evaluates existing and allocation conditions for instantaneous part of standard, middle graph B evaluates existing and allocation conditions for geometric mean part of standard, and bottom graph C shows the final allocation condition.

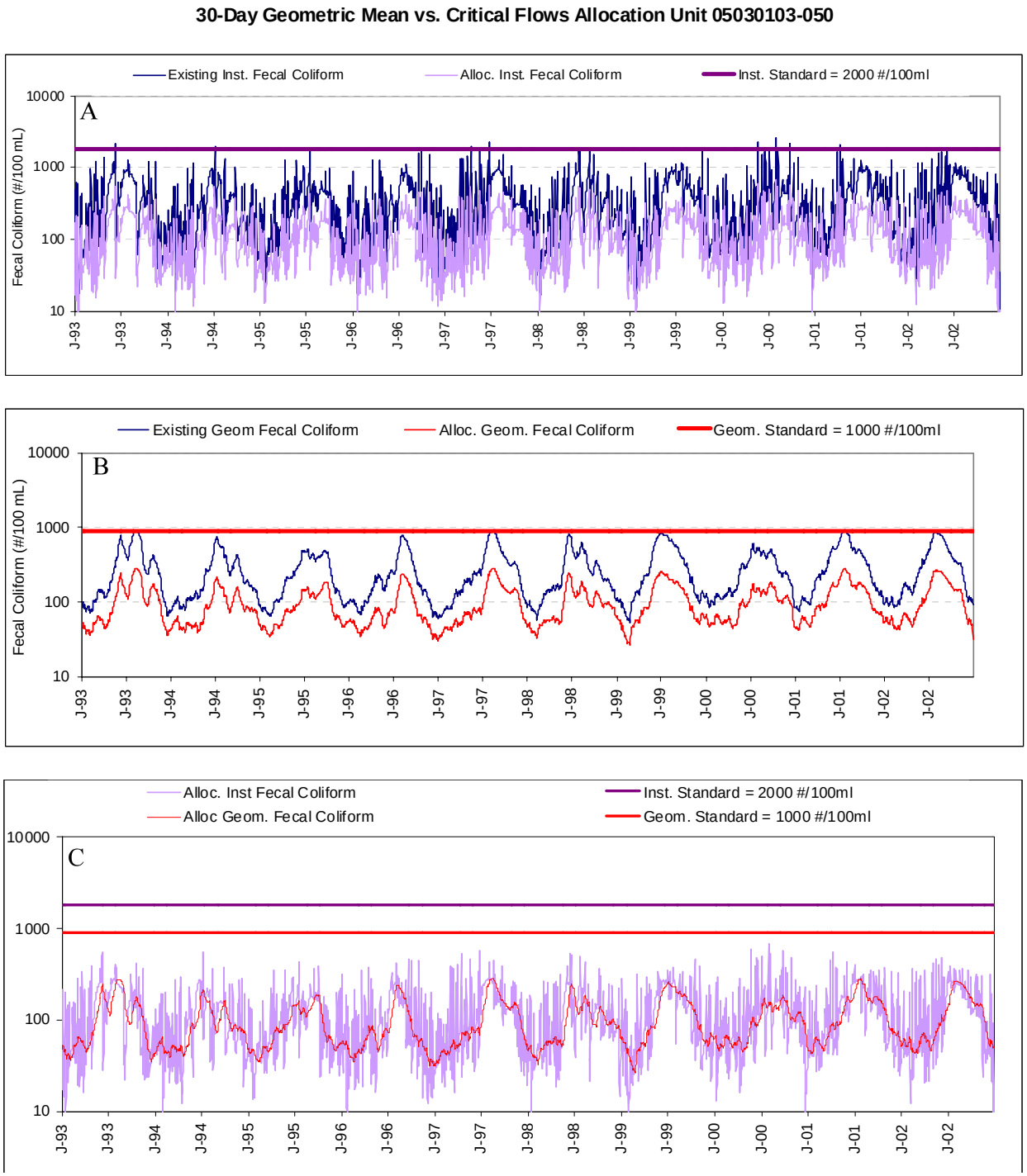

Figure 4-2. TMDL evaluation for assessment unit 05030103-050. Top graph A evaluates existing and allocation conditions for instantaneous part of standard, middle graph B evaluates existing and allocation conditions for geometric mean part of standard, and bottom graph C shows the final allocation condition.

