Loading Analysis Plan and Supporting Data Acquisition Needed for the

Ashtabula River Basin

Total Maximum Daily Load Development

Ashtabula River

Ohio EPA Technical Report AMS/2011-ASHTA-3

Division of Surface Water
Assessment and Modeling Section
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TMDL DEVELOPMENT

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Introduction

This document provides an overview of the information considered in proposing the strategy to address water quality impairments in the Ashtabula River watershed. These recommendations are based on data collected as part of a biological and water quality study in 2011. A description of the project area, sites, data types and methods can be found in the Ashtabula River watershed 2011 study plan document at ***https://epa.ohio.gov/portals/35/tmdl/Ashtabula_Study_Plan_Final_2011.pdf.***

A summary of the study results can be found in the biological and water quality report at ***https://www.epa.ohio.gov/Portals/35/documents/Ashtabula_River_TSD_2015.pdf***

Sites in the Ashtabula River watershed were assessed for aquatic life use and recreation use. The public water supply use was not assessed since no surface waters are used as a public water supply in this study area. The attainment of aquatic life and recreation use is based on specific restoration targets. This document examines those targets and lays out proposals for addressing each impairment. Where appropriate, methods are outlined to develop total maximum daily loads (TMDL) for specific pollutants.

Aquatic Life Use

Evaluation of Biocriteria

Attainment of Ohio EPA's biocriteria are based on fish and macroinvertebrate scores, as measured by the Index of Biotic Integrity (IBI), Modified Index of well-being (MIwb) and Invertebrate Community Index (ICI). Further explanations of Ohio EPA's biocriteria can be found in Ohio Administrative Code (OAC) Chapter 3745-1-07 and additionally at ***epa.ohio.gov/dsw/bioassess/BioCriteriaProtAqLife***. Goals for those indices in the Ashtabula River watershed are shown in Table 1. The attainment status for each site is shown in Figure 1 (nine lacustuary sites within the last two miles of Ashtabula River are not shown in this figure) and the scores for impaired sites are shown in Table 2. ALU assessment was completed at 26 sites (excluding the lacustuary) in the Ashtabula River watershed in 2011. The study encompassed five HUC-12 watersheds in Ashtabula County. Three of the 26 sites (excluding lacustuary sites) were documented as having partial or non-attainment. Nine sites were sampled in the Ashtabula River lacustuary. Seven of the nine lacustuary sites were documented as having partial or non-attainment.

Table 1 – Biological criteria applicable in the Ashtabula River watershed for aquatic life use designations.

Ecoregion	Biological Index	Assessment Method[2, 3]	Biological Criteria for the Applicable Aquatic Life Use Designations[1]	
			WWH	LRW
Erie-Ontario Lake Plains (EOLP)	IBI	Headwater	40	18
		Boat	40	18
		Lacustuary Target[4]	42	--
	MIwb	Wading	7.9	4.5
		Boat	8.7	5.0
		Lacustuary Target[4]	8.6	--
	ICI	All[5]	34	8
		Lacustuary Target[4]	34	--

[1] Aquatic Life Use (ALU) designations: warmwater habitat (WWH); exceptional warmwater habitat (EWH); modified warmwater habitat (MWH); coldwater habitat (CWH), limited resource waters (LRW) and seasonal salmonid habitat (SSH) do not have associated biological criteria.

[2] The assessment method used at a site is determined by the sampling method. Sampling method is generally determined by a Sites' drainage area (DA) but can vary based on site characteristics.
Headwater: DA ≤ 20 mi^2; wading: DA >20 mi^2 and ≤ 500 mi^2; Boat: > 500 mi^2

[3] MIwb not applicable to drainage areas less than 20 mi^2 (headwater sites).

[4] No biological criteria for lacustuaries are promulgated in the Ohio WQS: IBI, MIwb, and ICI targets are used to help determine a narrative assessment of the designated WWH aquatic life use status

[5] Limited to sites with appropriate conditions for artificial substrate placement.

