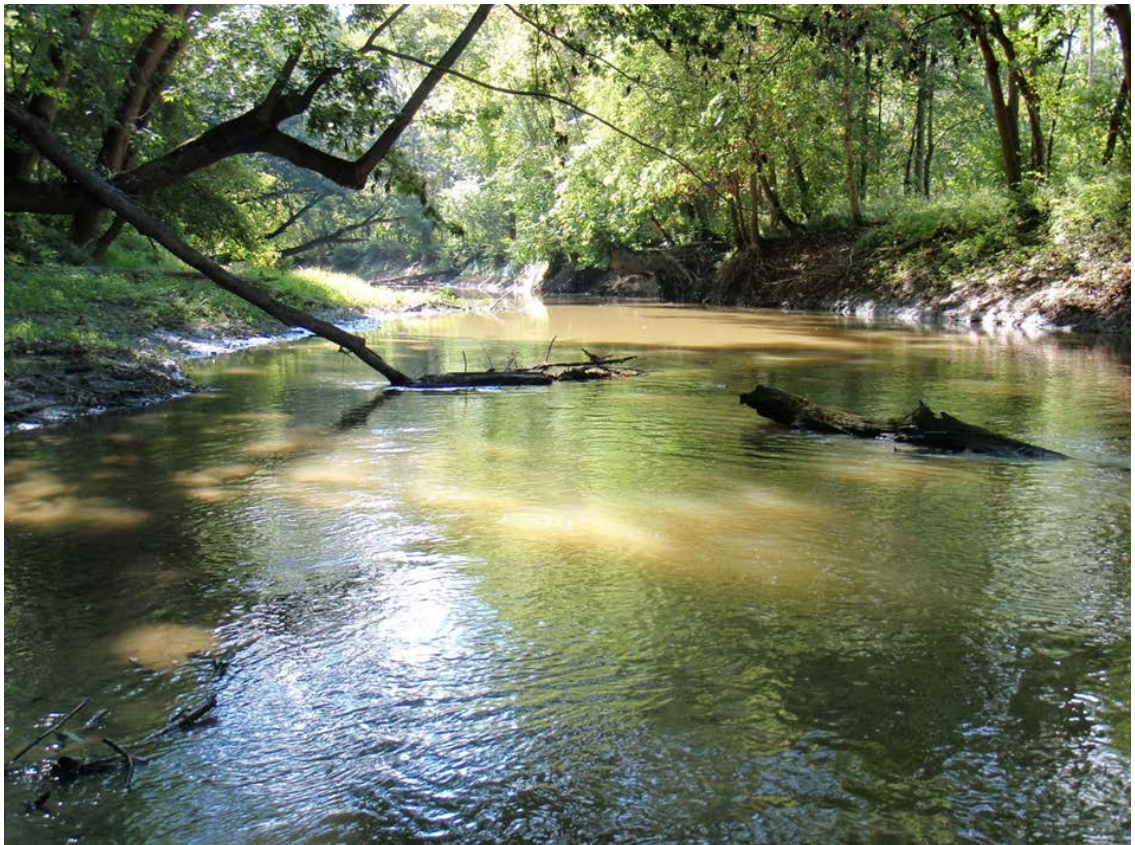




Loading Analysis Plan and Supporting Data Acquisition Needed for the Rocky River Watershed

Total Maximum Daily Load Development



Rocky River Watershed

Ohio EPA Technical Report AMS/2014-ROCKY-3

Division of Surface Water
Assessment and Modeling Section
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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 Rocky River watershed. These recommendations are based on data collected as part of a biological and water quality study in 2014-2015.

A description of the project area, sites, data types and methods can be found in the Rocky River study plan document at (epa.ohio.gov/static/Portals/35/tmdl/Rocky_River_Study_Plan_2014.pdf).

A summary of the study results can be found in the biological and water quality report at (epa.ohio.gov/static/Portals/35/tmdl/2014_RockyRiver_TSD_Final.pdf).

Sites in the Rocky River watershed were assessed for aquatic life use, recreation use and water supply use. 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.

The federal Clean Water Act (CWA) requires that states identify waters not meeting water quality goals and then prioritize them for action to restore their beneficial uses. The resulting list of prioritized impaired waters is known as the 303(d) list. The process of listing involves assigning a condition status (a category) for each of four beneficial uses (aquatic life, human health, recreation, and public water supply) for each assessment unit. For more information on impaired water listings and categories, please Ohio's Integrated Water Quality Monitoring and Assessment Report at: epa.ohio.gov/wps/portal/gov/epa/divisions-and-offices/surface-water/reports-data/ohio-integrated-water-quality-monitoring-and-assessment-report.