30-Day Geometric Mean vs. Critical Flows Allocation Unit 05030103-070

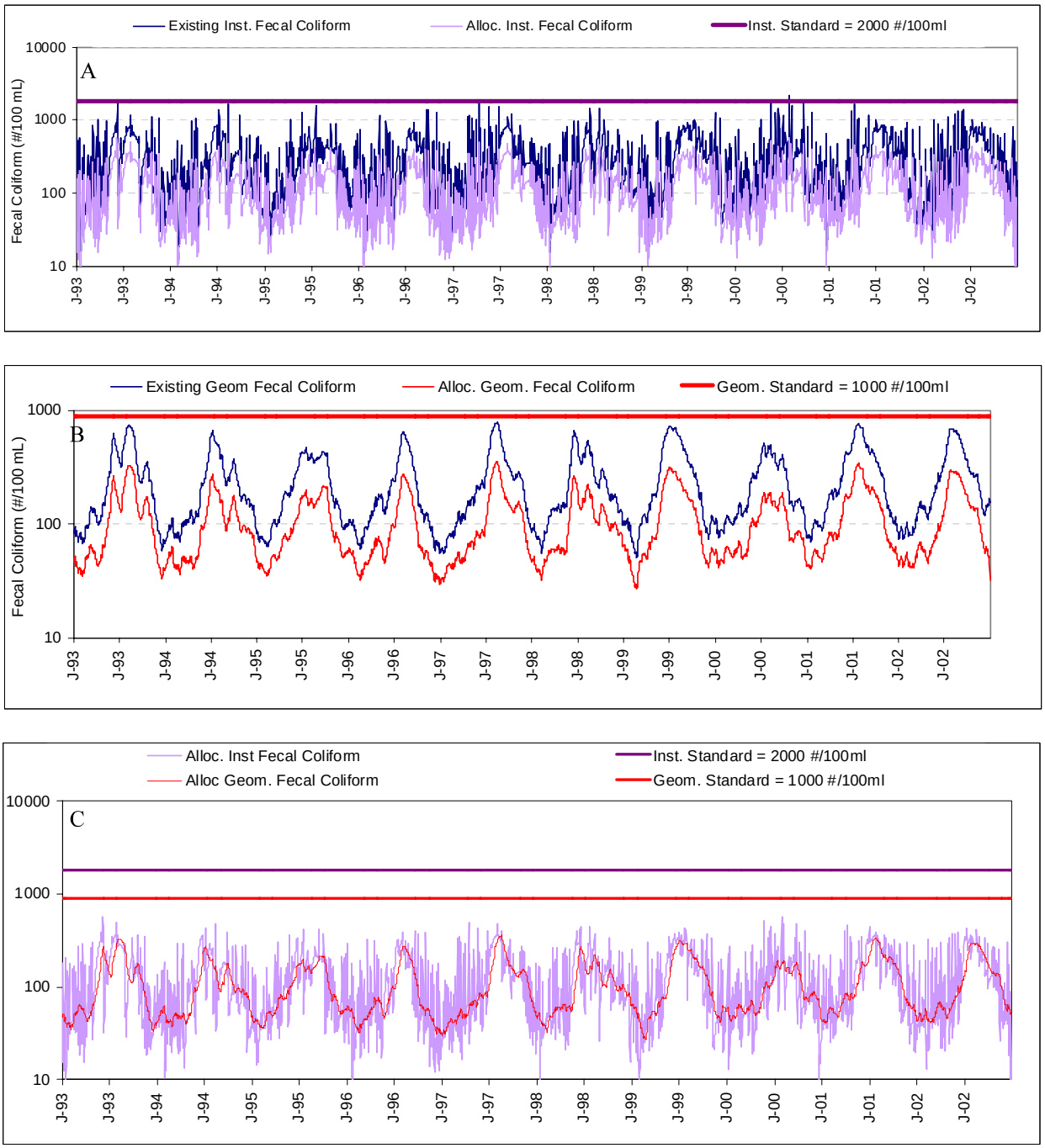

Figure 4-3. TMDL evaluation for assessment unit 05030103-070. Top graph A evaluates existing and allocation conditions for instantaneous part of standard, middle graph B evaluates existing and allocation conditions for geometric mean part of standard, and bottom graph C shows the final allocation condition.

