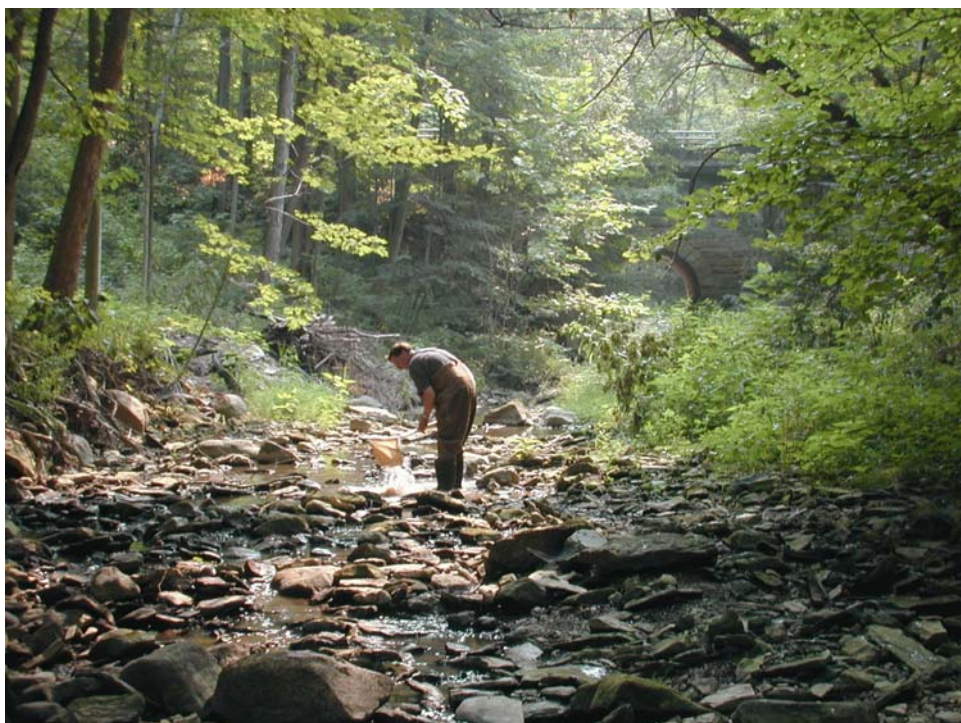


Division of Surface Water

Total Maximum Daily Loads for the Huron River Watershed



Unnamed Tributary to Cole Creek

**Final Report
August 9, 2005**

Bob Taft, Governor
Joseph P. Koncelik, Director

EXECUTIVE SUMMARY

The executive summary for this report can be found in Appendix A in the form of a fact sheet entitled, "Huron River Watershed TMDL Program". The fact sheet provides basic information regarding:

- the location of the watershed
- data which was collected in order to evaluate the watershed
- its current water quality status
- current programs underway to improve the watershed
- estimated pollutant load reductions needed to meet water quality targets
- recommendations for achieving additional pollutant load reductions

In addition to serving as an executive summary, the fact sheet can be used as an educational tool to promote implementation of recommended strategies to eliminate water quality impairments within the watershed.

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1.0 INTRODUCTION

The Clean Water Act (CWA) Section 303(d) requires States, Territories, and authorized Tribes to list and prioritize waters for which technology-based limits alone do not ensure attainment of water quality standards. Lists of these impaired waters (the section 303(d) lists) are made available to the public and submitted to the U.S. Environmental Protection Agency (U.S. EPA) for approval in even-numbered years. Further, the CWA and U.S. EPA regulations require that Total Maximum Daily Loads (TMDLs) be developed for all waters on the section 303(d) lists.

In the simplest terms, a TMDL is a cleanup plan for a watershed that is not meeting water quality standards. More specifically, a TMDL is defined as: 1) a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and 2) an allocation of that quantity among the sources of the pollutant. The process of formulating TMDLs for specific pollutants is therefore, a method by which impaired water body segments are identified and restoration solutions are developed. Ultimately, the goal of Ohio's TMDL process is full attainment of Water Quality Standards (WQS), which would subsequently lead to the removal of the water bodies from the 303(d) list.

The Ohio Environmental Protection Agency (Ohio EPA) has traditionally listed impaired waters and developed TMDLs on a watershed basis, using the 11-digit Hydrologic Unit Code system¹ as a basis for assessment. In the 2004 303(d) list, Ohio EPA identified assessment units 04100012 030, 04100012 010, and 04100012 020² as impaired in the Huron River watershed. Table 1 shows excerpts from the 303(d) list for these assessment units. All three assessment units are impaired for the aquatic life use, while only two assessment units are impaired for recreation use. Impairment due to the issuance of fish consumption advisories was not identified for any of the assessment units. The column entitled, "Priority Points" in Table 1 represents the ranking system used to prioritize the assessment units which are found to be impaired, and shows that the impairment in the first assessment unit (Huron River Mainstem, East Branch Huron River) is considered to be more serious than that found in the other two assessment units. (A detailed explanation of the priority points and a copy of the Ohio 2004 Integrated Water Quality Monitoring and Assessment Report which contains the 303(d) list can be accessed on Ohio EPA's website at: <http://www.epa.state.oh.us/dsw/tmdl/2004IntReport/2004OhioIntegratedReport.html>)

¹The United States is divided and sub-divided into successively smaller hydrologic units which are classified into multiple levels: regions, sub-regions, accounting units, cataloging units, sub-watersheds, etc. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) based on the multiple levels of classification in the hydrologic unit system. See <http://water.usgs.gov/GIS/huc.html> for more information regarding this classification system.

² In this report, assessment units are referred to using the eleven-digit designation (e.g. 04100012 030), using a three-digit designation (e.g. assessment unit 030), and using AU3. All three representations are used interchangeably.

Table 1. Impaired Assessment Units in the Huron River Watershed*

Assessment Unit	Description	Impairment of WQS**		Human Health: (FCA)***	Priority Points
		Aquatic Life Use	Recreation Use		
04100012 010	West Branch Huron River (headwaters to upstream Slate Run)	Yes	Yes		5
04100012 020	West Branch Huron River (upstream Slate Run to mouth)	Yes	No		3
04100012 030	Huron River Mainstem, East Branch Huron River	Yes	Yes		7

* Source: Ohio 2004 Integrated Water Quality Monitoring and Assessment Report, Appendix B.2.

** WQS means water quality standards.

*** FCA means fish consumption advisory.

It is important to note that although the Ohio 2004 Integrated Report shows impairment of the recreation use in the Huron River watershed, this assessment is more the result of the methodology used in this report than actual bacteria problems identified in the drainage area. The methodology triggers recreational use impairment for the entire assessment unit when the 75th percentile of all bacteria samples collected exceeds the water quality criteria for primary contact recreation. (See page 29 of the Ohio 2004 Integrated Report for a more detailed explanation of the methodology.) When the data set is small, as is the case in the Huron Basin, impairment could be triggered when only a small number of samples exceeds the threshold value. Sampling in the Huron River watershed resulted in 75th percentile bacteria counts that were only slightly higher than the threshold values used to identify the assessment units as impaired for the recreational use. Given the slight exceedance of the threshold values and because bacteria was generally not identified as a problem during sampling, it was determined that development of a TMDL for recreational use impairment is not warranted at this time. (See Chapter 2 for additional discussion of recreational use impairment.)

In 1998 and again in 2002, Ohio EPA conducted a detailed assessment of the chemical, physical and biological quality of streams for the Huron River TMDL, and these assessment were used in developing the 303(d) list for 2004. Table 2 shows a summary of the survey results for each assessment unit. In an attempt to reflect more current conditions in the watershed, survey results from only 2002 have been included in Table 2 when available. Results from the 1998 survey have been used for sites where data was not collected in 2002. Habitat alteration and nutrients are causes of impairment which are common to all three assessment units, while agricultural runoff is the source of impairment identified in each of the assessment units. Siltation is another important cause of impairment. Channelization was found to be a significant source of impairment as well. (See Table B-1 in Appendix B for a complete detailed listing of the causes and sources of water quality impairment identified in the 1998 and 2002 surveys.)

Table 2. Summary of Causes and Sources of Water Quality Impairment

Assessment Unit	Causes of Impairment *	Sources of Impairment *
04100012 010 (AU1) West Branch Huron River (headwaters to upstream Slate Run)	Organic enrichment / dissolved oxygen Nutrients Habitat alteration Siltation Oil & grease Flow alteration	Municipal point source Channelization Agricultural runoff Storage tank leaks Upstream impoundment
04100012 020 (AU2) West Branch Huron River (upstream Slate Run to mouth)	Habitat alteration Nutrients Natural limits	Channelization Agricultural runoff Natural
04100012 030 (AU3) Huron River Mainstem, East Branch Huron River	Flow alteration Pesticides Habitat alteration Nutrients Siltation Unknown Ammonia	Spills Agricultural runoff Municipal point source Small package plants

* The causes and sources included in this table represent only those which have been identified and ranked as having a “high” significance regarding impairment.

This report serves to document the Huron River TMDL process and provide for tangible actions to restore and maintain this watershed. The main objectives of the report are to describe the water quality and habitat condition of the Huron River and its tributaries and to quantitatively assess the factors affecting non or partial attainment of WQS. A draft implementation plan is also included. This plan addresses these factors and specifies monitoring to ensure actions are carried out and to measure the success of the actions proscribed. The remaining chapters of this report discuss the following topics:

- Chapter 2 - a description of the watershed, including location, topography, general history, population, and land use; a detailed discussion of the assessment of the watershed, including the water quality criteria attainment status and the causes and sources of water quality impairment.
- Chapter 3 - identification and explanation of the water quality targets for the watershed and a discussion of the current deviation from the targets.
- Chapter 4 - a discussion of the development of total maximum daily loads for the Huron River watershed, including the method of calculation and the margin of safety incorporated into the calculations.

- Chapter 5 - a discussion of the process used to ensure public participation towards the development of a plan to address the water quality impairments in the Huron River watershed.
- Chapter 6 - discussion of potential solutions or strategies which can be implemented in the watershed to address the total maximum daily loads (i.e. strategies which will allow the watershed to meet water quality criteria and/or targets established for certain pollutants).

2.0 WATERBODY OVERVIEW

2.1 Description of the Study Area

The Huron River watershed is located on the south shore of Lake Erie between Toledo and Cleveland, in Huron, Erie, Seneca, Richland and Crawford counties. The Huron River is 59.7 miles long and the watershed covers 403 square miles. It drains 261,000 acres of northern Ohio farmland. The study area included the Huron River mainstem and lacustrine zone³ from Milan to Lake Erie, the West Branch Huron River, the East Branch Huron River, and fifteen tributaries in these three main subwatersheds. The Huron River system flows through several Northwest Ohio cities including Huron, Milan, Norwalk, Monroeville, and Willard. The East Branch serves as the public drinking water supply for the City of Norwalk, and The Village of Monroeville draws its water supply from the West Branch Huron River. (See **Figure 1** on the following page for a map of the watershed and its location in relation to the state of Ohio.)

2.1.1 Ecoregions, Soils, and Topography

The East Branch Huron, West Branch Huron, and all of the tributaries except Mud Brook, originate in the Eastern Corn Belt Plains (ECBP) ecoregion, and flow north to Milan where they combine to form the mainstem of the Huron River. The mainstem of the Huron River, all of Mud Brook, and the lower segments of Rattlesnake, Seymore, and Megginson Creeks are contained in the Erie Ontario Drift and Lake Plain (EODLP) ecoregion. The topography of the watershed was formed by glacial action, and the soils consist of both glacial till plains and lake plains which has resulted in the high diversity of both the types and slopes of these soil types.

Ecoregions

The Eastern Corn Belt Plains (ECBP) ecoregion is a rich agricultural area that covers approximately 70 percent of the watershed. It has light colored, loamy, well drained soils formed from glacial deposits of the Wisconsin age, that were originally covered by natural beech forests. Today, extensive grain and livestock production occurs in this ecoregion. The turbid, low gradient streams in the ECBP ecoregion generally do not support exceptional fish communities.

The Erie Ontario Drift and Lake Plain (EODLP) ecoregion is a nearly level coastal strip of lacustrine deposits punctuated by beach ridges and swales. Soils are low in lime and less fertile than the ECBP ecoregion. Lake Erie's influence on the climate substantially

³ The term "lacustrine" was coined to specify the zone where Lake Erie water levels have intruded into tributary river channels. It is frequently characterized as being more sluggish and more turbid than upstream reaches of a river.

increases the growing season, and nursery, fruit and vegetable farms are important agricultural crops in this region. Urban and industrial land use is noteworthy in the lower Huron River watershed.

Soils and Topography

Soils in the watershed can be classified by ecoregion. The ECBP ecoregion has clayey, high lime soils generally derived from glacial till, and the EODLP has sandy loam soils derived from wave-washed glacial till and lacustrine-beach deposits. In the ECBP ecoregion of Huron and southern Erie counties, you find the predominant soils in the Cardington-Bennington-Condit association, which are characterized as deep, fine textured, glacial till

that is poorly to moderately well drained. The poorer drained Condit soils have a dark surface layer and are found on the lowest position of the landscape. Sink holes have been located in these areas of Megginson Creek, Slate Run and Frink Run. The lighter colored Bennington and Cardington soils are found on the slopes of the higher landscape positions. Patches of Chili-Oshtemo-Haskins association soils are located on outwash plains, kames and beach ridge areas of the East Branch and Seymour Creek watersheds. The area south of Willard is very flat and consists of organic soils belonging to the Colwood-Lenawee-Linwood association. The Linwood Muck and Lenawee Variant soils are characterized as black, mucky, very poorly drained soils, and wind erosion is significant in this area. (See **Figures 4 and 5** in Appendix C for detailed maps of the soils in the Huron River watershed.)

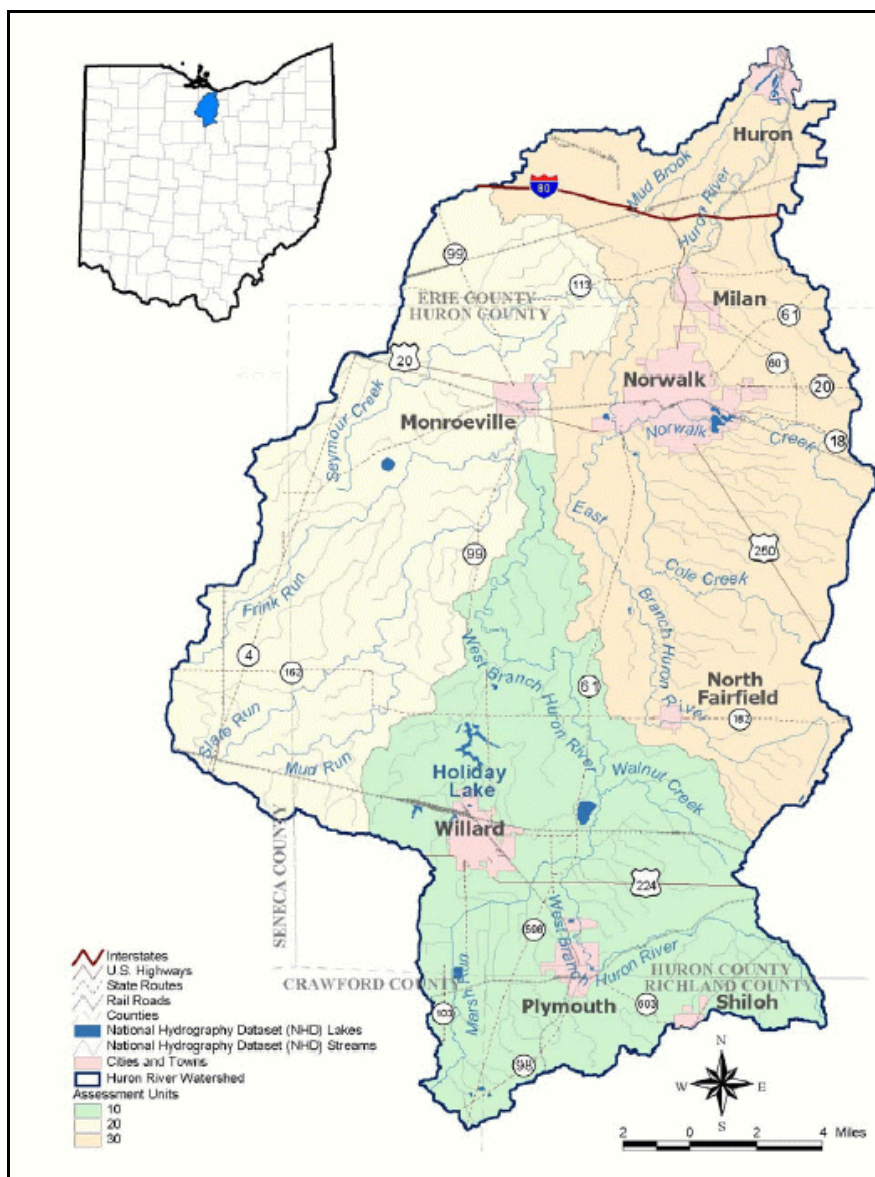


Figure 1. Huron River Watershed

Vegetable crops are intensively grown in the vicinity of Celeryville in southern Huron County. Soils in the Kibbie-Tuscola and Sisson-Tuscola associations are found on the uplands along the mainstem of the Huron River in Huron and Erie counties north of Norwalk. They are characterized as medium textured, somewhat poorly to moderately well drained. Topography drops quickly in the lower mainstem of the river, and the upland soils in this area and the Mud Brook sub-watershed are highly erodible. Soils found in the broad, flat floodplain and lacustrine zone of the mainstem are of the Marsh and Beaches association (more of a land type than a soil type); varying layers of sand which are submerged part of the year, and provide very good waterfowl habitat.

The Huron River has been identified as having among the highest suspended sediment yield in the state of Ohio, and the second highest in the Lake Erie Basin (SCS, 1989). Grain, specialty crop and livestock farming are predominant throughout the watershed. Many small streams have been channelized to assist drainage in the level, poorly drained soils of Huron and Seneca counties. Several areas in the three sub-watersheds contain soils in the highly erodible lands (HEL) category that are subject to either water or wind erosion above the tolerable erosion rate. HEL ground represents a threat to the productive capacity of the soil resource, as well as the aquatic resource when soil is transported off farmland into streams. Offsite damage from soil erosion costs millions of Ohio taxpayer dollars each year to remove sediment from drainage ditches, shipping harbors, and recreational areas.

2.1.2 Population Centers and Point Source Discharges

The Huron River watershed is largely rural with three cities; Huron, Norwalk, and Willard, and ten villages including Milan and Monroeville. Norwalk is the largest of these three cities with a population of approximately 16,000 according to the year 2000 Census. The populations of Huron and Willard are approximately 8,000 and 6,800, respectively, although portions of the City of Huron exist outside the boundaries of the Huron River basin.

The cities and villages within the Huron River basin are all served by wastewater treatment plants (WWTP) which discharge into streams within the watershed. Commercial establishments, schools, subdivisions, mobile home parks, and industries also discharge wastewater to Huron River basin streams under the authority of individual or general NPDES permits.⁴ **Table 3** on the following page shows the number of permitted discharges for each assessment unit, organized by type of facility. Most of the discharges have been classified as industrial or commercial. The majority of the permits for commercial establishments have been issued to motels and restaurants, while all the industrial type permits except five represent general permits for stormwater regulation. (See **Table D-1** in Appendix D for a complete listing of each permitted

⁴ NPDES permits are issued under the authority granted in the Clean Water Act for the National Pollutant Discharge Elimination System.

discharge, including the name of the facility, the receiving stream, and the type of discharge.

Table 3. Number of Permitted Discharges^a

Type of Permitted Facility	Huron River Watershed Assessment Unit		
	AU1- Upper West Branch	AU2- Lower West Branch	AU3- Huron River Mainstem and East Branch
POTWs ^b	2	1	4
Subdivisions and Mobile Home Parks	2	0	5
Schools	1	0	3
Other government entities ^c	3	0	4
Commercial establishments	0	0	11
Industries	6	2	18

^a The number of permitted discharges shows both individual and general NPDES permits.

^b "POTW" means publicly-operated treatment works for a city or village.

^c Includes government-owned facilities such as landfills, airports, etc.

The unincorporated areas of Holiday Lakes, New Haven, North Fairfield, Celeryville, Collins, East Townsend, Avery, Ohio Turnpike Gate 7 area, and North Monroeville currently do not have sanitary sewerage systems.

2.1.3 Land Use

Land use is primarily dedicated to agricultural activities with approximately 74 percent cropland, 15 percent woodland, and 3 to 11 percent urban and other land uses. (See **Figure 7** in Appendix C for a map showing the predominant land uses in the Huron River basin.) Moderate expansion in the urban areas of Milan, Norwalk, and Huron has resulted in increased erosion from development and polluted runoff from impervious surfaces impacting the urban streams.

Agriculture in the watershed is dominated by large, full time farm operations. In addition to the grain and specialty crop operations, there are an estimated 200 livestock farms in the watershed. (None of these farms are regulated as a Concentrated Animal Feeding Operation, or CAFO, as defined under federal regulations.) There are about 30 dairy farms, and the rest are split between hog and beef operations, with several cattle farms allowing direct livestock access to the streams. Other land uses include two golf courses, a recreation area at Holiday lakes, and a gravel quarry in the East Branch sub-watershed. The West Branch sub-watershed contains the 6.3 acre Willard Marsh State

Wildlife Area, and the Huron River mainstem includes the active solid waste landfill on Hoover Road, industrial/commercial operations, and the port of Huron (Huron SWCD, 1994).

2.1.4 Land Use Changes - Conservation Programs

A Section 319 grant was awarded to the Huron SWCD in December, 1994 for a nonpoint source implementation project in the East Branch Huron River watershed. The project was completed in December 1997, and accomplished several objectives, including 115 acres of new wooded or grassed buffers along streams and ditches, repair or replacement of 47 home septic systems, cost share on equipment to increase crop residue and various education programs to increase public awareness.

A second Section 319 grant was awarded in 1999 for continued nonpoint source reduction and education programs in the whole Huron River Watershed. Many programs from the East Branch 319 project were continued, and the new grant also included demonstration sites for streambank stabilization and intensive grazing, and incentives for livestock exclusion practices, sink hole erosion control structures, and on-farm agrichemical mixing/loading pads.

Conservation programs in farming are being promoted by the Natural Resources Conservation Service (NRCS) and local Soil and Water Conservation Districts (SWCDs) throughout the watershed. Conservation tillage practices have increased in the last ten years in all five counties. Erie SWCD and Huron SWCD have both added an urban stream specialist to their staffs to promote awareness of urban nonpoint pollution issues. In 1997, the Huron SWCD applied 56 grassed waterways totaling 49,905 feet, installed 20 erosion control structures, 3 animal waste systems, and one animal waste composting demonstration site through programs with CRP, ACP, or ODNR (Huron SWCD, 1997).

Beginning in late 1999, a new USDA program, Conservation Reserve Enhancement Program (CREP) became available to fund conservation buffer practices in the western Lake Erie watersheds, including the Huron River. This ten year program will be administered as a Federal/State partnership with a goal of establishing 65,000 acres of grass filter strips, riparian tree buffers, field windbreaks, and wetland restorations in Ohio. Huron County landowners have been strong participants in this incentive program

In 2005, Conservation Security Program (CSP) funds will be available for landowners in seven Ohio watersheds including the Huron and Vermilion watersheds to reward agricultural producers who have established and maintained conservation practices over the years. CSP, sometimes called the "Green Farm Bill" was first available in the Auglaize and St. Joseph watersheds in 2004. Natural Resources Conservation Service will administer the program in these watersheds. For more information on CSP see the NRCS website: <http://www.nrcs.usda.gov/programs/csp/>

2.2 Water Quality and Biological Assessment

2.2.1 Ohio Water Quality Standards and Designated Uses

Under the Clean Water Act every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters. These standards represent a level of water quality that will support the goal of "swimable/fishable" waters. **Table 4** provides a brief description of Ohio's water quality standards. Further information is available in Chapter 3745-1 of the Ohio Administrative Code (OAC).

<http://www.epa.state.oh.us/dsw/wqs/criteria.html>

The foundation for the Ohio Water Quality Standards (WQS) is the concept that public waters have beneficial uses that are to be available to the public. *Beneficial* uses assigned to a waterbody are termed *designated* uses. In order to ensure that these uses are available, the WQS establish water quality criteria by which achievement of designated use may be judged. Ohio WQS include both narrative and numeric water quality criteria. Narrative criteria are descriptive statements applicable to all waters of the state. Numeric criteria consist of biological, physical, and chemical measures. Comparison of instream conditions to applicable water quality criteria establishes a waterbody's achievement of designated use.

As part of the Huron River Basin TMDL process, Ohio EPA conducted a detailed assessment of chemical (water column, sediment)⁵, physical (flows, habitat), and biological (fish and aquatic insect) conditions in 1998 and reassessment in 2002 to determine if streams and rivers in the study area were attaining their designated uses. Aquatic life uses were found to be impaired to varying degrees in some streams within the watershed. Recreational uses were not evaluated in 1998, but no recreational use impairment was identified at sites where bacteria samples were collected in 2002, with the exception of one site that was found to be locally impacted by a septic discharge from a single residence just upstream of the site. (A detailed listing of aquatic life attainment status can be found in Appendix G.)

