State of Ohio
Environmental Protection Agency

Division of Surface Water

Total Maximum Daily Loads for the Blanchard River Watershed

Blanchard River at Riverbend Recreation Area, Hancock County
(photo courtesy of Tim Powell, 2006)

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Ted Strickland, Governor
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Appendix A: TMDL Aquatic Life Use Attainment and Assessment Unit Scores

Appendix B: Blanchard Watershed Total Phosphorus Loading Based on Land Use and Other Sources

Appendix C: TMDL Modeling Information

List of Acronyms and Abbreviations

BIT	Bacteria Indicator Tool
BMP	best management practice
BRWP	Blanchard River Watershed Partnership
CFU	colony forming unit
cm	centimeter
CNMP	Comprehensive Nutrient Management Plan
cnt/seas	counts per season
CO	consent agreement
Corps	U.S. Army Corps of Engineers
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSO	combined sewer overflow
CSS	combined sewer system
CWA	Clean Water Act
CWH	Cold Water Habitat
DA	drainage area
DEFA	Division of Environmental and Financial Assistance
DFFOs	Directors Final Findings and Orders
DNAP	Division of Natural Areas and Preserves
DSW	Division of Surface Water
DSWC	Division of Soil and Water Conservation
ECBP	Eastern Corn Belt Plains
ED	Environmental Defense
EQIP	Environmental Quality Incentives Program
EWH	Exceptional Warmwater Habitat
FC	Fecal Coliform
FSA	Farm Service Agency
gpd	gallons per day
GPS	geographic positioning system
GW	groundwater
HSTS	household sewage treatment system
HUC	hydrologic unit code
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
LA	load allocations
lb/yr	pounds per year
LEAP	Livestock Environmental Assurance Program
LID	low impact development
LTCP	Long-Term Control Plan
mg/L	milligrams per liter
MGD	million gallons per day
MHP	Mobile Home Park
MIWB	Modified Index of Well-Being
mi^2	square mile
ml	milliliter
MOR	monthly operating reports
MOS	margin of safety

MS4	municipal separate storm sewer system
MWH	Modified Warmwater Habitat
NACD	National Association of Conservation Districts
NEMO	Nonpoint Education for Municipal Official
NLCD	National Land Cover Dataset
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source
NRCS	Natural Resource Conservation Service
NWOFMP	Northwest Ohio Flood Mitigation partnership
OAC	Ohio Administrative Code
OAEA	Ohio Agricultural Environmental Assurance
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
OFAER	On Farm Assessment and Environmental Review
OFBF	Ohio Farm Bureau Federation
OLC	Ohio Livestock Coalition
ORC	Ohio Revised Code
PCR	Primary Contact Recreation
PIR	Pollution Investigation Report
PTI	Permit to Install
QHEI	Qualitative Habitat Evaluative Index
RC&D	Resource Conservation and Development
RI	return interval
RM	river mile
SCR	Secondary Contact Recreation
SCS	Soil Conservation Service
SSO	sanitary sewer overflow
SSO	separate sewer overflow
SSS	sanitary sewer system
SWCD	Soil and Water Conservation District
SWMP	Storm Water Management Plan
TMDL	total maximum daily load
tn/yr	tons per year
TP	total phosphorus
TSS	total suspended solids
U.S. EPA	U.S. Environmental Protection Agency
USDA-ARS	United States Department of Agriculture-Agricultural Research Service
USGS	U.S. Geologic Survey
WHC	Wildlife Habitat Council
WLA	wasteload allocations
WLEB	Western Lake Erie Basin
WPCLF	Water Pollution Control Loan Fund
WQC	Water Quality Certification
WQMP	Water Quality Management Plan
WQS	water quality standards
WRP	Wetland Reserve Program
WRRSP	Water Resource Restoration Sponsor Program
WTP	water treatment plant
WWH	Warmwater Habitat
WWMP	Wet Weather Management Plan
WWTP	Wastewater treatment plant

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1.0 TMDL OVERVIEW

1.1 General introduction

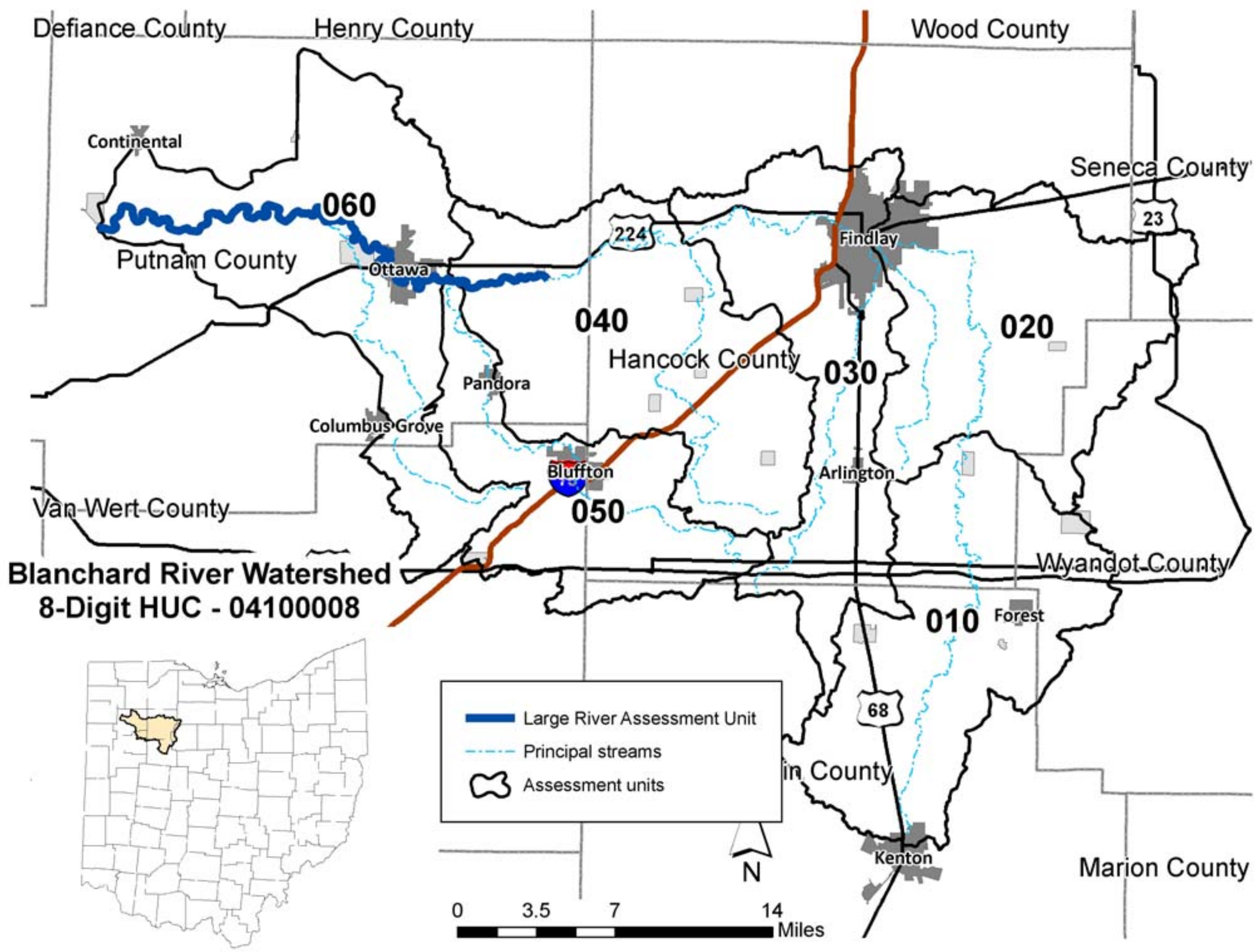
The Clean Water Act (CWA) Section 303(d) requires states, territories, and authorized tribes to list and prioritize waters for which technology based limits alone do not ensure attainment of water quality standards. The Section 303(d) list of impaired waters is made available to the public and submitted to the U.S. Environmental Protection Agency (USEPA) in even numbered years. The Ohio Environmental Protection Agency (Ohio EPA) identified the Blanchard River watershed as impaired in the 2008 Integrated Water Quality Monitoring and Assessment Report (Ohio EPA, 2008).

The CWA also requires that Total Maximum Daily Loads (TMDLs) be calculated for all waters on the Section 303(d) lists. A TMDL is defined as a calculation of the maximum amount of pollution that a water body can receive and still meet water quality standards and an allocation of that amount to the various pollutant sources. 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. The ultimate goal of Ohio's TMDL process is full attainment of biological and chemical Water Quality Standards (WQS) and subsequent removal of water body segments from the 303(d) list.

The Ohio EPA conducted a detailed assessment of the chemical, physical, biological, and bacterial quality of streams in the Blanchard watershed in 2005 (see Map 1.1). Results of this study are reported in the Biological and Water Quality Study of the Blanchard River (Ohio EPA, 2007). The beneficial uses assessed for this report are aquatic life, recreation, and human health (via fish tissue). The main causes of impairment identified for TMDL development are nutrient enrichment (total phosphorus), low dissolved oxygen, siltation, habitat alteration, and pathogens. Habitat alteration and low dissolved oxygen depletion are not load based quantities, but allocations for other impairing causes were calculated for these. No sport fish consumption advisory is in effect for the Blanchard River watershed, but fish tissue is considered impaired in some instances because body burdens of PCBs exceed the threshold level upon which human health criteria are based in the Ohio Water Quality Standards. Although Ohio does not currently include drinking water among the codified beneficial uses, a method to evaluate this use is currently under development. The quality of water supplies for the City of Findlay and Village of Ottawa were sampled during the 2005 survey.

This report documents the Blanchard River watershed TMDL process and provides for tangible actions to restore and maintain this water body. The main objectives of the report are to describe the water quality and habitat condition of the Blanchard River watershed and to quantitatively assess the factors affecting non or partial attainment of WQS. The Ohio EPA believes that developing TMDLs on a watershed basis is an effective approach towards meeting the goal of full attainment of WQS. As a result, water body conditions are summarized based on watershed assessment units (WAUs) aligned with the 11-digit Hydrologic Unit Code (HUC) system and by Large River Assessment Units (LRAUs) for river segments that drain an area >500 mi^2. A map of the Blanchard River watershed with individual watershed assessment units is shown in Map 1.1. A summary of the 303(d) listed assessment units in this report is presented in Table 1.1 and a summary of the causes and sources of impairment is presented in Table 1.2. A summary of the water quality impairments and how they are addressed through the development of a TMDL is presented in Table 1.3.

Strategies for achieving water quality goals are included in this report. Additionally, a local watershed action plan is being developed in its place by the Blanchard River Watershed Partnership.



Map 1.1. Blanchard River watershed assessment units and the large river unit

Table 1.1. Status of beneficial uses in the Blanchard River watershed.

Assessment Unit	Description	Beneficial Use Impairment			Priority Points (0-13)
		Aquatic Life	Recreation	Human Health (Fish Tissue)	
04100008 010	Blanchard River headwaters to below Potato Run	Yes	Yes	Yes	6
04100008 020	Blanchard River below Potato Run to above Eagle Creek	Yes	Yes	Yes	9
04100008 030	Blanchard River above Eagle Creek to above Ottawa Creek	Yes	Yes	Yes	7
04100008 040	Blanchard River above Ottawa Creek to above Riley Creek; excluding mainstem below Dukes Run	Yes	Yes	Yes	9
04100008 050	Riley Creek	Yes	Yes	Unknown	6
04100008 060	Blanchard River below Riley Creek to mouth; excluding mainstem	Yes	Yes	Unknown	7
04100008 001	Blanchard River mainstem below Dukes Run to mouth	No	No	Yes	1

Table 1.2. Summary of causes and sources of impairment as listed in the 2008 Integrated Report.

Assessment Unit	Causes of Impairment	Sources of Impairment
04100008 010 Blanchard River headwaters to below Potato Run	habitat alteration flow alteration temperature organic enrichment nutrient enrichment nitrate/nitrite phosphorus low dissolved oxygen ammonia pathogens	channelization stream bank destabilization tile drainage crop production with subsurface drainage municipal point sources combined sewer overflows home sewage treatment systems unknown source
04100008 020 Blanchard River below Potato Run to above Eagle Creek	habitat alteration temperature organic enrichment nutrient enrichment nitrate/nitrite	channelization crop production with subsurface drainage home sewage treatment systems

Assessment Unit	Causes of Impairment	Sources of Impairment
	phosphorus pathogens	
04100008 030 Blanchard River above Eagle Creek to above Ottawa Creek	habitat alteration flow alteration temperature organic enrichment nutrient enrichment nitrate/nitrite phosphorus siltation ammonia pathogens	channelization crop production with subsurface drainage dam impoundment urban runoff municipal point sources combined sewer overflows home sewage treatment systems
04100008 040 Blanchard River above Ottawa Creek to above Riley Creek; excluding mainstem below Dukes Run	habitat alteration organic enrichment nutrient enrichment nitrate/nitrite low dissolved oxygen siltation pathogens	channelization crop production with subsurface drainage livestock production home sewage treatment systems
04100008 050 Riley Creek	habitat alteration flow alteration temperature organic enrichment nutrient enrichment phosphorus nitrate/nitrite low dissolved oxygen siltation pathogens	channelization stream bank destabilization dam impoundment crop production with subsurface drainage home sewage treatment systems municipal point sources combined sewer overflows urban runoff
04100008 060 Blanchard River below Riley Creek to mouth; excluding mainstem	habitat alteration flow alteration organic enrichment phosphorus nitrate/nitrite low dissolved oxygen ammonia siltation pathogens	channelization crop production with subsurface drainage home sewage treatment systems package plants municipal point sources

Table 1.3 is a summary of the water quality impairments found within the watershed and if these impairments are addressed through the development of a TMDL, by some other means, or not at all.

Table 1.3. Impaired water uses addressed through TMDL development for the Blanchard River watershed (HUC 04100008).

	11 digit HUCs					
Causes of impairment	**010**	**020**	**030**	**040**	**050**	**060**
Aquatic Life Uses						
Siltation	na	na	S	S	S	S
Direct habitat alteration	S	S	S	S	S	S
Flow alteration	O	na	O	na	O	O
Total phosphorus	S	S	S	S	S	S
Nitrates	O	O	O	O	O	O
Nutrients	O	O	O	O	O	na
Organic enrichment	O	O	O	O	O	O
Dissolved oxygen	O	na	na	O	O	O
Ammonia	N	na	N	na	na	N
High temperature	N	N	T	na	N	na
Recreational Uses						
Pathogens	T	T	T	T	T	T

"T" means TMDL developed using WQS numeric criteria
"S" means a surrogate measure is used to calculate a TMDL
"O" means that other causes being addressed will adequately deal with this cause
"N" means TMDL Not developed
"na" means the cause of impairment does not apply in that assessment unit.

1.2 Public participation

Public involvement is key to the success of any TMDL project. From the beginning, Ohio EPA has invited participation in all aspects of the TMDL program. The 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 issued a report in July, 2000 to the Director of Ohio EPA on their findings and recommendations. The Blanchard River watershed TMDL project has been completed using the process endorsed by the advisory group.

Ohio EPA advanced public involvement in this TMDL project with assembly of a TMDL Team representative of all portions of the watershed. Members were drawn from public, private, nongovernmental organization (NGO) and individual citizen populations, representative of multiple interests and interactions with the watershed. The team approach provides a setting for: sharing the Agency's progress in the project, soliciting input and feedback on this progress, hearing concerns and receiving information and data relevant to the project work. Participating members include: Blanchard River Watershed Partners, park district staff, conservation agency staff, county health department administrators, engineering staff, landowners/farmers, municipal utility staff, regional planning commission staff, university faculty and students, WWTP operators and others.

During the three year project period Ohio EPA gave TMDL project updates and presentations at several public venues:

- A fish shocking and field sampling demonstration was conducted for the public in August 2005 along with an introduction to the TMDL process.
- A Blanchard River forum was sponsored by the Blanchard River Watershed Partnership (BRWP) and hosted by University of Findlay in May, 2006. Various state and local resource professionals were asked to present information relevant to the river as a resource for the community. Ohio EPA gave presentations on preliminary chemistry and biological sampling results, and the fish tissue study results for the Blanchard River. The forum was well attended by the public.
- Ohio EPA was invited to the BRWP annual meeting in October 2007 to a give a status report on TMDL findings and modeling work to date.
- Information/input meetings were held with external technical representatives of the watershed during February and March 2008 to discuss potential solutions for agricultural sources and urban sources of water quality impairment.
- A public meeting was held in April 2008 to gather public input and comment on the draft TMDL report.

In addition to the statewide recommendations for point source discharges, storm water, and public drinking water programs, these locally accepted solutions have credibility for addressing the agricultural sources of pollution. The feedback was used to complete the draft TMDL report prepared by Ohio EPA.

Through the public information process concerns were voiced regarding issues of both water quality and quantity in the watershed. Several floods during the January 2005 to February 2008 time frame have caused considerable property damage and raised awareness for multiple watershed issues concerning drainage, land use and flood damage mitigation.

The water quality studies done over several seasons and a variety of stream flow conditions indicate that the majority of impairments are caused by row crop and livestock agriculture in the Blanchard River watershed. Implementation of the TMDL will largely be accomplished through voluntary actions.

Ohio EPA acknowledges local volunteers' efforts to lead the Partnership to initiate development of a watershed action plan and educate the public on water resource issues. We encourage local leadership to promote watershed based planning to solve both water quantity and water quality problems. Projects that restore wetland and floodplain habitat and protect natural riparian areas may also provide some protection from flood damage.

Consistent with Ohio's current Continuous Planning Process (CPP), the draft TMDL report was available for public comment from January 28, 2009 through March 2, 2009. A copy of the draft report was available on Ohio EPA's Division of Surface Water web page at http://www.epa.state.oh.us/dsw/tmdl/index.aspx. General information on

TMDLs, water quality standards, 208 planning, permitting, and other Ohio EPA programs were also available on this site. No comments were submitted regarding this TMDL.

Public involvement is vital to the success of any TMDL project. Ohio EPA will continue to support the implementation process and will facilitate, to the fullest extent possible, restoration actions that are acceptable to the communities and stakeholders in the study area and to the Agency. Ohio EPA is reluctant to rely solely on regulatory actions and strongly advocates voluntary actions facilitated by the local stakeholders, watershed organization, and Agency partners to bring the Blanchard River watershed into water quality attainment.

2.0 DESCRIPTION OF THE PROJECT AREA

2.1 Project delineation

Ambient biological, water column chemical, and sediment sampling was conducted in the Blanchard River basin from June to October 2005 as part of the five-year basin approach for monitoring, assessment, and issuance of National Pollution Discharge Elimination System (NPDES) permits and to facilitate a Total Maximum Daily Load (TMDL) assessment. This study area included over 100 miles of the Blanchard River beginning in the headwaters and extending to near the confluence with the Auglaize River. Subwatersheds within the study area included Eagle Creek, Ottawa Creek, Cranberry Creek and Riley Creek. To the extent possible, tributary streams with at least 4 square miles of drainage were sampled.

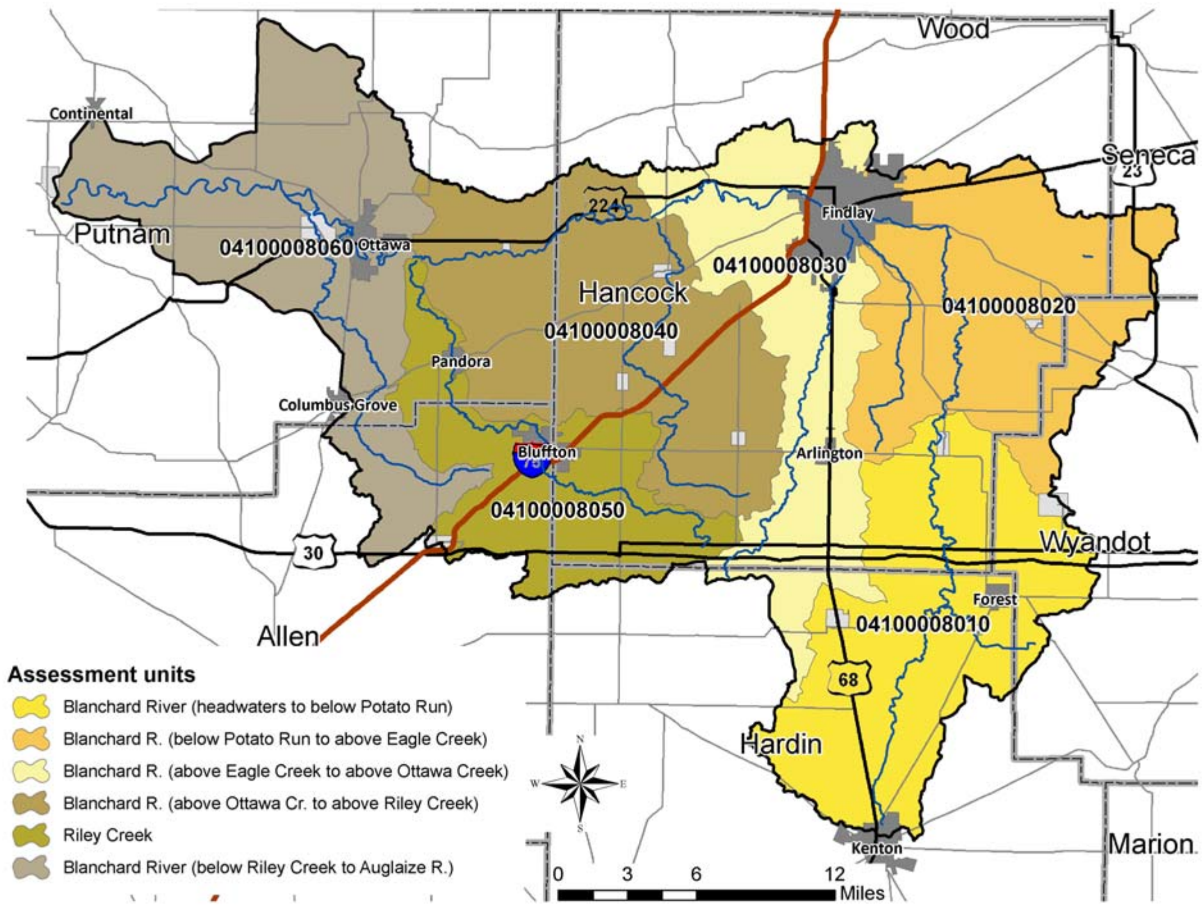
The 2005 Blanchard River study area included six watershed assessment units (WAUs) and a large river assessment unit (LRAU) (Figure 2). The six WAUs were: Blanchard River-headwaters to downstream Potato Run (river mile (RM) 76.27); Blanchard River-downstream Potato Run to downstream Eagle Creek (RM 76.27 to RM 58.10); Blanchard River- upstream Eagle Creek to upstream Ottawa Creek (RM 58.10 to RM 45.64); Blanchard River- upstream Ottawa Creek to upstream Riley Creek, excluding mainstem greater than 500 square miles (RM 45.64 to RM 30.08); Riley Creek; and Blanchard River- downstream Riley Creek to the Auglaize River, excluding the mainstem greater than 500 square miles (RM 30.08 to RM 0.00). The LRAU included the Blanchard River mainstem from downstream Dukes Run (RM 35.68) to the confluence with the Auglaize River (mainstem >500 square miles).

During 2005, fish and/or macroinvertebrate sampling was conducted at 115 locations in the Blanchard River watershed at sites ranging in drainage area from 0.9 square miles to 771 square miles. The survey resulted in the assessment of aquatic life use attainment at 84 sites. Fish and macroinvertebrate sampling was planned at each site; however, due to the limitations of resources, timing, and site suitability, a number of locations were sampled for only a single organism group.

Inorganic water chemistry grab samples and field measurements were collected at 118 sites in the Blanchard River study area at two-week intervals (six times) from mid-July to late September, 2005. Samples were analyzed for a variety of parameters including nutrients and metals. Additional samples for selected organics compounds were collected at 12 of these sites whenever inorganic samples were collected. At the seven sentinel sites and at the two drinking water intake sites, the additional samples were analyzed for the new age pesticides. At three sites in the City of Findlay area, the additional samples were analyzed for base neutral acids and polychlorinated biphenyls (PCBs).

Additionally, Datasonde™ continuous monitors were deployed at 36 sites for a 48-hour period near the end of July and early in August. The Datasonde™ continuous monitors were used again in 2006 to conduct additional temperature and dissolved oxygen studies in the headwaters, in the area of the Findlay dams and in Riley Creek.

A total of 30 sediment samples were analyzed for various physical and chemical properties. Physical attributes measured included particle size distribution, percent solids, and percent total organic carbon. Chemical attributes measured included metals, volatile and semi-volatile organic compounds, pesticides and PCBs.



Map 2.1. Watershed assessment units of the Blanchard River

Table 2.1. Watershed assessment unit description and drainage area

Assessment unit (HUC-11)	Sub-watershed (HUC-14)	Narrative description	Drainage area (mi^2)
04100008010	**Blanchard River (headwaters to below Potato Run)**		**141**
	- 010	Blanchard River headwaters to above Cessna Cr.	19.6
	- 020	Cessna Creek	23.3
	- 030	Blanchard River below Cessna Cr. to below The Outlet (1)	34.1
	- 040	Blanchard River below The Outlet (1) to above Potato Run	36.2
	- 050	Potato Run	27.7
04100008020	**Blanchard R. (below Potato Run to above Eagle Creek)**		**133**
	- 010	Blanchard River below Potato Run to above The Outlet (2) [except Brights Ditch]	22.8
	- 020	Brights Ditch	28.4
	- 030	The Outlet (2)	38.3
	- 040	Blanchard River below The Outlet (2) to above Eagle Cr. [except Lye Cr.]	15.9
	- 050	Lye Creek	28.0
04100008030	**Blanchard R. (above Eagle Creek to above Ottawa Creek)**		**115**
	- 010	Eagle Creek headwaters to below Flat Branch	26.6
	- 020	Eagle Creek below Flat Branch to Blanchard R.	34.7
	- 030	Blanchard River below Eagle Cr. to above Aurand Run	20.8
	- 040	Aurand Run	17.5
	- 050	Blanchard River below Aurand Run to above Ottawa Cr.	15.4
04100008040	**Blanchard R. (above Ottawa Cr. to above Riley Creek)**		**149**
	- 010	Ottawa Creek [except Tiderishi Cr.]	44.9
	- 020	Tiderishi Creek	19.4
	- 030	Blanchard River below Ottawa Cr. to above Moffitt Ditch	14.7
	- 040	Moffitt Ditch	13.6
	- 050	Blanchard River below Moffitt Ditch to above Dutch Run [except Dukes Run]	13.8
	- 060	Dukes Run	14.7

Assessment unit (HUC-11)	Sub-watershed (HUC-14)	Narrative description	Drainage area (mi^2)
	- 070	Dutch Run	15.1
	- 080	Blanchard River below Dutch Run to above Riley Cr.	12.7
04100008050	**Riley Creek**		**86**
	- 010	Riley Creek headwaters to above L. Riley Cr. (1)	14.2
	- 020	Little Riley Creek (1)	14.8
	- 030	Riley Creek below L. Riley Cr. (1) to above L. Riley Cr. (2)	15.5
	- 040	Little Riley Creek (2)	16.0
	- 050	Riley Creek below L. Riley Cr. (2) to Blanchard R. [except Cranberry Run]	13.4
	- 060	Cranberry Run	11.7
04100008060	**Blanchard River (below Riley Creek to Auglaize R.)**		**147**
	- 010	Blanchard River below Riley Cr. to above Cranberry Cr.	28.6
	- 020	Cranberry Creek	45.0
	- 030	Blanchard River below Cranberry Cr. to above Deer Cr. [except Miller City Cutoff and Bear Cr.]	13.9
	- 040	Miller City Cutoff	22.5
	- 050	Bear Creek	12.6
	- 060	Deer Creek	10.1
	- 070	Blanchard River below Deer Cr. to Auglaize River	14.6

2.2 Water resources

2.2.1 Blanchard River-headwaters (HUC 04100008-010)

The Blanchard River headwaters WAU (04100008-010) covers parts of Hancock, Hardin and Wyandot Counties and drains a total of 140.8 square miles. The WAU (-010) includes the first 28 miles of the Blanchard River mainstem from its headwaters to just downstream of Potato Run. The larger tributaries to the Blanchard River within this WAU include Cessna Creek, Shallow Run and Potato Run. The mainstem, along with two unnamed headwater tributaries, originates on the north side of Kenton, in Hardin County, flowing to the north and very slightly east. This upper reach has been modified and grass riparian areas are maintained to facilitate agricultural activities in the surrounding watershed. At RM 100.05 the stream is not much more than an open ditch with a drainage area of 16.2 square miles. Yet, just 4.4 miles downstream (at RM 95.60), after being joined by Cessna Creek and Shallow Run, the Blanchard River is already sizeable stream, with a drainage area of 61 square miles. This section of the remaining mainstem (about 16 to18 miles of the Blanchard River, flowing north to just upstream of Mt. Blanchard) is not maintained for drainage, is sinuous with good riparian zones, and has a rocky substrate. All of the WAU (-010) lies in the ECBP ecoregion. **Figure 2.1** is a schematic of the Blanchard River headwaters WAU, showing the approximate location of dischargers to the watershed.

2.2.2 The Outlet/Lye Creek (HUC 04100008-020)

The Outlet/Lye Creek WAU (04100008-020) is almost entirely contained in Hancock County except for the upper headwater reaches of some of the tributaries which extend into western Wyandot County and the southwest corner of Seneca County. The WAU (-020) includes 18.2 miles of the Blanchard River mainstem. The Blanchard River mainstem enters The Outlet/Lye Creek WAU (-020) just downstream of Potato Run and Mt. Blanchard, flowing almost directly north through 12 to 13 miles of rural area, mostly cropland. At SR 37 (RM 75.57), just downstream from Mt. Blanchard, the drainage area is 142 square miles. Buckrun Creek (9 square miles of drainage area) enters at RM 69.84 and Brights Ditch (28.6 square miles of drainage area) enters at RM 65.85. The first impoundment on the mainstem, a low head dam, is at RM 65.17, just east of the Findlay reservoirs, where the old drinking water intake was once located. The mainstem makes a 90˚ bend to the west at RM 63.63, its confluence with The Outlet (38.5 square miles drainage area), and continues to flow west for 5 more miles into the City of Findlay where it enters the Eagle Creek WAU (-030). It is just downstream of The Outlet where the drainage area of the Blanchard River mainstem becomes >200 square miles, which is the criteria defining a small river (vs. a wadeable stream), and different nutrient targets begin to apply. The second mainstem impoundment is at RM 62.40, on the north side of the Findlay reservoirs, where the main water intake for the City of Findlay is located. Several small tributaries drain developing areas from the north, east of Findlay, to the mainstem. The next in the series of mainstem impoundments through the Findlay area, known as the Riverside Dam, is in Riverside Park at RM 58.77, which the City of Findlay maintains for their backup water intake. Lye Creek (28.6 square miles drainage area) enters the Blanchard River from the south in the City of Findlay at RM 58.38 just before the mainstem enters into the Eagle Creek WAU (-030). All of The Outlet/Lye Creek WAU (-020) lies in the ECBP ecoregion. **Figure 2.2** is a schematic of The Outlet/Lye Creek WAU, showing the approximate location of dischargers to the watershed.

