Office of Water Quality

Total Maximum Daily Load Program

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Total Maximum Daily Load for *E. coli* Impairment St. Marys River Watershed and Maumee River, Adams and Allen Counties

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Total Maximum Daily Load (TMDL) for *Escherichia coli* (*E. coli*) in St. Marys River Watershed and Maumee River, Adams and Allen Counties, Indiana

Introduction

In accordance with section 303(d) of the Federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations (CFR), Part 130) it is required that States develop a Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting Water Quality Standards (WQS). TMDLs provide States a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL are to identify the sources of the impairment and determine the allowable levels of *E. coli* bacteria for the St. Marys River watershed in Adams and Allen Counties and *E. coli* bacteria for the Maumee River in Allen County in Indiana.

The Indiana Department of Environmental Management (IDEM) was awarded a 104(b)(3) grant by U.S. EPA Region 5 to complete TMDLs for the St. Marys River watershed and Maumee River in 2004. America's Clean Water Foundation was also awarded a grant for the services of Bruce Cleland, of US EPA Region 10, to assist IDEM in developing these watershed and river TMDLs. After IDEM and Mr. Cleland reviewed the initial data used to impair this watershed and river, a more comprehensive study was then initiated in the spring of 2004 to gain a thorough understanding of the St. Marys River watershed. IDEM sampled the St. Marys River watershed biweekly from March of 2004 through October of 2004. A partnership was also created with the City of Ft. Wayne to sample several sites in Adams and Allen County on the weeks opposite the IDEM sampling, from July of 2004 through October of 2004. This sampling was done to examine basic water quality throughout the St. Marys watershed, which included several key tributaries. Additional water quality data was not collected in the Maumee River during the 2004 sampling event.

These TMDLs will be separated into sections by impairment. When appropriate, each section will then be separated further into the St. Marys River watershed and Maumee River. Each section will contain detailed information regarding the waterbodies that are impaired for that parameter, a description of the impairment, sources of the impairment, the appropriate load allocations, waste load allocations, margin of safety, and implementation suggestions for that impairment. A general description of the St. Marys River watershed and Maumee River TMDLs are located below.

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St. Marys River Watershed

The St. Marys River watershed is located in Adams and Allen Counties in Indiana. The St. Marys River watershed is located in the Great Lakes Basin, hydrologic unit code 41000040. The St. Marys River watershed TMDL includes the St. Marys River, Habegger Ditch, Gates Ditch, Blue Creek, Yellow Creek, Martz Ditch, Borum Run, Holthouse Ditch, Kohne Ditch, Gerke Ditch, and Nickelsen Creek. The St. Marys River starts in Ohio and flows across the Ohio-Indiana State line into the southern part of Adams County. The St. Marys River continues north

through Adams and Allen County before it is joined by the St. Joseph River to create the Maumee River in the City of Fort Wayne and flows back into Ohio (Figure 1). Ohio also has the St. Marys River listed on their 303(d) List. Unfortunately, Ohio has their portion of the St. Marys River TMDL scheduled for completion in 2012. Due to complications in the Ohio scheduling of TMDLs, the Ohio portion of the St Marys River TMDL has to be completed at a later date. Ohio's TMDL Program has provided support in the completion of Indiana's St. Marys River watershed TMDL.

The St. Marys River watershed is listed on the 2002 303(d) List for *E. coli*, impaired biotic communities (IBC), ammonia, nutrients, algae, and total dissolved solids. On the 2004 303(d) List, the St. Marys River watershed is listed for *E. coli*, impaired biotic communities (IBC), ammonia, and nutrients. Based on the data collected in 2004 by IDEM and the City of Ft. Wayne, a reassessment was completed on the St. Mary River watershed. This reassessment was completed to define the extent of the impairments listed on the 2004 303(d) List and in turn confirmed the listings of the St. Marys River watershed that were on the 2002 303(d) List. The reassessment for the *E. coli* impairment resulted in the addition of the following segments in the St. Marys River watershed to the 2006 303(d) List: INA0443_T1019, INA0443_T1020, INA0442_00, INA0445_00, INA0446_00, INA0446_T1015, INA0448_00, INA0449_00, INA0453_00, INA0454_T1005, INA0454_T1012, INA0463_00, INA0463_T1003, INA0446_T1022, INA0465_00, and INA0465_T1002. The reassessment also determined that segment INA0446_T1013 will be split. In this segment, the headwaters will be changed to "being evaluated for *E. coli*" and will not appear on the 2006 303(d) List. However, the main stem of this segment up to the first tributary will be assessed as impaired for *E. coli* and will be listed on the 2006 303(d) Lists (Figure 1, Table 1).

Table 1: 2004 303(d) Listings for St. Marys River watershed

Waterbody Name	**303(d) List ID**	**Segment ID Number**	**Length (Miles)**	**Impairment**
St. Marys-Willshire	40	INA0434_00	2.84	*E. coli*
St. Marys River	40	INA0441_00	0.86	*E. coli*
St. Marys-Willshire	40	INA0434_00	2.84	*E. coli*
St. Marys River	40	Ina0441_00	0.86	*E. coli*
Blue Creek	40	INA0442_T1007	11.94	*E. coli*
Blue Creek	40	INA0445_T1006	12.28	*E. coli*, IBC, ammonia, nutrients
Duer Ditch (Adams) and Other Tribs	*to be determined	INA0445_00	9.33	*E. coli*
Blue Creek Headwaters (Adams)	*to be determined	INA0442_00	8.46	*E. coli*
Habegger Ditch	43	INA0443_T1008	5.8	*E. coli*, IBC, nutrients
Wittmer Ditch, No. 1	*to be determined	INA0443_T1020	2.98	*E. coli*
Farlow Ditch and Tribs	*to be determined	INA0443-T1019	11.01	*E. coli*
Gates Ditch	273	INA0443_T1014	1.17	*E. coli*

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Little Blue Creek	272	INA0444_00	22.12	*E. coli*
Borum Run and Tribs	*to be determined	INA0448_00	21.65	*E. coli*
Yellow Creek	274	INA0447_00	32.79	*E. coli*, IBC, nutrients
Martz Creek-Ruppert Ditch and Unnamed Tributaries	274	INA0447_T1002	9.82	*E. coli*
Holthouse Ditch-Kohne Ditch	275	INA0452_00	10.16	IBC, *E. coli*
St. Marys River	47	INA0448_T1016 INA0449_T1017 INA0453_T1018 INA0454_T1021	21.27	*E. coli*
St. Marys River	47	INA0461_T1004 INA0463_T1003 INA0465_T1002	16.43	*E. coli*, FCA for PCB & Hg
St. Marys River	*to be determined	INA0446_T1015	4.79	*E. coli*
Unnamed Trib of St. Marys River	276	INA0454_T1012	2.84	*E. coli*, IBC
Pleasant Mills and Tribs	*to be determined	INA0446_00	15.3	*E. coli*
Decatur Tribs	*to be determined	INA0449_00	7.12	*E. coli*
Gerke/Weber Ditch and Tribs	*to be determined	INA0453_00	17.53	*E. coli*
Snyder Ditch and Other Tribs	*to be determined	INA0463_00	10.61	*E. coli*
Junk Ditch	*to be determined	INA0465_00	6.55	*E. coli*
Spy Run Creek	278	INA0465_T1011	8.75	*E. coli*
Unnamed Tributaries to Spy Run Creek	Evaluated Assessment – will not be listed	INA0466_T1012	5.08	*E. coli*
Lowther Neuhaus Ditch	278	INA0466_T1013	3.03	*E. coli*
Unnamed Tributary to Lowther Neuhaus Ditch	278	INA0466_T1014	3.00	*E. coli*
St. Marys River	47	INA0466_T1022	0.5	*E. coli*
Maumee River	45	INA0511_M1007, INA0514_M1006, INA051A_M1003	15.58	*E. coli*
Maumee River	45	INA0516_M1005	4.34	**E. coli*, FCA for Hg and PCBs
Maumee River	45	INA0518_M1004, INA051C_M1002,	9.57	*E. coli*, FCA for Hg and PCBs

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		INA051D_M1003		

*303(d) numbers will be assigned as appropriate during the 2006 303(d) listing process. The total miles of the stream, may also be adjusted on the 2006 303(d) List.

The purpose of the St. Marys River watershed TMDL is to identify the sources and determine the allowable levels of *E. coli* bacteria, impaired biotic communities (IBC), ammonia, nutrients, algae, and total dissolved solids. For the waterbodies listed as having an impaired biotic community, the goal of the TMDL will be to identify the pollutants causing the impairment and then set the appropriate allocations or watershed practices based on the pollutants that have been identified. These activities will result in the attainment of the applicable WQS in the St. Marys River watershed in Adams and Allen Counties, Indiana.

Maumee River

The Maumee River is located in Allen County, Indiana. The Maumee River is formed by the joining of the St. Marys River and St. Joseph River in the City of Fort Wayne. The Maumee River then flows east through Allen County and across the Indiana-Ohio State line into Ohio. The major tributaries in the Maumee River include Trier Ditch, Bullerman Ditch, Gar Creek, Botern Ditch, Black Creek, Ham Interceptor Ditch, and other tributaries (Figure 2).

The Maumee River is listed on the 2002 and 2004 303(d) Lists for *E. coli*. *E. coli* samples collected at sites on the Maumee River and two of its major tributaries by the Allen County Health Department and the City of Ft. Wayne confirm the *E. coli* impairment as listed on the 2004 303(d) List. Segment, INA0516_M1005, of the Maumee River is not listed for *E. coli*. A reassessment was completed on this segment and it will be listed for *E. coli* on the 2006 303(d) List. The tributaries of Bullerman Ditch and Botern Ditch are listed on the 2004 303(d) List for impaired biotic communities (IBC). The tributary of Black Creek is listed on the 2004 303(d) List for nutrients and algae. The tributary of Ham Interceptor Ditch is listed on the 2004 303(d) List for impaired biotic communities and nutrients (Table 2). The Maumee River portion of this TMDL will only address the *E. coli* impairment on the Maumee River. The additional streams that have been impaired in the Maumee River Basin will be addressed in future TMDLs. The Maumee River is listed on the Ohio 2004 303(d) List for aquatic life impairment but not for recreational uses. Similar to the St. Marys TMDL, the Ohio portion of the Maumee River will be completed at a future time.

Table 2: 2004 303(d) Listings for Maumee River

Waterbody Name	**303(d) List ID**	**Segment ID Number**	**Length (Miles)**	**Impairment**
Maumee River	45	INA0511_M107 INA0514_M1006 INA051A_M1003	15.58	*E. coli*
Maumee River	45	INA0516_M1005	4.34	**E. coli*, FCA Hg & PCBs
Maumee River	45	INA0518_M1004 INA051C_M1002 INA051D_M1003	9.57	*E. coli*, FCA Hg & PCBs
Bullerman Ditch & other Tribs	266	INA0514_00	7.76	IBC
Botern Ditch & Tribs	267	INA0519_T1008	9.69	IBC

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Black Creek (Allen County)	268	INA051B_00	34.37	nutrients algae
Ham Interceptor Ditch	269	INA051E_00	38.36	IBC, nutrients

*will be added in the 2006 303(d) List

The purpose of the Maumee River TMDL is to identify the sources and determine the allowable levels of *E. coli* bacteria that will result in the attainment of the applicable WQS in the Maumee River in Allen County, Indiana.

E. coli TMDL for St. Marys River Watershed

The St. Marys River watershed can be divided into multiple sub-watersheds according to the major tributaries. Each of these major tributaries is impaired for *E. coli* separate from the St. Marys River *E. coli* impairment. These sub-watersheds are Blue Creek, Yellow Creek, Borum Run, Holthouse Ditch, and Nickelsen Creek. This section will address the TMDL required for the *E. coli* impairment in the St. Marys River watershed. Each of the sub-watersheds, in addition to the St. Marys River, will have a separate source assessment, while the numeric target, WLA, LA, and implementation activities will be applied to the entire St. Marys River watershed.

Section 1 Background for St. Marys River watershed

The St. Marys River watershed was listed for an *E. coli* impairment on Indiana's 2002 and 2004 303(d) Lists. On the 2002 303(d) List, Blue Creek, Gates Ditch, and Little Blue Creek were also listed for an *E. coli* impairment. On the 2004 303(d) List, Habegger Ditch was added for an *E. coli* impairment (Figure 1, Table 3).

Due to additional data collection by IDEM's Assessment Branch in 2004, the 303(d) listing was reassessed for the *E. coli* impairment. Based on the reassessment, for the 2006 303(d) List, the St. Marys River, the Unnamed Tributaries of Blue Creek, Fuch Ditch, Schugg Ditch, Swartz Ditch, Wittmer Ditch No.1, Wittmer Ditch No.2, Farlow Ditch, Peel Ditch, Smith Shoemaker Ditch, Borum Run, Brown Ditch, Miller Ditch, Hanhet Ditch, Bluhm Ditch, Hessler Ditch, Blair Ditch, Holthouse Ditch-Kohne Ditch, St. Marys River Tributary, Gerke Ditch & other tributaries, and Weber Ditch will be added (Figure 1).

The state of Ohio has the St. Marys River listed as impaired for *E. coli* on their 303(d) List. However, the TMDL for the St. Marys River in Ohio is not scheduled to be developed until 2012. Ohio EPA has provided information on the St. Marys River in Ohio in support of the IDEM TMDL Program's development of the St. Marys River watershed TMDL.

This TMDL address approximately 212.62 miles of the St. Marys River watershed in Adams and Allen Counties, Indiana, where designated uses are impaired by elevated levels of *E. coli* during the recreational season. Adams and Allen Counties are located in northeast Indiana (Figure 1). All of the twenty-five (25) segments of the listed streams for this TMDL are located in the Great Lakes Basin in hydrologic unit codes 05120201 and 05120202. The description of the study area, its topography, and other particulars are as follows:

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Table 3: 2004 303(d) Listings for the Major Tributaries of the St. Marys River Watershed

Waterbody Name	303(d) List ID	Segment ID Number(s)	Length (miles)	Impairment
Blue Creek	40	INA0442_T1007, INA0445_T1006	24.22	*E. coli*
Duer Ditch (Adams) and Other Tribs	* To be determined	INA0445_00	9.69	*E. coli*
Blue Creek Headwaters (Adams)	* To be determined	INA0442_00	8.46	*E. coli*
Habegger Ditch	43	INA0443_T1008	5.8	*E. coli*
Wittmer Ditch, No. 1	* To be determined	INA0443_T1020	2.98	*E. coli*
Farlow Ditch and Tribs	*To be determined	INA0443_T1019	11.01	*E. coli*
Gates Ditch	273	INA0443_T1014	1.17	*E. coli*
Little Blue Creek	272	INA0444_00	22.12	*E. coli*
Borum Run and Tribs	* To be determined	INA0448_00	21.65	*E. coli*
St. Marys River	47	INA0448_T1016	1.44	*E. coli*
Holthouse Ditch-Kohne Ditch	275	INA0452_00	10.16	*E. coli*
St. Marys River	47	INA0449_T1017, INA0453_T1018, INA0454_T1005, INA0454_T1021, INA0461_T1004, INA0463_T1003, INA0465_T1002	37.7	*E. coli*
Junk Ditch	*to be determined	INA0465_00	6.55	*E. coli*
St. Marys River	* To be determined	INA0446_T1015	4.79	*E. coli*
Yellow Creek	274	INA0447_00	32.79	*E. coli*, IBC, nutrients
Martz Creek-Ruppert Ditch and Unnamed Tributaries	274	INA0447_T1002	9.82	*E. coli*
St. Marys River Trib	276	INA0454_T1012	2.84	*E. coli*
Gerke/Weber Ditch and Tribs	* To be determined	INA0453_00	17.53	*E. coli*
Snyder Ditch and Other Tribs	* To be determined	INA0463_00	10.61	*E. coli*
Junk Ditch and Other Tribs	* To be determined	INA0465_00	6.55	*E. coli*
Spy Run Creek	278	INA0465_T1011	8.75	*E. coli*
Pleasant Mills and Tribs	* To be determined	INA0446_00,	15.3	*E. coli*
Decatur Tribs	* To be determined	INA0449_00	7.12	*E. coli*
Unnamed Tributaries to Spy Run Creek	Evaluated Assessment – will not be listed	INA0466_T1012	5.08	*E. coli*

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Lowther Neuhaus Ditch	278	INA0466_T1013	3.03	*E. coli*
Unnamed Tributary to Lowther Neuhaus Ditch	278	INA0466_T1014	3.00	*E. coli*
St. Marys River	47	INA0466_T1022	0.5	*E. coli*
*To be determined on 2006 303(d) List				

Historical data collected by IDEM's Assessment Branch documented elevated levels of *E. coli* in the St. Marys River watershed from 1991 to 2004. IDEM's Assessment Branch completed a survey of the watershed for the St. Marys River in 2000. In this survey, IDEM's Assessment Branch sampled four sites, five times, with the samples evenly spaced over a 30-day period from June 12, 2000 to July 10, 2000 (Figure 3). Each of the four sites violated the single sample maximum standard and geometric mean standard. This data was the basis for listing the St. Marys River watershed on the 2002 303(d) List.

An intensive survey was completed by IDEM's Assessment Branch in 2004. IDEM's Assessment Branch sampled fourteen sites, once every other week from March 2004 to October 2004 (Figure 3). The City of Ft. Wayne sampled seven of the same sites as IDEM on opposite weeks from July of 2004 through October of 2004. This enables IDEM to calculate a geometric mean value for these seven sites sampled from July 2004 to October 2004. Each of these sites violated the single sample maximum standard nine to twelve times in the survey. The geometric mean was violated 92% of the time (Attachment A).

The City of Ft. Wayne sampled the St. Marys River at two sites weekly during the recreational season from 2001 through 2004. These two sites had many violations of the single maximum and geometric mean standards over this time period (Figure 3, Attachment A).

The Allen County Health Department conducting a study to see the impact septic systems have on a waterbody. The Health Department chose sampling sites throughout Allen County that had a cluster of homes on septics with an adjacent stream. Three of Allen County Health Department sampling sites were in the St. Marys River watershed. These sites were sampled weekly during the recreational season from 2001 through 2004. All three of these sites violated the single sample maximum and geometric mean standard multiple times over this time period. Some of the single sample maximum standard violations were substantially higher than the water quality standards (Figure 3, Attachment A).

As part of a 319 grant, the Adams County Soil and Water Conservation District sampled twelve sites in the St. Marys River watershed approximately monthly from May of 2000 through May of 2001. These sampling locations were focused on the St. Marys River, Blue Creek, and Little Blue Creek. The single sample maximum standard was violated 83% of the time (Figure 3, Attachment A).

Section 2 Numeric Targets

The impaired designated use for the waterbodies in the St. Marys River watershed is for total body contact recreational use during the recreational season, April 1st through October 31st.

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Indiana Administrative Code 327 IAC 2-1.5-8(e)(2), establishes the full body contact recreational use *E. coli* WQS[1] for all waters in the Great Lakes system as follows:

> (2) *E. coli* bacteria, using membrane filter (MF) count, shall not exceed one hundred twenty-five (125) per one hundred (100) milliliters as a geometric mean based on not less than five (5) samples equally spaced over a thirty (30) day period nor exceed two hundred thirty-five (235) per one hundred (100) milliliters in any one (1) sample in a thirty (30) day period.

The sanitary wastewater *E. coli* effluent limits from point sources in the Great Lakes system during the recreational season, April 1st through October 31st, are also covered under 327 IAC 2-1.5-8(e)(2).

For the St. Marys River watershed during the recreational season (April 1st through October 31st), the target level is set at the *E. coli* WQS of 125 per one hundred milliliters as a 30-day geometric mean based on not less than five samples equally spaced over a thirty day period.

Section 3 Source Assessment

Section 3.1 Blue Creek Sub-Watershed

Watershed Characterization

The Blue Creek sub-watershed is located entirely in Adams County. Blue Creek starts in the southwest portion of the county near the Adams-Wells County Line. Blue Creek then flows southeast until it is joined by Habegger Ditch. Blue Creek then turns and starts to flow northeast before discharging into the St. Marys River. Little Blue Creek is the last major tributary to discharge into Blue Creek before it joins the St. Marys River (Figure 4).