Aquatic life use designations applicable to streams in the Huron watershed include Warmwater Habitat (WWH) and Modified Warmwater Habitat (MWH). WWH describes a stream segment that is capable of supporting and maintaining a balanced community of warmwater aquatic organisms. MWH describes a stream segment that is incapable of meeting WWH biocriteria because it has been subjected to extensive, maintained, and essentially permanent hydromodifications, where the activities have been sanctioned and permitted by state or federal law. A MWH stream can still support a

⁵ Detailed listings of the chemical and sediment data collected in 1998 and 2002 can be found in Appendices E and F, respectively. Prior to reviewing the data in Appendix E, it is recommended that Table E-2 on page 57 of the appendix be printed first in order to provide an explanation of the code names for parameters used in Table E-1.

limited warmwater aquatic community which typically includes species that are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

Table 4. Summary of the Components and Examples of Ohio's WQS

WQS Components	Examples of:	Description
Beneficial Use Designation	- Water supply uses - Public (drinking) - Agricultural - Industrial - Recreational Uses: - Beaches (Bathing waters) - Swimming (Primary Contact) - Wading (Secondary Contact) - Aquatic life habitat uses (partial list): - Exceptional Warmwater (EWH) - Warmwater (WWH) - Modified Warmwater (MWH) - Limited Resource Water (LRW)	Designated uses reflect how the water is potentially used by humans and how well it supports a biological community. Every water in Ohio has a designated use or uses; however, not all uses apply to all waters (they are water body specific). Each use designation has an individual set of numeric criteria associated with it, which are necessary to protect the use designation. For example, a water that was designated as a drinking water supply and could support exceptional biology would have more stringent (lower) allowable concentrations of pollutants than would the average stream. Recreational uses indicate whether the water can potentially be used for swimming or if it may only be suitable for wading.
Numeric Criteria	1. Chemical	Represents the concentration of a pollutant that can be in the water and still protect the designated use of the waterbody. Laboratory studies of organism's sensitivity to concentrations of chemicals exposed over varying time periods form the basis for these.
	2. Biological <i>Measures of fish health:</i> - Index of Biotic Integrity - Modified Index of Well Being <i>Measure of bug (macroinvertebrate) health:</i> - Invertebrate Community Index	Indicates the health of the instream biological community by using these 3 indices (measuring sticks). The numeric biological criteria (biocriteria) were developed using a large database of reference sites.
	3. Whole Effluent Toxicity (WET)	Measures the harmful effect of an effluent on living organisms (using toxicity tests).
	4. Bacteriological	Represents the level of bacteria protective of the potential recreational use.
Narrative Criteria (Also known as 'Free Froms')	General water quality criteria that apply to all surface waters. These criteria state that all waters shall be free from sludge, floating debris, oil and scum, color and odor producing materials, substances that are harmful to human, animal or aquatic life, and nutrients in concentrations that may cause algal blooms.	
Antidegradation Policy	This policy establishes situations under which the director may allow new or increased discharges of pollutants, and requires those seeking to discharge additional pollutants to demonstrate an important social or economic need. Includes State Resource Water Use Designation. Refer to http://www.epa.state.oh.us/dsw/wqs/wqs.html for more information.	

Aquatic life use attainment is assessed by comparing existing biological conditions to numeric biocriteria. Ohio's biocriteria are based upon three indices: the Index of Biotic Integrity (IBI), the Modified Index of Well-Being (MIwb), and the Invertebrate Community

Index (ICI). Each index assesses the kinds and relative abundances of various aquatic organisms living in a given stream. Index thresholds were developed from data collected at reference sites, and are distinguished by the type of reference site used as the basis to establish the threshold values (i.e. headwater sites, wading sites, or boat sites) and ecoregion:

- Huron-Lake Erie Plain (HELP);
- Eastern Corn Belt Plain (ECBP);
- Interior Plateau (IP);
- Erie/Ontario Lake Plain (EOLP); or
- Western Allegheny Plateau (WAP).

(The Huron River watershed lies within the HELP and ECBP ecoregions.) Based upon the applicable biocriteria, attainment status of the designated aquatic life use for stream segments is determined as follows: 1) full attainment - all indices are met; 2) partial attainment - some indices are met; or 3) non-attainment - no indices are met or one or more indices indicate poor community performance.

Recreational use designations applicable to streams in the Huron watershed include Primary Contact Recreation (PCR), and Secondary Contact Recreation (SCR). PCR describes waters suitable for full-body contact recreation, such as swimming and canoeing. SCR describes waters suitable for partial-body contact recreation, such as wading. The use attainment status of PCR and SCR is determined by comparing existing bacteria concentrations to numeric criteria for fecal coliform bacteria.

Current Beneficial Use Designations

All streams in the Huron River watershed are currently designated WWH for aquatic life use. The Huron River mainstem has an additional aquatic life use designation of seasonal salmonid habitat (SSH) from October to May.⁶ All streams in the watershed are also designated for agricultural water supply, industrial water supply, and primary contact recreation. Finally, the following locations are also designated for public water supply:

- Norwalk Creek at RMs 0.1 and 4.02
- West Branch Huron River at RMs 8.52 and 33.8
- Frink Run at RM 4.83

⁶ Chemical sampling data showed no instream water quality violations for water quality criteria applicable to the SSH use designation. Regarding WWH and MWH, the table showing aquatic life use attainment status in Appendix G and the discussion which follows in this chapter indicates those streams which are recommended for the modified warmwater habitat (MWH) use designation.

2.2.2 Use Attainment and Water Quality in the Huron River Basin

Ohio EPA assessed much of the Huron River mainstem and branches in 1998 and reassessed the branches and additional tributaries in 2002. The 2002 303(d) list was based primarily on the 1998 data. The 2002 biological and water quality survey of the Huron River watershed found significant improvement in portions of the basin, particularly in the East and West Branches. Because the 2002 results are the most representative of current conditions, TMDLs will be developed based on the most recent information where multiple years of data exist. The 1998 and 2002 survey information is represented in the 2002 and 2004 303(d) lists, respectively.

Table G-1 in Appendix G summarizes the results of the 1998 and 2002 biological and habitat assessments. The table is arranged from upstream to downstream and lists all the mainstem sites first, by river mile, then lists the sites on the streams that are tributary to the Huron River from upstream to downstream. Sites on the West Branch Huron River and its tributaries, then the East Branch Huron River and its tributaries, follow in the same format. The use attainment status is based on the appropriate aquatic life use designation for the stream segment as determined by the 2002 assessment. If the appropriate aquatic life use designation is different than the use designation that existed prior to the 2002 survey, it is identified as “recommended”.

It is apparent from **Table G-1** that, excluding the lacustrine segment, the Huron River mainstem and most of the East Branch Huron River and the West Branch Huron River are now in full attainment of the WWH aquatic life use. Approximately 80 percent of the over 80 free-flowing river miles in the mainstem and major branches met WWH criteria by 2002. With the exception of the extreme headwaters, an impaired segment downstream from the Plymouth WWTP (West Branch), and a stretch of the East Branch below a suspected pesticide spill, fish and macroinvertebrate performance was generally in the good to exceptional ranges. Two slight departures into partial attainment in the West Branch between Marsh Run and Slate Run were the result of fish communities dropping into the fair range. The departures were not considered severe and were attributed to either a small section of channelized habitat (site at RM 22.7) or ephemeral conditions, associated with the extended 2002 drought (site at RM 16.6). Not coincidentally, areas of high biological performance also tended to have intact physical habitats and riparian corridors. Based on QHEI⁷ scores, attaining stations in the mainstem and major branches also had good to exceptional physical habitat quality.

With the exception of municipal point source discharges, combined sewer overflows (CSOs), or urban runoff sources in Plymouth, Norwalk, and Willard, biological and water quality impairment in the Huron basin was most often associated with agricultural land usage in small drainage areas less than 20 square miles. The most common causes of

⁷ “QHEI” means Qualitative Habitat Evaluation Index and represents a measure of the instream and riparian habitat at specific locations along a stream. See Section 3.1.1 in Chapter 3 for further discussion of the QHEI.

impairment in these areas were siltation, channelization, or nutrient enrichment. Most often, these stressors appeared to operate in concert, rendering the chemical water quality and aquatic community degraded through a cumulative effect, rather than reflecting the input from a single discrete source.

2.3 Causes and Sources of Impairment

This section provides a discussion of the causes and sources of impairment for streams within each 11-digit assessment unit in the watershed. Impaired streams in Assessment Unit 1 (or AU1) are discussed first, followed by similar documentation for Assessment Units 2 and 3. **Figure 2** shows the attainment status for the entire Huron River watershed. The figure shows that all of the Huron River mainstem, the West Branch, the East Branch, and many of the remaining tributaries were assessed in 1998 and/or 2002. With two or three exceptions which were evaluated for modified warmwater habitat, the streams assessed and the attainment status shown in **Figure 2** is based upon meeting the warmwater habitat aquatic life designation. **Table B-1** in **Appendix B** provides a detailed listing of the impaired stream segments in the Huron River watershed, organized by assessment unit, along with the identified causes and sources of impairment. The remainder of this section 2.3 of Chapter Two is divided into three subsections, with each subsection presenting detailed information regarding the streams which were found to be impaired in HUC assessment units 04100012 010, 04100012 020, and 04100012 030.

2.3.1 Assessment Unit 1 (AU1) - Upper West Branch Huron River Basin

In general, sampling results from assessment unit 1 (or AU1) showed that a very high percentage of streams miles associated with large drainage areas were in attainment, while stream sites on streams with small drainage areas were likely to be in non-attainment or partial attainment. (See **Table 5**.) The watershed assessment unit score represents the composite grade or measure of the attainment status for aquatic life use in this assessment unit.⁸ An assessment unit (AU) score of 80 is used as the benchmark above which a watershed is considered to be in good condition relative to aquatic life use. A maximum AU score of 100 is possible, and the AU is considered meeting it's designated aquatic life use if all monitoring sites meet designations.

⁸The method used to calculate the watershed assessment score is presented in the Ohio 2004 Integrated Water Quality Monitoring and Assessment Report, Section 6.5.

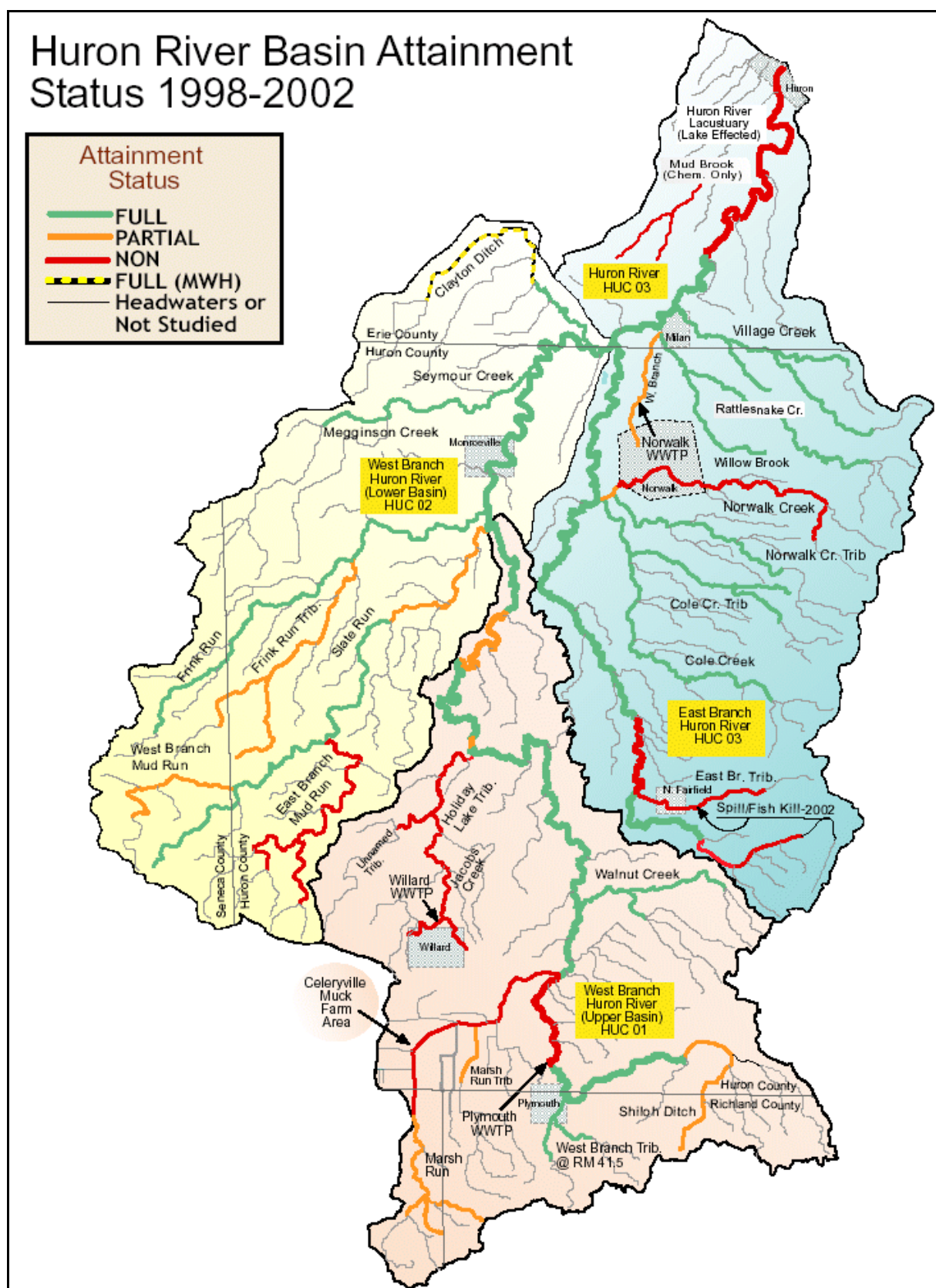


Figure 2 . Huron River Watershed Attainment Status

Table 5. Summary of Upper West Branch Huron River: Attainment Status

Upper West Branch Huron River Basin (headwaters to upstream Slate Run)	Total	Aquatic Life Attainment Status						Assessment Unit Score
		Full		Partial		NON		
		#	%	#	%	#	%	
HUC 04100012 010 (AU1)								
Sites < 20mi ² drainage area	13	3	15	4	20	6	65	54
Sites < 50mi ² drainage area	17	4	20	5	22	8	58	
Miles of assessed streams with > 50mi ² and < 500mi ² drainage area	19.7	17.2	87	2.5	13	0	0	
AU1 Summary The upper AU (HUC 04100012) includes the upper 27.9 miles of the West Branch Huron River, from the headwaters to the a point immediately upstream from confluence of Slate Run, and all associated tributaries. (See Figure 2.) All aquatic life use impairment of the West Branch Huron River mainstem was contained within AU1. Four discrete impacted segments were identified. Of these, the most significant, in terms of magnitude and severity, was associated with organic and nutrient loads from the Plymouth WWTP (RM 40.55). Impairment associated with this facility was identified in both 1998 and 2002. However, due to severe drought conditions, the severity of this impact increased in 2002. Unseasonably low surface flow, coupled with direct water withdrawals for agricultural and horticultural irrigation, eliminated the capacity of the upper West Branch Huron River to effectively assimilate treated waste loads from the Plymouth WWTP. Degraded water and quality and fair/poor community performance (non-attainment) were documented downstream from the WWTP for approximately five river miles. Departure from the WWH biocriteria for the remaining three impacted mainstem segments was modest (partial attainment) and related primarily to nutrients and habitat deficiencies (e.g., siltation and channelization). In some instances, the effects of these problems were exacerbated in 2002 by drought conditions. With the exception of the stream reach affected by Plymouth WWTP, nowhere did community performance in the West Branch fall below fair. In the Celeryville horticultural area, the severity of impacts to the macroinvertebrates in Marsh Run (very poor) suggests possible toxic impacts, over and above the influence of channelization and enrichment. The headwaters of the Holiday Lake watershed near Willard (Jacobs Creek) were impaired by numerous factors including channelization, urban runoff, the Willard WWTP, and a localized impact from an apparent fuel oil leak. Downstream from Holiday Lake, impoundment effects and sedimentation contributed to fair quality biological communities. Many of these stressors appeared to operate in concert, rendering the chemical water quality and aquatic community degraded through a cumulative effect, rather than reflecting the input from a single discrete source. The Ohio Department of Health advises that meals of freshwater drum caught in the Huron River in Huron and Erie County be limited to one per month because of mercury levels. Aquatic life use attainment status and biological indices for all sampling locations are presented in Appendix G in Table G-1.								

Table 5 shows that the watershed assessment unit score for AU1 is 54, suggesting that streams in this part of the Huron River basin are moderately impaired. Eighty-seven percent of the stream miles for streams having drainage areas between 50 and 500 square miles was in full attainment of water quality aquatic life use designation. However, nearly one-half of the sites assessed for streams with drainage areas less

than 20 square miles and for streams with drainage areas less than 50 square miles were in non attainment.

Figure 3 shown on the following page is a schematic of the attainment status for this assessment unit, and also shows the locations of tributaries, municipal and industrial point sources, and unsewered areas. Individual stream segments and sub-watersheds in AU1 failing to fully meet existing and recommended beneficial uses are discussed below and on the pages which follow.

Headwaters of West Branch (RM 47.6, Old State Road)

In the headwaters of the West Branch, performance of the fish communities was good but the fair condition of macroinvertebrates resulted in partial WWH attainment. While phosphorus levels were somewhat elevated (*i.e.*, above target levels) excessive sedimentation and historic channel modification appeared primarily responsible for the subpar performance. Further downstream, biological communities improved to the good and very good ranges prior to the Plymouth WWTP.

West Branch Downstream of Plymouth WWTP (approx. RMs 40.55 - 35, WWTP to about Marsh Run)

Biological impairment persisted downstream from the Plymouth WWTP (RM 40.55) for approximately five river miles in 1998 and 2002. The severity of impairment was most pronounced in 2002 with both fish and macroinvertebrates dropping to the fair and poor ranges. Enrichment impacts downstream from the WWTP were exacerbated by the extended summer drought and possibly by withdrawals of stream water for irrigation in the vicinity of the discharge.

Chemical water quality was also impacted downstream from the Plymouth WWTP. Sampling results clearly showed diminished D.O. and elevated concentrations of ammonia-N and total phosphorus downstream from the discharge – the latter reaching highly elevated levels (2.87 mg/l) in 1998. An actual reduction in the average concentration of nitrate+nitrite-N downstream from the WWTP indicates limited nitrification or possibly ammonification occurring within the facility's facultative lagoons. The Plymouth WWTP effluent frequently violates NPDES permit limits for carbonaceous biological oxygen demand (CBOD), total suspended solids (TSS), and dissolved oxygen (D.O.). Erratic ammonia-N loads (significant discrepancies between 50th and 95th percentile) and virtual absence of effluent nitrate+nitrite-N provide direct evidence of failing nitrification or as stated above, possibly ammonification. These various observations, portrayed a pattern of treatment failures and/or irregularities that have resulted in the impairment of the WWH use for several miles of the West Branch Huron River.

Physical alteration of the flow regime and the potential influence of stream water withdrawal for irrigation should be evaluated in greater detail in the future.

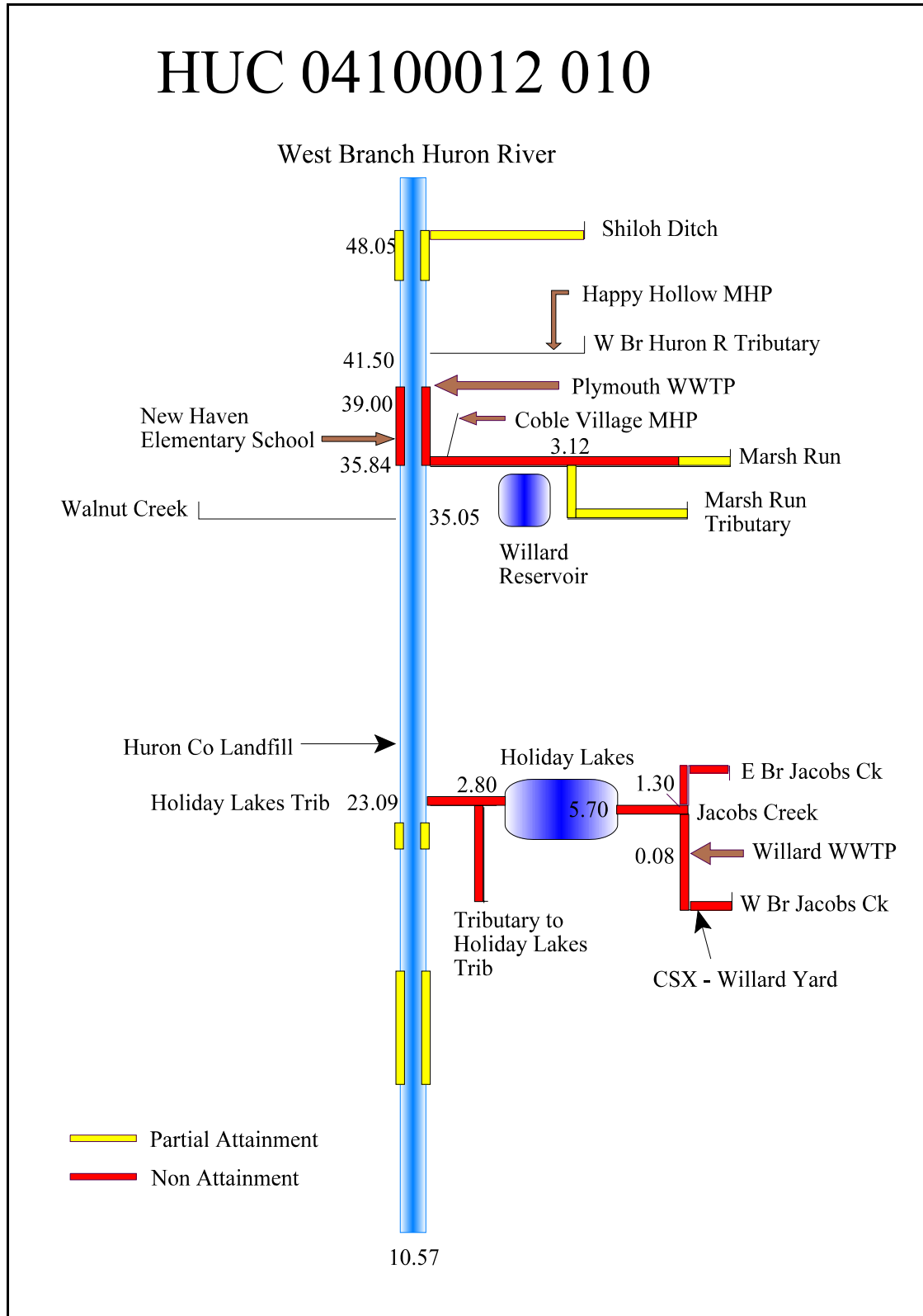


Figure 3. Attainment Status Schematic of Assessment Unit 010 (AU1)

West Branch (RM 23.0 - 22.5, Bauman Road)

Impairment within this reach was modest, being only 0.5 miles in total, and was due solely to the subpar performance of the fish community. In contrast with the upstream segment of the West Branch which was clearly impacted by a discrete point source, depressed community performance appeared well-correlated with deficient stream habitat (QHEI=57.5). Monotonous channel development and substrate embeddedness, related to previous channelization and low gradient were the primary habitat deficiencies. As the vast majority of the West Branch contained good to excellent habitat, this impact was a highly localized phenomenon.

West Branch (RM 16.6, Snyder Road)

Sampling of this station in 1998 yielded a community of aquatic organisms fully consistent with the WWH aquatic life use (full attainment). Re-sampling in 2002, however, found that the condition of the fish assemblage had declined, resulting in partial attainment. The apparent diminution in community performance appeared ephemeral, associated with the unseasonably low flow due to severe drought conditions in 2002. Analysis of the fish results indicated remarkable consistency between the 1998 and 2002 collections with one pronounced exception. A highly tolerant, omnivorous fish species (bluntnose minnow) was super-abundant in 2002, comprising nearly 50 percent of the assemblage. The numerical dominance of this species simply diluted proportional metrics, resulting in the deflated IBI score. Ohio EPA has observed a similar phenomenon in a limited number of circumstances, where stations are re-sampled on a regular basis. The rise and dominance of this taxa has been associated with anomalous flow conditions, including both temporary impoundment or significant low flow. For these reasons, the conditions observed in 2002 were likely ephemeral, and under a normal flow regime, the fish community should easily restructure itself.

All other segments of the Upper West Branch Huron River mainstem were found to contain fish and macroinvertebrate communities consistent with WWH biological criteria. Furthermore, chemical water quality remained well within expected ranges.

Shiloh Ditch (a.k.a., West Branch Huron River Trib. @ RM 48.05)

Shiloh Ditch is a small, historically modified headwater tributary of the West Branch Huron River. Direct channelization has resulted in severely deficient microhabitat quality.⁹ The physical extent and magnitude of the channelization has eliminated the reasonable possibility of this waterbody supporting a WWH aquatic community well into the foreseeable future. As such, the entire length of Shiloh Ditch was recommended to be re-designated as modified warmwater habitat (MWH).

⁹ The QHEI for Shiloh Ditch at RM 0.1 at Plymouth East Road was determined to be 41.5.

The 2002 survey results indicated partial attainment of the recommended MWH aquatic life near the mouth. Failure of the ambient biology to meet the prescribed biocriteria was a result of fair-poor performance of the benthic macroinvertebrate community. Sedimentation and channel simplification were the principal causes associated with impairment. The Shiloh WWTP, with a design flow of 0.12 MGD, is located over three miles further upstream from the mouth and has a history of discharging elevated levels of phosphorus. An impact from the plant could not be entirely discounted. However, the potential influence of the WWTP could not be distinguished from the siltation and channelization effects, given the WWTP's distance upstream and its small size. Future sampling in close proximity to the WWTP discharge is recommended.

Marsh Run

Much of the length of Marsh Run has been subjected to direct channel modification at some point in the past. Only the middle segment, draining the intensive agricultural and horticultural areas near Celeryville is actively maintained for improved drainage (approximately from the Celeryville Reservoir to State Route 598). The remaining upper and lower reaches either have already recovered, or the process of physical recovery is well underway. As presently drained, configured, and maintained, the highly artificial state of the middle segment will likely persist into the foreseeable future. Given this, the MWH aquatic life use designation was recommended for this reach. Remaining segments, headwaters and the lower mile, were recommended to retain the existing WWH designation.

Although historically modified, the upper reaches of Marsh Run were found to contain some positive habitat features (QHEI score equals 52.0 at RM 7.9, Kenestrick Rd.). The level of habitat quality was not consistent with WWH aquatic communities, but far better than that encountered downstream through the Celeryville area. Nevertheless, aquatic life use impairment within the headwaters of Marsh Run was the result of deficient habitat. As this reach is not actively maintained, much recovery has taken place since the original channel work. Furthermore, this gradual natural restoration or reestablishment of positive habitat features will likely continue, ultimately leading to full physical recovery at some point in the future. Natural abatement of the physical deficiencies identified above will eventually result in the restoration of WWH communities, and subsequently full attainment of the WWH aquatic life use.