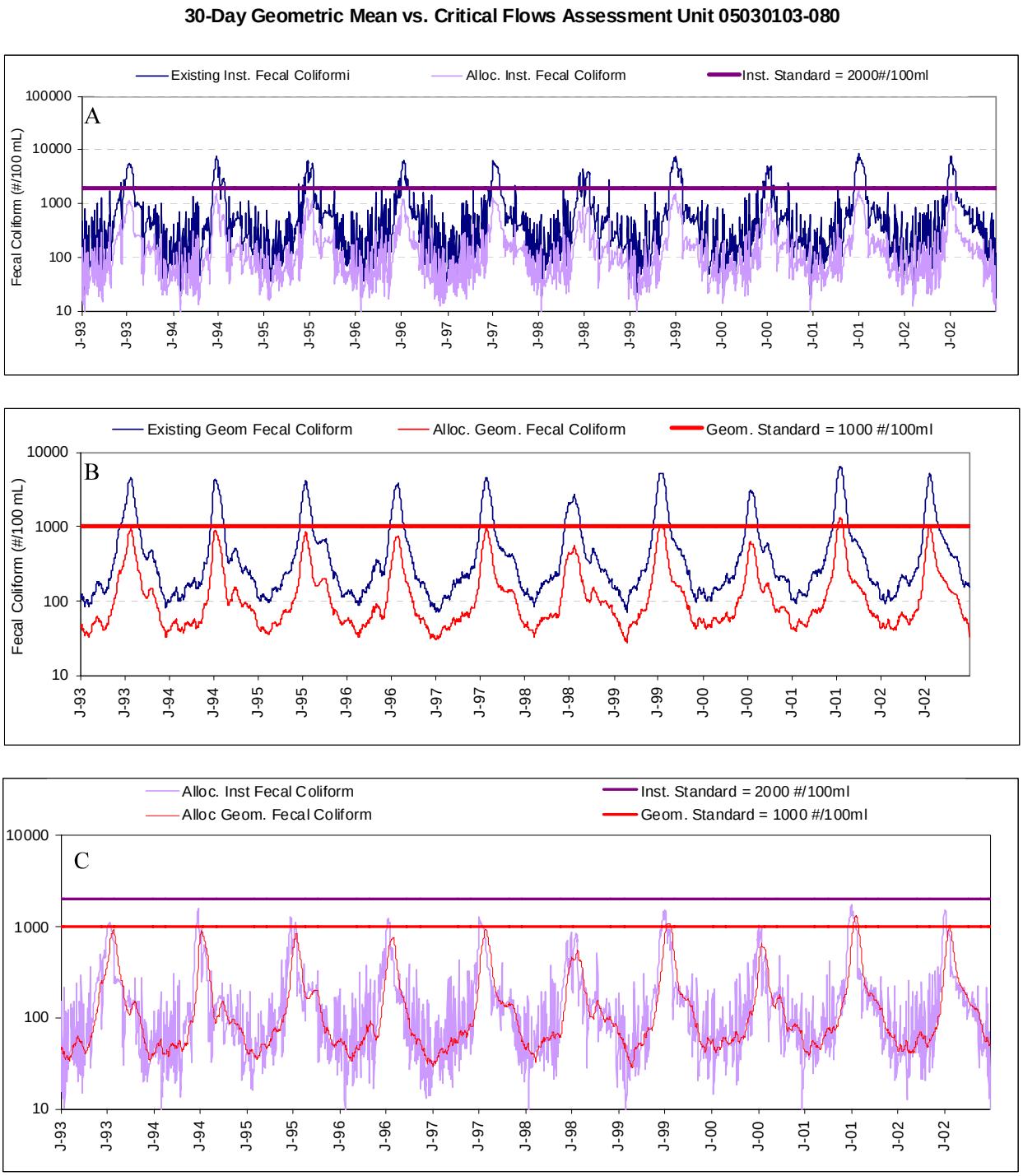

Figure 4-4. TMDL evaluation for assessment unit 05030103-080. Top graph A evaluates existing and allocation conditions for instantaneous part of standard, middle graph B evaluates existing and allocation conditions for geometric mean part of standard, and bottom graph C shows the final allocation condition.