2.2.3 Eagle Creek (HUC 04100008-030)

The Eagle Creek WAU (04100008-030) is almost entirely contained in Hancock County except for the very upper reaches of the Eagle Creek headwaters which extend into northern Hardin County. The WAU (-030) also includes 12.5 miles of the Blanchard

River mainstem from upstream of Eagle Creek, through the City of Findlay, to upstream of Ottawa Creek. Eagle Creek alone drains an area of about 61.4 square miles and flows through the southern half of the City of Findlay before meeting the Blanchard River. The Blanchard River mainstem enters the Eagle Creek WAU (-030) just upstream of the confluence with Eagle Creek in the City of Findlay at RM 58.10. It flows to the west and for the next two miles it is still within the City of Findlay where it passes over the Liberty St. Dam at RM 57.42, and receives discharges from 22 of Findlay's 24 combined sewer overflows (CSOs), some via Eagle Creek, Howard Run or other tributaries, and the discharge from the Findlay WWTP at RM 56.42. Nearly all of the Eagle Creek WAU lies in the ECBP ecoregion. Just a short section of the Blanchard River mainstem crosses into the HELP ecoregion about five miles upstream of the next WAU (-040). **Figure 2.3** is a schematic of the Eagle Creek WAU, showing the approximate location of dischargers to the watershed.

2.2.4 Ottawa Creek (HUC 04100008-040)

The Ottawa Creek WAU (04100008-040) covers the Blanchard River above Ottawa Creek (RM 45.64) to above Riley Creek (RM 30.08) and drains about 148.9 square miles. The Blanchard River below Dukes Run (RM 35.65) is excluded because it meets the definition of a large river (> 500 square miles) and is evaluated separately. **Figure 2.4** is a schematic of the Ottawa Creek WAU, showing the approximate location of dischargers to the watershed.

2.2.5 Riley Creek (HUC 04100008-050)

The Riley Creek WAU (04100008-050) covers parts of four counties and drains about 88.2 square miles. **Figure 2.5** is a schematic of Riley Creek WAU, showing the approximate location of dischargers to the watershed.

2.2.6 Cranberry Creek (HUC 04100008-060)

This WAU (04100008-060) drains a total of 147.3 square miles and covers the Blanchard River below Riley Creek (RM 30.08) to the mouth (RM 0.0). The Blanchard River mainstem is excluded since it meets the definition of a large river in this segment and is evaluated separately. **Figure 2.6** is a schematic of Cranberry Creek WAU, showing the approximate location of dischargers to the watershed.

2.2.7 Blanchard River

The Blanchard River large river assessment unit (LRAU) encompasses the mainstem from downstream Dukes Creek (RM 35.65) to the confluence with the Auglaize River. This portion of the mainstem has a drainage area in excess of the 500 square miles limit used in delineating assessment units with multiple water courses. Consequently, this reach is considered separately from smaller drainages within the basin when reporting on attainment status.

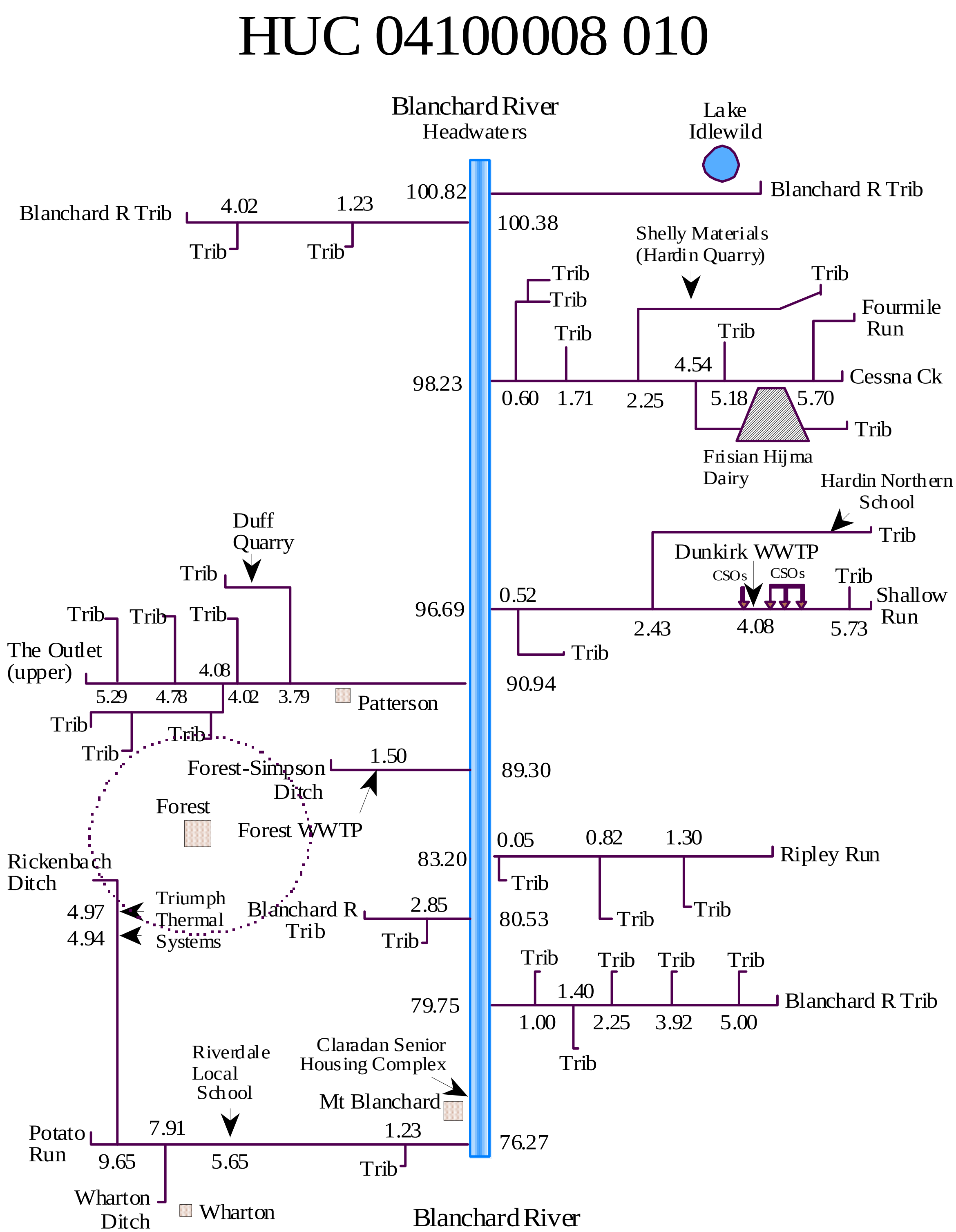


Figure 2.1. Schematic representation of the Blanchard River headwaters WAU (-010)

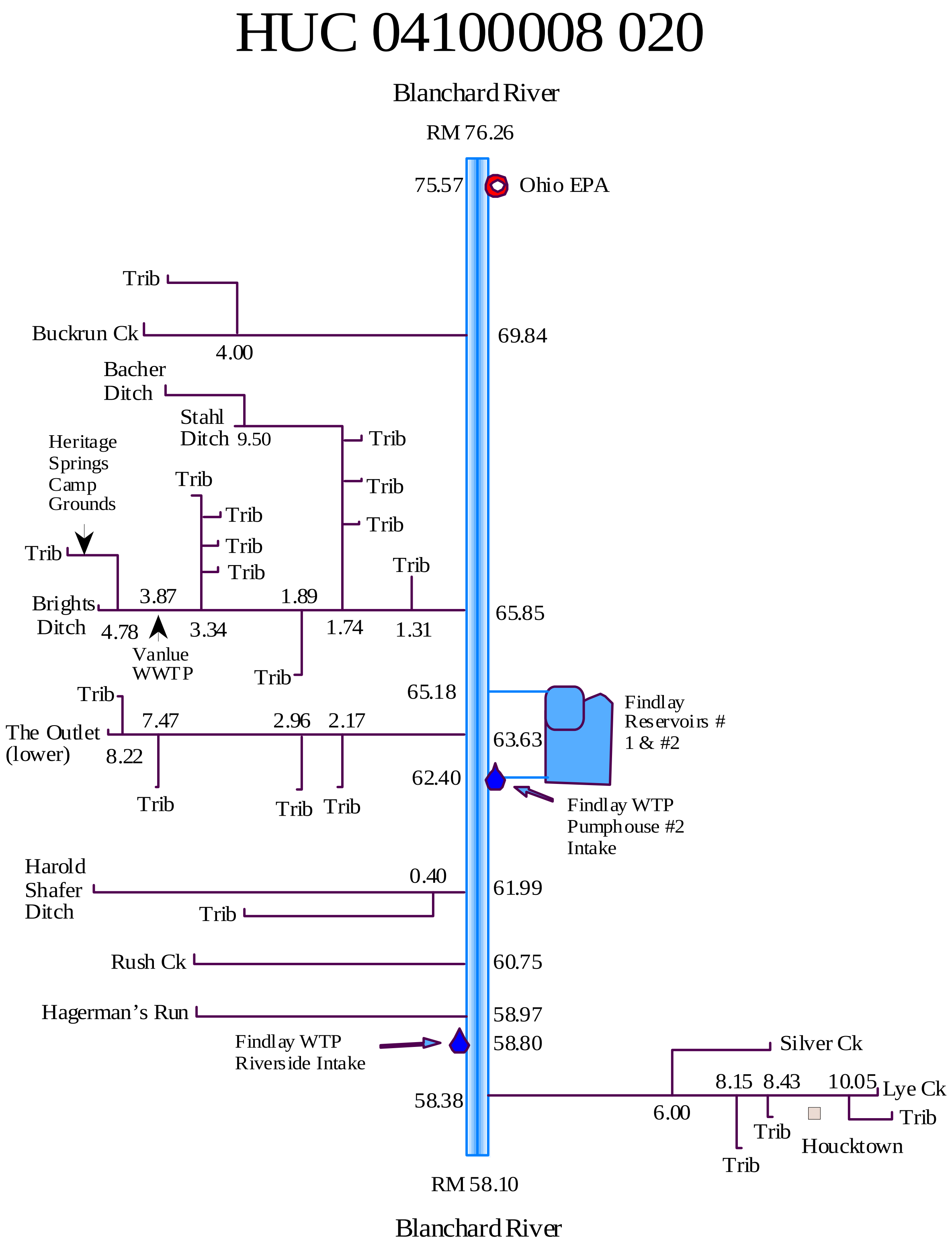


Figure 2.2. Schematic representation of The Outlet/Lye Creek WAU (-020)

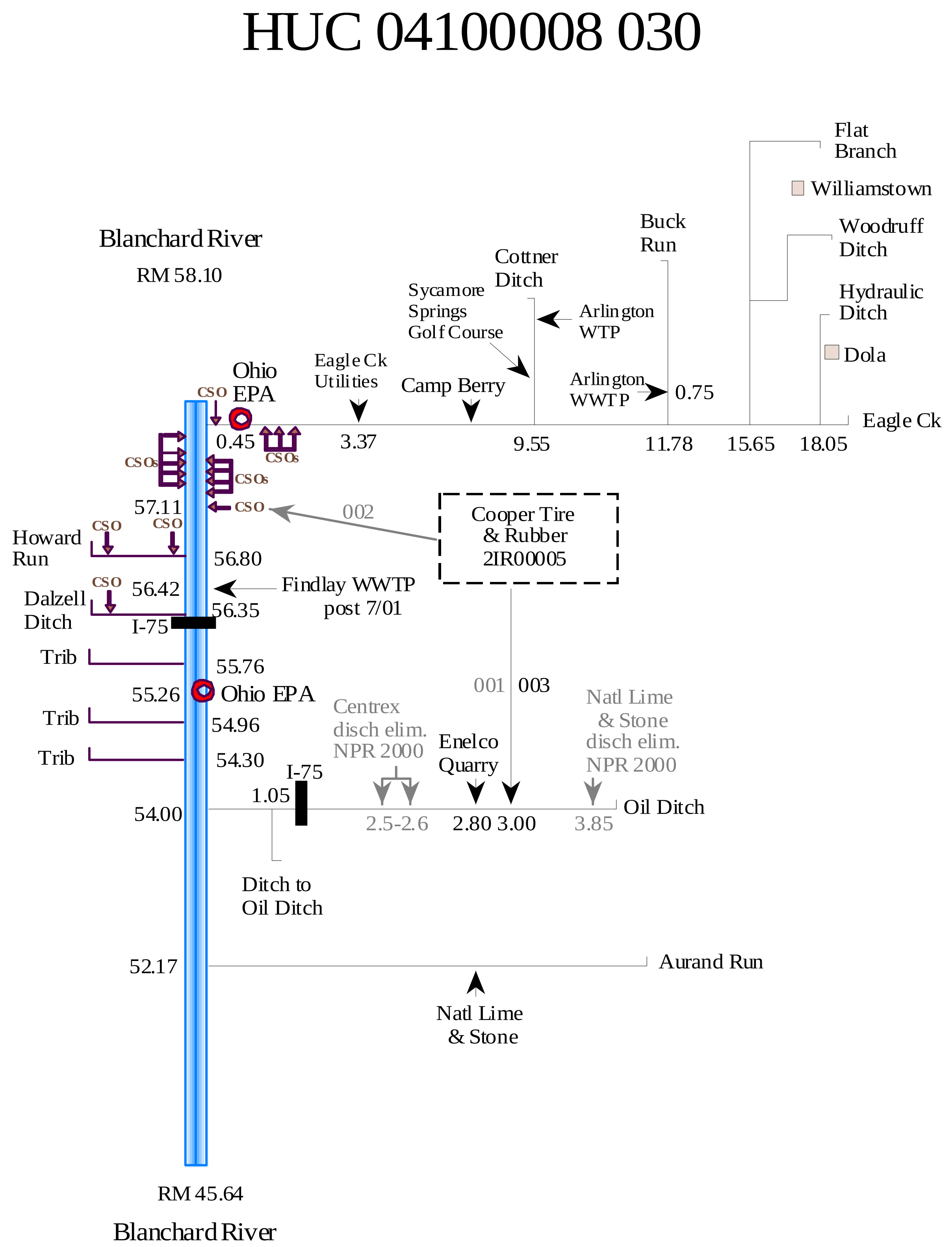


Figure 2.3. Schematic representation of the Eagle Creek WAU (-030)

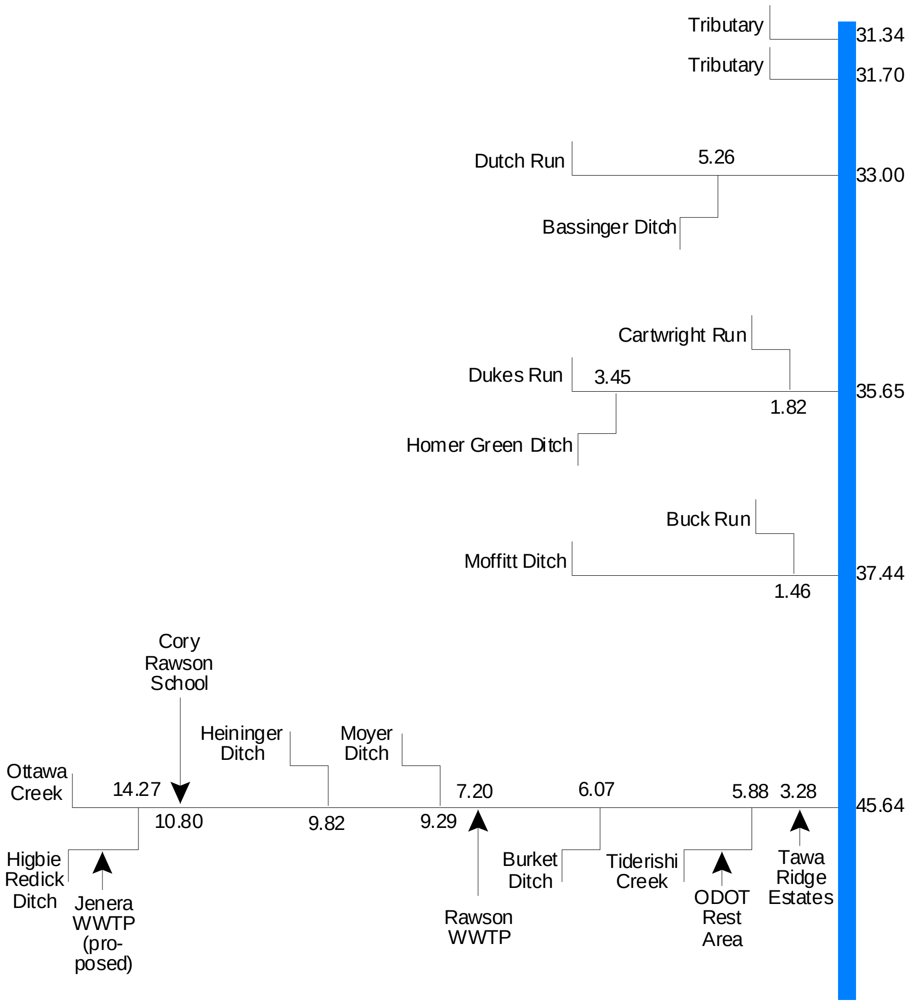


Figure 2.4. Schematic representation of Ottawa Creek WAU (-040)

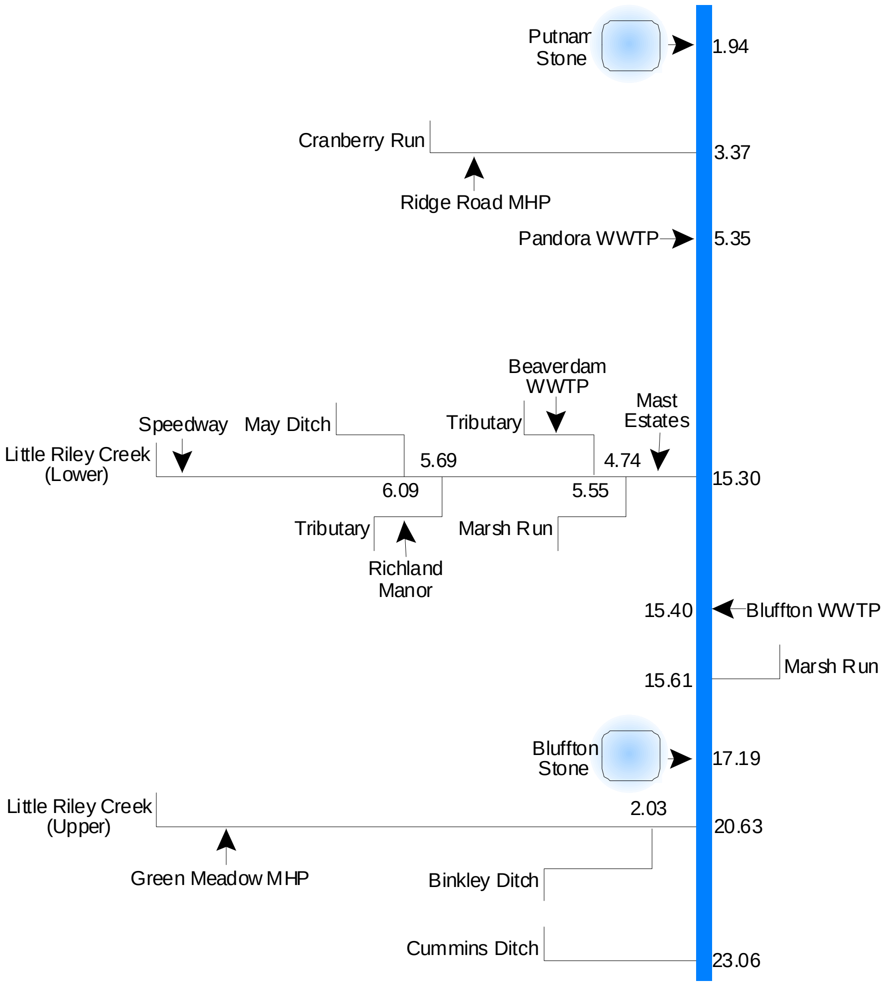


Figure 2.5. Schematic representation of the Riley Creek WAU (-050)

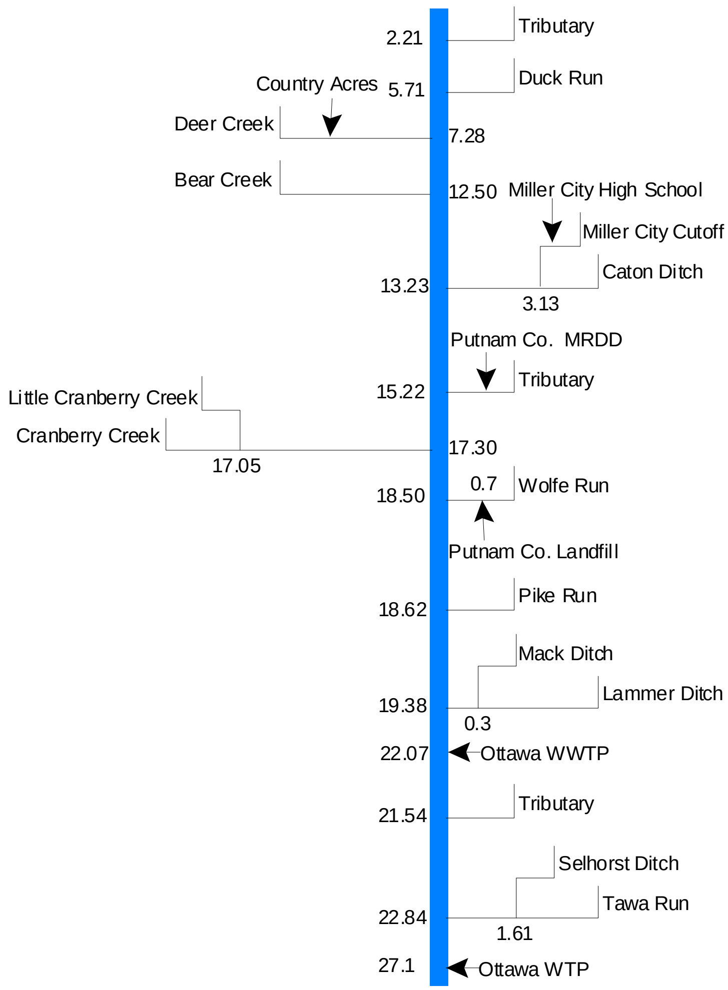
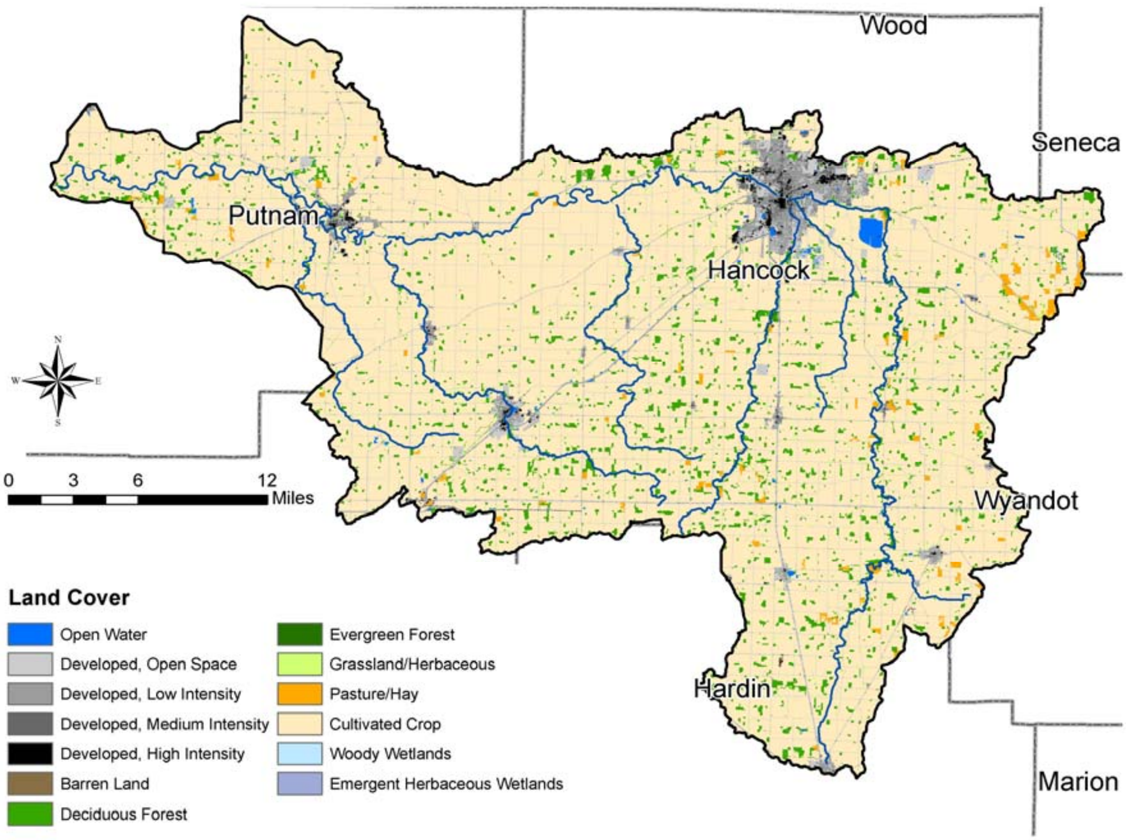


Figure 2.6. Schematic representation of Cranberry Creek WAU (-060)

2.3 Land use/ land cover

The Blanchard River watershed extends across two Major Land Resource Areas – MLRA 99 (Erie-Huron Lake Plain of the Lake States Fruit, Truck Crop, and Dairy Region) in the western part and MLRA 111 (Indiana-Ohio Till Plain of the Central Feed Grains and Livestock Region) in the eastern part.



Map 2.2. Land use map of the Blanchard River watershed

Table 2.2. Distribution of land cover types in the TMDL project area

Land Cover Classification	Percent of watershed land area	Area in acres	Area in square miles
Cultivated Crop	80.8%	398,922	623.3
Developed	10.1%	49,979	78.1
Forest	5.6%	27,416	42.8
Grassland/Herbaceous	1.6%	8,037	12.6
Pasture/Hay	1.0%	4,962	7.8
Open Water	0.5%	2,279	3.6
Wetlands	0.3%	1,586	2.5
Barren Land	0.0%	231	0.4
GRAND TOTAL	100%	493,413	771

The part of this watershed within MLRA 99 typically is a nearly level glacial lake plain with a few scattered ridges of sandy soils that represent past shorelines and moraines. Local relief typically varies by less than ten feet, except for the beach ridges and low moraines that can rise almost 30 feet above the general level of the landscape. The watershed within MLRA 111 is a landscape characterized by a gently undulating glacial Wisconsinan till plain, and most areas are dominated by ground moraines that are broken in places by lake plains, outwash plains, flood plains, and many recessional moraines. The ground moraines and lake plains in front of the recessional moraines are flat to undulating.

The entire land area of the Blanchard River watershed was surveyed using the Public Land Survey System (PLSS) and, consequently, cropland, pastureland, and forested areas typically are rectangular in shape. Agriculture typically consists of cash grain farming of corn, soybeans, and wheat production with some livestock production. Land use is 80.9 percent crop land, 2.6 percent pasture and grasslands, 5.6 percent forest, >1 percent wetlands, 10.1 percent urban and residential.

The following cities and villages are situated entirely or partly in the Blanchard River watershed: Arlington, Beaverdam, Benton Ridge, Bluffton, Columbus Grove, Continental, Dunkirk, Dupont, Findlay, Forest, Gilboa, Glandorf, Jenera, Kenton, Miller City, Mount Blanchard, Mount Cory, Ottawa, Pandora, Patterson, Rawson, Vanlue, and Wharton.

Prior to historical settlement, wetlands were common and, based on soil survey information, made up about 42 percent of the watershed. Due to the clearing of swamp forest and the subsequent drainage of the land, most of the wetlands have been artificially drained. Wetlands occurring in cropland currently constitute less than one percent of the watershed and wooded wetlands constitute about 3.2 percent of the watershed.

2.4 Soils, geology, and topography

The soils of the Blanchard River watershed formed in many different kinds of raw material including glacial till, lacustrine and beach deposits, glacial till, recent alluvium, material weathered from bedrock, and organic material.

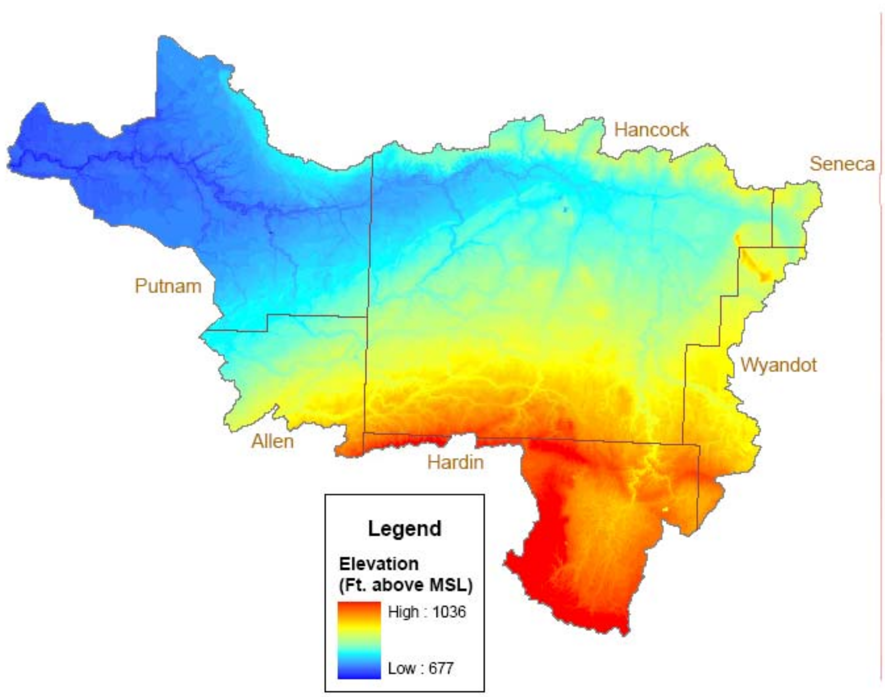
Bedrock geology consists of the Salina Group Dolomite in the western half of the watershed and Tymochtee, Greenfield, and Lockport Dolomites in the eastern half. Limestone quarries are scattered about in all counties within the watershed. Some karst features (e.g., sinkholes) exist in the northeastern part of the watershed in Wyandot County.

There are 256 different soil types occurring in the watershed, each with its separate soil management concerns, crop productivity, and capability for different land uses. The soils are dominantly nearly level, very poorly drained to gently sloping, somewhat poorly drained mineral soils formed in deposits of lacustrine material or glacial till, but also include small acreages of moderately well and well drained soils on sloping to very steep slopes, sandy soils on beach ridges or organic soils in depressional areas.

Nearly level and gently sloping areas of somewhat poorly drained Blount soils comprise about 30 percent of the watershed. Occupying flats and low knolls on glacial till plains, these soils need artificial drainage for grain crop production. In addition, sloping areas of Blount soils have a moderate hazard of erosion due to water. Associated with Blount soils in swales and depressional areas are very poorly drained Pewamo soils which comprise about 20 percent of the watershed and also need artificial drainage for farming.

The third most extensive soil in the watershed is very poorly drained Paulding clay, comprising about 5 percent. This nearly level soil needs artificial drainage for farming, although the efficiency of artificial subsurface drainage is hindered by the very high clay content of the subsoil.