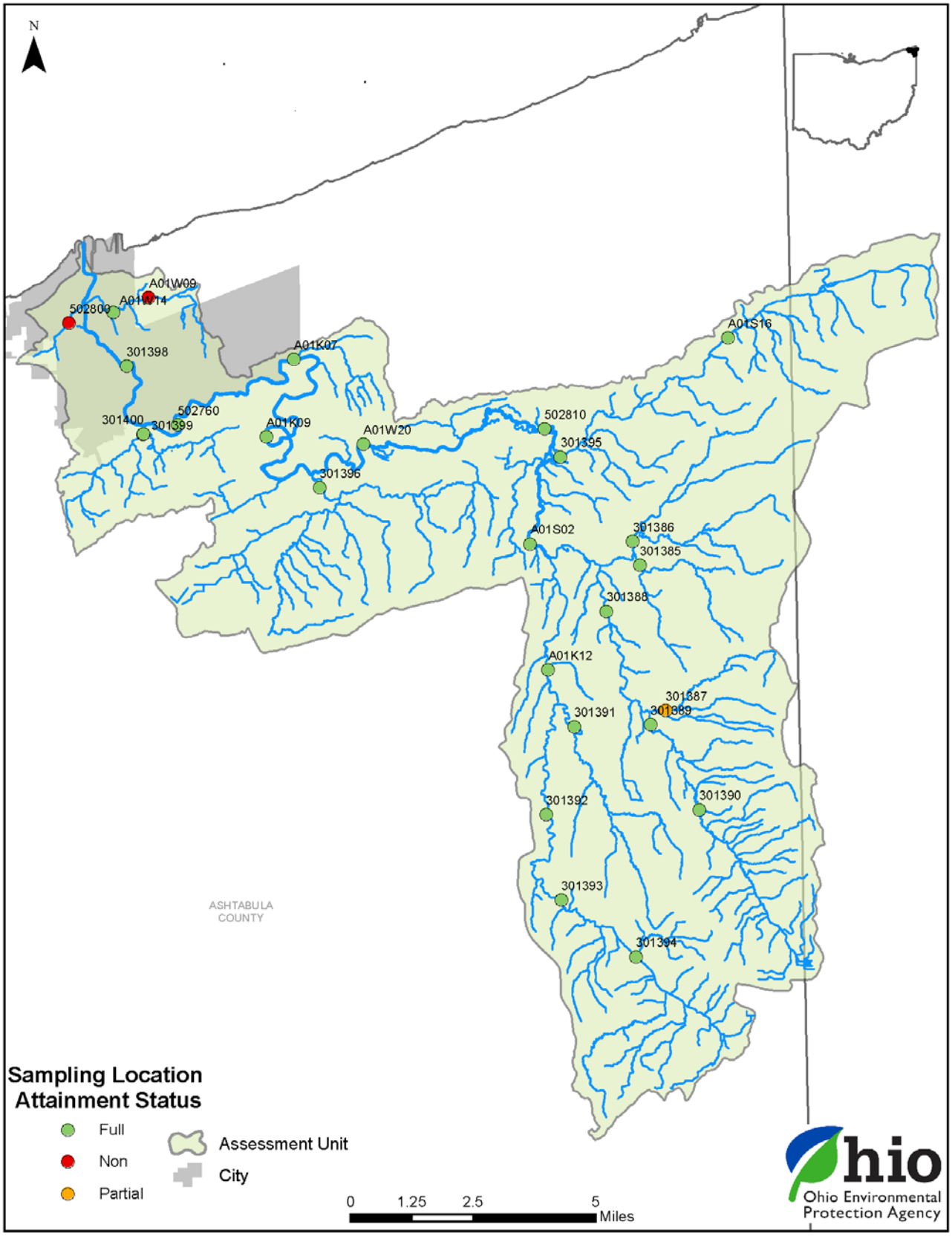

Figure 1 — Map summarizing ALU attainment status in the Ashtabula River watershed in 2011.

Table 2 – Aquatic life use attainment information for impaired sampling locations in the Ashtabula River watershed, 2011.