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/wps/portal/gov/epa/divisions-and-offices/surface-water/reports-data/biological-criteria-for-the-protection-of-aquatic-life. Goals for those indices in the Rocky River watershed are shown in Table 1. The attainment status for each site is shown in Figure 1 and the scores for impaired sites are shown in Table 2. Assessment for Aquatic Life Usage (ALU) was completed at 71 sites throughout Cuyahoga, Medina, Lorain, and Summit counties. The work covered 28 streams, both named and unnamed across 12 HUC 12 watersheds. Of the 71 sites 52 were in full attainment, 8 in partial attainment and 11 in non-attainment.

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

Ecoregion	Biological Index	Assessment Method ^{2,3}	Biological Criteria for the Applicable Aquatic Life Use Designations ¹		
			EWB	WWH	MWH ⁴
Erie-Ontario Lake Plains (EOLP)	IBI	Headwater	50	40	24
		Wading	50	38	24
		Boat	48	40	24 / 30
	Mlwb	Wading	9.4	7.9	6.2
		Boat	9.6	8.7	5.8 / 6.6
	ICI	All ⁵	46	34	22

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

² In general, the assessment method used at a site is determined by its drainage area (DA) according to the following:
Headwater: DA ≤ 20 mi²; wading: DA >20 mi² and ≤ 500 mi²; boat: DA > 500 mi².

³ Mlwb not applicable to drainage areas less than 20 mi² (headwater sites).

⁴ Biocriteria depend on type of MWH. MWH-C (due to channelization) is listed first, MWH-I (due to impoundment) is listed second, and MWH-A (mine affected) is listed third (only applicable in the WAP).

