Environmental Protection Agency

Loading Analysis Plan and Supporting Data Acquisition Needed for the

Licking River Watershed

Total Maximum Daily Load Development

Licking River downstream from Newark, RM 28.6.

Ohio EPA Technical Report AMS/2008-LICKI-3

Division of Surface Water
Assessment and Modeling Section
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Table of Contents

Introduction

This document provides an overview of the information considered in proposing the strategy to address water quality impairments in the Licking River watershed. These recommendations are based on data collected as part of a biological and water quality study in 2008. A description of the project area, sites, data types and methods can be found in the *2008 Study Plan for the Licking Watershed* (Ohio EPA, 2008). A summary of the study results can be found in *Biological and Water Quality Study of the Licking River and Selected Tributaries, 2008* (Ohio EPA, 2012).

Sites in the Licking River watershed were assessed for aquatic life use, recreation use and public drinking water supply use. The attainment of aquatic life and recreation use is based on specific criteria. This document examines those criteria and lays out proposals for addressing each impairment. Where appropriate, methods and targets are outlined to develop total maximum daily loads (TMDL) for specific pollutants.

There are no impairments of the public drinking water supply use in this study area as detailed in the current cycle of Ohio's Integrated Water Quality Monitoring and Assessment Report (Ohio EPA, 2022), and therefore public drinking water supply use is not further considered in this Load Analysis Plan.

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 see Ohio's Integrated Water Quality Monitoring and Assessment Report (Ohio EPA, 2022).

Aquatic Life Use

Evaluation of Biocriteria

Aquatic Life Use (ALU) attainment details are documented in the biological and water quality report in *Biological and Water Quality Study of the Licking River and Selected Tributaries, 2008* (Ohio EPA, 2012). Ohio EPA completed an assessment for ALU at 89 sites in this watershed. Of the 89 sites, 78 locations (87.6%) were in full attainment, 8 locations were in partial attainment (9.0%) and 3 locations (3.4%) were in non-attainment.

The attainment status for each site is shown in Figure 1. Table 1 lists assessment sites not meeting their ALU designation. This table also contains the causes and sources of impairment for each site.

Figure 1 — Map summarizing ALU attainment status in the Licking River watershed in 2008.

Table 1 - Aquatic life use attainment information for impaired sampling locations in the Licking River watershed, 2008.

Station	Location	ALU	River Mile		Drain. Area (sq. mi.)	QHEI	Attain. Status	Causes	Sources
Headwaters North Fork Licking River - 05040006 01 02									
R13W35	N. FK. LICKING R. DST. CENTERBURG WWTP TRIB @ CROTON RD.	WWH	37.91	H	7.2	78.5	Partial	Nutrients	Centerburg WWTP
								Ammonia (Total)	Centerburg WWTP
Vance Creek-North Fork Licking River - 05040006 01 04									
201206	VANCE CREEK NW OF UTICA @ CO. RD. 29 (BERGER RD)	WWH	0.70	H	9.8	73.5	Non	Nutrients	Agriculture
								Ammonia (Total)	Agriculture
								Oxygen, Dissolved	Agriculture
Log Pond Run-North Fork Licking River - 05040006 02 05									
300455	LOG POND RUN AT NEWARK @ RIVERSIDE DRIVE	WWH	0.10	H	1.3	49.5	Non	Chemical oxygen demand (COD)	Urban Runoff/Storm Sewers
Headwaters Raccoon Creek - 05040006 03 01									
R14P23	RACCOON CREEK 0.1 MI. UPST. JOHNSTOWN WWTP	WWH	23.90	H	12.4	69.0	Partial	Nutrients	Agriculture, Rural (Residential Areas), Site Clearance (Land Development or Redevelopment)
								Ammonia (Total)	Agriculture, Rural (Residential Areas), Site Clearance (Land Development or Redevelopment)
								Sedimentation/Siltation	Agriculture, Rural (Residential Areas), Site Clearance (Land Development or Redevelopment)
R14S13	RACCOON CREEK JUST DST. JOHNSTOWN WWTP	WWH	23.70	H	12.4	78.0	Partial	Nutrients	Johnstown WWTP, Agriculture, Rural (Residential Areas)
								Ammonia (Total)	Johnstown WWTP, Agriculture, Rural (Residential Areas)
								Sedimentation/Siltation	Agriculture, Rural (Residential Areas), Site Clearance (Land Development or Redevelopment)