Station	Location	Ecoregion/ALU	River Mile[a]	Drain. Area (mi^2)	IBI	MIwb[b]	ICI[c]	QHEI	Attain. Status	Causes	Sources
04110003 01 01 – East Branch Ashtabula River											
301387	East Branch of East Branch Ashtabula River at St Rt 7	EOLP/WWH	0.4[H]/0.39	2.5	38[NS]	NA	F*	76.5	**PARTIAL**	Natural conditions	None
04110003 01 05 – Lower Ashtabula River											
A01K03	Ashtabula River at Ashtabula, upstream of Field's Brook	EOLP/WWH	1.8[B]	129	NA	NA	20/-	NA	**(NON)**	Direct habitat alterations in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification
301777	Ashtabula River at Ashtabula, upstream and across from Field's Brook	EOLP/WWH	1.6[B]	129	46	9	12/24	38.5	**PARTIAL**	Direct habitat alteration	Channelization, habitat modification other than hydromodification
										Habit alteration in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification
										Priority organics	Inappropriate waste disposal
										Sediment screening value/ exceedance	Urban runoff/ storm sewer

Station	Location	Ecoregion/ALU	River Mile[a]	Drain. Area (mi^2)	IBI	MIwb[b]	ICI[c]	QHEI	Attain. Status	Causes	Sources
A01K02	Ashtabula River at Ashtabula, downstream of Field's Brook	EOLP/WWH	1.3[B]	137	43	8.5	NA	33	**PARTIAL**	Direct habitat alteration	Channelization, habitat modification other than hydromodification
										Habitat alteration in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification
										Priority organics	Inappropriate waste disposal
										Sediment screening value/ exceedance	Urban runoff/ storm sewer
300381	Ashtabula River at Ashtabula at 5½ Slip	EOLP/WWH	1.1[B]	137	37	8.7	32/44	54.5	**PARTIAL**	Direct habitat alteration	Channelization, habitat modification other than hydromodification
										Habitat alteration in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification
										Priority organics	Inappropriate waste disposal
										Sediment screening value/ exceedance	Urban runoff/ storm sewer

Station	Location	Ecoregion/ALU	River Mile[a]	Drain. Area (mi^2)	IBI	MIwb[b]	ICI[c]	QHEI	Attain. Status	Causes	Sources
301397	Ashtabula River at Ashtabula, downstream of 5½ Slip	EOLP/WWH	0.9[B]	137	40	9.3	28/22	67	**PARTIAL**	Direct habitat alteration	Channelization, habitat modification other than hydromodification
										Habitat alteration in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification
										Priority organics	Inappropriate waste disposal
										Sediment screening value/ exceedance	Urban runoff/ storm sewer
A01S23	Ashtabula River at Ashtabula at Coast Guard Station	EOLP/WWH	0.6[B]	137	42	9.3	24/26	45	**PARTIAL**	Direct habitat alteration	Channelization, habitat modification other than hydromodification
										Habitat alteration in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification
										Priority organics	Inappropriate waste disposal
										Sediment screening value/ exceedance	Urban runoff/ storm sewer
A01K01	Ashtabula River at Ashtabula near mouth	EOLP/WWH	0.3[B]	137	NA	NA	24/-	NA	**(NON)**	Direct habitat alteration	Channelization, habitat modification other than hydromodification

Station	Location	Ecoregion/ALU	River Mile[a]	Drain. Area (mi^2)	IBI	MIwb[b]	ICI[c]	QHEI	Attain. Status	Causes	Sources
										Habitat alteration in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification
										Priority organics	Inappropriate waste disposal
										Sediment screening value/ exceedance	Urban runoff/ storm sewer
502800	Strong Brook at Ashtabula at Lake Ave	EOLP/LRW	0.6[H]	2.7	12*	NA	P	58.3	**NON**	PCBs and PAHs in sediments	Urban runoff, inappropriate waste disposal
A01W09	Field's Brook at Ashtabula at State Rd	EOLP/WWH	1.8[H]/1.84	1.5	32*	NA	F*	47	**NON**	Direct habitat alterations	Channelization

a River Mile (RM) represents the Point of Record (POR) for the station, and may not be the actual sampling RM.
b MIwb is not applicable to headwater streams with drainage areas ≤ 20 mi^2.
c A narrative evaluation of the qualitative sample based on attributes such as EPT taxa richness, number of sensitive taxa, and community composition was used when quantitative data was not available or considered unreliable. VP=Very Poor, P=Poor, LF=Low Fair, F=Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional
ns Nonsignificant departure from biocriteria (≤4 IBI or ICI units, or ≤0.5 MIwb units).
* Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.
H Headwater site (draining ≤20 $miles^2$)
B Boat site (large or deep waters, necessitating the use of Boat sampling methods)