The flood plains in Hancock Co. are predominantly Sloan-Eels-Shoals Association which is deep, very poorly drained to moderately well-drained soils with a subsoil of loam to light silty clay loam. As the watershed moves into Putnam Co. and shifts from the Eastern Cornbelt Plains (ECBP) ecoregion to the Huron-Erie Lake Plains (HELP) ecoregion, there is a slight shift in the flood plain soils to Sloan-Shoals-Genesee Association consisting of very poorly drained silty clay loams and somewhat poorly drained to well-drained silt loams, formed in stratified alluvium. The predominant upland soils in Putnam Co. (the HELP ecoregion) are more varied, including Lenawee-Del Ray, Toledo-Fulton, Paulding-Roselms, and Hoytville-Nappanee Associations, but all are similar, with some combination of very poorly drained and somewhat poorly drained clays, silty clay loams, loams and silty loams formed in lacustrine sediments on glacial tills. More detailed information about soil types throughout the Blanchard River watershed can be found in: Soil Survey of Hardin County – 1989, Soil Survey of Hancock County – 1973, and Soil Survey of Putnam County – 1974.



Map 2.3. Digital elevation map of the Blanchard River watershed (from NRCS, 2008)

2.5 Population and growth trends and economic development

Population in the watershed has increased overall in the watershed since the 1970s. There were approximately 91,266 residents in the 2000 census. Hancock County, with the largest land area in the watershed (71 percent) also experienced the greatest growth and increase in density of population in the three townships surrounding the City of Findlay. Similar density increases were also noted in other urban areas of the watershed, including Bluffton, Ottawa and Glandorf in Allen and Putnam Counties. The growth in urban population was responsible for a trend in land use change that resulted in conversion of 2.6 percent of former row crop, pasture and forest lands to suburban residential land use.

2.6 Conservation and other efforts to restore and protect water quality

Table 2.3 shows the number of acres in which conservation practices have been applied in the watershed based on Farm Bill programs. This table does not necessarily reflect all of the acres where conservation practices have been applied (i.e., only those that received technical assistance).

Based on the information in Table 2.3, residue management and nutrient management have been applied the most widely, each amounting to more than 30,000 acres (roughly eight to nine percent of the watershed cropland). Buffers and wetland set asides total 921 acres, less than one percent of the cropland in the watershed, while wildlife habitat and tree establishment were planned for 3,470 acres at 0.9 percent of the cropland.

Table 2.3. Summary of key conservation practices and conservation systems applied in the Blanchard River watershed. The source of this information is the Natural Resource Conservation Service (NRCS) Performance Results System displayed in the Rapid Watershed Assessment – Data Profile report for the Blanchard River.

	FY01	FY02	FY03	FY04	FY05	FY06	Total
Total Conservation Systems Planned (acres)	16,447	7,465	8,346	N/A	5,083	14,222	51,563
Total Conservation Systems Applied (acres)	19477	6,837	6,291	N/A	4,517	7,121	44,243
Conservation Practices							
Erosion Control Total Soil Saved (tons/year)	29,398	18,960	4,712	N/A	5,026	2,928	61,024
Filter strips (393) (acres)	267	380	356	66	137	143	1,283
Grassed Waterways (412) (acres)	16	26	16	5	13	24	95
Prescribed Grazing (528 and 528A) (acres)	0	0	0	0	0	86	86
Residue Management (329A-C) (acres)	16,009	5,439	1,686	4,310	3,135	5,638	31,907
Riparian Forest Buffers (391) (acres)	15	7	20	0	8	3	53
Tree and Shrub Establishment (612) (acres)	21	29	67	0	17	143	277
Total Nutrient Management (590 - AFO & non-AFO) (ac)	16,697	7,145	6,179	1,052	1,564	3,411	34,996
Total Waste Management (313) (numbers)	0	3	1	0	0	0	4
Total Wetlands Created, Restored, or Enhanced (acres)	8	1	4	0	143	712	868
Total Wildlife Habitat (644 - 645)	1,099	202	528	275	107	1,257	3,193
Acres On Which A Farm Bill Program Conservation Practice Was Reported Applied							
Conservation Reserve Program	6,096	2,036	739	N/A	1,038	1,105	11,014
Environmental Quality Incentives Program	304	0	0	N/A	307	771	1,382
Farm and Ranchland Protection Program	0	0	0	N/A	0	0	0
Wetlands Reserve Program	0	0	0	N/A	281	542	823
Wildlife Habitat Incentives Program	0	0	0	N/A	0	0	0

3.0 APPLICABLE WATER QUALITY STANDARDS

3.1 Purpose and underlying authority

Under the CWA, 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 "swimmable/fishable" waters. A brief description of Ohio's WQS is presented in Table **3.1**. Further information is available in Chapter 3745-1 of the Ohio Administrative Code (Ohio EPA, 1993).

3.2 Ohio WQS

3.2.1 Definition of water uses

In the Blanchard River watershed, the aquatic life use designations that apply are warmwater habitat (WWH), modified warmwater habitat (MWH), and limited resource water (LRW). Waters designated as WWH are capable of supporting and maintaining a balanced integrated community of warmwater aquatic organisms (note: a coldwater habitat is a trout stream). Waters designated as MWH have been found to be incapable of supporting and maintaining a balanced integrated community of warmwater aquatic organisms due to irretrievable modifications of the physical habitat. Waters designated as LRW have been found to lack the potential for any resemblance of any other aquatic life habitat.

Another type of use in the WQS is for recreational purposes. The recreational use for the majority of the Blanchard River watershed is primary contact recreation (PCR). This designation is appropriate for streams that have a water depth of at least one meter over an area of at least 100 square feet or where canoeing is a feasible activity. If a water body is too small and shallow to meet either criterion, the secondary contact recreation (SCR) use applies. Waters that are designated as bathing waters (BW) are suitable for swimming where a lifeguard and/or bathhouse facilities are present.

3.2.2 Quality criteria to protect uses

Attainment of aquatic life uses is determined by directly measuring fish and aquatic insect populations to see if they are comparable to those seen in least impacted areas of the same ecological region and aquatic life use. Attainment benchmarks from these least impacted areas are established in the WQS in the form of "biocriteria", which are then compared to the measurements obtained from the study area. If measurements of a stream do not achieve the three biocriteria (fish: Index of Biotic Integrity (IBI) and modified Index of Well-being (MIwb); aquatic insects: Invertebrate Community Index (ICI) the stream is considered in "non attainment". If the stream measurements achieve some of the biological criteria, but not others, the stream is said to be in "partial-attainment". A stream that is in "partial attainment" is not achieving its designated aquatic life use, whereas a stream that meets all of the biocriteria benchmarks is said to be in full attainment.

The method used by Ohio EPA to evaluate attainment of recreation uses is described in the 2008 Integrated Report. Fecal coliform were used as the indicator organism and an assessment unit is considered impaired if, when all the raw data are pooled, the 75th percentile value exceeded the primary contact recreation (PCR) geometric mean criterion (1000 CFU/100 ml) or the 90th percentile value exceeded the PCR single sample maximum criterion (2000 CFU/100 ml).

3.2.3 Antidegradation protections

Antidegradation provisions describe the conditions under which water quality may be lowered in surface waters. Under such conditions water quality may not be lowered below criteria protective of existing beneficial uses unless lower quality is deemed necessary to allow important economic or social development. Antidegradation provisions are in Sections 3745-1-05 and 3745-1-54 of the OAC.

3.3 Regulatory programs that protect water quality

Regulated point source discharges

Any entity that discharges to a surface water of the state must obtain a National Pollutant Discharge Elimination System (NPDES) permit from the Ohio EPA Division of Surface Water. These permits limit the quantity of pollutants discharged and impose monitoring requirements and other conditions. The permits are designed to protect public health and the aquatic environment by helping to ensure compliance with state and federal regulations. Permits are classified as Individual and General.

Individual permits

Individual permits are unique to each facility. The discharge limits imposed in the permit are based on the type of operation, volume of discharge, receiving stream characteristics, and other factors. Those entities regulated by an individual NPDES permit in the Blanchard River watershed are listed in Table 3.2. Information regarding location of discharge, design flow, and annual average flow is included where appropriate. There are a total of 27 public and 11 industrial entities under permit.

General permits

General permits cover entities that have similar operations and types of discharges and that have a minimal affect on the environment. Types of discharges include:

- Industrial stormwater- associated with an industrial activity and discharged from a point source, including through a municipal separate storm sewer system
- Construction site stormwater- associated with activities that disturb > 1 acre

- Non contact cooling- waters that remove heat from a process, but do not come in contact with raw materials, products, or other wastes
- Petroleum corrective action- associated with clean up of surface and groundwater exposed to gasoline or related products
- Small sanitary sources- systems that discharge < 25,000 gallons per day
- Coal mines- associated with active coal strip mining
- Municipal separate storm sewer system (MS4)- any public entity that owns or operates a separate storm sewer system

In December 1999, USEPA promulgated Phase II storm water rules that required designated MS4 entities to submit permit applications. Phase II also required Ohio EPA to develop criteria to determine if MS4 entities with a population of 10,000 or more or a population density of 1,000/mi^2 must obtain permit coverage. Those entities regulated by a general NPDES permit in the Blanchard River watershed are listed in Table 3.3.

Unregulated point source discharges

Some point source facilities located in the study area are not regulated by the NPDES permit system. Many of these will eventually be issued a permit and some will be eliminated by sewer extensions. A list of these facilities is presented in Table 3.4.

Unsewered areas

Home sewage treatment systems are found mainly in rural areas and small villages. One common system employs a septic tank followed by a leaching tile field. The septic tank is a concrete box that provides primary treatment. It allows solids to settle and also promotes some decomposition. Solids will eventually fill the tank and routine cleaning is necessary. Water that overflows from the septic tank is distributed to a leaching tile field. This consists of pipe laid in trenches of gravel and sand that the wastewater slowly seeps into. Tile fields require a sufficient land area with well drained soils for them to operate effectively and they have a short life span. Home sewage treatment systems have minimal surface water impact if they are properly designed, installed, and maintained. Sometimes failed tile fields are bypassed into a storm sewer system or the nearest stream to prevent backing-up in yards and basements. This puts raw and poorly treated sewage in the stream and can be a major source of impairment, especially in larger communities and subdivisions. A list of unsewered villages located in the study area is presented in Table 3.5.

Table 3.1. Summary of Ohio's water quality standards.

Components	Examples	Description
Beneficial Use Designation	1. Water Supply • Public (drinking) • Agricultural • Industrial 2. Recreational Contact • Beaches (Bathing Waters) • Swimming (Primary Contact) • Wading (Secondary Contact) 3. Aquatic Life Habitats (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 body 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, water that was designated as a drinking water supply and could support exceptional biology would have more stringent 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 *Measures of fish health:* • Index of Biotic Integrity • Modified Index of Well Being *Measure of bug (macroinvertebrate) health:* • Invertebrate Community Index	Indicates the health of the instream biological community by using these three indices (measuring sticks). The numeric biological criteria (biocriteria) were developed using a large database of reference sites. These criteria are the basis for determining aquatic life use attainment.
	3. Whole effluent Toxicity (WET)	Measures the harmful effect of an effluent on living organisms.
	4. Bacteriological	Represents the level of bacteria protective of the potential recreation use.
Narrative Criteria (a.k.a. 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.	

Table 3.2. Summary of individual NPDES permits in the Blanchard River watershed.

Entity and Ohio EPA permit no.	**Receiving Stream (RM at discharge location)**	**Design Flow (MGD)**	**Annual 2005 Average Flow (MGD)**
Blanchard River Headwaters Watershed Assessment Unit (04100008-010)			
Mt Blanchard WWTP (proposed) 2PA00045	Blanchard River	—	
Dunkirk WWTP 2PB00061	Shallow Run (4.08)	0.137	0.38
Forest WWTP 2PB00044	Forest-Simpson Ditch (1.50)	0.20	0.07
Hardin Northern School 2PT00043	Shallow Run Tributary	0.01	0.002
Shelly Materials (Hardin Quarry) 2IJ00046	tile to Cessna Creek Tributary	1.10	0.55
Triumph Thermal Systems 2IS00001	Rickenbach (Schaefer) Ditch (4.97-4.94)	0.0515	0.03
Shelly Materials (Forest Quarry – formerly Duff Quarry) 2IJ00022	The Outlet (upper)	0.50	0.47
Outlet/Lye Creek Watershed Assessment Unit (04100008-020)			
Vanlue WWTP 2PA00016	Brights Ditch (3.87)	0.07	0.13
Eagle Creek Watershed Assessment Unit (04100008-030)			
Findlay WWTP 2PD00008	Blanchard River (56.42)	15.00	12.03
National Lime & Stone 2IJ00081	Aurand Run (2.80)	1.50	1.50
Enelco, Inc. (Tarbox-McCall Stone) Quarry 2IJ00064	Oil Ditch	1.00	1.00
BP Oil Findlay Bulk Plant 2IN00176	RR ditch to Blanchard River	—	
Camp Berry 2PR00146	Eagle Creek	0.015	<0.0001
Arlington WWTP 2PA00050	Buck Run Creek (0.75)	0.168	0.16
Arlington WTP 2IZ00000	Cottner Ditch to Eagle Creek	—	0.01
Ottawa Creek Watershed Assessment Unit (04100008-040)			
Tawa Ridge Estates 2PW00003	Ottawa Creek (3.28)	0.0028	
Ohio DOT I-75 Rest Area 2PP00019	Tiderishi Creek (3.82)	0.01	
Rawson WWTP 2PA00039	Ottawa Creek (7.20)	0.152	
Cory Rawson High School 2PT00031	Ottawa Creek (10.80)	0.0125	

Table 3.2. Summary of individual NPDES permits in the Blanchard River watershed.

Entity and Ohio EPA permit no.	**Receiving Stream (RM at discharge location)**	**Design Flow (MGD)**	**Annual 2005 Average Flow (MGD)**
Riley Creek Watershed Assessment Unit (04100008-050)			
Putnam Stone 2IJ00057	Riley Creek (1.94)	0.15	
Pandora WWTP 2PB00029	Riley Creek (5.35)	0.335	
Bluffton WWTP 2PC00005	Riley Creek (15.40)	1.90	
Bluffton Stone 2IJ00018	Riley Creek (17.19)	1.50	
Ridge Road MHP 2PY00046	Cranberry Run (4.0)	0.0035	
Mast Estates 2PG00038	Lower Little Riley Creek (3.6)	0.009	
Beaverdam WWTP 2PB00018	Lower Little Riley Creek Tributary (5.55/0.4)	0.10	
Richland Manor 2PR00199	Lower Little Riley Creek Tributary (5.69/0.1)	0.0186	
Speedway Super America # 3547 2PR00109	Lower Little Riley Creek (6.2)	0.015	
Cranberry Creek Watershed Assessment Unit (04100008-060)			
Country Acres 2PG00083	Deer Creek (1.58)	0.03	
Miller City High School 2PT00025	Miller City Cutoff (1.1)	0.008	
Putnam County Landfill 2IN00122	Wolfe Run (0.7)	—	
Putnam County Board of MRDD 2PG00112	Blanchard Tributary (15.2/0.6)	0.01	
Large River Assessment Unit (04100008-001)			
Ottawa WWTP 2PD00028	Blanchard River (22.16)	3.00	
Ottawa WTP 2IW00222	Blanchard River (27.1)	0.50	

Table 3.3. Summary of general permits in the Blanchard River watershed.

Entity	Ohio EPA Permit No.	Receiving Stream	Type
Blanchard River Headwaters Watershed Assessment Unit (04100008-010)			
Laidlaw Transit Inc	2GR00321	Blanchard River Tributary	ISW
Shelly Co	2GG00106	Cessna Creek Tributaries	ISW
ES Wagner Co	2GC00796	Ripley Run	CSW
ES Wagner Co	2GC00797	Ripley Run	CSW
ES Wagner Co	2GC00958	Unnamed Tributary To ODOT Ditch To Blanchard River	CSW
Hancock County Engineers Office	2GC00847	Blanchard River	CSW
Vreba Hoff Dairy Development LLC	2GC00277	Cessna Creek Tributary	CSW
Outlet/Lye Creek Watershed Assessment Unit (04100008-020)			
Createc Corp	2GR00546	City of Findlay MS4 to Blanchard River	ISW
Filtech Inc	2GR00503	City of Findlay MS4 to Blanchard River	ISW
Findlex Corp	2GR00165	City of Findlay MS4 to Blanchard River	ISW
Hilltop Energy Inc	2GR00095	Brights Ditch	ISW
Hisan Inc	2GR00197	City of Findlay MS4 to Blanchard River	ISW
Kuss Filtration	2GR00576	City of Findlay MS4 to Blanchard River	ISW
Pieco Inc DBA Superior Trim	2GR00599	City of Findlay MS4 to Blanchard River	ISW
United Parcel Service	2GG00225	Blanchard River Tributary	ISW
Arcadia Point Development	2GC00404	Regional Retention Pond For Brookstone	CSW
Best Construction	2GC00375	Lye Ck	CSW
Best Construction	2GC00538	Lye Ck	CSW
Best Construction	2GC00914	Lye Ck	CSW
Birchaven Estates At Eastern Woods Ltd	2GC00638	Blanchard River	CSW
Build Covington Greens LLC	2GC00337	City of Findlay MS4 to Blanchard River	CSW
CCA Inc	2GC00911	Blanchard River	CSW
Darden Restaurant	2GC00327	Blanchard River Tributary	CSW
Findlay One LLC	2GC00592	Retention Pond	CSW

Table 3.3. Summary of general permits in the Blanchard River watershed.

Entity	Ohio EPA Permit No.	Receiving Stream	Type
First Federal	2GC00041	City of Findlay MS4 to Blanchard River	CSW
FMT Inc	2GC00087	Blanchard River	CSW
Hancock County Engineers Office	2GC00853	Lye Creek, Blanchard River	CSW
Kohl's Dept Stores Inc	2GC00417	Blanchard River Tributary	CSW
ODOT District 1	2GC00255	Blanchard River	CSW
Owens Community College	2GC00245	County Storm Sewer	CSW
Patriot Ctr LLC Co/ Rudolph Libbe Properties	2GC00535	City Of Findlay Storm Sewer	CSW
Paul Ballinger	2GC01086	Blanchard River	CSW
Petti Construction	2GC00544	Blanchard River	CSW
Timberstone Construction Inc	2GC00323	Blanchard River Tributary	CSW
Timberstone Construction Inc	2GC00392	Blanchard River Tributary	CSW
Weinko Inc	2GC00882	Blanchard River Tributary	CSW
Weinko Inc	2GC00883	Blanchard River Tributary	CSW
Winkoe	2GC00260	Ditch	CSW
Eagle Creek Watershed Assessment Unit (04100008-030)			
Ball Metal Beverage Container Corp	2GG00050	Howard Run	ISW
Centrex Corp	2GR00204	Oil Ditch	ISW
Centrex Corp	2GR00205	Oil Ditch	ISW
Centrex Corp	2GR00207	City of Findlay Storm Sewers	ISW
Centrex Corp	2GR00208	Oil Ditch	ISW
Centrex Corp	2GR00210	Oil Ditch	ISW
Cooper Tire & Rubber Co	2GG00078	Oil Ditch	ISW
Dow Chemical Co	2GR00261	Howard Run	ISW
Dukes Transportation Services Inc	2GR00100	Aurand Run	ISW
Garner Trucking Inc	2GG00143	Aurand Run	ISW
Hancor Inc	2GR00034	Eagle Creek	ISW
Hancor Inc	2GR00035	Eagle Creek Tributary	ISW
Hyway Trucking Company	2GG00031	Blanchard River Tributary	ISW
National Lime & Stone Co	2GR00068	Aurand Run	ISW

Table 3.3. Summary of general permits in the Blanchard River watershed.

Entity	Ohio EPA Permit No.	Receiving Stream	Type
Owens Brockway Plastic Products Inc	2GG00286	Oil Ditch	ISW
Owens Brockway Plastic Products Inc	2GR00299	Oil Ditch	ISW
Remington Arms Co Inc	2GR00398	Eagle Creek	ISW
Spectrulite Consortium Inc	2GR00092	Blanchard River Tributary	ISW
Stoneco Inc	2GR00478	Aurand Run	ISW
Waste Management Of Ohio Inc	2GG00254	Oil Ditch	ISW
Waste Management Of Ohio Inc	2GR00160	Oil Ditch	ISW
Werk Brau Company Inc	2GR00289	City of Findlay Storm Sewers	ISW
Whirlpool Corp	2GR00258	City of Findlay Storm Sewers?	ISW
Wyandot Dolomite Inc	2GG00047	Aurand Run	ISW
Blanchard Valley Health Assoc	2GC00551	City of Findlay Storm Sewers	CSW
Blanchard Valley Health Assoc	2GC00998	Blanchard River Tributary	CSW
Brookview Homes Inc	2GC01242	Blanchard River Tributary	CSW
C-International	2GC00111	Howard Run	CSW
City Of Findlay	2GC00055	Blanchard River	CSW
Compass Environmental Inc	2GC00510	Oil Ditch	CSW
ES Wagner Co	2GC00785	Eagle Creek	CSW
ES Wagner Co	2GC00788	Eagle Creek	CSW
ES Wagner Co	2GC00795	Hydraulic Ditch	CSW
ES Wagner Co	2GC00799	Flat Branch	CSW
ES Wagner Co	2GC00800	Flat Branch	CSW
Findlay 75 LLC	2GC00088	Blanchard River Tributary	CSW
Findlay Professional Park LLC	2GC00399	Lake Cascades	CSW
Flag City Development Ltd	2GC00146	County Storm Sewer	CSW
Gateway Church	2GC00464	Aurand Run	CSW
Hancock Co Engrs Office	2GC01276	Howard Run	CSW
Hancock Co Engrs Office	2GC00514	Eagle Creek	CSW
Hancock Co Engrs Office	2GC00556	Blanchard River	CSW
Jim Baker	2GC00418	Aurand Run	CSW

Table 3.3. Summary of general permits in the Blanchard River watershed.

Entity	Ohio EPA Permit No.	Receiving Stream	Type
Marathon Ashland Pipe Line LLC	2GC00959	City of Findlay Storm Sewer to Blanchard River	CSW
Nigh Properties LLC	2GC00940	Storm Sewer to Eagle Ck	CSW
ODOT District 1	2GC00203		CSW
ODOT District 1	2GC00506	Riley Ck Tribs, Eagle Ck, Flat Branch, Blanchard R	CSW
ODOT District 1	2GC00637	Aurand Run	CSW
ODOT District 1	2GC00656	Blanchard River	CSW
ODOT District 1	2GC00695	Blanchard River	CSW
ODOT District 1	2GC01137	Blanchard River	CSW
RG Properties Inc	2GC00541	Blanchard River	CSW
Speedway Superamerica LLC	2GC00385	City Of Findlay MS4	CSW
Westend Properties Ltd	2GC00813	State Storm Sewer To Blanchard River Tributary	CSW
Whitson Properties	2GC01133	Blanchard River Tributary	CSW
Wick's Construction Co Inc	2GC00458	Ditch to Blanchard R	CSW
Wick's Construction Co Inc	2GC00803	Ditch to Blanchard R	CSW
BP Oil Company	2GU00030	Dalzell Ditch	PCA
Petroleum Systems Inc	2GU00014	Oil Ditch	PCA
Petroleum Systems Inc	2GU00041	Storm Sewer to Eagle Ck	PCA
Ottawa Creek Watershed Assessment Unit (04100008-040)			
Nelson Manufacturing Co.	2GR00433	Blanchard Tributary (30.81)	ISW
Putnam County Airport	2GC01002	Blanchard Tributary (32.31)	CSW
Ohio DOT (US Rt. 224)	2GC00400	Blanchard Tributary (35.35)	CSW
Ohio DOT (State Rt. 235)	2GC00214	Moffitt Ditch, Ottawa Creek Tributary (0.4)	CSW
Riley Creek Watershed Assessment Unit (04100008-050)			
Gerken Materials, Plant #5	2GG00241	Riley Creek	ISW
DTR Industries	2GG00035	Riley Creek	ISW
Gerken Materials, Plant #3	2GG00239	Riley Creek	ISW
Gerken Materials, Plant #10	2GG00243	Riley Creek	ISW
Tower Automotive	2GR00488	Marsh Run	ISW
Mid Bus, Inc.	2GR00119	Riley Creek	ISW

Table 3.3. Summary of general permits in the Blanchard River watershed.

Entity	Ohio EPA Permit No.	Receiving Stream	Type
Bluffton Septic Tank Co.	2GR00118	Lower Little Riley Creek	ISW
Marshall's Import Cars and Parts	2GR00150	Upper Little Riley Creek	ISW
Clemens Development Systems	2GC00125	Riley Creek	CSW
Village of Beaverdam	2GC00654	May Ditch	CSW
Allen County Engineers	2GC00084	Riley Creek	CSW
Allen County Engineers	2GC00008	Riley Creek	CSW
Ohio DOT	2GC00506	Binkley Ditch, Cummins Ditch, Riley Creek, Upper Little Riley Creek	CSW
Cranberry Creek Watershed Assessment Unit (04100008-060)			
WC Wood Company, Inc.	2GG00055	Cranberry Tributary (4.76)	ISW
Kahle&Langhals Ready Mix	2GG00099	Pike Run	ISW
LG Phillips Displays	2GR00417	Tawa Run	ISW
Touchstone CMP	2GC00120	Blanchard Tributary (21.52)	CSW
Van Ham Dairy LLC	2GC00303	Blanchard Tributary (2.21)	CSW
Village of Ottawa	2GC00574	Selhorst Ditch	CSW
Ohio DOT	2GC00252	Miller City Cutoff	CSW
Ohio DOT	2GC00465	Tawa Run	CSW

ISW Industrial Storm Water
CSW Construction Storm Water
SSD Small Sanitary Discharger
NCC Non-Contact Cooling Water
PCA Petroleum Corrective Action
MS4-R Municipal Separate Storm Sewer System- Rapidly Developing Watershed
MS4-B Municipal Separate Storm Sewer System- Baseline

Table 3.4. Point source facilities not currently regulated by an NPDES permit.

Entity	Receiving Stream (RM of Discharge)	Design Flow (MGD)
Blanchard River Headwaters Watershed Assessment Unit (04100008-010)		
Claradan County Senior Housing Complex 2PW00008	Blanchard River (77.98)	0.0018
Outlet/Lye Creek Watershed Assessment Unit (04100008-020)		
Heritage Springs Camp Grounds 2PR00182	Brights Ditch Tributary	0.0125
Eagle Creek Watershed Assessment Unit (04100008-030)		
Eagle Creek Utility Co. 2PU00004	Eagle Creek (3.37)	—
Sycamore Springs Golf Course 2PR00098	Cottner Ditch to Eagle Creek (0.70)	0.004
Ottawa Creek Watershed Assessment Unit (04100008-040)		
Trinity Lutheran Church	Higbie Redick Ditch 2.9	0.002
Putnam Acres Care Center	Blanchard River Tributary (32.31) 2.32	0.015
Riley Creek Watershed Assessment Unit (04100008-050)		
Green Meadows MHP	Binkley Ditch 4.0	0.0075
Cranberry Creek Watershed Assessment Unit (04100008-060)		
Pike Run Golf Course	Pike Run	__
Rod and Gun Campground	Pike Run	__
Large River Assessment Unit (04100008-001)		
N/A	N/A	N/A

Table 3.5. Areas where failed home sewage systems are a concern.

Location	Receiving Stream	Population
Blanchard River Headwaters Watershed Assessment Unit (04100008-010)		
Patterson	The Outlet – upper (90.94)	147
Mt. Blanchard	Blanchard River	478
Wharton	Wharton Ditch #1(trib to Potato Run)	393
Outlet/Lye Creek Watershed Assessment Unit (04100008-020)		
Houcktown	Lye Creek	data unavailable
Eagle Creek Watershed Assessment Unit (04100008-030)		
Williamstown	Flat Branch Trib	data unavailable
Ottawa Creek Watershed Assessment Unit (04100008-040)		
Jenera	Higbie Redick Ditch	227
Riley Creek Watershed Assessment Unit (04100008-050)		
N/A	N/A	N/A
Cranberry Creek Watershed Assessment Unit (04100008-060)		
Miller City	Miller City Cutoff	105
Maag / Kleeman Ditch Area (Roads North 11-J, 10-K & 10-L)	Cranberry Creek	data unavailable
Large River Assessment Unit (04100008-001)		
Gilboa	Blanchard River	173

4.0 WATERSHED ASSESSMENT RESULTS: STATUS OF WATER QUALITY RELATIVE TO THE STANDARDS

4.1 Recreational uses

The safety of waters in the study area for recreational activities was assessed using fecal coliform bacteria as the indicator organism. The presence of these organisms indicates that water has been contaminated by feces from warm blooded animals. Elevated bacteria counts, reported in colony forming units (CFU) per 100 ml of sample, increase the risk of illness for people who come in contact with the water.

Recreation use status was determined for each of six WAUs aligned with the 11 digit hydrologic unit, plus the mainstem LRAU. Results from the 2005 survey and a discussion of the test method are summarized in the *Ohio 2008 Integrated Water Quality Monitoring and Assessment Report*. Data that were pooled for statistical analysis included samples from the survey along with any from NPDES permit holders collected during the May 1-October 15 recreation season. The recreation use is considered impaired if either the 75th percentile exceeds 1,000 or the 90th percentile exceeds 2,000. The large river assessment unit was the only assessment unit not considered impaired.

Site specific evaluations of the Primary Contact Recreation use were done in the Blanchard River, Eagle Creek, Ottawa Creek, and Riley Creek. These larger streams were selected for a more detailed evaluation because they are more frequently used for activities like fishing, hunting, and boating. A minimum of five samples must be collected within any 30 day period during the recreation season to determine if a site meets the Ohio WQS criteria (OAC, Chapter 3745-1-07; Table 7.13). A site is considered in violation if the fecal coliform geometric mean exceeds 1,000 CFU/100 ml, or more than ten percent of the samples exceed 2,000 CFU/100 ml. Exceeding the geometric mean criterion indicates chronic water quality problems where the likelihood for becoming sick from water recreation is significant most or all of the time. A violation of only the criterion dealing with ten percent of the samples is more reflective of acute water quality problems that typically occur after runoff events.

Sanitary conditions were generally good in the Blanchard River mainstem. Only five of twenty-three sites were in violation and two of these were because of a single sample that violated the maximum. The three geometric mean violations were all located at sites in the headwaters within Hardin County. Eagle Creek was the most degraded of the tributary streams. All six sampled sites were in violation of the geometric mean criterion. Riley Creek also exhibited a fair amount of degradation. A total of six of eight sites were in violation, although two of these were due to a single sample that violated the maximum. Ottawa Creek was the least degraded of the tributaries. A total of three of five sites were in violation, including one due to a single sample.

4.1.1 Blanchard River headwaters WAU

An overall determination of the recreation use status was made for the entire WAU. Data used in the analysis includes samples collected during the May 1-October 15 recreation season obtained from both the 2005 stream survey and monthly operating reports filed by the Dunkirk and Forest WWTPs. The recreation use is considered impaired for this WAU (-010) because the 75th percentile was 2,700, and 90th percentile was 8,320.

A site specific evaluation of the Primary Contact Recreation (PCR) use was done for the Blanchard River mainstem because it is used for fishing and hunting. Three of these sites violated both the maximum criterion and the geometric mean criterion for primary contact recreation. A single high fecal coliform sample collected at each of the sites at RM 101.03 and RM 95.60 during high flow accounted for both the site specific maximum and the geometric mean violation, and is likely the result of runoff from the application of manure to surrounding farm fields. The site specific maximum was exceeded in nearly every sample collected at RM 100.05, which also resulted in a violation of the geometric mean at this site. Impacts from high fecal coliform here can be attributed to discharges from nearby on-lot septic systems.