Muddy Fork - 05040006 04 01									
300418	MUDDY FORK LICKING R. @ COLUMBIA RD.	WWH	3.70	H	6.3	70.5	Partial	Sedimentation/Siltation	Agriculture, Yard Maintenance, Site Clearance (Land Development or Redevelopment)
								Oxygen, Dissolved	Agriculture, Yard Maintenance, Site Clearance (Land Development or Redevelopment)
								Organic Enrichment Biological Indicators	Agriculture, Yard Maintenance, Site Clearance (Land Development or Redevelopment)
R14P15	MUDDY FORK AT PATASKALA @ CREEK RD.	WWH	0.08	H	14.1	68.0	Partial	Sedimentation/Siltation	Agriculture, Rural (Residential Areas), Yard Maintenance, Site Clearance (Land Development or Redevelopment)
								Organic Enrichment Biological Indicators	Agriculture, Rural (Residential Areas), Yard Maintenance, Site Clearance (Land Development or Redevelopment)
Buckeye Lake - 05040006 04 03									
R14P09	WASTEWEIR RUN NEAR BUCKEYE LAKE OVERFLOW @ ST. RT. 79	MWH-C	1.55	W	44.3	41.0	Non	Nutrients	Dam or Impoundment, Impacts from Hydrostructure Flow Regulation/modification
								Ammonia (Total)	Dam or Impoundment, Impacts from Hydrostructure Flow Regulation/modification
Timber Run-Licking River - 05040006 06 04									
R13S28	LICKING R. @ DILLON DAM	EWH	6.20	B	742.0	75.0	Partial	Nutrients	Dam or Impoundment
								Ammonia (Total)	Dam or Impoundment
300507	JOES RUN AT ZANESVILLE @ OLD NEWARK RD.	WWH	0.20	H	8.6	56.0	Partial	Sedimentation/Siltation	Urban Runoff/Storm Sewers
201150	TIMBER RUN AT ZANESVILLE @ MOUTH	WWH	0.10	H	11.8	54.0	Partial	Nutrients	Permitted waste water, Urban Runoff/Storm Sewers, Package Plant or Other Permitted Small Flows Discharges

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

a River Mile (RM) represents the Point of Record (POR) for the station and may not be the actual sampling RM.
H Headwater site (draining ≤20 miles^2).
W Wading site (non-boat site draining >20 miles^2).
B Boat site (large or deep waters, necessitating the use of boat sampling methods)

Aquatic Life Use Proposed Actions

Ohio EPA considers many factors when deciding how to address impairments. For some projects, no TMDL is required. The sites within 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 2.

Table 2 – Summary of ALU impairments and potential modeling approaches.

Station	Stream Name	River Mile	Assessment Unit (05040006)	Cause(s) of Impairment	Source(s) of Impairment	IR Cat.[1]	Action[2]	Method[3]	Parameter[4]
R13W35	N. FK. LICKING R.	37.91	01 02	Nutrients	Centerburg WWTP	5	Other	Follow-up	-
				Ammonia (Total)	Centerburg WWTP	5	Other	Follow-up	-
201206	VANCE CREEK	0.70	01 04	Nutrients	Agriculture	5	Other	Follow-up	-
				Ammonia (Total)	Agriculture	5	Other	Follow-up	-
				Oxygen, Dissolved	Agriculture	5	Other	Follow-up	-
300455	LOG POND RUN	0.10	02 05	Chemical oxygen demand (COD)	Urban Runoff/Storm Sewers	5	Other	Follow-up	-
R14P23	RACCOON CREEK	23.90	03 01	Nutrients	Agriculture, Rural (Residential Areas), Site Clearance (Land Development or Redevelopment)	5	Other	Follow-up	-
				Ammonia (Total)	Agriculture, Rural (Residential Areas), Site Clearance (Land Development or Redevelopment)	5	Other	Follow-up	-
				Sedimentation/Siltation	Agriculture, Rural (Residential Areas), Site Clearance (Land Development or Redevelopment)	5	TMDL	QHEI-sed	Sediment