Sampling results from Marsh Run through the highly modified and well-drained Celeryville area (RM 3.7, Buckingham Rd.) were reflective of impacts from nutrient enrichment, habitat modification and possible toxicity from pesticide residues. In comparison with the headwaters, the condition of the fish community declined from fair to poor (IBI=26) in this stream segment. Similarly, the macroinvertebrate community performance portrayed a significant decline through this reach, from marginally good within the headwaters, to very poor at Buckingham Road. The impact portrayed by these data from the combined influence of simplified macrohabitat and nutrient enrichment was more severe than expected, suggesting the presence of substances toxic to stream invertebrates. Given the very poor performance of the macrobenthos,

the recommended MWH aquatic life use for the middle segment of Marsh Run is considered impaired (in non-attainment).

Macrohabitat quality was considerably advanced through the lower mile of Marsh Run. (The QHEI score at RM 0.2, State Route 61 was 60.0.) Although lingering evidence of previous channel modifications were still present, mainly manifest in limited riparian cover and a deeply incised active channel, this segment appeared to contain a minimum complement of positive features associated with the wetted (channel development, substrates, and in-stream cover). Measures of chemical water quality and ambient biological performance indicated degraded conditions, despite vastly improved habitat. This was primarily a result nutrient enrichment, originating from adjacent agricultural land use and exported material from the intensively cultivated and well-drained Celeryville area located upstream. The stimulating effects of nutrients upon instream productivity were directly indicated by a highly variable dissolved oxygen regime and the presence of excessive algal growth. Given the lack of a continuously shaded corridor, additional nutrients delivered to the lower reach are readily converted into nuisance biomass. Lastly, a mild septic odor was present, likely a result of failing on-site septic system(s). Although this source undoubtedly delivered nutrients and fecal coliform bacteria to Marsh Run, the ultimate effects appeared minimal, and at most functioned as a tertiary cause and source of aquatic life use impairment.

Tributary to Marsh Run (RM 3.12)

Like the middle reach of Marsh Run, the unnamed tributary to Marsh Run at RM 3.12 is extensively modified and maintained for improved drainage by the Celeryville Conservancy District. The very low QHEI score of 36.5 indicates an obviously deficient habitat. The profound level of habitat modification and the presence of an active maintenance program make this is an ideal candidate for the MWH designation. Fish community performance (an IBI score of 36) easily met the MWH biocriterion. However, macroinvertebrate community health was poor, resulting in partial attainment of the modified use. Unlike the nearby Marsh Run site at RM 3.7, impacts to the macroinvertebrates appeared more reflective of nutrient enrichment and associated low dissolved oxygen. In contrast to the middle reach of Marsh Run, evidence of toxic substances was not strongly indicated.

Jacobs Creek Subbasin

Jacobs Creek is a small tributary to Holiday Lake, formed by the confluence of two headwater branches near the town of Willard. The upper drainage receives urban runoff from Willard and effluent discharges from the Willard WWTP (West Branch Jacobs Creek RM 0.04) and the CSX Willard Yard (West Branch Jacobs Creek at RM 0.80). Chemical and fish sampling was conducted upstream from the WWTP in the West Branch while macroinvertebrates were collected upstream from the discharge in the East Branch Jacobs Creek. Fish community performance throughout the Jacobs Creek subbasin was in the poor range and macroinvertebrates were fair.

Upstream from the WWTP, the biology appeared reflective of limited stream habitat. Although many positive habitat features were observed, including a natural channel and a wooded riparian corridor, the creek branches are very small (less than 1 square mile drainage area) and substrates consisted primarily of shifting and unstable sand. This stream segment appeared to have been scoured regularly, affected by pulsed and forceful urban runoff from Willard. Additionally, the West Branch site appeared impacted by an apparent spill or release of petroleum distillate (likely diesel fuel) from an unknown upstream source. Given the very small size of West Branch Jacobs Creek, the deleterious effects of these stressors was magnified.

Habitat conditions worsened at the lower most station of Jacobs Creek (Egypt Road at RM 0.6), downstream from the Willard WWTP and the confluence with the East Branch. This reach had obviously been channelized in the past, with little recovery evident. Substrates were similar to that encountered upstream—mainly fine, shifting, and unstable sand. Despite being situated downstream from the WWTP, no obvious negative effects were observed due to the discharges from this facility. While the potential for impacts associated with this facility can not be completely dismissed, the condition of the fish community appeared more reflective of deficient stream habitat and other nonpoint sources. No evidence of the petroleum contamination observed upstream (in West Branch Jacobs Creek) was found at RM 0.6.

Holiday Lake Tributary (RM 23.09)

The Holiday Lake dam overflow becomes a tributary to the West Branch Huron River at RM 23.09 (i.e., Holiday Lake Tributary). This waterbody was sampled immediately down-stream from the spillway at RM 3.0. Impairment in the biology (i.e., non attainment) was primarily associated with the effects of the upstream impoundment: modified flow regime, export of organic material and nutrients, and excessive sedimentation (loose, unstable sand substrates).

Unnamed Tributary to Holiday Lake Tributary (RM 23.09/2.8)

The unnamed tributary flows into the Holiday Lake Tributary at RM 2.8. Poor performance of the fish assemblage at RM 0.3 appeared related to the artificial flow regime of the unnamed tributary. The station was located immediately downstream from what appeared to be a hastily built, concrete low head dam. The stream segment immediately downstream from the spillway was completely de-watered and at the time of the collection (July 17, 2002), no water was observed flowing over the dam. Surface flow was observed to begin approximately 30 meters downstream from the dam, as water emerged from the substrates, eventually forming steady and consistent discharge. It appeared that surface flow for the lower reach is a result of water forced from the dam pool through the hyporheic zone (i.e., the boundary area of water between the stream bed and groundwater). Nearly every aspect of the fish assemblage at RM 0.3 appeared diminished, including a lack of sensitive taxa and an overwhelming

dominance of tolerant and pioneering species¹⁰, reaching 85 percent and 82 percent, respectively. In particular, the abundance of pioneering taxa strongly suggests that the lower segment of this tributary is in a perpetual state of recovery, the community being subjected to regular pronounced stress.

Macroinvertebrates were sampled in the free-flowing section, upstream from the small impoundment. Community health was considered fair but, unlike the fish, impairment appeared associated with excessive silt deposition and loose, unstable sand substrates. The specific source(s) of sediment was uncertain but a very steep wooded hillside with sparse understory along the river likely contributed to the sediment load.

Water chemistry samples were collected within the small impoundment located between the fish and macroinvertebrate sampling sites. Sulfate and dissolved solids concentrations were found to be highly elevated. Specific source(s) of the chemicals are not known at this time.

2.3.2 Assessment Unit 2 (AU2) - Lower West Branch Huron River Basin

Sampling conducted in assessment unit 2 (or AU2) showed that 100 percent of the streams assessed having large drainage areas were in full attainment. A reasonably high number of sites located on streams with smaller drainage areas were also found to be in full attainment. (See **Table 6.**) Six of the nine sampling sites on streams with less than 20 square miles were in full attainment, while seven of the eleven sites on streams with less than 50 square miles met the requirements for full attainment. The composite watershed assessment unit score for AU2 is 80, indicating that conditions are relatively good but that not all of the sampling sites and stream miles were determined to be in full attainment.

Figure 4 shown on page 25 depicts the attainment status of stream segments for AU2. As illustrated in the figure, partial attainment or nonattainment was limited to a few small tributaries in this basin. The entire mainstem of the lower West Branch was in full attainment. The schematic also indicates that the effluent discharged from the Monroeville WWTP does not appear to have a significant impact on the biological communities of the lower West Branch. The remainder of this section discusses the individual stream segments and sub-watersheds in AU2 failing to fully meet their existing and recommended beneficial uses.

¹⁰ Pioneering species can be characterized as the first species expected to re-populate an area after desiccation.

Lower Slate Run

Only the lower 4.1 miles of Slate Run failed to meet WWH criteria. Departure from the criteria in 1998 was a result of the fish community falling short of the WWH criteria. Habitat quality appeared to be the primary cause of impairment, a result of the natural features (predominance of slate substrate) and possible historic modification. Impairment in 2002 was heightened or made worse by drought conditions, resulting in intermittent flow. This served to exacerbate existing natural limiting features, namely shallow depth and bedrock substrates. Both fish and macroinvertebrates failed to meet WWH criteria during the 2002 drought. It is important to consider that this reach has never fully supported WWH communities since original investigations in the early 1980s.

Table 6. Summary of Lower West Branch Huron River: Attainment Status

Lower West Branch Huron River Basin - Slate Run to mouth HUC 04100012 020 (AU2)	Total	Aquatic Life Attainment Status						Assessment Unit Score
		Full		Partial		NON		
		#	%	#	%	#	%	
Sites < 20mi ² drainage area	9	6	67	2	22	1	11	80
Sites < 50mi ² drainage area	11	7	59	2	10	2	31	
Miles of assessed streams with > 50mi ² and < 500mi ² drainage area	10.5	10.5	100	0	0	0	0	
AU2 Summary The Lower West Branch (AU2 or HUC 04100012 020) includes the lower 11 miles of the West Branch Huron River and its tributaries from Slate Run, upstream from Monroeville, to the East Branch Huron River (See Figure 2.) Mainstem biological communities were in Full attainment throughout the length of the lower West Branch by 2002 and biological impairment was mostly limited to a few headwater tributaries and the lower reaches of Slate Run. Siltation, nutrients and habitat modification associated with agriculture were the primary causes and sources of impairment in the tributaries along with natural flow alteration in lower Slate Run. Like other impaired small drainages in the Huron River basin, many of these stressors appeared to operate in concert, rendering the chemical water quality and aquatic community degraded through a cumulative effect, rather than reflecting the input from a single discrete source. The Ohio Department of Health advises that meals of freshwater drum caught in the Huron River in Huron and Erie County be limited to one per month because of mercury levels. Aquatic life use attainment status and biological indices for all sampling locations are presented in Appendix G in Table G-1.								

West Branch Mud Run

Impairment of the West Branch Mud Run in 1998 was solely due to the failure of the benthic macroinvertebrate community to achieve a level of performance greater than fair for the WWH use designation. Composition of the macrobenthos appeared

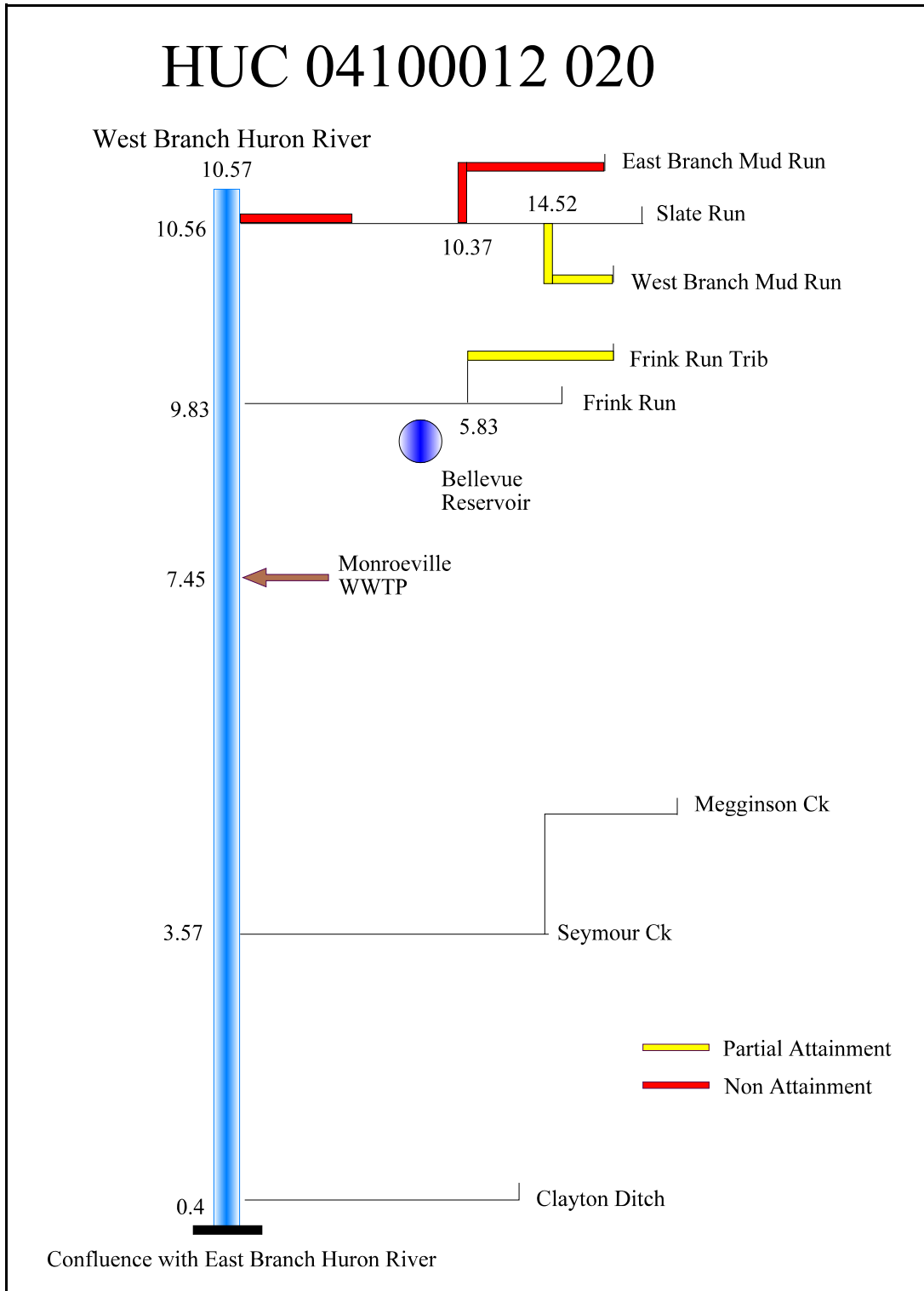


Figure 4. Attainment Status Schematic of Assessment Unit 020 (AU2)

reflective of nutrient enrichment. As observed elsewhere within the study area, the results from water quality analysis revealed high dissolved oxygen concentrations, further suggesting nutrient enrichment.

Tributary to Frink Run @ RM 5.83

This small agricultural stream is an historically modified, direct tributary to Frink Run at RM 5.83. Fair to poor community performance resulted in partial attainment of the recommended MWH use designation. The combination of siltation, nutrient enrichment, channelization, and near intermittence were the associated causes of impairment.

East Branch Mud Run

Direct evidence of organic enrichment was indicated in East Branch Mud Run. Two exceedances of the average WWH dissolved oxygen criterion were observed among the five water column samples collected from East Branch Mud Run. Furthermore, the range of dissolved oxygen concentrations was relatively narrow (4.1 to 6.3 mg/l), with all values well below seasonal and regional norms. These data were indicative of chronic, low grade organic enrichment. A lack of good habitat - mainly monotonous channel development (due to channelization), predominance of silt substrates, and very low summer flow – likely amplified the effects of the organic enrichment and resulting biological oxygen demand (BOD). It is likely that the BOD or organic load of the East Branch Mud Run would have been effectively assimilated if natural stream habitat was conserved. In its present highly modified state, *normal* background loads appeared to directly impact the dissolved oxygen regime, thus affecting ambient biological performance. Finally, deficient community features often common to streams impacted by nutrients and habitat alteration were evident in East Branch Mud Run. These features included a large proportion of environmentally tolerant omnivorous species and a lack of environmentally sensitive taxa.

2.3.3 Assessment Unit 3 (AU3) - Huron River Mainstem and East Branch Huron River Basins

Assessment Unit 3 (AU3) sampling results showed that a significant portion of stream miles in large drainage areas were impaired. Much of this impairment is associated with the lacustrine zone of the Huron River mainstem. (See **Table 7.**) Significant portions of the streams with small drainage areas were found to be impaired as well. The composite watershed assessment unit score for AU3 shows that only 50 percent of the basin is in full attainment.

On page 28, **Figure 5** shows a schematic representation of the attainment status of streams in this assessment unit. This figure illustrates that non attainment in AU3 is limited to the headwaters of the East Branch, the lower reach of the Huron River

mainstem, a East Branch tributary, Norwalk Creek, Mud Brook, and the Mud Brook tributary. Partial attainment of aquatic life designated uses was found in a section of Norwalk Creek and the West Branch of Rattlesnake Creek.

Table 7. Summary of Huron River Mainstem and East Branch: Attainment Status

Huron River and East Branch Huron River Basins - headwaters to Lake Erie	Total	Aquatic Life Attainment Status						Assessment Unit Score
		Full		Partial		NON		
		#	%	#	%	#	%	
HUC 04100012 030 (AU3)								
Sites < 20mi ² drainage area	14	7	50	2	14	5	36	50
Sites < 50mi ² drainage area	18	10	62	3	20	5	18	
Miles of assessed streams with > 50mi ² and < 500mi ² drainage area	16.1	5.9	37	0	0	10.2	63	
AU3 Summary Assessment unit 030 (HUC 041000012-030), includes the entire length of the Huron River mainstem, from its source at the confluence of the East and West Branches, to Lake Erie, and the entire East Branch Huron River basin. (See Figure 2.) This AU drains portions of both the Eastern Corn Belt Plains (ECBP) and Huron-Erie Lake Plains (HELP) ecoregions. The Huron River mainstem and its direct tributaries are contained entirely within the HELP. In addition, the lower 10 miles of the mainstem is pooled and sluggish (lake affected) as the river flows through the lacustrine deposits of Lake Plain. The East Branch Huron River is a transboundary stream, coursing through and draining both the ECBP and HELP. The majority of the East Branch catchment is contained within the ECBP, entering the HELP just prior to joining the West Branch to form the Huron River mainstem. Several factors contribute to impairment in the 10 mile stretch of the lower mainstem between Milan and Lake Erie. The low gradient (lake affected) characteristics of this segment create ideal conditions for sediment deposition from upstream agricultural sources. Also, nutrients are retained within the segment due to protracted flushing rates and contribute to highly enriched conditions. These problems were further exasperated by harbor/marina development and the Huron Basin WWTP in the lower mile of the river. The free flowing section of the Huron River and most of the East Branch was in Full attainment of WWH by 2002. Two exceptions were the result of impacts to the macroinvertebrates and included the upper headwaters of the East Branch (RM 24.7 - intermittent flow, excessive algal growth) and at least a mile stretch downstream from a suspected pesticide spill near North Fairfield (RM 19.98). Tributary sites were largely in Full attainment except for urban/CSO and municipal WWTP impacted drainages in Norwalk (Norwalk Creek, West Branch Rattlesnake Creek) and the unnamed tributary in North Fairfield impacted by the suspected pesticide spill. The upper reaches of Norwalk Creek were also affected by nutrients and habitat alteration associated with agriculture. Chemical sampling in upper Mud Brook found excessive ammonia and nutrient levels downstream from a series of small WWTPs in the headwaters. These package plants are scheduled for elimination within the next two years. Ohio EPA will continue to regulate all package plants under the terms and conditions of their NPDES permits until they are abandoned and facilities are connected to the regional sanitary sewer system. The Ohio Department of Health advises that meals of freshwater drum caught in the Huron River in Huron and Erie County be limited to one per month because of mercury levels.								

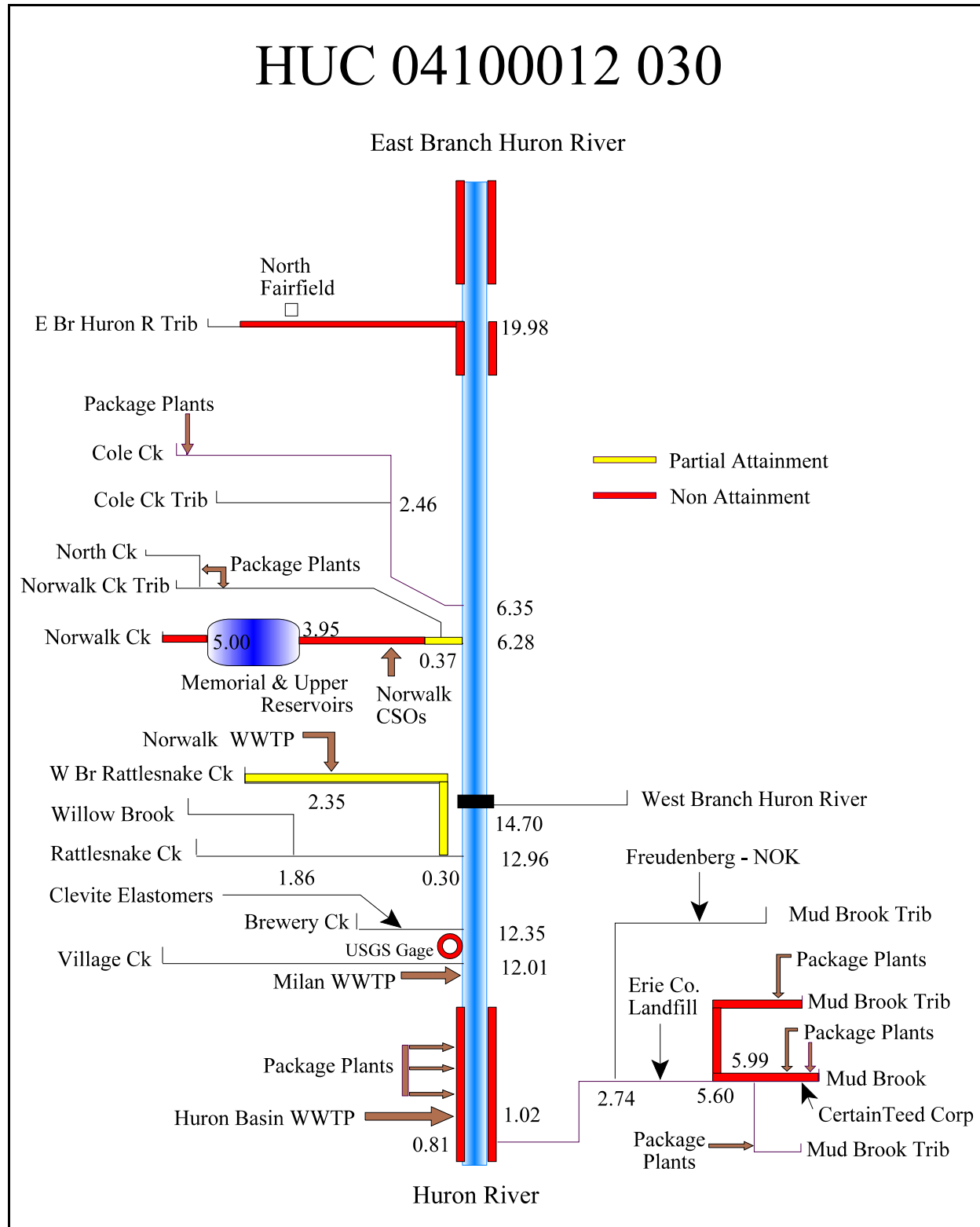


Figure 5. Attainment Status Schematic of Assessment Unit 030 (AU3)

In the remainder of this section, the individual stream segments and sub-watersheds in AU3 below failing to fully meet their existing and recommended beneficial uses are discussed in some detail.

East Branch Huron River

A total of 24.6 miles of the 30.64 mile length of the East Branch Huron River was sampled and assessed as part of the 1998 and 2002 basin surveys. Based on the 1998 biosurvey results, only 1.5 miles (or five percent) of the East Branch Huron River were in full attainment of the WWH aquatic life use designation. Partial attainment was indicated for the remaining 23.1 miles (or 93.9 percent). However, results based upon resampling in 2002 found significant improvement, particularly among fish populations. Non attainment of WWH was limited to the extreme headwaters where the flow is intermittent and a localized reach impacted by an apparent pesticide spill. Full attainment in the East Branch increased from five percent in 1998 to 77 percent in 2002.

Based on 1998 results, the associated causes and sources for aquatic life use impairment were not entirely clear. Nearly every indicator of environmental quality fell within acceptable ranges; only total phosphorus was found elevated (>1.0 mg/l). Also, dissolved oxygen concentrations in the upper reaches of the East Branch were skewed to high values (maximum of 15 mg/l at RM 21.0), suggesting an enrichment effect. Partial attainment of the WWH biocriteria was due to the failure of the fish community to consistently meet the prescribed biocriterion. The pervasive departure from WWH was possibly a result of generally deficient macrohabitat quality, compounded by modest nutrient enrichment.¹¹

In 2002, East Branch community health varied considerably at some locations, but primarily indicated a significant improving trend. In contrast to 1998, fish communities performed at or above the WWH benchmark throughout the entire length of the East Branch. Macroinvertebrates generally maintained good to exceptional quality during both sampling years with two pronounced exceptions:

- First, poor quality communities in the headwaters (RM 24.7) were severely impacted by intermittent flow and a die off of extensive algal mats in the open channel near State Road. Re-establishment of a woody riparian border would benefit this section of stream.
- Second, macroinvertebrate communities recovered to full attainment by RM 21.0 (SR 162), but experienced additional, severe impacts at RM 19.1, (Hanville Corners Rd.) downstream from an apparent pesticide spill in the East Branch Tributary @ RM 19.98. Elevated DDTs and endosulfan sulfate were detected in both the East Branch Tributary and East Branch sediments collected downstream. Impacts to

¹¹ Concentrations of total phosphorous as low as 0.06 mg/l have been shown to negatively impact lotic communities (Miltner and Rankin, 1998).

fish communities were limited to the tributary, but the macroinvertebrate results suggest toxic impacts from the “spill” extended for at least a mile downstream from the confluence.

Overall, the results from the 2002 investigation were uncharacteristically divergent from the 1998 survey data. Improvements in the performance of the fish community were indicated throughout, bringing this group into correspondence with the WWH biocriterion. Concurrently, the performance of the macrobenthos remained relatively stable with the exception of the intermittent headwaters and the site downstream from the suspected pesticide spill. This represents a reversal in the pattern of ambient biological performance documented in 1998, where impairment was due solely to a failure of the fish community to meet the WWH biocriterion. The primary causes of these significant changes are largely unknown. These results are all the more puzzling given that, outside of modest nutrient enrichment, no firm or compelling cause or causes for the initial impairments were identified in 1998. The changes in fish community performance were systemic, evident at most sites throughout the length of the East Branch. Normal or natural temporal variation is excluded as a possible explanation for this trend. Analysis of Ohio’s state-wide reference site re-sampling efforts has shown the persistent and stable nature of riverine aquatic communities through time in the absence of an emergent stressor.