The Village of Mt. Blanchard is bounded on the west by the Blanchard River mainstem and on the east by Potato Run just about on to two miles upstream of where Potato Run flows into the mainstem at the downstream boundary of the Blanchard River Headwaters WAU (-010). Mt. Blanchard has no centralized collection or treatment of residential and commercial sanitary waste. A sampling survey conducted in 1994 indicated that discharges from Mt. Blanchard's combined sewers are having a negative impact on the water quality of the Blanchard River. Mt. Blanchard has an approved plan to build a controlled discharge lagoon wastewater treatment system, but currently remains unsewered.

Dunkirk has several CSOs that are still impacting the stream, causing high fecal coliform counts in the section of Shallow Run that flows through and downstream of Dunkirk.

The Village of Patterson remains unsewered and continues to impact the water quality of The Outlet (upper) at and downstream of RM 3.00 causing high fecal coliform counts.

Forest-Simpson Ditch continues to be grossly polluted by the effluent from the Forest WWTP lagoons, as originally identified in the 1983 study. Fecal coliform counts exceeded the site specific maximum in three of six grab samples.

A CSO from the Village of Forest is the likely source of high fecal coliform counts in Rickenbach Ditch. Fecal coliform counts exceeded the site specific maximum at two sites downstream of the CSO in two of six grab samples.

Wharton Ditch is confluent to Potato Run at RM 7.91. During the 1983 Biological and Water Quality Survey of the Blanchard River and Selected Tributaries, Wharton Ditch was not sampled, but Potato Run was sampled at RM 7.90 and the results showed elevated fecal coliform counts (3,000 – 100,000 CFU/100ml, median 23,000 CFU/100ml), as well as elevated levels of ammonia and phosphorus. The cause of these water quality impacts to Potato Run was attributed to the storm sewer effluent from the unsewered Village of Wharton which discharges to Wharton Ditch.

Figure 4.1. Wharton Ditch downstream of Wharton's storm sewer discharge with evidence of contamination from septic discharges.

During the 2005 survey samples were collected in Wharton Ditch immediately downstream of Wharton's storm sewer discharge (Figure 4.1). The water here was gray and had a very strong septic odor, fecal coliform counts (81,000 - >200,000 CFU/100 ml, median >200,000 CFU/100ml) were above the site specific maximum, and there were numerous other violations of the WQS chemical specific criteria. It is clear from these results that the Village of Wharton has continued to have a significant negative impact on the water quality of both Wharton Ditch and Potato Run since the sampling that was conducted 22 years ago.

4.1.2 The Outlet/Lye Creek WAU

An overall determination of the recreation use status was made for the entire WAU. Data used in the analysis includes samples collected during the May 1-October 15 recreation season obtained from both the 2005 stream survey and monthly operating reports filed by the Vanlue WWTP. The 75th percentile was only 542 CFU/100 ml, but the recreation use is considered impaired because the 90th percentile was 4,110 CFU/100 ml.

A site specific evaluation of the Primary Contact Recreation (PCR) use was done for the Blanchard River mainstem because it is used for fishing and hunting. None of the sites violated the geometric mean and there was only one violation of the site specific maximum.

The unsewered Village of Houcktown discharges untreated sewage to Lye Creek near Hancock CR 26 (RM 9.44-9.45). Lye Creek is impaired here by high fecal coliform counts, as well as high ammonia levels, phosphorus levels above target, and fluctuating and often supersaturated dissolved oxygen levels.

In Stahl Ditch, higher fecal coliform along with some higher ammonia results, high phosphorus levels at TR 199, and lower dissolved oxygen, indicate that runoff from fertilizers and manure application is a possible source, or water quality at the sample location may have been locally affected by the discharge of failed septic systems nearby.

4.1.3 Eagle Creek WAU

An overall determination of the recreation use status was made for the entire WAU. Data used in the analysis includes samples collected during the May 1-October 15 recreation season obtained from both the 2005 stream survey and monthly operating reports filed by the Findlay WWTP. Recreation is considered impaired because the 75th percentile was 1,800 CFU/100 ml, and 90th percentile was 4,600 CFU/100 ml.

A site specific evaluation of the PCR use was done for Eagle Creek, as well as the Blanchard River mainstem within in the Eagle Creek WAU, because it is used for fishing and hunting. None of the Blanchard River sites violated WQS criteria, but all of the Eagle Creek sites exceeded 2,000 CFU/100 ml in at least two of five samples (40 percent or more) and the geometric means at all Eagle Creek sites exceeded 1,000 CFU/100 ml.

At most of the Eagle Creek sites the high fecal coliform samples were associated with high flow conditions following rain events. However, the fecal coliform levels in Eagle Creek at CR 27, the most upstream site, and at Lincoln St, the most downstream site, consistently violated the WQS criteria throughout the survey. At the upstream site, the source could be local septic tank discharges upstream that were not identified. The Lincoln St. site is downstream of the Eagle Creek Utility discharge and several City of Findlay CSOs; which are all contributing to high fecal coliform levels in Eagle Creek.

Hydraulic Ditch flows along the east side of the unsewered Village of Dola, and although no discharges of untreated sanitary waste from Dola to Hydraulic Ditch were specifically identified during this survey, it does not preclude the potential that one or more exist. Three of the six grab samples tested for fecal coliform exceeded the PCR maximum.

The unsewered community of Williamstown is situated about equidistant between Flat Branch and Woodruff Ditch. Although no discharges to either stream from the Williamstown area were specifically identified during this survey, it does not preclude the potential that one or more exist. Two sites were sampled in Flat Branch, upstream (RM 1.11) and downstream (RM 0.06) of Woodruff Ditch. While data suggests there may be a source of ammonia, nitrate-nitrite and phosphorus upstream of each of the sites, there were no fecal coliform levels that exceeded the PCR maximum.

4.1.4 Ottawa Creek WAU

An overall determination of the recreation use status for the WAU was made by pooling a combination of survey and MOR data. The recreation use is considered impaired because the 75th percentile was 1,600 CFU/100 ml and the 90th percentile was 5,400 CFU/100 ml.

Site specific evaluations of the PCR use were done on the Blanchard River and Ottawa Creek because they are popular sport fishing destinations. The Blanchard River at CR 53 (RM 41.31) had five samples collected June 27-July 25. The geometric mean was 302 CFU/100 ml and the maximum count was 1,400 CFU/100 ml, so this site meets PCR criteria. A set of five samples was collected at five sites on Ottawa Creek June 28-July 26. The site at CR 12 in Orange Township (RM 18.52) violated the maximum criteria, while the sites at CR 12 in Union Township (RM 14.67) and TR 79 (RM 4.82) violated both the geometric mean and maximum. Potential sources in the area include the Rawson WWTP, home sewage systems, and livestock. The Rawson plant is a lagoon system with a controlled discharge to Ottawa Creek at RM 7.2. It presently serves the Villages of Rawson and Mt. Cory and construction of sewers is underway to connect Benton Ridge. The plant did not discharge during the study period and the only flow reported in 2005 was 5.48 million gallons in November. Another potential source is manure settling ponds at the Cramer duck farm located on CR 54. It is not known if these ponds have overflows, but they probably get washed out during high water since they are in the floodplain.

4.1.5 Riley Creek WAU

An overall determination of the recreation use status for the WAU was made by pooling a combination of survey and MOR data (Bluffton WWTP, Pandora WWTP). The recreation use is considered impaired because the 75th percentile was 2,200 CFU/100 ml and the 90th percentile was 7,600 CFU/100 ml.

Site specific evaluations of the PCR use were done on Riley Creek because it is a popular sport fishing destination. A set of five samples was collected at eight sites from June 29-July 27. Six of these sites violated the maximum criterion and three of those violated the geometric mean criterion.

An impact from home sewage systems and possibly runoff from livestock is evident at TR 51 (RM 19.40). This was the first site that violated the geometric mean criterion. The highest levels were documented at Spring Street (RM 15.41) just above the Bluffton WWTP. The source here is probably the Jefferson Street CSO, since there were several rainstorms during July that were heavy enough to trigger an overflow. These overflows were also identified as a major problem during the 1991 study, but Bluffton has made major collection system improvements since that time. The last site to violate the geometric mean criterion was outside Bluffton at Fett Road (RM 13.05) and this is probably a lingering impact from CSOs.

4.1.6 Cranberry Creek WAU

An overall determination of the recreation use status for the WAU was done by pooling a total of 70 bacteria counts from samples collected at 12 survey sites. The recreation use is considered impaired because the 75th percentile was 2,400 CFU/100 ml and the 90th percentile was 9,280 CFU/100 ml.

4.1.7 Blanchard LRAU

An overall determination of the recreation use status for the LRAU was made by pooling a combination of survey and MOR data (Ottawa WWTP). The recreation use is not considered impaired because the 75th percentile was 408 CFU/100 ml and 90th percentile was 992 CFU/100 ml.

Site specific evaluations of the PCR use were done on the Blanchard River because it is commonly used for fishing, hunting, and canoeing. A set of five samples was collected at seven sites from June 27-July 25. None of the individual sites violated the geometric mean criterion. One sample collected at Putnam CR 15 (RM 13.37) on July 19 violated the maximum criterion. Counts at all sites tended to be higher than normal on this date. A likely reason is that there were heavy rainstorms several days before the sampling event. These storms tend to increase the impact from sewage bypasses, CSOs, and runoff in livestock production areas.

4.2 Aquatic life uses

Current and recommended aquatic life, water supply and recreation uses are presented in the aquatic life use attainment table (Appendix A), which provides biological index scores/assessments for each of the sampled locations and causes and sources of impairment. Thirty four (40.4 percent) of the assessed sites fully met the designated or recommended aquatic life use. Twenty (23.8 percent) of the sites partially met and thirty (35.7 percent) of the sites were not attaining their designated or recommended use. A number of the tributary streams evaluated in this study were originally designated for aquatic life use in the 1978 and 1985 Ohio WQS; others were previously undesignated. The current biological assessment methods and numerical criteria did not exist then. This study, as an objective and robust use evaluation, is precedent setting in comparison to the 1978 and 1985 designations. Several streams have been evaluated for the first time using a standardized biological approach as part of this study. Ohio EPA is obligated by a 1981 public notice to review and evaluate all aquatic life use designations outside of the warmwater habitat (WWH) use prior to basing any permitting actions on the existing, unverified use designations. Thus, some of the following aquatic life use recommendations constitute a fulfillment of that obligation.

Previous biological and habitat evaluations of selected streams in the Blanchard River watershed resulted in the application of the WWH aquatic life use for the Blanchard River, Potato Run, Shallow Run, Eagle Creek and Ottawa Creek. Sampling conducted in 2005 confirmed the WWH designation for each of these streams.

4.2.1 Blanchard River headwaters WAU

Attainment status was determined for sixteen sites in the Blanchard River Headwaters watershed, representing approximately 47 assessed stream miles in the assessment unit. Four sites representing thirteen assessed stream miles, fully met the current or recommended aquatic life use. One site, representative of seven assessed miles, partially met and eleven sites, totaling 25 assessed stream miles, were in non-attainment of the current or recommended aquatic life use.

Biological communities in the Blanchard River headwaters WAU were impacted by a combination of factors related to agricultural practices in the watershed along with inadequate waste treatment from several of the small communities in the area. Pollution sources from these communities included CSOs, WWTP effluent and releases from unsewered areas. Hydromodification, principally channelization, affected 79 percent of the impaired stream miles. Instream habitat and natural flow regimes were altered as a result. Often riparian vegetation was limited to grasses and low growing brush. The combination of exposure to sunlight and elevated nutrients promoted the excessive algal growth and wide swings in dissolved oxygen concentrations. An excess of nutrients, and impacts associated with dissolved oxygen/organic enrichment and ammonia were identified as causative factors for 65, 53, and 29 percent of the impaired miles, respectively. Thermal modification (i.e. elevated temperature) impacted approximately nine percent of the impaired miles.

Despite a highly modified habitat, the upper site on the Blanchard River (RM 101.0-101.3) supported fish and macroinvertebrates that at least marginally met ecoregional expectations. Requisite credible data collection requirements were lacking to complete an evaluation of the status of use attainment at RM 100.1, but, the site supported a macroinvertebrate community that was consistent with the WWH use. Significant impact to biological resources was documented at further downstream at RMs 97.5 and 96.0. Pollution tolerant bluntnose minnows comprised an inordinately high proportion of the community and the number of mayfly and caddisfly taxa collected from the available habitat declined from 15 at RM 101.0 to no more than seven taxa at RMs 97.5 and 96.0. Habitat alteration related to agricultural was a contributing factor to wide fluctuations in dissolved oxygen and elevated daytime heating of the stream. Additionally, RM 96.0 is downstream from the confluence of Shallow Run. CSOs in the Village of Dunkirk have been identified as a source of organic load and elevated nutrients to Shallow Run and, subsequently, the Blanchard River mainstem.

Fish and macroinvertebrate communities were markedly improved at RM 88.2/88.3. Fish community scores were in the very good range and the macroinvertebrate community yielded an ICI score in the exceptional range.

While the macroinvertebrate community continued to exceed minimum ecoregional expectations, the fish community condition declined significantly at RM 82.1 despite an improved habitat (QHEI= 62.5) compared with RM 88.3. It appeared that nutrient inputs from the surrounding watershed were elevated, favoring more pollution tolerant fish species. An IBI score in the fair range at RM 82.1 was due, in large part, to a high abundance of Bluntnose Minnows (*Pimephales* notatus) and a limited diversity of round bodied sucker species. Biological sampling reflected partial attainment of a WWH aquatic life use as a result. Chemical sampling confirmed that nutrients were elevated at this site and diurnal dissolved oxygen levels fluctuated in excess of five mg/l and went below 4.0 mg/l for significant periods of time.

In summary, approximately nine miles of the mainstem Blanchard River met the WWH use. Seven miles partially met ecoregional expectations and nine miles were not attaining the WWH use. An additional three miles were not fully assessed but did yield a macroinvertebrate assemblage in good condition.

None of the three unnamed tributaries to the Blanchard River met even the modest expectations of the recommended MWH use. One or both of the biological groups were in poor or very poor condition at each of the three sampled locations. Habitat alteration and a commensurate limited capacity to assimilate nutrients related to agricultural production in the surrounding watersheds were the most immediate impacts to the streams. Additional impacts were also likely due to elevated stream temperatures and wide swings in dissolved oxygen concentration.

Requisite credible data collection requirements were lacking to complete an evaluation of the status of the aquatic life use attainment of Cessna Creek at RM 5.6; but, the macroinvertebrate community at the site was consistent with the WWH use. Forty-three taxa were collected from the natural substrates including nine pollution sensitive taxa. Macroinvertebrate sampling produced a similar result at RM 3.1 and the fish community IBI score of 40 also met ecoregional expectations. Closer to the mouth of Cessna Creek the fish and macroinvertebrate community condition declined commensurate with a lowering in the habitat quality at the site. The cumulative effects of agricultural related instream and riparian habitat alterations were reflected in fish and macroinvertebrate assemblages at the site. The diversity of macroinvertebrates collected was just slightly more than half the number collected at RM 3.1. Pollution intolerant fish species were absent and simple lithophilic fish were present in low abundance. Simple lithophiles require clean unembedded substrates for propagation of their eggs. Full attainment of the WWH use at RM 3.1 is an indication that the non-attainment documented at RM 0.5 can be rectified by allowing recovery of typical WWH stream attributes.

Requisite credible data collection requirements were lacking to complete an evaluation of the status of the aquatic life use attainment of Shallow Run, but the macroinvertebrate community at both sites was reflective of an impaired resource. Both sampled locations, at RM 3.0 and 0.9 were predominated by pollution tolerant taxa and were in poor to very poor condition. An earlier investigation of Shallow Run done in 1983 produced similar results. Impacts to the stream included elevated nutrients and ammonia levels downstream from the Village of Dunkirk, made worse by the channelized condition of the stream. Although the water quality in Shallow Run has improved since Dunkirk constructed its treatment lagoons in 1988, Dunkirk has several CSOs that are still impacting the stream, causing low dissolved oxygen, high ammonia concentrations, phosphorus loading and high fecal coliform counts in the section of

Shallow Run that flows through and downstream of Dunkirk. The physical nature of the stream provided for effective water transport away from adjacent farm fields but negatively impacted the biology of the stream in limiting habitat and increasing the likelihood for elevated water temperatures and wide variation in dissolved oxygen concentrations.

No macroinvertebrate sampling was conducted on the Outlet (upper) at RM 3.6 and the fish were in only fair condition. Both organism groups were in marginally good condition at RM 0.3; owing, in part, to more heterogeneous substrates. Variation in the substrates is a benefit to fish and macroinvertebrates communities in that the population is more evenly distributed rather. This is one of the principle impacts that result when streams are maintained primarily to remove excess water from the surrounding landscape. Additional improvement in biological community condition is possible by limiting of organic and nutrient loadings from the unsewered Village of Patterson.

Fish and macroinvertebrate assemblages in Forest-Simpson Ditch at RM 0.8 were both in very poor condition, and reflected severely degraded water quality. Pollution tolerant taxa dominated both assemblages and just fifteen fish were collected. Forest-Simpson Ditch has been channelized and continues to be grossly polluted by the effluent from the Forest WWTP lagoons, as originally identified in the 1983 study. The Forest WWTP lagoon discharge upstream from RM 0.8 contributed a high nutrient and organic load that overwhelmed the stream.

Figure 4.2. Forest-Simpson Ditch at TR 195 downstream of Forest WWTP lagoons showing exceptionally high algae production.

Water in the stream is pea green as indicated in Figure 4.2. Chemical sampling documented chronically low dissolved oxygen levels along with elevated ammonia and phosphorus concentrations.

Ripley Run failed to attain a WWH use due to the poor condition of the fish community at RM 0.1. The macroinvertebrate community was in marginally good condition. Unusually high ammonia concentrations were measured on two of six occasions during the summer of 2005, the source of which was undetermined (See water quality discussion). Intermittent toxic levels of ammonia in combination with a somewhat limiting habitat appeared to be the principle causes for non-attainment of the WWH use near the mouth of Ripley Run.

Requisite credible data collection requirements were lacking to complete an evaluation of the status of the aquatic life use of Rickenbach Ditch, but the macroinvertebrate community was reflective of an impaired resource at RM 1.2. The stream was nearly dry for a significant portion of the 2005 sampling period. The site was predominated by pollution tolerant taxa reflecting poor community condition. Impacts to the stream included elevated nutrients contributed by a CSO in the Village of Forest along with TDS and metals from the Triumph Thermal Systems discharge (permit no. 2IS00001). Water quality impacts were likely made worse by the channelized condition of the stream.

Both fish and macroinvertebrate sampling results from Potato Run were in the fair range at RM 9.6 with a limited habitat and nutrient enrichment related to agriculture being the principle causes of non-attainment. Pollution tolerant and pioneering fish comprised a large majority of the population which negatively affected the IBI score. Pioneering species are able to take advantage of unstable and impacted habitats where competition with other species is limited. Correspondingly, pollution tolerant macroinvertebrate taxa comprised a large portion of the community at RM 9.6. The fish community showed continued impairment at RM 1.8 even though habitat at the site was improved. The IBI score remained in the fair range. The MIwb score, which is a measure of fish community structure, was in the very poor range, owing to the predominance of a single tolerant species, *Pimephales notatus* (Bluntnose Minnow). Further downstream at RM 0.1 supported a relatively diverse macroinvertebrate fauna. The results suggested a gradual lessening of water quality impacts with increasing stream size; however, the influence of limited habitat and nutrient inputs in the upper watershed still tended to overwhelm beneficial attributes of improved habitat at RM 1.8.

4.2.2 The Outlet/Lye Creek WAU

Attainment status was determined for eight sites in the Outlet/Lye Creek WAU, representing approximately 33 assessed stream miles in the watershed. Limited sampling of an additional eight sites allowed for a determination of aquatic life use designation but credible data requirements negated a complete evaluation of attainment status. Four sites representing eighteen assessed stream miles, fully met the current or recommended aquatic life use. Three sites, representative of eleven assessed miles, partially met and one site, totaling four assessed stream miles, was in non-attainment of the current or recommended aquatic life use.

Biological communities in the Outlet/Lye Creek WAU were impacted primarily by factors related to agricultural practices in the watershed. Elevated nutrients, and impacts associated with dissolved oxygen/organic enrichment were identified as causative factors for 100 percent, and 53 percent, of the impaired miles, respectively. Hydromodification, principally channelization, affected 47 percent of the impaired stream miles. Instream habitat and natural flow regimes were altered as a result. Often riparian vegetation was limited to grasses and low growing brush. The combination of exposure to sunlight and elevated nutrients promoted excessive primary productivity.

Three headwater sites (<20 square miles drainage area) received both fish and macroinvertebrate sampling. All three met the recommended MWH aquatic life use. Just one of six additional headwater sites where qualitative macroinvertebrate sampling only was conducted produced assemblages that were consistent with a MWH use. Overall the sampling results were typical for headwater sized streams throughout the entire Blanchard River watershed, in that impacts were evident principally as a result of agricultural practices in the watershed.

Five wadable streams sites with drainage areas in excess of 20 square miles in the Outlet/Lye Creek WAU also demonstrated impacts to significant portions of the assessed miles. Only one location (Blanchard River at RM 71.9) supported both fish and macroinvertebrate communities that met ecoregional expectations. Two additional sites supported good to very good macroinvertebrate communities but lacked fish sampling results needed to provide a complete evaluation of aquatic life use status.

The community condition of fish and macroinvertebrates in the mainstem reach of the Blanchard River in the Outlet/Lye Creek WAU (04100008-020) was reflective of the interaction between nutrient levels and the assimilative capacity of the stream. The macroinvertebrate community condition was rated very good to exceptional at the three sampled locations (RMs 75.8, 71.9 and 61.7). Each site supported a good diversity of mayfly and caddisfly taxa. IBI scores were reflective of a fish community that structurally, at least, marginally met with ecoregional expectations even though pollution sensitive species were not well represented. However, MIwb scores, which are reflective of the relative proportionality of species within the fish community, were more variable. MIwb ecoregional expectations were not met at RMs 75.6 and 61.9. This imbalance was due largely to a predominance of pollution tolerant bluntnose minnows (*Pimephales notatus*). Their occurrence was an indicator of an abundant food source in the form of suspended organic matter and phytoplankton. Agriculture related nutrient enrichment was frequently encountered in water quality sampling within this reach of the mainstem. Additionally, elevated water temperatures were a concern at RM 61.9.

The depression expressed in the MIwb scores at RMs 75.6 and 61.9 corresponded with elevated nutrients documented in the chemical sampling results. The site at RM 75.6 was in partial attainment of ecoregional expectations, due to the nutrient load from the upper watershed. The mainstem then meanders through rural areas and woodlands for about ten miles with only one significant but small tributary, Buckrun Creek (drainage area less than ten square miles), before receiving any other inputs. Relatively good quality habitat and flow conditions in this stretch of the mainstem help to assimilate the nutrient load so that the biological criteria were in full attainment at RM 71.9. Additional nutrients are contributed in flow from Brights Ditch and The Outlet upstream from RM 61.9. Flow altering impoundments are located downstream of each of these tributaries. Consequently, the segment of the mainstem that includes the site at RM 61.9 was again reduced to partial attainment.

Requisite credible data collection requirements were lacking to complete an evaluation of the status of the aquatic life use of Buckrun Creek but, qualitative macroinvertebrate sampling marginally met expectations of the recommended MWH use.

Macroinvertebrate community condition rated a high fair evaluation. Ten EPT taxa were recorded but only four sensitive taxa were collected. The sampled reach was primarily pooled and predominated by the pollution tolerant snail, *Helisoma anceps*. The cumulative effects of agricultural related instream and riparian habitat alteration and a commensurate limited capacity to assimilate nutrients were the most immediate causes of impact to Buckrun Creek. Additional impacts were also likely due to elevated stream temperatures and wide swings in dissolved oxygen concentration given the physical nature of the stream.

Qualitative macroinvertebrate sampling of Stahl Ditch at RM 7.3 produced a largely pollution tolerant community. Only 21 taxa were collected including just one sensitive taxon. The sampling results reflected an enriched water quality condition and proclivity for wide variation in dissolved oxygen concentration. Phosphorus concentrations were elevated. Possible sources included fertilizer and/or manure application applied to surrounding agricultural fields and improperly functioning onsite septic systems. The poor macroinvertebrate community at RM 7.3 was a less than goal result; however, status in the upper reaches of the stream was not fully assessed due to incomplete data quality requirements. The macroinvertebrate community was improved at RM 4.4 compared to RM 7.3 owing to the contribution of ground water to the steam flow. Fifty taxa were collected including nine sensitive taxa. Fish sampling at RM 4.4 yielded an IBI score of 34, which is in the fair range. Taken together, biological sampling results were consistent with the recommended MWH use at RM 4.4.

Requisite credible data requirements were not met for the sampled sites on Brights Ditch so a complete evaluation of aquatic life status was not done. However, macroinvertebrate sampling results were illustrative of the effects of a limited habitat. Macroinvertebrate sampling was conducted at three locations. The macroinvertebrate condition at RMs 3.8 and 2.4 was poor; well below minimum expectations of the proposed MWH aquatic life use, but was much improved at RM 0.3, rating a good narrative evaluation. Pollution tolerant organisms predominated in the headwaters and no sensitive macroinvertebrate taxa were collected at either of the two upstream sites versus twelve that were identified at RM 0.3. The significant improvement in community condition noted near the mouth reflected an improved habitat. Beneficial habitat attributes at RM 0.3 included ground water contributed flow and large sized substrates. In addition to the habitat related limitations, agricultural practices in the watershed also contributed to elevated nutrients and low dissolved oxygen concentrations recorded in water chemistry results during the 2005 sampling period.

Flow contributed by ground water in The Outlet (lower) produced a volume that was significantly higher than similarly sized ECBP streams and supported fish assemblages more typical of a much larger stream. The net result was that no typical headwater fish species were recorded at either of the headwater sized sites (RM s 7.7 and 6.1). The diversity of fish taxa at RMs 7.7, 6.1 and 4.5 produced IBI scores that attained WWH expectations. Still, the effects of the monotonous habitat (QHEI= 39.0) at RM 4.5 were manifest in a fish assemblage predominated by pollution tolerant creek chubs and yielded a MIwb score in the poor range (MIwb = 5.7). The macroinvertebrate sampling results met or exceeded expectations of the recommended MWH use. The collected assemblages reflected marginally attaining to nearly exceptional conditions. In modified watercourses, significant variability in the macroinvertebrate condition is relatively common given microhabitat differences between the various sites as long as the chemical water quality is acceptable. Overall, the water quality in The Outlet was fairly good except for extremely high levels of nitrate-nitrite.

Sampling of Lye Creek at RMs 9.4 and 6.7 was for macroinvertebrates only. Despite relatively good substrates at the sites, neither was supporting macroinvertebrate communities that were consistent with the recommended MWH use. High phosphorus levels attributed to the unsewered community of Houcktown and runoff from adjacent agricultural fields contributed a significant nutrient load to this reach of Lye Creek. Limited overhead canopy combined in combination with elevated nutrients produced an enriched water quality condition with wide swings in dissolved oxygen concentration and elevated daytime heating. As a result, pollution tolerant taxa comprised a large portion of the total taxa collected. An ICI score of 20 verified that macroinvertebrate community condition was no better at RM 2.6. Pollution tolerant oligochaetes accounted for nearly 80 percent of the organisms collected from the artificial substrates and the result of natural substrate sampling was similar to the previous sites. IBI and MIwb scores met expectations for a MWH use at RM 2.6 but the fish community also reflected significant enrichment in the predominance of bluntnose minnows (*Pimephales notatus*) among the 25 taxa collected. In all, pollution tolerant fish comprised 73 percent of the total catch. The net result of sampling at RM 2.6 was partial attainment of the recommended MWH aquatic life use. Attainment status of the upstream sites could not be fully evaluated due to the lack of fish sampling results; nevertheless, significant impacts related to agricultural practices and the unsewered community of Houcktown were evident.

4.2.3 Eagle Creek WAU

Attainment status was determined for fifteen sites in the Eagle Creek WAU, representing approximately 34.5 assessed stream miles in the watershed. Limited sampling of three additional sites allowed for a determination of aquatic life use designation but credible data requirements negated a complete evaluation of attainment status. Four sites representing 10.5 assessed stream miles, fully met the current or recommended aquatic life use. Six sites, representative of thirteen assessed miles, partially met and five sites, totaling eleven assessed stream miles, were in non-attainment of the current or recommended aquatic life use.

Biological communities in the Eagle Creek WAU were impacted primarily by factors related to agricultural practices in the watershed. Elevated nutrients, and impacts associated with dissolved oxygen/organic enrichment were identified as causative factors for 92 percent, and 40 percent, respectively, of the impaired miles. Flow alteration, principally to facilitate agricultural activities, affected 64 percent of the impaired stream miles. Instream habitat and natural flow regimes were altered as a result. Impacts within the Findlay urban area included elevated stream temperature and widely fluctuating dissolved oxygen concentrations that were attributed to the Liberty Street dam, CSOs and urban runoff.

The impoundment formed behind the Liberty Street Dam had a significant impact on fish and macroinvertebrate assemblages in the Blanchard River. The change from a free flowing stream to a pond like environment alone can limit the diversity of typical WWH communities. Additionally the impoundment acted as a sink, collecting silt and pollutants from area CSOs and contained in storm water runoff. Water temperatures were often elevated and wide swings in dissolved oxygen concentrations were documented during the summer sampling period. As a result, poor habitat and degraded water quality combine to impact biological communities. Fish and macroinvertebrate community conditions were rated as fair and poor, respectively within the Liberty Street dam pool (RM 57.8/57.9).

The proliferation of plankton within the impoundment had an effect downstream from the dam (RM 57.3). The now food rich water released over the dam produced an immediate increase in facultative and pollution tolerant macroinvertebrate taxa that consumed the plankton. Total organism density of nearly 4500 organisms per square foot was recorded on the artificial substrate samplers and a similar high density was noted on the natural substrates. Fish sampling results met ecoregional expectations but the macroinvertebrate community was in only fair condition despite relatively good habitat.

Water quality downstream of the dam appeared to be within water quality criteria, based on the grab samples collected during the 2005 survey year. However, the water quality and sediment sampling conducted downstream from the Liberty Street Dam in April 2005 found PAHs (polycyclic aromatic hydrocarbons) in the sediments at levels above the water quality criteria for the protection of human health, and benzo(a)pyrene, one of the PAHs, was also detected in the water at levels above the water quality criteria (Hull & Associates, 2005). The suspected source was the former Brandman Tire Facility. There are also seven CSOs within 300 yards upstream or downstream of the Liberty St. Dam. The most downstream of these CSOs, at RM 57.11, has a history of problems with oil seepage. Some evidence of oil seepage was observed along the bank in the area upstream of Broad St. during sediment collection in October 2005.

The site on the Blanchard River upstream from Broad Street (RM 57.9) was in a reach with low gradient and a wide modified channel. The fish community marginally attained WWH expectations but the macroinvertebrate community was in only fair condition owing primarily to a lack of current at the site. An overriding habitat influence negated the identification of any impact associated with nearby industrial sites and CSO releases, nevertheless, sediments near Broad St. (RM 56.83) were contaminated with PAHs and PCBs.

The Findlay WWTP discharged an average of about 12 MGD during 2005 and is a major source of nutrient loading to the Blanchard River. A significant increase in the levels of nitrate-nitrite and phosphorus from below target to well above target occurred downstream of the Findlay WWTP. There also appeared to be a slight depression in dissolved oxygen concentrations approximately ten miles downstream of the WWTP discharge based on the surface grab samples.