Station	Stream Name	River Mile	Assessment Unit (05040006)	Cause(s) of Impairment	Source(s) of Impairment	IR Cat.[1]	Action[2]	Method[3]	Parameter[4]
R14S13	RACCOON CREEK	23.70	03 01	Nutrients	Johnstown WWTP, Agriculture, Rural (Residential Areas)	5	Other	Follow-up	-
				Ammonia (Total)	Johnstown WWTP, Agriculture, Rural (Residential Areas)	5	Other	Follow-up	-
				Sedimentation/Siltation	Agriculture, Rural (Residential Areas), Site Clearance (Land Development or Redevelopment)	5	TMDL	QHEI-sed	Sediment
300418	MUDDY FORK LICKING R.	3.70	04 01	Sedimentation/Siltation	Agriculture, Yard Maintenance, Site Clearance (Land Development or Redevelopment)	5	TMDL	QHEI-sed	Sediment
				Oxygen, Dissolved	Agriculture, Yard Maintenance, Site Clearance (Land Development or Redevelopment)	5	Other	Follow-up	-
				Organic Enrichment Biological Indicators	Agriculture, Yard Maintenance, Site Clearance (Land Development or Redevelopment)	5	Other	Follow-up	-
R14P15	MUDDY FORK	0.08	04 01	Sedimentation/Siltation	Agriculture, Rural (Residential Areas), Yard Maintenance, Site Clearance (Land Development or Redevelopment)	5	TMDL	QHEI-sed	Sediment
				Organic Enrichment Biological Indicators	Agriculture, Rural (Residential Areas), Yard Maintenance, Site Clearance (Land Development or Redevelopment)	5	Other	Follow-up	-
R14P09	WASTEWEIR RUN	1.55	04 03	Nutrients	Dam or Impoundment, Impacts from Hydrostructure Flow Regulation/modification	5	Other	Follow-up	-
				Ammonia (Total)	Dam or Impoundment, Impacts from Hydrostructure Flow Regulation/modification	5	Other	Follow-up	-

Station	Stream Name	River Mile	Assessment Unit (05040006)	Cause(s) of Impairment	Source(s) of Impairment	IR Cat.[1]	Action[2]	Method[3]	Parameter[4]
R13S28	LICKING R.	6.20	06 04	Nutrients	Dam or Impoundment	5	Other	Follow-up	-
				Ammonia (Total)	Dam or Impoundment	5	Other	Follow-up	-
300507	JOES RUN	0.20	06 04	Sedimentation/Siltation	Urban Runoff/Storm Sewers	5	TMDL	QHEI-sed	Sediment
201150	TIMBER RUN	0.10	06 04	Nutrients	Permitted wastewater, Urban Runoff/Storm Sewers, Package Plant or Other Permitted Small Flows Discharges	5	Other	Follow-up	-

[1] IR Cat. (Integrated Report Category)

Category	Definition/interpretation
5	Water body is impaired for this parameter, and it needs to be addressed by additional actions

[2] Action

Abbreviation	Definition/interpretation
Other	Action will be taken outside of a new TMDL
TMDL	A Total Maximum Daily Load (TMDL) will be developed

[3] Method

Abbreviation	Definition/interpretation
Follow-up	Follow-up sampling is required to determine if the attainment status has changed after ongoing implementation has occurred or to clarify/verify the listed cause of impairment.
QHEI-sed	Sub-metrics of the QHEI (Qualitative habitat evaluation index) will be used to address sedimentation and embeddedness.

[4] Parameter – For TMDL or Other actions, the parameter listed in this field will be the pollutant or non-pollutant stressor used to address impairment. This parameter will match a heading in the Proposed Targets section.

The following subsections are organized to explain the various methods being used to address the proposed actions outlined in Table 2 above.