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

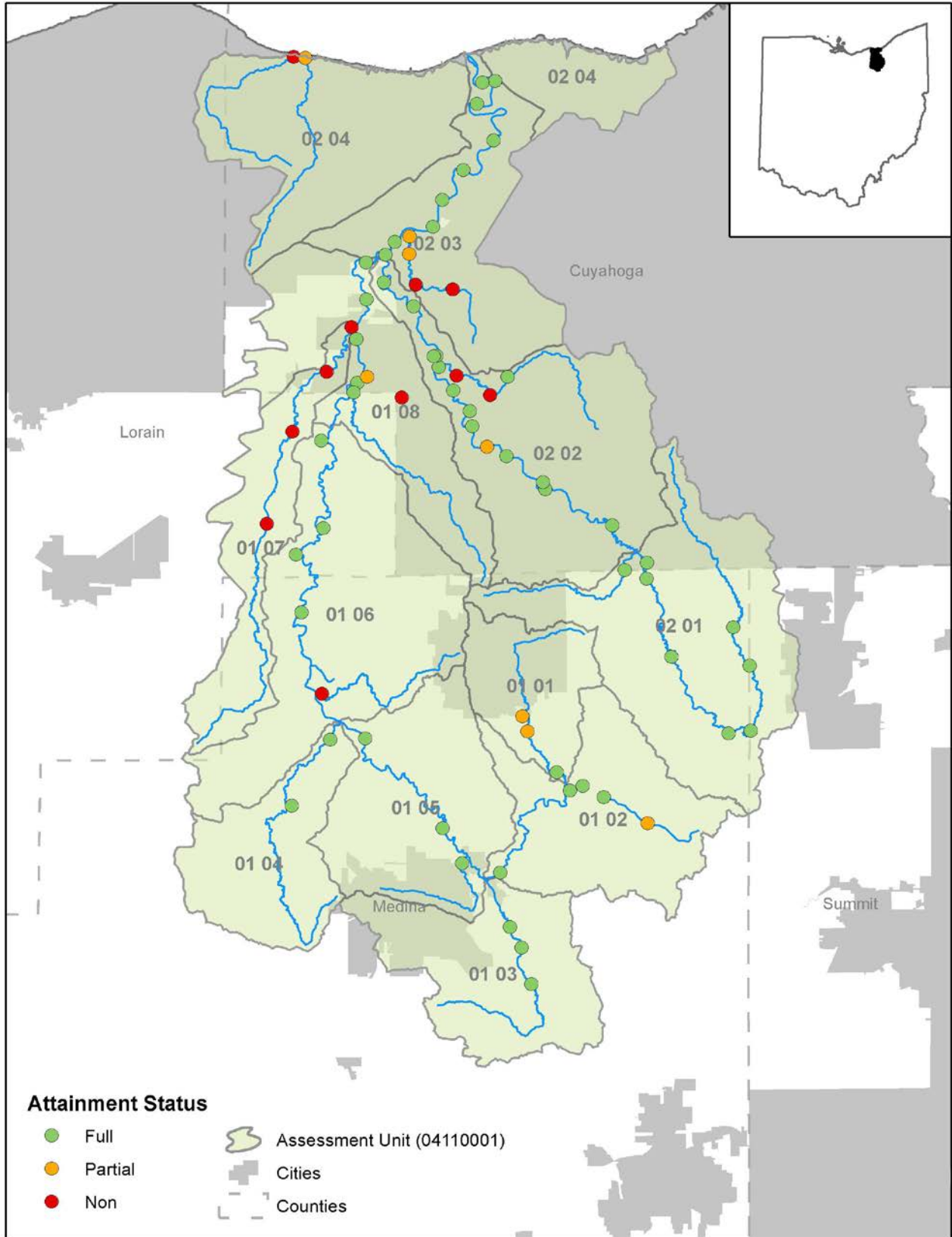


Figure 1 – Map summarizing ALU attainment status in the Rocky River watershed in 2014-2015.

Table 2 – Aquatic life use attainment information for impaired sampling locations in the Rocky River watershed, 2014-2015.

HUC-12 (04110001)	Station	Location	Ecoregion/ ALU	River Mile ^a	Drain. Area (mi ²)	IBI	MIwb ^b	ICI ^c	QHEI	Attain. Status	Causes	Sources
01 01	501840	Plum Creek S of Lake Sleepy Hollow at Carpenter Rd.	EOLP/ WWH	(3.02) ^H	8.8	50	-	F*	69.5	PARTIAL	Other flow regime alterations	Urban runoff/stormwater
01 01	T01K14	Plum Creek adj. Carpenter Rd., ust old Medina 500 WWTP	EOLP/ WWH	(2.5) ^H	10.4	46	-	F*	70.8	PARTIAL	Other flow regime alterations	Urban runoff/stormwater
01 02	302577	Granger Ditch at SR 94, ust. Medina Co No. 11 WWTP (via trib. at RM 2.1)	EOLP/ WWH	(1.75) ^H	7.8	42	-	F*	46	PARTIAL	Natural (flow or habitat) Habitat Alterations	Natural sources (rheopalustrine) Channelization
01 06	T01K12	Cossett Creek SR 252	EOLP/ WWH	(0.2) ^H	4.1	<u>24*</u>	-	G	63.3	NON	Natural (flow or habitat)	Natural sources
01 07	T01K11	Plum Creek Akins Rd., upst. Plum Creek WWTP	EOLP/ WWH	(8.5) ^H	7.6	22*	-	MG ^{NS}	52	NON	Low DO Habitat Alterations	Natural sources (rheopalustrine) Channelization
01 07	T01A33	Plum Creek N of Columbia Station at Jaquay Rd., dst. Plum Creek WWTP	EOLP/ WWH	(4.92) ^H	14.3	<u>24*</u>	-	MG ^{NS}	61	NON	Low DO Habitat Alterations	Natural sources (rheopalustrine) Channelization
01 07	T01P23	Plum Creek S of Olmstead Falls at Ohio Turnpike	EOLP/ WWH	(2.5) ^H	16.2	<u>22*</u>	-	MG ^{NS}	70	NON	Natural (Fish passage - Plum Cr. Gorge) Other flow regime alterations	Natural sources (Plum Cr. Gorge) Urban runoff/storm sewers
01 07	T01P23	Plum Creek at Olmstead Falls at Columbia Rd., dst. Old-Brentwood WWTP	EOLP/ WWH	(0.25) ^H	17.6	<u>20*</u>	-	MG ^{NS}	70	NON	Natural (Fish passage - Plum Cr. Gorge) Other flow regime alterations	Natural sources (Fish Passage - Plum Cr. Gorge) Urban runoff/storm sewers