Proposed Actions

Ohio EPA considers many factors when deciding how to address impairments. For some projects, no TMDL is required. The watershed may be in attainment or the impairment is being addressed by another program/entity so no further action by the Division of Surface Water is necessary. Additionally, the cause of impairment may be natural (i.e., flow or habitat), in which case no action is required. For those needing a TMDL, the complexity of each impairment—including the primary origin of the pollutant, its delivery mechanisms and the waterbody kinetics involved—will determine the complexity needed in a model. Additionally, Ohio EPA must take into consideration ongoing efforts in the watershed, previous TMDL analyses, the questions to be answered by a model and the amount of effort required to complete the model. Depending on the method selected, the Agency may be required to return to the watershed and collect additional data, and it is possible the modeling approach may change. A summary of Ohio EPA's preliminary modeling approaches is presented in Table 3.

Table 3 – Summary of ALU impairments and potential modeling approaches

Station	Stream Name	River Mile	HUC 12 (04110003)	Cause(s) of Impairment	Source(s) of Impairment	Action	Method[1]
301387	East Branch of East Branch Ashtabula River	0.39	01 01	Natural conditions	None	N/A	
A01K03	Ashtabula River	1.8	01 05	Direct habitat alterations in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification	TMDL	QHEI
301777	Ashtabula River	1.6	01 05	Direct habitat alterations	Channelization, habitat modification other than hydromodification	TMDL	QHEI
				Habitat alteration in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification	TMDL	QHEI
				Priority organics	Inappropriate waste disposal	Other	Follow-up
				Sediment screening value/exceedance	Urban runoff/storm sewer	Other	Follow-up

Station	Stream Name	River Mile	HUC 12 (04110003)	Cause(s) of Impairment	Source(s) of Impairment	Action	Method[1]
A01K02	Ashtabula River	1.3	01 05	Direct habitat alterations	Channelization, habitat modification other than hydromodification	TMDL	QHEI
				Habitat alteration in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification	TMDL	QHEI
				Priority organics	Inappropriate waste disposal	Other	Follow-up
				Sediment screening value/exceedance	Urban runoff/storm sewer	Other	Follow-up
300381	Ashtabula River	1.1	01 05	Direct habitat alterations	Channelization, habitat modification other than hydromodification	TMDL	QHEI
				Habitat alteration in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification	TMDL	QHEI
				Priority organics	Inappropriate waste disposal	Other	Follow-up
				Sediment screening value/exceedance	Urban runoff/storm sewer	Other	Follow-up
301397	Ashtabula River	0.9	01 05	Direct habitat alterations	Channelization, habitat modification other than hydromodification	TMDL	QHEI
				Habitat alteration in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification	TMDL	QHEI
				Priority organics	Inappropriate waste disposal	Other	Follow-up
				Sediment screening value/exceedance	Urban runoff/storm sewer	Other	Follow-up

Station	Stream Name	River Mile	HUC 12 (04110003)	Cause(s) of Impairment	Source(s) of Impairment	Action	Method[1]
A01S23	Ashtabula River	0.6	01 05	Direct habitat alterations	Channelization, habitat modification other than hydromodification	TMDL	QHEI
				Habitat alteration in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification	TMDL	QHEI
				Priority organics	Inappropriate waste disposal	Other	Follow-up
				Sediment screening value/exceedance	Urban runoff/storm sewer	Other	Follow-up
A01K01	Ashtabula River	0.3	01 05	Direct habitat alterations	Channelization, habitat modification other than hydromodification	TMDL	QHEI
				Habitat alteration in streamside or littoral vegetative cover	Channelization, habitat modification other than hydromodification	TMDL	QHEI
				Priority organics	Inappropriate waste disposal	Other	Follow-up
				Sediment screening value/exceedance	Urban runoff/storm sewer	Other	Follow-up
502800	Strong Brook	0.6	01 05	PCBs and PAHs in sediments	Urban runoff, inappropriate waste disposal	Other	Follow-up
A01W09	Field's Brook	1.84	01 05	Direct habitat alterations	Channelization	TMDL	QHEI

[1] Due to space limitations there are several abbreviations used to describe the analysis or remediation method. Those abbreviations are defined as follows:

Abbreviation	Definition/interpretation
TMDL	A Total Maximum Daily Load (TMDL) will be completed for the impairment.
Follow-up	Follow-up assessment is required to determine if the attainment
Revise listing	Based on survey findings, the listing will be updated in a subsequent Integrated Report and a TMDL or other action will not be required (i.e., a category 5 could be revised to a category 4c—not a pollutant).
QHEI	"Qualitative habitat evaluation index" is used as a means to address impairment due to inadequate habitat quality.