Partial attainment downstream from the Findlay WWTP (RM 54.7) resulted from widely differing fish index scores recorded in the initial sampling pass on June 11 versus the subsequent sampling conducted October 14. An IBI score of 28 was recorded in June and increased to 44 in October. Similarly, MIwb scores were 7.0 and 8.2 in June and October, respectively. The averaged IBI and MIwb scores were in the fair range. The disparate results suggest an impaired community condition possibly due to an upset in the operation of the Findlay WWTP followed by a reestablishment of the warmwater fish community in the intervening period between sampling passes. The macroinvertebrate community produced a very good ICI score of 42 at RM 55.2. The community structure was indicative of moderate to high enrichment but, given the conditions upstream from the Findlay WWTP, an influence from the discharge on the macroinvertebrate community could not be directly correlated.

The remaining two Blanchard River sites (RMs 49.8 and 46.5) in the Eagle Creek WAU were located within the HELP ecoregion. The river took on characteristics typical of the ecoregion with a predominance of silt/sand substrates and limited riffle/run development. The channel was incised and accumulations of woody debris and sand provided areas where flow velocity was increased to a moderate level. Despite the changes in the nature of the river, habitat measurements were consistent with the WWH use. Biological sampling results exceeded minimum ecoregional expectations at both locations with index scores in the good to exceptional range. Pollution sensitive macroinvertebrate taxa were well represented. MIwb scores of 9.7 at both sites (in the exceptional range) were markedly improved over the fair result recorded downstream from the Findlay WWTP, and indicative of a much more balanced and stable fish assemblage.

Out of 12.5 assessed stream miles of the Blanchard River in the Eagle Creek WAU, 4.5 miles fully met WWH ecoregional expectations. Seven miles partially met and one mile was in non-attainment.

One or both organism groups sampled at five of six sampling locations on Eagle Creek failed to meet ecoregional expectations. Out of 13 assessed stream miles, just one mile fully met WWH ecoregional expectations. Six miles partially met and six miles were in non-attainment. The results generally reflected a chronic widespread impact from agricultural practices in the watershed; principally alteration of the natural flow regimen via tile drainage and the addition of nutrients to the system. The site downstream from Buck Creek (RM 11.6) was the only location where both fish and macroinvertebrate communities were in a less than goal condition. Biological performance at this site coincided with an increase in phosphorus and ammonia attributable to the Village of Arlington WWTP discharge. The fish community showed additional decline at RM 9.1 and was reflected in an IBI score in the poor range. The only site where full attainment was documented was at RM 3.7. The remaining sites had marginally good to good macroinvertebrate communities but one or both of the fish index scores were in the fair range. Hydraulic Ditch, Flat Branch, Buck Run, and Cottman Ditch are all tributaries of Eagle Creek. The Arlington WWTP, Arlington WTP, Sycamore Springs Golf Course, Camp Berry, Eagle Creek Utilities, and City of Findlay CSOs are all point sources under permit to discharge to Eagle Creek and its tributaries. Eagle Creek does not appear able to assimilate the cumulative load of ammonia or phosphorus from the multiple dischargers in the watershed. Fecal coliform levels were also consistently a problem in Eagle Creek, particularly in Findlay.

Requisite credible data collection requirements were lacking to complete an evaluation of the status of the aquatic life use of Hydraulic Ditch at RM 1.5, but the macroinvertebrate community was rated in good condition. Thirty-eight taxa were collected from the natural substrates including thirteen EPT taxa (ephemeroptera, plecoptera, trichoptera). The results suggested adequate water quality that enabled the establishment of a relatively diverse macroinvertebrate community. It is important to note that these organisms can often be found in areas with overall monotonous habitat as long as suitable substrate is sporadically present. Often, a single piece of woody debris or an occasional rock located in sufficient current allows for the establishment of low density populations of relatively pollution sensitive taxa. Chemical sampling results indicated that nutrient levels (ammonia, nitrate-nitrite and phosphorus) were at least occasionally elevated.

Tiling of the surrounding agricultural areas likely exacerbated the limited dry weather flow of Flat Branch. Elevated nutrients were also a concern. Phosphorus levels at both RMs 1.1 and 0.1 were consistently elevated in grab samples collected during the summer sampling period. The nitrogen parameters were also occasionally elevated. The macroinvertebrate community was in fair condition at RM 1.1. The assemblage was reasonably diverse; 37 taxa were collected, but only two were considered pollution sensitive. A lack of sufficient water in the stream negated fish sampling at the site. Biological sampling at RM 0.1 yielded a marginally good macroinvertebrate assemblage and a fish result in the poor range (IBI= 26). Over the course of the summer, the stream at RM 0.1 became intermittent. As a result, fish sampling was conducted along a reach of disconnected pools. The fish community was moderately diverse, twelve species were recorded, but pollution tolerant creek chubs (*Semotilus atromaculatus*) predominated. Non-attainment of the WWH aquatic life use was attributed to nutrient enrichment and flow alteration to facilitate row crop agriculture along with frequently low dissolved oxygen levels.

Buck Run failed to meet ecoregional expectations. The Arlington WWTP discharge has consistently exceeded the design capacity of 0.168 MGD. Organic loading and elevated ammonia levels had a significant impact on biological communities, as a result. The impact was likely exacerbated by the channelized nature of the stream. Significant accumulations of organic sediment were noted along the stream margins. Qualitative macroinvertebrate sampling produced a limited diversity of taxa, none of which were considered pollution sensitive. The macroinvertebrate community was indicative of a poor resource condition. The fish community was in marginally better condition and yielded an IBI score in the fair range. A relatively diverse assemblage was collected, but pollution tolerant and omnivorous species (*i.e.*, bluntnose minnows and white suckers) predominated.

The fish community of Aurand Run at RM 2.7 was in good condition. Relatively pollution sensitive darter and sculpin species were well represented and pollution tolerant and pioneering fishes were not overly abundant, suggesting that the community was in stable, balanced condition. An IBI score of 40, in the good range, resulted. Commensurate macroinvertebrate sampling at RM 0.5 also yielded an assemblage that was indicative of good community condition. Thirty nine taxa were collected in moderate to low density, eleven of which are consider pollution sensitive. It was also noted that enrichment did not appear to be excessive even though nitrogen and phosphorus data indicated that there may have been a localized source of untreated sewage upstream. The fecal coliform data also supported this theory.

4.2.4 Ottawa Creek WAU

The Blanchard River at CR 53 (RM 41.31) was the only mainstem site within this WAU. It is designated as WWH, PCR, AWS, and IWS based on previous field assessments. Habitat conditions at CR 53 (RM 41.3) were similar to other sites downstream from Findlay. Low gradient and an incised channel were significant impediments to the development of a more diverse habitat by limiting channel sinuosity and keeping sediment confined within the river channel. Mid channel areas contained significant rubble substrates but heavy siltation was noted in areas that were out of direct current flow.

Dutch Run is a tributary of the Blanchard River confluent at RM 33.00 that is about 14 miles in length and drains an area of 14.8 square miles. It is within the HELP ecoregion and designated as WWH, PCR, AWS, and IWS based on the 1978 Ohio WQS. It is channelized and has legal drain status in Putnam County where it is maintained by the county soil and water conservation district (SWCD). Most riparian vegetation has been removed from the banks except the lower three miles which has a narrow wooded corridor. The channel held water throughout the study, but flow was often stagnant at TR O (RM 5.79). The stream was designated as a WWH in a previous rulemaking but the use had never been verified based on biological sampling. The 2005 survey included sites at RM 5.8 and 1.7. Both locations were previously channelized. QHEI values recorded at RM 5.8 and 1.7 on Dutch Run of were 23.5 and 26.5, respectively and reflected the highly modified nature of the stream. Nevertheless, fish and macroinvertebrate sampling results were consistent with a WWH use at RM 1.7. Based on the 2005 results, a MWH use is recommended for Dutch Run upstream from the confluence of Bassinger Ditch (RM 5.26) along with continuing the WWH use downstream from Bassinger Ditch to the confluence with the Blanchard River.

Dukes Run is a tributary of the Blanchard River confluent at RM 35.65 that is about nine miles in length and drains an area of 14.7 square miles. It is within the HELP ecoregion and designated as WWH, PCR, AWS, and IWS based on the 1978 Ohio WQS. It is channelized, under petition in Putnam County, and has legal drain status in Hancock County where it is maintained by the SWCD (a.k.a. Moyer Ditch). Most riparian vegetation has been removed from the banks except the lower two miles which has a narrow wooded corridor. The channel held water throughout the study, but flow was often stagnant at CR M (RM 1.90).

Dukes Run was designated as a WWH in a previous rulemaking but the use had never been verified based on biological sampling. Results of the 2005 survey included sites at RM 1.9 and 1.1. Both locations were previously channelized; however, the downstream site had recovered a largely natural sinuosity that increased the heterogeneity of instream habitat. QHEI scores of 48 and 50 at RM 1.9 and 1.1 do not singularly identify the suitability of a WWH use. However, biological communities fully met the use at RM 1.1. The upper site (RM 1.9) was impacted by unobstructed cattle access and interstitial flow which limited the macroinvertebrate community. A WWH is an attainable use with continued recovery of natural stream attributes; however, alteration of the stream hydrology which benefits agricultural production will likely continue to impinge on the diversity of fish and macroinvertebrate taxa that the stream is able to support.

Cartwright Run is a tributary of Dukes Run confluent at RM 1.82 that is about 4.5 miles in length and drains an area of 5.8 square miles. It is within the HELP ecoregion and designated as WWH, PCR, AWS, and IWS based on the 1978 Ohio WQS. It is channelized and has legal drain status in Putnam County where it is maintained by the SWCD (a.k.a. Snavely Ditch). Virtually all riparian vegetation has been removed from the banks. The channel held water throughout the study, but flow was often stagnant at CR M (RM 0.02). Physical habitat features and limited stream energy makes a MWH aquatic life use for Cartwright Run applicable.

Moffitt Ditch is a tributary of the Blanchard River confluent at RM 37.44 that is about eight miles in length and drains an area of 15.8 square miles. It is within the HELP ecoregion and is designated as WWH, PCR, AWS, and IWS based on the 1978 Ohio WQS.

Moffitt Ditch was designated as a WWH in a previous rulemaking but the use had never been verified based on biological sampling. However, analysis of biological condition and habitat attributes of the waterway were consistent with a MWH use. The 2005 survey included sites at RM 2.4 and 0.5. The stream is channelized, essentially a canal, with no sinuosity or riparian vegetation. The channel held water throughout the study, but flow was often stagnant at CR 53 (RM 2.37). QHEI scores were 21.0 and 27.5 at RM 2.4 and 0.5, respectively, and both sites possessed four high influence modified habitat attributes. The recommendation of the MWH use should not be considered a downgrading of aquatic life use for Moffitt Ditch. Rather, the 2005 survey accomplished the first systematic ambient assessment of the appropriate use.

Buck Run is a tributary of Moffitt Ditch confluent at RM 1.46 that is about five miles in length and drains an area of 5.6 square miles. It is within the HELP ecoregion and does not have assigned use designations. It is channelized and has legal drain status in Hancock County where it is maintained by the SWCD. Virtually all riparian vegetation has been removed from the banks and it is essentially a canal with no sinuosity. The stream bottom consisted of primarily fine grained substrates. The channel held water throughout the study, but flow was often stagnant at TR 20 (RM 0.18). Physical habitat features and limited stream energy makes a MWH aquatic life use an appropriate use for Buck Run.

Ottawa Creek is a tributary of the Blanchard River confluent at RM 45.64 that is about 23 miles in length and drains an area of 64.3 square miles. It originates in the ECBP ecoregion and transitions into the HELP ecoregion at about RM 9.2 and is designated as WWH, PCR, AWS, and IWS based on a study done in 1993. The channel in the upper half of the creek has been extensively modified and cleared of riparian vegetation. Flow is more natural in the lower half and woodlots are more common. The channel held water throughout the study, but flow was stagnant at times in the headwaters.

Ottawa Creek was designated with a WWH use based on biological/ water quality survey conducted in 1993. The 2005 survey confirmed the appropriateness of the use based on current habitat conditions and biological performance. Even though the stream lacked areas of fast current and had limited riffle/run/pool development, QHEI scores of five sites on Ottawa Creek ranged from 52.0 to 67.0. Beneficial attributes included relatively abundant instream cover and a diversity of substrates sizes. .

Tiderishi Creek is a tributary of Ottawa Creek confluent at RM 5.88 that is about 12 miles in length and drains an area of 19.4 square miles. It is within the ECBP ecoregion and is designated PCR, AWS, and IWS based on the 1978 Ohio WQS. Most of the stream is channelized and it is maintained by the Hancock County SWCD above TR 64 (RM 9.5). Riparian corridors are narrow if present, except for where the creek flows through isolated woodlots. Lack of water in the channel was a problem during much of the study period. Flow was intermittent at CR 26 (RM 7.28) and the creek was actually dry at TR 44 (RM 4.57) during two of the sampling events. No fish sampling was conducted at TR 44. Water flow was continual near the mouth of Tiderishi Creek (RM0.1).

Tiderishi Creek had not been evaluated using biological and habitat data prior to the 2005 survey. A WWH use was assigned to the stream in the 1978 and 1985 water quality standards but never verified. The stream at RM 7.3 was little more than a conveyance for drainage of runoff from the surrounding agricultural fields. A QHEI score of 40 was recorded with modified habitat attributes exceeding typical warmwater features by a ratio of 9:2. Similar conditions were encountered at RM 4.6. Based on conditions encountered in 2005, a MWH use is recommended for Tiderishi Creek upstream from the Norfolk and Western railroad crossing (RM 2.90). The WWH should be maintained on Tiderishi Creek downstream from RM 2.90. Habitat was improved somewhat below this point and additional flow benefited aquatic communities. A QHEI score of 58.0 was recorded at RM 0.1 and fish and macroinvertebrate sampling reflected partial attainment of the WWH use. Habitat conditions in the lower reach make WWH attainment a reasonable expectation with a lessening of nutrient inputs to Tiderishi Creek.

Higbie-Redick Ditch is a tributary of Ottawa Creek confluent at RM 14.37 that is about five miles in length and drains an area of 7.0 square miles. It is within the ECBP ecoregion and designated as MWH, SCR, AWS, and IWS based on a study done in 1993. It was channelized in 1951 and has shown little recovery even though it is not formally maintained. There is virtually no riparian vegetation except for a grass buffer strip in the lower two miles and a narrow wooded corridor above this point. The channel held water throughout the study due to shallow bedrock and subsequent ground water recharge and there was usually a slow current velocity at TR 59 (RM 0.76).

4.2.5 Riley Creek WAU

Cranberry Run is a tributary of Riley Creek confluent at RM 3.37 that is about ten miles in length and drains an area of 11.7 square miles. It is within the HELP ecoregion and designated as PCR, AWS, and IWS based on the 1978 Ohio WQS. The stream is maintained by the Putnam County SWCD. A QHEI score of 31.5 was recorded at Cool Road (RM 6.7) on Cranberry Run which was channelized and had a predominantly muck substrate. The stream held very little water and was overgrown with grass. Modified habitat attributes outnumbered warm water attributes by a margin of 10:1. Habitat conditions were improved at RM 1.2. The lower site (RM 1.2) had more heterogeneous substrates, additional flow volume and supported a relatively good macroinvertebrate community; consistent with a WWH use. A package plant that serves the Ridge Road mobile home park is the only point source under permit and it discharges at RM 4.0. Water quality was generally good except that levels of nitrate-nitrite were elevated at times.

Cranberry Run had not been evaluated using biological and habitat data prior to the 2005 survey. A WWH use was assigned to the streams in the 1978 and 1985 water quality standards but never verified. Based on conditions encountered in 2005, a MWH use is recommended for Cranberry Run upstream from Riley Township Road 7L (RM 3.05). The WWH use should be maintained on Cranberry Run downstream from TR-7L.

Lower Little Riley Creek is a tributary of Riley Creek confluent at RM 15.30 that is about 9.5 miles in length and drains an area of 15.8 square miles. It is within the ECBP ecoregion and designated as PCR, AWS, and IWS based on a study done in 1991. Most land is used for crop production except for commercial and residential developments in Beaverdam and Bluffton. Several regulated point sources are in the basin, including the Beaverdam WWTP. This is a controlled lagoon system and it did not discharge during the study period. Small package plants that serve a truck stop, nursing home, and subdivision are also present. Water quality was poor and degraded by low dissolved oxygen, elevated nutrients, and bacteria. Dissolved oxygen was below the OMZA in eight of sixteen samples, and six of these violated the OMZM. Phosphorus was above the target level in sixteen of sixteen samples and the median values were four to eight times the target. Not enough fecal coliform samples were collected to do site specific evaluations, but ten of sixteen tested at the three sites exceeded the PCR maximum.

Lower Little Riley Creek was designated with a WWH aquatic life use based on biological sampling conducted in 1991. The sampling involved a survey of conditions beginning at RM 2.4 and extended downstream to the confluence with Riley Creek. The 2005 study lengthened the surveyed reach upstream an additional 3.1 miles. Sampling at RM 4.3 and RM 5.5 was the first occasion to adequately assess the applicability of aquatic life uses in the upper reaches of the stream using a standardized biological evaluation. The channel held very little water at Swaney Road (RM 5.50), had good flow at Hillville Road (RM 4.30), and was dry at Riley Street (RM 0.03) late in the summer. It is suspected that water seeps into fractures in the bedrock here. Much of the creek is channelized and it is under petition in Allen County for a drainage project. Based on the 2005 results, a MWH use is recommended for Lower Little Riley Creek from the upper reaches downstream to the confluence of Marsh Run at RM 4.74. This portion was highly modified; yielding a QHEI score of 25.5. Habitat structure at RM 4.3 was much improved resulting in a QHEI score of 64.5.

Marsh Run is a tributary of Riley Creek confluent at RM 15.61 that is about 4.5 miles in length and drains an area of 7.6 square miles. It is within the ECBP ecoregion and designated as PCR, AWS, and IWS based on the 1978 Ohio WQS. Marsh Run had not been evaluated using biological and habitat data prior to the 2005 survey. A WWH use was assigned to the stream in the 1978 and 1985 water quality standards but never verified. Marsh Run was a highly modified watercourse with limited biological communities. It has legal drain status in Hancock County where it is maintained by the SWCD. At TR 51 (RM 1.8), major habitat features included a straight, shallow channel with little instream cover and minimal water under low flow conditions. Modified habitat attributes outnumbered warm water attributes by a margin of 11:1 and netted a QHEI score of 33.0. A MWH use is recommended for Marsh Run. Poor habitat conditions and low dissolved oxygen are the likely causes of biological impairment.

Upper Little Riley Creek is a tributary of Riley Creek confluent at RM 20.63 that is about 6.5 miles in length and drains an area of 14.9 square miles. It is within the ECBP ecoregion and designated as PCR, AWS, and IWS based on the 1978 Ohio WQS. Storm water from Marshall's Import Cars and Parts (permit # 2GR00150) is a source at TR 27 (RM 2.64). In addition, the bridge was replaced here during the study and a landowner was clearing riparian vegetation. Water quality was degraded mainly by low dissolved oxygen and siltation. One of the samples at TR 51 (RM 1.00) had 0.031 µg/L of mercury detected, which is above the OMZA for human health. Runoff from the auto scrap yard is a possible source since mercury is commonly used in auto switches.

Upper Little Riley Creek had not been evaluated using biological and habitat data prior to the 2005 survey. A WWH use was assigned to the stream in the 1978 and 1985 water quality standards but never verified. Although much of Upper Little Riley Creek was formally channelized it is not under county maintenance. Remnant impacts of channelization were in evidence but recovery of more natural habitat attributes was ongoing. QHEI scores at RM 2.7and 1.0 of 50 and 53.5, respectively, do not singularly identify the suitability of a WWH use. However, only one high influence modified habitat attribute was noted (no sinuosity at RM 2.7). A WWH should be an attainable use with continued recovery and controls to limit the input of embedding sediments.

Riley Creek is a tributary of the Blanchard River confluent at RM 30.08 that is about 27.5 miles in length and drains an area of 88.2 square miles. Geographically, it transitions from the ECBP to the HELP ecoregion at about RM 15.0, but maintains many habitat characteristic of the ECBP. Additionally the stream is designated as

WWH, PCR, AWS, and IWS based on a study done in 1991. It is not maintained for drainage, but has a history of habitat and flow alterations. Channelization and removal of riparian vegetation are practiced in the headwaters and there are some areas where limestone bedrock was mined from the stream bed. Low head dams located at RM 7.5, 7.3, 4.6, and 1.3 have resulted in impounded sections. There are also small concrete dams at RM 6.0 and 5.0, but they do not alter flow much. Some degree of water quality and habitat degradation was documented at every site; which translated into biological impairment in most instances. Fish were in attainment in the lower 7.6 miles, but scores were generally poor to very poor above that point.

The WWH aquatic life use designation was based on biological sampling conducted in 1991 that began at RM 17.9 and extended downstream to the confluence with the Blanchard River. The 2005 study lengthened the surveyed reach upstream an additional seven miles. Sampling at RMs 24.9, 22.6 and 19.4 was the first occasion to adequately assess the applicability of aquatic life uses in the upper reaches of the stream using a standardized biological approach. Based on the 2005 results, a MWH use is recommended for Riley Creek upstream from the confluence of Upper Little Riley Creek at RM 20.63. This portion was highly modified, yielding a QHEI score of 32.5 at RM 24.9 and 37.0 at RM 22.6 with three high influence modified habitat attributes and a 10:2 ratio of modified to warmwater attributes. Habitat structure at RM 19.4 was improved. No high influence modified attributes were noted and the QHEI score increased to 55.5.

4.2.6 Cranberry Creek WAU

Deer Creek is a tributary of the Blanchard River confluent at RM 7.28 that is about four miles in length and drains an area of 10.9 square miles. It is within the HELP ecoregion and designated as WWH, PCR, AWS, and IWS based on the 1978 Ohio WQS. The appropriateness of the WWH use, however, had not been investigated. Conditions encountered in 2005 demonstrated that a less stringent use was more appropriate. It is channelized and has legal drain status above State Rt. 694 (RM 2.8) where it is maintained by the Putnam County SWCD (a.k.a. Erhart Ditch). Most riparian vegetation has been removed from the banks except the lower 1.5 miles is wooded. The channel held water throughout the study, but flow was occasionally stagnant at State Rt. 115 (RM 1.57). A QHEI score of 32.0 was recorded at RM 1.6. Typically, WWH streams have no more than one high influence modified attribute and a variety of typical warmwater attributes. Evaluation of habitat at the site recorded five high influence modified habitat attributes and zero typical warmwater habitat attributes. The physical condition of the stream negated a WWH use, rather, a modified warmwater habitat use (MWH) is recommended. The recommendation of the MWH use should not be considered a downgrading of the aquatic life use; rather, the 2005 survey was the first systematic ambient assessment of appropriate expectations.

Bear Creek is a tributary of the Blanchard River confluent at RM 12.50 that is about 7.5 miles in length and drains an area of 13.2 square miles. It is within the HELP ecoregion and designated as WWH, PCR, AWS, and IWS based on the 1978 Ohio WQS. It is channelized and under petition for legal drain status in Putnam County. Virtually the entire stream is devoid of riparian vegetation. Ohio law stipulates that chemical criteria for the WWH use be applied to undesignated waterways; however, the 2005 sampling effort demonstrated that a less stringent use was more appropriate. The channel was often dry above CR K (RM 4.70) where the stream is essentially a roadside ditch and flow was intermittent as far downstream as TR I-14 (RM 0.32). A QHEI score of 26.0 was recorded at RM 0.4 and modified habitat attributes eclipsed typical warm water features by a ratio of 11:1. The physical condition of the stream limited biological performance and negated the WWH use, rather, a modified warmwater habitat use is recommended. The MWH use recommendation should not be considered a downgrading of aquatic life use. Rather, the 2005 survey accomplished a first time systematic assessment to establish the appropriate use.

Caton Ditch is a tributary of the Blanchard River confluent at RM 13.23 that is about eight miles in length and drains an area of about 17.8 square miles. It is within the HELP ecoregion and designated as WWH, PCR, AWS, and IWS in the 1978 Ohio WQS. The appropriateness of the WWH use, however, had not been investigated. Conditions encountered in 2005 demonstrated that a less stringent use was more appropriate. The watercourse was channelized many years ago and has shown little recovery even though it is not under a county maintenance program. Most riparian vegetation has been removed from the banks except the lower 4 miles has a narrow wooded corridor. A QHEI score of 48.0 was recorded at RM 0.3. A principle feature that precluded a WWH aquatic life use was the modification of the drainage area hydrology to facilitate agricultural activities. The channel was often dry at CR 13 (RM 4.11) and, at times, flow was intermittent at State Rt. 108 (RM 3.02). The recommendation of the MWH use should not be considered a downgrading of aquatic life use; rather, the 2005 survey was a first time systematic assessment to determine appropriate expectations.

The Miller City Cutoff is a tributary of Caton Ditch confluent at RM 3.13 that is about 4.5 miles in length and drains an area of nine square miles. It is within the HELP ecoregion and does not have assigned aquatic life and recreation use designations. Ohio law stipulates that chemical criteria for the WWH use be applied to undesignated waterways such as Miller City Cutoff; however, the 2005 sampling effort demonstrated that a less stringent use was more appropriate. The watercourse is a man-made roadside ditch that diverted the headwaters of South Powell Creek from the Auglaize River watershed into the Blanchard River watershed. The 2005 investigation of biological condition and habitat attributes of the stream was consistent with the MWH use. The recommendation of the MWH use should not be considered a downgrading of aquatic life use; rather, the 2005 survey was a first time systematic assessment to determine appropriate expectations.

Cranberry Creek is a tributary of the Blanchard River confluent at RM 17.30 that is about 24.5 miles in length and drains an area of about 45 square miles. It is located within the HELP ecoregion and designated as WWH, PCR, AWS, and IWS based on a previous field assessment conducted in 1983. The stream is channelized and jointly maintained by the Putnam County SWCD and Allen County Engineers. A flood abatement project was recently completed that included cutting and clearing of trees from the mouth to State Rt. 12 and reconstruction and widening of the channel from State Rt. 12 to the Village of Rockport. The stream held water throughout the study, but flow was occasionally stagnant in low gradient areas and became intermittent in the headwaters. Flows measured during the study period at CR J (RM 1.64) ranged from 0.5-5.6 cfs, with a median value of 1.5 cfs.

The WWH use on Cranberry Creek was based on previous work done in the Blanchard River watershed in and documented in "Biological and Water Quality Study of the Blanchard River and Selected Tributaries" January, 1985. The 1985 report did not include any biological or habitat measurements. The work done in 2005 included both QHEI and/or biological assessments of four sites on Cranberry Creek. The majority of the stream supported biological communities consistent with a WWH use for the HELP ecoregion, but the upper portion of the watershed was extensively modified. A QHEI score of 41.0 at RM 19.9 was not much lower than scores recorded at RM 12.9 and RM 7.8 but four high influence modified attributes were noted and modified attributes exceeded typical warmwater features by a ratio of 9:2. Based on the 2005 results, at least marginal attainment of the WWH use was possible where sufficient drainage area size assured continual flow but a MWH use is more appropriate for the headwaters of Cranberry Creek. The MWH use should be applied to Cranberry Creek upstream from the confluence of Little Cranberry Creek.

Little Cranberry Creek is a tributary of Cranberry Creek confluent at RM 17.05 that is about 4.2 miles in length, drains an area of 7.0 square miles and was a previously undesignated and unassessed stream. Ohio law stipulates that the WWH use be applied to unassessed waterways; however, the 2005 sampling effort demonstrated that a less stringent use was more appropriate. Little Cranberry Creek was channelized around 1948 and some maintenance has been done by landowners since then. A flood abatement project is currently being drafted by the Allen County SWCD. A QHEI score of 25.0 was recorded at RM 0.8 and no beneficial warmwater habitat features were noted. The physical condition of the stream limited biological performance and negated the WWH use, rather, a modified warmwater habitat use is recommended. The MWH use recommendation should not be considered a downgrading of aquatic life use. Rather, the 2005 survey accomplished the first systematic ambient assessment the appropriate use.

Pike Run is a tributary of the Blanchard River confluent at RM 18.62 that is about 4.5 miles in length and drains an area of 5.5 square miles. It is within the HELP ecoregion and designated as WWH, PCR, AWS, and IWS based on the 1978 Ohio WQS. The aquatic life use for Pike Run had not been evaluated using biological and habitat data prior to the 2005 survey. The WWH use was assigned to the stream but never verified. The stream is channelized and has legal drain status above TR F-6 where it is maintained by the Putnam County SWCD. A QHEI score of 51.0 was recorded at RM 0.7 and modified habitat attributes moderately exceeded typical warmwater features by a ratio of 7:5. The stream possessed relatively natural functioning channel with coarse substrates. A major limiting factor was a moderate to heavy silt cover and significant embeddedness. The physical condition of the stream was such that, with needed water quality and habitat improvements, a commensurate increase in fish and macroinvertebrate community condition is likely; making the a WWH use the appropriate designation.

4.2.7 Blanchard LRAU

Stream habitat of the Blanchard River in the LRAU was reflective of the combination of a predominantly agricultural land use, silty soils and widespread drainage improvements in the surrounding watershed. Flow is confined within steep banks that trap sediment within the stream channel. Drainage improvements in the watershed speeds the flush of water into the mainstem which increases the erosive force of storm flows; destabilizing stream banks. This was particularly apparent at RM 8.6 where recent loss of streambank soil had created a gravel bar immediately downstream. The bar restricted the flow under low flow conditions and provided a more heterogeneous substrate that benefited the macroinvertebrate community at the site. Overall, a mixture of beneficial and modified habitat attributes was present in the LRAU. The mainstem was not affected directly by channelization and mid channel areas contained significant boulder/cobble substrates. Conversely, little instream cover was observed and a moderate to heavy silt cover was noted. The low gradient nature of the topography precluded significant areas of fast current and led to fair to poor riffle/run/pool development. QHEI scores ranged from 48.5 to 62.0, values that were in line with WWH attainability and reflected the landscape alteration and limitations to greater habitat diversity inherent to HELP ecoregion.

This reach of stream was designated with a WWH aquatic life use based on a previous biological survey. Sampling in 2005 of fish and macroinvertebrates revealed assemblages that while not particularly diverse, were consistent with a WWH use. The fish community sampling of eight sites produced, at best, one sensitive species, a low occurrence of round bodied suckers and a predominance of omnivores. IBI scores were in the marginally good to good range and MIwb values were in the good to exceptional range. Similarly, the assortment of macroinvertebrate taxa documented exhibited a level of diversity and community structure consistent with a WWH use. Macroinvertebrate sampling of seven sites between RM 35.4 and RM 2.4 produced communities that reflected marginally good to exceptional resource condition. A moderate diversity of pollution sensitive taxa was collected at each site and suggested acceptable water quality conditions even though habitat conditions were less than ideal. No impact attributed to the Ottawa WWTP discharge was apparent in the performance of the fish and macroinvertebrate assemblages. Siltation and generally slow current velocity appeared be principle determinants of macroinvertebrate and fish community structure in the Blanchard River LRAU.

4.3 Source water uses

Source water assessments for two major public water supplies drawing water from the Blanchard River, the City of Findlay in Hancock County and the Village of Ottawa in Putnam County, were completed by Ohio EPA, Northwest District Office in 2003.

Protection areas were delineated and potential pollutant sources were identified in those protection areas.

A Corridor Management Zone (CMZ) was delineated along streams and tributaries within the source water assessment area (drainage area to the Blanchard River). The zone runs a total of ten miles upstream from the intake, and includes tributaries that drain into the Blanchard. The zone is 1,000 feet wide on each side of the Blanchard and 500 feet wide on each side of any tributaries. The Emergency Management Zone (EMZ) is a protection zone in the immediate vicinity of the intake in which the public water supply operator would have little or no time to respond to a spill.