East Branch Huron River Tributary @ RM 19.98

This East Branch tributary drains agricultural lands upstream from the village of North Fairfield. In addition to standard row crop agriculture, specialty crop production (vegetables) and orchards are also located upstream. The cultivation of these specialty crops often requires the use of pesticides different from those applied to traditional agricultural areas.

A large fish kill and very poor macroinvertebrate communities were encountered in the tributary during 2002 sampling. Sediment sampling detected endosulfan sulfate and high DDT levels. Follow-up sampling found reduced levels of these contaminants in sediment samples collected 8 months later and fish were seen in the stream, an indication of recovery. These observations suggest that the severe biological impacts in 2002 resulted from a single sudden exposure to a large quantity of toxic contaminants, such as a pesticide spill, rather than chronic exposure to an existing or continuing source of toxicity. Extensive algal mats observed in open canopied areas suggest nutrient enrichment may be an additional, underlying problem in the tributary.

Norwalk Creek

Norwalk Creek is a direct tributary to the East Branch Huron River, joining the mainstem at RM 6.28. The stream originates in the rural, agricultural landscape, then flows through and drains the southern half of the City of Norwalk. As the creek enters Norwalk, stream flow is captured and diverted for domestic use through two upground

reservoirs before over-flowing into Norwalk Creek at RM 3.95. Flow from these impoundments can also be directed or pumped to a third impoundment where the water supply intake is located. The City can completely control the reservoir overflow to Norwalk Creek at RM 3.95, but the downstream flows appear augmented by groundwater infiltration; even when there is no reservoir release, the Norwalk Creek streambed downstream from the spillway does not dry up.

Based on the performance of the fish and benthic macroinvertebrate communities, the entire length of the Norwalk Creek was found to be impaired. However, causes and sources of impairment were sharply different between the upper, agricultural influenced reach (upstream RM 5.0) and the lower, urban influenced section, downstream from Norwalk and the Norwalk reservoirs.

Ambient biological performance upstream from Norwalk was suggestive of modest nutrient enrichment. Water quality analysis reinforced this observation as phosphorus was found to be elevated. Agricultural enrichment, exacerbated by small stream size appeared to be the principal associated stressor upstream from Norwalk.

Community performance at RM 1.8 (S. Pleasant St. in Norwalk) was characterized as fair and phosphorus remained elevated. Multiple stressors, in addition to those identified upstream, appeared operative within this reach, and in combination depressed community performance. These stressors included modified stream habitat, releases from CSOs, urban runoff, and upstream reservoirs. Although incomplete, recovery was indicated near the mouth (downstream from Norwalk) as all but one of the community indices met the WWH biological criteria, and all water quality parameters remained in acceptable ranges.

Huron River Mainstem

A total of 14.5 miles of the Huron River (mainstem) was sampled and assessed as part of the 1998 basin survey from the Milan Wildlife Area to Lake Erie. Sampling in 2002 was limited to a single site in the upper reaches of the mainstem at RM 14.5.

The simplification of instream habitat (e.g., channel development, gradient, substrate composition) associated with the transition of the Huron River, from the high gradient upper reaches to the low gradient Lake Plain was abrupt. Good to excellent stream habitat upstream of RM 9.8 – characterized by a diverse channel morphology, good stream flow, and an abundance of coarse substrates - was replaced in the lower segment of the Huron River mainstem by monotonous conditions, mainly pooled areas with heavy deposits of fine sediment. Fully attaining aquatic communities were contained exclusively within the upper, free-flowing segment near Milan from RM 9.8 to RM 14.7.

Aquatic life use impairment was documented through the lower segment, and appeared associated with severely deficient riverine habitat, as the Huron River enters and courses through the lacustrine deposits of Lake Plain. Given a very low gradient (<1.4

ft./mile) and the periodic seiche effects from Lake Erie, turnover or flushing rates through the lower Huron River appeared very low, allowing the accumulation of nutrients and sediments from discrete and diffuse upstream sources. This resulted in eutrophic conditions. Stimulated algal activity was clearly evidenced by a highly variable dissolved oxygen regime, as instream concentrations were found to range between 4.2 mg/l and 13.0 mg/l. These data were the result of multiple day-time grab samples, and thus likely underestimated dissolved oxygen depletion after sunset.

The input of treated wastewater from the Huron Basin WWTP and other minor POTWs (via Mud Brook) appeared to be secondary factors to the combined influences of deficient habitat and nutrient loads from upstream sources in determining the biological health of the lower Huron River mainstem. This conclusion was based on the observation that nutrients, solids and parameters representing oxygen demand displayed a longitudinal step-wise increase in concentration well before, and in fact peaked upstream from these entities. These data appeared consistent with limited turnover or flushing rates through the lower Huron River. Furthermore, the concentrations of these parameters was markedly reduced closer to the mouth, as the Huron River joined and subsequently mixed with the waters of Lake Erie.

Ammonia-N was divergent from the pattern described above for the other parameters, in that concentrations continued to rise through the lower mile. Rather than diminishing, as observed for the other water quality parameters, ammonia-N reached its highest observed concentrations downstream from these POTWs. Although no water quality violations or exceedances of the ammonia-N criteria for WHH were documented, the rise appeared associated the aforementioned POTWs, and corresponded with the lowest dissolved oxygen concentrations observed on the mainstem.¹²

The rise in ammonia-N above background levels began at approximately RM 3.0 (well upstream from the Huron Basin WWTP. This trend may have been a result of ammonification of excess nitrogen in the channel, associated with the eutrophic conditions that characterized the lower ten miles of the Huron mainstem. The Huron Basin WWTP and small POTWs in Mud Brook may have served as additional sources of nitrogen to the lower mile of the Huron, and may, periodically, export loadings upstream through the action of a seiche. The apparent longitudinal increase in the concentration of ammonia-N beginning at RM 3.0, may have been related to one, or some combination of these factors. Resolution of the source(s), fate, and ultimate effect of the ammonia-N observed through the lower three river miles of the Huron River could not be conclusively deduced at present. However, it is clear that ambient biological performance precipitously declined at approximately RM 10.0, corresponding with the entry of the Huron River into the Lake Plain. By and large, biological performance continued a steady incremental decline through the lower ten miles before discharging into Lake Erie. Furthermore, direct and indirect non-biological evidence of significant

¹² Excessive ammonia-N can directly and indirectly affect the dissolved oxygen regime of surface waters.

nutrient enrichment and degraded physical habitat were abundant well over six miles upstream from the first known point source of pollution.

Ultimately, the effects of habitat homogeneity, sedimentation, nutrient enrichment, and flow attenuation combined to render the lower Huron River impaired. Effluents released by the Huron Basin WWTP, and possibly lesser sources of pollution via Mud Brook, likely served only to exacerbate the conditions for the lower mile. Taking into account the potential influence of a sieche, the affected reach may at times extend upstream to include a total of approximately three river miles. Currently, the Huron Basin WWTP is working to eliminate sewage overflows and increase ammonia removal by July 2006.

Mud Brook

Mud Brook is a tributary to the Huron River that enters the lacustrine at RM 0.81. Due to limited sampling resources, the evaluation of Mud Brook was based solely on water column and sediment sampling in 1998. The principal sampling objectives were to evaluate the influence of several small WWTPs (located within the headwaters), and the Erie County Landfill.

Water quality criteria exceedances for ammonia and phosphorus concentrations well in excess of the 1.0 mg/l phosphorus guideline were indicative of inadequately treated sewage at the uppermost sampling station (RM 6.25, Mason Rd.). The impacted water quality appeared directly related to the small package plants in the headwaters. Additional evidence supporting the culpability of these small facilities included numerous and frequent violations of their respective NPDES permit limits.

Plans are currently under design by the Erie County Commissioners to extend sanitary sewers to the State Route 250/Mason Road area of the package plants within the next two years. Wastewater would be transported to the Erie County Huron Basin WWTP for treatment. Ohio EPA will continue to regulate all package plants under the terms and conditions of their NPDES permits until they are abandoned and facilities are connected to the regional sanitary sewer system. (See Chapter 6, Section 6.2.3.)

The results from sediment sampling indicated little, if any off-site contamination from the Erie County Landfill. Organic contaminants occurred at concentrations well below method detection limits, and with the exception of aluminum, sediment metals were ranked as non-elevated or only slightly elevated. Aluminum was elevated both upstream and downstream from the landfill and thus, may have reflected background conditions or regional norms.

West Branch Rattlesnake Creek

The entire length of the West Branch Rattlesnake Creek failed to support the WWH aquatic life use designation in 1998. Numerous environmental stressors combined to render the West Branch impaired. Upstream from the Norwalk WWTP, degraded

physical habitat, urban runoff, and nutrients were identified as the primary associated stressors, characterized through the performance of habitat and water quality indicators. Similar factors appeared to cause negative impacts downstream from the WWTP, however, these deficiencies were exacerbated by effluents from the Norwalk WWTP and CSO releases.

Water quality exceedances for selected metals and high phosphorus were detected downstream from the plant although these concentrations were related to a single isolated incident, probably a storm event. Monthly operating report data from the Norwalk WWTP revealed very few NPDES violations, and with the exception of two grab samples high in total residual chlorine, bioassays found the effluent was not acutely toxic in 1998 and 2003. The facility is an obvious source of nitrogen, as effluent nitrate concentrations as high as 20.5 mg/l have been recorded. Additionally, septic and petroleum odors, and apparent sewage solids have been documented in West Branch Rattlesnake Creek as far as a mile downstream from the WWTP, possibly a result of CSO discharges.

3.0 PROBLEM STATEMENT

The goal of the TMDL process is full attainment of the Water Quality Standards established for aquatic life and recreation uses summarized in **Table 4**. As presented in Chapter 2, aquatic life uses are impaired to some degree in each of the assessment units of the Huron River watershed. The major causes for non attainment of aquatic life uses are excessive nutrients, sedimentation, habitat degradation, flow alteration, and organic enrichment, which are all interrelated.

Nutrients

Except under unusual circumstances, nutrients rarely approach concentrations in the ambient environment that are toxic to aquatic life. *Quality Criteria for Water* concluded that “levels of nitrate nitrogen at or below 90 mg/l would not have [direct] adverse effects on warmwater fish” (U.S. EPA, 1976). However, nutrients, while essential to the functioning of healthy aquatic ecosystems, can have negative effects at much lower concentrations by:

- altering trophic dynamics
- increasing algal and macrophyte production (Sharpely *et al.*, 1994)
- increasing turbidity (via increased phytoplanktonic algal production)
- decreasing average dissolved oxygen concentrations
- increasing fluctuations in daily dissolved oxygen and pH.

Such changes are caused by excessive nutrient concentrations creating shifts in species composition away from functional assemblages of intolerant species, benthic insectivores and top carnivores (e.g., darters, insectivorous minnows, redhorse, sunfish, and black basses) typical of high quality warmwater streams towards less desirable assemblages of tolerant species, niche generalists, omnivores, and detritivores (e.g., creek chub, bluntnose minnow, white sucker, carp, green sunfish) typical of degraded warmwater streams (OEPA, 1999). In some segments of the Huron River watershed, nutrient concentrations as characterized by phosphorus and nitrogen parameters are excessive in comparison with statewide data from unimpaired streams. Other indicators of nutrient enrichment problems that have been documented in impaired stream segments include: depressed dissolved oxygen levels and wide diel swings, excessive algae, and trophic species shifts.

Habitat

The effects of nutrient enrichment are exacerbated by poor physical habitat; conversely, high quality habitat can mitigate those effects. High quality riverine habitats with intact riparian zones and natural channel morphology may decrease the potentially adverse effects of nutrients by assimilating excess nutrients directly into plant biomass (e.g., trees and macrophytes), by sequestering nutrients into invertebrate and vertebrate

biomass, by “deflecting” nutrients into the immediate riparian zone during runoff events (see reviews by Malanson, 1993; Barling and Moore, 1994), and by reducing sunlight through shading which is a principal limiting factor in algal production. Also, high quality habitats minimize nutrient retention time in the water column during *low flows* because they tend to have high flow velocities in narrow low flow channels (e.g., unbraided vs. braided riffles), and coarse substrates with little potential for adsorption. Additionally, a healthy community of aquatic organisms typical of high quality habitats process and utilize nutrients very efficiently.

Poor quality habitat with reduced or debilitated riparian zones (either no riparian zone is present or runoff bypasses the zone via field tiles) and simplified channel morphology generally exacerbate the deleterious effects of nutrients. Under these circumstances, several conditions are likely to influence the severity of the nutrient impact, including:

- a reduction of the riparian uptake and conversion of nutrients
- an increased retention time for nutrients through increased sediment-water column interface via a wide channel and subsequent loss of low flow energy (e.g., increased intermittency)
- a retention of nutrients within the channel due to diminished filtering time during overland flow events
- allowing full sunlight to stimulate nuisance growths of algae.

These factors also interact to increase the retention of nutrients attached to fine sediments, and in planktonic and attached algae (OEPA, 1999). As expected, low gradient streams, are more susceptible to the effects of nutrients because of longer nutrient and sediment retention times. An example in the Huron River watershed is the sluggish, lake affected section of the lower mainstem between Milan and Lake Erie.

Sediment

Sediment flux in and out of an ecosystem is a natural process. When deposition exceeds export, however, degradation of habitat may result. Sediment deposited on the streambed fills interstitial spaces within the substrate, eliminating the niche in which bottom-dwelling organisms reside. Because phosphorus is delivered to streams attached to fine particles, low gradient streams with a high bedload of fine sediment also provide more time for the available phosphorus to be utilized in undesirable ways such as the production of excess algal biomass, thus promoting tolerant and omnivorous organisms and circumventing assimilation among multiple species and trophic levels (OEPA, 1999).

Excessive sedimentation or siltation was a common cause of impairment in the Huron basin and was initially documented on the QHEI, stream habitat evaluation sheets. **Table 8** lists the 11 streams in the Huron River basin where siltation was listed as a moderate to high cause of impairment with the associated QHEI notation concerning the magnitude of deposition (moderate to heavy). Other related habitat features such as land use, embeddedness, channel development, riparian width, etc. are also included.

Table 8. Huron Basin Streams in Non or Partial Attainment where Siltation was Listed as a Moderate or High Cause of Impairment.

Note: Habitat feature descriptions are based on QHEI (fish) or macroinvertebrate field sheet entries (1998-2002).

Stream	Attainment	Land Use	Siltation	Channel	Embeddedness	Riparian
Assessment Unit 1 (AU1) - Upper West Branch Huron River basin: Headwaters to Slate Run						
W. Br. Huron R. (RM 47.5)	PARTIAL	Row crop	Mod.-Heavy	Channelized, Recovering	Mod.-Extensive	Mod.-None
Shiloh Ditch	PARTIAL	Row crop	Mod.-Heavy	Channelized, Recovering-Recent/ no recovery	Mod.-Extensive	Wide-None
Marsh Run (RM 7.9)	PARTIAL	Row crop	Mod.-Heavy	Channelized, Recovering-Recent/ no recovery	Mod.-Extensive	V. Narrow
Jacob's Creek and Branches	NON	Ust./Dst. WWTP Urban	Moderate	Channelized, Recovered/ Recovering	Mod.-Extensive	Mod.-Wide
			Primarily sand/embeddedness opposed to fine silt.			
Holiday Lake Trib.	NON	Dst. Holiday Lake	Normal-Mod.	Channelized, Recovered/ Recovering	Extensive (sand)	Wide
			Primarily sand/embeddedness opposed to fine silt.			
Unnamed Trib. to Holiday Lake Trib.	NON	Forest Residential	Mod.-Heavy	Channelized, Recent/ no recovery	Mod.-Extensive (silt/sand)	Wide-V. Narrow
Assessment Unit 2 (AU2) - Lower West Branch Huron River basin: Slate Run to mouth						
E. Br. Mud Run	NON	Row crop	Mod.-Heavy	Channelized, Recent/ no recovery	Mod.-Extensive	Mod - V. Narrow
Trib. to Frink Run	PARTIAL	Row crop	Mod.-Heavy	Channelized, Recovering	Mod.-Extensive	Mod-Narrow
Assessment Unit 3 (AU3) - Huron River and East Branch Huron River basins						
E. Br. Huron R. (RM 24.7)	PARTIAL 1998 NON 2002	Row Crop	Normal-Mod. (heavy muck/ dead algae nr. bridge in 2002)	Channelized, Recovering (1998) Recovered (2002)	Normal-Mod. 1998 Moderate 2002	V. Narrow
			Siltation impacts secondary to severe intermittence/ enrichment in 2002 (macroinvertebrates)			

Table 8. Huron Basin Streams in Non or Partial Attainment where Siltation was Listed as a Moderate or High Cause of Impairment.

Note: Habitat feature descriptions are based on QHEI (fish) or macroinvertebrate field sheet entries (1998-2002).

Stream	Attainment	Land Use	Siltation	Channel	Embeddedness	Riparian
E. Br. Huron R. (RM 21.0)	PARTIAL 1998 FULL 2002	Row crop	Mod.-Heavy	Channelized, Recent/ no recovery	Mod.-Extensive	Wide- V. Narrow
			Significant habitat improvement in 2002 (FULL attain.)			
West Branch Rattlesnake Cr. (RM 2.4)	PARTIAL	Ust. WWTP, Urban	Mod.-Heavy	Channelized, Recent/ no recovery	Extensive	None- V. Narrow
(RM 1.4)	PARTIAL	Dst. WWTP, Ag./residential	Extensive (macroinverts.)	None- recovering	Moderate	Wide-none
			Primarily sand/embeddedness opposed to fine silt.			
Huron River (RMs 9.8-0.0)	NON	Lacustuary Row crop	Very Silty	Channelized, lake effect	Extensive	Mostly Narrow

Silt-impaired sites were almost exclusively listed as having moderate to heavy siltation. Most affected sites were also located in small agricultural landscapes of less than 20 square miles, had moderate to extensive levels of embeddedness, were channelized or formerly modified, and often had narrow or incomplete riparian corridors.

Flow Alteration and Channelization

Flow modification and habitat alteration through channelization can exacerbate the effects of sedimentation. Flow modification describes any alteration to a stream's natural flow regime such as upstream impoundments, irrigation withdrawals, or agricultural field tiling. Channelization is the removal of trees from stream banks coupled with deepening and often straightening the stream course, and is a direct cause of sedimentation. Channelization increases both the amount of sediment trapped by downstream impoundments the amount of sedimentation resulting from bank erosion. In addition, channelization and tiling to expedite drainage also result in the loss or reduction of sustained stream flow, and less flow for a given drainage area means less assimilative capacity from a pollutant loadings standpoint.

Habitat alterations, such as channel modification and the denuding of riparian zones, can also have detrimental effects upon instream dissolved oxygen (D.O.) concentrations. Denuding riparian zones increases the water temperature which lowers D.O. solubility. Channelized streams affect D.O. concentrations by limiting the potential for atmospheric re-aeration. Atmospheric re-aeration occurs more readily in faster-moving, highly agitated stream segments. Streams with high-quality pool/riffle

complexes are more agitated than channelized streams lacking such natural characteristics. Water flowing through a quality riffle consisting of variable substrate effectively stirs oxygen into the stream.

Portions of the Huron River stream network were historically modified and some continue to be maintained in a modified state to facilitate rapid drainage for rowcrop production. Rowcrop agriculture accounts for 62 percent of the land use in the watershed while the second greatest land use, pastureland, accounts for 18 percent of the watershed. Agricultural activities remain the major source of habitat degradation responsible for non attainment of aquatic life uses in many of the tributaries.

Organic Enrichment

Consistently low D.O. is often symptomatic of organic enrichment. Organic enrichment usually occurs with loadings of putrescible material to the stream that increase the oxygen demand. Elevated nutrient levels (particularly phosphorus) which result in detrimentally high algal production can lead to organic enrichment when the subsequent algal die-off supports oxygen consumptive microorganisms. Excessive ammonia-N loading throws the equilibrium between the various forms of nitrogen out of balance, and results in a significant increase in nitrification, which is highly consumptive of D.O.

The macroinvertebrate community is highly sensitive to organic enrichment and examination of species composition can specifically indicate this type of impairment. Impacts to macroinvertebrates may include shifts in community composition to populations of organisms tolerant of organic wastes, the elimination or reduction of pollution sensitive forms, reductions in population diversity, and sharp increases in densities of pollution tolerant forms. (Hilsenoff, 1987 and 1988) Most often, the sources of organic enrichment include inadequately treated sanitary wastewater discharges from WWTPs, combined sewer overflows (CSOs), and home sewage treatment systems (HSTs), or runoff from land applied manure.

Parameters Selected for Total Maximum Daily Load Development

The parameters selected for Total Maximum Daily Load development are: **habitat** (including **flow** and **sedimentation**), **total suspended solids**, **nitrite+nitrate**, and **total phosphorus**.

Rather than develop sediment mass loadings or flow augmentation budgets, which would be infeasible with the information available, the Qualitative Habitat Evaluation Index (QHEI) will be used as a comprehensive measurement of these and other intrinsically linked physical features which act together to promote or preclude aquatic life use attainment. Specifically, aggregate QHEI scores are delineated as numerical habitat (including flow and sediment) goals.

D.O. impairment is attributable to organic enrichment and/or nutrient enrichment and can be exacerbated by habitat alteration. However, D.O. is not a parameter for which an allowable load can be calculated. Considering the cause and effect relationship between the sources of pollutants that contribute to oxygen demand in the stream and the D.O. related impairment in the Huron River study area, the following TMDL development strategy was employed:

- Where runoff is the source of D.O. impairment, the reduction of nutrient loading from the runoff is necessary to improve D.O. levels.
- Where an unsewered area is the source of D.O. impairment, the reduction of ammonia and nutrient loading is needed to improve D.O. levels.
- Where point source discharges are the source of D.O. impairment, the load of oxygen-demanding substances must be reduced to improve D.O. levels.
- In segments that are affected by multiple stressors (including habitat alteration), improvement is reliant upon a combination of these load reductions and restoration goals.

3.1 Target Identification

The establishment of instream numeric targets is a significant component of the TMDL process. The numeric targets serve as a measure of comparison between observed instream conditions and conditions that are expected to restore the designated uses of the segment. The TMDL identifies the load reductions and other actions that are necessary to meet the target, thus resulting in the attainment of applicable water quality standards.

3.1.1 Habitat (Sedimentation)

Various habitat quality attributes including stream flow are strongly correlated with the health of aquatic communities, but are not parameters for which allowable loads are normally calculated. Conversely, although sediment loads can be inferred from parameters such as total suspended solids (TSS), the relationship between this surrogate measurement and aquatic life use attainment is less predictable. To address habitat and sedimentation, Ohio EPA has previously utilized Qualitative Habitat Evaluation Index (QHEI) scores as target values, analogous to the concept of load based assimilative capacity for TMDL development and implementation.

The QHEI is a stream habitat assessment tool developed by the Ohio EPA (Rankin, 1989). It is a composite score ranging from 18 to 100 summed from six physical habitat categories. These are: substrate, instream cover, riparian characteristics, channel characteristics, pool/riffle quality, and gradient/drainage area. Each of these categories are subdivided into specific attributes that are assigned a point value reflective of the attribute's association with aquatic life. High scores are assigned to attributes correlated with high biological integrity and low scores are progressively assigned to

less desirable habitat features. **Appendix H** shows the categories, attributes, and scores that make up the index. Ohio EPA QHEI assessments are conducted by trained investigators at every watershed sampling location in conjunction with biological monitoring. Ohio EPA has completed more than 20,000 QHEI assessments since the mid 1980's. Although some minor improvements have been instituted, the fundamental categories and scoring techniques are essentially unchanged. Subsequently, the data underpinning any single QHEI determination is appreciable. The association between aquatic life use attainment and QHEI scores is as strong as the correlation between any other stress agent.

The TMDL process assumes achievement of adopted targets computed from modeling equations will coincide with aquatic life use attainment. Progressive stressor load *reductions* are expected to yield incremental gains toward use attainment. In this way, use of QHEI scores as TMDL targets may be regarded as a parallel concept analogous with the targets construed from pollutant loading calculations. However, QHEI scores embody both positive and negative attributes and an overall *increasing* value is correlated with higher biological integrity. A total QHEI score of greater than or equal to 60 implies habitat conditions are conducive to WWH aquatic life use attainment and is an appropriate target.

Alternatively, QHEI scores in the 40's are considered poor to fair. Under these conditions, habitat is not only insufficient to offer WWH communities the basic rudiments for existence, it effectively acts to prevent biological performance consistent with that use. QHEI scores in that range result from:

- silty, embedded substrates
- channel morphology homogeneity
- limited flow attributes
- functionless cover
- inadequate riparian conditions
- in a general sense, from too much human modification of the stream course and immediate land use

When habitat conditions are degraded to this level, the aquatic community is unable to withstand impacts, the period of recovery from a sporadic impairment is protracted, and the aspect which is most germane to TMDL development – reduction of a particular pollutant load – will have little measurable biological effect as long as habitat conditions remain below the threshold that is correlated with WWH attainment in Ohio.

Substrate Sub-Scores as Restoration Targets

Results from the 1998 and 2002 surveys of the Huron River watershed found 13 water bodies either heavily or moderately impacted by siltation. Substrate sub-score target values were developed for these waters to serve as restoration end points. These data were taken directly from the evaluation of physical habitat contained within the QHEI. As sedimentation is the primary or secondary cause of aquatic life use impairment for

these impacted waters, employing the resulting QHEI score in its entirety as a target or stated goal would not yield the accuracy needed. The effects of other, non-substrate, components of physical habitat on the resulting score could undervalue or diminish a specific evaluation of the changes in substrate composition, and the degree of embeddedness, which are the principle agents of environmental damage associated with sedimentation.