ALU assessments were completed at 35 sites in the Ashtabula River watershed (including nine sites in the lacustuary) in 2011. This work covered five HUC-12 watersheds in Ashtabula county. Of the 35 sites within the Ashtabula River watershed, 10 were documented as having partial- or non-attainment. One of these 10 sites was impaired due to natural causes or sources, therefore removing it from TMDL consideration. Nine sites were impaired for direct habitat alterations, alteration in streamside, priority organics, sediment screening value/exceedance, and PCBs and PAHs in sediment.

Seven sites on the Ashtabula Lacustuary (mainstem) listed direct habitat alterations in the streamside as the cause of impairment. These sites will be handled directly with a QHEI habitat TMDL.

In addition to direct habitat alterations and habitat alterations in the streamside (or littoral vegetation), six out of seven sites in the Ashtabula Lacustuary were listed as being impaired due to priority organics and sediment screening value. These six sites occur within the two miles of the lacustuary section of the Ashtabula River that are designated as an Area of Concern (AOC) or hot spot.

Under the Great Lakes Legacy Act of 2002, the Ashtabula Lacustuary, which is within the Ashtabula AOC, had significant dredging between 2005 – 2007. This operation removed 500,000 cubic yards of contaminated sediment. An estimated 25,000 pounds of PCBs and other contaminants were removed through dredging. In 2014, under the Great Lakes Restoration Initiative, 126,000 cubic yards were dredged from the upper and lower river.

To ensure future navigation activities, the Strategic Navigation Channel Operation and Maintenance has routinely dredged the Ashtabula River mouth. This biennial routine dredging operation has removed significant contaminated sediment as listed below (Ohio EPA – Melanie Barbis, June 2019):

2009: 70,000 (cubic Yards) Routine O&M
2011: 111,000 (cubic Yards) Routine O&M
2013: 158,000 (cubic Yards) Routine O&M
2015: 100,000 (cubic Yards) Routine O&M
2017: 175,000 (cubic Yards) Routine O&M
2019: 430,000 (cubic yards) Routine O&M (Planned)

Because so much work has been done in this area, it is recommended these sites be revisited for biological assessments.

Strong Brook was listed as having polluted sediment. In the Ashtabula TSD, it states: "The source of the PCB contamination in the stream can conclusively be assigned to the Clean Harbors PPM facility." Clean Harbors PPM, LLC, which was the source of impairment, has implemented a PCB Control Plan in accordance with National Pollutant Discharge Elimination System Permit (NPDES) Permit 3ll00202 Part II Paragraph J. Clean Harbors will continue to implement the control plan for routine monitoring and inspection of storm/sewer drains, manholes and catch basins. As a part of the control plan, if PCBs are found in excess of 1.0 ppm in any samples collected, Clean Harbors will hydro-clean the sewer system within 14 days of obtaining the sample results (Ohio EPA – Donna Kniss, June 2019). With all these measurable improvements, biological assessment follow up will be appropriate course of action.

Direct habitat alteration is listed as the cause of impairment at Field's Brook, and a QHEI TMDL will address the impairment.

Proposed Targets

Habitat

Since its development, the Qualitative Habitat Evaluation Index (QHEI) has been used to evaluate habitat at most biological sampling sites and there is an extensive database that includes QHEI scores and other water quality variables. Strong correlations exist between QHEI scores and the biological indices used in Ohio's water quality standards such as the Index of Biotic Integrity (IBI). Through statistical analyses of data for the QHEI and the biological indices, target values have been established for QHEI scores with respect to the various aquatic life use designations (Ohio EPA 1999). These targets are shown in Table 4.