A reassessment using the data gathered by IDEM in 2004 was completed on the Blue Creek sub-watershed during the development of the St. Marys River watershed TMDL. In addition to portions of Blue Creek, all of Gates Ditch, and Habegger Ditch being listed as impaired for *E. coli*, the reassessment concluded that the headwaters of Blue Creek, Farlow Ditch & Tributaries, Wittmer No. 1 Ditch and Duer Ditch & other tributaries will be listed on the 2006 303(d) List as impaired for *E. coli*. The 2004 reassessment resulted in the entire Blue Creek sub-watershed being scheduled to be listed as impaired for *E. coli* on the 2006 303(d) List. The St. Marys River watershed TMDL will address the *E. coli* impairment as it will appear on the 2006 303(d) List. The data that was collected by the City of Ft. Wayne in conjunction with IDEM data collected in 2004 supported the conclusions of the reassessment.

E. coli Data

Twelve of the thirty sampling sites for the St. Marys River watershed are located in the Blue Creek sub-watershed. At one of the twelve sampling sites, Site 3, *E. coli* data was not collected leaving eleven sampling sites in the Blue Creek sub-watershed sampled for *E. coli*. Five of the eleven sampling sites, for *E .coli* (as indicated by the purple asterisk on Figure 4) were sampled by the Adams County Soil & Water Conservation District from May of 2000 to October of 2000 monthly. Four of the eleven sampling sites for *E. coli* (noted by red triangles on Figure 4) were sampled by IDEM's Assessment Branch from March of 2004 to October of 2004 biweekly. One

[1] *E. coli* WQS = 125 cfu/100ml or 235 cfu/100ml; 1 cfu (colony forming units)= 1 mpn (most probable number)

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of the sampling sites, Site 7, was sampled by the Adams County Soil & Water Conservation District and IDEM. The Adams County Soil and Water Conservation District sampled this site from May of 2000 through Oct of 2000 and April of 2001 through May of 2001 monthly. IDEM's Assessment Branch sampled this site biweekly from March of 2004 through Oct of 2004. The remaining sampling site, Site 11, (as indicated by the blue hexagon on Figure 4) was sampled by the City of Ft. Wayne and IDEM's Assessment Branch from March of 2004 to October of 2004. IDEM's Assessment Branch sampled this site biweekly from March of 2004 to October of 2004. The City of Ft. Wayne sampled this site on the opposite weeks IDEM's Assessment Branch sampled this site from July of 2004 to October of 2004. This allowed IDEM's TMDL Program to obtain a geometric mean value from the data collected from July of 2004 to October of 2004 (Attachment A).

The data collected by the Adams County Soil & Water Conservation District in 2000 had an *E. coli* single sample maximum standard average violation 89% of the time. The data collected by IDEM and the City of Ft. Wayne in 2004 had an average *E. coli* single sample maximum standard violation 86% of the time and a geometric mean standard violation 100% of the time. The highest single sample maximum standard *E. coli* value was recorded at >48,000 cfu/100mL at Site 11 in 2004. Combining all data, the *E. coli* values ranged from just over the single sample maximum standard to >48,000 cfu/100mL. The highest geometric mean value was recorded at >22,719 cfu/100mL at Site 11 in 2004.

Seven of the eleven sampling sites represent *E. coli* values for Blue Creek. The remaining five sample sites represent the major tributaries to Blue Creek. All eleven sampling locations were sampled at the mouth of the major tributaries, and had elevated levels of *E. coli*. The sampling sites on Blue Creek also had an elevated level of *E. coli*. The major tributaries in the Blue Creek sub-watershed are listed separately as being impaired for *E. coli*, but it can be concluded that these tributaries are contributing to the *E. coli* impairment in Blue Creek.

Landuse

Landuse information was assembled in 1992 using the Gap Analysis Program (GAP). In 1992, approximately 94% of the landuse in the Blue Creek sub-watershed was agriculture. The remaining landuse for the Blue Creek sub-watershed consisted of approximately 5% forested, 0.4% palustrine wetlands, 0.7% urban (Figure 5). A comparison of 1992 landuse with the aerial photos taken in 2003 shows no substantial changes to the Blue Creek sub-watershed have occurred.

Wildlife

Wildlife is a known source of *E. coli* impairments in waterbodies. Many animals spend time in or around waterbodies. Deer, geese, ducks, raccoons, turkeys, and other animals all create potential sources of *E. coli*. Wildlife contributes to the potential impact of contaminated runoff from animal habitats, such as urban park areas, forest, and cropland.

Septic Systems

Many homes within the Blue Creek sub-watershed treat wastewater with on-site septic systems. Failing septic systems are known sources of *E. coli* impairment in waterbodies. In 2001, the Adams County Health Department completed a study to identify homes that have only septic tanks and no additional treatment systems throughout the county. Many of these systems then discharge directly to a stream or to a field tile that will carry the wastewater to streams. This

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study found an estimated 35% of the homes, approximately 10,000 residents, in rural Adams County have only a septic tank and no additional treatment for their wastewater. This study also identified seven unsewered communities. These seven unsewered communities represent 10% of the approximate 10,000 residents who are neither connected to a municipal treatment plant or using a complete on-site septic system. The remaining 90% live in rural communities that are not as accessible to connecting to a municipal system. Six of the seven unsewered communities are located in the St. Marys River watershed. These six communities are Pleasant Mills, Arcadia Village Subdivision and surrounding area, Monmouth, Preble-Magley, Peterson, and Sunnybrook (or Andrews) Subdivision. In 1986, the Adams County Health Department began requiring new homes in the rural, unsewered areas to install on-site septic systems according to the Indiana State Department of Health rules and regulations. Many of the homes in these communities were built prior to 1986 and are not covered under this new regulation. As of February 2005, approximately 750 to 800 on-site septic systems exist in Adams County, which is an increase from approximately 600 onsite systems in 2001. (Smith, T., 2005)

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

There are three NPDES permitted facilities located in the Blue Creek sub-watershed (Figure 4, Appendix 1). Pleasant Mill #2/Meshberger Bros. Stone Plant #2 (ING490084) discharges to Blue Creek and does not contain a sanitary component. Bing-Lear Manufacturing Group, Berne (IN0058980) discharges to Habegger Ditch and does not contain a sanitary component. Berne STP (IN0021369) discharges to the Wabash River, which is not located in the St. Marys River watershed. However, the Berne STP effluent outfall did, until several years ago, discharge to Habegger Ditch. Pleasant Mill #2, Meshberger Bros. Stone Plant #2 and the Bing-Lear Manufacturing Group, Berne STP are not considered sources of *E. coli* to the Blue Creek sub-watershed since there is no sanitary component in their discharge. Even though the Berne STP effluent outfall has a sanitary component to its discharge, its outfall is no longer located on Habegger Ditch, so the Berne STP effluent outfall is also not considered a source of *E. coli* to the Blue Creek sub-watershed.

Combined Sewer Overflows (CSO) & Sanitary Sewer Overflows (SSO)

The City of Berne is the only CSO community in the Blue Creek sub-watershed (Figure 6, Appendix 2). The City of Berne has three CSO outfalls. These three CSO outfalls discharge to Sprunger Ditch, which is a tributary of Habegger Ditch. The City of Berne submitted their CSO Long Term Control Plan (LTCP) in August of 2002. The City of Berne and IDEM's office of Enforcement are currently working on an agreed order to address CSOs and SSOs in the collection system. SSOs are not a permitted activity and are not considered a legal discharge. CSO and SSO outfalls are considered a source of *E. coli* to the Blue Creek sub-watershed.

Confined Feeding Operations and Concentrated Animal Feeding Operations

The removal and disposal of the manure, litter, or processed wastewater that is generated as the result of confined feeding operations falls under the regulations for confined feeding operations (CFOs) and concentrated animal feeding operations (CAFOs). There are twenty CFOs in the Blue Creek sub-watershed (Figure 4). Three of the CFOs are designated as CAFOs (Figure 3, Appendix 3). The CFO and CAFO regulations (327 IAC 16, 327 IAC 15) require operations "not cause or contribute to an impairment of surface waters of the state." The active animal operations in Blue Creek sub-watershed have no open enforcement actions at this time. However, these operations are still considered a potential source of *E. coli* for the Blue Creek sub-watershed TMDL.

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Small Animal Operations

There are many smaller livestock operations in the watershed. These operations, due to their small size, are not regulated under the CFO or CAFO regulations. These operations may still have an impact on the water quality and the *E. coli* impairment. No specific information on these small livestock operations is currently available for the remaining portion of the Blue Creek sub-watershed. However, it is believed that these small livestock operations may be a source of *E. coli* impairment.

Section 3.2 Yellow Creek Sub-Watershed

Watershed Characterization

The Yellow Creek sub-watershed is located entirely in Adams County. Smith Ditch and Johnson Ditch combine to form Yellow Creek. Straight Branch and Hendricks Ditch flow into Yellow Creek downstream of the Smith Ditch and Johnson Ditch confluence. Yellow Creek flows northeast until it is joined by Martz Ditch. Ruppert Ditch is the major tributary of Martz Ditch. After Martz Ditch joins Yellow Creek, Yellow Creek then flows northwest to the St. Marys River (Figure 7).

A reassessment using the data gathered by IDEM in 2004 was completed on the Yellow Creek sub-watershed during the development of the St. Marys River watershed TMDL. It was determined that the headwater streams are not impaired for *E. coli* and will be delisted on the 2006 303(d) List. This includes the tributaries of Straight Branch, Smith Ditch, Johnson Ditch, and Hendricks Ditch. Yellow Creek, Martz Ditch, and Ruppert Ditch will remain on the 2006 303(d) List as impaired for *E. coli*. The St. Marys River watershed TMDL will address the *E. coli* impairment as it will appear on the 2006 303(d) List. The data that was collected by the City of Ft. Wayne in conjunction with IDEM data collected in 2004 supported the conclusions of the reassessment.

E. coli Data

Two of the thirty sampling sites for the St. Marys River watershed are located in the Yellow Creek sub-watershed. One of the two sampling sites is located on Martz Ditch before its confluence with Yellow Creek. This site was sampled biweekly by IDEM's Assessment Branch from March 2004 to October 2004. The remaining sampling site was located on Yellow Creek after the confluence of Martz Ditch. This sampling site was sampled by the City of Ft. Wayne and IDEM's Assessment Branch from March of 2004 to October of 2004. IDEM's Assessment Branch sampled this site biweekly from March of 2004 to October of 2004. The City of Ft. Wayne sampled this site on the opposite weeks IDEM's Assessment Branch sampled this site, from July of 2004 to October of 2004. This allowed IDEM's TMDL Program to obtain a geometric mean value from the data collected from July of 2004 to October of 2004 (Figure 7, Attachment A).

The *E. coli* data collected on Martz Ditch in 2004 has an average *E. coli* single sample maximum standard violation rate 68% of the time. The *E. coli* data collected on Yellow Creek by IDEM and the City of Ft. Wayne in 2004 had an average *E. coli* single sample maximum standard violation 84% of the time and a geometric mean standard average violation 100% of the time. The highest single sample maximum standard *E. coli* value was recorded at >48,392 cfu/100mL on Yellow Creek in 2004. Combining all data collected in the Yellow Creek sub-watershed, the

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E. coli values ranged from above 300 cfu/100mL to >48,000 cfu/100mL with an average single sample maximum standard violation 76% of the time. The highest geometric mean value was recorded at 39,720 cfu/100mL at Site 16 on Yellow Creek in 2004 (Figure 7).

The sampling site on Martz Ditch was taken at the mouth. The sample taken at the Yellow Creek sampling location downstream of the confluence with Martz Ditch had elevated levels of *E. coli*. Martz ditch and its tributary are listed separately as being impaired for *E. coli*, but it can be concluded that these tributaries are contributing to the *E. coli* impairment in Yellow Creek.

Landuse

Landuse information was assembled in 1992 using the Gap Analysis Program (GAP). In 1992, approximately 95% of the landuse in the Yellow Creek sub-watershed was agriculture. The remaining landuse for the Yellow Creek sub-watershed consisted of approximately 4% forested, 0.4% palustrine wetlands, 1% urban (Figure 8). A comparison of 1992 landuse with the aerial photos taken in 2003 shows no substantial changes to the Yellow Creek sub-watershed have occurred.

Wildlife

Wildlife is a known source of *E. coli* impairments in waterbodies. Many animals spend time in or around waterbodies. Deer, geese, ducks, raccoons, turkeys, and other animals all create potential sources of *E. coli*. Wildlife contributes to the potential impact of contaminated runoff from animal habitats, such as urban park areas, forest, and cropland.

Septic Systems

Many homes within the Yellow Creek sub-watershed treat wastewater with on-site septic systems. Failing septic systems are known sources of *E. coli* impairment in waterbodies. In 2001, the Adams County Health Department completed a study to identify homes that have only septic tanks and no additional treatment systems throughout the county. Many of these systems then discharge directly to a stream or to a field tile that will carry the wastewater to streams. This study found an estimated 35% of the homes, approximately 10,000 residents, in rural Adams County have only a septic tank and no additional treatment for their wastewater. This study also identified seven unsewered communities. These seven unsewered communities represent 10% of the approximate 10,000 residents who are neither connected to a municipal treatment plant or using a complete on-site septic system. The remaining 90% live in rural communities that are not as accessible to connecting to a municipal system. Six of the seven unsewered communities are located in the St. Marys River watershed. These six communities are Pleasant Mills, Arcadia Village Subdivision and surrounding area, Monmouth, Preble-Magley, Peterson, and Sunnybrook (or Andrews) Subdivision. The Arcadia Subdivision is located in the Yellow Creek sub-watershed. In 1986, the Adams County Health Department began requiring new homes in the rural, unsewered areas to install on-site septic systems according to the Indiana State Department of Health rules and regulations. Many of the homes in these communities were built prior to 1986 and are not covered under this new regulation. As of February 2005, approximately 750 to 800 on-site septic systems exist in Adams County, which is an increase from approximately 600 onsite systems in 2001. (Smith, T., 2005)

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National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

There is one NPDES permitted facility located in the Yellow Creek sub-watershed (Figure 7, Appendix 1). Monroe Water Department (IN0048151) discharges to Yellow Creek and does not contain a sanitary component. Since Monroe Water Department does not have a sanitary component, it is not considered a source of *E. coli* to the Yellow Creek sub-watershed.

Confined Feeding Operations and Concentrated Animal Feeding Operations

The removal and disposal of the manure, litter, or processed wastewater that is generated as the result of confined feeding operations falls under the regulations for confined feeding operations (CFOs) and concentrated animal feeding operations (CAFOs). There are five CFOs in the Yellow Creek sub-watershed, none of which are considered CAFOs (Figure 7, Appendix 3). The CFO and CAFO regulations (327 IAC 16, 327 IAC 15) require operations "not cause or contribute to an impairment of surface waters of the state." The active animal operations in Yellow Creek sub-watershed have no open enforcement actions at this time. However, these operations are still considered a potential source of *E. coli* for the Yellow Creek sub-watershed.

Small Animal Operations

There are many smaller livestock operations in the watershed. These operations, due to their small size, are not regulated under the CFO or CAFO regulations. These operations may still have an impact on the water quality and the *E. coli* impairment. No specific information on these small livestock operations is currently available for the remaining portion of the Yellow Creek sub-watershed. However, it is believed that these small livestock operations may be a source of the *E. coli* impairment.

Section 3.3 Borum Run Sub-Watershed

Watershed Characterization

The Borum Run sub-watershed is located entirely in Adams County. The headwater streams of Blair Ditch, Bluhm Ditch, Hahnert Ditch, and Hessler Ditch combine to form Borum Run. Borum Run flows northeast and discharges into the St. Marys River. Miller Ditch is the only major tributary to Borum Run (Figure 9).

A reassessment using the data gathered by IDEM in 2004 was completed on the Borum Run sub-watershed during the development of the St. Marys River watershed TMDL. The Borum Run sub-watershed was not listed as being impaired on any 303(d) List. Based on the data gathered by IDEM's Assessment Branch in 2004, the reassessment concluded that the entire Borum Run sub-watershed is impaired for *E. coli* and Borum Run is now scheduled to be listed as impaired for *E. coli* on the 2006 303(d) List. The 2006 303(d) listing will include the following waterbodies: Borum Run, Miller Ditch, Hessler Ditch, Hahnert Ditch, Bluhm Ditch, and Blair Ditch. The St. Marys River watershed TMDL will address the *E. coli* impairment as it will appear on the 2006 303(d) List.

E. coli Data

One of the thirty sampling sites for the St. Marys River watershed is located in the Borum Run sub-watershed. This sampling site is located near the mouth of Borum Run. This site was

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sampled biweekly by IDEM's Assessment Branch from March 2004 to October 2004 (Figure 9, Attachment A).

The *E. coli* data collected on Borum Run in 2004 had an average *E. coli* single sample maximum standard violation 59% of the time. The highest single sample maximum standard *E. coli* value was recorded at 11,199 cfu/100mL on Borum Run in 2004.

The location of the sampling site on Borum Run is representative of the Borum Run sub-watershed. Since the landuses in the Borum Run sub-watershed are homogenous, it can be concluded that the tributaries are contributing to the *E. coli* impairment in Borum Run.

Landuse

Landuse information was assembled in 1992 using the Gap Analysis Program (GAP). In 1992, approximately 93% of the landuse in the Borum Run sub-watershed was agriculture. The remaining landuse for the Borum Run sub-watershed consisted of approximately 6% forested, 0.07% palustrine wetlands, 0.7% urban (Figure 10). A comparison of 1992 landuse with the aerial photos taken in 2003 shows no substantial changes to the Borum Run sub-watershed have occurred.

Wildlife

Wildlife is a known source of *E. coli* impairments in waterbodies. Many animals spend time in or around waterbodies. Deer, geese, ducks, raccoons, turkeys, and other animals all create potential sources of *E. coli*. Wildlife contributes to the potential impact of contaminated runoff from animal habitats, such as urban park areas, forest, and cropland.

Septic Systems

Many homes within the Borum Run sub-watershed treat wastewater with on-site septic systems. Failing septic systems are known sources of *E. coli* impairment in waterbodies. In 2001, the Adams County Health Department completed a study to identify homes that have only septic tanks and no additional treatment systems throughout the county. Many of these systems then discharge directly to a stream or to a field tile that will carry the wastewater to streams. This study found an estimated 35% of the homes, approximately 10,000 residents, in rural Adams County have only a septic tank and no additional treatment for their wastewater. This study also identified seven unsewered communities. These seven unsewered communities represent 10% of the approximate 10,000 residents who are neither connected to a municipal treatment plant or using a complete on-site septic system. The remaining 90% live in rural communities that are not as accessible to connecting to a municipal system. Six of the seven unsewered communities are located in the St. Marys River watershed. These six communities are Pleasant Mills, Arcadia Village Subdivision and surrounding area, Monmouth, Preble-Magley, Peterson, and Sunnybrook (or Andrews) Subdivision. In 1986, the Adams County Health Department began requiring new homes in the rural, unsewered areas to install on-site septic systems according to the Indiana State Department of Health rules and regulations. Many of the homes in these communities were built prior to 1986 and are not covered under this new regulation. As of February 2005, approximately 750 to 800 on-site septic systems exist in Adams County, which is an increase from approximately 600 onsite systems in 2001 (Smith, T., 2005).

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

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There is one NPDES permitted facility located in the Borum Run sub-watershed (Figure 9, Appendix 1). The White Horse Mobile Home Park (IN0044199) has a total residual chlorine limit, which is an indication of a sanitary component to its discharge. The facility did have significant water quality violations, including total residual chlorine, in 2001. These violations did result in an enforcement action and an agreed order. Since the completion of these enforcement activities, which resulted in changes at the treatment facility, the White Horse Mobile Home Park has been in compliance with the water quality standards.

Previously, facilities with design flows less than 1 MGD (typically minor municipals and semipublics) were not required to have *E. coli* effluent limits or conduct monitoring for *E. coli* bacteria, provided they maintained specific total residual chlorine levels in the chlorine contact tank. The assumption was that as long as chlorine levels were adequate in the chlorine contact tank, the *E. coli* bacteria would be deactivated and compliance with the *E. coli* WQS would be met by default. The original basis for allowing chlorine contact tank requirements to replace bacteria limits was based on fecal coliform, not *E. coli*. No direct correlation between the total residual chlorine levels and *E. coli* bacteria can be conclusively drawn. Further, it has been shown that exceedances of *E. coli* bacteria limits may still occur when the chlorine contact tank requirements are met. Due to the complications of comparing total residual chlorine to *E. coli*, it is difficult to determine to what extent, if any, this discharger could be contributing to the *E. coli* impairment in the Borum Run sub-watershed.