Therefore, rather than relying on the QHEI score, the substrate metric contained within the QHEI, was broken out to be used independently. Additionally, specific substrate attributes within the substrate metric itself were also employed to describe existing (impacted) conditions and to establish restorative goals. The measure of overall siltation and overall substrate embeddedness were both used to this end. This additional extraction of substrate information was needed to further rarefy the description of substrate conditions and to set meaningful and measurable goals. Just as the entire QHEI score employed as a monitoring tool may conceal important changes in any of the underlying metrics, the aggregate substrate metric may mask important changes in the condition of the stream bed. Compensatory substrate features such as substrate diversity, substrate origin, or dominance of large coarse material may, in the aggregate, result in an adequate overall substrate score. However, these positive features may be rendered functionless, if embedded by fine clays and silts. It is for this reason that important components of the substrate metric, namely siltation and embeddedness, were treated separately. (Development of substrate targets is discussed on page 50.)

3.1.2 Total Suspended Solids (Sedimentation)

Ohio EPA does not have a WQS for suspended sediment or total suspended solids because their effect is dependent on numerous stream variables such as gradient. Since Ohio lies within both glaciated and unglaciated geology, it has a range of ecoregions, and thus its streams vary greatly. High gradient streams in the unglaciated portion of Ohio can withstand a greater sediment load than a low gradient stream in the glaciated portion simply because it can transport the sediment out at a higher rate.

In order to develop a target for total suspended solids which can be used as a surrogate for suspended sediment, potential TSS target values were extracted from categorical analyses of chemical, physical, and ambient biological data collected from Ohio's Ecoregional reference stations (Ohio EPA 1999). These sites represent least impacted reference, or background conditions for all physiographic provinces within the State, and form the backbone of Ohio's robust monitoring and assessment program.

The regional reference approach advocated and practiced by the Ohio EPA provides for an objective delineation of "natural" background conditions for waters of the State, not only for ambient biological performance, but water column and sediment chemistry as well.

The development and maintenance of the reference site data base, and regular re-sampling of specific reference stations has allowed Ohio EPA to empirically derive TMDL restorative targets as needed for waters impacted by novel, unregulated or otherwise poorly-studied pollutants. The power of these regional data lies in the fact that they represent real-world observations from least or minimally impacted surface waters. Furthermore, through frequency analysis, the association of chemical data with ambient biological performance allows the development of a *range* of in-stream concentrations, concurrent with discrete categories of environmental quality (e.g., exceptional, good, fair, and poor) or aquatic life use attainment status (e.g., full, partial or non). An additional benefit of this approach is that target values derived in this manner have built-in or inherent margins of safety, as they represent regional background conditions directly linked with ambient biological performance.

Despite the intrinsic value and power of a regional reference approach for selecting TMDL targets, the principal question regarding TSS in the context of the Huron River is not the validity of the associated reference data. Instead, it is the appropriateness of the use of TSS as an indirect measure of sedimentation. Gray, *et al.* (2000), found the relationship between TSS and sediment deposition imperfect. The weakness of the correlation between the two is the result of important variables that have a direct bearing on sedimentation (e.g., flood plain geometry, gradient, particle size and type of solid, and frequency of turbid flows), but are not captured by, or controlled for, in a simple measure of suspended solids. These and other hydrologic and fluvial features likely account for the large uncertainty or error in predicting sediment deposition by TSS. However, in the absence of other widely available and cost effective analytical measures, the use of TSS as a proxy for sedimentation in the context of TMDL development is not untenable or unreasonable, provided appropriate caution is applied and uncertainties are fully accounted for in the selection of a restoration target. In order to account for the possibility of significant error in estimating sedimentation from TSS measurements, a discussion of the stringency of TSS targets derived from regional data and final recommendations is presented below.

A conservative target¹³ possesses a greater likelihood of successful abatement of documented sedimentation problems, as it represents the central tendency of regional reference conditions. Implementation of measures that would be required to meet a stringent TSS target in an attempt to bring impacted waters in-line with typical regional reference stations would undoubtedly reduce gross sediment loads significantly. However, the associated costs of achieving substantially lower in-stream TSS values are not trivial. Due to the weak predictive power of the TSS/sedimentation relationship, the inferred environmental benefit (i.e., abatement of sedimentation impacts) may not be proportional to reduced in-stream TSS values. Additionally, and of equal importance, predicted environmental benefits may be disproportional to associated cost, and may, in effect, represent a poor return on the expenditure of scarce environmental dollars. There is a real danger of recommending costly and overly aggressive

¹³ A conservative target in this context is considered to be less than or equal to the 50th percentile of reference site values.

landscape remedies that may fail to achieve the desired outcome. Conversely, these efforts might result in the restoration of the impaired waters, but possibly through superfluous or excessive “treatment,” when a higher target (75th or 90th percentile of reference condition) may have achieved identical or similar results. All of these risks stem from our inability to confidently predict in-stream sedimentation from TSS.

The probability of successful abatement of sediment problems with a more liberal target of less than or equal to the 75th percentile of reference condition, decreases with increasing deviation above the regional median or central tendency of reference conditions. Higher TSS values associated with more liberal targets approximate thresholds or maximum TSS concentrations concurrent with WWH communities.

The most apparent risk associated with a liberal target is that it may underestimate the needed reduction in sediment delivered from the landscape, and thus fail to achieve the desired effect of reduced in-stream sedimentation sufficient to restore impaired waters. However, increased likelihood of unsuccessful abatement must be balanced with lower cost and effort associated with a more liberal TSS target. The initial capital outlay and necessary outreach efforts to gain voluntary compliance among the various rural stakeholders would be less than those associated with more stringent recommendations.

Given the limited power of TSS to serve as a proxy measure for sedimentation, it would seem reasonable and prudent to recommend higher target TSS values as a first step, as required actions on the landscape are less onerous for watershed residents using the higher target values. If the target is found inadequate or under-protective, it can easily be adjusted and re-evaluated as part of the iterative process built into TMDL development. Initiating sediment reduction efforts with a liberal target allows the flexibility to work from higher allowable concentrations to lower concentrations, if needed, rather than front loading the process from the start with a stringent and more costly target of uncertain efficacy. Under this scenario, a defacto incremental analysis may be conducted over time on an ad hoc basis, thus ensuring that target values and efforts needed to meet them are commensurate with environmental benefit.

The Huron River watershed spans portions of the Huron Erie Lake Plain (30 percent), and Eastern Corn Belt Plains (70 percent) ecoregions. The weighted averages of the 90th percentiles of the reference sites draining 200 to 1000 square miles within these ecoregions is 66.0 mg/l. This value was used as the target to calculate the necessary TSS reductions in all of the Huron River basin assessment units.

3.1.3 Nutrients: Total Phosphorus and NO₂+NO₃

Phosphorus was identified as a nutrient causing impairment in the Huron watershed. While the Ohio EPA does not currently have statewide numeric criteria for phosphorus, potential targets have been identified in a technical report titled *Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams* (Ohio EPA, 1999). This document provides the results of a study analyzing the effects of nutrients on the aquatic assemblages of Ohio streams and rivers. The study reaches a number of conclusions and stresses the importance of habitat and other factors, in addition to instream nutrient concentrations, as having an impact on the health of biologic communities. The study also includes proposed phosphorus target concentrations based on observed concentrations associated with acceptable ranges of biological community performance within each ecoregion. The total phosphorus targets are shown in **Table 9**. It is important to note that these nutrient targets are not codified in Ohio's water quality standards; therefore, there is a certain degree of flexibility as to how they can be used in a TMDL setting.

Table 9. Nutrient Targets (in mg/l)

Watershed Size	Targets by Use Designation	
	WWH ¹	MWH
<u>Phosphorus</u>		
Eastern Corn Belt Plains Criteria (ECBP)		
Headwaters (drainage area < 20 mi ²) (H)	0.07	0.58
Wadeable (20 mi ² < drainage area < 200 mi ²) (W)	0.11	0.22
Small Rivers (200 mi ² < drainage area < 1000 mi ²)	0.16	0.25
Huron Erie Lake Plain (HELP)		
Headwaters (drainage area < 20 mi ²) (H)	0.08	0.42
Wadeable (20 mi ² < drainage area < 200 mi ²) (W)	0.11 ²	0.33
Small Rivers (200 mi ² < drainage area < 1000 mi ²)	0.17	0.25
<u>NO₂+NO₃</u>		
for all ecoregions and drainage areas	1.5	

¹ No HELP data available, statewide criteria are used instead.

² No HELP data available; ECBP criteria used instead (less restrictive than statewide criteria).

Ohio's standards also include narrative criteria which limit the quantity of nutrients which may enter waters. Specifically, Ohio Administrative Code (OAC) Rule 3745-1-04 (E) states that all waters of the state shall be free from nutrients entering the waters as a result of human activity in concentrations that create nuisance growths of aquatic weeds and algae. In addition, OAC Rule 3745-1-04(D) states that all waters of the state shall be free from substances entering the waters as a result of human activity in concentrations that are toxic or harmful to human, animal, or aquatic life and/or are rapidly lethal in the mixing zone. Excess concentrations of nutrients that contribute to non-attainment of biological criteria may fall under either OAC Rule 3745-1-04 (D) or (E) prohibitions.

Using the same technical report identified on the previous page, targets for NO₂+NO₃ were developed as shown in Table 9. A value of 1.5 mg/l was used for all ecoregions and drainage areas.

3.2 Current Deviation from Targets

The difference between observed instream conditions and the numeric targets established in **Section 3.1** assists in determining the load reduction or other actions that are necessary to restore the designated uses in impaired areas of the watershed. The deviation from target translates to the percent reduction in load required to meet target conditions, which is then used in calculating the TMDL that will protect aquatic life and other beneficial uses.

3.2.1 Habitat and Sedimentation

Ohio EPA utilizes the QHEI to assess stream habitat quality including sediment and flow characteristics. The QHEI is best used in a macro-scale approach to evaluate the habitat components of a stream reach or a sub-basin, as opposed to the characteristics of a single sampling site. As such, an individual site may have poor physical habitat due to localized disturbance or may seem to be an oasis of outstanding attributes yet the biological performance at that location will reflect the prevailing habitat conditions in the watershed network. Thus, it is important to consider aggregate QHEI scores to understand how the various component scores may exert site specific influences.

It is most useful to consider habitat data on a drainage area basis. Headwater streams (drainage area less than 20 square miles) tend to reflect the immediate land use. Instead of regarding these streams as linear entities, it is more pragmatic to appreciate them as a product of the upstream and adjacent landscape. On the other hand, it may be prudent to evaluate linear data for large streams or rivers (drainage area greater than 50 square miles) which are often able to assimilate a local perturbation with minimal consequence.

Average QHEI scores above 60 for stream reaches or sub-basins are generally conducive to WWH aquatic life use attainment. **Figure 6** below illustrates QHEI scores from the three Huron River basin watershed assessment units for two distinct aquatic habitats: small streams, less than 20 square miles; and larger streams, greater than 20 square miles (range 20-380, excluding the lacustrine of the Huron River mainstem).

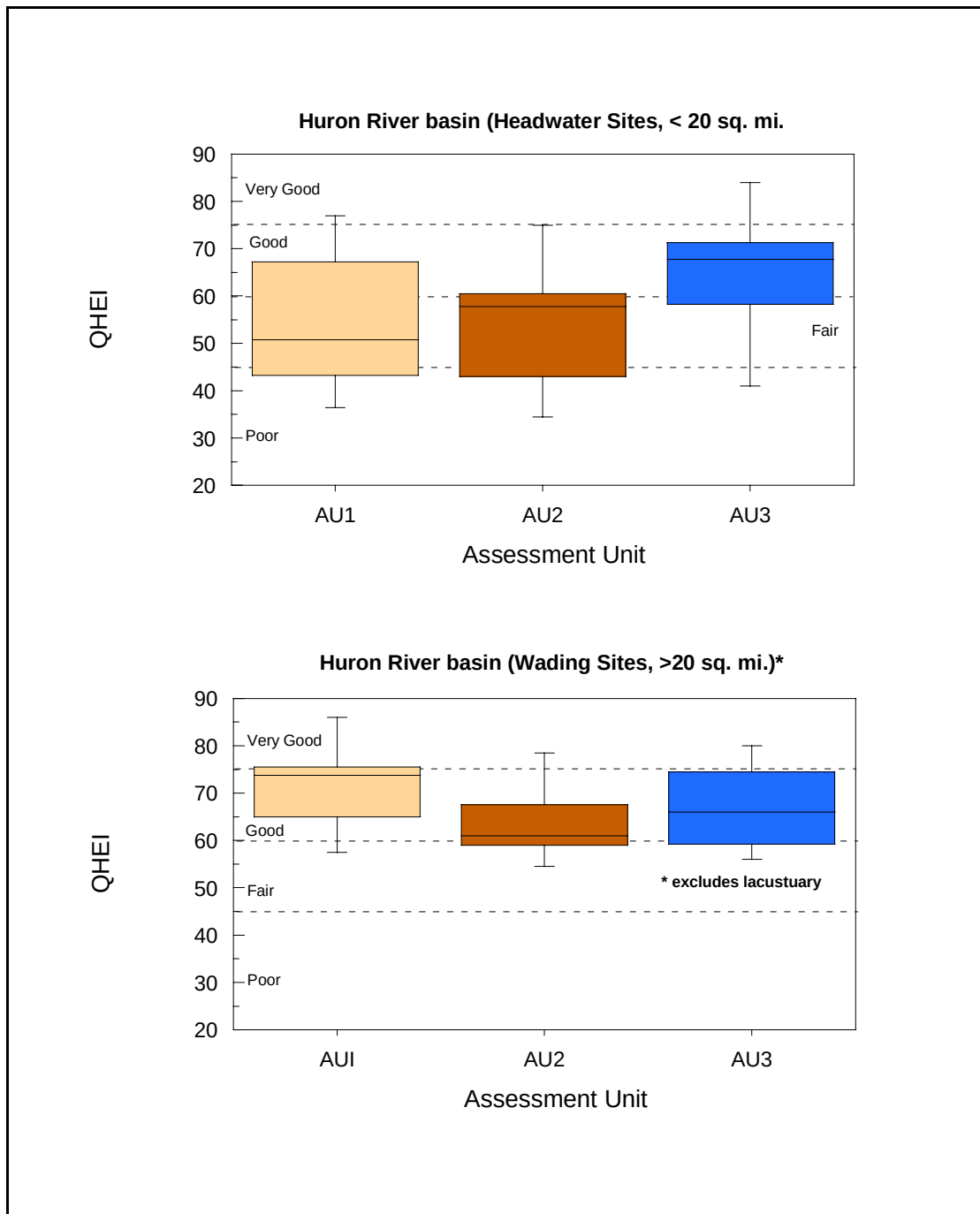


Figure 6. Box and Whisker Plots of QHEI Scores from Sample Locations by Drainage Area and Assessment Unit: 1998 and 2002.

The boxes and “whisker” lines surrounding each box in **Figure 6** represent various percentile values for the QHEI scores in each assessment unit. The horizontal line inside each box represents the median value, while the top and bottom of each box shows the 75th and 25th percentiles, respectively. The whisker lines (or plots) above and below each box represents the 90th and 10th percentile values, respectively.

The median QHEI values for the sites in each assessment unit have been compared to the QHEI TMDL target score of QHEI=60. As seen in **Figure 6**, small streams in AU1 and AU2 which drained less than 20 square miles deviated the most from the target. The median QHEI scores in AU1 and AU2 were 50.75 and 57.75, respectively. Scores lower than the QHEI target were generally associated with excessive siltation, substrate embeddedness, historic channel modification with limited recovery, and a general lack of wooded riparian vegetation. Of the sites visited, only the middle reaches of Marsh Run near Celeryville and upper Clayton Ditch are under active ditch maintenance.

Among 20 pertinent biological sample locations, the median QHEI score in AU1 (Upper West Branch Huron River) and AU2 (Lower West Branch Huron River) was 52. Approximately one quarter of the sites displayed habitat attributes deemed clearly sufficient for WWH aquatic life use (QHEI > 60), while one-fourth harbored poor aquatic habitat (25th percentile=43). In contrast, most small streams in AU3 (East Branch Huron and Huron River mainstem) had good habitat quality, capable of supporting WWH communities, with a median QHEI equal to 67.75 and the 25th percentile QHEI score equal to 58. Comparatively better quality in AU3 appears related to the somewhat higher relief and stream gradient in the eastern portion of the basin and somewhat less intensive row crop agriculture.

Physical habitat in Huron River basin streams greater than 20 square miles (excluding the lacustrary) was good throughout the study area. (See **Figure 6**.) Biological impairment associated with habitat at these sites was rare and primarily related to locally channelized segments (*i.e.*, West Branch Huron River at Baum Rd.), natural habitat limitation associated with extensive bedrock outcroppings (*i.e.*, lower Slate Run), or limited recovery from historic channelization and ongoing channel maintenance upstream (*i.e.*, lower Marsh Run).

Compared to many other extensively modified stream systems in the northern and northwestern portions of the state, the level of habitat impairment in the Huron basin is not particularly severe. Also, most impairment is primarily limited to smaller headwater drainages (less than 20 square miles). The larger branches have generally maintained intact stream habitat and riparian borders and are able to assimilate or entrain excess nutrient and silt loadings from nonpoint sources upstream. Widespread but relatively modest habitat impairment in the headwaters is mostly attributable to the lack of large scale, “petition ditch” stream maintenance programs in the basin (an exception being Marsh Run in the Celeryville horticultural area). Most historically-modified streams in the area have shown at least some recovery as re-channelization has not occurred in recent years. Other factors that are beneficial to streams in the Huron basin are the relatively high stream gradients, and a continuous flow throughout the year in most of the small drainages. Also, much of the southern-most headwaters of the East and

West Branches are underlain by glacial moraine deposits that tend to buffer the impacts associated with past modification activity.

In order to provide some direction regarding the relative amount of habitat improvement needed, median QHEI scores from 1998 and 2002, stratified by sub-basin drainage area, are presented in **Table 10**. The deviation from the QHEI target is expressed as an absolute score and as a percentage. Review of **Table 10** attests that median habitat conditions in AU1 deviate by 15 percent from the QHEI target for less than 20 square mile drainage area streams. Proportionally less mitigation is necessary to improve the small-sized stream habitat conditions in AU2 (5 percent), but this small deviation is somewhat misleading. As shown in **Figure 6**, habitat quality at most AU2 sites fell in the fair to poor ranges with both the median and 75th percentile scores near or below the target level. Excessive siltation, embeddedness, low gradient and historic modification were the primary reasons for the modest scores.

Table 10. QHEI Scores and Deviation from Targets

Assessment Unit		Drainage Area (square miles)	
		< 20 Square Miles	> 20 Square Miles
<i>AU1 (Upper West Branch Huron River basin)</i>			
Median QHEI		50.8	73.8
Deviation	Score	9.2	--
	%	15.3	--
<i>AU2 (Lower West Branch Huron River basin)</i>			
Median QHEI		57.8	61
Deviation	Score	3.2	--
	%	5.3	--
<i>AU3 (East Branch Huron and Huron River mainstem basins)</i>			
Median QHEI		67.8	67.3
Deviation	Score	--	--
	%	--	--

Unlike AU2, habitat quality in AU3 was consistently above target level with approximately 75 percent of scores falling above target levels. However, due to resource constraints, small stream sampling in 1998-2002 included few sites in the lacustrine deposit portion of AU3 between Milan and Lake Erie in Erie County. Many of these streams, with a notable exception being Mud Brook, have been modified for agricultural drainage or to prevent flooding and likely exhibit more severe levels of

habitat degradation than was found in the tributaries to the East Branch and upper Huron mainstem.

Development of Substrate Targets and Deviation from Targets

Overall substrate targets were developed following the method used in the *Sandusky River TMDL* (Ohio EPA, 2004). Water bodies designated as WWH were given a substrate target of 12.5 (out of a possible score of 20). A substrate target of 10 was assigned to waters designated MWH. Measures of both siltation and embeddedness contained within the substrate metric of the QHEI consist of four narrative categories. Each of the four categories are given a numeric value (positive, negative or null), contributing to or diminishing the cumulative substrate score.

For the purposes of target derivation, departure from the QHEI scoring criteria was necessary, and proxy numeric values were assigned to each of the four categories, ranging between 0 and 3. A value of zero corresponds to the lowest evaluation, and represents a heavily silted or extensively embedded stream. A value of three corresponds to the highest possible state, silt free or not embedded. WWH targets for siltation and embeddedness were developed by calculating the average of the two intermediate narrative categories (1 and 2). MWH targets were calculated similarly, the target being the average of the two lowest categories (0 and 1). Existing substrate conditions, associated targets, and deviation from targets for primary and secondary sediment impacts within the Huron River basin are presented in **Tables 11** and **12**.

Table 11. Substrates Scores, Substrate Targets, and Deviation from Target

Note: Data in this table includes only streams identified as being heavily or moderately impacted by sedimentation in Huron River Basin, 1998-2002.

Assessment Unit/ Waterbody	Aquatic Life Use	Substrate Score	Substrate Target	Deviation from Target
AU 1: West Branch Huron River (Headwaters to Slate Run)				
W. Branch Huron River (RM 47.5) [OH84201]	WWH	9.0	12.5	-3.5 (28%)
Shiloh Ditch (RM 0.1) [OH8418]	MWH	10.0	10.0	0.0(target met)
Marsh Run (RM 7.9) [OH8416]	WWH	10.0	12.5	-2.5(20%)
(RM 3.7)	MWH	11.0	10	+1.0(target exceeded)
(RM 0.2)	WWH	13.0	12.5	+0.5(target exceeded)

Table 11. Substrates Scores, Substrate Targets, and Deviation from Target

Note: Data in this table includes only streams identified as being heavily or moderately impacted by sedimentation in Huron River Basin, 1998-2002.

Assessment Unit/ Waterbody	Aquatic Life Use	Substrate Score	Substrate Target	Deviation from Target
Marsh Run Trib. (@RM3.2) [OH8419.1]	MWH	12.0	10.0	+2(target exceeded)
Jacobs Creek (RM 0.6) [OH8421]	WWH	12.0	12.5	-0.5(4%)
W. Branch Jacobs Creek (RM 1.5) [OH8421]	WWH	12.0	12.5	-0.5(4%)
Holiday Lake Trib. [aka W. Br. Trib. @ RM 23.09 (RM 3.0)] [OH8418.2]	WWH	16.0	12.5	+3.5(target exceeded)
Trib. To Holiday Lake Trib. (RM 0.3) [OH8418.21]	WWH	14.5	12.5	+2.0(target exceeded)
AU 2: West Branch Huron River (Slate Run to East Branch Huron River)				
East Branch Mud Run (RM 1.4) [OH8415]	WWH	5.0	12.5	-7.5(60%)
West Branch Mud Run (RM 0.6) [OH8416]	WWH	9.5	12.5	-3.0(24%)
Frink Run Trib. (RM 5.83) [OH8411.1]	MWH	10.0	10.0	0.0 (target met)
AU3: Huron River and East Branch Huron River				
E. Branch Huron^a River (RM 24.7) [OH8407]	WWH	10.5	12.5	-2.0(16%)
West Branch^b Rattlesnake Creek (RM 0.3) [OH843.1]	WWH	9.8	12.5	-2.7(21.6%)
a - Most current (2002) habitat data used to derive substrate score. b - Mean substrate score from both 1998 sampling stations.				

Table 12. Siltation and Overall Embeddedness Score, Restoration Targets, and Deviation from Targets

Note: Data in this table includes only streams identified as being heavily or moderately impacted by sedimentation in Huron River Basin, 1998-2002.

Assessment Unit Waterbody	Aquatic Life Use	Silt/Embeddedness ^a Score	Respective Target Values ^b	Deviation from Target
AU 1: West Branch Huron River (Headwaters to Slate Run)				
W. Branch Huron River (RM 47.5) [OH84201]	WWH	0.0/0.5	1.5	-1.5/-1.0
Shiloh Ditch (RM 0.1) [OH8418]	MWH	0.5/0.5	0.5	0.0/0.0 (targets met)
Marsh Run (RM 7.9) [OH8416]	WWH	0.5/0.0	1.5	-1.0/-1.5
(RM 3.7)	MWH	1.0/1.0	0.5	+1/+1 (target exceeded)
(RM 0.2)	WWH	1.0/1.0	1.5	-0.5/-0.5
Marsh Run Trib. (@RM3.2) [OH8419.1]	MWH	1.0/1.0	0.5	+0.5/+0.5 (target exceeded)
Jacobs Creek (RM 0.6) [OH8421]	WWH	1.0/0.0	1.5	-0.5/-1.5
W. Branch Jacobs Creek (RM 1.5) [OH8421]	WWH	1.0/1.0	1.5	-0.5/-0.5
Holiday Lake Trib. [aka W. Br. Trib. @ RM 23.09 (RM 3.0)] [OH8418.2]	WWH	1.5/0.0	1.5	0.0/-1.5 (target met for silt)
Trib. To Holiday Lake Trib. (RM 0.3) [OH8418.21]	WWH	2/2	1.5	+0.5/+0.5 (target exceeded)
AU 2: West Branch Huron River (Slate Run to East Branch Huron River)				
East Branch Mud Run (RM 1.4) [OH8415]	WWH	0.5/0.5	1.5	-1.0/-1.0

Table 12. Siltation and Overall Embeddedness Score, Restoration Targets, and Deviation from Targets

Note: Data in this table includes only streams identified as being heavily or moderately impacted by sedimentation in Huron River Basin, 1998-2002.

Assessment Unit Waterbody	Aquatic Life Use	Silt/Embeddedness ^a Score	Respective Target Values ^b	Deviation from Target
West Branch Mud Run (RM 0.6) [OH8416]	WWH	1.0/1.0	1.5	-0.5/-0.5
Frink Run Trib. (RM 5.83) [OH8411.1]	MWH	0.5/0.5	0.5	0.0/0.0 (target met)
AU3: Huron River and East Branch Huron River				
E. Branch Huron^c River (RM 24.7) [OH8407]	WWH	1.0/1.0	1.5	-0.5/-0.5
West Branch^d Rattlesnake Creek (RM 0.3) [OH843.1]	WWH	1.0/1.0	1.5	-0.5/-0.5
a - Both siltation and embeddedness are components of an aggregate substrate score contained within the QHEI. Four narrative categories describe the amount of siltation and overall substrate embeddedness. Within the QHEI, each is ascribed a numerical value (positive, negative or null), contributing to or diminishing the overall substrate metric score. For the purpose of target derivation, proxy numeric values were assigned to each of the four categories, ranging between 0-3. b - WWH targets for siltation and embeddedness were estimated by calculating the average (proxy number) between the two intermediate categories (1 and 2). MWH targets for siltation and embeddedness were estimated by calculating the average (proxy number) between the two lowest categories (0 and 1). c - Most current (2002) habitat data used to derive siltation and embeddedness score. d - Mean substrate score from both 1998 sampling stations.				