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5.0 LOAD ALLOCATIONS

Load allocations (LAs) are identified for nonpoint source pollutant loadings in support of final TMDL allocations that will lead to attainment of water quality standards. Allocation analysis was performed by applying the model to identify the assimilative capacity of the receiving water and determining how the allowable loading capacity can be allocated among the various sources. The results are presented in Tables 5-1 to 6-9. The source load reduction is based on eliminating all loads from CSOs, illegal straight pipe sewage connections, and livestock. Depending on the AU, additional reductions are also necessary for stormwater runoff from pasture lands and urban areas. The need for such significant reductions is based primarily on meeting the instantaneous 2,000 counts/100 mL part of the standard during wet weather events. Meeting only the geometric mean part of the standard, or meeting the standard during only dry weather periods, would not require such significant reductions. This finding is similar to that reported by USGS from an evaluation of *E. coli* conditions in the Mahoning River at Youngstown (USGS, 2002).

Table 5-1. Load allocations summary table for Eagle Creek (assessment unit 05030103-040).

Sources	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
Direct			
Straight Pipes	0.00E+00	0.00E+00	NA
Other*	6.42E+13	3.85E+13	40%
Indirect			
Pasture**	7.51E+14	3.75E+13	95%
Built up***	1.02E+13	2.03E+11	98%
Other****	7.03E+14	7.03E+14	0%
Total	1.53E+15	7.79E+14	49%

* Includes pets, livestock, wildlife
** Includes hayland
*** Urban pervious and urban impervious
**** Includes wetland, forest, failing septic systems and all other
NA = Not Applicable

Table 5-2. Load allocations summary table for Mahoning River above Duck Creek and below Eagle Creek (assessment unit 05030103-050).

Sources	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
Direct			
Straight Pipes	4.92E+14	0.00E+00	100%
Other*	1.05E+14	6.32E+13	40%
Indirect			
Pasture**	1.20E+15	5.98E+14	60%
Built up***	1.53E+14	7.64E+13	50%
Other****	8.80E+14	4.40E+14	60%
Total	2.83E+14	1.18E+15	58%

* Includes pets, livestock, wildlife
** Includes hayland
*** Urban pervious and urban impervious
**** Includes wetland, forest, failing septic systems and all other

Table 5-3. Load allocations summary table for Duck Creek (assessment unit 05030103-050).

Sources	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
Direct			
Straight Pipes	0.00E+00	0.00E+00	NA
Other*	2.11E+14	1.05E+13	95%
Indirect			
Pasture**	1.91E+14	9.53E+12	95%
Built up***	7.94E+12	3.97E+11	95%
Other****	1.35E+13	6.73E+11	95%
Total	4.23E+14	2.11E+13	95%

* Includes pets, livestock, wildlife
** Includes hayland
*** Urban pervious and urban impervious
**** Includes wetland, forest, failing septic systems and all other
NA = Not Applicable

Table 5-4. Load allocations summary table for Mosquito Creek (assessment unit 05030103-070).

Sources	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
Direct			
Straight Pipes	3.26E+12	0.00E+00	100%
Other*	5.69E+12	5.69E+12	0%
Indirect			
Pasture**	1.37E+14	1.37E+14	0%
Built up***	5.85E+13	5.85E+13	0%
Other****	1.86E+13	1.86E+13	0%
Total	2.23E+14	2.20E+14	1%

* Includes pets, livestock, wildlife
** Includes hayland
*** Urban pervious and urban impervious
**** Includes wetland, forest, failing septic systems and all other

Table 5-5. Load allocations summary table for Mud Creek (assessment unit 05030103-070).