HUC-12 (04110001)	Station	Location	Ecoregion/ ALU	River Mile ^a	Drain. Area (mi ²)	IBI	MIwb ^b	ICI ^c	QHEI	Attain. Status	Causes	Sources
01 08	T01A17	Blodgett Creek Upst. old Strongsville A WWTP	EOLP/ WWH	(1.61) ^H	3.1	<u>24*</u>	-	MG ^{NS}	59	NON	Other flow regime alterations	Urban runoff/storm sewers
											Direct habitat alterations	Channelization
											Fish passage barrier	Hydrostructure Impacts on Fish Passage (Box Culvert)
01 08	T01A23	Blodgett Creek at Lindbergh Rd., dst old Strongsville A WWTP	EOLP/ WWH	(0.17) ^H	4.1	44	-	F*	58	PARTIAL	Other flow regime alterations	Urban runoff/storm sewers
											Direct habitat alterations	Channelization
02 02	T01W2 9	East Branch Rocky River at Strongsville, between SR 42 and I-71	EOLP/ WWH	(9.35) ^W	59	41	8.7	F*	71	PARTIAL	Other Flow Regime Alterations	Dam or Impoundment Sedimentation/Siltation
02 02	501650	Baldwin Creek at Big Cr. Parkway, dst. Strongsville C WWTP	EOLP/ WWH	(2.61) ^H	8.3	<u>20*</u>	-	32 ^{NS} (2015)	60.5	NON	Other flow regime alterations	Urban runoff/storm sewers
02 02	T01W5 9	Baldwin Creek near Berea at Eastland Rd.	EOLP/ WWH	(1.13) ^H	9.6	<u>26*</u>	-	MG ^{NS}	61	NON	Fish-Passage Barrier	Dam or Impoundment
											Other flow regime alterations	Urban runoff/storm sewers
02 03	T01W7 6	Abram Creek, Dst. Airport storm drain, at Eastland Rd.	EOLP/ WWH	(3.15) ^H	6.8	<u>18*</u>	-	F*	62	NON	Low DO	Natural Sources (Palustrine)
											Other flow regime alterations	Urban runoff/storm sewers
											Fish-Passage Barrier (enclosure/dam)	Hydrostructure, Impacts on Fish Passage (enclosure/dam)

HUC-12 (04110001)	Station	Location	Ecoregion/ ALU	River Mile ^a	Drain. Area (mi ²)	IBI	MIwb ^b	ICI ^c	QHEI	Attain. Status	Causes	Sources
02 03	T01P13	Abram Creek N of Berea Immediately ust. Airport enclosure, at Grayton Rd.	EOLP/ WWH	(1.9) ^H	8.9	<u>20</u> *	-	LF*	62	NON	Low DO	Natural Sources (Palustrine)
											Other flow regime alterations	Urban runoff/storm sewers
											Fish-Passage Barrier (enclosure/dam)	Hydrostructure, Impacts on Fish Passage (enclosure/dam)
02 03	501830	Abram Creek near Berea Dst. Airport enclosure, NASA property, at Cedar Point Rd.	EOLP/ WWH	(0.84) ^H	9.7	46	-	F*	62	PARTIAL	Other flow regime alterations	Urban runoff/storm sewers
02 03	T01S04	Abram Creek at Brook Park Near mouth, at West Area Rd.	EOLP/ WWH	(0.3) ^H	10.1	54	-	F*	59	PARTIAL	Other flow regime alterations	Urban runoff/storm sewers
02 04	T01P20	Porter Creek at Bay Village, at US 6	EOLP/ WWH	(0.1) ^H	8.3	34*	-	LF*	68.3	NON	Other flow regime alterations	Urban runoff/storm sewers
02 04	T01P21	Cahoon Creek at Bay Village, at US 6	EOLP/ WWH	(0.08) ^H	5.4	36 ^{NS}	-	F*	58.3	PARTIAL	Other flow regime alterations	Urban runoff/storm sewers

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 mi².

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 miles²).

W Wading site (non-boat site draining >20 miles²).