3.2.2 Total Suspended Solids

The SWAT model was used by Tetra Tech, Inc. for Ohio EPA to quantify the existing loading from three causes of water quality impairments, including total suspended solids (TSS), nitrite+nitrate, and phosphorus, and to determine the necessary reduction of each to eliminate the impairments. A summary of the SWAT modeling results can be found in **Section 4.1.2** in Chapter 4, and can be found in detail in **Appendix C**.

SWAT modeling results which simulate the existing TSS load for each assessment unit (AU) were calibrated with observed TSS data from Ohio EPA water quality monitoring stations. The model performed best at stations which drained the largest drainage

areas. Therefore, it is considered acceptable to use model output from each of the large assessment units in the development of the TMDL. Because the development of the TSS target was consistent with a large drainage area approach, using only data from reference sites draining from 200 to 1000 square miles, a comparison between the model output and the TSS target is also appropriate.

Table 13 below presents the existing TSS loading in each of the three Huron River Basin Assessment Units based on SWAT model output, the target loading for each AU, calculated using the TSS target concentration of 66 mg/l, and the deviation from target, which equates to the percent reduction needed to improve water quality and restore aquatic life uses.

Table 13. Total Suspended Solids Loading and Deviation from Target

Assessment Unit	Existing TSS Loading ¹ (1000 kg/yr)	Target TSS Loading ² (1000 kg/yr)	Deviation from Target ³
Assessment Unit 1 (AU1) Upper W Br Huron River basin: Headwaters to Slate Run	3,740	1,890	49%
Assessment Unit 2 (AU2) Lower W Br Huron River basin: Slate Run to mouth	6,190	3,150	49%
Assessment Unit 3 (AU3) Huron River and E Br Huron River basins	9,100	3,170	65%

¹ Simulated loading based on SWAT model output for each assessment unit.

² Calculated from SWAT modeled flow for each assessment unit and TSS target concentration of 66 mg/l.

³ The deviation from target is represented as the percent reduction from the existing loading that would be required to meet the target loading.

3.2.3 Nutrients: Total Phosphorus and NO₂+NO₃

Table 14 lists the stream segments in each AU where nutrient enrichment (in the form of phosphorus) was identified as a cause of impairment. For each assessment unit (HUC11), the 75th percentile instream observed phosphorus concentration from the nutrient impaired streams in the AU was compared to the target phosphorus concentration to determine the deviation from target. By using the 75th percentile, phosphorus reductions should provide better protection from concentrations that are the result of rainfall events. The deviation from target of the median instream observed phosphorus concentration is also presented for comparison. **Table 15** reports a similar evaluation for NO₂+NO₃.

Phosphorus and NO₂+NO₃ loadings in the Huron basin were also evaluated for each assessment unit using the Soil Water Assessment Tool (SWAT) model. (See Chapter 4.) Results of this analysis helped to identify proportional contributions from the various sources of phosphorus in the watershed. This information was then used to determine which implementation practices will most effectively reduce phosphorus to meet target levels.

Table 14. Instream Total Phosphorus Values and Deviation from Target

Stream	Number of Observations	Instream Observed: TP (mg/l)				Target	Median Deviation from Target ¹	75 th %tile Deviation from Target ¹
		Min	Max	Median	75 th %tile			
AU1 (HUC 010)								
W Br Huron R (RM 53.2 -35.84)	35	0.07	2.87	0.17	0.25	0.11	35%	56%
Holiday Lakes Trib	6	0.09	0.56	0.16	0.21	0.07	56%	67%
Jacobs Ck	6	0.12	0.31	0.18	0.20	0.07	61%	65%
W Br Jacobs Ck (ust WWTP)	6	0.15	1.34	0.29	0.32	0.07	76%	78%
Marsh Run	12	0.05	2.14	0.11	0.22	0.11	--	50%
Marsh Run Trib (3.12)	6	0.05	0.07	0.06	0.07	0.07	--	--
W Br Huron R Trib (41.50)	6	0.05	0.08	0.06	0.07	0.07	--	--
Total AU1 nutrient impaired streams ²	77	0.05	2.87	0.15	0.23	0.07	53%	70%
AU2 (HUC 020)								
E Br Mud Run	5	0.10	0.43	0.14	0.19	0.07	50%	63%
W Br Mud Run	5	0.05	0.08	0.06	0.07	0.07	--	--
Frink Run Trib (5.83)	4	0.07	0.27	0.18	0.20	0.58	--	--
Total AU2 nutrient impaired streams ²	14	0.05	0.43	0.11	0.18	0.07	36%	61%
AU3 (HUC 030)								
Huron R	53	0.05	1.30	0.16	0.29	0.17	--	41%
Mud Brook	12	0.21	3.79	0.53	1.33	0.11	79%	92%
W Br Rattlesnake Ck	9	0.12	1.53	0.43	0.93	0.08	81%	92%
E Br Huron R (RM 30.64 - 6.28)	41	0.05	1.80	0.09	0.15	0.11	--	27%
Norwalk Ck	22	0.05	2.12	0.09	0.16	0.07	22%	56%
E Br Huron R Trib (19.98)	3	0.13	0.16	0.15	0.16	0.07	53%	56%
Total AU3 nutrient impaired streams ²	140	0.05	3.79	0.14	0.28	0.11	21%	61%

¹ For each stream listed, the deviation from target is represented as the percent reduction from the median and from the 75th percentile instream concentrations that would be required to meet the target concentration.

² For each Assessment Unit, the statistics presented are based on the instream concentrations from the phosphorus impaired streams in that Assessment Unit (listed). Target for the AU is based on the target which applies to the majority of phosphorus impaired streams.

Table 15. Instream NO₂+NO₃ Values and Deviation from Target

Stream	Number of Observations	Instream Observed: TP (mg/l)				Target	Median Deviation from Target ¹	75 th %tile Deviation from Target ¹
		Min	Max	Median	75 th %tile			
AU1 (HUC 010)								
W Br Huron R (RM 53.2 -35.84)	35	0.10	4.47	0.61	0.78	1.5	--	--
Holiday Lakes Trib	6	0.21	0.81	0.48	0.61	1.5	--	--
Jacobs Ck	6	3.88	8.62	7.40	7.64	1.5	79.7	80.4
W Br Jacobs Ck (ust WWTP)	6	0.70	1.09	0.98	1.02	1.5	--	--
Marsh Run	12	0.10	6.37	0.44	3.36	1.5	--	55.4
Marsh Run Trib (3.12)	6	0.10	2.64	0.12	0.42	1.5	--	--
W Br Huron R Trib (41.50)	6	0.17	1.26	0.44	0.60	1.5	--	--
Total AU1 nutrient impaired streams ²	77	0.10	8.62	0.61	1.09	1.5	--	--
AU2 (HUC 020)								
E Br Mud Run	5	0.30	7.99	2.42	4.06	1.5	38.0	63.1
W Br Mud Run	5	0.10	3.64	0.48	3.17	1.5	--	52.7
Frink Run Trib (5.83)	4	0.10	6.09	0.10	1.60	1.5	--	6.3
Total AU2 nutrient impaired streams ²	14	0.10	7.99	0.56	3.52	1.5	--	57.4
AU3 (HUC 030)								
Huron R	53	0.10	9.71	1.80	2.99	1.5	16.7	49.8
Mud Brook	12	1.70	8.84	5.05	6.98	1.5	70.3	78.5
W Br Rattlesnake Ck	9	0.10	20.50	2.28	12.00	1.5	34.2	87.5
E Br Huron R (RM 30.64 - 6.28)	41	0.10	7.71	0.43	2.08	1.5	--	27.9
Norwalk Ck	22	0.12	4.14	0.51	1.40	1.5	--	--
E Br Huron R Trib (19.98)	3	0.88	11.30	10.00	10.65	1.5	85	85.9
Total AU3 nutrient impaired streams ²	140	0.10	20.50	1.38	3.24	1.5	--	53.7

¹ For each stream listed, the deviation from target is represented as the percent reduction from the median and from the 75th percentile instream concentrations that would be required to meet the target concentration.

² For each Assessment Unit, the statistics presented are based on the instream concentrations from the NO₂+NO₃ impaired streams in that Assessment Unit (listed). Target for the AU is based on the target which applies to the majority of NO₂+NO₃ impaired streams.

4.0 TOTAL MAXIMUM DAILY LOADS

A TMDL provides a mechanism to recommend controls required to meet water quality standards. The TMDL is the sum of the wasteload allocations for the point sources and the load allocations for natural background and nonpoint sources in a watershed. Also included in TMDL calculations is a margin of safety (implicit or explicit) to account for any uncertainty regarding the relationship between pollutant load and water quality. Attainment of water quality standards (WQS) will require a combination of pollutant load reductions and improvement of other conditions such as instream and riparian habitat, cropland and livestock management practices, and stormwater management if they have been identified as causes of impairment.

For the Huron River watershed, some of the major causes of impairment are linked to habitat modifications that are directly and indirectly related to the predominant land use of agriculture. For example, the widespread installation of drainage tiles designed to quickly drain agricultural lands has the undesirable effect of desiccating the headwaters during periods of low precipitation. This lack of flow makes most of the headwater streams in the watershed more susceptible to nutrient enrichment from relatively small pollutant sources.

As mentioned in Chapter 3, the major causes of non-attainment of the aquatic life use are dissolved oxygen/organic enrichment, excessive nutrients, sedimentation, habitat degradation and flow alteration. The attainment of WQS in Ohio requires meeting criteria based on the health of the aquatic biological community (biocriteria). Chemical water quality criteria are established as a surrogate for direct measurement of the aquatic biological community to allow a determination if a particular pollutant is present in amounts that are projected to cause impairment in an aquatic biological community. In the Huron River watershed report, nutrients (nitrite+nitrate and phosphorus) and sedimentation have been targeted for load reductions, and thus, their respective instream chemical concentrations are compared to target concentrations to determine needed reductions.

4.1 Method of Calculation

In order, to quantify basin-wide sediment and nutrient loading, the Soil Water Assessment Tool (SWAT), a midrange model, was used. Load duration curves were used to further assess the SWAT results. For one stream segment on the West Branch, Multi-SMP, a simplified model, was used to assess the effects of a waste water treatment plant on instream dissolved oxygen (D.O.). The requirements of this project are met by the use of the modeling approaches that are summarized in **Table 16**.

Table 16. Modeling Approach Summary

Model or Method	Parameters Analyzed	Goals	How was it used?
Soil Water Assessment Tool (SWAT), Load Duration Curves and Stream Gage Monitoring Data	● Phosphorus ● TSS ● Nitrites+Nitrates	Quantify the total nutrient load in the Huron River and major tributaries. Evaluate and compare nutrient loadings between sub-watersheds and between point and nonpoint sources	● Quantify the existing loads from both point and nonpoint sources. ● To compare the magnitude of necessary load reduction.
Multi-SMP Water Quality Model	● Dissolved Oxygen ● CBOD ● Ammonia	Evaluate the <u>instream</u> water quality under steady flow conditions.	● Determine the loading level that the impaired stream segment can receive and still achieve water quality standards under low flow, critical conditions.
Ecological Assessment Techniques and Models	● Phosphorus ● TSS ● IBI ● ICI ● QHEI ● Substrate ● Instream cover ● Riparian ● quality	Establish targets for parameters with no criteria. Evaluate parameters which are not directly incorporated in the other models. Directly address the biocriteria impairment issues.	● Determine numeric targets for phosphorus and habitat where no criteria exists ● Compare attaining reference sub-watersheds to impaired sub-watersheds in the Huron River basin. Assist in determining needed changes in the impaired sub-watershed ● Determine effects of habitat characteristics on instream concentrations of nutrients, TSS, and D.O..

Due to the variety of conditions that are affecting the streams, several approaches were used to determine the TMDLs for this report. The approaches are as follows:

- Determine that water quality criteria and other numeric targets are achieved in the stream when the stream flow is not rapidly changing. This method was used for D.O. to address the impact of organic enrichment from oxygen-demanding parameters (mainly CBOD and ammonia).
- Determine the nonpoint and point source loading contributions to the stream network. This method determined the annual suspended sediment, phosphorus and nitrite+nitrate (NO₂+NO₃) loads to the stream. Information regarding seasonal variations is also provided. (See **Appendix C.**)

- Establish current habitat and substrate conditions and quantify desired habitat and substrate goals. This method quantifies sedimentation and habitat degradation. (See Chapter 3.)

4.1.1 Multi-SMP: Simplified D.O. Model

As mentioned above, the headwaters are most susceptible to pollutant loads during low stream flow periods, due to lack of dilution flow. In the Huron River mainstem, the Multi-SMP model (a simplified D.O. model) was used to simulate the instream D.O. regime from the headwaters in the West Branch Huron River, downstream of Plymouth (river mile 39.0 to river mile 22.7). The use of a simple D.O. model is applicable in cases where more than 50 percent of the streamflow is due to wastewater plant effluent. Such is the case for this stream reach, which is located in Assessment Unit 0400012-010, or AU1 (or AU10). During critical low flow periods (summer), the effluent flow at the Plymouth WWTP discharge point exceeds the streamflow.

The model was calibrated using data collected by Ohio EPA surveys conducted during summer conditions in 2002 and 2003. Refer to **Appendix I** for detailed results of the Multi-SMP modeling. **Figure 7** shows the results of the D.O. calibration performed for the Huron River downstream of the Plymouth WWTP. The D.O. data was collected under summer conditions. Although a validation survey was not performed, D.O. data collected with submersible monitors (datasondes) during August of the same year reflected the same trends. The average D.O. measured during the August 2003 D.O. survey is shown in **Figure 8** on the following page, and confirms the location of the D.O. sag (RM 38.4) shown in the modeling.

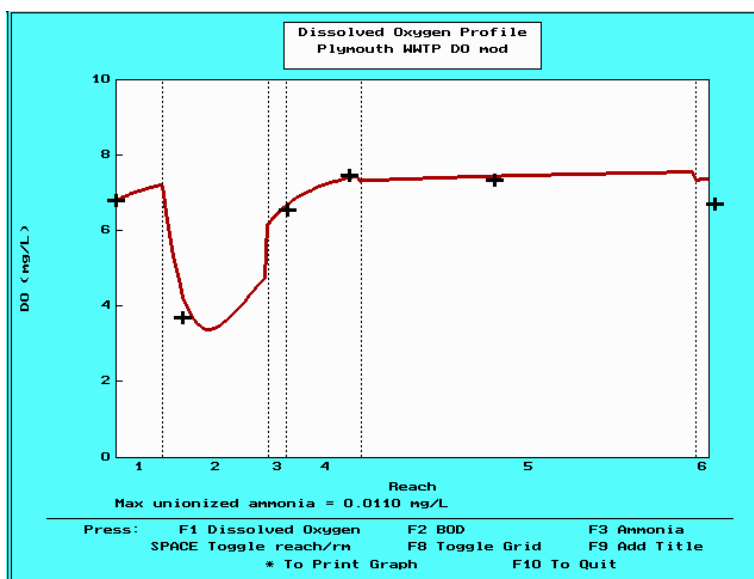


Figure 7. Results of D.O. Calibration Model

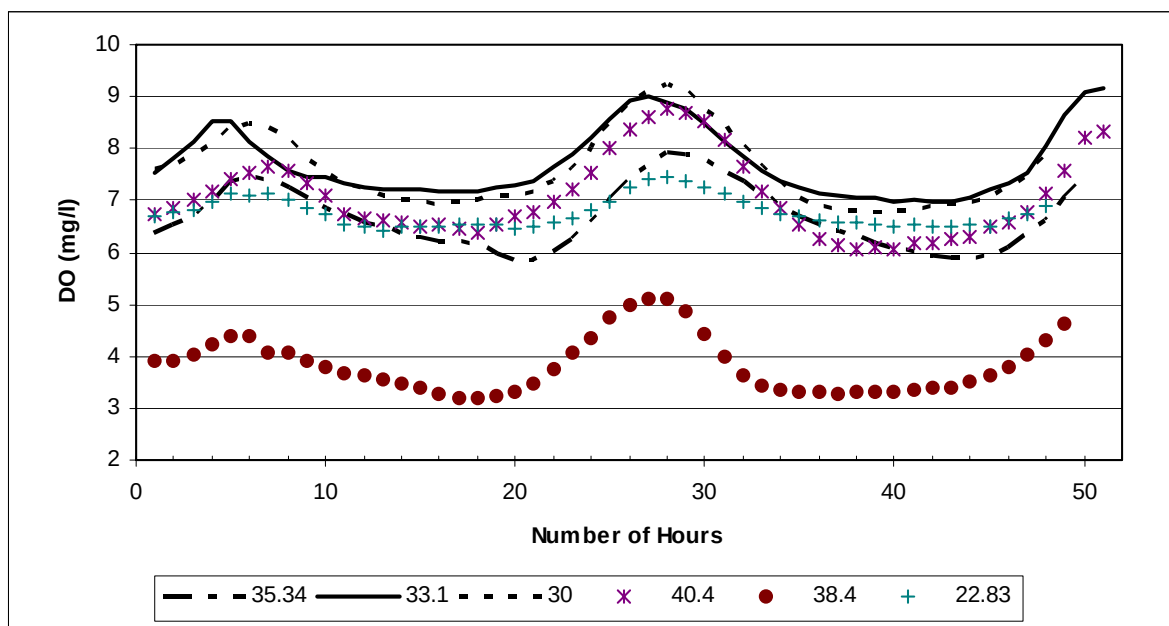


Figure 8. West Branch Huron River: Sonde D.O. Values (8/26/2003 - 8/28/2003)

The calibrated Multi-SMP model for the Huron River was used to simulate water quality under summer and winter 7Q10¹⁴ design conditions. Once calibrated the model inputs were changed to reflect 7Q10 low flow conditions to determine instream D.O. at this critical condition. The response by D.O. to these summer critical conditions is shown in **Figure 9**. As can be seen, the D.O. drops to zero downstream of the Plymouth WWTP. By changing the model inputs for the discharger's D.O., CBOD, and ammonia, new discharger limits can be determined which will raise instream D.O. concentrations to a point where there will not be a D.O. violation during critical conditions. The model-based CBOD, ammonia and D.O. concentrations needed during critical conditions to keep downstream D.O. above the WQS of 5.0 mg/l are shown in **Table 17**. The model results are displayed in **Figure 10**. This figure shows that with the

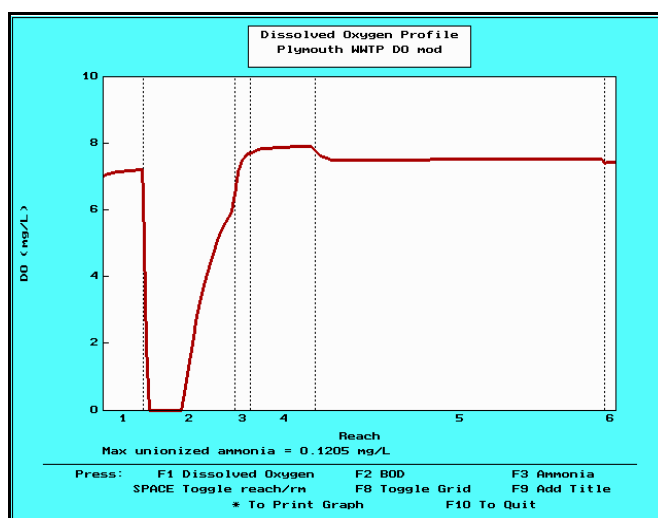


Figure 9. Existing Summer Critical Condition

¹⁴ The 7Q10 flow is a stream flow estimate generally based upon historical data, and is determined to be the low flow which occurs only once every ten years for a period of seven consecutive days.

new more stringent limits, D.O. improves from the existing condition and no longer drops below the D.O. water quality standard of 5.0 mg/l.

Table 17. Existing Conditions and New Permit Limits (all values in mg/l)

Season	CBOD ₅		NH ₃ -N		D.O.	
	Existing	New	Existing	New	Existing	New
Summer	67.2	11.	1.5	1.0	6.1	6.1
Winter	69.7	25.	9.2	9.2	7.4	5.0

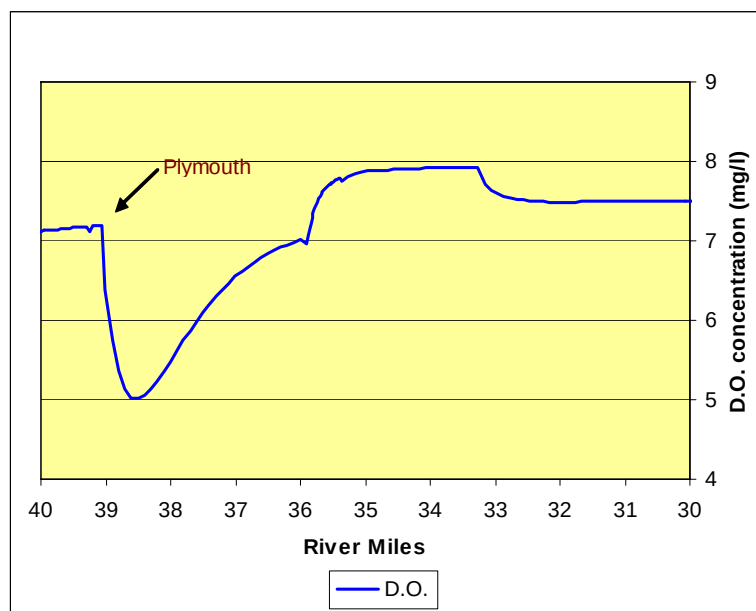


Figure 10. Plymouth WWTP D.O. Profile

4.1.2 SWAT - Suspended Sediment, Phosphorus and Nitrite+Nitrate

The SWAT model was used by Tetra Tech, Inc. in order for Ohio EPA to quantify the existing loading from three causes of water quality impairments, and to determine the necessary reduction of sediments, phosphorus, and nitrite+nitrate in order to eliminate the impairments. The details of the SWAT modeling that are summarized here, can be found in **Appendix C**.

The entire Huron Basin was divided into 3 hydraulic units. The model hydrology was calibrated based on flow data from USGS gage 04199000 at Milan, Ohio and a suite of other information such as erosion, meteorological, reservoir, point source and agricultural practice data. Comparison between the observed versus simulated average monthly flow was good; the correlation between observed and simulated data was $R^2 = 0.86$. The relationship between the observed versus simulated average weekly flow ($R^2 = 0.67$) was not as good as the monthly flow correlation, but was still considered acceptable. Once the hydrology was calibrated, total suspended solids and nutrient (phosphorus and $\text{NO}_2 + \text{NO}_3$) calibration was performed. Since data for total suspended solids exist and data for suspended sediment does not exist, total suspended solids was used as a surrogate for suspended sediment.

Water quality calibration involved the examination of data from 5 sites throughout the basin used by Ohio EPA for water quality monitoring:

- Station 501030 is on the main stem of the Huron River and drains most of the watershed
- Station K01W12 drains a large portion of the West Branch Huron River
- Station K01W22 drains a headwaters portion of the East Branch Huron River
- Station K01P06 drains a headwaters portion of the West Branch Huron River
- Station K01P04 drains the Cole Creek subwatershed

4.1.3 SWAT Conclusions

The model appears to perform better at the stations draining the largest areas (i.e., stations 501030 and K01W12) and has some limitations as applied to the smaller areas. The results are considered acceptable because the TMDL is primarily based on the output for each of the three large Assessment Units.

Several modeling scenarios were run to assess the benefit of various implementation practices on water quality. The practices include: reduced tillage, filter strips, reduced fertilizer application rates, discharger phosphorus limits and combinations of each. The scenario results for nutrients and total suspended solids (TSS) along with the water quality targets and needed reductions are detailed in **Appendix C**. In order to provide implementation choices, fertilizer reduction was examined on two levels: a 10 percent reduction and a 25 percent reduction. The model scenario graphs and reduction tables

in **Appendix C** help to visualize the advantage gained by a 25 percent reduction versus a 10 percent reduction. When the other nutrient reduction methods are combined, there is more instream reduction benefit, but also greater associated costs. Ultimately, the entities who do the corrective actions (implementation) will need to determine which scenario(s) make the most sense and are affordable.

The results of each of the TSS modeling scenarios indicate that the combined reduction will achieve the target in assessment units 10 and 20 but not in assessment unit 30. In order to meet the TSS target in assessment unit 30 a 65 percent reduction in TSS must occur, however, the model predicts only a 50 percent reduction in TSS is achieved by implementing the scenarios considered.

The results of the total phosphorus modeling shows that the target will be achieved in all three (10, 20 and 30) assessment units. In contrast, none of the NO₂+NO₃ loads will meet targets based on the SWAT modeling. This is partially due to the fact that SWAT is limited in its ability to simulate best management practices that might best address NO₂+NO₃ loads. For example, controlling water in drainage tiles has been shown to reduce nitrogen loads by up to 50 percent. (See Section 4.0 in **Appendix C**.) Controlled drainage cannot be simulated by SWAT, but if one assumes that tile control will yield a 50 percent reduction, then implementation of this strategy will result in NO₂+NO₃ loadings meeting the target.

4.1.4 Comparison of Load Duration Curve Results

To further assess the performance of the SWAT model, the target exceedances identified by SWAT were compared to exceedances calculated using load duration curves. Load duration curves are useful because they provide an independent assessment of existing water quality conditions in relation to flow. For the three Assessment Units, the SWAT model shows that total suspended solids and phosphorus targets are exceeded during high flow events, and that NO₂+NO₃ targets are exceeded at various flow levels, which is most likely related to the timing of nitrogen fertilizer application. The load duration curve results demonstrate these same trends.