Confined Feeding Operations and Concentrated Animal Feeding Operations

The removal and disposal of the manure, litter, or processed wastewater that is generated as the result of confined feeding operations falls under the regulations for confined feeding operations (CFOs) and concentrated animal feeding operations (CAFOs). There are no CFOs or CAFOs in the Borum Run sub-watershed

Small Animal Operations

There are many smaller livestock operations in the watershed. These operations, due to their small size, are not regulated under the CFO or CAFO regulations. These operations may still have an impact on the water quality and the *E. coli* impairment. No specific information on these small livestock operations is currently available for the remaining portion of the Borum Run sub-watershed. However, it is believed that these small livestock operations may be a source of the *E. coli* impairment.

Section 3.4 Holthouse Ditch Sub-Watershed

Watershed Characterization

The Holthouse Ditch sub-watershed is located entirely in Adams County. Bracht Ditch and Berry Ditch combine to form Holthouse Ditch. Holthouse Ditch flows northeast to its confluence with the St. Marys River (Figure 11).

A reassessment using the data gathered by IDEM in 2004 was completed on the Holthouse Ditch sub-watershed during the development of the St. Marys River watershed TMDL. It was determined that the headwater streams are not impaired for *E. coli* and will be delisted on the 2006 303(d) List. This includes the tributaries of Bracht Ditch and Berry Ditch. Holthouse Ditch and Kohne Ditch will remain on the 2006 303(d) List as impaired for *E. coli*. The St. Marys

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River watershed TMDL will address the *E. coli* impairment as it will appear on the 2006 303(d) List. The data that was collected by the City of Ft. Wayne in conjunction with IDEM data collected in 2004 supported the conclusions of the reassessment.

E. coli Data

One of the thirty sampling sites for the St. Marys River watershed is located in the Holthouse Ditch sub-watershed. This sampling site is located on Holthouse Ditch downstream of Kohne Ditch. The City of Ft. Wayne and IDEM's Assessment Branch from March of 2004 to October of 2004 sampled the site. IDEM's Assessment Branch sampled this site biweekly from March of 2004 to October of 2004. The City of Ft. Wayne sampled this site from July of 2004 to October of 2004 on the opposite weeks that IDEM's Assessment Branch sampled the site. This allowed IDEM's TMDL Program to obtain a geometric mean value from the data collected from July of 2004 to October of 2004 (Figure 11, Attachment A).

The *E. coli* data collected on Holthouse Ditch by IDEM and the City of Ft. Wayne in 2004 had an average *E. coli* single sample maximum standard violation of 62% of the time and a geometric mean standard violation of 72% of the time. The highest single sample maximum standard *E. coli* value was recorded at 39,720 cfu/100mL on Holthouse Ditch. The highest geometric mean value was recorded at 32,081 cfu/100mL at this site.

The sampling site on Holthouse Ditch was taken downstream of Kohne Ditch and had an elevated level of *E. coli*. Kohne Ditch is listed along with Holthouse Ditch on the 303(d) List. It can be concluded that based on the location of the sampling site during the sampling event completed in 2004 that Kohne Ditch is contributing to the *E. coli* impairment in Holthouse Ditch.

Landuse

Landuse information was assembled in 1992 using the Gap Analysis Program (GAP). In 1992, approximately 93% of the landuse in the Holthouse Ditch sub-watershed was agriculture. The remaining landuse for the Holthouse Ditch sub-watershed consisted of approximately 3% forested, 1% palustrine wetlands, 2% urban, and 1% water (Figure 12). A comparison of 1992 landuse with the aerial photos taken in 2003 shows no substantial changes to the Holthouse Ditch sub-watershed have occurred.

Wildlife

Wildlife is a known source of *E. coli* impairments in waterbodies. Many animals spend time in or around waterbodies. Deer, geese, ducks, raccoons, turkeys, and other animals all create potential sources of *E. coli*. Wildlife contributes to the potential impact of contaminated runoff from animal habitats, such as urban park areas, forest, and cropland.

Septic Systems

Many homes within the Holthouse Ditch sub-watershed treat wastewater with on-site septic systems. Failing septic systems are known sources of *E. coli* impairment in waterbodies. In 2001, the Adams County Health Department completed a study to identify homes that have only septic tanks and no additional treatment systems throughout the county. Many of these systems then discharge directly to a stream or to a field tile that will carry the wastewater to streams. This study found an estimated 35% of the homes, approximately 10,000 residents, in rural Adams County have only a septic tank and no additional treatment for their wastewater. This study also

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identified seven unsewered communities. These seven unsewered communities represent 10% of the approximate 10,000 residents who are neither connected to a municipal treatment plant or using a complete on-site septic system. The remaining 90% live in rural communities that are not as accessible to connecting to a municipal system. Six of the seven unsewered communities are located in the St. Marys River watershed. These six communities are Pleasant Mills, Arcadia Village Subdivision and surrounding area, Monmouth, Preble-Magley, Peterson, and Sunnybrook (or Andrews) Subdivision. In 1986, the Adams County Health Department began requiring new homes in the rural, unsewered areas to install on-site septic systems according to the Indiana State Department of Health rules and regulations. Many of the homes in these communities were built prior to 1986 and are not covered under this new regulation. As of February 2005, approximately 750 to 800 on-site septic systems exist in Adams County, which is an increase from approximately 600 onsite systems in 2001 (Smith, T., 2005).

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

There is one NPDES permitted facility located in the Holthouse Ditch sub-watershed (Figure 11, Appendix 1). The Country Acres Association (IN0055417) has a total residual chlorine limit, which is an indication of a sanitary component to its discharge. This facility has had significant violations of their total residual chlorine limits, among other violations, over the past four years. IDEM's TMDL Program has brought this to the attention of IDEM's Inspector, IDEM's Compliance Section, IDEM's Enforcement Section, and IDEM's Data Management Section. These sections are reviewing the violations more closely to understand the nature of the violations.

Previously, facilities with design flows less than 1 MGD (typically minor municipals and semipublics) were not required to have *E. coli* effluent limits or conduct monitoring for *E. coli* bacteria, provided they maintained specific total residual chlorine levels in the chlorine contact tank. The assumption was that as long as chlorine levels were adequate in the chlorine contact tank, the *E. coli* bacteria would be deactivated and compliance with the *E. coli* WQS would be met by default. The original basis for allowing chlorine contact tank requirements to replace bacteria limits was based on fecal coliform, not *E. coli*. No direct correlation between the total residual chlorine levels and *E. coli* bacteria can be conclusively drawn. Further, it has been shown that exceedances of *E. coli* bacteria limits may still occur when the chlorine contact tank requirements are met. Due to the complications of comparing total residual chlorine to *E. coli*, it is difficult to determine to what extent, if any, this discharger could be a source of *E. coli* in the Holthouse Ditch sub-watershed.

Confined Feeding Operations and Concentrated Animal Feeding Operations

The removal and disposal of the manure, litter, or processed wastewater that is generated as the result of confined feeding operations falls under the regulations for confined feeding operations (CFOs) and concentrated animal feeding operations (CAFOs). There are eleven CFOs in the Holthouse Ditch sub-watershed, none of which are considered CAFOs (Figure 11, Appendix 3). The CFO and CAFO regulations (327 IAC 16, 327 IAC 15) require operations "not cause or contribute to an impairment of surface waters of the state." The active animal operations in Holthouse Ditch sub-watershed have no open enforcement actions at this time. However, these operations are still considered a potential source of *E. coli* for the Holthouse Ditch sub-watershed.

Small Animal Operations

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There are many smaller livestock operations in the watershed. These operations, due to their small size, are not regulated under the CFO or CAFO regulations. These operations may still have an impact on the water quality and the *E. coli* impairment. No specific information on these small livestock operations is currently available for the remaining portion of the Holthouse Ditch sub-watershed; however, it is believed that these small livestock operations may be a source of the *E. coli* impairment.

Section 3.5 Nickelsen Creek Sub-Watershed

Watershed Characterization

The Nickelsen Creek sub-watershed is located in Adams and Allen Counties. Nickelsen Creek starts in the northwest corner of Adams County and flows north into Allen County where it discharges to the St. Marys River. Lambert Ditch is the major tributary to Nickelsen Creek and discharges to Nickelsen Creek at the Adams-Allen County Line (Figure 13).

A reassessment using the data gathered by IDEM in 2004 was completed on the Nickelsen Creek sub-watershed during the development of the St. Marys River watershed TMDL. Nickelsen Creek was not listed on the 2004 303(d) List but will be listed on the 2006 303(d) List for *E. coli*. It was determined that Lambert Ditch should not be listed as impaired for *E. coli*. This conclusion was based on the sampling location on Nickelsen Creek in comparison to the location of the confluence of Lambert Ditch to Nickelsen Creek. The St. Marys River watershed TMDL will address the *E. coli* impairment as it will appear on the 2006 303(d) List. The data that was collected by the City of Ft. Wayne in conjunction with IDEM data collected in 2004 supported the conclusions of the reassessment.

E. coli Data

One of the thirty sampling sites for the St. Marys River watershed is located in the Nickelsen Creek sub-watershed (Figure 13, Attachment A). This sampling site is located on Nickelsen Creek upstream of the confluence of Lambert Ditch. This sampling site was sampled by the City of Ft. Wayne and IDEM's Assessment Branch from March of 2004 to October of 2004. IDEM's Assessment Branch sampled this site biweekly from March of 2004 to October of 2004. The City of Ft. Wayne sampled this site from July of 2004 to October of 2004 on the opposite weeks IDEM's Assessment Branch sampled this site. This allowed IDEM's TMDL Program to obtain a geometric mean value from the data collected from July of 2004 to October of 2004.

The *E. coli* data collected on Nickelsen Creek by IDEM's Assessment Branch and the City of Ft. Wayne in 2004 had an average *E. coli* single sample maximum standard violation 72% of the time and a geometric mean standard violation 91% of the time. The highest single sample maximum standard *E. coli* value was recorded at >48,400 cfu/100mL. The highest geometric mean value was recorded at 16,082 cfu/100mL.

Landuse

Landuse information was assembled in 1992 using the Gap Analysis Program (GAP). In 1992, approximately 93% of the landuse in the Yellow Creek sub-watershed was agriculture. The remaining landuse for the Yellow Creek sub-watershed consisted of approximately 5% forested, 1% palustrine wetlands, 0.3% urban (Figure 14). A comparison of 1992 landuse with the aerial photos taken in 2003 shows no substantial changes to the Yellow Creek sub-watershed have occurred.

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Wildlife

Wildlife is a known source of *E. coli* impairments in waterbodies. Many animals spend time in or around waterbodies. Deer, geese, ducks, raccoons, turkeys, and other animals all create potential sources of *E. coli*. Wildlife contributes to the potential impact of contaminated runoff from animal habitats, such as urban park areas, forest, and cropland.

Septic Systems

Many homes within the Nickelsen Creek sub-watershed treat wastewater with on-site septic systems. Failing septic systems are known sources of *E. coli* impairment in waterbodies. In 2001, the Adams County Health Department completed a study to identify homes that have only septic tanks and no additional treatment systems throughout the county. Many of these systems then discharge directly to a stream or to a field tile that will carry the wastewater to streams. This study found an estimated 35% of the homes, approximately 10,000 residents, in rural Adams County have only a septic tank and no additional treatment for their wastewater. This study also identified seven unsewered communities. These seven unsewered communities represent 10% of the approximate 10,000 residents who are neither connected to a municipal treatment plant or using a complete on-site septic system. The remaining 90% live in rural communities that are not as accessible to connecting to a municipal system. Six of the seven unsewered communities are located in the St. Marys River watershed. These six communities are Pleasant Mills, Arcadia Village Subdivision and surrounding area, Monmouth, Preble-Magley, Peterson, and Sunnybrook (or Andrews) Subdivision. In 1986, the Adams County Health Department began requiring new homes in the rural, unsewered areas to install on-site septic systems according to the Indiana State Department of Health rules and regulations. Many of the homes in these communities were built prior to 1986 and are not covered under this new regulation. As of February 2005, approximately 750 to 800 on-site septic systems exist in Adams County, which is an increase from approximately 600 onsite systems in 2001. (Smith, T., 2005)

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

There are no NPDES permitted facilities located in the Nickelsen Creek sub-watershed.

Storm Water General Permit Rule 13

There is one municipal separate storm sewer systems (MS4) community, Allen County, in the Nickelsen Creek sub-watershed. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11). It can be determined that the MS4 community of Allen County is a potential source of *E. coli* to the Nickelsen Creek sub-watershed. However, it is difficult to determine, prior to the completion of the permit requirements, if this MS4 community is a significant source of *E. coli* in the Nickelsen Creek sub-watershed.

Confined Feeding Operations and Concentrated Animal Feeding Operations

The removal and disposal of the manure, litter, or processed wastewater that is generated as the result of confined feeding operations falls under the regulations for confined feeding operations (CFOs) and concentrated animal feeding operations (CAFOs). There are two CFOs in the Nickelsen Creek sub-watershed, none of which are considered CAFOs (Figure 13, Appendix 3).

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The CFO and CAFO regulations (327 IAC 16, 327 IAC 15) require operations "not cause or contribute to an impairment of surface waters of the state." The active animal operations in Nickelsen Creek sub-watershed have no open enforcement actions at this time. However, these operations are still considered a potential source of *E. coli* for the Nickelsen Creek sub-watershed.

Small Animal Operations

There are many smaller livestock operations in the watershed. These operations, due to their small size, are not regulated under the CFO or CAFO regulations. These operations may still have an impact on the water quality and the *E. coli* impairment. No specific information on these small livestock operations is currently available for the remaining portion of the Nickelsen Creek sub-watershed. However, it is believed that these small livestock operations may be a source of the *E. coli* impairment.

Section 3.6 St. Marys River

Watershed Characterization

The St. Marys River in Adams County is located in a predominantly agricultural watershed. The St. Marys River flows from Ohio into the middle of Adams County. Upon entering Indiana, the St. Marys River flows northwest through the City of Decatur in Adams County into Allen County. The St. Marys River flows through the City of Ft. Wayne in Allen County before it joins the St. Joseph River to create the Maumee River. Four of the sub-watersheds mentioned in Section 3 are located entirely in the Adams County portion of the St. Marys River. These sub-watersheds are Blue Creek, Yellow Creek, Borum Run, and Holthouse Ditch. The Nickelsen Creek sub-watershed starts in Adams County, but flows into Allen County before joining the St. Marys River. In addition to these five sub-watersheds, numerous tributaries that are impaired for *E. coli* enter the St. Marys River. These tributaries include Pleasant Mills & Tributaries, Decatur Tributaries, Gerke/Weber Ditch & Tributaries, St. Marys River Tributary, Snyder Ditch & other tributaries, and Junk Ditch & other tributaries (Figure 15).

A reassessment using the data gathered by IDEM's Assessment Branch in 2004 was completed on the St. Marys River during the development of the St. Marys River watershed TMDL. On the 2004 303(d) List, segment INA0454_T1012 of the St. Marys River was not listed as being impaired for *E. coli*. The reassessment concluded that on the 2006 303(d) List that segment INA0454_T1012 of the St. Marys River will be listed as impaired for *E. coli*. In addition, the reassessment concluded that a number of the tributaries were contributing to the *E. coli* impairment on the St. Marys River and should be listed as impaired on the 2006 303(d) List. These tributaries include Pleasant Mills & tributaries, Decatur Tributaries, Gerke/Weber Ditch & tributaries, Synder Ditch & other tributaries, and Junk Ditch & other tributaries. The St. Marys River watershed TMDL will address the *E. coli* impairment as it will appear on the 2006 303(d) List.

E. coli Data

Ten of the thirty sampling sites for the St. Marys River watershed are located on the St. Marys River (Attachment A). Four of the ten sampling sites (noted by the purple asterisks on Figure 16) were sampled by the Adams County Soil & Water Conservation District from May of 2000 through Oct of 2000 and April of 2001 through May of 2001, monthly. Combining the *E. coli* data at these four sampling sites, these four sites violated the single sample maximum standard

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approximately 85% of the time. The highest single sample maximum standard was recorded at 24,000 cfu/100mL at Site 19.

Two of the ten sampling sites (noted by orange circles on Figure 16) were sampled by the City of Ft. Wayne in 2001 through 2004 weekly from April to October. Combining the data at these two sites per year, in 2001 the single sample maximum daily standard was violated approximately 80% of the time and violated the geometric mean 100% of the time. The highest single sample maximum *E. coli* value in 2001 was recorded at 6,000 cfu/100mL. In 2002, the single sample maximum daily standard violated approximately 65% of time and the geometric mean standard violated approximately 98% of the time. The highest single sample maximum *E. coli* value in 2002 was recorded at 5,400 cfu/100mL. In 2003, the single sample maximum daily standard violated 30% of the time and the geometric mean standard violated 38% of the time. The highest single sample maximum *E. coli* value in 2003 was recorded at 5400 cfu/100mL. In 2004, the single sample maximum daily standard violated approximately 74% of the time. The highest single sample maximum *E. coli* value in 2004 was recorded at >48,400 cfu/100mL.

Two of the ten sampling sites were sampled by IDEM's Assessment Branch biweekly from March of 2004 to October of 2004. The City of Ft. Wayne sampled this site from July of 2004 to October of 2004 on the opposite weeks IDEM's Assessment Branch sampled this site. This allowed IDEM's TMDL Program to obtain a geometric mean value from the data collected from July of 2004 to October of 2004. The single sample maximum standard was violated approximately 71% of the time and the geometric mean standard violated 100% of the time. The highest *E. coli* value was recorded at >48,400 cfu/100mL.

One of the ten sampling sites was sampled by IDEM's Assessment Branch, the City of Ft. Wayne, and the Adams County Soil and Water Conservation District. IDEM's Assessment Branch sampled the site biweekly from March 2004 through October 2004. The City of Ft. Wayne sampled this site from July 2004 through October 2004 on opposite weeks IDEM's Assessment Branch sampled this site. The Adams County Soil and Water Conservation District sampled this site from May of 2000 through October of 2000 and April of 2001 through May of 2001, monthly. The data collected in 2004 had a single sample maximum standard violation 60% of the time and a geometric mean violation 100% of the time. The highest *E. coli* value in 2004 was recorded at 12,260 cfu/100mL. The data collected in 2000 and 2001 had a single sample maximum standard violation 75% of the time. The highest *E. coli* value in 2002 to 2001 was recorded at 3,200 cfu/100mL.

The last site, Site 14, was sampled by Adams County Soil and Water Conservation District and IDEM's Assessment Branch (noted by the purple asterisk and red triangle on Figure 16). The Adams County Soil and Water Conservation District sampled this site from May of 2000 through October of 2000 and April of 2001 through May of 2001, monthly. IDEM's Assessment Branch sampled this site from March 2004 through October of 2004, biweekly. The single sample maximum standard in 2000 to 2001 was violated 75% of the time. The highest *E. coli* value was recorded at 13,600 cfu/100mL. In 2004, the single sample maximum standard was violated 75% of the time. The highest *E. coli* value was recorded at >24,200 cfu/100mL.

Tributaries

Each of the sub-watersheds described in Section 3.0 has a sampling point located close to the mouth of the major waterbody in the sub-watershed. This site was chosen to represent the amount of *E. coli* coming into the St. Marys River from that particular sub-watershed. Each of these sub-watersheds is impaired for *E. coli*. Along with these sub-watersheds, many tributaries

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along the St. Marys River in Adams County are also impaired for *E. coli*. Based on the *E. coli* data collected on the St. Marys River and its major tributaries, it can be concluded that these tributaries are contributing to the *E. coli* impairment in St. Marys River (Figure 16).

St. Marys River in Ohio

The St. Marys River is impaired in Ohio for *E. coli*. Site 12 was taken on the St. Marys River in the town of Wilshire, Ohio. This site was sampled to represent the load of *E. coli* coming into Indiana from Ohio. This site confirmed that the St. Marys River, before it enters Indiana, is impaired for *E. coli* and is contributing to the *E. coli* impairment on the St. Marys River in Indiana.

Landuse

Landuse information was assembled in 1992 using the Gap Analysis Program (GAP). In 1992, approximately 78% of the landuse along the St. Marys River was agriculture. The remaining landuse the area along the St. Marys River consisted of approximately 12% urban, 1% palustrine wetlands, 8% urban (Figure 17). A comparison of landuse information from 1992 with aerial photos taken in 2003 shows there is no substantial change to the area along the St. Marys River.

Wildlife

Wildlife is a known source of *E. coli* impairments in waterbodies. Many animals spend time in or around waterbodies. Deer, geese, ducks, raccoons, turkeys, and other animals all create potential sources of *E. coli*. Wildlife contributes to the potential impact of contaminated runoff from animal habitats, such as urban park areas, forest, and cropland.