One of the strongest correlations found through the statistical analyses described above is the negative relationship between the number of modified attributes and the IBI scores. Modified attributes are features or conditions of the stream that have poor habitat quality and therefore are assigned relatively fewer points or negative points in the QHEI scoring. A sub-group of the modified attributes shows a stronger impact on biological performance; these are termed high influence modified attributes (Table 5).

In addition to the overall QHEI scores, targets for the maximum number of modified and high influence modified attributes have been developed. For example, in order to meet the targets, streams designated as WWH cannot have more than four modified attributes, of which no more than one can be a high influence modified attribute. For simplicity, a pass/fail distinction is made indicating whether or not each of the three targets is being met. Targets are set for: 1) the total QHEI score; 2) the maximum number of all modified attributes; and 3) the maximum number of high influence modified attributes. If the minimum target is satisfied, then that category is assigned a "1," if not, it is assigned a "0." To satisfy the habitat TMDL, the stream segment in question should achieve a score of three.

Table 4 – QHEI targets for habitat TMDLs

Habitat TMDL Targets			
QHEI Category	*Target*		*Score*
	WWH	*EWH*	
QHEI Score	≥ 60	≥ 75	+ 1
High Influence #	≤ 1	0	+ 1
Total # Modified	≤ 4	≤ 2	+ 1
	Habitat TMDL ►		+ 3

Table 5 – Itemization of modified attributes for computing habitat TMDLs

High Influence Modified Attributes	Moderate Influence Modified Attributes	
• Recent channelization or no recovery • Silt/muck substrate • Low or no sinuosity (drainage area ≤ 20 mi^2) • Sparse/no cover • Maximum pool depth < 40 cm (wadeable or headwater sites)	• Recovering channelization • Heavy/moderate silt cover • Sand substrate (boat sites) • Hardpan substrate origin • Fair/poor development • Low or no sinuosity (drainage area > 20 mi^2) • Only 1-2 cover types	• Intermittent pools and max pool depth < 40 cm • No fast current • High/moderate substrate embeddedness • High/moderate riffle embeddedness • No riffle

Recreation Use

Evaluation of Criteria

Attainment of recreation use goals is based on numeric criteria for *Escherichia coli* (*E. coli*) as an indicator bacterium. These criteria, shown in Table 6, are also the targets used for TMDLs. Table 7 lists attainment of recreation use based on criteria at the time of assessment, which were different than the current standards. However, any TMDLs created for those assessment units will use the updated values in Table 6.

Table 6 – Water quality criteria for recreation use

Recreation Use	*Escherichia coli* (colony forming units per 100 mL)	
	90-day geometric mean	Statistical threshold value[1]
Bathing water	126	410[a]
Primary contact recreation	126	410
Secondary contact recreation	1030	1030

[1] These criteria shall not be exceeded in more than 10 percent of the samples taken during any ninety-day period.

[a] A beach action value of 235 E. coli colony counts per 100 mL shall be used for the purpose of issuing beach and bathing water advisories.

Table 7 – Recreation use attainment information for impaired sampling locations in the Ashtabula River watershed, 2011.