Follow-up monitoring is recommended prior to TMDL development to address some causes: IR Cat: 5 - Action: Other

Several causes of impairment outlined in Table 2 for the Licking River watershed are from impacts that may not persist. Since the most recent assessment performed in 2008, several actions in the watershed may have ameliorated these causes.

For example, the North Fork of the Licking River at River Mile 37.91 had an impairment caused by nutrients and ammonia that were attributed to the Centerburg wastewater treatment plant. Since the study in 2008, a new wastewater treatment plant was completed and operational in 2016. In addition, Centerburg has installed about 13,000 feet of sewer to eliminate a dedicated sanitary sewer overflow.

Similarly, Raccoon Creek at River Mile 23.7 had impairment caused by nutrients and ammonia that were attributed to the Johnstown wastewater treatment plant. In 2023, projects are underway at that facility including a sanitary sewer extension and a relief sewer project to reduce inflow and infiltration.

Because of these factors and others, follow-up monitoring is recommended prior to development of a TMDL. When this follow-up monitoring occurs another study plan, water quality results, and Loading Analysis Plan will be published prior to any new TMDL development. All three of those future documents will include public comment periods before they are considered final.

TMDL to address sediment impairments required: IR Cat: 5 - Action: TMDL

The cause of impairment for several sites outlined on Table 2 for the Licking River watershed was due to impacts from sedimentation and/or siltation.

The cause of impairment for five sites outlined was sedimentation and/or siltation, specifically Racoon Creek RM 23.90, Raccoon Creek RM 23.70, Muddy Fork RM 3.70, Muddy Fork RM 0.08 and Joe's Run at RM 0.20. Many sources of sedimentation were identified including agriculture, rural residential areas, yard maintenance, and site clearance for land development.

A sediment TMDL calculated using QHEI sub-metrics will appropriately address this cause of impairment. Sediment impairments for this watershed will be developed in a separate report that will include several other watersheds. Updates to this separate sediment TMDL report will be posted to ***Ohio EPA's multi-watershed TMDL webpage***.

Aquatic Life Use Proposed Targets

Sediment

Since its development, the 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).

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 particular 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 3 lists targets for each of these metrics.

Table 3 – QHEI targets for sediment TMDLs

Sediment TMDL Targets		
QHEI Category	WWH/ MWH	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 4, are also the targets used for TMDLs. Table 5 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 4.

Table 4 – 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 90-day period.

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

Table 5 - Recreation use attainment information for impaired sampling locations in the Licking River watershed, 2008.

Station	Stream Name	HUC-12 (05040006)	River Mile	# Samples	Geo. Mean	Max Value
201207	Otter Fork	0101	0.2	5	338	570
300445	Otter Fork	0101	9.28	5	405	970
300446	Otter Fork	0101	4.13	5	470	730
300443	North Fork Licking R.	0102	33.8	7	326	510
300444	North Fork Licking R.	0102	28.9	7	365	620
R13W35	North Fork Licking R.	0102	37.91	7	1232	2300
201205	Sycamore Creek	0103	0.1	4	433	710
300447	Sycamore Creek	0103	5.87	5	450	750
300448	Tuma Run	0103	0.46	5	846	1200
201206	Vance Creek	0104	0.7	5	386	2200
R13S12	North Fork Licking R.	0104	23.9	7	220	530
300449	Lake Fork	0201	10.86	5	1530	4200
300450	Lake Fork	0201	7.95	5	642	5400
300451	Lake Fork	0201	4.77	5	261	2100
R13S08	Lake Fork	0201	0.05	5	414	2000
300452	Clear Fork	0202	5.5	5	205	830
R13S04	North Fork Licking R.	0203	11.13	7	80	1700
R13S05	North Fork Licking R.	0203	15.5	7	113	860
R13S06	North Fork Licking R.	0203	17.1	7	117	640
R99Q32	North Fork Licking R.	0203	17.7	9	100	590
300453	Dry Run	0204	7.6	5	263	710
300454	Dry Run	0204	4.97	5	207	430
300455	Log Pond Run	0205	0.1	4	375	660
R13P04	North Fork Licking R.	0205	2.82	7	88	870
R13S01	North Fork Licking R.	0205	0.05	9	89	680
R14P23	Raccoon Creek	0301	23.9	7	1194	4600
R14S13	Raccoon Creek	0301	23.7	7	1016	4000
R14S15	Raccoon Creek	0301	26.2	7	1214	9900
201182	Lobdell Creek	0302	0.2	8	536	1500
201187	Lobdell Creek	0302	8.6	5	165	650
300406	Raccoon Creek	0303	15.12	7	488	1400
300407	Raccoon Creek	0303	15.35	7	498	850
R14P24	Moots Run	0303	0.55	5	190	810
300458	Salt Run	0304	0.2	5	128	1100
603380	Raccoon Creek	0304	0.54	7	437	790
R14P28	Raccoon Creek	0304	11.7	9	516	3200
R14P31	Raccoon Creek	0304	8.25	7	684	3100
R14P33	Raccoon Creek	0304	9.18	7	479	1800
R14P15	Muddy Fork	0401	0.08	5	319	1200
R14S28	South Fork Licking R.	0402	31.55	7	589	2100