Septic Systems

Many homes within the St. Marys watershed treat wastewater with on-site septic systems. Failing septic systems are known sources of *E. coli* impairment in waterbodies. In 2001, the Adams County Health Department completed a study to identify homes that have only septic tanks and no additional treatment systems throughout the county. Many of these systems then discharge directly to a stream or to a field tile that will carry the wastewater to streams. This study found an estimated 35% of the homes, approximately 10,000 residents, in rural Adams County have only a septic tank and no additional treatment for their wastewater. This study also identified seven unsewered communities. These seven unsewered communities represent 10% of the approximate 10,000 residents who are neither connected to a municipal treatment plant or using a complete on-site septic system. The remaining 90% live in rural communities that are not as accessible to connecting to a municipal system. Six of the seven unsewered communities are located in the St. Marys River watershed. These six communities are Pleasant Mills, Arcadia Village Subdivision and surrounding area, Monmouth, Preble-Magley, Peterson, and Sunnybrook (or Andrews) Subdivision. In 1986, the Adams County Health Department began requiring new homes in the rural, unsewered areas to install on-site septic systems according to the Indiana State Department of Health rules and regulations. Many of the homes in these communities were built prior to 1986 and are not covered under this new regulation. As of February 2005, approximately 750 to 800 on-site septic systems exist in Adams County, which is an increase from approximately 600 onsite systems in 2001. (Smith, T., 2005)

As was mentioned earlier, the Allen County Health Department conducted a study to see the potential effect a community of homes with septic systems has on a stream. Communities of

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homes were chosen throughout Allen County. Three of these communities are located along the St. Marys River. Site 26 is representative of a community in Poe (Figure 16). This community is connected to a pipe that runs over the bank into the St. Marys River. The Allen County Health Department took the sample from the pipe as the discharge came down the bank of the St. Marys River. This site represents approximately seventy homes and a few businesses and churches. Most of these homes do not have a permit for a septic system by the Allen County Health Department and have around a 90% failure rate (Chapple, G. 2005). The sampling data collected by the Allen County Health Department, weekly during the recreational season from 2001 through 2004 show *E. coli* values no lower than 250 cfu/100mL and as high as >2,000,000 cfu/100mL.

Site 27 is the second Allen County Health Department sampling site located along the St. Marys River. Site 27 represents a natural drain located on the Westside of US 27, south of Monroeville Road (Figure 16). This sampling site represents two communities. The community on the east side has approximately fifty homes and a church with a school. The community on the west side is a mobile home park with approximately forty trailers. These two communities were connected to municipal sewers in February of 2003. The Allen County Health Department data collected weekly during the recreational season from 2001 to 2004 does show a reduction in the *E. coli* level between the 2003 and 2004 sampling events. This site went from violating 100% of the time in 2003 to violating 79% in 2004. The *E. coli* values in 2003 ranged from 1200 cfu/100mL to 340,000 cfu/100mL to values in 2004 ranging from 300 cfu/100mL to 56,000 cfu/100mL.

Site 28 is the third Allen County Health Department sampling site located along the St. Marys River. Site 28 represents an older subdivision located at the intersection of Bluffton Road and Hamilton Road. This older subdivision drains to Thiele Drain/Harber Ditch. This community was sampled at Bluffton Rd, north of I-469, which is north of the community. This older subdivision has approximately twenty homes. On aerial photos, the sampling site is surrounded by an elementary school on the east side and a warehouse on the west side. Both of these buildings are connected to municipal sewer systems. Some of the homes in this community are newer and have absorption fields. The Allen County Health Department *E. coli* data was also collected weekly during the recreational season from 2001 to 2004. This site has an average single sample violation of 77%, which is lower than the two previous sites. This lower average can be attributed to the sampling location. The high *E. coli* values range in the 100,000's cfu/100mL.

Overall, the data collected at these three sites show significant septic systems failure in Allen County. Septic systems are considered to be a significant source of *E. coli* to the St. Marys River in Allen, as well as, in Adams County.

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

Ten permitted NPDES facilities discharge into the St. Marys River or its tributaries that are not represented in the five sub-watersheds (Figure 18, Appendix 1). Three of the ten permitted facilities have *E. coli* limits. These are Decatur STP (IN0039314), Hessen Utilities/Country Court Estates MHP (IN0045292), and Hoagland STP- Allen County Regional Sewer District (IN0048119).

The Decatur STP discharges to the St. Marys River. This facility has recorded violations of their *E. coli* limits in 2003. However, according to IDEM's inspector this was due to the heavy rain events and flooding of the St. Marys River. Since, the Decatur STP is not violating, except

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during extreme weather conditions, this facility is not considered a significant source of *E. coli* to the St. Marys River.

Hessen Utilities/Country Court Estates MHP discharges to Marion Ditch, which is a tributary to the St. Marys River. This facility has had *E. coli* limits since July of 2004. Prior to the initiation of *E. coli* limits, Hessen Utilities/Country Court Estates MHP had total residual chlorine limits. IDEM's TMDL Program has found a significant record of violations of their total residual chlorine limit since 2002. Out of the four *E. coli* values recorded from the facility in 2004, three of them violated the *E. coli* water quality standard. Currently, there is no open enforcement case for this facility. Due to the significant violations at Hessen Utilities/Country Court Estates MHP, this facility is considered a significant source of *E. coli* to the St. Marys River.

The Hoagland WWTP/Allen County Regional Sewer District discharges to Houk Ditch, which is a tributary to the St. Marys River. This facility has not reported violations of their *E. coli* water quality standard. Therefore, the Hoagland WWTP/Allen County Regional Sewer District is not considered a significant source of *E. coli* to the St. Marys River.

Two of ten NPDES facilities have total residual chlorine limits. These facilities are Oak Ridge Estates MHP (IN0036901) and Mill Road Estates (IN0109835). Previously, facilities with design flows less than 1 MGD (typically minor municipals and semipublics) were not required to have *E. coli* effluent limits or conduct monitoring for *E. coli* bacteria, provided they maintained specific total residual chlorine levels in the chlorine contact tank. The assumption was that as long as chlorine levels were adequate in the chlorine contact tank, the *E. coli* bacteria would be deactivated and compliance with the *E. coli* WQS would be met by default. The original basis for allowing chlorine contact tank requirements to replace bacteria limits was based on fecal coliform, not *E. coli*. No direct correlation between the total residual chlorine levels and *E. coli* bacteria can be conclusively drawn. Further, it has been shown that exceedances of *E. coli* bacteria limits may still occur when the chlorine contact tank requirements are met.

Oak Ridge Estates MHP has had significant violations of its total residual chlorine limit from 2000 to 2004 that could have affected the sampling completed in 2001 and 2004. IDEM's inspector sent the facility an Inspection Summary/Violation letter in April of 2004. In response to this letter, the facility hired a contractor to address the Summary/Violation letter. The data that the facility has submitted to IDEM in 2005 has not shown total residual chlorine limit violations. Due to the complications of comparing total residual chlorine to *E. coli*, it is difficult to determine to what extent this discharger is a source of *E. coli* to the St. Marys River.

Mill Road Estates has had significant violations of its total residual chlorine limit that could have affected the sampling completed in 2001 and 2004. The violations have resulted in an enforcement action and an agreed order. To date, according to IDEM's Enforcement Section the requirements in the agreed order have not been met by the facility. Due to the complications of comparing total residual chlorine to *E. coli*, it is difficult to determine to what extent this discharger is a source of *E. coli* to the St. Marys River.

The remaining five NPDES permitted facilities to the St. Marys River do not have a sanitary component to their discharge or are a pretreatment permit. These facilities include Ruan Transport Corporation (INP00194), Bunge North American LLC/Central Soya (IN0000591), B&B Custom Plating (IN0052302), Stone-Street Quarry (IN0000612), and Cintas Mechanical Laundry Division (ING250055). Since these five facilities do not contain a sanitary component to their discharge, or do not discharge to a stream, they are not considered a source of *E. coli* to the St. Marys River.

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Combined Sewer Overflows (CSO) & Sanitary Sewer Overflows (SSO)

There are two CSO communities along the St. Marys River (Figure 19, Appendix 2). The City of Decatur has four CSOs. All of the City of Decatur's CSOs discharge to the St. Marys River. The City of Decatur submitted their CSO Long Term Control Plan to IDEM in July of 2002. The City of Ft. Wayne has twenty-five CSOs and two SSOs. Of the twenty-five CSOs, twenty-four of them discharge directly to the St. Marys River. The remaining CSOs and the two SSOs discharge to drains that then go to the St. Marys River. The City of Ft. Wayne submitted their CSO Long Term Control Plan to IDEM in December of 2004. SSOs are not a permitted activity and considered an illegal discharge. CSO and SSO outfalls are considered a significant source of *E. coli* to the St. Marys River.

Storm Water General Permit Rule 13

There are three municipal separate storm sewer system (MS4) communities; the City of Decatur, the City of Ft. Wayne, and Allen County in the St. Marys River. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11). It can be determined that the MS4 communities of Allen County and the City of Ft. Wayne and the City of Decatur are a potential source of *E. coli* to the St. Marys River. However, prior to the completion of the permit requirements, it is difficult to determine the magnitude of *E. coli* impact these MS4 communities have on St. Marys River.

Confined Feeding Operations and Concentrated Animal Feeding Operations

The removal and disposal of the manure, litter, or processed wastewater that is generated as the result of confined feeding operations falls under the regulations for confined feeding operations (CFOs) and concentrated animal feeding operations (CAFOs). There are nine CFOs near the St. Marys River, none of which are considered CAFOs (Figure 20, Appendix 3). The CFO and CAFO regulations (327 IAC 16, 327 IAC 15) require operations "not cause or contribute to an impairment of surface waters of the state." The active animal operations near the St. Marys River have no open enforcement actions at this time. However, these operations are still considered a potential source of *E. coli* for the St. Marys River.

Small Animal Operations

There are many smaller livestock operations in the watershed. These operations, due to their small size, are not regulated under the CFO or CAFO regulations. These operations may still have an impact on the water quality and the *E. coli* impairment. No specific information on these small livestock operations is currently available for the remaining portion of the St. Marys River, However, it is believed that these small livestock operations may be a source of the *E. coli* impairment.

Section 4.0 Linkage Analysis

The linkage between the *E. coli* concentrations in the St. Marys River watershed and the potential sources of *E. coli* provides the basis for the development of this TMDL. Analysis of this relationship allows for estimating the total assimilative capacity of the stream and any needed load reductions. Water quality duration curves were created for the sampling sites in the St. Marys River watershed that were sampled by IDEM and the City of Ft. Wayne in 2004. A flow duration interval is described as a percentage. Zero (0) percent corresponds to the highest stream

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discharge (flood condition) and 100 percent corresponds to the lowest discharge (drought condition). These sampling sites are representative of the hydrodynamics of the St. Marys River watershed (Attachment B). This section will discuss the water quality durations and the linkage of Section 3.0 for each sub-section of the St. Marys River watershed and the St. Marys River.

4.1 Blue Creek Sub-Watershed

4.1.1 Water Quality Duration Curves

Water quality duration curves were created for six of the ten sampling sites in the Blue Creek sub-watershed (Attachment C). Site LES040-0099 is located at the mouth of Habegger Ditch. This site had an average geometric mean of 1007 cfu/100mL. Site LES040-0023 is located at Gates Ditch, which also represents sources coming from Farlow Ditch. This site had an average geometric mean of 1748 cfu/100mL. According to the water quality duration curves, *E. coli* violations occurred more consistently at Site LES040-0023, than at Site LES040-0099. This indicates a more constant source of *E. coli* at Site LES040-0023, than at site LES040-0099.

Site LES040-0011 is located on Blue Creek below the confluence of Gates Ditch to Blue Creek. The geometric mean value for Site LES040-0011 is 1074 cfu/100mL. According to the water quality duration curves, the *E. coli* values are similar to Sites LES040-0099 and LES040-0023. This indicates there are additional constant sources of *E. coli*.

Site LES040-0010 is located at the mouth of Little Blue Creek. The average geometric mean value at this site is 815 cfu/100mL. This is the lowest average geometric mean value of the six sites in the Blue Creek sub-watershed. The *E. coli* violations are highest during mid-range to moist flow conditions, which is different than seen at the previous three sites. Sources of *E. coli* that spike during mid-range to moist flow conditions are caused by precipitation events and runoff.

Site LES040-0066 is located on Blue Creek below the confluence of Little Blue Creek into Blue Creek. The average geometric mean at this site is 856 cfu/100mL. This is a decrease from the *E. coli* values at the upstream site, Site LES040-0011, and a decrease in *E. coli* values at LES040-0010 located at the mouth of Little Blue Creek. This decrease in *E. coli* values indicates that Little Blue Creek is diluting Blue Creek. According to the water quality duration curves, from Site LES040-0011 to Site LES040-0066, there is a leveling of the *E. coli* values over the flow conditions. This indicates that while runoff does play an important part in the water quality impairment, there are still many constant sources of *E. coli* in the watershed.

Site LES040-0009 is located near the mouth of Blue Creek after the confluence of the Unnamed Tributary (Duer Ditch). The average geometric mean at this site is 1243 cfu/100mL. In comparison to the upstream sites in the Blue Creek sub-watershed, the water quality duration curve for this site indicates the *E. coli* levels are increasing in conjunction with the stream flow levels.

4.1.2 Source Linkage

The landuse in this sub-watershed is predominately agricultural. Row crops comprise 88% of the landuse. The soils in this sub-watershed necessitate the use of field tiles to drain excess water from the fields. These field tiles then drain to the nearest stream. Field tiles are not

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themselves sources of *E. coli*, but they can carry *E. coli* from land applied manure, runoff from the fields and pastures, and other sources of *E. coli* not adjacent to the streams. The high *E. coli* value during mid-range to high flow conditions indicates the presence of *E. coli* transportation by field tiles.

Pasture is considered 11% of the landuse. This indicates the presence of non-regulated smaller animal operations in this sub-watershed. Animals located in these smaller animal operations are not as likely to enter a stream during high flow conditions. Since there is a continuous source of *E. coli* present in this watershed during dry conditions, this would indicate that animals have direct access to the stream.

Wildlife is a known source of *E. coli*. The predominant agricultural and forested landuses in this sub-watershed create ideal habitat for wildlife. Wildlife would contribute during all flow conditions with possible spikes in *E. coli* levels during extreme high flow conditions due to runoff or flooding which carries large quantities of *E. coli* at one time.

This area is known for Amish communities. Amish communities are not required to follow state guidelines for waste removal. Therefore, the significance of the Amish community impact on the *E. coli* impairment for these streams is unknown.

There is a lack of E. coli sampling for Farlow Ditch, Duer Ditch, and other unnamed tributaries. The location of the sampling sites in this sub-watershed indicates that these tributaries are contributing to the E. coli impairment. It is unclear as to the magnitude that these tributaries contribute to the E. coli impairment.

None of the NPDES permitted facilities in this sub-watershed contain a sanitary component in their discharge; therefore, these facilities are not considered sources of *E. coli*.

Permitted CFOs and CAFOs are clustered in the headwaters of Blue Creek. CFOs and CAFOs could be sources of *E. coli* during high flow conditions on the water quality duration curve. These facilities have the potential to cause a violation of the *E. coli* water quality standard through land application or a malfunction at the facility. However, all of these facilities are operating in compliance with their permit.

Septic systems are a known source of *E. coli* for this sub-watershed based on information provided to IDEM by the Adams County Health Department (Adams County Health Department personnel communication). The septic systems described by this information would provide a constant source of *E. coli* particularly during low to mid-range flow conditions. According to the water quality duration curve, there are consistent violations of the *E. coli* water quality standard during these flow conditions. Septic systems can also fail during higher flow conditions by leaching to a field tile or other type of pipe that discharges to the stream. Violations of the *E. coli* water quality standard are shown on the water quality duration curves during high flow, but not consistently.

There are two CSOs and one SSO from the town of Berne in this sub-watershed. Site LES040-0099 and Site LES040-0023 are located downstream of these CSOs and SSO. CSOs and SSOs are shown on water quality duration curves during high flow events. Sites LES040-0099 and LES040-0023 show higher *E. coli* values during high flows, than any of the other six sampling sites in this sub-watershed. It can be concluded that CSOs and SSOs are a source of *E. coli* in this sub-watershed.

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4.1.3 Conclusions

The *E. coli* data has an average single sample maximum violation 85% of the time and a geometric mean violation 100% of the time. There are no known NPDES permits, CFO, or CAFO violations. CSOs and SSOs from the town of Berne are a significant source of *E. coli*. Based on the water quality duration curves, it can be concluded that the majority of sources of *E. coli* in this watershed are nonpoint sources which include small animal operations, Amish communities, wildlife, leaking and failing septic systems.

4.2 Yellow Creek Sub-Watershed

4.2.1 Water Quality Duration Curves

Water quality duration curves were created for the two sampling sites in the Yellow Creek sub-watershed (Attachment C). In 2004, IDEM sampled both sites and the City of Ft. Wayne sampled one of the sites. Site LES040-0040 is located at the mouth of Martz Ditch. The geometric mean value at this site was 531 cfu/100mL. According to the water quality duration curves, there are no violations during dry flow conditions. Most of the violations for *E. coli* occur during the mid-range to moist conditions. This could be due to the small drainage area, 9.8 square miles, of Martz Ditch at this site. Due to the small drainage area, this stream is more quickly affected by precipitation. During dry conditions, base flow in the stream is minimal, so there are fewer continuous sources of *E. coli*. During higher flow conditions, sources of *E. coli* enter the stream during the "first flush" and then the water moves quickly through the stream. High flow conditions occur after the "first flush" has moved through the stream, causing the peaks of *E. coli* to be less in smaller drainage area streams. This is what is shown in the water quality duration curves.

Site LES040-0038 is located on Yellow Creek after the confluence of Martz Ditch to Yellow Creek. The average geometric mean value at this site is 1150 cfu/100mL. Unlike Site LES040-0040, this site has continuous sources of *E. coli* as indicated by the *E. coli* values during dry conditions on the water quality duration curves. In addition, the high flow *E. coli* values are higher than at Site LES040-0038, which is consistent with larger drainage area streams that have a less flashy response to precipitation.

4.2.2 Source Linkage

The landuse in this watershed is predominately agricultural. Row crops comprise 87% of the landuse. The soils in this sub-watershed necessitate the use of field tiles to drain excess water from the fields. These field tiles then drain to the nearest stream. Field tiles themselves are not sources of *E. coli*, but they can carry *E. coli* from land-applied manure, runoff from the fields and pastures, and other sources of *E. coli* not adjacent to the streams. The high *E. coli* values during mid-range to high flow conditions indicate the presence of *E. coli* transportation by field tiles.

Pasture comprises 8% of the landuse. This indicates the presence of non-regulated smaller animal operations in this sub-watershed. Animals are not as likely to enter a stream during high flow conditions. Since there is a continuous source of *E. coli* present in this watershed during dry conditions, this would indicate that animals have direct access to the stream.

Wildlife is a known source of *E. coli*. The predominant agricultural and forested landuses in this sub-watershed create ideal habitat for wildlife. Wildlife would contribute during all flow

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conditions with possible spikes during extreme high flow conditions due to runoff or flooding.

Amish communities will more likely be found in the headwaters of this sub-watershed. Amish communities are not required to follow state guidelines for waste removal. Therefore, the significance of the Amish community impact on the *E. coli* impairment for these streams is unknown.

Due to a lack of sampling in the headwater streams in this sub-watershed, the headwater streams are not listed as impaired. Since there are known sources of *E. coli* in the headwater streams, the assumption can be made that these headwater streams are contributing to the *E. coli* impairment in the downstream sections of this sub-watershed. However, it is unclear as to the magnitude that these tributaries play a part in the impairment.

None of the NPDES permitted facilities in this sub-watershed contain a sanitary component in their discharge and are not sources of *E. coli*.

Permitted CFOs are found in the impaired and non-impaired sections of Yellow Creek sub-watershed. CFOs and CAFOs could be shown on the water quality duration during high flow conditions. Though these facilities have the potential to cause a violation of the *E. coli* water quality standard through land application or a malfunction at the facility, all of these facilities are operating in compliance with their permit.