Station	Stream Name	River Mile	# Samples	Geometric Mean	Maximum Value	Attainment Status	Possible Source(s)
04110003 01 01 – East Branch Ashtabula River							
301390	East Br. Ashtabula River	7.97	5	623	1200	NON	Agriculture, failing HSTSs
301389	East Br. Ashtabula River	5.47	5	462	830	NON	Agriculture, failing HSTSs
301388	East Br. Ashtabula River	2.40	12	1038	12000	NON	Agriculture, failing HSTSs
301387	East Br. Of East. Branch Ashtabula River	0.39	5	550	1100	NON	Agriculture, failing HSTSs
301386	Trib to East Branch Ashtabula River	0.3	5	731	2200	NON	Agriculture, failing HSTSs
301385	Trib to East Branch Ashtabula River	1.10	5	400	1100	NON	Agriculture, failing HSTSs
04110003 01 02 – West Branch Ashtabula River							
301394	West Br. Ashtabula River	11.28	5	443	1,800	NON	Agriculture, failing HSTSs
301393	West Br. Ashtabula River	9.04	5	342	1,600	NON	Agriculture, failing HSTSs
A01K12	West Br. Ashtabula River	2.70	12	614	17,000	NON	Agriculture, failing HSTSs
301391	Trib to West Branch Ashtabula River	0.92	5	439	1,600	NON	Agriculture, failing HSTSs
04110003 01 03 – Ashtabula Creek							
A01S16	Ashtabula Creek	5.24	5	337	770	NON	Agriculture, failing HSTSs
301395	Ashtabula Creek	0.28	12	697	120,000	NON	Agriculture, failing HSTSs
04110003 01 04 – Upper Ashtabula River							
502810	Ashtabula River	23.80	5	148	300	NON	Agriculture, failing HSTSs
A01W20	Ashtabula River	19.03	12	572	22,000	NON	Agriculture, failing HSTSs
A01K09	Ashtabula River	13.90	5	277	570	NON	Agriculture, failing HSTSs
301396	Trib to Ashtabula River	0.43	5	257	810	NON	Agriculture, failing HSTSs
04110003 01 05 – Lower Ashtabula River							
301398	Ashtabula River	3.42	12	1,094	17,000	NON	Agriculture, failing HSTSs
A01W14	Fields Brook	0.89	5	331	820	NON	Agriculture, failing HSTSs
502780	Field Brooks	0.33	12	1176	16,000	NON	Agriculture, failing HSTSs
301399	Hubbard Run	0.21	5	248	600	NON	Agriculture, failing HSTSs
301400	Trib to Hubbard Run	0.10	5	337	2,400	NON	Agriculture, failing HSTSs

Station	Stream Name	River Mile	# Samples	Geometric Mean	Maximum Value	Attainment Status	Possible Source(s)
301763	Strong Brook	0.46	12	2,289	13.000	NON	Agriculture, failing HSTSs

Proposed Actions

Concentrations of *E. coli* exceeding the water quality standard are due to both pervasive and direct sources. Two predominant pathways exist for pathogen delivery to water bodies. The first pathway is pathogen-rich discharge, including material such as poorly treated or untreated effluent from wastewater treatment plants, combined sewer overflows, sanitary sewer overflows, household sewage treatment systems and livestock access to streams. This is delivered to the stream by direct discharge. The second pathway is pathogen-rich runoff/drainage from nonpoint sources. The associated delivery mechanism is precipitation-driven wash-off. This type of transport involves the delivery of pathogen-rich material by overland flow during precipitation and runoff events (e.g., summer storms, snowmelt, etc.).

Due to these mechanisms of delivery, the sources of pathogens in surface waters can be determined to a certain extent via the level of stream flow observed. Therefore, Ohio EPA proposes using the load duration curve (LDC) framework for recreation use TMDLs. LDCs are an empirical method of determining TMDL pollutant loading and needed reductions. The main advantage of the use of LDCs is in this method's ability to differentiate loads from various types of sources based on stream flow regime. While this is a fairly basic modeling method, relationships between bacteria source contributions and flow regimes are straight forward. In-stream processes and interactions between pathogen sources are assumed conservative (i.e., not occurring) in this method. Figure 2 shows an example LDC with corresponding TMDL calculations represented in Table 8.