Station	Stream Name	HUC-12 (05040006)	River Mile	# Samples	Geo. Mean	Max Value
300410	Honey Creek	0403	0.8	5	628	6700
R14P09	Wasteweir Run	0403	1.55	5	156	1300
R99Q27	Buckeye Lake Feeder Canal	0404	0.5	4	161	190
R14P18	South Fork Licking R.	0405	28.25	6	378	2900
201173	South Fork Licking R.	0406	19.1	7	596	12000
R14P05	South Fork Licking R.	0406	15.75	7	288	760
R14P07	South Fork Licking R.	0406	12.96	7	204	360
R14P11	South Fork Licking R.	0406	21.24	7	202	630
R14P17	Ramp Creek	0407	0.22	5	264	19000
300411	Dutch Fork	0408	3.63	5	1020	20000
300413	Dutch Fork	0408	0.92	5	255	390
603370	South Fork Licking R.	0409	1.8	7	239	25000
R14P01	South Fork Licking R.	0409	0.35	9	228	16000
R14P08	South Fork Licking R.	0409	8.88	9	332	2500
R14S17	Beaver Run	0409	0.45	5	492	2400
R14S18	Beaver Run	0409	2.07	5	1172	3400
300459	Claylick Creek	0501	0.1	5	478	9200
300460	Little Claylick Creek	0501	0.17	4	1012	10000
300472	Wilkins Run	0502	0.15	5	824	28000
R13S20	Lost Run	0502	0.2	5	1027	17000
R13S21	Lost Run	0502	4.08	5	1100	11000
300470	Rocky Fork Licking R.	0503	6.4	7	500	24000
R13S10	Rocky Fork Licking R.	0503	2.91	7	354	23000
R13S22	Painter Run	0503	0.23	5	565	7300
R13S23	Long Run	0503	0.54	5	1110	11000
R13S24	Rocky Fork Licking R.	0503	10.4	7	409	25000
R13S25	Rocky Fork Licking R.	0503	16	7	1020	38000
R13S26	Rocky Fork Licking R.	0503	1.2	9	257	21000
601770	Licking River	0504	26.75	30	60	430
601770	Licking River	0504	26.75	30	192	470
601770	Licking River	0504	26.75	30	191	400
601770	Licking River	0504	26.75	30	230	32000
R13W07	Licking River	0504	28.65	6	96	480
300500	Brushy Fork	0601	3.14	5	599	730
300501	Brushy Fork	0601	1.3	5	263	580
201161	Big Run	0602	5.1	5	771	1700
300504	Big Run	0602	3.28	5	515	940
300502	Stump Run	0603	1.02	5	471	1300
201150	Timber Run	0604	0.1	5	191	470
300506	Bartlett Run	0604	0.44	5	548	5800

Station	Stream Name	HUC-12 (05040006)	River Mile	# Samples	Geo. Mean	Max Value
300507	Joes Run	0604	0.2	5	730	9300
R13S27	Licking River	0604	3.68	7	129	1300

Recreation Use 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 6.

Figure 2 – Example load duration curve.