Septic systems are a known source of *E. coli* for this sub-watershed based on information provided to IDEM by the Adams County Health Department. The septic systems as described in this information would provide a consistent source of *E. coli* particularly during low to mid-range flows. One of the six communities, Arcadia Village Subdivision, is located in this sub-watershed. According to the water quality duration curve for Site 16, there are consistent violations of the *E. coli* water quality standard during these flow conditions. Septic systems can also be failing during higher flow conditions by leaching to a field tile or other type of pipe to the stream. For Site LES040-0040, in particular, violations of the *E. coli* water quality standard are shown on the water quality duration curves during high flow, but not consistently.

4.2.3 Conclusions

The *E. coli* data has an average single sample maximum violation 76% of the time and a geometric mean violation 100% of the time. There are no known NPDES permits, CFO, and CAFO violations. Based on the water quality durations curves, it can be concluded that the majority of sources of *E. coli* in this watershed are nonpoint sources which include small animal operations, Amish communities, wildlife, leaking and failing septic systems.

4.3 Borum Run Sub-Watershed

4.3.1 Water Quality Duration Curves

A water quality duration curve was created for the sampling site in the Borum Run sub-watershed (Attachment C). Site LES040-0097 is located at the mouth of Borum Run. The geometric mean value at this site is 259 cfu/100mL. According to the water quality duration curves, there are no violations during dry flow conditions. Most of the violations for *E. coli* occur during the mid-range to moist conditions. This could be due to the small drainage area,

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14.4 square miles, of Borum Run at this site. Due to the small drainage area, this stream is more quickly affected by precipitation. During dry conditions, base flow is minimal in the stream, so there are fewer continuous sources of *E. coli*. During higher flow conditions, sources of *E. coli* to enter the stream during the "first flush" and then the water moves quickly through the stream. High flow conditions occur after the "first flush" has moved through the stream, causing the peaks of *E. coli* to be less in smaller drainage area streams. This is what the water quality duration curves show.

4.2.2 Source Linkage

The landuse in this watershed is predominately agricultural. Row crops comprise 90% of the landuse. The soils in this sub-watershed necessitate the use of field tiles to drain excess water from the fields. These field tiles then drain to the nearest stream. Field tiles themselves are not sources of *E. coli*, but they can carry *E. coli* from land-applied manure and runoff from the fields and pastures, and other sources of *E. coli* not adjacent to the streams. The high *E. coli* values during mid-range to high flow conditions indicate the presence of *E. coli* transportation by field tiles.

Pasture comprises 3% of the landuse. This indicates the presence of non-regulated smaller animal operations in this sub-watershed. Animals are not as likely to enter a stream during high flow conditions. Since there is a continuous source of *E. coli* present in this watershed during dry conditions, this would indicate that animals have direct access to the stream.

Wildlife is a known source of *E. coli*. The predominant agricultural and forested landuses in this sub-watershed create ideal habitat for wildlife. Wildlife would contribute during all flow conditions with possible spikes during extreme high flow conditions due to runoff or flooding.

There is a lack of *E. coli* sampling throughout this sub-watershed. The sampling site located at the mouth of Borum Run violates the *E. coli* water quality standard, indicating that the entire sub-watershed is impaired for *E. coli*. It is unclear the magnitude the headwater streams play a part in the impairment.

The one NPDES permitted facility with a sanitary component in this sub-watershed, White Horse Mobile Home Park, is now considered to be in compliance. This facility had violations of the WQS during the 2001 sampling of the St. Marys River Watershed. Since the completion of the enforcement activities and the resulting changes in treatment of the facility, the White Horse MHP is in compliance with WQS. The water quality duration curves do not indicate that this facility is a significant source of *E. coli* to the sub-watershed. White Horse MHP is not considered a significant source adding to the *E. coli* impairment.

Septic systems are a known source of *E. coli* for this sub-watershed based on information provided to IDEM by the Adams County Health Department. The septic systems as described in this information would provide a consistent source of *E. coli* particularly during low to mid-range flows. According to the water quality duration curve, there are consistent violations of the *E. coli* water quality standard during these flow conditions. Septic systems can also fail during higher flow conditions by leaching to a field tile or other type of pipe to the stream. Violations of the *E. coli* water quality standard are shown on the water quality duration curves during high flow, but not consistently.

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4.2.3 Conclusions

The *E. coli* data has an average single sample maximum violation 59% of the time. There are no known current NPDES permit violations. The downstream portion of this sub-watershed is located on the edge of the City of Decatur. This is the first sub-watershed to be in an urban area. Based on the water quality durations curves, it can be concluded that the majority of sources of *E. coli* in this watershed are nonpoint sources which include small animal operations, Amish communities, wildlife, leaking and failing septic systems.

4.3 Holthouse Ditch Sub-Watershed

4.3.1 Water Quality Duration Curves

A water quality duration curve was created for the sampling site in the Holthouse Ditch sub-watershed (Attachment C). Site LES050-0008 is located on Holthouse Ditch after the confluence of Kohne Ditch to Holthouse Ditch. This geometric mean value at this site is 706 cfu/100mL. The water quality duration curve for this site shows higher *E. coli* values during moist to high flows conditions.

4.3.2 Source Linkage

The landuse in this watershed is predominately agricultural. Row crops comprise 90% of the landuse. The soils in this sub-watershed necessitate the use of field tiles to drain excess water from the fields. These field tiles then drain to the nearest stream. Field tiles are not themselves sources of *E. coli*, but they can carry *E. coli* from land applied manure and runoff from the fields and pastures, and other sources of *E. coli* not adjacent to the streams. The high *E. coli* value during mid-range to high flow conditions indicates the presence of *E. coli* transportation by field tiles.

Pasture comprises 4% of the landuse. This indicates the presence of non-regulated smaller animal operations in this sub-watershed. Animals are not as likely to enter a stream during high flow conditions. Since there is a continuous source of *E. coli* present in this sub-watershed during dry conditions, this would indicate that animals have direct access to the stream.

Urban comprises 2% of the landuse. The downstream portion of this sub-watershed flows through the Southern edge of the City of Decatur. Urban areas create more impervious surfaces that cause an increase of runoff from precipitation to the nearby streams. With an increase in runoff, there are higher levels of *E. coli* in the higher flow conditions. The urbanized area also creates an environment where constant sources, agriculture, septic systems, and smaller WWTP, are less commonly a source of *E. coli*.

Wildlife is a known source of *E. coli*. The predominant agricultural and forested landuses in this sub-watershed create ideal habitat for wildlife. Wildlife would contribute during all flow conditions with possible spikes during extreme high flow conditions due to runoff or flooding.

The headwater streams are not listed as impaired. This is due to a lack of *E. coli* sampling in the headwater streams in this sub-watershed. Since there are known sources of *E. coli* in the headwater streams, the assumption can be made that these headwater streams are contributing

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to the *E. coli* impairment in the downstream sections of this sub-watershed. However, it is unclear as to the magnitude that these tributaries play a part in the impairment.

The one NPDES permitted facility with a sanitary component in this sub-watershed, Country Acres Estates, is possibly contributing to the *E. coli* impairment. This facility has had multiple years of noncompliance, which would have influenced the sampling for this sub-watershed. Currently this facility has been referred to IDEM's Enforcement Section for noncompliance.

Permitted CFOs and CAFOs are clustered in the headwaters of Holthouse Ditch. CFOs and CAFOs would be shown on the water quality duration during high flow conditions. Though these facilities have the potential to cause a violation of the *E. coli* water quality standard through land application or a malfunction at the facility, all of these facilities are operating in compliance with their permit.

Septic systems are a known source of *E. coli* for this sub-watershed based on information provided to IDEM by the Adams County Health Department. The septic systems as described in this information would provide a consistent source of *E. coli* particularly during low to mid-range flows. One of the six communities, Peterson Community, is located in this sub-watershed. According to the water quality duration curve, there are consistent violations of the *E. coli* water quality standard during these flow conditions. Septic systems can also fail during higher flow conditions by leaching to a field tile or other type of pipe to the stream. Violations of the *E. coli* water quality standard are shown on the water quality duration curves during high flow, but not consistently.

4.3.3 Conclusions

The *E. coli* data has an average single sample maximum violation of 62% and a geometric mean violation 72%of the time. One NPDES permit is potentially a significant source of *E. coli* to this sub-watershed. The CFOs and CAFOs have no known violations and are considered to be in compliance. Based on the water quality durations curves, it can be concluded that the majority of sources of *E. coli* in this watershed are nonpoint sources which include small animal operations, wildlife, runoff from urban areas, clustering of smaller communities outside of the City of Decatur, and leaking and failing septic systems.

4.4 Nickelsen Creek Sub-Watershed

4.4.1 Water Quality Duration Curves

A water quality duration curve was created for the sampling site in the Nickelsen Creek sub-watershed (Attachment C). Site LES050-0015 is located on Nickelsen Creek before the confluence of Lambert West Ditch to Nickelsen Creek. This geometric mean value at this site is 630 cfu/100mL. The water quality duration curve for this site shows higher *E. coli* values during moist to high flows conditions.

4.4.2 Source Linkage

The landuse in this watershed is predominately agricultural. Row crops comprise 88% of the landuse. The soils in this sub-watershed necessitate the use of field tiles to drain excess water from the fields. These field tiles then drain to the nearest stream. Field tiles are not themselves sources of *E. coli*, but they can carry *E. coli* from land applied manure, runoff

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from the fields and pastures, and other sources of *E. coli* not adjacent to the streams. The high *E. coli* value during mid-range to high flow conditions indicates the presence of *E. coli* transportation by field tiles.

Pasture comprises 5% of the landuse. This indicates the presence of non-regulated smaller animal operations in this sub-watershed. Animals are not as likely to enter a stream during high flow conditions. Since there is a continuous source of *E. coli* present in this watershed during dry conditions, this would indicate that animals have direct access to the stream.

Forests comprise 5% of the landuse. The forested areas are located along the stream bank, which creates a buffer strip. Buffer strips assist in slowing the time of transport of the contaminant, in this case *E. coli*, to the stream. Due to the choice of sampling location, this is only slightly reflected in the results. This is especially evident in the dry to moist conditions with an increase in compliance of the *E. coli* water quality standards.

Wildlife is a known source of *E. coli*. The predominant agricultural and forested landuses in this sub-watershed create ideal habitat for wildlife. Wildlife would contribute during all flow conditions with possible spikes during extreme high flow conditions due to runoff or flooding.

Due to the sampling location being before the confluence of Lambert West Ditch, this stream is not considered impaired. However, based on the landuse of this sub-watershed, it can be determined that Lambert West Ditch is a source of *E. coli* to Nickelsen Creek. It is unclear as to the magnitude that this tributary plays a part in the impairment.

Allen County is considered an MS4 community. Only a small portion of the downstream segment is included in Allen County. This downstream segment contains a small number of homes; therefore, this is not considered a significant source of *E. coli* to this sub-watershed.

There are two permitted CFOs in this sub-watershed. CFOs would be shown on the water quality duration curve during high flow conditions. Though these facilities have the potential to cause a violation of the *E. coli* water quality standard through land application or a malfunction at the facility, all of these facilities are operating in compliance with their permit.

Septic systems are a known source of *E. coli* for this sub-watershed based on information provided to IDEM by the Adams County Health Department. The septic systems as described in this information would provide a consistent source of *E. coli* particularly during low to mid-range flows. According to the water quality duration curve, there are consistent violations of the *E. coli* water quality standard during these flow conditions. Septic systems can also fail during higher flow conditions by leaching to a field tile or other type of pipe to the stream. Violations of the *E. coli* water quality standard are shown on the water quality duration curves during high flow, but not consistently.

4.4.3 Conclusions

The *E. coli* data have an average single sample maximum violation 72% of the time and an average geometric mean violation 91% of the time. There are no known NPDES permits in this watershed. There are no CFO violations and the CFOs are considered to be in compliance. The Allen County MS4 community is considered a source of *E. coli*, but not a significant source. Based on the water quality durations curves, it can be concluded that the

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majority of sources of *E. coli* in this watershed are nonpoint sources which include small animal operations, wildlife, leaking and failing septic systems.

4.5 St. Marys River

4.5.1 Water Quality Duration Curves

Water quality duration curves were created for five of the nine sampling sites along the St. Marys River (Attachment C). Site UNK000-0007 is located on the St. Marys River in Willshire, Ohio. This represents the sources of *E. coli* in the St. Marys River from Ohio. The geometric mean value at this site is 380 cfu/100mL. The water quality duration curve for this site shows higher *E. coli* values during dry flow conditions, which would indicate more of a continuous source of *E. coli*.

Site LES040-0007 is located on the St. Marys River at SR 101, north of Pleasant Mills. This is the first site on the St. Marys River after it enters from Ohio just after the confluence of the Blue Creek sub-watershed. The geometric mean for this site is 436 cfu/100mL. The water quality duration curve for this site using the 2004 IDEM sampling data shows higher *E. coli* values during moist conditions. Using IDEM's data from 1988 to 2004, this site still has higher *E. coli* values in moist conditions, but shows constant *E. coli* violations during dry conditions. The constant violations during dry conditions indicate continuous sources of *E. coli*. One of the major constant sources of *E. coli* is the Blue Creek sub-watershed.

Site LES060-0006 is located on the St. Marys River, near the town of Poe. The geometric mean for this site is 493 cfu/100mL. The town of Poe has been recognized by the Allen County Health Department as a known area for septic failure. This is confirmed by the water quality duration curves showing higher *E. coli* levels during moist conditions and a few high *E. coli* values during dry conditions. This sampling site was taken downstream of the discharge from the town of Poe. In addition, the Allen County Health Department has taken samples at the Town of Poe's discharge before it enters the St. Marys River. These *E. coli* values are extremely high during all flow conditions.

Site 29 is located on the St. Marys River at Ferguson Road. This sampling site is on the south edge of the City of Ft. Wayne. The geometric mean for this site was 189 cfu/100mL. According to the water quality duration curves, there is less of a continuous source of *E. coli* and more of storm driven source of *E. coli*. These results would be expected in more urbanized areas.

Site 30 is located at Spy Run Bridge on the St. Marys River. This sampling site is located in the middle of the City of Ft. Wayne before the St. Marys River joins with the St. Joseph River to form the Maumee River. The geometric mean for this site is 318 cfu/100mL. According to the water quality duration curves, there is a consistent *E. coli* violation during all flow conditions. This means that there are many different sources of *E. coli* at this sampling site.

4.5.2 Source Linkage

The landuse in this watershed is predominately agricultural. Row crops comprise 71% of the landuse. The soils in this sub-watershed necessitate the use of field tiles to drain excess water from the fields. These field tiles then drain to the nearest stream. Field tiles are not themselves sources of *E. coli*, but they can carry *E. coli* from land applied manure and runoff

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from the fields and pastures, and other sources of *E. coli* not adjacent to the streams. The high *E. coli* values in the downstream sites during mid-range to high flow conditions indicate the presence of *E. coli* transportation by field tiles.

Pasture comprises 7% of the landuse. This indicates the presence of non-regulated smaller animal operations in this sub-watershed. Animals are not as likely to enter a stream during high flow conditions. Since there is a continuous source of *E. coli* present in this watershed during dry conditions in the downstream sites, this would indicate that animals have direct access to the stream.

Wildlife is a known source of *E. coli*. The predominant agricultural and forested landuses in this sub-watershed create ideal habitat for wildlife. Wildlife would contribute during all flow conditions with possible spikes during extreme high flow conditions due to runoff or flooding.

Four NPDES permitted facilities discharge into the St. Marys River. Two of these facilities, Decatur STP and Oak Ridge Estates, have a sanitary component to their discharge. Neither of these facilities had significant violations of their permit limits and are both considered to be in compliance. The remaining NPDES permitted facilities discharge into the sub-watersheds of the St. Marys River. These facilities have been discussed earlier in this section as the facility is relevant to the appropriate sub-watershed.

There are three MS4 communities, the City of Decatur, the City of Fort Wayne, and Allen County, in the St Marys River watershed. To date, permits have not been issued for any of these MS4 communities. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11).

Many tributaries to the St. Marys River do not fall within a sub-watershed. Based on the landuse and sampling locations on the mainstem of the impaired sections of the St. Marys River, these tributaries are considered to be impaired and a source of *E. coli* to the mainstem of the St. Marys River.

Permitted CFOs and CAFOs are located in the sub-watersheds of the St. Marys River. These CFOs and CAFOs are addressed in the above sections for each sub-watershed. CFOs and CAFOs would be shown on the water quality duration during high flow conditions. Though these facilities have the potential to cause a violation of the *E. coli* water quality standard through land application or a malfunction at the facility, all of these facilities are operating in compliance with their permit.

Septic systems are a known source of *E. coli* for this sub-watershed based on information provided to IDEM by the Adams County Health Department and the Allen County Health Department. The Adams County Health Department's septic information is prevalent mainly in the sub-watersheds. The Allen County Health Department sampled three communities, Sites 26, 27, and 28, in the St. Marys River watershed. Site 27 and 28 are communities located along two unimpaired tributaries to the St. Marys River. Site 26 is the sampling site from the discharge of the Town of Poe before the discharges flows into the St. Marys River (Attachment A). *E. coli* levels at all these sites show extremely elevated levels of *E. coli*. The septic systems as described in this information would provide a consistent source of *E. coli* particularly during low to mid-range flows. According to the water quality duration curve, there are consistent violations of the *E. coli* water quality standard during these flow

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conditions. Septic systems can also be failing during higher flow conditions by leaching to a field tile or other type of pipe to the stream. Violations of the *E. coli* water quality standard are shown on the water quality duration curves during high flow, but not consistently.

There are twenty-four CSOs from the City of Ft. Wayne that flow into the St. Marys River. In addition, one CSO and two SSOs empty into to a natural drain that flows to Highland Drain. These CSOs and SSOs are located between Sites 29 and 30. There are four CSOs from the City of Decatur that discharge into the St. Marys River. These are located north of Site 18 and Site 19. None of the water quality duration curves captured the influence of the Decatur CSOs on the St. Marys River. CSOs and SSOs are shown on water quality duration curves during high flow events. Site 4 and Site 5 show higher *E. coli* values during high flows, than any of the other six sampling sites. It can be concluded that CSOs and SSOs are a source of *E. coli* in this sub-watershed. CSOs are a known source of *E. coli*. It is difficult to determine to what extent these discharges have on the *E. coli* impairment in the St Marys River watershed. The Long Term Control Plans (LTCP) that are under review at IDEM will provide the necessary guidelines to insure that the CSOs do not cause or contribute to the impairment of the St. Marys River watershed.

Both the City of Ft. Wayne and City of Decatur have SSOs identified in their NPDES permits. SSOs are prohibited from discharging at any time and any discharge may be addressed through an enforcement action.

4.5.3 Conclusions

The *E. coli* data has an average single sample maximum violation 70% of the time and an average geometric mean violation 86% of the time. The known NPDES permits that have a sanitary component are in compliance. There are no CFO violations and CFO facilities are considered to be in compliance. The Allen County, Decatur, and Ft. Wayne MS4 communities are considered sources of *E. coli*, but not significant sources. CSOs and SSOs from the City of Decatur and the City of Ft. Wayne are sources of *E. coli* to the St. Marys River. The sub-watershed and other tributaries are major sources of *E. coli* to the mainstem of the St. Marys River. The load of *E. coli* in the St. Marys River in Ohio is above Indiana's *E. coli* water quality standards. The St. Marys River is impaired for *E. coli* in Ohio and their sources of *E. coli* will be addressed at a later date through an Ohio-based TMDL. Based on the water quality durations curves, it can be concluded that the majority of sources of *E. coli* in this watershed are nonpoint sources which include small animal operations, wildlife, leaking and failing septic systems. In addition, the CSOs and SSOs are a major source of *E. coli* for the mainstem of the St. Marys River.

TMDL Development

The TMDL represents the maximum loading that can be assimilated by the waterbody while still achieving the Waters Quality Standard (WQS). As indicated in the Numeric Targets section of this document, the target for this *E. coli* TMDL is 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1 through October 31. Concurrent with the selection of a numeric concentration endpoint, TMDL development also defines the critical conditions that will be used when defining allowable levels. Many TMDLs are designed as the set of environmental conditions that, when addressed by appropriate controls, will ensure attainment of WQS for the pollutant. For example, the critical

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conditions for the control of point sources in Indiana are given in 327 IAC 5-2-11.1(b). In general, the 7-day average low flow in 10 years (Q7, 10) for a stream is used as the design condition for point source dischargers. However, *E. coli* sources to St. Marys River watershed arise from a mixture of dry and wet weather-driven conditions, and there is no single critical condition that would achieve the *E. coli* WQS. For the St. Marys River watershed and the contributing sources, there are a number of different allowable loads that will ensure compliance, as long as they are distributed properly throughout the watershed.