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. Ohio EPA must also 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 (04110001)	Cause(s) of Impairment	Source(s) of Impairment	Action	Method ¹
501840	Plum Creek	(3.02) ^H	01 01	Other flow regime alterations	Urban runoff/stormwater	N/A	N/A
T01K14	Plum Creek	(2.5) ^H	01 01	Other flow regime alterations	Urban runoff/stormwater	N/A	N/A
302577	Granger Ditch	(1.75) ^H	01 02	Natural (flow or habitat)	Natural sources (rheopalustrine)	N/A	N/A
				Habitat Alterations	Channelization	TMDL	QHEI
T01K12	Cossett Creek	(0.2) ^H	01 06	Natural (flow or habitat)	Natural sources	N/A	N/A
T01K11	Plum Creek	(8.5) ^H	01 07	Low DO	Natural sources (rheopalustrine)	N/A	N/A
				Habitat Alterations	Channelization	TMDL	QHEI
T01A33	Plum Creek	(4.92) ^H	01 07	Low DO	Natural sources (rheopalustrine)	N/A	N/A
				Habitat Alterations	Channelization	TMDL	QHEI
T01P23	Plum Creek	(2.5) ^H	01 07	Natural (Fish passage - Plum Cr. Gorge)	Natural sources (Plum Cr. Gorge)	N/A	N/A
				Other flow regime alterations	Urban runoff/storm sewers	N/A	N/A
501950	Plum Creek	(0.25) ^H	01 07	Natural (Fish passage - Plum Cr. Gorge)	Natural sources (Fish Passage - Plum Cr. Gorge)	N/A	N/A
				Other flow regime alterations	Urban runoff/storm sewers	N/A	N/A
				Other flow regime alterations	Urban runoff/storm sewers	N/A	N/A
T01A17	Blodgett Creek	(1.61) ^H	01 08	Direct habitat alterations	Channelization	TMDL	QHEI
				Fish passage barrier	Hydrostructure Impacts on Fish Passage (Box Culvert)	N/A	N/A

Station	Stream Name	River Mile	HUC 12 (04110001)	Cause(s) of Impairment	Source(s) of Impairment	Action	Method ¹
T01A23	Blodgett Creek	(0.17) ^H	01 08	Other flow regime alterations	Urban runoff/storm sewers	N/A	N/A
				Direct habitat alterations	Channelization	TMDL	QHEI
T01W29	East Branch Rocky River	(9.35) ^W	02 02	Other Flow Regime Alterations	Dam or Impoundment	N/A	N/A
				Sedimentation/Siltation		TMDL	QHEI-sed
501650	Baldwin Creek	(2.61) ^H	02 02	Other flow regime alterations	Urban runoff/storm sewers	N/A	N/A
T01W59	Baldwin Creek	(1.13) ^H	02 02	Fish-Passage Barrier	Dam or Impoundment	N/A	N/A
				Other flow regime alterations	Urban runoff/storm sewers	N/A	N/A
T01W76	Abram Creek	(3.15) ^H	02 03	Low DO	Natural sources (Palustrine)	N/A	N/A
				Other flow regime alterations	Urban runoff/storm sewers	N/A	N/A
				Fish-Passage Barrier (enclosure/dam)	Hydrostructure, Impacts on Fish Passage (enclosure/dam)	N/A	N/A
T01P13	Abram Creek	(1.9) ^H	02 03	Low DO	Natural sources (Palustrine)	N/A	N/A
				Other flow regime alterations	Urban runoff/storm sewers	N/A	N/A
				Fish-Passage Barrier (enclosure/dam)	Hydrostructure, Impacts on Fish Passage (enclosure/dam)	N/A	N/A
501830	Abram Creek	(0.84) ^H	02 03	Other flow regime alterations	Urban runoff/storm sewers	N/A	N/A
T01S04	Abram Creek	(0.3) ^H	02 03	Other flow regime alterations	Urban runoff/storm sewers	N/A	N/A
T01P20	Porter Creek	(0.1) ^H	02 04	Other flow regime alterations	Urban runoff/storm sewers	N/A	N/A
T01P21	Cahoon Creek	(0.08) ^H	02 04	Other flow regime alterations	Urban runoff/storm sewers	N/A	N/A

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
QHEI	"Qualitative habitat evaluation index" is used as means to address impairment due to inadequate habitat quality. More information regarding the QHEI method can be found at epa.ohio.gov/portals/35/documents/QHEIManualJune2006.pdf .
QHEI-sed	Sub-metrics of the QHEI used to evaluate aspects of habitat quality as a surrogate for addressing impairment due to excess sediment.

Eight sites in the Rocky River watershed are impaired due to natural sources. Of these, low DO attributed to wetlands influence (palustrine and rheopalustrine) was identified at four stations. Cossett Creek (RM 0.2) was impaired by intermittent flow and Granger ditch (RM 1.75) by a combination of rheopalustrine conditions (natural) and historic channelization (anthropogenic). Because these sites are primarily impaired due to natural causes, they are exempt from TMDL requirements for this type of impairment. The remaining causes of impairment in the Rocky River watershed are flow regime alterations, fish passage barriers, direct habitat alteration, and sedimentation/siltation.