Sources	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
Direct			
Straight Pipes	0.00E+00	0.00E+00	NA
Other*	9.36E+13	1.87E+13	80%
Indirect			
Pasture**	8.63E+13	1.73E+13	80%
Built up***	1.40E+13	2.80E+12	80%
Other****	6.09E+12	1.22E+12	80%
Total	2.00E+14	4.00E+14	80%

* Includes pets, livestock, wildlife
** Includes hayland
*** Urban pervious and urban impervious
**** Includes wetland, forest, failing septic systems and all other
NA = Not Applicable

Table 5-6. Load allocations summary table for Meander Creek (assessment unit 05030103-070).

Sources	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
Direct			
Straight Pipes	0.00E+00	0.00E+00	100%
Other*	1.21E+13	3.63E+12	70%
Indirect			
Pasture**	3.18E+13	9.54E+12	70%
Built up***	6.19E+12	1.86E+12	70%
Other****	2.93E+12	8.79E+11	70%
Total	5.30E+13	1.59E+13	70%

* Includes pets, livestock, wildlife
** Includes hayland
*** Urban pervious and urban impervious
**** Includes wetland, forest, failing septic systems and all other

Table 5-7. Load allocations summary table for Squaw Creek (assessment unit 05030103-070).

Sources	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
Direct			
Straight Pipes	2.16E+12	0.00E+00	100%
Other*	1.36E+14	2.04E+13	85%
Indirect			
Pasture**	8.03E+13	8.03E+11	99%
Built up***	8.78E+12	8.78E+10	99%
Other****	5.80E+12	8.70E+11	85%
Total	2.33E+14	2.21E+13	90%

* Includes pets, livestock, wildlife
** Includes hayland
*** Urban pervious and urban impervious
**** Includes wetland, forest, failing septic systems and all other

Table 5-8. Load allocations summary table for Mill Creek (assessment unit 05030103-080).

Sources	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
Direct			
Straight Pipes	0.00E+00	0.00E+00	NA
Other*	3.28E+15	1.64E+14	95%
Indirect			
Pasture**	4.50E+14	2.25E+13	95%
Built up***	1.52E+14	7.62E+12	95%
Other****	2.54E+13	1.27E+12	95%
Total	3.91E+15	1.95E+14	95%

* Includes pets, livestock, wildlife
** Includes hayland
*** Urban pervious and urban impervious
**** Includes wetland, forest, failing septic systems and all other
NA = Not Applicable

Table 5-9. Load allocations summary table for Crab Creek (assessment unit 05030103-080).

Sources	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
Direct			
Straight Pipes	0.00E+00	0.00E+00	0%
Other*	1.35E+14	1.35E+14	0%
Indirect			
Pasture**	1.41E+15	1.41E+15	0%
Built up***	3.00E+14	3.00E+14	0%
Other****	1.01E+15	1.01E+15	0%
Total	2.86E+15	2.86E+15	0%

* Includes pets, livestock, wildlife
** Includes hayland
*** Urban pervious and urban impervious
**** Includes wetland, forest, failing septic systems and all other

Table 5-10. Load allocations summary table for Yellow Creek (assessment unit 05030103-080).

Sources	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
Direct			
Straight Pipes	0.00E+00	0.00E+00	0%
Other*	3.36E+14	1.68E+13	95%
Indirect			
Pasture**	1.43E+15	7.16E+13	95%
Built up***	6.03E+13	3.02E+12	95%
Other****	1.63E+13	8.17E+11	95%
Total	1.84E+15	9.22E+13	95%

* Includes pets, livestock, wildlife
** Includes hayland
*** Urban pervious and urban impervious
**** Includes wetland, forest, failing septic systems and all other

6.0 WASTELOAD ALLOCATIONS

There are a number of wastewater treatment plants within the Mahoning River watershed that are subject to the NPDES permit program. The existing loads from the wastewater treatment plants and industrial facilities were estimated based on data reported in their monthly operating reports (MORs) and were used to calibrate the model. Wasteload allocations have been established equal to their permitted monthly loads and are shown in Tables 6-1 to 6-9. No reductions to the permitted loads for the wastewater treatment plants and industrial facilities are being recommended as part of this TMDL, because within the NPDES program all permits are written to meet water quality standards set at the design flows for WWTPs or other facilities. Therefore, the WLA is the current loading.