For most pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). For *E. coli* indicators, however, mass is not an appropriate measure because *E. coli* is expressed in terms of organism counts (or resulting concentration) (USEPA, 2001). The geometric mean *E. coli* WQS allows for the best characterization of the watershed. Therefore, this *E. coli* TMDL is concentration-based consistent with 327 IAC 5-2-11.1(b) and 40 CFR, Section 130.2 (i) and the TMDL is equal to the geometric mean *E. coli* WQS for each month of the recreational season (April 1 through October 31).

Allocations

TMDLs are comprised 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 uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is denoted by the equation:

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

The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. The overall loading capacity is subsequently allocated into the TMDL components of WLAs for point sources, LAs for nonpoint sources, and the MOS. This *E. coli* TMDL is concentration-based consistent with USEPA regulations at 40 CFR, Section 130.2(i).

To investigate further the potential sources mentioned above, an *E. coli* load duration curve analysis, as outlined in an unpublished paper by Cleland (2002), was developed for each sampling site in the watershed. The load duration curve analysis is a relatively new method utilized in TMDL development. The method considers how stream flow conditions relate to a variety of pollutant loadings and their sources (point and non-point).

In order to develop a load duration curve, continuous flow data is required. The USGS gage for the Harber Ditch, which was retired in 1991, was used for the tributary watersheds. The Little River gage was then used to determine the flow on the sampling day for the load duration curve analysis. A regression analysis between the Little River (03324000) and the Harber Ditch gage data (Figure 21) was done to confirm the use of the Little River data to supplement the information at the retired Harber Ditch gage. The Little River is located in an adjacent watershed of the St. Marys River watershed. This comparison uses a coefficient of determination value, R^2, to indicate the "fit" of the data. The comparison found the coefficient of determination, R^2, to be 0.74. Values near 1.0 for R^2 indicate a good fit of the data, whereas values near 0.0 indicate a poor fit of the data. Therefore, flow data from USGS gage (03354000) in Little River was used to supplement the Harber Ditch data. Although Harber Ditch is not a listed segment, it is a tributary that flows into the St. Marys from the west. Watershed characteristics are quite similar to the listed tributaries (e.g. dominated by row crop agriculture). Thus, the duration curve derived

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from flow information collected at Harber Ditch is used for the other tributaries. St. Marys River gage (04182590) was used for the development of the *E. coli* load duration curve analysis for the St. Marys River watershed TMDL.

The flow data is used to create flow duration curves, which display the cumulative frequency of distribution of the daily flow for the period of record. The flow duration curve relates flow values measured at the monitoring station to the percent of time that those values are met or exceeded. Flows are ranked from extremely low flows, which are exceeded nearly 100% of the time, to extremely high flows, which are rarely exceeded. Flow duration curves are then transformed into load duration curves by multiplying the flow values along the curve by applicable water quality criteria values for *E. coli* and appropriate conversion factors. The load duration curves are conceptually similar to the flow duration curves in that the x-axis represents the flow recurrence interval and the y-axis represents the allowable load of the water quality parameter. The curve representing the allowable load of *E. coli* was calculated using the single sample maximum and geometric mean standards of 235 *E. coli* per 100 ml and 125 *E. coli* per 100 ml, respectively. The final step in the development of a load duration curve is to add the water quality pollutant data to the curves. Pollutant loads are estimated from the data as the product of the pollutant concentrations, instantaneous flows measured at the time of sample collection, and appropriate conversion factors. In order to identify the plotting position of each calculated load, the recurrence interval of each instantaneous flow measurement was defined. Water quality pollutant monitoring data are plotted on the same graph as the load duration curve that provides a graphical display of the water quality conditions in the waterbody. The pollutant monitoring data points that are above the target line exceed the water quality standards (WQS); those that fall below the target line meet the WQS (Mississippi DEQ, 2002).

Wasteload Allocations

There are sixteen permitted dischargers in the St. Marys River watershed. Seven of the sixteen permitted dischargers have a sanitary component to their discharge. Four of these sixteen permitted dischargers already have *E. coli* limits in their permits. Three of these sixteen permitted dischargers have total residual chlorine limits in their permits. Eight of these sixteen do not have a sanitary component in their discharge or are a pretreatment permit that is connected to another WWTP for additional treatment. One of these permitted dischargers' effluent does not discharge to the St. Marys River Watershed but has CSOs and SSOs that discharge to this watershed.

The WLA for permitted activities is set at the WQS of 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1st through October 31st.

The WLA for prohibited discharges from SSOs and septic systems with straight pipe discharges directly to streams is set at zero (0.0).

Load Allocations

The LA for nonpoint sources is equal to the WQS of 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1st through October 31st. The LA will use the geometric mean of each sampling location to determine the reduction necessary to comply with WQS at each site (Appendix 4). The reductions have additionally been broken down into a flow regime that will help identify critical flows and areas for the implementation of this TMDL (Appendix 4).

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Load allocations may be affected by subsequent work in the watershed. There are currently no watershed projects or plans in the St Marys watershed. However, there have been several watershed projects completed in the surrounding areas. IDEM plans to work with the watershed coordinators in the surrounding areas along with local government agencies to encourage interest in watershed projects. It is anticipated that watershed projects will be useful in continuing to define and address the nonpoint sources of the *E. coli* in the St. Marys River watershed.

Margin of Safety

A Margin of Safety (MOS) was incorporated into this TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can be either implicit (i.e., incorporated into TMDL analysis thorough conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an implicit MOS by applying a couple of conservative assumptions. First, no rate of decay for *E. coli* was applied. *E. coli* bacteria have a limited capability of surviving outside of their hosts. Therefore, a rate of decay is normally applied. However, applying a rate of decay could result in a discharge limit that would be greater than the *E. coli* WQS, thus no rate of decay was applied. IDEM determined that applying the *E. coli* WQS of 125 per one hundred milliliters to all flow conditions and with no rate of decay for *E. coli* is a more conservative approach that provides for greater protection of the water quality. Therefore, the *E. coli* WQS was applied to all flow conditions thus creating a more conservative MOS for this TMDL.

Seasonality

Seasonality in the TMDL is addressed by expressing the TMDL in terms of the *E. coli* WQS for total body contact during the recreational season (April 1st through October 31st) as defined by 327 IAC 2-1-6(d). There is no applicable total body contact *E. coli* WQS during the remainder of the year in Indiana. Because this is a concentration-based TMDL, *E. coli* WQS will be met regardless of flow conditions in the applicable season.

Monitoring

Future *E. coli* monitoring of the St. Marys River watershed will take place during IDEM's five-year rotating basin schedule and/or once TMDL implementation methods are in place. In addition, IDEM will also work with the City of Ft. Wayne, the Allen County Health Department, and the Adams County SWCD to collect additional data from any sampling they may have completed. Monitoring will be adjusted as needed to assist in continued source identification and elimination. When these results indicate that the waterbody is meeting the *E. coli* WQS, IDEM will monitor at an appropriate frequency to determine if Indiana's 30-day geometric mean value of 125 *E. coli* per one hundred milliliters is being met.

Reasonable Assurance Activities

Reasonable assurance activities are programs that are in place or will be in place to assist in meeting the St. Marys River watershed TMDL allocations and the *E. coli* Water Quality Standard (WQS). Following is a list of reasonable assurance activities that pertain to the St. Marys River watershed.

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

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For the permitted dischargers that have only total residual chlorine limits in their current permits, IDEM's TMDL program proposes that *E. coli* limits and monitoring be added when the next permit renewals are issued.

Three CSO communities discharge to the St. Marys River watershed. These facilities are currently in the NPDES Long Term Control Plan permitting process. This process will address any concern about CSO discharges causing or contributing to the violation of the *E. coli* WQS.

Two SSO communities discharge to the St. Marys River watershed. This activity is prohibited. Continual monitoring and work with these facilities is needed to eliminate these types of discharges. This will assure that they no longer cause or contribute to violations of the *E. coli* WQS.

Storm Water General Permit Rule 13

MS4 permits are being issued in the state of Indiana. The three MS4 communities in the St. Marys River watershed are the City of Decatur, City of Ft. Wayne, and Allen County. Once these permits have been issued and implemented, they will improve the water quality in the St. Marys River watershed. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11). These permits will be used to address storm water impacts in the St. Marys River watershed.

Confined Feeding Operations and Confined Animal Feeding Operations

CFOs and CAFOs are required to manage manure, litter, and process wastewater pollutants in a manner that does not cause or contribute to the impairment of *E. coli* WQS.

Watershed Projects

Two 319 grants were awarded to the Adams County Soil and Water Conservation District in 1999 and 2000. These grants were to address nutrient management. The information gathered for these grants will be useful to build upon for work in this watershed.

IDEM has recently hired a Watershed Specialist for this area of the state. The Watershed Specialist will be available to assist stakeholders with starting a watershed group, facilitating planning activities, and serving as a liaison between watershed planning and TMDL activities in the St. Marys River watershed.

Potential Future Activities

Nonpoint source pollution, which is the primary cause of *E. coli* impairment in this watershed, can be reduced by the implementation of "best management practices" (BMPs). BMPs are practices used in agriculture, forestry, urban land development, and industry to reduce the potential for damage to natural resources from human activities. A BMP may be structural, that is, something that is built or involves changes in landforms or equipment, or it may be managerial, that is, a specific way of using or handling infrastructure or resources. BMPs should be selected based on the goals of a watershed management plan. Livestock owners, farmers, and urban planners, can implement BMPs outside of a watershed management plan, but the success of BMPs would be enhanced if coordinated as part of a

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watershed management plan. Following are examples of BMPs that may be used to reduce *E. coli* runoff:

Watershed Groups - Adams and Allen County along with the City of Ft. Wayne have shown and interested in forming a group to address the impairments in the St. Marys River watershed.

Riparian Area Management - Management of riparian areas protects stream banks and riverbanks with a buffer zone of vegetation, either grasses, legumes, or trees.

Manure Collection and Storage - Collecting, storing, and handling manure in such a way that nutrients or bacteria do not run off into surface waters or leach down into groundwater.

Contour Row Crops - Farming with row patterns and field operations aligned at or nearly perpendicular to the slope of the land.

Manure Nutrient - Testing - If manure application is desired, sampling and chemical analysis of manure should be performed to determine nutrient content for establishing the proper manure application rate in order to avoid over application and runoff.

Drift Fences - Drift fences (short fences or barriers) can be installed to direct livestock movement. A drift fence parallel to a stream keeps animals out and prevents direct input of *E. coli* to the stream.

Pet Clean-up / Education - Education programs for pet owners can improve water quality of runoff from urban areas.

Septic Management/Public Education - Programs for management of septic systems can provide a systematic approach to reducing septic system pollution. Education on proper maintenance of septic systems as well as the need to remove illicit discharges could alleviate some anthropogenic sources of *E. coli*.

Conclusion

The sources of *E. coli* to the St. Marys River include both point and nonpoint sources. In order for the St. Marys River watershed to achieve Indiana's *E. coli* WQS, the wasteload and load allocations for the St. Marys River watershed in Indiana have been set to the *E. coli* WQS of 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty day period from April 1st through October 31st. Achieving the wasteload and load allocations for the St. Marys River watershed depends on:

1) *E. coli* limits being added to dischargers who monitor for total residual chlorine.
2) Continued monitoring of facilities that do not use disinfection to assure compliance with the *E. coli* WQS.
3) Assure compliance with CFO and CAFO permits so that they do not cause or contribute to violations of the *E. coli* WQS.
4) Nonpoint sources of *E. coli* being controlled by implementing best management practices in the watershed.

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5) The issuance of the MS4 permits for the City of Decatur, City of Ft. Wayne, and Allen County.
6) The issuance of a LTCP for the City of Decatur, the City of Ft. Wayne, and Allen County.

The next phase of this TMDL is to identify and support the implementation of activities that will bring the St. Marys River watershed in compliance with the *E. coli* WQS. IDEM will continue to work with its existing programs on implementation. In the event that designated uses and associated water quality criteria applicable to the St. Marys River watershed are revised in accordance with applicable requirements of state and federal law, the TMDL implementation activities may be revised to be consistent with such revisions. Additionally, IDEM will work with local stakeholder groups to pursue best management practices that will result in improvement of the water quality in the St. Marys River watershed.

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E. coli TMDL for Maumee River

Section 1 Background for Maumee River

The Maumee River was listed for an *E. coli* impairment on Indiana's 2002 and 2004 303(d) Lists (Table 2). On the 2002 303(d) List, Bullerman Ditch, Bottern Ditch, and Black Creek (Allen) were listed for impaired biotic communities and nutrients (Figure 22).

Upon further investigation into the Maumee River listing on the 2004 303(d) List, it was discovered that a segment in the middle of the river was not listed. A reassessment was completed on the Maumee River and segment INA0516_M1005 will be listed as impaired for *E. coli* on the 2006 303(d) List.

This TMDL address approximately 29.49 miles of the Maumee River in Allen County, Indiana, where recreational uses are impaired by elevated levels of *E. coli* during the recreational season. Allen County is located in northeast Indiana (Figure 22). All of the seven segments for the listed streams of this TMDL are located in the Great Lakes Basin in hydrologic unit code 014100005010. The description of the study area, its topography, and other particulars are as follows:

Historical data collected by IDEM documented elevated levels of *E. coli* in the Maumee River at two fixed station sampling locations from 1991 to 2000. IDEM completed sampling at two sites on the Maumee River in 2000. For this sampling event, IDEM sampled two sites, five times, with the samples evenly spaced over a 30-day period from June 12, 2000 to July 11, 2000 (Figure 22). These two sites violated the single sample maximum standard and the geometric mean standard. This data was the basis for the listing of the Maumee River on the 2002 303(d) List.

The City of Ft. Wayne sampled the Maumee River at two sites weekly during the recreational season from 2001 through 2003 (Figure 22, Attachment D).

The Allen County Health Department conducted a study to see the impact septic systems have on a waterbody. The Health Department chose sampling sites throughout Allen County that had a cluster of homes on septics with an adjacent stream. Six of the Allen County Health Department sampling sites were in the Maumee River. These sites were sampled weekly during the recreational season from 2001 through 2004. All six of these sites violated the single sample maximum and the geometric mean standard multiple times over this time period. Some of the single maximum standard violations were substantially higher than the water quality standards (Figure 22, Attachment D).

Section 2 Numeric Targets

The impaired designated use for the waterbodies in the Maumee River is for total body contact recreational use during the recreational season, April 1st through October 31st.

The Indiana Administrative Code, 327 IAC 2-1.5-8(e)(2), establishes the full body contact recreational use *E. coli* WQS[2] for all waters in the Great Lakes system as follows:

[2] *E. coli* WQS = 125 cfu/100ml or 235 cfu/100ml; 1 cfu (colony forming units)= 1 mpn (most probable number)

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(2) *E. coli* bacteria, using membrane filter (MF) count, shall not exceed one hundred twenty-five (125) per one hundred (100) milliliters as a geometric mean based on not less than five (5) samples equally spaced over a thirty (30) day period nor exceed two hundred thirty-five (235) per one hundred (100) milliliters in any one (1) sample in a thirty (30) day period.

The sanitary wastewater *E. coli* effluent limits from point sources in the Great Lakes system during the recreational season, April 1st through October 31st, are also covered under 327 IAC 2-1.5-8(e)(2).

For the Maumee River during the recreational season (April 1st through October 31st), the target level is set at the *E. coli* WQS of 125 per one hundred milliliters as a 30-day geometric mean based on not less than five samples equally spaced over a thirty day period.

Section 3 Source Assessment

Watershed Characterization

The Maumee River is created by the St. Joseph River and St. Marys River in Allen County. The Maumee River then flows east into Ohio. Many tributaries enter the Maumee River. None of the major tributaries are listed on the 303(d) List as being impaired. These tributaries include Bullerman Ditch, Trier Ditch, Gar Creek, Botern Ditch, Black Creek, Ham Interceptor Ditch, and other tributaries (Figure 22).

E. coli Data

E. coli data has been collected on four sites in the Maumee River (Figure 22, Attachment D). IDEM's Assessment Branch sampled two sites (Site 1 and Site 9) on the Maumee River five times weekly from June of 2000 to July of 2000. This enabled IDEM's TMDL Program to calculate a geometric mean value. These sites violated the single sample maximum standard and geometric mean standard 100% of the time.

IDEM's Assessment Branch and the City of Ft. Wayne have *E. coli* data for the same site, Site 6, on the Maumee River (Figure 22, Attachment D). IDEM sampled this site monthly during the recreational season from 1991 to 1997. Additionally, IDEM's Assessment Branch sampled this site once monthly in April of 2000 and August of 2000 and then again in April of 2003. For IDEM's Assessment Branch sampling, this site violated the single sample maximum standard 54% of the time. The sample collected in April of 2003 did not violate the single sample maximum standard. The City of Ft. Wayne sampled this site weekly during the recreational season from 2001 to 2003. For the City of Ft. Wayne data, this site violated the single sample maximum standard an average of 61% of the time. The highest single sample was recorded at 8000 cfu/100mL. The geometric mean standard was violated and average of 73% of the time.

The City of Ft. Wayne sampled one site, Site 2, on the Maumee River weekly during the recreational season from 2001 to 2003 (Figure 22, Attachment D). This site violated the single sample maximum standard an average of 57% of the time. The highest *E. coli* value was recorded at 20,000 cfu/100mL. This site violated the geometric mean value an average of 73% of the time.

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Tributaries

The major tributaries of Bullerman Ditch, Botern Ditch, Black Creek, Gar Creek, Trier Ditch, and Ham Interceptor Ditch are not impaired for *E. coli* on the 303(d) List(Figure 22). There has not been enough data collected on these tributaries to determine if they are impaired or to what extent they are contributing to the *E. coli* impairment in the Maumee River.

Landuse

Landuse information was also assembled in 1992 using the Gap Analysis Program (GAP). In 1992, approximately 82% of the landuse in the Maumee River was agriculture. The remaining landuse for the Maumee River consisted of approximately 9% developed, 2% palustrine wetlands, 7% forested (Figure 23).

Wildlife

Wildlife is a known source of *E. coli* impairments in waterbodies. Many animals spend time in or around waterbodies. Deer, geese, ducks, raccoons, turkeys, and other animals all create potential sources of *E. coli*. Wildlife contributes to the potential impact of contaminated runoff from animal habitats, such as urban park areas, forest, and cropland.

Septic Systems

Homes within the Maumee River are almost entirely on septics. Failing septic tanks are known sources of *E. coli* impairment in waterbodies. As was mentioned earlier, the Allen County Health Department conducted a study to see the potential effect a community of homes with septic systems has on a stream. Communities of homes were chosen throughout Allen County. Six of these communities are located along the St. Marys River.

Site 3 is located on Trier Ditch south of Meyer Road, south of Hovel/Mckinnie (Figure 22). The Allen County Health Department believes this site is representative of an Industrial Area and possibly a community of homes south of the sampling site (G. Chapple, 2005). Aerial photos confirm a community of homes located south of the sampling location. The *E. coli* data was collected weekly during the recreational season from 2001 to 2004. This sampling site had an average single sample violation 67% of the time and an average geometric mean standard violation 86% of the time. The highest *E. coli* value was recorded at 18,000 cfu/100mL (Attachment D).

Site 4 is the second Allen County Health Department sampling site located in the Maumee River. Site 4 was sampled on Bender #2 at Paulding Road, east of Hartzell (Figure 22). This sampling site represents a community of approximately twenty homes south of the sampling location. These twenty homes were being considered for the Regional Sewer District, but this community was too great a distance from the Regional Sewer District (G. Chapple, 2005). The *E. coli* data was collected weekly during the recreational season from 2001 to 2004. This sampling site had an average single sample violation 85% of the time and an average geometric mean standard violation 96% of the time. The highest *E. coli* value was recorded at 133,000 cfu/100mL (Figure 22, Attachment D).

Site 5 is the third Allen County Health Department sampling site located in the Maumee River. Site 5 represents a community located near Trier Drain, south of the sampling location at Rose & Broadway by the railroad tracks. The Allen County Health Department *E. coli* data was also

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collected weekly during the recreational season from 2001 to 2004. This sampling site had an average single sample violation 83% of the time and an average geometric mean standard violation 83% of the time. The highest *E. coli* value was recorded at 18,000 cfu/100mL (Figure 22, Attachment D).