4.2 Critical Conditions

The SWAT modeling for this report is very detailed and its results are graphically displayed as monthly median values in **Appendix C, Figures 30 - 38**. The fact that the model is so detailed can be misleading because at times peak loads can greatly exceed the target. If the impairments to the Huron River were due to toxic parameters, targets exceeding peaks would be unacceptable, however, the parameters of concern are not toxic. Suspended sediment, phosphorus, and NO₂+NO₃ are chronic causes of impairments, therefore, the concern is focused on long term instream concentrations.

4.2.1 Total Suspended Solids (Sedimentation)

Over time, sediment builds up on the stream bottom, filling in interstitial spaces, covering rocks and woody debris, and ultimately imbedding spaces used by aquatic insects, limiting both the macro-invertebrates and fish potential and thus causing impairment. The destruction of living spaces for insects can cause stress, making them less tolerant and more susceptible to other stressors such as eutrophication (i.e. the consequence of high phosphorus and NO₂+NO₃ loading), or can limit their populations directly by removing habitat or causing death.

Implementation for this project includes reducing suspended sediment through numerous methods, including conservation tillage, filter strips, and by maintaining or adding riparian cover. Reducing suspended sediment will help in two ways by: 1) increasing habitat for insects thus bolstering populations, and 2) reducing phosphorus which comes attached to soil particles. As discussed in Chapter 3, keeping or adding riparian cover will help to reduce soil runoff and reduce sunlight to the stream, thus reducing the availability of two essential ingredients for algal photosynthesis. By reducing sunlight and phosphorus, the effects of algae on D.O. will be reduced.

The critical condition for suspended sediment occurs during storm events. As discussed previously, row crops make up 62 percent of the Huron River basin. The period when fields are tilled and unvegetated becomes the most critical period with regard to suspended sediment. The proposed implementation strategy to increase conservation tillage (tillage reduction) and filter strips works directly toward reducing suspended sediment during this critical period.

4.2.2 Nutrients

Primary productivity of temperate fresh water systems is limited by the availability of nutrients (phosphorus and nitrogen). Phosphorus is naturally scarce, and is the principle limiting nutrient. In other words, productivity is controlled by the amount of available phosphorous. With the exception of a profound or catastrophic nutrient enrichment impact such as some type of spill, the problems faced with nutrients are

often directly linked to habitat quality: physical features (substrate composition, channel morphology, etc.) and condition of the riparian area (degree to which it is vegetated). Nutrients can either be safely assimilated (processed, converted, and attenuated to high value biomass such as trees and agricultural crops) or rapidly converted in to nuisance, low value, biomass such as algae. Macro habitat can control, to a large extent, the ultimate effects of nutrients upon the quality of the affected stream reach.

The effects of enrichment can be complex. Excess phosphorus and NO_2+NO_3 can and do stimulate algal production (both filamentous and phytoplankton), and higher aquatic plants. These organisms have a strong, if not controlling influence, on an aquatic system as the primary source of fixed carbon, and largely control the D.O. regime. Nutrient rich waters will often display a highly variable D.O. regime, controlled by photosynthesis and respiration. D.O. concentrations can range between supersaturation and depletion over a 24-hour period. This can obviously create very stressful conditions for a wide range of aquatic organisms. Also, a classic nutrient enrichment scenario can result in a organic enrichment scenario if there is a die off of vegetable material. The subsequent decay can significantly increase BOD in a manner identical to organic enrichment, ultimately leading to diminished, or depleted D.O.

Phosphorus, especially, and to some extent NO_2+NO_3 , create impairments not by spiking in concentration but by constantly fueling the growth of algae, which lowers oxygen during the dark phase of photosynthesis during which carbon dioxide is produced and oxygen is consumed. The production of algae ultimately leads to the decomposition of dead cells, which also consumes oxygen. Along with high suspended sediment concentrations, phosphorus spikes tend to occur during storm events.

The load duration curve in **Figure 11** (see the following page) demonstrates that the likelihood of an exceedance of targets is greater during high flows. During a storm event, a portion of the phosphorus laden soil particles will flush harmlessly through a stream system but a portion will settle out on to the stream bed. The portion that settles out can later be resuspended into the water column when the sediment is disturbed, thus reintroducing phosphorus to the system (Wade 2001). These sediments may represent a considerable transient storage pool of phosphorus. In a study done on the Illinois River, it was concluded that over 35 percent of the phosphorus transported during surface runoff conditions was likely from resuspension of phosphorus retained by stream sediments (Haggard, 2003). This chronic addition of phosphorus stays in the system and can be utilized by algae. Again, if riparian habitat has been removed, sunlight will add to the problem.

The two critical conditions for phosphorus are high flow when it enters the stream system attached to soil particles, and low flow when it is released into the water column from sediment. Low flow conditions are also critical when point sources exist. Though largely influenced by agriculture, there are 29 mostly small WWTPs which do add phosphorus to the stream system. The low density residential makeup in the basin is only 1.3 percent and high density 0.3 percent. Agriculture is a far more significant source of phosphorus with 61.8 percent row crops and 18.3 percent pasture and hay.

(See **Appendix C, Table 4.**) Though the focus of this report is on phosphorus reduction through agricultural practices, the impact of phosphorus from point sources was considered in the modeling by limiting all permitted dischargers to 1.0 mg/l. The tillage reduction practices mentioned above for the control of suspended sediment has the greatest impact for phosphorus reduction, resulting in reductions of 22, 24, and 19 percent in assessment units (AU) 10, 20, and 30, respectively. Filter strips reduce phosphorus by 15 percent in all three units. (See **Appendix C, Table 12.**) Therefore, the implementation practices used for the suspended sediment critical conditions also apply to phosphorus.

Though phosphorus is the controlling nutrient, NO₂+NO₃ can add to the nutrification of a stream system and thus can add to algae production. Nitrogen readily leaches through soil and into stream systems. Tiling exacerbates the removal of nitrogen from the fields. Spring time before corn planting is the critical period for stream nitrogen. This is addressed in the report with the assumption that drainage tile management can reduce field to stream nitrogen by 50 percent as discussed previously on page 62.

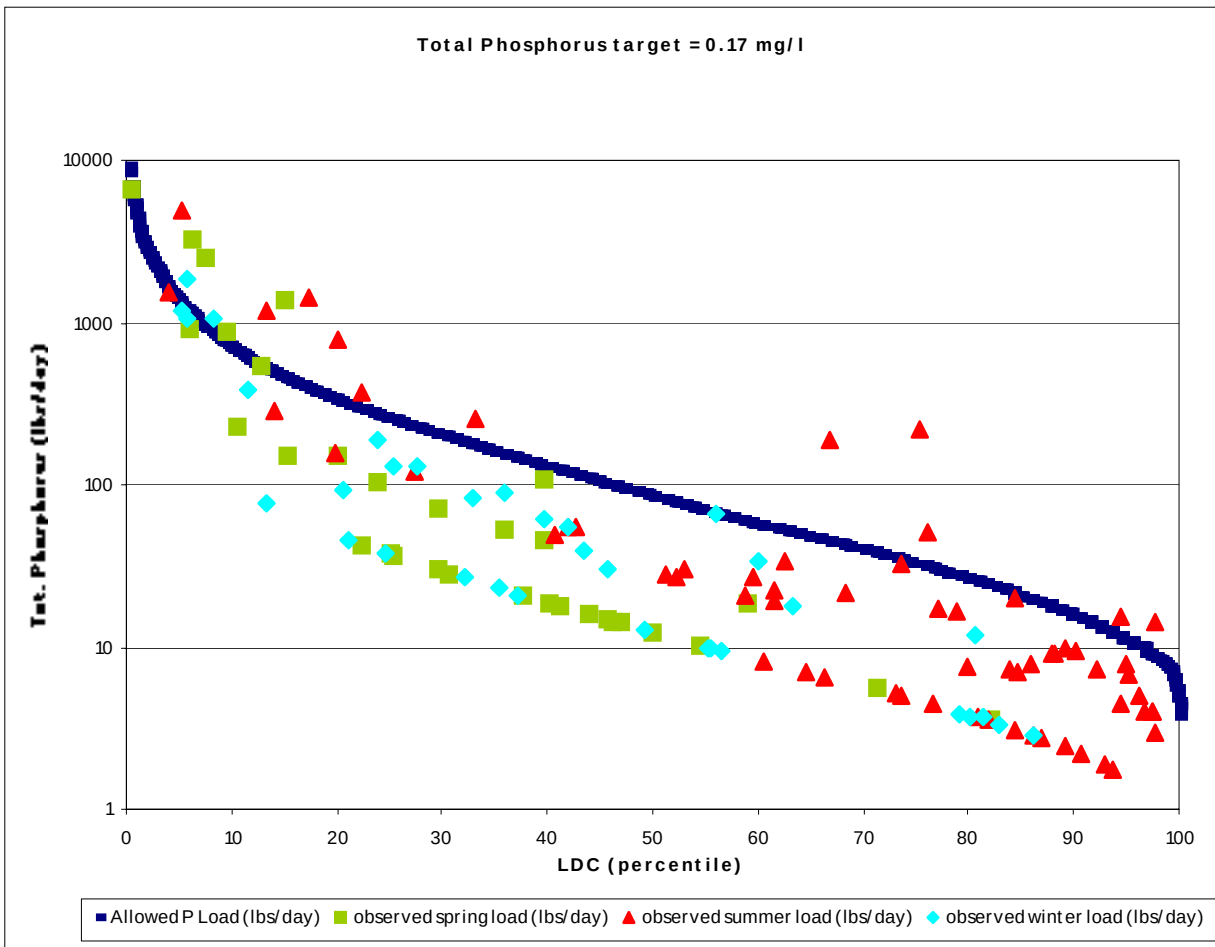


Figure 11. Load Duration Curve for Total Phosphorus (Huron River at Milan USGS Gage)

4.3 Margin of Safety

The statute and regulations require that a TMDL include a margin of safety to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA § 303(d)(1)(C), 40 C.F.R. § 130.7(c)(1)). EPA guidance explains that the margin of safety (MOS) may be: 1) implicit - incorporated into the TMDL through conservative assumptions in the analysis; or 2) explicit - expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

There are several areas where an implicit margin of safety is incorporated, including the 303(d) listing process and the target development process. An explanation for each of these areas is provided below.

4.3.1 TMDL Priority 303(d) Listing

It is important to keep in mind during the evaluation of the TMDL that there is a major difference in Ohio's program from other regional programs. In Ohio, one way a stream segment is listed on the 303(d) list is for failure to attain the appropriate aquatic life use as determined by direct measurement of the aquatic biological community. Many other regional or state programs rely solely on chemical samples in comparison to chemical criteria to determine water quality and designated use attainment. However, relying solely on chemical data does not take into account any of the parameters or other factors for which no criteria exist but that affect stream biology, nor does it account for multiple stressor situations. Therefore, the chemical-specific approach misses many biologically-impaired streams and may not detect a problem until it is severe. Ohio's approach incorporates an increased level of assurance that Ohio's water quality problems are being identified. Likewise, removing a stream segment from the 303(d) list requires attainment of the aquatic life use determined by the direct measurement of the aquatic biological community. This provides a high level of assurance (and an implicit margin of safety) that if the TMDL allocations do not lead to sufficiently improved water quality then the segments remain on the list until true attainment is achieved.

The use of nutrient targets that are based on data from relatively unimpacted reference sites provides an additional implicit safety factor. These data constitute a background concentration of nutrients in a stream; unimpacted streams generally have nutrient levels well below those needed to meet biological water quality standards. As the stream becomes impacted, nutrient levels can rise, but the stream can still meet the water quality standards based on other factors such as the presence of good habitat. Once the nutrient levels rise high enough or other factors change which no longer mitigate the effects of nutrients, then the biological community is impacted, and the stream is impaired. By using nutrient targets based on data from relatively unimpacted sites (i.e., sites that have nutrient concentrations that are in the median range are in

attainment of biological water quality criteria), the targets themselves are set at a conservative level. In other words, water quality attainment is likely to occur at levels higher than these targets and the difference between this actual level where attainment can be achieved and the selected target is an implicit margin of safety.

Another conservative assumption implicit in the target used is that the phosphorus targets for WWH streams were applied for all the tributaries, even though some of the streams (Tributary to Frink Run, Shiloh Ditch, Marsh Run and Tributary to Marsh Run) are recommended for Modified Warmwater Habitat (which have less restrictive targets). If the targets recommended for the MWH segments had been used, a smaller phosphorus reduction would have been recommended.

4.3.2 Total Suspended Solids (Sedimentation)

The development of target values for TSS have inherent **(implicit)** margins of safety based upon the methodology used to derive the targets. See the discussion on page 40 in Chapter 3 for a detailed explanation of the TSS target development and its relation to margin of safety.

4.3.3 Nutrients

Since the entry of total phosphorus into aquatic systems is tied to sediment, that is, phosphorus enters attached to sediment particles, the MOS inherent in the sediment calculations can also be considered an implicit MOS for phosphorus. However, more importantly, the target used for TP is supported by an extensive data base utilizing more than 7500 grab samples for the entire reference site database. Such a database lends itself to confidence in correlative thresholds for various parameters such as TP, thus, the confidence gained by such a strong target foundation lessens the need for a MOS.

4.3.4 Habitat

The habitat targets and the specific aspects of the habitat (riparian and substrate) that are degraded as shown in Chapter 3 add another layer of potential protection to achieving the WQS. They do so by providing additional guidance on alternate means to reduce the nutrient load to the stream and directly improve stream conditions so that an increase in assimilative capacity is possible due to improved ecosystem structure which is vital to the biological community. Ohio EPA's ability to add habitat targets, and provide guidance on the improvement of the habitat is an implicit margin of safety made possible through extensive ecosystem monitoring and analysis, and should be recognized as a margin of safety in these TMDLs.

4.4 TMDL Allocations

As discussed earlier in Chapter 4, TMDLs are composed of the sum of individual wasteload allocations (WLAs) for point sources and general load allocations (LAs) for nonpoint sources and natural background levels. In addition, TMDLs must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, a TMDL can be defined by the equation:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

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

- Current conditions were assessed using the observed data, load duration curves, and the SWAT model (refer to Chapter 3).
- Current conditions were compared to TMDL targets identified for each pollutant (refer to Sections 3.1 and 3.2 in Chapter 3).
- The allowable loads for each pollutant were determined based on existing flow conditions (from SWAT) and the TMDL target concentrations.

The allowable loads were then allocated among point and nonpoint sources and the TMDL allocation results are presented in Table 18, 19, and 20. The estimated existing point and nonpoint source loads (from SWAT) are also presented in the tables so that the magnitude of the load reductions can be determined. The needed reductions from nonpoint sources range from 11 percent for TP in Assessment Unit 30 to 68 percent for TSS (also in Assessment Unit 30). No reductions are specified for point sources because they are already meeting their current permit limits.

The individual WLAs for each facility in the watershed are shown in Table 21 and include estimates of the stormwater loads from communities regulated under the Phase II NPDES Program (i.e., the City of Huron, the City of Willard, the City of Norwalk).

Table 18. Summary of Total Phosphorus TMDL for Huron River Watershed

Component	Assessment Unit (AU)		
	AU 10	AU 20	AU 30
Existing Load (kg/yr)	5,620	8,040	12,520
Loading capacity (kg/yr)	4,210	4,620	11,870
Existing Nonpoint Source Load (kg/Yr)	3,706	7,325	5,978
LA (kg/yr)	2,296	3,905	5,328
LA Reduction	38%	47%	11%
Existing Point Source Load (kg/yr)	1,914	715	6,542
WLA (kg/yr)	1,914	715	6,542
WLA Reduction	0%	0%	0%

Items in **bold** are EPA-approved components.

Table 19. Summary of TSS TMDL for Huron River Watershed

<i>Component</i>	<i>Assessment Unit (AU)</i>		
	<i>AU 10</i>	<i>AU 20</i>	<i>AU 30</i>
Existing Load (1000 kg/yr)	3,740	6,190	9,100
Loading capacity (1000 kg/yr)	1,890	3,150	3,170
Existing Nonpoint Source Load (kg/Yr)	3,599	6,186	8,663
LA (1000 kg/yr)	1,749	3,146	2,733
LA reduction	51%	49%	68%
Existing Point Source Load (1000 kg/yr)	141	4	437
WLA (1000 kg/yr)	141	4	437
WLA allocation reduction	0%	0%	0%

Items in **bold** are EPA-approved components of the TMDL.

The SWAT modeling results summarized in Appendix C demonstrate that several of the identified implementation scenarios are likely to result in meeting the required TSS and TP load reductions. SWAT is not able to model the types of controls necessary to achieve the nitrate+nitrite reductions, but these are also believed to be achievable through the use of available best management practices such as controlled drainage.

Table 20. Summary of Nitrate+Nitrite TMDL for Huron River Watershed

<i>Component</i>	<i>Assessment Unit (AU)</i>		
	<i>AU 10</i>	<i>AU 20</i>	<i>AU 30</i>
Existing Load (kg/yr)	85,710	145,040	246,240
Loading capacity (kg/yr)	59,130	105,420	166,410
Existing Nonpoint Source Load (kg/Yr)	63,489	142,940	182,200
LA (kg/yr)	36,909	103,320	102,370
LA reduction	42%	28%	44%
Existing Point Source Load (kg/yr)	22,221	2,100	64,040
WLA (kg/yr)	22,221	2,100	64,040
WLA allocation reduction	0%	0%	0%

Items in **bold** are EPA-approved components of the TMDL.

Table 21. Individual WLAs for Huron River TMDLs					
AU	OEPA Permit	Facility Name	Sediment (1000kg/yr)	Total Phosphorus (kg/yr)	NO2+NO3 (kg/yr)
10	2IN00135	Huron Co Landfill	<1	<1	<1
10	2IT00001	CSX Transportation - Willard Yard	<1	5	2
10	2PB00014	Plymouth WWTP	16	976	2,300
10	2PD00005	Willard WWTP	25	832	18,177
10	2PT00013	Willard City Schools (New Haven Elementary Sch)	<1	1	2
10	2PY00030	Coble Village MHP	<1	<1	<1
10	2PY00053	Will-O-Brook MHP	<1	<1	<1
10	N/A	City of Willard Phase II Stormwater ^A	100	100	1,740
		Subtotals for AU10	141	1,914	22,221
20	2IG00023	Marathon Ashland Pipeline LLC - Bellevue Terminal	<1	<1	<1
20	2PB00004	Monroeville WWTP	4	715	2,100
		Subtotals for AU20	4	715	2,100
30	2IA00002	CertainTeed Corp - Avery Plant	11	148	40
30	2IF00013	Glidden Co	3	80	32
30	2IJ00005	Huron Lime Co	<1	<1	<1
30	2IN00001	Freudenberg - NOK	<1	1	<1
30	2IN00137	Erie Co Landfill	1	9	4
30	2IN00182	BP Oil Co Norwalk Bulk Plant	<1	<1	<1
30	2IR00006	Clevite Elastomers-Milan	1	20	8
30	2IY00050	Milan WTP	<1	3	1
30	2PB00037	Milan WWTP	1	596	1,440
30	2PC00001	Huron Basin WWTP	11	490	8,384
30	2PD00024	Norwalk WWTP	34	2,048	24,234
30	2PG00116	Huron Co Airport	<1	<1	<1
30	2PP00043	ODOT Dist 3 Norwalk Garage	<1	<1	<1
30	2PR00053	Consolidated Stores - Big Lots #34	<1	2	4
30	2PR00058	Super 8 Motel	<1	61	143
30	2PR00059	Comfort Inn Motel	<1	50	119
30	2PR00060	Days Inn Motel	<1	83	197
30	2PR00069	Huron River Estates Subd	<1	12	29
30	2PR00073	Hampton Inn	<1	49	116
30	2PR00087	Homestead Inn Restaurant	<1	21	49
30	2PR00091	Huron River Valley Resort	<1	1	2
30	2PR00093	Milan Travel Park	<1	23	55
30	2PR00152	Norwalk Elks Lodge #730	<1	1	2
30	2PR00174	Berlin Milan Local Schools (Edison High School)	<1	2	5
30	2PR00183	Norwalk American Legion Post 41	<1	<1	<1
30	2PS00006	Lake Erie Manufacturers Outlet Mall	<1	14	32
30	2PT00010	Ehove Joint Vocational School	<1	30	71
30	2PT00041	Christie Lane School & Workshop	<1	<1	<1

Table 21. Individual WLAs for Huron River TMDLs					
AU	OEPA Permit	Facility Name	Sediment (1000kg/yr)	Total Phosphorus (kg/yr)	NO₂+NO₃ (kg/yr)
30	2PY00031	Fieldcrest MHP	<1	6	14
30	2PY00040	Alpine Trail MHP	<1	3	7
30	2PY00054	Meadowbrook Mobile Estates (MHP)	<1	<1	1
30	N/A	City of Huron Phase II Stormwater ^A	40	30	790
30	N/A	City of Norwalk Phase II Stormwater ^A	190	130	3,940
Subtotals for AU30			292	3,913	39,719
Grand Totals (AU10 + AU20 + AU30)			437	6,542	64,040

^APhase II stormwater loads estimated from SWAT modeling results and area of each community as a proportion of each assessment unit.

5.0 PUBLIC PARTICIPATION

Ohio EPA convened an External Advisory Group (EAG) in 1998 to assist the Agency with the development of the TMDL program in Ohio. The EAG met multiple times over eighteen months and in July 2000 issued a report to the director of Ohio EPA on their findings and recommendations. The Huron TMDL has been completed using the process endorsed by the EAG.

Ohio EPA involved the partners and public stakeholders in the Huron River TMDL project by soliciting input and recommendations for action during an initial meeting on June 2, 2004 which was hosted by the Erie Basin Resource and Development Council in Norwalk, Ohio. Attendees included representatives from the Huron Soil and Water Conservation District (SWCD), the Huron Natural Resources Conservation Service (NRCS), Erie and Huron Farm Bureaus, City of Willard, the Erie SWCD, Erie County Health Department, Erie Basin RC&D Council, Seneca County FSA, the Ohio Department of Natural Resources (ODNR) and Ohio EPA.

The public outreach portion of the meeting included three presentations by Ohio EPA on chemical, physical and biological integrity of the watershed and an overview of why public participation is critical to the TMDL process. The Huron County SWCD also gave a presentation on the programs available through their office to address some of the pollution sources in the watershed.

Some of the issues and concerns that were expressed at this initial meeting included:

- Public information sessions covering implementation strategies.
- Coordinate TMDL with public drinking water source plans.
- Involve the health departments in the watershed. They can talk to citizens on manure and septic issues.
- Who will set the requirements for nonpoint pollution sources.
- Seek the involvement of the Farm Bureau because TMDL issues will affect them the most.
- Seek the involvement of other organizations such as urban developers, county commissioners and regional planning organizations.
- Plan for an additional stakeholder meeting.

A second stakeholder meeting was held on November 18, 2004. Discussion topics included:

- Review of TMDL process to date.
- Information and discussion on restoration strategies.
- General impairments in the watershed.
- Enforcement of permitted facilities and unsewered communities.
- Urban storm water management for the city of Huron.
- Road and agricultural ditches.

Consistent with Ohio's current Continuous Planning Process (CPP), the draft TMDL report was public noticed on June 3, 2005, and a copy of the draft report was posted on Ohio EPA's web page (www.epa.state.oh.us/dsw/tmdl/index.html). In addition, copies of the report were distributed to local libraries. A summary of the comments received and the associated responses have been compiled and are available in **Appendix J**.

Public involvement is the keystone to the success of any TMDL project. Ohio EPA will continue to support the implementation process and will facilitate to the fullest extent possible an agreement acceptable to the communities and stakeholders in the watershed and to Ohio EPA. Ohio EPA is reluctant to rely solely on regulatory actions and strongly upholds the need for voluntary actions facilitated by local stakeholders and Agency partners to bring the Huron River Watershed into attainment.

Table 22. Huron River Watershed Involvement

Date	Time	Subject(s)
Jun. 2, 2004	9:00 a.m. to 1:00 p.m.	Presentations by Ohio EPA, Huron SWCD
Nov. 13, 2004	9:00 a.m. to 1:00 p.m.	Review Huron TMDL process to date and discuss restoration strategies

6.0 IMPLEMENTATION AND MONITORING RECOMMENDATIONS

Restoration methods to bring an impaired water body into attainment with water quality standards generally involve an increase in the water body's capacity to assimilate pollutants, a reduction of pollutant loads, or some combination of both. As described in Section 2.3, the causes of impairment in the Huron River are siltation, habitat degradation, flow alteration, nutrient enrichment, and low dissolved oxygen. Therefore, an effective restoration strategy would include habitat improvements and reductions in pollutant loads, potentially combined with some additional means of increasing the assimilative capacity of the stream.

Potential restoration strategies used to achieve the TMDL restoration targets might include:

- Public education for awareness of watersheds and water quality
- Riparian buffer initiatives
- Natural stream management principles
- Corridor protection ordinances
- Dam evaluation and removal
- Flood plain management
- Flow augmentation
- Evaluation of irrigation withdrawals
- Sediment and erosion control practices in agricultural and urban areas
- Post-construction storm water management practices
- Reduce the use of residential fertilizers and pesticides
- Proper use and storage of fertilizers and pesticides
- Conservation farming practices
- Comprehensive nutrient management plans
- Livestock waste management plans
- Home sewage treatment system management and maintenance
- Planned growth/development strategies
- Phase I and II Storm Water Pollution Prevention Plans (SWP3s) and Storm Water Management Programs (SWMPs)
- Limit and reuse point source discharge water
- NPDES program - permit limitations and compliance schedules
- Elimination/control of combined sewer overflows (CSOs)
- Municipal pretreatment program
- Centralized treatment for unsewered communities

6.1 Huron River TMDL Implementation Strategy

Ohio EPA is taking an iterative, adaptive approach to implementation for this TMDL project. Point source reductions will be achieved through effluent limitations, compliance schedules, special conditions in existing dischargers' NPDES permits, and the designation of additional MS4s for NPDES permit coverage. A schedule will be

developed for issuance of NPDES permits consistent with implementing the TMDL recommendations. Permits will be issued such that:

- a new discharge will not exceed the loading capacity of the receiving stream in relation to phosphorus and ammonia
- stormwater management plans (SWMPs) will be developed and implemented which address the causes of impairment;
- trends in in-stream concentrations will be tracked, and the NPDES permits will include an option for permit modifications should data indicate in-stream total phosphorus, ammonia and D.O. levels have achieved stable and desirable levels or the use designations are being fully met.