The leading cause of ALU impairment in the Rocky River watershed was other flow regime alterations. Urban runoff and stormwater were identified as primary sources for 14 stations within the watershed and accounted for most waters so identified. This impairment type is a product of the well-drained urban and suburban landscape that typifies much of the study area. Although similarly classified, one site on East Branch Rocky River (RM 9.35) had a flow regime alteration that was sourced from a dam or impoundment. Because flow regime alterations are not a pollutant (a category 4C in the Integrated Report), no TMDL is required to address these impairments.

Barriers to fish passage were identified as an important or controlling factor for ALU impairment for six sites on four streams within the study area: Plum Creek (RMs 0.25 and 2.5), Blodgett Creek (RM 1.61), Baldwin Creek (RM 1.13), and Abram Creek (RMs 1.9 & 3.15). The fish passage barrier on Plum Creek (RM 0.25 & 2.5) is naturally caused by the Plum Creek Gorge. Middle Baldwin Creek is isolated by a small lowhead dam about a mile from its confluence with the East Branch Rocky River. The recent enclosure (culverting) of nearly a mile of stream by the Cleveland Hopkins International Airport (CHIA) and a small lowhead dam located immediately downstream from CHIA serve to isolate much of Abram Creek. One site on Blodgett Creek (RM 1.61) has a fish passage barrier caused by a box culvert preventing fish passage. Because fish passage barriers are not pollutants (a category 4C in the Integrated Report), no TMDL is required at these sites for that cause of impairment.

Based upon the findings of the Rocky River TSD (Ohio EPA 2020) regarding delayed ALU recovery, the Northeast Ohio Regional Sewer District (NEORS) independently initiated an experimental fish reintroduction effort on Plum Creek. Large numbers of brook species were collected within the Rocky River basin, transported upstream from the Plum Creek Gorge, and released at several locations within the headwaters of Plum Creek (NEORS, 2020). NEORS will continue to monitor upper Plum Creek to determine if previously impacted isolated waters may be restored through fish reintroduction.

Sedimentation/siltation is listed as a cause of impairment at East Branch Rocky River (RM 9.35) sourced by excessive deposition of sand within the upper limits of the low head dam pool. This site is in a transitional area between lotic and lentic habitats. The East Branch and most of the larger waterbodies within the Rocky River basin would appear to safely process or assimilate existing bedload sediment. However, in this instance normal bedload that would otherwise be easily sorted and transported (processed) through the system, is, by and large, summarily dumped due to the loss of stream power. The impoundment created an energy starved depositional area where normal background sediment load drops-out. Therefore, the sedimentation is due to local conditions, not a result of excess sediment loss from the upland or banks and no TMDL is required.

Direct habitat alterations and habitat alterations caused by channelization are listed as the cause of impairment at five sites in the Rocky River watershed. These sites will be addressed with a habitat TMDL.

The current ALU impairment attributed to low DO on Abram Creek (RM 3.15 & 1.9) is primarily due to natural sources (palustrine and rheopalustrine conditions in the headwaters). Following remediation efforts by CHIA, gross loads have been significantly reduced with improvements in biological performance. CHIA continues winter monitoring of Abram Creek to ensure limited impact from airport runoff.

The Baldwin Creek subwatershed is dominated by high clay content soils which increases the negative impact of storm water runoff and is highly vulnerable to soil erosion. On Baldwin Creek there are two sites (RM 1.13 & 2.61) impaired by urban runoff/storm sewers. The Cuyahoga Soil & Water Conservation District (Cuyahoga SWCD) has two nonpoint source implementation strategy projects to address impairments on Baldwin Creek, using natural channel design methods. The first project titled “1:Baldwin- S of Baron” would stabilize 2,726 linear feet of stream bank, connect 0.19 acres of floodplain, and restore 1,363 linear feet of stream channel of a Baldwin Creek tributary. The second project titled “Greenbriar Valley Floodplain Restoration - East Branch Rocky River” would relocate a section of headwater stream to its original channel, remove invasive species and revegetate the wetland and upstream of the relocation area (Ohio EPA 2021). Taken together, the projected benefits to Baldwin Creek of these projects would include attenuation of stormwater, yielding greater hydrologic stability; remedial treatment of stormwater through wetland detention; reduced sedimentation by increased floodplain storage of fine sediment; and stabilization and aggradation of incised and eroding channels through relocation, natural stream design, and grade control structures. Given the distance between the headwaters where these projects are proposed and the impacted segment of Baldwin Creek, impact on downstream ALU attainment is unknown. However, the efforts and projected benefits would without question represent real incremental improvements to the overall hydrology, channel function, and sediment budget of Baldwin Creek, which over time should serve to lessen existing stressors.