Site 7 is the fourth Allen County Health Department sampling site located in the Maumee River. Site 7 represents a strip development of homes located near Rushart Drain, south of the sampling location at Berthaud Road, south of Slusher. This strip development of homes contains approximately twenty homes with some newer homes that have absorption fields. The Allen County Health Department *E. coli* data was also collected weekly during the recreational season from 2001 to 2004. This sampling site had an average single sample violation 92% of the time and a geometric mean standard violation 100% of the time. The highest *E. coli* value was recorded at >200,000 cfu/100mL (Figure 1, Attachment D).

Site 8 is the fifth Allen County Health Department sampling site located in the Maumee River. Site 8 represents a community located near Wilbur Drain, south of the sampling location at Ehle Road. This community contains approximately fifteen homes. The Allen County Health Department *E. coli* data was also collected weekly during the recreational season from 2001 to 2004. This sampling site had an average single sample violation 87% of the time and a geometric mean standard violation 100% of the time. The highest *E. coli* value was recorded at 120,000 cfu/100mL (Figure 22, Attachment D).

Site 10 is the sixth Allen County Health Department sampling site located in the Maumee River. Site 10 represents a community located near Litzenberg Drain, south of the sampling location at State Line Road, north of Dawkins Road. The Allen County Health Department *E. coli* data was also collected weekly during the recreational season from 2001 to 2004. This sampling site had an average single sample violation 64% of the time and a geometric mean standard violation 89% of the time. The highest *E. coli* value was recorded at 400,000 cfu/100mL (Figure 22, Attachment D)

Overall, the data collected at these six sites show that septic systems are failing in Allen County. Septic systems are considered a significant source of *E. coli* to the Maumee River.

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

There are six NPDES permitted facilities in the Maumee River (Figure 22, Appendix 5). One of the six permitted discharges, Ft. Wayne Municipal STP (IN0032191), only has *E. coli* limits and total residual chlorine (TRC) in their permit. Ft. Wayne Municipal STP has not had violations of either their *E. coli* or TRC limits in the past 4 years. Therefore, this permitted discharger is considered to be in compliance and is not considered a significant source of the *E. coli* impairment in the Maumee River.

One of the six NPDES permitted facilities, Woodburn Municipal STP (IN0021407), does not have *E. coli* or TRC limits, but does contain a sanitary component. Woodburn Municipal STP is a lagoon system, so its permit does not include *E. coli* limits. It was believed that an extended retention time of sanitary wastewater was sufficient to provide a natural attrition of *E. coli* that would be in compliance with Indiana's *E. coli* Water Quality Standards. However, recent studies completed by Ron Turco from Purdue University have indicated that *E. coli* may live longer in this environment than originally believed. Therefore, it is unclear at this time to determine how significant a source of *E. coli* the Woodburn Municipal STP is to the Maumee River. In order to determine the if Woodburn Municipal STP is contributing to the *E. coli* impairment on the

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Maumee River, IDEM's TMDL Program will recommend *E. coli* reporting requirements to be added to this permit during its next permit renewal.

The remaining four of the six dischargers do not have *E. coli* or total residual chlorine limits in their permits. None of these four dischargers has a sanitary component to their discharge. Therefore, *E. coli* limits do not apply to their permits. These permitted dischargers are not contributing to the sources of *E. coli* in the Maumee River.

Storm Water General Permit Rule 13

There are two municipal separate storm sewer systems (MS4) communities, the City of Ft. Wayne and Allen County in the Maumee River. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11). It is difficult to determine to what extent, if any, these MS4 communities could be a source of *E. coli* in the Maumee River.

Combined Sewer Overflows (CSO)

There are two CSO communities in the Maumee River. The City of Ft. Wayne has ten CSOs that discharge in the Maumee River. The City of New Haven has four CSOs that discharge in the Maumee River (Figure 22, Appendix 6). The City of Ft. Wayne's CSO Long Term Control Plan (LTCP) has recently submitted their CSO LTCP to IDEM. The City of New Haven submitted their CSO LTCP in July of 2002. CSO outfalls are considered a source of *E. coli* to the Maumee River.

Confined Feeding Operations and Concentrated Animal Feeding Operations

The removal and disposal of the manure, litter, or processed wastewater that is generated as the result of confined feeding operations falls under the regulations for confined feeding operations (CFOs) and concentrated animal feeding operations (CAFOs). There are nineteen CFOs in the Maumee River (Figure 22). Two of the CFOs are considered CAFOs (Appendix 7). The CFO and CAFO regulations (327 IAC 16, 327 IAC 15) require operations "not cause or contribute to an impairment of surface waters of the state." There are currently no open enforcement actions on any of the operational CFOs and CAFOs in Maumee River. Therefore, these operations are not considered a significant source of *E. coli* for the Maumee River TMDL.

Small Animal Operations

There are many smaller livestock operations in the watershed. These operations, due to their small size, are not regulated under the CFO or CAFO regulations. These operations may still have an impact on the water quality and *E. coli* impairment. No specific information on these small livestock operations is currently available for the remaining portion of the Maumee River. However, it is believed that these small livestock operations may be a source of *E. coli*.

Section 4 Linkage Analysis

The linkage between the *E. coli* concentrations in the Maumee River and the potential sources of *E. coli* provides the basis for the development of this TMDL. Analysis of this relationship allows for estimating the total assimilative capacity of the stream and any needed load reductions. Water quality duration curves were created for three samplings sites in the Maumee River watershed

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that were sampled by IDEM and the City of Ft. Wayne from 1991 to 2003. A flow duration interval is described as a percentage. Zero (0) percent corresponds to the highest stream discharge (flood condition) and 100 percent corresponds to the lowest discharge (drought condition). These sampling sites are representative of the hydrodynamics of the Maumee River (Attachment E). This section will discuss the water quality durations and the linkage of the Maumee River.

Water Quality Duration Curves

Water quality duration curves were created for three sampling sites along the Maumee River (Attachment F). Site MAU-ANT is located on the Maumee in Ft. Wayne, Indiana within the mixing zone of the St. Marys and St. Joseph Rivers. This represents the sources of *E. coli* in the Maumee River from both of these River systems. This geometric mean value at this site is 244 cfu/100mL. The water quality duration curve for this site shows higher *E. coli* values throughout the curve with clusters during mid-range and high flow conditions. This indicates continuous source of *E. coli* with inputs during larger rain events.

Site MAU-LAN is located on the Maumee River at Landin Road. This is the first site on the Maumee River after the St. Marys and St. Joseph River mixing zone. The geometric mean for this site is 255 cfu/100mL. The water quality duration for this site is a similar curve to the MAU-ANT. This indicates load added between the two sampling sites.

Site M-114 is located on the Maumee River, near the town of Woodburn. The geometric mean for this site is 430 cfu/100mL. The water quality duration for this site shows consistent violations of WQS with little change during different flow conditions. This indicates constant sources of *E. coli*.

Source Linkage

Landuse information was also assembled in 1992 using the Gap Analysis Program (GAP). In 1992, approximately 82% of the landuse in the Maumee River watershed was agriculture. The remaining landuse for the Maumee River watershed consisted of approximately 9% developed, 2% palustrine wetlands, 7% forested (Figure 23).

Row crops comprise 71% of the landuse. The soils in this sub-watershed necessitate the use of field tiles to drain excess water from the fields. These field tiles then drain to the nearest stream. Field tiles are not themselves sources of *E. coli*, but they can carry *E. coli* from land applied manure and runoff from the fields and pastures, and other sources of *E. coli* not adjacent to the streams. The high *E. coli* values in the downstream sites during mid-range to high flow conditions indicate the presence of *E. coli* transportation by field tiles.

Pasture comprises 7% of the landuse. This indicates the presence of non-regulated smaller animal operations in this sub-watershed. Animals are not as likely to enter a stream during high flow conditions. Since there is a continuous source of *E. coli* present in this watershed during dry conditions in the downstream sites, this would indicate that animals have direct access to the stream.

Wildlife is a known source of *E. coli*. The predominant agricultural and forested landuses in this sub-watershed create ideal habitat for wildlife. Wildlife would contribute during all flow conditions with possible spikes during extreme high flow conditions due to runoff or flooding.

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Six NPDES permitted facilities discharge into the Maumee River. Two of these facilities, Ft. Wayne STP and Woodburn Municipal STP, have a sanitary component to their discharge. Neither of these facilities has significant violations of their permit limits and is considered to be in compliance. The remaining four NPDES permitted facilities do not have a sanitary component to there discharge.

There are two MS4 communities, the City of Ft Wayne and Allen County, on the Maumee River. To date, permits have not been issued for any of these MS4 communities. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11).

The major tributaries to the Maumee River are Bullerman Ditch, Botern Ditch, Black Creek, Gar Creek, Trier Ditch, and Ham Interceptor Ditch. These tributaries are not impaired for *E. coli* (Figure 22). Data has not been collected on these tributaries. Due to the continuous impairment of the Maumee River, it is assumed that the tributaries contribute to the *E. coli* impairment. However, the lack of data makes it impossible to determine to what extent these tributaries are contributing to the *E. coli* impairment in the Maumee River.

Permitted CFOs and CAFOs are located in the Maumee River. CFOs and CAFOs would be shown on the water quality duration during high flow conditions. Though these facilities have the potential to cause a violation of the *E. coli* water quality standard through land application or a malfunction at the facility, all of these facilities are operating in compliance with their permit.

Septic systems are a known source of *E. coli* the Maumee River based on information provided to IDEM by the Allen County Health Department. The Allen County Health Department sampled several communities, sites 3, 4, 5, 7, 8, and 10, in the Maumee River. *E. coli* levels at all these sites show extremely elevated levels of *E. coli*. The septic systems as described in this information would provide a consistent source of *E. coli* particularly during low to mid-range flows. According to the water quality duration curve, there are consistent violations of the *E. coli* water quality standard during these flow conditions. Septic systems can also fail during higher flow conditions by leaching to a field tile or other type of pipe to the stream. Violations of the *E. coli* water quality standard are shown on the water quality duration curves during high flow, but not consistently. (G. Chapple, 2005).

There are two CSO communities in the Maumee River watershed. The City of Ft. Wayne has ten CSOs that discharge in the Maumee River watershed. The City of New Haven has four CSOs that discharge in the Maumee River watershed (Figure 22, Appendix 6). The City of Ft. Wayne CSO Long Tern Control Plan (LTCP) has recently submitted their CSO LTCP to IDEM. The City of New Haven submitted their CSO LTCP in July of 2002. CSO outfalls are considered a source of *E. coli* to the Maumee River.

There are ten CSOs from the City of Ft. Wayne that flow into the Maumee River. These CSOs are located between Sites 1 and 3. There are four CSOs from the City of New Harmony that discharge into tributaries of the Maumee River. These are located south of Site 3. CSOs are shown on water quality duration curves during high flow events. All of these sites show higher *E. coli* values during high flows. It can be concluded that CSOs are a source of *E. coli* the Maumee River. CSO are a know source of *E. coli*. It is difficult to determine to what extent these discharges have on the *E. coli* impairment in the Maumee River watershed. The Long Term Control Plan (LTCP) that is under review at IDEM will provide the necessary guidelines to insure that the CSOs do not cause or contribute to the impairment of the Maumee River.

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Conclusions

The *E. coli* data has an average single sample maximum violation 70% of the time and an average geometric mean violation 86% of the time. The known NPDES permits that have a sanitary component are in compliance. There are no CFO violations and the CFOs are considered to be in compliance. The Allen County and Ft. Wayne MS4 communities are considered sources of *E. coli*, but not significant sources. CSOs from the City of Ft. Wayne and New Harmony are sources of *E. coli* to the Maumee River. Tributaries are sources of *E. coli*, at an unknown magnitude, to the Maumee River. Based on the water quality durations curves, it can be concluded that the majority of sources of *E. coli* in this waterbody are nonpoint sources which include small animal operations, wildlife, leaking and failing septic systems. In addition, the CSOs are a major source of *E. coli* for the Maumee River.

Section 5 TMDL Development

The TMDL represents the maximum loading that can be assimilated by the waterbody while still achieving the Water Quality Standard (WQS). As indicated in the Numeric Targets section of this document, the target for this *E. coli* TMDL is 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1 through October 31. Concurrent with the selection of a numeric concentration endpoint, TMDL development also defines the critical conditions that will be used when defining allowable levels. Many TMDLs are designed as the set of environmental conditions that, when addressed by appropriate controls, will ensure attainment of WQS for the pollutant. For example, the critical conditions for the control of point sources in Indiana are given in 327 IAC 5-2-11.1(b). In general, the 7-day average low flow in 10 years (Q7, 10) for a stream is used as the design condition for point source dischargers. However, *E. coli* sources to Maumee River arise from a mixture of dry and wet weather-driven conditions, and there is no single critical condition that would achieve the *E. coli* WQS. For the Maumee River and the contributing sources, there are a number of different allowable loads that will ensure compliance, as long as they are distributed properly throughout the watershed.

For most pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). For *E. coli* indicators, however, mass is not an appropriate measure because *E. coli* is expressed in terms of organism counts (or resulting concentration) (USEPA, 2001). The geometric mean *E. coli* WQS allows for the best characterization of the watershed. Therefore, this *E. coli* TMDL is concentration-based consistent with 327 IAC 5-2-11.1(b) and 40 CFR, Section 130.2 (i) and the TMDL is equal to the geometric mean *E. coli* WQS for each month of the recreational season (April 1 through October 31).

Section 6 Allocations

TMDLs are comprised 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 uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is denoted by the equation:

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

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The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. The overall loading capacity is subsequently allocated into the TMDL components of WLAs for point sources, LAs for nonpoint sources, and the MOS. This *E. coli* TMDL is concentration-based consistent with USEPA regulations at 40 CFR, Section 130.2(i).

To investigate further the potential sources mentioned above, an *E. coli* load duration curve analysis, as outlined in an unpublished paper by Cleland (2002), was developed for each sampling site in the watershed. The load duration curve analysis is a relatively new method utilized in TMDL development. The method considers how stream flow conditions relate to a variety of pollutant loadings and their sources (point and non-point).

In order to develop a load duration curve, continuous flow data is required. The USGS gage for the Maumee River (04183000) located near New Harmony, Indiana was used for development of the *E. coli* load duration curve analysis for the Maumee River TMDL. USGS gage (04183000) is located on the Maumee River in Allen County

The flow data is used to create flow duration curves, which display the cumulative frequency of distribution of the daily flow for the period of record. The flow duration curve relates flow values measured at the monitoring station to the percent of time that those values are met or exceeded. Flows are ranked from extremely low flows, which are exceeded nearly 100% of the time, to extremely high flows, which are rarely exceeded. Flow duration curves are then transformed into load duration curves by multiplying the flow values along the curve by applicable water quality criteria values for *E. coli* and appropriate conversion factors. The load duration curves are conceptually similar to the flow duration curves in that the x-axis represents the flow recurrence interval and the y-axis represents the allowable load of the water quality parameter. The curve representing the allowable load of *E. coli* was calculated using the daily and geometric mean standards of 235 *E. coli* per 100 ml and 125 *E. coli* per 100 ml, respectively. The final step in the development of a load duration curve is to add the water quality pollutant data to the curves. Pollutant loads are estimated from the data as the product of the pollutant concentrations, instantaneous flows measured at the time of sample collection, and appropriate conversion factors. In order to identify the plotting position of each calculated load, the recurrence interval of each instantaneous flow measurement was defined. Water quality pollutant monitoring data are plotted on the same graph as the load duration curve that provides a graphical display of the water quality conditions in the waterbody. The pollutant monitoring data points that are above the target line exceed the water quality standards (WQS); those that fall below the target line meet the WQS (Mississippi DEQ, 2002).

Wasteload Allocations

As previously mentioned, there are six permitted dischargers in the Maumee River. Two of the six permitted dischargers have a sanitary component to their discharge. One of these six permitted dischargers already has *E. coli* limits in their permits. One of these six does not have a disinfection requirement and the TMDL group is recommending monitoring to insure compliance with the WQS. The remaining four of these six permitted dischargers do not have a sanitary component to there discharge.

There are two MS4 communities, the City of Ft. Wayne, and Allen County, in the Maumee River. To date, these permits have not been issued for any of these MS4 communities. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11).

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The WLA is set at the WQS of 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1st through October 31st.

The WLA for prohibited discharges septic systems with straight pipe discharges directly to streams is set at zero (0).

Load Allocations

The LA for nonpoint sources is equal to the WQS of 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty-day period from April 1st through October 31st. The LA will use the geometric mean of each sampling location to determine the reduction necessary to comply with WQS at each site (Appendix 8). The reductions have additionally been broken down into a flow regime, which will help identify critical flows and areas for the implementation of this TMDL (Table 4).

Load allocations may be affected by subsequent work in the watershed. There are currently no watershed projects or plans on the Maumee River. However, there have been watershed projects completed in the surrounding areas. IDEM plans to work with the watershed coordinators in the surrounding areas along with local government agencies to encourage interest in watershed projects. It is anticipated that watershed projects will be useful in continuing to define and address the nonpoint sources of the *E. coli* in the Maumee River.

Margin of Safety

A Margin of Safety (MOS) was incorporated into this TMDL analysis. The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can be either implicit (i.e., incorporated into TMDL analysis thorough conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings). This TMDL uses an implicit MOS by applying a couple of conservative assumptions. First, no rate of decay for *E. coli* was applied. *E. coli* bacteria have a limited capability of surviving outside of their hosts; therefore, a rate of decay normally would be applied. However, applying a rate of decay could result in a discharge limit that would be greater than the *E. coli* WQS, thus no rate of decay was applied. Second, the *E. coli* WQS was applied to all flow conditions. This adds to the MOS for this TMDL. IDEM determined that applying the *E. coli* WQS of 125 per one hundred milliliters to all flow conditions and with no rate of decay for *E. coli* is a more conservative approach that provides for greater protection of the water quality.

Seasonality

Seasonality in the TMDL is addressed by expressing the TMDL in terms of the *E. coli* WQS for total body contact during the recreational season (April 1st through October 31st) as defined by 327 IAC 2-1.5-8(e)(2). There is no applicable total body contact *E. coli* WQS during the remainder of the year in Indiana. Because this is a concentration-based TMDL, *E. coli* WQS will be met regardless of flow conditions in the applicable season.

Monitoring

Future *E. coli* monitoring of the Maumee River will take place during IDEM's five-year rotating basin schedule and/or once TMDL implementation methods are in place. In addition, IDEM will also work with the City of Ft. Wayne and the Allen County Health Department to collect

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additional sampling they might have completed. Monitoring will be adjusted as needed to assist in continued source identification and elimination. When these results indicate that the waterbody is meeting the *E. coli* WQS, IDEM will monitor at an appropriate frequency to determine if Indiana's 30-day geometric mean value of 125 *E. coli* per one hundred milliliters is being met.

Section 8 Reasonable Assurance Activities

Reasonable assurance activities are programs that are in place or will be in place to assist in meeting the Maumee River TMDL allocations and the *E. coli* Water Quality Standard (WQS). Following is a list of reasonable assurance activities that pertain to the St. Marys River watershed.

National Pollutant Discharge Elimination System (NPDES) Permitted Dischargers

For the permitted discharger that has a sanitary component and does not have a disinfection requirement, IDEM's TMDL program proposes that *E. coli* monitoring be added when the next permit renewals are issued.

Storm Water General Permit Rule 13

MS4 permits are being issued in the state of Indiana. The two MS4 communities in the Maumee River are the City of Ft. Wayne and Allen County. Once these permits have been issued and implemented, they will improve the water quality in the Maumee River. Guidelines for MS4 permits and timelines are outlined in Indiana's Municipal Separate Storm Sewer System (MS4) Rule 13 (327 IAC 15-13-10 and 327 IAC 15-13-11). These permits will be used to address storm water impacts in the Maumee River.

Confined Feeding Operations and Confined Animal Feeding Operations

CFO and CAFO are required to manage manure, litter, and process wastewater pollutants in a manner that does not cause or contribute to the impairment of *E. coli* WQS.

Watershed Projects

The Maumee River Basin Commission is an active group which has the mission to provide regional leadership and promote flood control, soil and water conservation, and related resource management through a coordinated and comprehensive planning and implementing approach.

IDEM has recently hired a Watershed Specialist for this area of the state. The Watershed Specialist will be available to assist stakeholders with starting a watershed group, facilitating planning activities, and serving as a liaison between watershed planning and TMDL activities in the Maumee River.