Potential pollutant sources were mapped in the protection zones after reviewing federal and state databases, conducting windshield surveys and interviewing water treatment plant personnel. The Village of Ottawa has 35 potential pollutant sources in the Corridor Management Zone and none in the Emergency Management Zone. The City of Findlay has 45 potential pollutant sources in the Corridor Management Zone and none in the Emergency Management Zone.

The source water assessments included biological and chemical monitoring information. Overall, the water quality within the Ottawa and Findlay CMZ is good, with only sporadic exceedences for the Ohio EPA Water Quality Criteria (OAC 3745-1). However, the monitoring sites on Riley Creek that are upstream of the Village of Ottawa CMZ were all in non-attainment of the warmwater habitat (WWH) use, and found to be impacted primarily by the discharge from combined sewer overflows, and the Bluffton WWTP discharge. Also some Blanchard River monitoring sites above the CMZ were only partially attaining the WWH use primarily because of the Findlay wastewater treatment plant (WWTP) discharge. However, with improvement at the Findlay WWTP plant, these conditions should improve.

Based on information compiled for the assessment, the Village of Ottawa drinking water source protection area is susceptible to agricultural runoff, industrial and commercial sources, home construction, feedlot runoff, unsewered areas, wastewater treatment discharges, combined sewer overflows, junk yard runoff, transportation related spills, pesticide and fertilizer tank farms and gas line rupture. Nitrate and several pesticides (alachlor, atrazine, metolachlor, metribuzin, simizine, cyanazine and acetochlor) have been detected in the finished water, indicating an impact on the source water from land use within the watershed. Atrazine was detected at levels above the maximum contaminant level (MCL) of 3.0 ug/l, but the drinking water standard is based on a running average of the quarterly sampling and historically the Village of Ottawa has not exceeded the MCL for this contaminant.

Based on information compiled for the assessment, the City of Findlay drinking water source protection area is susceptible to agricultural runoff, industrial stormwater, gas and gas line rupture and gas and oil wells, wastewater treatment discharges, cemeteries, airports, silage, farm machinery repair, pesticide/fertilizer/petroleum storage areas, pastures, closed and inactive landfills. Nitrate and several pesticides (alachlor, atrazine, metolachlor, metribuzin, simizine, and cyanazine) have been detected in the finished water, indicating an impact on the source water from land use within the watershed. A review of the City of Findlay compliance monitoring data (for treated water) from 1991-2003 revealed that the system had no health based or MCL violations.

As reported in Section 4.3 Source Water Uses, the Blanchard River contains high amounts of minerals, and as a result, criteria for several secondary pollutants were exceeded. Nutrient levels exceeded criteria in the spring which ultimately led to algae blooms in the summer as water temperatures increased. Reducing nutrients in spring runoff from the upper watershed may eliminate these late summer algae blooms. In addition, herbicides such as atrazine and metolachlor detected in the source water indicate that non-point source runoff in agricultural areas is a source of herbicides to the river. These pesticides persist in the environment.

4.3.1 City of Findlay

The City of Findlay operates a community public water system that serves a population of approximately 40,000 people through 17,192 service connections. A community public water system is a system that regularly supplies drinking water from its own sources to at least 15 service connections used by year-round residents of the area or regularly serves 25 or more people throughout the entire year. The Blanchard River serves as source water for the reservoirs through an intake located at river mile 62.40 (pump house #2). Water is pumped from the Blanchard River into Reservoir #2 and flows by gravity into Reservoir #1. It is then pumped from Reservoir #1 to the water treatment plant. If necessary, it is also possible to pump water from Reservoir #2 to the treatment plant. An intake located at river mile 65.18 (pump house #1) was used before Reservoir #2 was built, but it is no longer in service. The flow augmentation line is located here and water can be pumped from the reservoirs into the river either during low flow periods or when water levels in the reservoirs are too high. A back-up intake for the water treatment plant is located in the Blanchard River at river mile 58.80 (Riverside Park). This line goes directly to the plant, but is never used. The system's treatment capacity is approximately 16.2 million gallons per day, but current average production is 6.57 million gallons per day. Water is pumped from the Blanchard River to upground reservoirs for storage prior to treatment. The City of Findlay's treatment processes include lime softening, coagulation, sedimentation, filtration, stabilization, fluoridation, and disinfection.

The PWS use in the Blanchard River was evaluated based on Lake Erie basin human health criteria (OAC 3745-1-33) using six sets of grab samples collected at the Findlay Pump house #2 intake (RM 62.40). These criteria are designed to protect source waters to the extent that public water systems would meet MCLs for finished water using conventional treatment only. The criteria apply within 500 yards (0.28 mile) of an intake. The river contains high amounts of minerals and, as a result, criteria for several secondary pollutants were exceeded. All results for iron and manganese were above respective OMZA values. Both the MCL and PWS criteria for nitrate are 10.0 mg/L. None of the survey results were above this level and concentrations ranged from 1.47-7.03 mg/L, with a median value of 2.56 mg/L.

Samples for herbicide and insecticide analysis were also collected at the Findlay Pump house #2 intake (RM 62.40). No insecticides were detected in any of the samples. The most commonly detected herbicides, with trade name in parenthesis, were Atrazine (AAtrex) in four of six samples and Metolachlor (Dual) in five of six samples. Both of these are extensively used in crop production areas for selective weed control in corn and soybeans. There is also a frequently used mixture of Atrazine and Metolachlor marketed under the trade name of Bicep. Acetochlor (Harness) and Simazine (Princep) were detected in two of the six samples.

Findlay Reservoir #2 was assessed by the Ohio EPA during the 2005 field season and all work was done from the deepest part of the lake within the conservation pool. During each of three sampling events a temperature, dissolved oxygen, pH, and conductivity profile was recorded at 1 meter intervals and the secchi transparency depth was measured. Samples for lab analysis were collected from the water column at ½ meter below the surface and ½ meter above the bottom. Additional samples were collected to determine chlorophyll a concentration and a vertical tow net was used to collect phytoplankton and zooplankton specimens. A sediment sample was also collected during one of the sampling events.

A variety of parameters were tested in the water column samples, including physical attributes, oxygen demand, nutrients, metals, and pesticides. Results were compared to applicable Ohio Water Quality Standards and Drinking Water Standards. Statewide Water Quality Criteria (3745-1-07) are established for the protection of aquatic life and Lake Erie Basin Criteria (3745-1-33) are established for the protection of human health and wildlife. Primary Drinking Water Standards (OAC 3745-81) are set for pollutants with serious human health implications and are usually expressed as maximum contaminant levels (MCLs). Some of these pollutants include metals, nitrate, pesticides, and organic disinfection byproducts. Secondary Contaminant Standards (OAC 3745-82) are set for pollutants associated with aesthetic constituents like taste, odor, and color. Some of these pollutants include sulfates, iron, and manganese.

Water quality in Findlay Reservoir #2 was good based on results from the three sampling events. A thermocline never developed during the summer, indicating that wind and wave action keep the water column mixed. Dissolved oxygen levels at bottom depths in the summer fell below the statewide average criteria for warmwater habitat streams of 5.0 mg/L, but never fell below the minimum criteria of 4.0 mg/L. Nutrients are a concern in lakes because excessive levels trigger nuisance algae blooms. Nutrient criteria for lakes in Ohio are currently under development, but federal criteria based on regional reference sites are available in the interim (U.S. EPA, 2000). Criteria for lakes in aggregate ecoregion VI include; total phosphorus- 37.5 µg/L, total nitrogen-0.78 mg/L, chlorophyll a- 8.59 µg/L, and secchi depth- 1.356 meters. Results showed that nutrient levels exceeded criteria in the spring and this ultimately led to algae blooms in the summer as water temperatures warmed. Summer chlorophyll a concentrations increased from 9.11 µg/L in August to 48.35 µg/L in September and secchi depth decreased from 2.60 m to 0.75 m, respectively. Reducing nutrients contained in spring runoff from the upper watershed would be of great benefit to water quality in the reservoir by eliminating these late summer algae blooms. Levels of secondary contaminants like iron and manganese were above drinking water standards at times, but these values were usually at bottom depths near the sediment interface.

4.3.2 Village of Ottawa

The Ottawa WTP is a public utility located at 1972 Agner Street that produces and distributes potable water. The facility pumps water from the Blanchard River via an intake at RM 28.50 into a 20 acre upground reservoir for storage and subsequent treatment. This storage capability makes it possible to selectively pump water from the river when pollutant concentrations are at their lowest. Ottawa is classified as a community public water system by the Ohio EPA Division of Drinking and Ground Waters (DDAGW). Drinking water standards and monitoring requirements are defined in the Safe Drinking Water Act and Ohio Public Drinking Water Standards. All community public water systems are required to prepare and distribute an annual Consumer Confidence Report that summarizes finished water quality. No violations were documented by Ottawa in the 2004 report, indicating that a good quality product is distributed.

The PWS use in the Blanchard River was evaluated based on Lake Erie basin human health criteria (OAC 3745-1-33) using six sets of grab samples collected at Putnam CR 8 (RM 28.88). These criteria are designed to protect source waters to the extent that public water systems would meet MCLs for finished water using conventional treatment only. The criteria apply within 500 yards (0.28 mile) of an intake and, even though sampling was done at 0.38 mile from the intake, results are still representative of source water at the intake and can provide useful information. The river contains high amounts of minerals and, as a result, criteria for several secondary pollutants were exceeded. All results for iron, all but one result for manganese, and one result for dissolved solids were above respective OMZA values. Both the MCL and PWS criteria for nitrate are 10.0 mg/L. None of the survey results were above this level and concentrations ranged from 1.65-8.34 mg/L, with a median value of 3.44 mg/L. Ottawa is required to test their drinking water for nitrate once per month. Results for treated water samples tested through July 2005 ranged from 0.23-1.40 mg/L.

Samples for herbicide and insecticide analysis were collected at Putnam CR 8 (RM 28.88) and again at State Rt. 115 (RM 9.05). No insecticides were detected in any of the samples. The most commonly detected herbicides, with trade name in parenthesis, were Atrazine (AAtrex) in eight of twelve samples and Metolachlor (Dual) in twelve of twelve samples. Both of these are extensively used in crop production areas for selective weed control in corn and soybeans. There is also a frequently used mixture of Atrazine and Metolachlor marketed under the trade name of Bicep. Concentrations were considerably higher at State Rt. 115 due to the increase in drainage area and amount of land used for crop production. These results indicate that runoff in agricultural areas is a source of herbicides in the river and that they persist in the environment. Ottawa is required to test for Alachlor, Atrazine, and Simazine monthly during the summer and quarterly the rest of the year. Treated water samples tested through July 2005 detected Atrazine in one sample, but it was well below the MCL.

Excessive algae blooms are common in the Blanchard River near Ottawa because of nutrient enrichment. These blooms cause taste and odor problems and are linked to the formation of disinfection byproducts. It is suspected that algae cells are the major source of organic matter in Trihalomethane formation when chlorine is added for disinfection. Certain blue green algae have been shown to emit micocystins that can cause liver damage. Samples from the Blanchard River were filtered and analyzed for chlorophyll a content to quantify the amount of algae in Ottawa's source water. Results varied somewhat during the study period and concentrations ranged from 6.79-20.06 µg/L, with a median value of 12.04 µg/L.

4.4 Fish consumption

Forty-two fish tissue samples were collected from the Blanchard River in 2005 by Ohio EPA's Ecological Assessment Section. These samples were collected to characterize fish tissue contaminant concentrations for both consumption advisory and impairment assessments. Samples were collected from twelve locations on the Blanchard: adjacent to Mt. Blanchard (RM 77.7), upstream and downstream State Route 15 upstream of Findlay (RM 69.1), at Township Road 208 (RM 61.9), at County Road 88 (RM 61.2), upstream U.S. 75 (RM 56.3), downstream County Road 139 (RM 53.8), upstream State Route 235 (Blanchard Landings) (RM 46.1), upstream County Road 53 bridge (RM 41.6), at Gilboa Bridge (RM 35), upstream Blanchard Avenue (RM 21), at State Route 115 (RM 9), and adjacent Putnam County Road 22 (RM 0.8).

Nine species of fish were sampled (number of samples follow in parenthesis): bluegill sunfish (two), channel catfish (five), common carp (ten), freshwater drum (two), largemouth bass (seven), rock bass (six), smallmouth bass (three), white crappie (two), and yellow bullhead (five).

Eight contaminants were detected in fish tissue: cadmium, lead, mercury, selenium, PCBs, total DDT, dieldrin, and trans-nonachlor. Contaminant levels were evaluated as averages per species for the purposes of determining the need for advisories or impairment status.

Of the eight contaminants detected, only mercury and PCBs were found at levels that would trigger an advisory. Bluegill sunfish, white crappie, and yellow bullhead each had mercury levels in the two meals per week advisory range. Channel catfish, common carp, freshwater drum, largemouth bass, rock bass, and smallmouth bass each had mercury levels in the one meal per week advisory range. PCBs were detected in common carp in the unrestricted consumption range and in channel catfish in the one meal per week range.

No special advisories were issued as a result of the contaminants found in fish tissue because the highest levels found would have triggered one meal per week advisories, and there already exists a statewide one meal per week advisory due to ubiquitous mercury contamination.

The Blanchard River was listed as impaired for fish consumption due to PCB contamination in channel catfish and common carp in the 2008 Integrated Report. The threshold for listing a water body as impaired in the Lake Erie basin was 23 µg/kg total PCB in fish tissue. The average concentration of PCBs in channel catfish from the Blanchard was 142 µg/kg, and for common carp was 35 µg/kg.

The reason the Blanchard is listed as impaired for fish tissue due to PCBs in the 2008 Integrated Report, yet has no specific fish consumption advisory due to PCBs, is due primarily to the use of different toxicity endpoints in the calculations used to develop advisory and impairment thresholds. The Integrated Report calculation uses a cancer slope factor of 2.0 $(mg/kg/day)^{-1}$, as determined by U.S. EPA in their Integrated Risk Information System profile for polychlorinated biphenyls. Fish advisories use a health protection value of 0.05 µg/kg/day, which was agreed upon in the Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory (1993). The advisory threshold results in an excess cancer risk no greater than one in ten thousand to someone consuming up to 32 grams/day of channel catfish or carp from the Blanchard. The threshold used in the Integrated Report would result in an excess cancer risk no greater than one in one hundred thousand to someone consuming 15 grams/day of fish from the Blanchard for the river to be declared unimpaired for fish tissue PCB contamination.

4.5 Addressing impaired water uses through TMDL development

The preceding sub-sections discuss the status of water quality in the Blanchard River watershed in terms of meeting the water quality standards and attaining designated water uses. This sub-section discusses what is done with that information and actions that follow.

Water quality standards are meant to protect the safe use of water resources, and when they are not met, the reasons for this failure are identified and listed as causes of use impairment. Additionally the sources from which these stressors originate are identified and listed. This information is documented in an Integrated Report (IR) that is produced every two years, and fulfills reporting requirements of the Clean Water Act found both in section 305(b), which requires an overview of the status of water quality, and section 303(d), which requires that a list be made of all waterbodies that fail to meet WQS. Ohio's Integrated Report for 2008 can be found at http://www.epa.state.oh.us/dsw/tmdl/2008IntReport/2008OhioIntegratedReport.aspx . Tables 1.2 and 1.3 in Section 1.1 summarize the stressors that are listed as causes of impairment in this project area and the impaired water uses that are addressed through a TMDL.

Section 303(d) of the CWA not only requires listing of impaired water bodies, but also that total maximum daily loads (TMDL) be developed for the stressors that are impairing them.

5.0 LINKAGE ANALYSES

5.1 How the identified stressors lead to impaired uses

The determination of impairment in rivers and streams in Ohio is straightforward – the numeric biocriteria are the principal arbiter of aquatic life use attainment and impairment. The rationale for using biocriteria has been extensively discussed elsewhere (Karr, 1991; OEPA, 1987a,b; Yoder, 1989; Miner and Borton, 1991; Yoder, 1991).

Ohio EPA relies on an interpretation of multiple lines of evidence including water chemistry, sediment, habitat, effluent and land use data, biomonitoring results, and biological response to describe the causes (e.g., nutrients) and sources (e.g., agricultural runoff, municipal point sources, septic systems) associated with observed impairments. The initial assignment of the principal causes and sources of impairment that appear on the section 303(d) list do not necessarily represent a true "cause and effect" relationship. Rather, they represent the association of impairments (based on response indicators) with stressor and exposure indicators whose links with the survey data are based on previous experience with similar situations and impacts. The reliability of the identification of probable causes and sources is increased where many such prior associations have been identified.

The following paragraphs are provided to present the varied causes of impairment that were encountered during the 2005 study. While the various perturbations are presented under separate headings, it is important to remember that they are often interrelated and cumulative in terms of the detrimental impact that can result.

5.1.1 Habitat and flow alterations

Habitat and flow alterations result from the manipulation of drainage. Common practices in agricultural areas include channelization, installation of subsurface tile systems, and removal of riparian vegetation. Channelized streams are constructed to increase capacity, flow rate, and efficiency of tiles. Tiles lower the water table to facilitate the cultivation of fields and the removal of vegetation facilitates long term maintenance. Habitat lost directly impacts biological communities by limiting the complexity of living spaces available to aquatic organisms. Consequently, communities are not as diverse. Drainage systems keep water from ponding and slowly filtering through the soil, thus recharging groundwater and augmenting the stream at a lower volume and more sustained rate. The end result is flows that are flashy and streams that frequently become intermittent or dry.

There are other consequences that result from the loss of riparian vegetation. It eliminates an important source of coarse organic matter essential for a balanced ecosystem. In addition, an intact tree canopy limits the energy input from the sun and moderates temperature and evaporation.

Increased amounts of sediment are likely to enter streams altered for drainage by either overland transport or increased bank erosion. The removal of wooded riparian areas furthers the erosion process. Deep trapezoidal channels keep all but the highest flow events confined within the artificially high banks. As a result, areas that were formerly flood plains and allowed for the removal of sediment from the primary stream channel no longer serve this function. Drainage practices that reduce or eliminate water movement and sources of turbulence (riffles, snags, and meanders) can exacerbate organic enrichment impacts by limiting re-aeration.

5.1.2 Sedimentation

Whenever the natural flow regime is altered to facilitate drainage, increased amounts of sediment are likely to enter streams either by overland transport or increased bank erosion. The removal of wooded riparian areas furthers the erosion process. Channelization keeps all but the highest flow events confined within the artificially high banks. As a result, areas that were formerly flood plains and allowed for the removal of sediment from the primary stream channel no longer serve this function. As water levels fall following a rain event, interstitial spaces between larger rocks fill with sand and silt and the diversity of available habitat to support fish and macroinvertebrates is reduced. Silt also can clog the gills of both fish and macroinvertebrates, reduce visibility thereby excluding sight feeding fish species, and smother the nests of lithophilic fishes. Lithophilic spawning fish require clean substrates with interstitial voids in which to deposit eggs. Conversely, pioneering species benefit. They are generalists and best suited for exploiting disturbed and less heterogeneous habitats. The net result is a lower diversity of aquatic species compared with a typical warmwater stream with natural habitats.

Sediment also impacts water quality, recreation, and drinking water. Nutrients absorbed to soil particles remain trapped in the watercourse. Likewise, bacteria, pathogens, and pesticides which also attach to suspended or bedload sediments become concentrated in waterways where the channel is functionally isolated from the landscape. Community drinking water systems address these issues with more costly advanced treatment technologies.

5.1.3 Nutrient enrichment

Phosphorus and nitrogen are nutrients that are essential for aquatic plant and algae growth. Most waters naturally contain enough of these nutrients to support native aquatic life. However, an over-abundance of these nutrients can over-stimulate plant and algae growth such that they create water quality problems, (USEPA, 2007). In Ohio 94 of 224 assessment units, or 42%, were found to be impaired due to excessive nutrient loading, and are included on the 2008 state 303(d) lists for water quality problems. The problems caused by nutrient enrichment of lakes, stream, and rivers are not unique to Ohio as many other waterbodies across the United States have also been identified as impaired by nutrients. Nutrient impairments affect the survival of many aquatic species of fish; affect the safety of drinking water supplies; affect the aesthetics of recreational areas, and the ability to navigate through rivers and lakes.

In freshwater systems, phosphorus is typically the nutrient that is in short supply relative to biological needs, which means that the productivity of aquatic plants and algae can be controlled by limiting the amount of phosphorus entering the water. Large diurnal swings in pH and dissolved oxygen may occur as excessive amounts of nutrients are metabolized by aquatic plants and algae. The range of these swings is often measured to exceed the state water quality criteria established to protect fish and other aquatic organisms in their various life stages. Therefore, the amount of phosphorus currently entering these waters exceeds the seasonal loading capacity and must be reduced if these water quality problems are to be resolved. The sources of phosphorus loading vary depending on the human activities and conditions in a specific watershed, (USEPA, 2007).

5.1.4 Pathogens

Bacteria levels in streams are a concern because they are a human health issue and affect attainment of recreation uses. People can be exposed to organisms while wading, swimming, and fishing. In the Blanchard River watershed, fecal coliform were used as indicator organisms to evaluate risk of exposure to pathogens. Fecal coliform bacteria are relatively harmless in most cases, but their presence indicates that the water has been contaminated with feces from a warm-blooded animal. Although intestinal organisms eventually die off outside the body, some will remain virulent for a period of time and may be dangerous sources of infection. This is especially a problem if the feces contained pathogens or disease producing bacteria and viruses. Reactions to exposure can range from an isolated illness such as skin rash, sore throat, or ear infection to a more serious wide spread epidemic. Some types of bacteria that are a concern include *Escherichia*, which cause diarrhea and urinary tract infections, *Salmonella*, which cause typhoid fever and gastroenteritis (food poisoning), and *Shigella*, which cause severe gastroenteritis or bacterial dysentery. Some types of viruses that are a concern include polio, hepatitis A, and encephalitis. Disease causing microorganisms such as cryptosporidium and giardia are also a concern.

Since fecal coliform bacteria are associated with warm-blooded animals, there are both human and animal sources. Human sources, including effluent from sewage treatment plants or discharges by septic systems, are a more continuous problem. Contamination from combined sewer overflows are associated with wet weather events. Animal sources are usually more intermittent and are also associated with rainfall, except when domestic livestock have access to the water. Large livestock farms store manure in holding lagoons and this creates the potential for an accidental spill. Liquid manure applied as fertilizer is a runoff problem if not managed properly and it sometimes seeps into field tiles.

5.2 Relationship between stressors and their respective sources

Sources of pollution are usually classified as either point or non-point. The location of point sources is easy to identify at the end of a pipe and most are regulated by a permit to control quality of effluent. The location of non-point sources is difficult to identify because they come from all land uses. They are difficult to control and not often regulated, but have a major impact on water quality. Section 319 of the CWA was ratified in 1987 to require states to develop non-point source management programs.

5.2.1 Point sources

Point sources include municipal and industrial types. The wastewater they discharge can contain a wide variety of pollutants, but of particular concern are organic matter and nutrients. *Organic enrichment* contributes to dissolved oxygen sags and is usually measured with the BOD test. *Nutrient enrichment* can stimulate plants and algae to grow to the point where they are a nuisance and detrimental to the environment. The compounds ammonia, nitrate, and phosphorus are measured to evaluate the extent of enrichment.

Sewage treatment plants are designed to provide conditions suitable for microbes to convert organic compounds into stable inorganic compounds. Two components that are important for a system to operate efficiently are a long retention time and oxygen. These conditions stimulate bacterial respiration, which converts organic carbon to carbon dioxide and water. Another important process performed by bacteria involves the nitrogen cycle, which converts organic nitrogen and ammonia to ammonium, then nitrite, and finally nitrate. The treatment of phosphorus usually requires the addition of chemicals to encourage particles to adsorb to their surface and coagulate in masses heavy enough to precipitate out of the wastewater. This is why most phosphorus ends up in sludge, making it an attractive fertilizer.

5.2.2 Combined sewer overflows

These types of sewer systems carry both sanitary waste and storm water runoff. They are not a problem during dry weather, because treatment plants are designed to handle these flows. It is during wet weather that CSOs and bypasses become a concern, because they activate to prevent flooding of the system. Since this wastewater is not treated it contains a high amount of *organic matter, nutrients, and pathogens*. It can also contain a high amount of metals and oily waste.

5.2.3 Agriculture (grain and livestock)

Agriculture is the number one industry in Ohio and it is the predominant land use in the Blanchard River watershed. The major commodities produced include field, fruit, and vegetable crops and a variety of livestock. Pollution problems that arise include the introduction of *sediment, organic matter, nutrients, pathogens, and pesticides*.

The cultivation of land for crop production makes it susceptible to water and wind erosion and this increases the amount of sediment in streams. It also increases the amount of nutrients, especially phosphorus, and pesticides that are applied to crops to increase yield. Although nitrate passes easily thorough soil it still contributes to pollution problems because it enters through field tiles installed to improve drainage.

A major concern with livestock production is the management of manure. Confined feeding areas usually require the collection and storage of manure and this creates the potential for spills. Pasture land contributes to pollution too, especially if the livestock have unrestricted access to the stream.

5.2.4 Septic systems

Septic systems are used to treat sanitary sewage in areas where no municipal facilities exist. These systems usually employ a settling tank followed by either a leaching field or sand filters. They have a finite life span and require routine maintenance to operate properly. When poorly designed or neglected they contribute loads of *organic matter, nutrients, and pathogens.* Another problem that occurs in small towns is cross connecting failed systems to storm sewers. This solves the problem of sewage backing up in yards and basements, but severely harms the environment.

5.2.5 Storm water

Storm water runoff can be a significant source of impairment. Runoff from lands modified by human activities can harm surface water resources in several ways, including the changing of natural habitat and hydrologic patterns and elevating pollutant concentrations and loadings. Storm water runoff may contain or mobilize high levels of contaminants, such as *sediment, nutrients, heavy metals, pathogens, toxins*, oxygen-demanding substances, and floatables.

The origin of storm water includes discharges from Phase II MS4s and both Phase I and II Industrial and Construction activities. An MS4 is any public entity (city, village, transportation department, university, military base, etc.) that owns or operates a separate storm sewer system.

5.2.6 Channelization/ riparian removal

Channelization alters the stream habitat by redefining the natural structure and form of a stream to make it straight, wide, and deep. This is done to increase capacity and flow rate and improve the operation of internal drainage systems. The removal of riparian vegetation is often conducted as a part of channelization projects. This practice reduces friction, allows farming closer to the channel, and facilitates maintenance activities.

5.2.7 Impoundments

Most dams were constructed for flood control, but some were intended to enhance navigation, recreation, and provide impounded water for public drinking water supplies. The construction of a dam of any size impedes the natural flow of water through the channel and causes detrimental changes in water temperature and dissolved oxygen in the impounded section of the stream behind the dam. The dam itself stops fish migration, unless special fish “ladders” allow access around the dam to spawning grounds upstream of the impoundment.

6.0 METHODS OF TMDL DEVELOPMENT

A TMDL defines the maximum or minimum conditions in which a waterbody can meet its water quality standards. Development of TMDLs requires identifying the target conditions, such as the concentration of a given pollutant. The target state is compared to the existing conditions to determine how much abatement is needed to restore water quality. The contribution made by the relevant sources of the stressors is estimated in order to allocate the total maximum daily load (TMDL) among those sources.

This chapter discusses target selection and the methods used in estimating the existing conditions. It also discusses the methods used to determine the level of abatement needed (e.g., pollutant reductions) and the allocation of the TMDL to the relevant sources. The TMDL results are presented in Chapter 7.

6.1 Selection of water quality target values

TMDL development entails identifying the minimum threshold conditions under which the water quality standards can be met. These conditions, or targets, are often presented as a pollutant concentration. For the Blanchard River TMDL concentration-based targets are established for total phosphorus and fecal coliform bacteria. Conditions not associated with a specific pollutant concentration can also have targets provided that those conditions are measureable through a suitable means. Both habitat quality and sediment loading have targets that are not based on concentrations but rather on scores from a qualitative index.

The targets used for fecal coliform bacteria come directly from the water quality standards. In contrast, aquatic life use (ALU) requires that surrogate targets not included in the water quality standards be used. The attainment status of ALU is based on measures of the aquatic community captured in three biological indices. These indices do not reflect any specific water quality stressors in need of abatement and do not lend themselves for TMDL development. However, the stressors causing ALU impairment are identified during the water quality assessment and placed on the 303(d) list (see Section 4.5).

To make the connection between the water quality standards and the water quality stressors responsible for preventing ALU attainment, the Ohio EPA analyzed a large database to establish suitable targets. The ***Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams*** (Ohio EPA, 1999) documents the results of statistical analyses comparing the biological indices used in the water quality standards and several water quality variables such as nutrients and habitat index scores. All of the targets used to address the TMDLs for ALU, total phosphorus, habitat and sediment, are based on the findings documented in the ***Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams*** (Ohio EPA, 1999).

The following sub-sections discuss the specific targets used in developing TMDLs to address recreational use and ALU impairments.

6.1.1 Nutrient targets: total phosphorus

For the purpose of this TMDL, total phosphorus is used as an indicator for the degree of nutrient enrichment because it is frequently the limiting nutrient to primary production in streams and rivers of Ohio. While the Ohio EPA does not currently have statewide numeric criteria for nutrients, 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). Targets are proposed for total phosphorus concentrations based on observed concentrations associated with acceptable ranges of the biological community metrics. The total phosphorus targets used in this report are shown in Table 6.1.

Ohio's standards also include narrative criteria that limit the quantity of nutrients which may enter state waters. Specifically, 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.

Table 6.1. Total phosphorus targets for warm water habitats (WWH) and modified warm water habitats (MWH)

Use designation	Watershed size	Total phosphorus (mg/l)
WWH	Headwaters (drainage area < 20 mi^2)	0.08
	Wadeable (20 mi^2 < drainage area < 200 mi^2)	0.10
	Small River (200 mi^2 < drainage area < 1000 mi^2)	0.17
MWH	Headwaters (drainage area < 20 mi^2)	0.34
	Wadeable (20 mi^2 < drainage area < 200 mi^2)	0.28
	Small River (200 mi^2 < drainage area < 1000 mi^2)	0.25

6.1.2 Fecal coliform

The Water Quality Standards for fecal coliform bacteria are meant to protect recreational water uses by limiting the risk for human illness due to exposure to pathogenic microorganisms. Pathogenic organisms include bacteria, viruses, and protozoan. Humans can be exposed to water-borne pathogens through skin contact or accidental ingestion which can lead to skin irritation, gastroenteritis, or other more serious illnesses.

Fecal coliform (FC) is a measure of the number of organisms within the fecal coliform sub-group of bacteria. Fecal coliform reside in the intestinal tracts of warm blooded animals and are excreted in their wastes. By and large FC are not pathogenic organisms; however, as their concentrations exceed a threshold value it becomes increasingly probable that pathogenic organisms are present in concentrations that are threatening to public health.

Fecal coliform are measured in lieu of other pathogenic organisms because they are much easier to detect and identify than the many individual pathogenic organisms that may be present. Since a large number of pathogens enter waterbodies in association with human or animal wastes, fecal coliform are appropriate surrogates for pathogenic organisms.