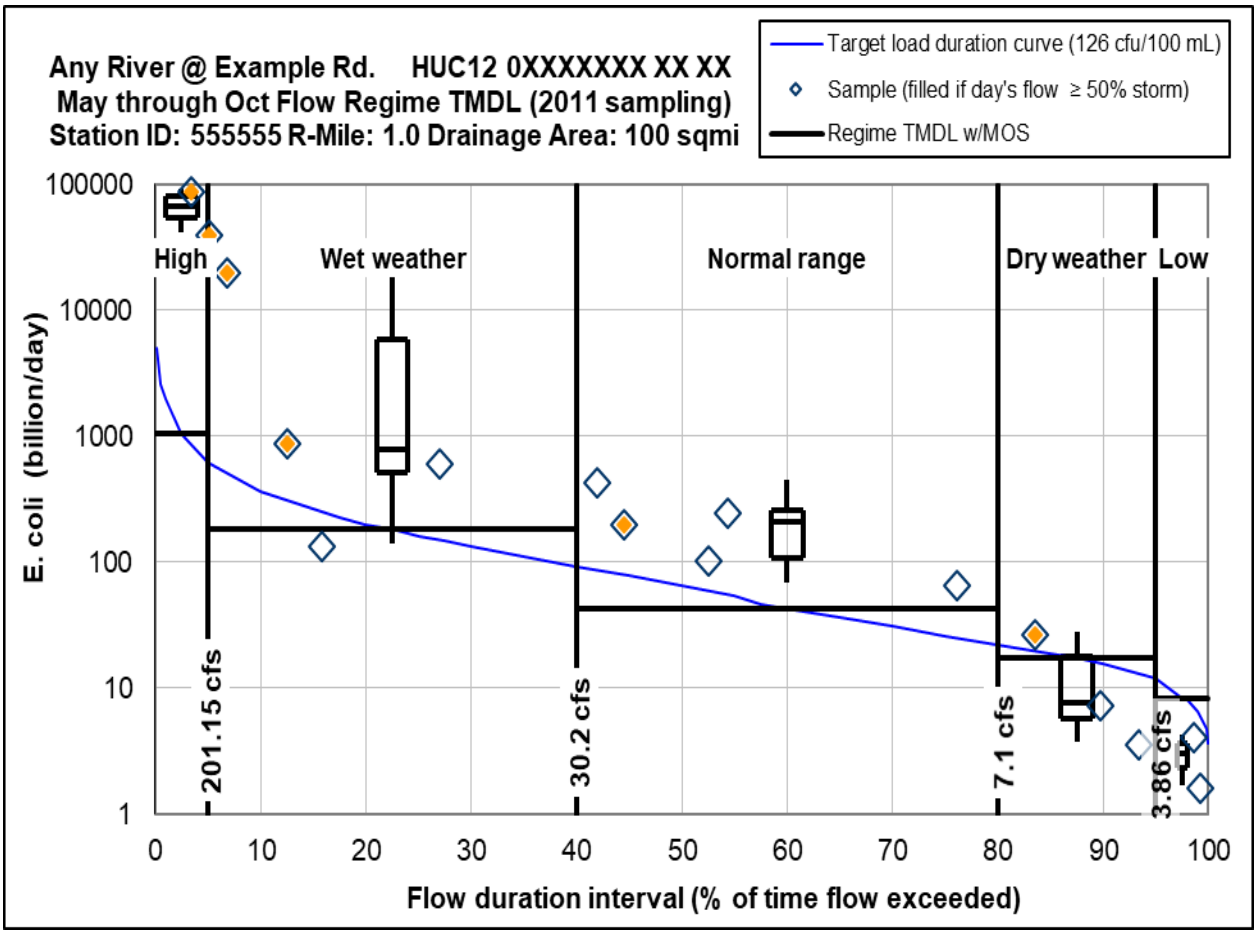

Figure 2 – Example load duration curve.

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

TMDL and duration intervals	High 0-5%	Wet weather 5-40%	Normal range 40-80%	Dry weather 80-95%	Low 95-100%
Samples Per Regime	2	4	5	3	2
Median Sample load	66807	781	209.25	7.72	2.99
Total Load Reduction Required	98.9%	82.8%	84.7%	NA	NA
Total Maximum Daily Load	1036.68	182.09	43.25	17.26	8.35
Margin of Safety: 20%	207.34	36.42	8.65	3.45	1.67
Allowance for Future Growth	62.20	10.93	2.60	1.04	0.50
Load Allocation	740.71	127.29	27.63	8.98	2.58
Wasteload Allocation Total	26.43	7.46	4.37	3.80	3.60
MS4	23.01	4.04	0.96	0.38	0.19
Example Town WWTP XPX00XXX	3.41	3.41	3.41	3.41	3.41

Reference

Ohio EPA (Ohio Environmental Protection Agency – Division of Surface Water). 1999. *Association between nutrients, habitat, and the aquatic biota of Ohio's rivers and streams.* Published at: ***http://epa.ohio.gov/portals/35/guidance/assoc_load.pdf.***

US Army Corps of Engineers, Mary Beth Giancarlo and US Fish and Wildlife Service, Jo Ann Banda, *personal communications to Melanie Barbis (Ohio EPA), June 14, 2019.*

Safety-Kleen Systems Inc., Stephen Fleming, P.E., *personal communication to Ms. Virginia Wilson (Ohio EPA), April 29, 2019.*