The CSOs in the watershed are also subject to the NPDES permit program and are also therefore included as wasteload allocations in the TMDL process. A long-term goal of 100 percent reductions from CSOs is being recommended as part of this TMDL.

Table 6-1. Wasteload allocations summary table for Eagle Creek (assessment unit 05030103-040).

Permit No.	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
OH0131474	1.09E+10	1.09E+10	0%
OH0045462	2.89E+12	2.89E+12	0%
OH0025330	2.06E+12	2.06E+12	0%
OH0038547	1.16E+12	1.16E+12	0%
OH0044300	1.82E+11	1.82E+11	0%
OH0123676	8.91E+10	8.91E+10	0%
OH0025801	5.69E+11	5.69E+11	0%
Total	6.96E+12	6.96E+12	0%

Table 6-2. Wasteload allocations summary table for Mahoning River above Duck Creek and below Eagle Creek (assessment unit 05030103-050).

Permit No.	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
OH0011193	2.93E+11	2.93E+11	0%
OH0107484	5.45E+10	5.45E+10	0%
OH0117561	5.07E+10	5.07E+10	0%
OH0129682	5.49E+10	5.49E+10	0%
OH0022110	4.48E+12	4.48E+12	0%
OH0043851	1.61E+12	1.61E+12	0%
OH0023671	1.79E+11	1.79E+11	0%
OH0023868	2.94E+13	2.94E+13	0%
OH0038792	6.84E+11	6.84E+11	0%
OH0091901	1.12E+10	1.12E+10	0%
OH0126225	7.24E+09	7.24E+09	0%
OH0129241	1.26E+10	1.26E+10	0%
OH0129755	8.38E+07	8.38E+07	0%
OH0011878	1.40E+12	1.40E+12	0%
OH0020443	5.64E+12	5.64E+12	0%
OH0024091	3.29E+11	3.29E+11	0%
OH0044113	5.37E+11	5.37E+11	0%
OH0045675	1.84E+11	1.84E+11	0%
OH0129658	9.01E+11	9.01E+11	0%
OH0125792	9.93E+09	9.93E+09	0%
OH0129178	7.82E+10	7.82E+10	0%
OH0107433	1.91E+11	1.91E+11	0%
OH0128490	2.47E+10	2.47E+10	0%
OH0128708	1.12E+10	1.12E+10	0%
OH0037893	5.54E+09	5.54E+09	0%
OH0038539	2.50E+11	2.50E+11	0%
OH0038571	3.02E+11	3.02E+11	0%
OH0045641	2.80E+11	2.80E+11	0%
OH0123854	1.09E+09	1.09E+09	0%
OH0131326	6.60E+09	6.60E+09	0%
OH0091740	1.45E+11	1.45E+11	0%
OH0123757	1.60E+11	1.60E+11	0%

Permit No.	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
OH0126365	2.43E+10	2.43E+10	0%
All CSOs	6.20E+15	0.00E+00	100%
Total	6.25E+15	4.73E+13	99%

Table 6-3. Wasteload allocations summary table for Duck Creek (assessment unit 05030103-050).

Permit No.	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
OH0128872	8.75E+10	8.75E+10	0%

Table 6-4. Wasteload allocations summary table for Mosquito Creek (assessment unit 05030103-070).

Permit No.	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
OH0010863	2.25E+12	2.25E+12	0%
OH0043401	2.79E+13	2.79E+13	0%
OH0044881	7.90E+10	7.90E+10	0%
OH0064301	1.76E+09	1.76E+09	0%
OH0091634	2.86E+11	2.86E+11	0%
OH0092550	4.90E+10	4.90E+10	0%
OH0126250	1.05E+10	1.05E+10	0%
OH0128571	3.36E+10	3.36E+10	0%
OH0128732	1.17E+10	1.17E+10	0%
OH0128856	7.62E+09	7.62E+09	0%
OH0128937	2.18E+10	2.18E+10	0%
OH0128945	1.97E+09	1.97E+09	0%
OH0129071	5.83E+10	5.83E+10	0%
All CSOs	2.16E+15	0.00E+00	100%
Total	2.19E+15	3.07E+13	99%

Table 6-5. Wasteload allocations summary table for Mud Creek (assessment unit 05030103-070).