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 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	
<ul style="list-style-type: none"> Recent channelization or no recovery Silt/muck substrate Low or no sinuosity (drainage area ≤ 20 mi²) Sparse/no cover Maximum pool depth < 40 cm (wadable or headwater sites) 	<ul style="list-style-type: none"> Recovering channelization Heavy/moderate silt cover Sand substrate (boat sites) Hardpan substrate origin Fair/poor development Low or no sinuosity (drainage area > 20 mi²) Only 1-2 cover types 	<ul style="list-style-type: none"> Intermittent pools and max pool depth < 40 cm No fast current High/moderate substrate embeddedness High/moderate riffle embeddedness No riffle

Sediment

Numeric targets for sediment are based on three sub-metrics of the QHEI. Although the QHEI evaluates the overall quality of stream habitat, some of its component sub-metrics consider aspects of stream habitat that are closely related to and/or impacted by the sediment delivery and transport processes occurring in the system. The QHEI sub-metrics used in the sediment TMDL are the substrate, channel morphology, and bank erosion/riparian zone. Table 6 lists targets for each of these metrics.

Table 6 – QHEI targets for sediment TMDLs

Sediment TMDL Targets		
QHEI Category	WWH	EWH
Substrate	≥ 13	≥ 15
Channel	≥ 14	≥ 15
Riparian	≥ 5	≥ 5
Sediment TMDL ►	≥ 32	≥ 35

The substrate sub-metric evaluates predominant substrate types, the amount and origin of these types and the degree of embeddedness and silt cover. This is a qualitative evaluation of the amount of excess fine material in the system and the ability of the channel to assimilate or sort the sediment load.

The channel morphology sub-metric considers sinuosity, riffle and pool development, channelization and channel stability. Except for stability, each of these aspects is directly related to channel form, sediment transport, erosion,

and deposition within the channel. Stability reflects the degree of channel erosion, which indicates the potential of the stream to be a significant sediment source.

The bank erosion and riparian zone sub-metric also reflects the likely degree of in-stream sediment sources. The evaluation of floodplain quality is included in this sub-metric, which relates to the capacity of the system to assimilate sediment loads.

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 7, are also the targets used for TMDLs. Table 8 lists attainment of recreation use based on criteria at the time of assessment, which were different than the current standards. Criteria at the time of assessment is not shown in this report. However, any TMDLs created for those assessment units will use the updated values in Table 7.

Table 7 – Water quality criteria for recreation use

Recreation Use	<i>Escherichia coli</i> (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 8 – Recreation use attainment information for impaired sampling locations in the Rocky River watershed, 2014-2015.

Station	Stream Name	HUC-12 (04110001)	River Mile	# Samples	Geo. Mean	Maximum Value	Attain. Status	Possible Source(s)
302573	Plum Creek	01 01	0.5	8	553	2300	NON	Failing HSTS, Urban Runoff
501960	Rocky River	01 02	0.45	13	510	4500	NON	Failing HSTS, Agricultural Runoff
301181	Rocky River	01 03	32.26	16	992	11000	NON	Agricultural Runoff, Urban Stormwater
501900	Rocky River	01 05	21.75	14	250	4800	NON	Failing HSTS, Agricultural Runoff
T01W94	Rocky River	01 06	7.4	2	308	430	NON	Agricultural Runoff
T01S11	Rocky River	01 06	13.3	7	234	930	NON	WWTP, SSO, Agricultural Runoff
302622	Plum Creek	01 07	0.45	15	631	4400	NON	Urban Stormwater, HSTS
501850	Rocky River	01 08	0.39	15	485	17000	NON	Urban Stormwater, Agricultural
501660	Rocky River	02 01	26.63	8	663	6900	NON	Failing HSTS
T01W38	Rocky River	02 01	17.5	8	205	930	NON	Agricultural Runoff, Failing HSTS
501690	Rocky River	02 02	15.15	8	455	3300	NON	Failing HSTS, Urban Stormwater
T01W27	Rocky River	02 02	8.2	8	1981	8700	NON	Urban Stormwater
501740	Rocky River	02 02	1.28	17	645	20000	NON	Failing HSTS, Urban Stormwater
T01G01	Baldwin Creek	02 02	0.38	8	2792	20000	NON	WWTP, SSO, Urban Stormwater, Failing HSTS
T01W19	Rocky River	02 03	11.65	16	618	22000	NON	Failing HSTS, Urban Stormwater
T01W12	Rocky River	02 03	7.6	8	914	20000	NON	WWTP, CSO, Urban Stormwater
T01W03	Rocky River	02 03	1.8	8	1154	24000	NON	WWTP, CSO, Urban Stormwater
T01K02	Rocky River	02 03	0.7	8	1190	27000	NON	WWTP, CSO, Urban Stormwater
302626	Rocky River	02 03	0.1	5	264	630	NON	CSO, Urban Stormwater
T01S04	Abram Creek	02 03	0.3	5	430	11000	NON	Urban Stormwater
T01P20	Porter Creek	02 04	0.1	8	1184	31000	NON	Urban Stormwater, aging pipes
T01P21	Cahoon Creek	02 04	0.08	8	873	8700	NON	Urban Stormwater, aging pipes