Potential Future Activities

Non-point source pollution, which is the primary cause of *E. coli* impairment in this watershed, can be reduced by the implementation of "best management practices" (BMPs). BMPs are practices used in agriculture, forestry, urban land development, and industry to reduce the potential for damage to natural resources from human activities. A BMP may be structural, that is, something that is built or involves changes in landforms or equipment, or it

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may be managerial, that is, a specific way of using or handling infrastructure or resources. BMPs should be selected based on the goals of a watershed management plan. Livestock owners, farmers, and urban planners, can implement BMPs outside of a watershed management plan, but the success of BMPs would be enhanced if coordinated as part of a watershed management plan. Following are examples of BMPs that may be used to reduce *E. coli* runoff:

The interest from the City of Ft. Wayne, both Adams and Allen county health department should provide the catalyst needed to promote implementation in the Maumee River.

Riparian Area Management - Management of riparian areas protects stream banks and riverbanks with a buffer zone of vegetation, either grasses, legumes, or trees.

Manure Collection and Storage - Collecting, storing, and handling manure in such a way that nutrients or bacteria do not run off into surface waters or leach down into ground water.

Contour Row Crops - Farming with row patterns and field operations aligned at or nearly perpendicular to the slope of the land.

Manure Nutrient Testing - If manure application is desired, sampling and chemical analysis of manure should be performed to determine nutrient content for establishing the proper manure application rate in order to avoid over-application and runoff.

Drift Fences - Drift fences (short fences or barriers) can be installed to direct livestock movement. A drift fence parallel to a stream keep animals out and prevents direct input of *E. coli* to the stream.

Pet Clean-up / Education - Education programs for pet owners can improve water quality of runoff from urban areas.

Septic Management/Public Education - Programs for management of septic systems can provide a systematic approach to reducing septic system pollution. Education on proper maintenance of septic systems as well as the need to remove illicit discharges could alleviate some anthropogenic sources of *E. coli*.

Conclusion

The sources of *E. coli* to the Maumee River include both point and nonpoint sources. In order for the Maumee River to achieve Indiana's *E. coli* WQS, the wasteload and load allocations for the Maumee River in Indiana have been set to the *E. coli* WQS of 125 per one hundred milliliters as a geometric mean based on not less than five samples equally spaced over a thirty day from April 1st through October 31st. Achieving the wasteload and load allocations for the Maumee River depends on:

1) *E. coli* monitoring being added to insure lagoon dischargers meet WQS.
2) CFOs and CAFOs not violating their permits.
3) Nonpoint sources of *E. coli* being controlled by implementing best management practices on the waterbody.
4) The issuance of the MS4 permits for the City of Ft. Wayne and Allen County.
5) The issuance of the LTCP for the City of Ft. Wayne.

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6) Inadequate and failing septic systems need to be replaced.

The next phase of this TMDL is to identify and support the implementation of activities that will bring the Maumee River in compliance with the *E. coli* WQS. IDEM will continue to work with its existing programs on implementation. In the event that designated uses and associated water quality criteria applicable to the Maumee River are revised in accordance with applicable requirements of state and federal law, the TMDL implementation activities may be revised to be consistent with such revisions. Additionally, IDEM will work with local stakeholder groups to pursue best management practices that will result in improvement of the water quality in the Maumee River.

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Appendix 1: NPDES Permits in the St. Marys River Watershed

Facilities with *E. coli* Limits

Permit No.	Facility Name	Receiving Waters	St. Marys River Watershed
IN0039314	Decatur Municipal STP	St. Marys River	
IN0044199	White Horse Mobile Home Park	Borum Run via Miller	
IN0045292	Hessen Utilities	Marion Ditch	
IN0048119	Hoagland WWTP/ Allen Co Regional Sewer District	Houk Ditch	
IN0021369	Berne STP	Wabash River	Blue Creek

Facilities with Total Residual Chlorine Limits

Permit No.	Facility Name	Receiving Waters	St. Marys River Watershed
IN0036901	Oak Ridge Estates	St. Marys River via Bulham Ditch	
IN0055417	Country Acres Association WWTP	Kohne Ditch	
IN0109835	Mill Road Estates	St. Marys River	

Facilities with no Total Residual Chlorine or *E. coli* Limits

Permit No.	Facility Name	Receiving Waters	St. Marys River Watershed
IN0048151	Monroe Water Department	Yellow Creek	
IN0052302	B&B Custom Plating	St. Marys River via Tributary	
IN0058980	Bing-Lear Manufacturing Group, Berne	Habegger Ditch	Blue Creek
ING250026	Ft. Wayne Metals	Bradbury Ditch	
ING490084	Meshberger Bros Stone Plt #2	Blue Creek	Blue Creek
INP000069	Bing-Lear Manufacturing Group, Berne	Berne STP	Blue Creek
INP000194	Ruan Transport Corporation	Decatur STP	
INP000197	Driggs Farms of Indiana, Inc	Decatur STP	

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Appendix 2: Combined Sewer Overflows in St. Marys River Watershed

City of Ft. Wayne

CSO

Outfall #	Location	Receiving Waters
004	J02-90, 210' South of bridge at W. Jefferson & St. Marys River	St. Marys River
005	J11-164, 210' Southeast of Manito Blvd & Indiana Village Blvd	St. Marys River
007	K03-92, 250' Southeast of Electic Ave. & Brown Street	St. Marys River
011	K06-233, 230' Southeast of Main St. & Camp Allen Dr.	St. Marys River
012	K06-234, 230' Southeast of Main St. & Camp Allen Dr.	St. Marys River
013	K06-298, 80' North of Thieme Dr. & Berry St.	St. Marys River
014	K07-106, 60' West of Dinnen Ave. & Packard Ave.	St. Marys River
016	K07-109, 280' Southwest of Broadway & Kinsmoor Ave.	St. Marys River
017	K07-176, 130' Southwest of St. Marys Pkwy	St. Marys River
018	K11-165, 150' West of Broadway & Rudisill Blvd	St. Marys River
019	K11-178, 150' West of Broadway & Rudisill Blvd	St. Marys River
020	K15-116, 1300' West of Hartman Rd & Westover Rd	St. Marys River
021	K19-044, 850' West of Old Mill Rd. & Fairfax Ave.	St. Marys River
023	L06-103, 90' Northwest of Jackson St & Superior St	St. Marys River
024	L06-420, 220' North of Superior St. & Fairfield Ave.	St. Marys River
025	L06-421, 220' North of Superior St & Fairfield Ave.	St. Marys River
026	M10-151, 310' East of Third St. & Calhoun St.	St. Marys River
027	M10-202, 200' Southeast of Third St. & Calhoun St.	St. Marys River
028	M10-238, 150' East of St. Marys River Bridge & Spy Run Ave.	St. Marys River
029	M10-265, 230' East of Duck St. & Barr St.	St. Marys River
032	M10-306, 120' North of Clair St. & Harrison St.	St. Marys River
033	M10-313, 200' Southeast of Third St. & Calhoun St.	St. Marys River
054	O23-080, 240' East of Mercer Ave. & Hollis Ln.	Natural Drain #4
056	J03-313, Brown Street Pump Station	St. Marys River
067	K19-077, 310' Southeast of Hartman Rd & Foster Park Dr.	St. Marys River

SSO

Outfall #	Location	Receiving Waters
070	N23-121, 230' east of the intersection at John & Warfield	Highland Drain
071	N23-122, 290' east of the intersection at John & Warfield	Highland Drain

City of Decatur

CSO

Outfall #	Location	Receiving Waters
005	Swirl Concentrator	St. Marys River
008	Marshall Street	St. Marys River
009	Monroe Street	St. Marys River
011	Jefferson Street	St. Marys River

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City of Berne

CSO

Outfall #	Location	Receiving Waters
003	Welty Street & Compromise	Sprunger Ditch to Habegger Ditch
004	Main & Ruesser	Sprunger Ditch to Habegger Ditch

SSO

Outfall #	Location	Receiving Waters
006	North End of East Water Street	Sprunger Ditch to Habegger Ditch

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Appendix 3: CFO & CAFO in St. Marys River Watershed

				Approved Animals												
Log #	**Name**	**St. Marys River Watershed**	**NPDES #**	**Nursery Pigs**	**Growers/ Finishers**	**Sows/ Boars**	**Beef**	**Dairy**	**Dairy Calves**	**Veal**	**Layers**	**Pullets**	**Broilers**	**Turkeys**	**Ducks**	**Sheep**
8	Gary Steffen	Holthouse Ditch						60								
65	Grace Farms	Blue Creek									60,000					
91	Carl Lotter	Yellow Creek		4,200												
123	Jim Fiechter	Blue Creek			920											
469	Jerry Lee Graber	Blue Creek		320	920								6,000			
590	Ted Liechty	Blue Creek	ING800590								119,000					
635	Charles W Hill	Blue Creek			1,400											
638	Troyer Swine	Blue Creek			1,000											
684	Lynn Myers	St. Marys River			1,920											
902	David Hill	Blue Creek			625											
933	SDD Hogs, Inc	Blue Creek	ING800933		3,600											
944	ISCF Brothers Pork	Blue Creek			2,000											
948	Philip R Moser	Holthouse Ditch		1,185	500											
971	Emanuel Schmidt	Blue Creek		500	300											
1065	Pigs in a Blanket	Nickelsen Creek		2,880												
1197	Earl Gerber Farms, Inc	Holthouse Ditch										96,000				
1306	Triple G Ranch	Blue Creek		500	800	166										
1607	Triple T Farms, Inc	Holthouse Ditch		900	450		350						63,000			
1882	Gerald & Charles Miller	St. Marys River		250	1,945	110										

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				Approved Animals												
Log #	**Name**	**St. Marys River Watershed**	**NPDES #**	**Nursery Pigs**	**Growers/ Finishers**	**Sows/ Boars**	**Beef**	**Dairy**	**Dairy Calves**	**Veal**	**Layers**	**Pullets**	**Broilers**	**Turkeys**	**Ducks**	**Sheep**
1886	Alvin Schwartz	Yellow Creek			1,950											
2206	Cottonwood Corporation	Holthouse Ditch		2,400	2,400											
2369	Allen Buuck	Nickelsen Creek			410											
2435	ADM Alliance Nutrition, Inc	St. Marys River		1,000	702	351	376	82	56		2,800		1,452	1,440		
2548	Daniels J Michaels	Yellow Creek		510	255						8,200					
3005	Joel Houk	Holthouse Ditch		200	500	96										
3281	Gene Witte	St. Marys River		360	200	80										
3292	South 40 Farm			600		415										
3615	KMV Family Farms	St. Marys River						375								
3668	David H LaFontaine	Yellow Creek									81,000					
3737	Stan Von Gunten	Blue Creek										33,600				
3944	Moser Bros-Pine Hill Acres	Holthouse Ditch		160		576										
3985	Double G Farms	Blue Creek		200	580	99										
4037	Kirkland Farms	Holthouse Ditch			1,500											
4038	County Line Swine	Blue Creek		900	600	415										
4067	Fuelling Farms	St. Marys River														600

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				Approved Animals												
Log #	**Name**	**St. Marys River Watershed**	**NPDES #**	**Nursery Pigs**	**Growers/ Finishers**	**Sows/ Boars**	**Beef**	**Dairy**	**Dairy Calves**	**Veal**	**Layers**	**Pullets**	**Broilers**	**Turkeys**	**Ducks**	**Sheep**
4181	Victor Steiner	Yellow Creek		240	506	172										
4307	Stoller Poultry, Inc	Blue Creek			1,920						100,410					
4421	Kaehr Ag Inc	Blue Creek		460	600	204										
4637	Rigger Pork, Inc (Masterpork)	Blue Creek		800	120	619										
4964	Paul Rumple	Holthouse Ditch			6,000											
4997	Bruce Dick	Borum Run		240	540	146										
5007	Progress Pork	Blue Creek			2,000											
6000	Irish Acres Dairy	Blue Creek	ING806000					1,552	360							
6020	S&G Poultry	Blue Creek	ING806020								132,000					
6049	Tri Oak Farms, Inc	Blue Creek		320	500	134										
6159	Stan Biberstein	Holthouse Ditch									63,000					
6175	Jerry Lambright	Blue Creek													3,000	
6201	Ron Aschliman	Holthouse Ditch			3,040											
6239	James & Ron Collins	Holthouse Ditch			700											
6330	Steve Henry	Blue Creek										50,000				
4039	Thomas Wyss	St. Marys River			154											
4683	Duane E Franz	St. Marys River		400	530	100										
4942	Robert J Schuhler	St. Marys River		500	364	324										

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Appendix 4: St. Marys River Watershed Reductions

E. Coli (cfu/100mL) Duration Curve Zone Geometric Means and Reductions

Site ID								Site Name
	Blue Watershed							
	High	Moist	Mid-Range	Dry	Low	Site Geometric Mean	Overall Site Reductions	Area	
LES040-0011	2940.1	1428.1	892.9	366.2		1082.4	88.4	51.8	Blue Creek -- Salem Rd., South of CR 300 S
LES040-0066	3205.2	1797.2	622.8	158.4		868.2	85.6	71	Blue Creek -- CR 300 S, E of CR 000
LES040-0009	7549.8	3316.3	474.8	346.9		1425.1	91.2	79.6	Blue Creek -- SR 124, East of SR 101
LES040-0099	5298.9	1571.5	779.8	218.1		1091	88.5	8.4	Habegger Ditch -- CR 150 E at CR 500 S
LES040-0023	6208	3951.6	909.7	1311.8		2326.1	94.6	20.1	Gates Ditch -- CR400 S, East of CR 200 E
LES040-0010	1162.5	1105.9	824.1	295.5		748	83.3	16.3	Little Blue Creek -- CR 400 S (17 S Rd), West of CR 600 E
	Yellow Watershed							
	High	Moist	Mid-Range	Dry	Low	Site Geometric Mean	Overall Site Reductions	Area	
LES040-0040	1492.5	775.3	1052.9	65.3		531.1	76.5	9.8	Martz Creek -- CR 200 N, West of US 33
LES040-0038	5508.4	980.2	673.3	480.8		1149.8	89.1	24.5	Yellow Creek -- CR 250 N, East of Salem Road

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Holthouse / Borum / Nickelson / Unnamed								
High	Moist	Mid-Range	Dry	Low	Site Geometric Mean	Overall Site Reductions	Area	
698.1	465.4	286	48.9		259.7	51.9	14.4	Borum Run -- Mercer Rd in Decatur, then Salem Rd at lift station
6059.2	687.7	306.2	194.8		706.1	82.3	27.3	Holthouse Ditch -- CR 200 W, South of US 224
3849.9	766.9	327.8	163		630.2	80.1	12.2	Nickelsen Creek -- CR 1100 N, West of CR 550 W
5711.1	2133	346.9	372.4		1120.1	88.8	2.3	Unnamed Tributary -- Barkley Rd, E of US 27/33
St. Mary's River								
High	Moist	Mid-Range	Dry	Low	Site Geometric Mean	Overall Site Reductions	Area	
150	960.3	248.3	586.1		380.5	67.1	354	St. Marys River -- Ohio SR 81, Wilshire, OH
261.3	1019.5	499.2	271.3		435.8	71.3	467.8	St. Marys River -- SR 101 Bridge, North of Pleasant Mills
505.1	774.4	476.9	628.1	243.6	491	74.5	467.8	St. Marys River -- Fixed Station @ Pleasant Mills
1119.9	1411.2	139.3	269.1		493.4	74.6	643.2	St. Marys River -- Hoagland Rd. near Poe
1967.7	905.8	414.8	284	374.2	601.3	79.2	672	St. Marys River -- Fixed Station @ Ferguson Road
304.3	357.2	159.3	202.3	69.5	189.3	33.9	672	St. Marys River -- Ferguson Road
1933.6	1009.4	736.8	537	243.7	716	82.5	820	St. Marys River -- Fixed Station @ Spy Run
391.9	431.6	226.2	323	263.2	318	60.7	820	St. Marys River -- Spy Run Bridge

	Maumee River								
	High	Moist	Mid-Range	Dry	Low	Site Geometric Mean	Overall Site Reductions	Area	
MAU-ANT	364.3	277.8	133.4	350.7	182.8	244	48.8	1,900	Maumee River -- Anthony Boulevard
MAU-LAN	297.5	263.4	166.6	393.2	211.1	255.3	51	1,967	Maumee River -- Landin Road
M-129	2600	993	159.4	387.5	252.3	525.9	76.2	1,967	Maumee River -- Fixed Station @ Landin Road
M-114	1567.4	911.6	369.9	253	110.4	430.3	70.9	2,050	Maumee River -- Fixed Station near Woodburn

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Appendix 5: NPDES Permits in the Maumee River Watershed

Facilities with *E. coli* Limits and Total Residual Chorine

Permit No.	Facility Name	Receiving Waters
IN0032191	Ft. Wayne Municipal STP	Maumee River

Facilities with no Total Residual Chlorine or *E. coli* Limits with Sanitary Component

Permit No.	Facility Name	Receiving Waters
IN0021407	Woodburn Municipal STP	Maumee River

Facilities with no Total Residual Chlorine or *E. coli* Limits with No Sanitary Component

Permit No.	Facility Name	Receiving Waters
IN0000485	Norfolk & Western Railway Co	Trier Ditch
IN0000507	BF Goodrich Tire Manufacturing	Maumee River
ING490049	Hanson Aggregates, Midwest W.	Carson Drain
INM020346	New Haven CSS	N/A

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Appendix 6: Combined Sewer Overflows in Maumee River Watershed

City of Ft. Wayne

CSO Outfall #	Location	Receiving Waters
039	N06-022, 120' North of Hanna St. & Berry St.	Maumee River
048	O10-252, 350' West of Edgewater & Garfield	Maumee River
050	O10-277, 100' North of Coombs St. & Herbert St.	Maumee River
055	P06-192, 430' North of N. Anthony Blvd. & Wayne St.	Maumee River
057	P10-121, Stormwater Liftstation Wet Well	Maumee River
058	O06-34, 390' Northwest of Edsall Ave. & Dwenger Ave.	Maumee River
060	R06-31, 670' Northeast of Greenwalt Ave. & Maumee River	Unnamed Ditch to Maumee River
061	R14-137, 200' West of Lavern Ave. & State Blvd.	Baldwin Ditch
062	R14-138, 200' West of Lavern Ave. & State Blvd	Baldwin Ditch
064	S02-35. 610' Southeast of Coliseum Blvd. S.	Unnamed Ditch to Maumee River

City of New Haven

CSO Outfall #	Location	Receiving Waters
001	Near the Town's Abandoned Wastewater Treatment Facility	Martin Drain
002	East side of Bench Mark 761 and the N&W Railroad Crossing	Martin Drain
003	N.E. of the intersection of West Street & South Street	Trier Ditch
004	Just North of the Crossing of Brookwood Drive & Trier Ditch	Trier Ditch

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Appendix 7: CFO & CAFO in Maumee River Watershed

			Approved Animals						
Log #	**Name**	**NPDES #**	**Nursery Pigs**	**Growers/ Finishers**	**Sows/ Boars**	**Beef**	**Dairy**	**Dairy Calves**	**Ducks**
23	Bruce Brenneke						370	60	
470	Harmony Farms			385					
571	Ned S. Byer		500	740	156				
573	Richard & David Hartmann			200					
575	Schlatter Stock Farms			500		400			
708	Mark S. Rekeweg			1,600					
952	Steve R. Schneider		620	300	152				
1200	Victor Eicher			500					
1222	Lake Farms			270					
2219	Flat Rock LLC		1,200	160	477				
2485	Richard & David Hartmann		1,000	1,490					
2991	Richard Rodenbeck		300	300	30				
3967	Michael J. May		200	225	86				
4001	Schlatter Stock Farm		125	1,550					
4820	Brinkman & Son Farm		100	500	82				
4840	Jim Kline		140	600	120				
6098	Jurgielewicz Duck Farm	ING806098							5,000
6195	Schlatter Stock Farms-Ward Rd			4,000					
6287	Mark & Brenda Rekeweg	ING806287	1,100	4,600					

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Appendix 8: Reductions for the Maumee River Watershed

Maumee River									
	High	Moist	Mid-Range	Dry	Low	Site Geometric Mean	Overall Site Reductions	Area	
MAU-ANT	364.3	277.8	133.4	350.7	182.8	244	48.8	1,900	Maumee River -- Anthony Boulevard
MAU-LAN	297.5	263.4	166.6	393.2	211.1	255.3	51	1,967	Maumee River -- Landin Road
M-129	2600	993	159.4	387.5	252.3	525.9	76.2	1,967	Maumee River -- Fixed Station @ Landin Road
M-114	1567.4	911.6	369.9	253	110.4	430.3	70.9	2,050	Maumee River -- Fixed Station near Woodburn

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