The criterion for fecal coliform specified in OAC 3745-1-07 are applicable outside the mixing zone and vary for waters determined primary contact recreation (PCR) and secondary contact recreation (SCR). For PCR the standard states the geometric mean content, based on not less than five samples within a thirty-day period, shall not exceed 1000 counts per 100 ml and shall not exceed 2000 counts per 100 ml in more than 10 percent of the samples taken during any thirty-day period. The SCR standard varies in that it requires fecal coliform not to exceed the geometric mean value of 5000 per 100 ml in more than ten percent of the samples taken during any thirty-day period. There is no geometric mean component of the standard for SCR designated waters. Most of the stream segments in the Blanchard River watershed are designated as PCR. Table 6.2 lists those that are designated SCR.

Table 6.2. Streams and river segments designated as Secondary Contact Recreation (SCR) within the Blanchard River watershed.

Description	River Mile(s)	WAU	HUC 14
Blanchard River	101.03, 100.05, 97.42	Headwaters	04100008-010-010, -030 (97.42)
Forest-Simpson Ditch	0.8	Headwaters	04100008-010-030
Shallow Run	4.7, 4.0	Headwaters	04100008-010-030
Rickenbach Ditch	4.98, 4.93, 1.18	Headwaters	04100008-010-050
Buck Run	3.57, 0.56	Eagle Creek	04100008-030-020
Higbie-Redick Ditch	0.76	Ottawa Creek	04100008-040-010

6.1.3 Habitat alteration and sedimentation

Habitat TMDL targets and the qualitative habitat evaluation index (QHEI)

Poor habitat quality is an environmental condition, rather than a pollutant load, so development of a load-based TMDL for habitat is not possible. Nonetheless, habitat is an integral part of stream ecosystems and has a significant impact on aquatic community assemblage and consequently on the potential for a stream to meet the bio-criteria within Ohio's water quality standards (see Section 2.3). In addition, U.S. EPA acknowledges that pollutants, conditions or other environmental stressors can be subject to the development of a TMDL to abate those stressors in order to meet water quality standards. Thus, sufficient justification for developing habitat TMDLs is established.

The qualitative habitat evaluation index (QHEI) was developed by the Ohio EPA (Rankin, 1989) with one of the objectives being to create a means for distinguishing impacts to the aquatic community from pollutant loading versus poor stream habitat. The design of the QHEI in conjunction with its statistically strong correlation to the bio-criteria makes it an appropriate tool for developing habitat TMDLs.

The QHEI assigns a numeric value to an individual stream segment (typically 150-200 meters in length) based on the quality of its habitat. The actual number values of the QHEI scores do not represent the quantity of any physical properties of the system but provide a means for comparing the relative quality of stream habitat. However, even though the numeric value is derived qualitatively, subjectivity is minimized because scores are based on the presence and absence and relative abundance of unambiguous habitat features. Reduced subjectivity was an important consideration in developing the QHEI and has since been evidenced through minimal variation between scores from various trained investigators at a given site as well as consistency with repeated evaluations (Rankin, 1989).

The QHEI evaluates six general aspects of physical habitat that include channel substrate, instream cover, riparian characteristics, channel condition, pool/riffle quality, and gradient. Within each of these categories or sub-metrics, points are assigned based on the ecological utility of specific stream features as well as their relative abundance in the system. Demerits (i.e., negative points) are also assigned if certain features or conditions are present which reduce the overall utility of the habitat (e.g., heavy siltation and embedded substrate). These points are summed within each of the six sub-metrics to give a score for that particular aspect of stream habitat. The overall QHEI score is the sum of all of the sub-metric scores.

Since its development the QHEI has been used to evaluate habitat at most biological sampling sites and currently there is an extensive database that includes QHEI scores and other water quality variables. Strong correlations exist between QHEI scores and some its component sub-metrics and the biological indices used in Ohio’s water quality standards such as the Index of Biotic Integrity (IBI). Through statistical analyses of data for the QHEI and the biological indices, target values have been established for QHEI scores with respect to the various aquatic life use designations (Ohio EPA 1999). For the aquatic life use designation of warm water habitat (WWH) an overall QHEI score of 60 is targeted to provide reasonable certainty that habitat is not deficient to the point of precluding attainment of the biocriteria. An overall score of 75 is targeted for streams designated as exceptional warm water habitat (EWH) and a minimum score of 45 is targeted for modified warm water habitat (MWH) streams.

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

In addition to the overall QHEI scores, targets for the maximum number of modified and high influence modified attributes have been developed. For streams designated as WWH, there should no more than four modified attributes of which no more than one should be a high influence modified attribute. Table 6.3 lists modified and high influence modified attributes and provides the QHEI targets used for this habitat TMDL. For simplicity, a pass/fail distinction is made telling whether each of the three targets are being met. Targets are set for: 1) the total QHEI score, 2) maximum number of all modified attributes, and 3) maximum number of high influence modified attributes only. If the minimum target is satisfied, then that category is assigned a "1", if not, it is assigned a "0". To satisfy the habitat TMDL, the stream segment in question should achieve a score of three.

Table 6.3. QHEI targets for the habitat TMDL that are applicable to warmwater habitats.

	Overall QHEI Score	**All Modified Attributes**	
		High Influence Modified Attributes	**All Other Modified Attributes**
Range of Possibilities	12 to 100 points	- Channelized or No Recovery - Silt/Muck Substrate - Low Sinuosity - Sparse/No Cover - Max Pool Depth < 40 cm (wadeable streams only)	- Recovering Channel - Sand Substrate (boat sites) - Hardpan Substrate Origin - Fair/Poor Development - Only 1-2 Cover Types - No Fast Current - High/Moderate Embeddedness - Ext/Mod Riffle Embeddedness - No Riffle
Target	Overall score >= 60	Total number < 2	Total number < 5[a]
TMDL Points Assigned if Target is Satisfied	+ 1	+ 1	+ 1

[a] Total number of modified attributes includes those counted towards the high influence modified attributes.

Sediment TMDL targets and the qualitative habitat evaluation index (QHEI)
The QHEI is also used in developing the sediment TMDL for this project. Numeric targets for sediment are based upon sub-metrics of the QHEI. Although the QHEI evaluates the overall quality of stream habitat, some of its component sub-metrics consider particular aspects of stream habitat that are closely related to and/or impacted by the sediment delivery and transport processes occurring in the system.

The QHEI sub-metrics used in the sediment TMDL are the substrate, channel morphology, and bank erosion and riparian zone. Table 6.4 lists targets for each of these metrics.

- The substrate sub-metric evaluates the dominant substrate materials (i.e., based on texture size and origin) and the functionality of coarser substrate materials in light of the amount of silt cover and degree of embeddedness. This is a qualitative evaluation of the amount of excess fine material in the system and the degree to which the channel has assimilated (i.e., sorts) the loading.
- The channel morphology sub-metric considers sinuosity, riffle, and pool development, channelization, and channel stability. Except for stability each of these aspects are directly related to channel form and consequently how sediment is transported, eroded, and deposited within the channel itself (i.e., this is related to both the system's assimilative capacity and loading rate). Stability reflects the degree of channel erosion which indicates the potential of the stream as being a significant source for the sediment loading.
- The bank erosion and riparian zone sub-metric also reflects the likely degree of instream sediment sources. The evaluation of floodplain quality is included in this sub-metric which is related to the capacity of the system to assimilate sediment loads.

Table 6.4. QHEI targets for the sediment TMDL that are applicable to warmwater habitats.

Sediment TMDL =	**Substrate**	**+**	**Channel Morphology**	**+**	**Riparian Zone/Bank Erosion**	
For WWH >=	13	+	14	+	5	>= 32

6.2 Method for quantifying the existing conditions

It is necessary to know the existing conditions in the basin in order determine the needed level of abatement (i.e., comparison between the target and existing conditions). The following sub-sections provide a summary of the technical approach used in estimating the existing load. Additional detail regarding load calculations can be found in the appendices.

6.2.1 Nutrients: total phosphorus

Total phosphorus loading from nonpoint source pollution is estimated using a watershed loading model in which precipitation, land cover and land management, and relatively diffuse discharges from home septic treatment systems are the primary considerations. In contrast, an instream decay model is used to estimate loading under dry conditions when point sources are the dominant or only total phosphorus contributor. See section 6.2.2, Low Flow Pollutant Loading, for a discussion about estimating total phosphorus under critical low flow conditions.

Generalized Watershed Loading Function (GWLF)
In using a watershed loading model, both the hydrology of the system and the transport of the pollutants of interest must be estimated. The hydrologic cycle for the subwatersheds receiving nutrient TMDLs is simulated using the Generalized Watershed Loading Function model (Haith, 1992) through the desktop simulation called BasinSim 1.0 (Dai, 2000). The model predicts stream flow based on precipitation, evapotranspiration, land uses and soil characteristics. Figure 6.1 shows the hydrologic model of Generalized Watershed Loading Function (GWLF) model.

GWLF simulates runoff, groundwater recharge and stream flow by a water-balance method using measurements of daily precipitation and average temperature. Runoff is calculated using the Natural Resources Conservation Service's Runoff Curve Number method (USDA, 1986).

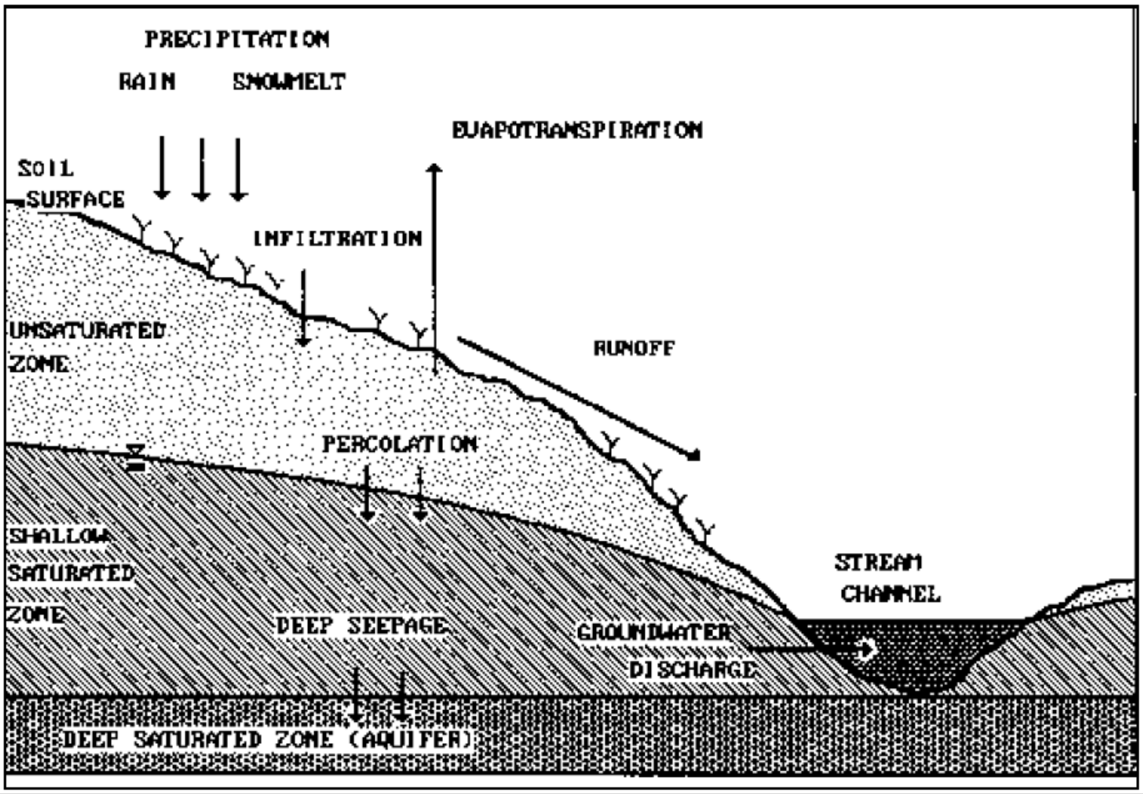
Groundwater recharge is determined by tracking daily water balances in the unsaturated and shallow saturated zones. Stream flow is computed as the sum of the groundwater discharge from the shallow saturated zone (baseflow) and the surface runoff. The model computes the daily water balance and resulting stream flow.

Input files for GWLF
GWLF requires four input files in order to estimate total phosphorus loading which are: long term flow, weather, transport and nutrients.

<u>Long term flow input file</u>
The basis of nutrient modeling is a calibrated hydrologic model. Each sub-basin was calibrated to long term flow data from the USGS gage in Findlay (gage number 04189000). The measured flows from the sentinel sites were curve fitted to the stage height measurements documented from the USGS gage. This relationship was used to calculate flows for the remaining stage height measurements for which flows were not measured. A long term flow data set was calculated by developing a statistical relationship between these 25 measured flows and the long term USGS gage at Findlay (04189000) flow dataset. The BasinSim model output for each modeled area is compared to this calculated long term flow dataset input file for calibration.

Seven sentinel sites were setup on the major tributaries to the Blanchard River to assess the major influences to the river. Sentinel sites are sites where frequent water chemistry samples are taken and where bridges are used to relate stream stage heights to stream flow. Six of these sites were visited between 5/31/05 and 1/09/07, with one long term Blanchard River site at CR 140 starting on 2/02/05.

Figure 6.1. GWLF model hydrology component interaction (Dai et al., 2000).



Weather input file

To determine daily temperature and precipitation for each HUC 11, data from the Midwestern Regional Climate Centers (MRCC) weather stations were used. The coverage over a HUC11 study area from each weather station was weighted based on the Thiessen polygon method (Chow et al., 1988; Linsley et al., 1982).

Transport input file

This file supplies the model with information needed to calculate stream flow. See Figure 6.1 for the hydraulic model representation. The parameters needed for these algorithms deal with flow recession, seepage (or percolation), water storage in the soil, evapotranspiration, and soil erosion. Several input values were determined from the characteristics of the Blanchard River basin, while some were simply default values inherent to the model. Sources for the watershed specific values include the National Land Cover Dataset (NLCD) for land cover data and the Natural Resource Conservation Service's State Soil Geographic (STATSGO) and Soil Survey Geographic Database (SSURGO) databases for soils information.

Nutrient input file

Nutrient data for rural source areas pertain to dissolved phosphorus in runoff and solid-phase nutrients in sediment. The daily rate of nutrient (phosphorus) accumulation must be supplied to the model for each urban land use. Model input values used to approximate nutrient loading from septic systems require per capita rates for nutrient loading to septic systems, nutrient assimilation due to plant uptake, and estimates of the number of people served by each type of system. Phosphorus loading from point sources is assumed to be in a dissolved form and the model calls for specific values for each month of the simulation period. Groundwater is also assumed to yield only dissolved forms of phosphorus and the loading rate was the model's default values (Haith et al., 1992).

Manure is another important source of nutrients in runoff. The model requires that the months for beginning and ending land application of manure and the respective land use be supplied. The average total phosphorus value (1.605 mg/l) from data collected over 63 runoff sampling events near fields that have had manure applied was used as the total phosphorus runoff input value. This number was applied to the number of acres found to have manure applied.

To estimate manure production, numbers of livestock distributed by animal type were taken from the Ohio Department of Agriculture 2004 Annual Report and Statistics (Ohio Department of Agriculture 2004). The report provides numbers aggregated by Ohio County. Values by watershed assessment unit were derived from spatial overlay of the watershed assessment unit boundary onto the county boundary. Thus, an areal proportion of livestock number can be assigned to each assessment unit. The amount of land that received applied manure was applied to both the pastured and cultivated field land uses. It was assumed that all the pasture land received manure then the remainder of manure was assumed to be applied to cultivated field, so the cultivated field land use was divided into two land uses, one with manure application and one without.

The apportioning was done considering certain assumptions such as; how much manure each type of livestock produces, phosphorus concentrations in the manure, how farmers determined how many acres are needed to dispose of/use the manure without over applying phosphorus or nitrogen, what months manure is field applied, percentage of calves versus cows, and so on.

Direct and indirectly modeled areas

Approximately 87 percent of the Blanchard River basin was covered by the GWLF model. Sentinel sites were established on the major tributaries and the mainstem in order to gather chemistry and flow data for model support. These sentinel sites are located at the outlets of the modeled areas.

The GWLF model output for total phosphorus was used to derive the existing conditions. The output was sorted by month and the averages of four seasons; winter, spring, summer, and fall were taken. The seasonal average daily loads showed a correlation to drainage area, therefore the existing conditions for the un-modeled areas could be derived from the modeled areas.

For load allocations the maximum TMDLs were calculated the same way as existing conditions were, by relating the maximum TMDLs for the modeled areas to their respective drainage areas. Then the resultant regression formula was used to determine the maximum TMDLs for the un-modeled tributaries.

MS4 areas

In order to calculate the total phosphorus contribution from the MS4 area the transport and nutrient model input files were adjusted to reflect the “hardened” conditions of the urban area, which contain increased impervious surfaces such as pavements and roofs. The point source dischargers and failing septic systems were set to zero due to negligible or altogether absent presence in this area. Using National Land Cover Database the land use and areas within the MS4 were determined; however all other inputs from the Eagle Creek model set up were left unchanged. This setup allowed the model to calculate only the urban land use contribution. The MS4 area includes the metropolitan Findlay area minus the area covered by CSOs, since that area is not part of the separated storm sewer area. The dissolved phosphorus portion of the model output was almost entirely (97 percent) from groundwater, so it was subtracted from the total phosphorus output in order to calculate just the runoff load. Also, only the runoff flow was used to calculate the load, the ground water portion was excluded. This allowed for the calculation of phosphorus from just the urban land use area. Then, as with the other modeled areas, the target concentration of 0.1 and 0.17 mg/l, for wadable streams and small rivers respectively, were multiplied by the output flows to determine the target load.

Point sources: continuous dischargers

Wasteload allocations for the minor NPDES dischargers, which primarily employ continuously discharging lagoon systems, were calculated from the instream water quality target and the average effluent flow volume. The average flow volume was derived from data in the monthly operating reports (MOR) that includes a flow rate and total phosphorus concentration on days that monitoring occurred (which ranged from 4 to 23 days in a month). Monthly flow volumes were calculated based on the average daily flow volume times the number of days in that month. Each of the unique monthly flow volumes was summed to establish an annual flow volume. The wasteload allocation is determined by the product of the instream water quality target and the flow volume of interest (e.g., daily, monthly, or annual). This effluent load is selected because under low flow conditions there is essentially no dilution, therefore the effluent concentration of total phosphorus must equal the instream water quality target.

The needed reduction is calculated from the existing effluent loading, which again is based on the MOR data. Daily loads are determined from the daily flow volume and associated total phosphorus concentration. The daily average is multiplied by the number of days in the month to determine average monthly loads which are summed to establish the annual load. The needed reduction is calculated as the daily difference between the target load and existing load. An averaged is taken for each month and summed to create an annual value in the same manner as described above.

Point sources: controlled dischargers
Controlled dischargers only discharge when there is some prescribed minimum flow volume in the receiving stream. The waste load allocations were based on controlled discharges occurring when there is sufficient dilution in the receiving stream to accommodate an effluent concentration that is ten times greater than the instream water quality target. The total flow volume was calculated as the average discharge volume (derived from years of data) times the number of days in which discharges occur throughout the year. This total flow volume was multiplied by the target effluent concentration, which is ten times the instream water quality target.

6.2.2 Low flow pollutant loading

The Blanchard River mainstem is not attaining aquatic life use (ALU) from RM 97.5 to 55.2 due to a suite of causes defined as organic enrichment and dissolved oxygen, nutrients, thermal modification (i.e., high water temperature), and habitat alteration. For the segment of mainstem traversing the urban corridor of Findlay (approximate RM 62 to 55), an instream kinetics water quality model (QUAL2K) was constructed to simulate critical stream conditions and compare strategies for remediation. This QUAL2K model was implemented to address these specific urban related, point source and impoundment related causes: thermal modification, nutrients, and organic enrichment and dissolved oxygen (Table 6.5). Some sources of aquatic life use impairment (related to the causes of nutrients and organic enrichment) are associated with crop production, combined sewer overflows (CSOs), and urban runoff. Crop production and urban runoff sources are addressed using the GWLF model as discussed in section 6.2.1. Allocations for point-source nutrient loads emanating from Findlay Water Pollution Control Facility (WPCF) as generated from the QUAL2K simulations are described here.

Figure 6.2. Longitudinal extent of QUAL2K modeling analysis with respect to City of Findlay and Blanchard River watershed.

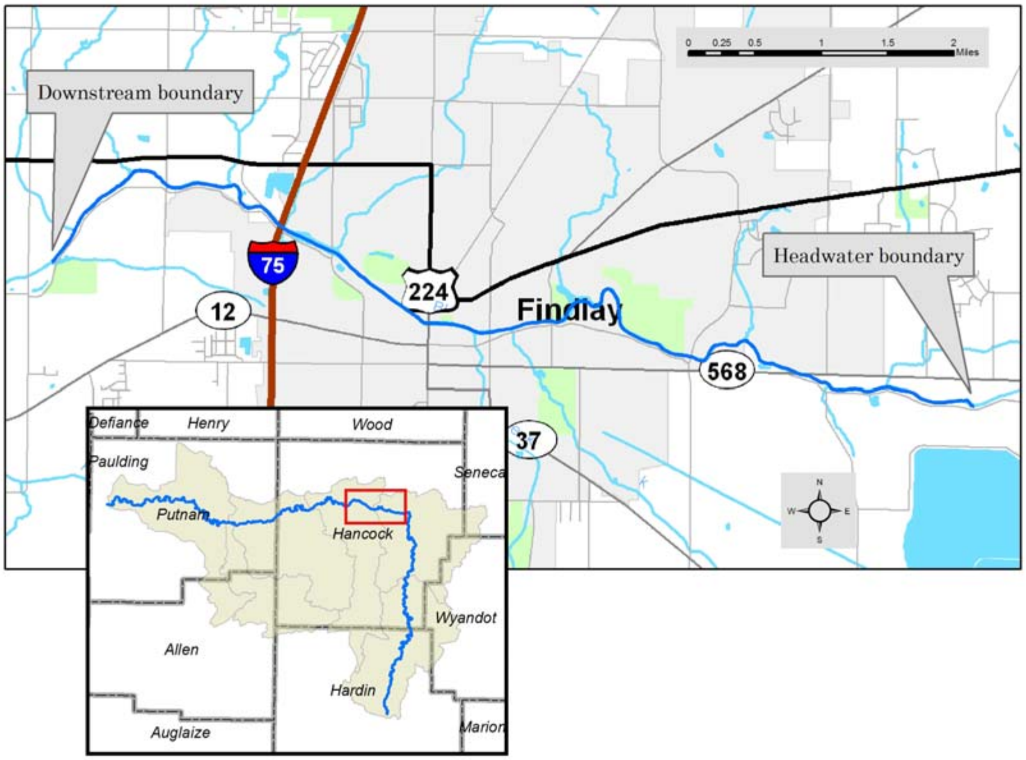


Table 6.5. Causes of ALU impairment (as listed in 2007 TSD) within the QUAL2K modeled river segment of the Blanchard R mainstem and corresponding approaches for TMDL development.

HUC	Description	River Mile	Causes	TMDL Development			
				QUAL2K nutrient/DO /temp	GWLF nutrient	QHEI habitat/flow	QHEI sediment
-020-040	Blanchard R mainstem	61.7/61.9	organic enrichment		x		
			nutrients		x		
			thermal modification	x			
-030-030		57.8/57.9	thermal modification	x			
			organic enrichment/DO	x			
			habitat alteration (development-related)			x	
			siltation				x
		57.3	habitat alteration				
			thermal modification	x		x	
			nutrients		x		
			organic enrichment/DO	x			
		56.9/56.8	thermal modification	x			
			nutrients		x		
			habitat alteration (development-related)			x	
		55.2/54.7	nutrients	x	x		
			organic enrichment/DO	x			
			thermal modification	x			

Instream decay model: QUAL2K

QUAL2K is a one dimensional, steady state model which is used to simulate dissolved oxygen (DO), carbonaceous BOD (CBOD), algae as chlorophyll-a, organic and inorganic phosphorus, and the nitrogen series. The model considers stream reaeration from the atmosphere and sediment oxygen demand among other processes. QUAL2K is supported and distributed by U.S. Environmental Protection Agency and has been widely used for studying the impact of conventional pollutants on streams.

The study area is divided into a sequence of reaches (Figure 6.3) and within each reach there exists one to four elements where physical/chemical processes are simulated as a steady state (invariant with time) phenomenon. The Blanchard River (Findlay) study area was divided into 18 reaches with a headwater boundary established just upstream of the Findlay PWS (public water supply) intake (RM 62.6) and a downstream boundary established just upstream of the confluence with Oil Ditch (RM 54.05) (Figure 6.2).

Each reach represents a stretch of river that has constant hydraulic characteristics (e.g., slope, velocity, bottom width, among others). While both the mainstem and tributaries can be modeled as interacting segments, for the Blanchard River (Findlay) model the tributaries were considered as fixed inputs. The entire course of elements for all reaches is considered a series of linked, completely mixed reactors. Each element, though, is a separate system which has an initial external input (from just upstream and/or laterally from seepage or tributary and wastewater inflow) and internal chemical reaction which either increase or decrease the parameter of concern (e.g., DO or temperature). The outflow from one element represents the inflow into the next downstream element.

For calibrating the Blanchard QUAL2K model, a field survey was conducted on August 1-3, 2006 where flow, water chemistry, grab sample water chemistry, composite sample water chemistry, and cross sectional profiles were measured over multiple locations of the mainstem and all significantly flowing incoming tributaries. The QUAL2K model was developed for August 2, 2006 when the streamflow at the USGS gauge was 49.0 cfs. For developing the TMDL, the QUAL2K model was developed for critical stream conditions using a flow return interval of 7Q10 (8.89 cfs). Critical stream conditions imply summer low stream flow and warm water temperatures, and wastewater effluent set to NPDES permit limits and design flow. A 7Q10 flow is statistical value representing the minimum average 7-day flow with a recurrence-interval of 10 years. The 7Q10 flow was calculated at the USGS gauge location using DFLOW (v. 3.1) for the period 1982-2007.

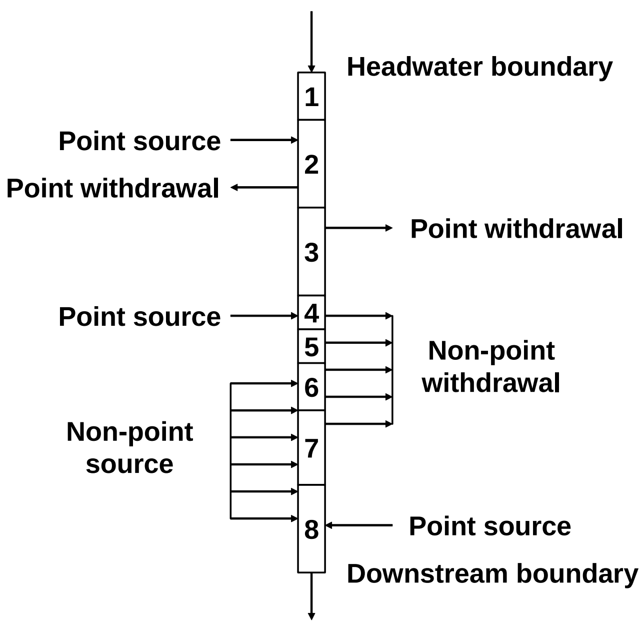


Figure 6.3. General segmentation scheme for the QUAL2K model showing reaches (numbered), boundary locations, and lateral inputs (or withdrawals). In this simplified scheme (Chapra and Pelletier, 2006), tributaries are considered as fixed, point source inputs.

Upstream boundary conditions for the QUAL2K model were characterized by using monitoring data (flow and water chemistry) collected at RM 62.6 (Figure 6.4) during the August 1-3 2006 survey. Downstream boundary conditions were not established for the Blanchard QUAL2K model.

Diffuse sources are allowed in the QUAL2K model as uniformly distributed flow over the entire length of a reach. Often these are included in the simulation to ensure better balancing of flow and water chemistry at each monitoring station. For the Blanchard QUAL2K model, the flow and water chemistry balance for each monitoring station was satisfactory. No known evidence of distributed inflow (from groundwater and subsurface bank flow) was observed or documented. Hence, no diffuse sources were recognized in this modeling effort.

Point sources are recognized in the QUAL2K model as wastewater effluent and incoming tributaries (where they themselves are not simulated but considered as a fixed input). The sole wastewater source in the Blanchard QUAL2K model is the Findlay WPCF at RM 56.42 (reach #16; Figure 6.4). Tributary inputs are defined in Table 6.6.

Table 6.6. Definition of tributary inputs (considered as fixed point sources) into the Blanchard QUAL2K model.

Tributary (monitoring location)	Reach #	RM	Drainage Area (mi^2)
Harold Shafer Ditch @ SR 568	2	61.99	4.9
Un-named Tributary @ Saratoga Dr (Rush Ck)	3	60.75	1.8
Hagerman's Run	5	58.97	1.1
Lye Ck	7	58.38	27.9
Eagle Ck @ Lincoln St	9	58.10	61.0
Howard Run	15	56.80	4.8
Dalzell Ditch	16	56.35	1.1
Un-named Tributary @ US 224 (W of River Rd)	17	55.76	1.6
Un-named Tributary @ US 224 (W of CR 140)	18	54.96	1.7
Un-named Tributary downstream CR 139	18	54.30	4.2

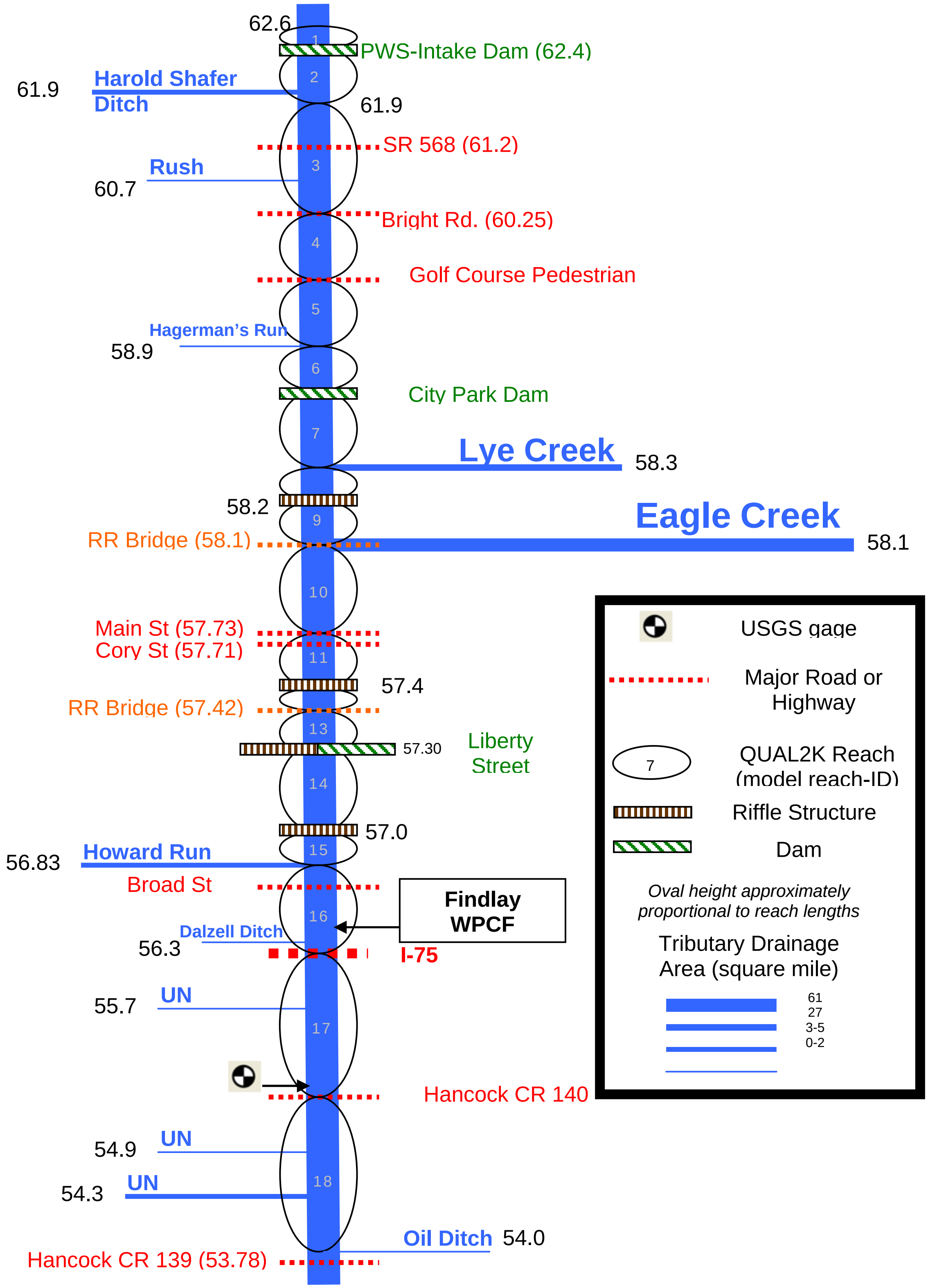


Figure 6.4. Schematic showing QUAL2K reach segments (ovals) for the Blanchard River mainstem (Findlay), locations of existing dams and installed riffle structures (2007), road crossings, tributaries, and corresponding river mile-markers.