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 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 9.

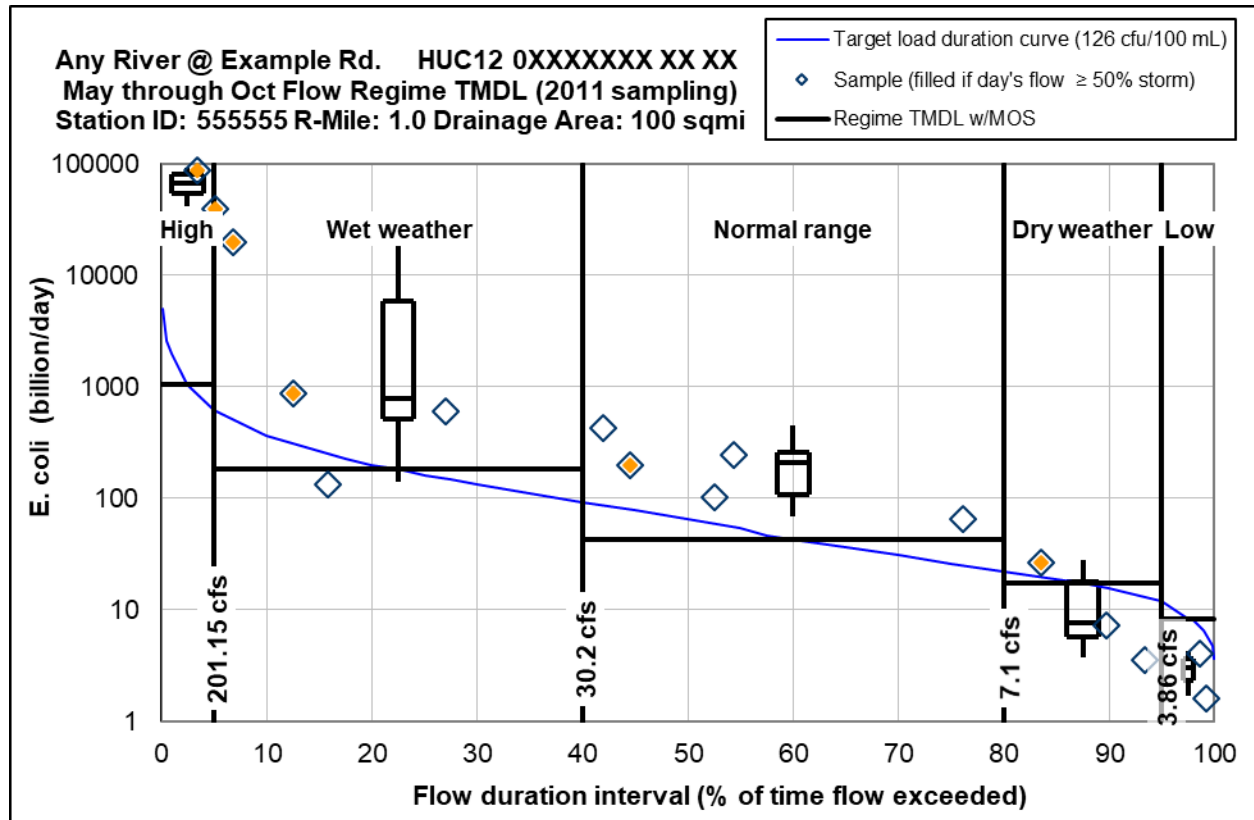


Figure 2 – Example load duration curve.

Table 9 – 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

References

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