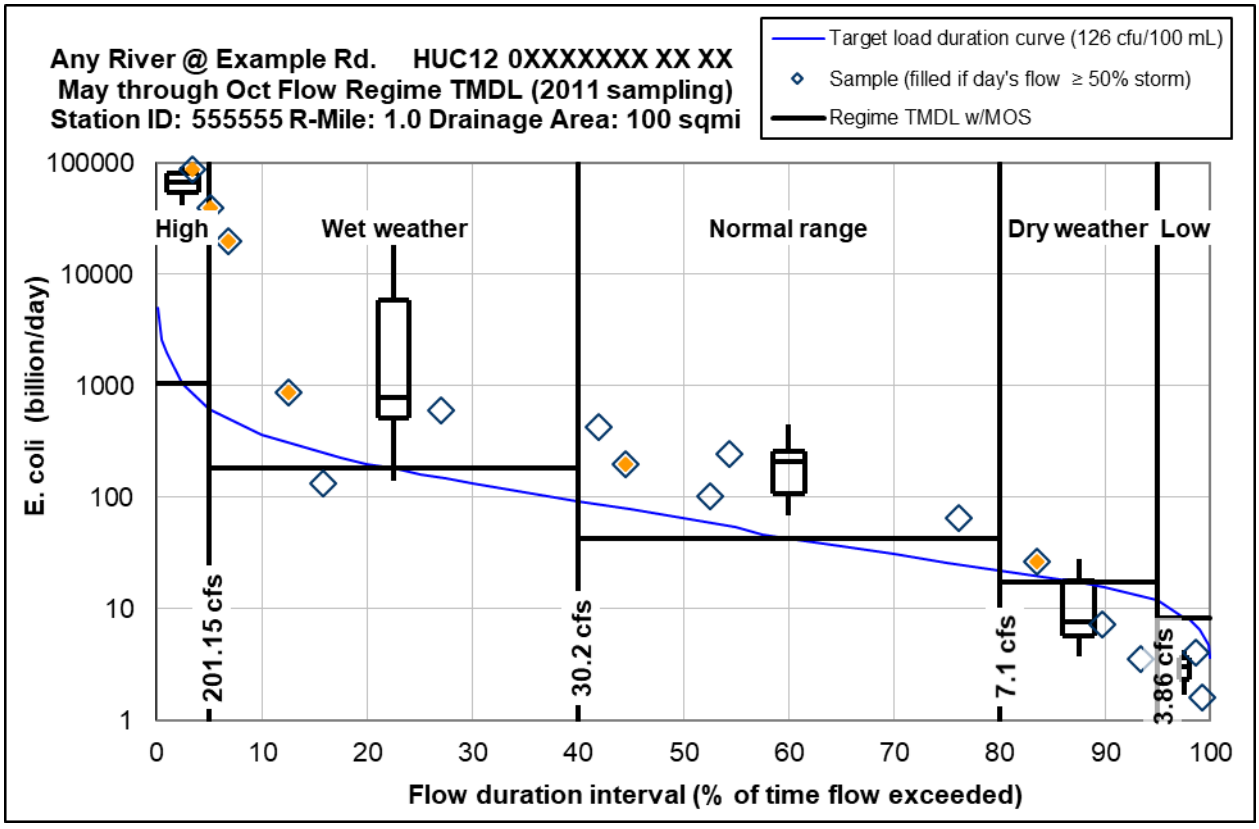

Table 6 – Example TMDL table calculations (from above load duration curve).

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

Recreation Use Proposed Targets

The primary contact recreation geometric mean criterion of 126 colony forming units per 100 mL *E. coli* will be used as the target concentration for the recreation use TMDL. As shown as the blue curve in the example load duration curve of Figure 2, above, this target concentration is converted into a load throughout the calculated flow regime. The black horizontal lines in Figure 2 and the "Total Maximum Daily Load" row in Table 6 show the TMDL values for five flow regime categories. This TMDL is the median of the curve load within each flow regime category.

References

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: ***epa.ohio.gov/wps/portal/gov/epa/divisions-and-offices/surface-water/reports-data/technical-bulletins***

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