Permit No.	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
OH0107450	3.30E+11	3.30E+11	0%
Total	3.30E+11	3.30E+11	0%

Table 6-6. Wasteload allocations summary table for Meander Creek (assessment unit 05030103-070).

Permit No.	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
OH0045721	2.31E+13	2.31E+13	0%
OH0046078	8.07E+11	8.07E+11	0%
OH0117587	3.27E+10	3.27E+10	0%
Total	2.39E+13	2.39E+13	0%

Table 6-7. Wasteload allocations summary table for Squaw Creek (assessment unit 05030103-070).

Permit No.	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
OH0044504	3.90E+10	3.90E+10	0%
OH0097993	4.92E+11	4.92E+11	0%
OH0117625	1.28E+10	1.28E+10	0%
OH0129038	2.43E+10	2.43E+10	0%
OH0129062	4.30E+10	4.30E+10	0%
OH0129089	8.10E+10	8.10E+10	0%
Total	6.92E+11	6.92E+11	0%

Table 6-8. Wasteload allocations summary table for Mill Creek (assessment unit 05030103-080).

Permit No.	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
OH0021776	6.92E+12	6.92E+12	0%
OH0037249	3.52E+13	3.52E+13	0%
All CSOs	1.31E+15	0.00E+00	100%
Total	1.35E+15	4.21E+13	97%

Table 6-9. Wasteload allocations summary table for Crab Creek (assessment unit 05030103-080).

Permit No.	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
OH0092461	1.50E+11	1.50E+11	0%
OH0126004	2.08E+10	2.08E+10	0%
OH0128953	5.50E+10	5.50E+10	0%
All CSOs	2.01E+15	0.00E+00	100%
Total	2.01E+15	2.26E+11	100%

Table 6-10. Wasteload allocations summary table for Yellow Creek (assessment unit 05030103-080).

Permit No.	Total Seasonal Loading for Existing Conditions (cfu/summer)	Total Seasonal Loading for Allocation Conditions (cfu/summer)	Percent Reduction
OH0128287	5.27E+09	5.27E+09	0%
OH0024325	1.02E+13	1.02E+13	0%
Total	1.02E+13	1.02E+13	0%

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7.0 MARGIN OF SAFETY

The MOS accounts for any uncertainty concerning the relationship between pollutant loading and receiving water quality. The MOS can be implicit (e.g., incorporated into the TMDL analysis through conservative assumptions) or explicit (e.g., expressed in the TMDL as a portion of the loading) or a combination of both. For the Mahoning River TMDL, the MOS was included explicitly at 10 percent by determining the loading capacity based on not exceeding 90 percent of the numeric criteria (i.e., 1,800 counts/100 mL instead of 2,000 counts/100 mL for the instantaneous part of the criterion and 900 counts/100 mL instead of 1,000 counts/100 mL for the geometric mean part of the criterion). A moderate margin of safety was determined to be appropriate because the model is believed to be providing good information on the relationship between pollutant loadings and receiving water quality. Please refer to Appendix A Figures 9 to 27 for details on the results of the modeling.

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8.0 SEASONAL VARIATION

A TMDL must consider seasonal variation in the derivation of the allocation. By using continuous simulation (modeling over a period of several years), seasonal variations in hydrologic conditions and source loadings were inherently taken into account. The fecal coliform counts simulated on a daily time step by the model were compared to TMDL targets and an allocation was developed that would meet these targets during the summer critical conditions. Figures 4-1 to 4-4 illustrate the cyclic seasonal nature of the data and the allocations. The allocations are for April through October recreational use with the primary contact standard.

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9.0 MONITORING PLAN

OEPA will continue its quarterly sampling of the Mahoning River at Lowellville and Leavittsburg to determine compliance with water quality standards and to track long-term trends. The NPDES facilities will also be required to continue to submit the results of their ambient water quality sampling collected for their monthly operating reports. These data will also be useful in tracking long-term trends.