Implementation of nonpoint source reduction measures will be achieved through a locally adopted implementation strategy built around non-regulatory and voluntary incentive programs. Local input to the implementation strategy will result in a planning and decision-making process that leads to reasonable and sustainable actions that will be the most effective in restoring water resources in the watershed.

Ohio EPA recommends an approach that directs resources to improve the overall habitat and physical stability of streams throughout the watershed. Often, we noted that impaired stream function was not the result of one discrete source, such as a wastewater discharge or runoff from a single feedlot. The cumulative effect of multiple impairments like sediment and habitat degradation in the lacustrine (river/lake) area, or excess nutrients in a small stream with little or no flow, appeared to work in concert to degrade the chemical water quality and aquatic communities.

A two-tiered approach that prescribes land management practices and promotes natural channel stability will be most effective in achieving nutrient and sediment load reductions. Traditional BMPs (best management practices) and barriers should be targeted at the stream segments most vulnerable to erosion during high flow storm events. Restoring stream habitat and maintaining channel stability will increase the nutrient and sediment assimilative capacity of streams during normal and lower flow conditions. In particular, phosphorus strategies will need to be targeted for implementation in the smaller drainage areas in order to achieve the recommended reductions.

6.1.1 Resource Conservation and Harbor Dredging Programs

The local implementation strategy will evaluate existing conservation programs and seek opportunities for new funding sources for landowners willing to try innovative practices. Several existing voluntary nonpoint source control programs available in this watershed are highlighted below.

The 2002 USDA Farm Bill provides funding for several programs including the Environmental Quality Incentive Program (EQIP), and the Conservation Reserve Program (CRP) which have reduced agricultural contributions of nutrients and sediment

in this watershed. A new incentive based program, the Conservation Security Program (CSP), was first available in 2004 for landowners in the Auglaize and St Joseph River watersheds. In October 2004, it was announced that \$28.4 million in CSP funds would be available for five priority watersheds, including the Huron and Vermilion rivers in Ohio, with sign-up of participants during 2005. This voluntary program will support ongoing conservation stewardship of agricultural working lands by rewarding producers who maintain and enhance the condition of natural resources in these watersheds. A limited number of participants will be considered on the basis of past conservation efforts and willingness to perform additional conservation activities during their five to ten year contracts. More information on the 2002 Farm Bill and Conservation Security Program is available at the following web site: <http://www.nrcs.usda.gov/programs/csp>.

There have been two Section 319 Nonpoint Source grant funded projects implemented in this watershed since 1994, and the Huron River watershed will be considered a priority watershed for TMDL implementation funding in FY2006 and beyond. Local partners will be encouraged to submit proposals that implement recommendations of the TMDL plan. Additional information on the Nonpoint Source Program and 319 grants is available on Ohio EPA's web site at: <http://www.epa.state.oh.us/dsw/nps/index.html>

Ohio's Water Pollution Control Loan Fund (WPCLF) has two funding sources for nonpoint source pollution control available through the Ohio EPA Division of Environmental and Financial Assistance (DEFA). The Linked Deposit Loan Program provides low interest loans through local banks to aid landowners in implementing nonpoint source reduction projects such as residential on-lot septic system repair or replacement, agricultural BMPs, stream corridor restoration, and sanitary sewer connections.

The other WPCLF funding mechanism, Water Resource Restoration Sponsor Program (WRRSP), is a unique opportunity for municipalities and local partners to work together on a stream restoration project. When a publically owned wastewater treatment system obtains a WPCLF loan for plant expansion or other improvements, the reduction in interest on the loan repayment can be used to "sponsor" a smaller local watershed project. There is an additional discounted loan rate for municipalities who enter these partnerships. Some uses of WRRSP could be to finance riparian easement purchase, stream channel and wetland restoration and protection, and match monies for other funding sources such as Section 319 grants. Additional information on Linked Deposit loans and WRRSP is available on the Ohio EPA web site at: <http://www.epa.state.oh.us/defa/wpclf.html>.

The US Army Corps of Engineers (ACOE) is responsible for maintaining sufficient water depths within the Great Lakes shipping ports. In 2005, Ohio EPA granted authorization to the ACOE under Section 401 of the Clean Water Act to dredge approximately 200,000 cubic yards of sediment from the Huron Harbor shipping channel. The dredged material will be disposed in a submerged (open lake) site three miles north of the Huron Harbor Light in Lake Erie. The sediment analysis in 2000 indicated a large percentage of the material is small clay and silt particles that are unsuitable for beach nourishment. This sediment analysis indicates that an ongoing delivery of soil from farm

and construction site runoff and stream channel erosion continues to be deposited in the Huron Harbor.

Recognizing that reducing the frequency or amount of dredging will result in an economic benefit, traditional funding sources such as the USDA Farm Bill should be targeted towards highly erodible lands to reduce sedimentation in the watershed. As part of Phase I and Phase II of the Storm Water Program, storm water controls must be implemented that address sediment reduction, such as in the areas of construction activity, post-construction storm water management, and pollution prevention/good housekeeping for municipal operations.

6.2 Reasonable Assurances

As part of an implementation strategy, reasonable assurances provide a level of confidence that the wasteload allocations and load allocations in TMDLs will be implemented by Federal, State, or local authorities and/or by voluntary action. The local stakeholders will develop documentation that differentiates the enforceable and non-enforceable selected actions necessary to achieve the restoration targets. Reasonable assurances for planned point source controls, such as wastewater treatment plant upgrades and changes to NPDES permits, will be placed on a schedule for implementation of planned NPDES permit actions. For non-enforceable actions (certain nonpoint source activities), assurances must include: 1) demonstration of adequate funding; 2) process by which agreements/arrangements between appropriate parties (e.g., governmental bodies, private landowners) will be reached; 3) assessment of the future of government programs which contribute to implementation actions; and 4) demonstration of anticipated effectiveness of the actions. It will be important to coordinate activities with those governmental entities that have jurisdiction and programs in place to implement the nonpoint source actions (e.g., county soil and water conservation district offices, county health departments, local Natural Resource Conservation Service offices of the U.S. Department of Agriculture, municipalities and local governmental offices).

6.2.1 Minimum Elements of an Approvable Implementation Plan

Whether an implementation plan is for one TMDL or a group of TMDLs, it should include at a minimum the following eight elements:

- *Implementation actions/management measures*
- *Time line*
- *Reasonable assurances*
- *Legal or regulatory controls*
- *Time required to attain water quality standards*
- *Monitoring plan*
- *Milestones for attaining water quality standards*

- *TMDL revision procedures*

6.2.2 Reasonable Assurances Summary

This is a summary of the regulatory, non-regulatory and incentive-based actions applicable to or recommended for the Huron River watershed. Many of these activities deal specifically with the point source discharge regulatory actions. Non-regulatory and incentive-based programs are currently delivered through existing local conservation authorities and nonpoint source reduction activities:

Regulatory:

- NPDES permit renewal with compliance schedule for WWTP improvements at Plymouth and Huron Basin.
- NPDES permit schedules for CSO elimination or Long Term Control Plans for cities of Willard and Norwalk
- Statewide Rules for Home Sewage Treatment/Disposal
- Enforcement of Storm Water Phase I and II regulations
- Sediment and erosion control practices for construction projects
- Implementation of post-construction storm water controls on construction projects
- Implementation of the 208 Water Quality Plan in regards to development and sewer extensions.

Non-regulatory:

- Evaluation of dam(s) for removal
- Flow augmentation in headwater streams or near point source discharges and irrigation withdrawals
- Periodic stream monitoring to measure progress
- Development and local acceptance of an implementation plan which includes:
 - Watershed awareness education activities
 - Storm water management programs
 - Source protection of ground and surface drinking water supplies (SWAP)
 - Septic system improvements
 - Agricultural conservation practices
 - Riparian buffer initiatives
 - Manure nutrient management plans
 - Urban nutrient (fertilizer) management plans
 - Water table management/controlled drainage
 - Recommendations for an updated drainage maintenance program
 - Restore natural stream and flood plain function
 - Encourage local health departments to implement Home Sewage Treatment System (HSTS) Plans in watershed

Incentive-based:

- Section 319 grant opportunities for implementation projects that support the strategy and goals of this TMDL

- USDA Farm Bill programs for agricultural BMPs, including the new Conservation Security Program (CSP) incentives
- Lake Erie CREP for buffer practices throughout the Lake Erie watersheds
- Clean Ohio Grant Fund opportunities for natural resource protection and improvement and farmland BMPs
- Various loan opportunities for WWTP improvements
- Low interest loan opportunities through WPCLF Linked Deposit program
- Funding opportunities through WRRSP program for riparian/habitat improvements
- Farmers Home Administration (FmHA) grants and WPCLF loan opportunities for centralized wastewater treatment in small communities
- Ohio Environmental Education Fund administered by Ohio EPA
- Lake Erie Protection Fund and Great Lakes Commission grant opportunities

6.2.3 Point Source Controls

Implementation of the TMDL for the Huron River watershed NPDES permit holders will result in language in the Schedule of Compliance for NPDES permits and new limits for phosphorus. In addition, several facilities are currently in the process of making improvements to the wastewater treatment plant or the collection system which will reduce the discharge of pollutants into the Huron River watershed.

Norwalk WWTP

The City of Norwalk currently has four (4) Combined Sewer Overflows (CSO's) . A Long Term Control Plan spanning fifteen (15) years was recently agreed upon for wastewater treatment plant and sanitary sewer collection system improvements which will result in the elimination of two of the CSO's, and a reduction of overflow events for the remaining two CSOs.

Erie County Huron Basin WWTP

The Erie County Huron Basin WWTP discharging to the Huron River at river mile 1.02 recently completed wastewater treatment plant improvements to enhance ammonia removal to meet an NPDES compliance schedule. Further improvements are planned to eliminate raw sewage overflows at the plant headworks and a westside pump station.

Package Plants

Several package plants located in the area of State Route 250 and Mason Road, discharging to Mud Brook will be eliminated in 2 to 3 years following a planned State Route 250 sanitary sewer extension. Routing the wastewater from this area to the Erie County Huron Basin WWTP and eliminating the existing package plant discharges will

address the ongoing operational and maintenance problems associated with them and should improve the overall quality of effluent discharges.

Milan and Monroeville WWTPs

Phosphorus was identified as a source of impairment in this watershed. The Villages of Milan and Monroeville currently monitor for phosphorus. A monthly average phosphorus limit of 1.0 mg/l is recommended to be included in all municipal NPDES permits, including the Milan WWTP permit. Suggested NPDES Compliance Schedule language is as follows:

“The permittee shall comply with the final effluent limitation for phosphorus as soon as practicable, but not later than the first day of the 60th month after the effective date of the permit. Status reports describing the progress towards meeting the final phosphorus limit of 1.0 mg/l shall be submitted to the Ohio EPA Northwest District Office as follows:

- a. 12 months after the effective date of the permit;
- b. 24 months after the effective date of the permit;
- c. 36 months after the effective date of the permit; and
- d. 48 months after the effective date of the permit.”

Plymouth WWTP

The Plymouth WWTP, discharging at RM 39.0, is considered a source of impairment for the West Branch of the Huron River. A compliance schedule to meet permit limits has been included in the permit renewal (permit # 2PB00014*ED). The compliance schedule can be summarized as follows:

- Compliance with the final effluent limitations of the permit as expeditiously as practicable.
- Detail plans for plant and sewer system improvements shall be submitted as soon as possible, but not later than 18 months from the effective date of the permit.
- Advertising of construction bids, receiving bids, and awarding contracts as soon as possible, but not later than 24 months from the effective date of the permit.
- Commence construction as soon as possible, but not later than 30 months from the effective date of the permit.
- Complete construction as soon as possible, but not later than 35 months from the effective date of the permit.
- Attain operational level of the treatment works and meet final effluent limitations as soon as possible, but not later than 36 months from the effective date of the permit.

Phosphorous monitoring was also included in the Plymouth permit renewal in order to quantify the amount of phosphorus being discharged to the river. It is anticipated that these changes will address the problems of low dissolved oxygen and elevated

concentrations of ammonia and phosphorus which have caused water quality impairments downstream from the Plymouth WWTP discharge.

TMDL Re-opener Language

Re-opener language will be included in the renewal of NPDES permits in the Huron River watershed which will explicitly allow Ohio EPA to modify, revoke, or reissue a permit based upon requirements of the approved TMDL. Changes to a permit could include new or revised effluent limits, revised monitoring requirements, and/or other conditions which would be necessary for TMDL implementation.

Stormwater Discharges

Currently there are four regulated Municipal Separate Storm Sewer Systems (MS4s) in the TMDL area. Three have obtained permit coverage while one was granted a waiver. This is discussed further on pages 76 through 78 in this chapter. There are also many sites with coverage under the NPDES General Permit for Storm Water Discharges Associated with Industrial Activities. (See Appendix D.) Numerous sites are also covered under the NPDES General Permit for Storm Water Discharges associated with Construction Activities.¹⁵

6.2.4 Unsewered Areas

There are several villages in the Huron River watershed that do not have a central wastewater collection and treatment system, including Holiday Lakes, New Haven, North Fairfield, Celeryville, Collins, East Townsend, Steuben, and North Monroeville. Residential wastewater often flows into septic tank-type systems which then discharge to a community storm sewer system without further treatment. The discharges from these combined sewers contribute to water quality degradation in the receiving streams of the Huron River watershed. (See “Home Sewage Treatment System Management” under Section 6.2.5 for further discussion of unsewered communities.)

6.2.5 Nonpoint Source Controls

Agricultural Sedimentation and Nutrient Enrichment

The Huron River watershed is a predominately agricultural area used mostly for row crop production and, to a smaller degree, livestock production. In the past ten to fifteen

¹⁵ Due to the temporary nature of construction sites, persons interested in reviewing a current listing of the locations covered under the General Permit for Construction Activities should contact Ohio EPA's Division of Surface Water.

years, conservation efforts by farmers, local partnerships and units of government have reduced non-point sources of pollution significantly, and efforts in this direction continue. However, agricultural contributions of sediment and nutrients continue to be problematic in the smaller tributary and headwater streams.

As discussed previously, landowners can take advantage of several incentive programs that will cover significant costs of adopting Best Management Practices on farmland, while educational initiatives exist to boost participation in these programs. The Livestock Environmental Assurance Program, CREP, and other 2002 Farm Bill programs are available through the Farm Service Agency and Soil and Water Conservation Districts in each county of the watershed.

Drainage water management is an agricultural practice that was recently added to the Natural Resources Conservation Service Technical Guide as Standard 554. This practice is designed to improve water quality and maximize crop yield on flat crop fields that have a subsurface drainage system. This is accomplished by installing permanent flow control structures and utilizing a nutrient management plan to regulate the discharge of seasonally high flows that transport nutrients to surface or ground water. The system is designed to remove enough water to provide adequate drainage, but maintain the water table to benefit growing crops, while not adversely impacting adjoining properties. Drainage water management practices may be eligible for funding through traditional agricultural assistance programs such as CRP and EQIP.

Partners in the Huron River watershed will again be eligible for Section 319 grant funds beginning in FY 2006. The priority focus for funding will be projects that eliminate water quality impairments, or restore a stream segment to the aquatic use designation specified in a TMDL report.

Habitat Alteration and Hydromodification

A lack of instream and riparian habitat, and low water levels in small tributary streams and maintained channels caused multiple impairments in the Huron watershed. In this study, the primary difference between small streams that were attaining their aquatic use designations and those that were not, was most likely related to the amount of nutrient enrichment and the presence or absence of continuous stream flow. In other words, the impacts of sediment and nutrients were magnified by poor physical habitat or intermittent flow. Conversely, good physical habitat and adequate flow can be effective in assimilating these pollutants.

Habitat improvements, especially to the quality of the substrate, stream channel, and riparian characteristics, are recommended throughout the watershed with special effort directed at the following non-attaining streams and stream segments:

- West Branch Huron River, RM 23.0 - 22.5
- Shiloh Ditch
- Marsh Run

- Tributary to Marsh Run
- Jacobs Creek
- Lower Slate Run
- East Branch Mud Run
- East Branch Huron River, RM 24.0
- Norwalk Creek, RM 1.8
- Huron River mainstem, RM 9.8 - 0.0
- West Branch Rattlesnake Creek

Restoration that yields an increase in the Habitat (QHEI) score to an average of 60 for WWH is desired. The target for the QHEI provides a means for evaluating success for any activities performed in terms of how likely it is for an aquatic life use to be restored. When QHEI values begin to exceed 60 for WWH, the likelihood that a warmwater aquatic fauna will be supported is greater than when the scores are lower. In these stream segments, all aspects of the habitat, substrate, instream cover, riparian and channel characteristics, and pool riffle quality need improvement.

Habitat Protection and Restoration

Preservation of natural habitat is key in maintaining the existing level of assimilative capacity of the watershed. Actions such as preserving natural drainage features, maintaining riparian areas, disconnecting impervious surfaces, minimizing impervious areas, and installing post-construction structural storm water management practices are recommended.

Unlike the standard practices for reducing sediment and nutrient runoff from crop land, the solutions for habitat and flow-impaired streams may not be implementation of BMPs that are familiar to local producers and have well-established incentive programs. Instead, improved habitat will rely on long term changes and social acceptance of new trends in agricultural drainage practices. Implementation actions could include:

- Adopt riparian protection ordinances that prevent flood plain encroachment and riparian removal
- Promote physical stability in streams by restoring active flood plains
- Promote wetlands to provide flood water storage and enhance groundwater recharge and seasonal flow augmentation
- Utilize drainage water management practices on agricultural fields with subsurface drainage systems
- Promote natural stream management and filter strips to reduce the frequency of maintenance on petition ditches
- Evaluate the Holiday Lake dam for modification or removal
- Limit water withdrawals below base flow from Marsh Run for crop irrigation
- Reduction of drainage maintenance assessment if filter strips are established and maintained

Home Sewage Treatment System Management

Septic systems impact water quality in the Huron River watershed through both point and nonpoint discharges from failed, inadequately designed, or discharging systems in small unincorporated villages and rural areas. Individual sewage systems are used to treat household sanitary waste in areas where no municipal treatment facilities exist. When poorly designed or neglected, they contribute loads of organic matter, nutrients, and pathogens. Site limitations such as lot size, soil type and depth to bedrock or groundwater further reduce effectiveness and increase system failures leading to surface or groundwater contamination.

Implementation actions to address these sources of pollution would include, identification and replacement of faulty septic systems, elimination of on-site septic systems through extension of municipal sanitary sewers, and public education on septic system maintenance. Section 319 grant funds are available to assist homeowners with repair or replacement of failed septic systems in critical areas of the watershed. To be eligible for grant funding, a county health department must prepare and receive Ohio EPA approval of a county wide or watershed based Home Sewage Treatment System (HSTS) plan. Such plans have already been approved for Huron and Erie County.

In small towns and unincorporated areas, water quality and public health can be severely impacted when multiple homes bypass failed systems into the storm sewers or local streams. The State Water Quality Management Plan and 208 plan should identify the need to further assess and address sewage disposal needs in a number of small communities in the Huron River watershed, including Holiday Lakes, New Haven, North Fairfield, Celeryville, Collins, East Townsend, Steuben, and North Monroeville.

Storm Water Management

In the Huron watershed, sources of stream impairment may include storm water discharges from Phase I and II Industrial, Construction, and Municipal activities. Those industrial facilities with NPDES permit coverage for storm water discharges associated with industrial activities must develop and implement a Storm Water Pollution Prevention Plan (SWP3) which identifies potential sources of pollution. The SWP3 must also describe and ensure the implementation of practices to reduce pollutants in storm water discharges. It is recommended that these facilities review their SWP3's during their annual comprehensive site compliance evaluation to ensure that appropriate BMPs are implemented that address the causes of impairment for this watershed.

Phase II Storm Water regulations now require that prescribed management practices for construction activities be described in a site's SWP3, including:

- Installation and maintenance of sediment and erosion control practices for construction projects which, either by themselves or as part of a total common plan of development or sale, collectively disturb one acre or more; and

- Implementation of post-construction storm water controls on construction projects which, either by themselves or as part of a total common plan of development or sale, collectively disturb one acre or more.

So that a receiving stream's physical, chemical, and biological characteristics are protected and stream functions are maintained, the post-construction storm water practices shall provide perpetual management of runoff quality and quantity. To meet the post-construction requirements of the NPDES Construction General Permit, the SWP3 must contain a description of the post-construction BMPs that will be installed during construction for the site and the rationale for their selection. The rationale must address the anticipated impacts on the channel and floodplain morphology, hydrology, and water quality. The post-construction BMP(s) chosen must be able to detain storm water runoff for protection of the stream channels, stream erosion control, and improved water quality.

The four regulated small MS4s in the Huron watershed must either obtain NPDES permit coverage for their storm water discharges or request a waiver. The City of Huron and Erie County currently are Co-Permittees (Ohio EPA Number 2GQ00027) with coverage under the NPDES General Permit for Small MS4s. The Ohio Department of Transportation also has permit coverage (Ohio EPA Number 4GQ00000). Under this permit, entities are required to have a Storm Water Management Program (SWMP) implemented by March 2008 for all areas served by their MS4 within the Sandusky Urbanized Area (UA). In the SWMP, BMPs addressing six Minimum Control Measures are implemented to minimize and to prevent storm water pollution. The six Minimum Control Measures are: Public Outreach and Education, Public Participation, Illicit Discharge Detection/Elimination, Sediment and Erosion Control (construction site program), Post-Construction Storm Water Management, and Pollution Prevention for Municipal Operations.

Per federal regulations, Ohio EPA must consider certain small MS4s located outside of the UA for inclusion in the MS4 NPDES permit program. Under consideration are MS4s within municipalities with a population of 10,000 or more and a density of 1,000 per square mile. The City of Norwalk meets this criteria. Ohio EPA is currently reviewing small MS4s against Ohio EPA's permit designation criteria, which is "when surface waters of the state within a county, township or municipality where a small MS4 is located are listed as impaired in the most recent final report submitted to the United States EPA by the director to fulfill the requirements of section 303(d) of the act (33 U.S.C. section 1313(d), effective October 10, 2000)." As urban runoff impacts were noted in Norwalk, it is recommended that Ohio EPA designate the City to obtain NPDES permit coverage.

Under OAC Chapter 3745-39, a small MS4 shall be designated by the director to obtain Ohio NPDES permit coverage for discharges when a storm water discharge from the small MS4 results in or has the potential to result in an exceedance of Ohio water quality standards, including impairment of a designated use, or other significant water quality impacts including habitat and biological impacts to surface waters of the state. Due to the impact of urban runoff on Jacobs Creek, it is recommended that the City of

Willard be designated. Small MS4s notified to obtain NPDES permit coverage will have 180 days from designation in which to apply.

It should be noted that while the Ohio Turnpike Commision is a permittee and has developed an SWMP, their permit coverage does not extend to, nor is required for, portions of their system outside the UA. So, while the Ohio Turnpike passes through this watershed, their SWMP is not required to be implemented in this area. Erie County, the City of Huron, ODOT, and the Ohio Turnpike, should evaluate extending their Storm Water Management Programs in this watershed to areas outside the UA. The formation of a stakeholder based advisory group to guide the development of a Storm water program in a Watershed Implementation Plan would be an important first step. Implementation actions could include drafting ordinances for storm water and sediment and erosion control, and expanding existing programs (i.e. Soil and Water Conservation Districts (SWCDs) to include storm water monitoring. Public education, such as developing an adult education program about storm water pollution, would be an important and necessary part of the implementation plan.

Public Education

The local SWCDs and park districts may have nonpoint source education staff that deliver programs and information to help local landowners and public officials understand causes, sources and solutions to nonpoint pollution. The primary focus would be building public awareness about the value of a healthy watershed and the importance of reducing/eliminating these sources of pollution. Funding for nonpoint source (NPS) education in the Huron watershed is available through grants from ODNR Division of Soil and Water Conservation and the Ohio Environmental Education Fund administered by Ohio EPA.

6.3 Process for Monitoring and Revision

An initial monitoring plan to determine whether the TMDL has resulted in attainment of water quality standards and to support any revisions to the TMDL that might be required begins with in-stream water quality chemical monitoring. This sampling will be done at a minimum by those permit holders with individual NPDES permits at locations upstream and downstream of their outfalls and at ambient monitoring stations to be collected by Ohio EPA.

A biological and water quality study of the Huron River, similar to that conducted by the Ohio EPA in 1998 and 2002 will be scheduled when indications suggest that major changes in the watershed have occurred. In addition, interim and/or surrogate measures that document progress in water quality improvement are recommended. Consideration must be given to the lag time between source control actions (habitat improvements and loading reductions) and observable/measurable instream effects, especially for nonpoint sources.

A tiered approach to monitoring progress and validating the TMDL will be followed; the tiered progression includes:

1. Confirmation of completion of implementation plan activities;
2. Evaluation of attainment of chemical water quality criteria;
3. Evaluation of biological attainment.

A TMDL revision will be triggered if any one of these three broad validation steps is not being completed, or if the WQS are not being attained after an appropriate time interval. If the implementation plan activities are not being carried out within a reasonable time frame as specified in the implementation plan, then action should be taken by appropriate entities (e.g. a local watershed group) who have a stake or vested interest in keeping the implementation activities on schedule. Once the majority of (or the major) implementation plan items have been carried out and/or the chemical water quality has shown consistent and stable improvements, then a full scale biological and chemical watershed assessment will be completed to evaluate attainment of the use designations. If chemical water quality does not show improvement and/or water bodies are still not attaining water quality standards after the implementation plan has been carried out, then a TMDL revision will be initiated. The Ohio EPA will initiate the revision if no other parties wish to do so.

A more detailed and inclusive monitoring plan could be developed by a local watershed group which would describe steps in a monitoring program, including timing and location of monitoring activities, parties responsible for monitoring, and quality assurance and quality control procedures. It may include a method to determine whether actions identified in the implementation plan are actually being carried out and criteria for determining whether these actions are effective in reaching the TMDL targets. It is recommended that a local watershed group work with the Ohio EPA to develop such a monitoring plan.

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