OEPA is scheduled to re-evaluate the entire watershed in 2008 as part of the rotating basin monitoring schedule. Further studies have been ongoing in the Mahoning since 1997, with Rivers Unlimited sponsoring River Resource Economics Studies.

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10.0 REASONABLE ASSURANCES

As part of an implementation plan, reasonable assurances provide a level of confidence that the wasteload allocations and load allocations in TMDLs will be implemented by Federal, State, or local authorities and/or by voluntary action. Stakeholders will implement BMPs that directly correlate to water quality goals and attainment standards. BMP implementation is dependent on availability of funding from State, local, and Federal sources. Reasonable assurances for planned point source controls, such as wastewater treatment plant upgrades and changes to NPDES permits, include a schedule for implementation of planned NPDES permit actions. In the regulatory framework, basin-wide limits for NPDES dischargers will be an available tool to reduce the discharge. For non-enforceable actions (certain nonpoint source activities), assurances must include 1) demonstration of adequate funding; 2) process by which agreements/arrangements between appropriate parties (e.g., governmental bodies, private landowners) will be reached; 3) assessment of the future of government programs which contribute to implementation actions; and 4) demonstration of anticipated effectiveness of the actions. It will be important to coordinate activities with those governmental entities that have jurisdiction and programs in place to implement the nonpoint source actions (e.g., county soil and water conservation district offices, county health departments, local Natural Resource Conservation Service offices of the U.S. Department of Agriculture, municipalities and local governmental offices).

Non-regulatory actions would include finalization of an implementation plan, discussed further in the next section, which includes education activities, stormwater management, agricultural BMPs, stream channel restoration and periodic stream monitoring to measure progress. BMPs include but are not limited to fertilizer reduction, riparian buffer, natural stream channel design, increased no-till farming, manure/nutrient management, etc.

Incentive-based projects would include 319 projects, funding a watershed coordinator for public outreach and education, and various loan opportunities for agriculture practices and riparian/habitat improvements.

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11.0 IMPLEMENTATION

Generally, implementation of BMPs relies on voluntary and incentive programs, such as government cost-sharing. Therefore, the implementation plan should show there is reasonable assurance that nonpoint source controls will be implemented and maintained. Long-term watershed water quality monitoring will also be important in evaluating the effectiveness of BMPs. The implementation plan will include a time schedule describing when the activities necessary to implement the TMDL will occur. This would include a time line for implementation of BMPs and/or control actions.

Urban issues are a major a factor affecting water quality in the Mahoning River watershed, with 84 industrial facilities and wastewater treatment plants located in the watershed. Fecal coliform enters the system in many ways, including CSOs, SSOs, permitted discharge, unsewered areas and stormwater runoff. Long-term control plans for the cities of Warren, Youngstown, and Girard are being developed to address CSOs in these communities. New stormwater Phase II requirements also require that the communities in the watershed implement best management practices to control stormwater runoff to the maximum extent practicable. This study has also confirmed that the cumulative impact of numerous so-called “unsewered areas” can have a significant impact on water quality and therefore no future home sewage treatment systems should be allowed to discharge “off-lot” for new construction sites.

Animal waste is also a significant contributor to nonpoint source pollution in the Mahoning River watershed. Implementation actions include the voluntary development of manure nutrient management plans, promotion of evolving technologies for safe land application of manure, grid soil sampling of lands proposed for manure application, establishment of grassed filter strips, building of manure storage facilities according to NRCS specifications, exclusion of livestock from streams with alternate water supplies, and certification of manure applicators.

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12.0 PUBLIC PARTICIPATION

This TMDL "The Total Maximum Daily Load (TMDL) report for the Mahoning River, Ohio, Watershed" is completed by the USEPA in conjunction with the OEPA and Tetra Tech, Inc., under Section 303(d) of the Clean Water Act, and was put on public notice on July 28, 2004. The TMDL report includes the name and location of the waterbody segments and the pollutant of concern (fecal coliform). The Mahoning River watershed was identified as a priority impaired water on Ohio's 2004 303(d) list (OEPA, 2004). Public comments and the responsiveness summary have been added at the end of this document.

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