Calibration of QUAL2K model for the Blanchard River (Findlay) mainstem

The Blanchard QUAL2K model was calibrated for flow, water temperature, dissolved oxygen, phytoplankton, nitrate, and phosphorus species (both total and inorganic) from measurements taken during the August 2006 field survey. These measurements included instream mainstem and tributaries, and Findlay WPCF effluent. Model calibration results are presented in Appendix C; however total phosphorus will be discussed here briefly.

A sharp increase in both total and inorganic phosphorus was realized once Findlay WPCF effluent enters the mainstem. The target concentration (0.16 mg/L) of total phosphorus was exceeded from this point downstream (RM 56.3 to RM 54.0 and beyond). The target value was derived from Ohio EPA (1999) for the Eastern Cornbelt Plains Ecoregion (ECBP), small river drainage systems, and for achieving an IBI score above 40 units. See Figure 6.5 for a graphical display of the calibration results.

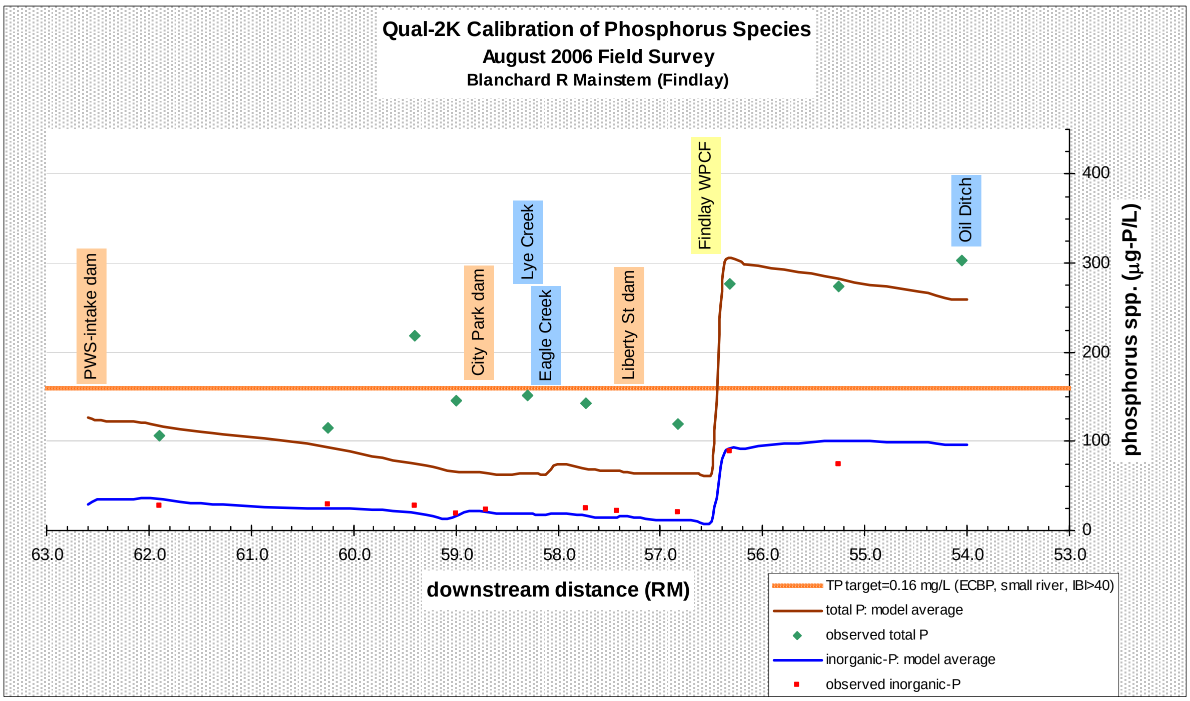


Figure 6.5. Longitudinal distribution of model predicted <u>total phosphorus</u> and <u>inorganic phosphorus</u> (ortho-phosphate) concentrations compared to observed values and total phosphorus water quality criterion.

6.2.3 Pathogens: fecal coliform

The pathogen simulation period extended from April 1999 to February 2007. TMDL allocations were computed over the period – May 2000 to February 2007, which is 1.1 years shorter than the simulation period. Allocations were completed for the six watershed assessment units and the MS4 region in Findlay. The MS4 region does not contain drainages maintained by combined sewer overflows (Figure 6.6).

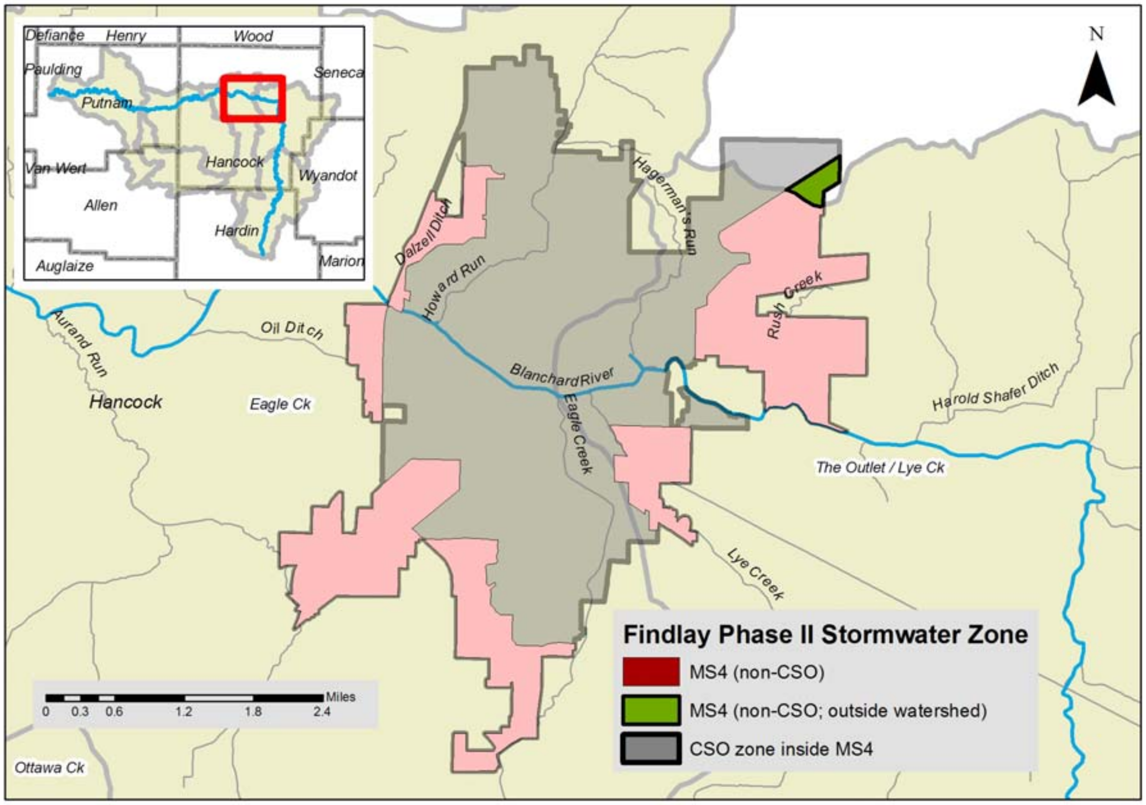


Figure 6.6. Location of MS4 (municipal separate storm-sewer system) under Phase II stormwater management program for Findlay, Ohio.

Determination of nonpoint and point loading sources was determined through direct inputs to streams (point) and surface runoff/washoff (nonpoint) (Table 6.7). Target loads (TMDL) are simply a product of streamflow (volumetric flow rate) and the water quality criterion.

Daily surface runoff was determined from the NRCS curve-number method. This method requires daily precipitation depth, land cover type, and soil hydrologic group. Precipitation input was generated from the method described above. Land use was determined from the National Land Cover Dataset (Homer et al., 2001) and soil hydrologic group was determined from NRCS SSURGO (Soil Survey Staff, 2005) digital soil layers. Both factors determine the curve number, which was area-weighted within each assessment unit.

Total daily precipitation was synthesized from a collection of six gauges. Each gauge's contribution to the HUC-11 area was determined by Theissen polygon weighting. Data was produced from the Midwestern Regional Climate Center in Champaign IL.

Total streamflow was estimated as the sum of surface runoff, baseflow, flow from residential septic systems, and waste flow from cattle instream. Surface runoff was determined from the curve-number technique described above. Baseflow was determined from hydrograph separation using the USGS PART method (Rutledge, 1998). Daily streamflow from the USGS Blanchard River at Findlay gauge (346 square mile) was partitioned into storm and baseflow using PART. The baseflow for each assessment unit was proportioned by area.

To estimate manure production, numbers of livestock distributed by animal type were taken from the Ohio Department of Agriculture 2004 Annual Report and Statistics (Ohio Department of Agriculture 2004). The report provides numbers aggregated by Ohio County. Values by watershed assessment unit were derived from spatial overlay of the watershed assessment unit boundary onto the county boundary. Thus, an areal proportion of livestock number can be assigned to each assessment unit.

One direct contribution of pathogens to the stream system occurs from livestock access to the stream. Using Bacteria Indictor Tool (BIT) (U.S. Environmental Protection Agency 2000) assumptions, only beef cattle have access to streams. Beef cattle are assumed to be either kept in feedlots or allowed to graze (depending on the season). When grazing, a certain proportion is assumed to have direct access to streams. An assumption is made that all beef cattle are confined from December through March, inclusive. Then from April through November, only 15 percent of the total number in the watershed can graze, and half of this amount has direct access to streams. Thus, about eight percent of the total number of livestock in the watershed has direct access to the stream. BIT assumes that dairy cattle are only kept in feedlots. Therefore all of their waste is used for manure application (divided between cropland and pastureland).

NPDES permittees are assumed to be discharging effluent with fecal coliform concentrations at or below their permit limit of 1000 cfu/100 ml. Accounting for NPDES loads was achieved by taking their design flow and allowance of the full permit limit (i.e., 1000 cfu/100 ml). Any permittee discharging above the permit limit will be managed through the NPDES compliance program where efforts are made to assist the permittee in meeting the fecal coliform criterion.

An assessment of CSO discharges was made for the communities with recognized CSO outfalls: Findlay, Bluffton, Pandora, Forest, and Dunkirk. CSO discharges were not accounted for in the current pathogen model because either discharge information has not been reported and/or the community is under a long-term control plan (LTCP) or is in the process of reconstructing their sewer infrastructure for separation. Further, CSO discharges occur on an intermittent basis and would not contribute substantially to the total pathogen load of the assessment unit. A summary of known CSO information on these communities is presented in Table 6.8. Concentrations of fecal coliforms from CSO discharges have been reported nationally at $4.2 \cdot 10^6$ cfu/100 ml (Dorian et al., 1981) and from 10^5-10^7 cfu/100 ml (Water Environment Federation, 1999).

The number of people using a household septic system was determined from several sources. Initial estimates of population were extracted from the US Census 2000 block enumerations for specific 11-digit HUCs (those used in the GWLF nutrient model described elsewhere in this report). The HUC total was then decremented by the number of people in a sewer service-area to yield an unsewered population estimate.

For areas outside the HUC but still included in the WAU, the US Census 1990 block group enumeration was employed and sewage treatment attributes (i.e., public, septic tank or cesspool, and other) were assessed.

Table 6.7. Characterization of existing loads, target loads, and load allocation for the Blanchard River pathogen analysis.

Development Step	Source		Approach
Determination of Existing Load	Point Source (NPDES)		Product of design flow and the fecal coliform average standard currently in place for a given permittee.
	Washoff from Land		Livestock manure and wildlife fecal exports distributed by land cover type and transported to stream via surface runoff. This approach encompasses the MS4 Zone in the City of Findlay.
	HSTS		Population served by failing HSTS estimated via US Census Bureau. Failure rate identified by Hancock County Health Department. Fecal coliform load based upon population estimates and a per capita loading rate.
	Beef Cattle in Stream		Proportion of beef cattle that are estimated to graze, then a sub-set that are expected to have stream access.
TMDL: Calculation of Target Load (Loading Capacity)			*Product of daily discharge at the outlet of each watershed assessment unit (WAU) and the chronic criterion for fecal coliform (i.e., geometric mean concentration).*
Proposed Allocation	**WLA**	Point Source (NPDES)	Product of design flow and the fecal coliform average standard currently in place for a given permittee (same as existing load determination).
	WLA	MS4	The allocation for the MS4 Zone (City of Findlay) is computed exactly as in the Washoff from Land (LA) (see below).
	LA	Washoff from Land	The washoff allocation is the residual loading capacity once the NPDES WLA and 5 percent HSTS have been allocated.
	LA	HSTS	Failing HSTS are allocated a fecal coliform load equal to a 5 percent failure rate.
	LA	Beef Cattle in Stream	A 100 percent removal of beef cattle in streams is proposed so that a zero loading is authorized.

Definitions
LA: load allocation
WLA: wasteload allocation
HSTS: home sewage treatment systems (i.e., residential septic systems)
MS4: municipal separate storm sewer system

For Hancock County, residential septic systems were estimated to have a failure rate of 50 percent (Hancock County Health Department, 2004). The report states, “based on the number of household sewage treatment systems in Hancock County that are older than 30 years, it is assumed that the majority of the systems in Hancock County are discharging off-lot, installed in unsuitable soils, and have little or no maintenance." A 50 percent failure rate was applied to all septic systems in the Blanchard River watershed. Hancock County occupies approximately 50 percent of the total Blanchard watershed area and it is assumed that the remaining counties that comprise a large percentage of the watershed (Putnam and Hardin counties) have a similar failure rate.

Table 6.8. Summary of CSO outfall and correction efforts within the Blanchard River watershed.

Facility	Remediation Plan	Flow Discharge 2000-2007		WAU
		Frequency (% of days)	Median Flow Volume (MGD)	
Forest	LTCP approved 1997; in progress	26.4	0.050	Headwaters
Dunkirk	no LTCP; submitted plans for separating sewers; in progress	5.1	0.002	Headwaters
Findlay†	actively completing LTCP	3.7	1.82	Eagle Ck
Pandora	no LTCP; General Plan 1986; per Administrative Orders are actively separating sewers; deadline 12/28/2010	no reporting	--	Riley Ck
Bluffton	LTCP approved 1997; in progress	no reporting	--	Riley Ck

Findlay†: Flow record extends from 2003-2006 due to facility reporting requirement. For 2007, high rainfall produced several flooding events which in turn prevented monitoring of CSO overflows. The exception was December 2007 which reported a median of 5.25 MGD.

6.2.4 Habitat and sedimentation

Actual scores from the QHEI (see Section 6.1.3) were used in determining the existing condition. No further estimation of habitat quality or sediment loading was performed.

6.3 Margin of safety, critical conditions and seasonality, and method for making allocations to the sources

6.3.1 Margin of safety

Total phosphorus

There is a strong implicit margin of safety (MOS) in developing the total phosphorus TMDLs. The total phosphorus target concentration was taken from the *Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams* (Ohio EPA, 1999) which is derived from data taken only in the summer. However, this target value was also applied to the other three seasons; fall, winter, and spring when it is likely that the aquatic ecosystem is less sensitive to total phosphorus because water temperatures are cooler. Using the summer target for the other seasons provides an implicit MOS. An explicit MOS of three percent was also added to the percent reduction required during the summer season.

Fecal coliform
An explicit margin-of-safety of four percent was incorporated into the maximum allowable load to account for uncertainty in model representation of pathogen origin and transport. An implicit margin-of-safety was used in developing runoff generated loads arising from land application of manure and because NPDES pathogen loads were based on design flow of the effluent.

Loading capacity is calculated as the product of the seasonal flow volume and the fecal coliform target concentration. No attempt is made to link downstream loading capacity with upstream loading via instream processing. Only die-off of land accumulated bacteria prior to wash off is considered in the BIT method. In reality, considerable die-off occurs between the source of loading and the TMDL endpoint, and this loss represents in an additional implicit margin of safety.

Habitat and sediment
There is an implicit margin of safety applied to the habitat and sediment TMDLs based on conservative target values used. The targets from the *Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams* (Ohio EPA, 1999) are conservative because attainment of aquatic life uses has been demonstrated even when the targets are not met.

6.3.2 Critical conditions and seasonality

The critical condition for aquatic organisms is the summer when excessive algal growth, high instream temperatures, and reduced stream flows occur, all of which leads to relatively low dissolved oxygen levels. Low dissolved oxygen is among the most significant stresses placed on the aquatic communities, particularly fishes. Algae production is highest in the summer when light availability and warm temperatures are maximized. Therefore nutrient enrichment during this time feeds largely unlimited algae productivity which ultimately leads to low dissolved oxygen conditions. Shifts in the food base also alter the aquatic community by allowing otherwise less competitive species prosper under these skewed conditions.

The summer concentration of phosphorus in the water column, however, is dependent upon more than summer phosphorus load contributed to the stream. As phosphorus readily attaches to sediment, detachment of adsorbed phosphorus in bottom sediments can lead to elevated instream concentrations regardless of the magnitude of short term loads. As a result, it is the long-term, or chronic, phosphorus load and sediment load that is more directly related to the degradation of water quality. For this reason phosphorus and sediment TMDLs were developed to include loading occurring throughout the year however, where conditions are particularly stressful to the biota due to stream impoundments, a decay model is used to determine if point source loading needs to be reduced during this critical time of the year.

Seasonality is accounted for in the aquatic life indices. Biological and habitat indices are measures of aggregate annual conditions reflecting compounding factors over time. The use of these indices reflects the collective seasonal effects on the biota. The measurement of these indices during the summer period reflects the biotic performance during critical conditions.

The critical condition for pathogens is a “first flush” situation during the summer when pre-storm flows are the lowest and build-up of bacteria is at its highest. Summer is also the period when the probability of recreational contact is the greatest. For these reasons recreational use designations are only applicable from May 1 to October 15, so pathogen TMDLs were developed for this time period.

6.3.3 Method for calculating reductions and allocating to the sources

Total phosphorus

The reductions needed in the assessment units were calculated as percent reductions derived from the ratio of the needed load reduction to the existing load. The result is a monthly needed percent reduction. The targets were grouped by season and the average calculated to derive the average seasonal target load.

Some small subwatersheds were not directly modeled despite being impaired for nutrients. The amount of nutrient reduction prescribed for these subwatersheds was derived from other larger, subwatersheds (Ottawa Cr., The Outlet, Eagle Cr., and Cranberry Cr.) that were modeled and that best represented them. The target reductions from the four basins were averaged and any negative target values, which indicates existing conditions do not need to be reduced, were set to zero. The averages were then applied to the unsampled basins based on basin size and use designation.

Average TMDL: average daily load (kg/day)

The average TMDL (kg/d) is simply calculated by subtracting the needed reduction (kg/d) from the existing condition (kg/d).

Maximum TMDL: maximum daily load (kg/day)

The maximum load allocation (LA) TMDLs for the modeled basins were calculated by using the 95th percentile of existing data, following USEPA draft guidance, *Options for Expressing Daily Loads in TMDLs* (USEPA, 2007). The model outputs consisted of 15 years of monthly simulations, from 1991 to 2006. The first year was omitted to allow the model to stabilize, therefore only 168 monthly results were used. These 168 values were separated into seasons then the 95th percentile was calculated for each seasons.

The maximum waste load allocations (WLA) for the same basins were calculated by using the 95th percentile of the monthly WLA model inputs. If there were no dischargers in the basin the result is zero. If there is no discharger data then a value was assigned based on data from other similar type of facilities. For both the modeled and un-modeled areas septic systems are considered to be a point source (WLA). The maximum TMDL calculation is calculated as the average daily load times 0.95.

Fecal coliform

A portion of the pathogen TMDL was reserved for NPDES effluent at the fecal coliform permit limit concentrations (Table 6.7). The capacity leftover (i.e., the remaining TMDL) was allocated to nonpoint sources that contributed pathogens to the stream system through surface washoff.

A primary source of pathogens was from ineffective HSTS and livestock manure. In total manure enters rivers and streams through direct contributions to streams from livestock, manure washoff from pastures, application onto fields from livestock in confinement, and various wildlife contributions (direct and indirect). The following four points of discussion reflect how TMDL allocations (i.e., reductions) are made in the model simulations.

a) Management of livestock manure: direct stream inputs

All beef cattle were excluded from streams through fencing to produce a direct zero-export of pathogens into the channel. For all livestock types, only beef cattle were permitted to access streams. However, once beef cattle were eliminated from streams, their presence in the pasture would increase albeit at a lesser loading rate than direct access to streams.

b) Management of livestock manure: pasture and land application

Manure from cattle (both beef and dairy) and sheep is assumed to be contributed to pastureland in proportion to time spent grazing. For confined animals, manure from cattle (both beef and dairy), swine, and poultry are assumed to be collected and applied to cropland. Two restoration approaches were implemented. The first was to reduce poultry numbers by 40 percent and thus transport this same percentage of poultry litter outside the watershed. Transport of this manure type is the most feasible compared to all others and reduces the land application contribution. The 40 percent reduction, or a subset of, could also correspond to improved land management practices that would reduce the runoff transport to the stream system. The second approach was to increase the runoff coefficient within the washoff function for both urban (0.5 in) and non-urban (0.65 in) land uses to 0.8 in and 0.95 in, respectively. The runoff coefficient affects both pasture and land application components of manure export. Increasing the runoff coefficient mimics the installation of land management practices in the upland watershed areas to reduce transport of pathogens at the point of generation. The runoff coefficient represents the depth of runoff required to transport 90 percent of the pathogen load downslope.

c) Residential septic systems
The failure rate was reduced from fifty percent to five percent over each of the six assessment units to reflect strong, consistent, and widespread enforcement of the Ohio HSTS rule (Ohio Administrative Code 3701-29).

d) NDPES wastewater effluent
Because inputs to the pathogen model for wastewater sources were established at the legal permit limit of 1000 cfu/100 ml, no adjustments to NPDES loads were considered.

Using the strategies defined in a-c above, all fecal coliform concentrations are now below the chronic and acute TMDL for each assessment unit and each month of the recreation season (Figure 6.6). However, one should note that attainment of the chronic criterion for recreation use can not be achieved alone by eliminating cattle in streams and reducing failure rate of home septic systems. Even when the failure rate was reduced to zero percent, exceedences of the chronic criterion still occur. Some form of land management practice or manure export is required to bring the existing load at or below the fecal coliform TMDL.

7.0 TMDL RESULTS

7.1 Total phosphorus

Table 7.1 shows the TMDLs that were developed for the Blanchard River watershed for total phosphorus using the GWLF model. Table 7.1 is organized by assessment unit and in some instances is further sub-divided into smaller watersheds to reflect differences in use designations. Included in the table is location information, type of allocation, estimate of existing loading, and the reduction required to meet the TMDL limits. Also included are the average and maximum TMDL values expressed on a daily time scale.

Appendix B shows the GWLF land use summary for all but one of the years that were modeled. This information indicates how much phosphorus is coming from each of the land uses and point sources and can be useful in developing water quality restoration strategies.

In summary, the majority of total phosphorus loading in the watershed is run-off from row crop agriculture which is by far the dominant land use in the basin. Other notable sources include point sources, such as discharges from schools, highway roadside rests, waste water treatment plants, and failing home sewage treatment systems. In most cases, small discharges contribute a low percentage of the total phosphorus load over the course of a year and are generally not issued permit limits for phosphorus. However, they can impact streams during periods of low flow when the potential for dilution is low.

Table 7.1. Total phosphorus TMDLs, existing loads, and needed reductions for each of the WAUs in the Blanchard River watershed.

Area of assessment (and/or AU)	Aquatic life use	Season	Type of allocation	Average of existing conditions (kg/day)	Target: average needed reduction (percent)	Explicit MOS (kg/day)	Average TMDL: average daily load (kg/day)	Maximum TMDL: maximum daily load (kg/day)
HUC - 010 Blanchard R. Headwaters	WWH (wadable)	winter	LA	201	*69.4*	*na*	**61.5**	**709**
		spring	LA	81.3	*9.26*	*na*	**73.8**	**349**
		summer	LA	71.3	*78.2*	*2.14*	**13.4**	**354**
		fall	LA	61.9	*84.0*	*na*	**9.90**	**383**
		annual	WLA	2.24	*15.4*		**1.89**	**2.87**
			HSTS	3.05	*90.0*		**0.305**	**2.89**
HUC - 020 Blanchard R. with The Outlet	WWH (wadable)	winter	LA	115	*61.1*	*na*	**44.7**	**326**
		spring	LA	68.9	*16.7*	*na*	**57.4**	**202**
		summer	LA	67.6	*72.1*	*2.03*	**16.8**	**211**
		fall	LA	40.8	*71.1*	*na*	**11.8**	**151**
		annual	WLA	1.04	*52.6*		**0.491**	**1.50**
			HSTS	3.37	*90.0*		**0.337**	**3.20**
HUC - 020-030 The Outlet	MWH (wadable)	winter	LA	32.5	*0.0*	*na*	**32.5**	**99.7**
		spring	LA	18.6	*0.0*	*na*	**18.6**	**59.9**
		summer	LA	17.4	*21.9*	*0.52*	**13.1**	**59.5**
		fall	LA	10.30	*9.4*	*na*	**9.33**	**47.1**
		annual	WLA	*na*	*na*		***na***	***na***
			HSTS	0.0767	*90.0*		**0.008**	**0.073**
HUC - 030-020 Eagle Creek	WWH (wadable)	winter	LA	54.4	*59.7*	*na*	**21.9**	**161**
		spring	LA	28.3	*3.2*	*na*	**27.4**	**93.3**
		summer	LA	25.9	*66.8*	*0.78*	**7.8**	**102.0**
		fall	LA	15.4	*64.6*	*na*	**5.45**	**68.5**
		annual	WLA	1.69	*41.1*		**1.00**	**2.83**
			HSTS	8.98	*90.0*		**0.897**	**8.53**

Area of assessment (and/or AU)	Aquatic life use	Season	Type of allocation	Average of existing conditions (kg/day)	Target: average needed reduction (percent)	Explicit MOS (kg/day)	Average TMDL: average daily load (kg/day)	Maximum TMDL: maximum daily load (kg/day)
HUC - 040-010 & 020 Ottawa & Tiderishi Creeks	WWH (wadable)	winter	LA	66.5	*86.1*	*na*	**9.24**	**257**
		spring	LA	26.6	*54.5*	*na*	**12.1**	**108**
		summer	LA	44.2	*85.6*	*1.33*	**5.04**	**177**
		fall	LA	28.4	*88.4*	*na*	**3.29**	**129**
		annual	WLA	2.35	*71.5*		**0.671**	**2.35**
			HSTS	4.67	*90.0*		**0.467**	**4.44**
HUC - 050 Riley Creek	WWH (wadable)	winter	LA	103	*66.3*	*na*	**34.7**	**336**
		spring	LA	44.0	*13.0*	*na*	**38.2**	**270**
		summer	LA	53.2	*75.7*	*1.60*	**11.3**	**173**
		fall	LA	41.0	*74.1*	*na*	**10.6**	**202**
		annual	WLA	9.63	*38.5*		**5.92**	**11.6**
			HSTS	1.31	*90.0*		**0.13**	**1.25**
HUC - 060-040 Miller City Cutoff	MWH (head waters)	winter	LA	7.72	*0.0*	*na*	**7.72**	**23.8**
		spring	LA	0.00	*0.0*	*na*	**0.00**	**12.3**
		summer	LA	5.15	*5.6*	*0.16*	**4.71**	**19.1**
		fall	LA	2.06	*1.9*	*na*	**2.03**	**10.5**
		annual	WLA	0.025	*71.5*		**0.00712**	**0.157**
			HSTS	0.186	*90.0*		**0.0186**	**0.176**
HUC - 060 Caton Ditch (includes Miller City Cutoff)	MWH (wadable)	winter	LA	25.5	*5.0*	*na*	**24.18**	**81.4**
		spring	LA	9.7	*0.0*	*na*	**9.69**	**42.2**
		summer	LA	14.9	*22.3*	*0.45*	**11.15**	**56.4**
		fall	LA	7.16	*19.2*	*na*	**5.78**	**38.2**
		annual	WLA	*na*	*na*		***na***	***na***
			HSTS	0.553	*90.0*		**0.055**	**0.525**

Area of assessment (and/or AU)	Aquatic life use	Season	Type of allocation	Average of existing conditions (kg/day)	Target: average needed reduction (percent)	Explicit MOS (kg/day)	Average TMDL: average daily load (kg/day)	Maximum TMDL: maximum daily load (kg/day)
HUC - 040-040 Moffit Ditch	MWH (head waters)	winter	LA	14.3	*0.0*	*na*	**14.30**	**44.9**
		spring	LA	3.15	*0.0*	*na*	**3.15**	**23.2**
		summer	LA	8.93	*5.6*	*0.27*	**8.16**	**33.4**
		fall	LA	3.93	*1.9*	*na*	**3.85**	**20.5**
		annual	WLA	*na*	*na*		***na***	***na***
			HSTS	0.206	*90.0*		**0.0206**	**0.195**
HUC - 040-060 Dukes Run	WWH (head waters)	winter	LA	13.2	*72.9*	*na*	**3.59**	**41.4**
		spring	LA	2.50	*34.5*	*na*	**1.64**	**21.4**
		summer	LA	8.32	*77.8*	*0.25*	**1.60**	**31.1**
		fall	LA	3.62	*76.9*	*na*	**0.83**	**18.8**
		annual	WLA	*na*	*na*		***na***	***na***
			HSTS	0.662	*90.0*		**0.066**	**0.629**
HUC - 060-050 Bear Cr.	MWH (head waters)	winter	LA	11.7	*0.0*	*na*	**11.7**	**36.7**
		spring	LA	1.60	*0.0*	*na*	**1.60**	**18.9**
		summer	LA	7.49	*5.6*	*0.23*	**6.84**	**28.0**
		fall	LA	3.20	*1.9*	*na*	**3.14**	**16.5**
		annual	WLA	*na*	*na*		***na***	***na***
			HSTS	1.03	*90.0*		**0.103**	**0.977**
HUC - 060-060 Deer Creek	MWH (head waters)	winter	LA	9.49	*0.0*	*na*	**9.49**	**29.4**
		spring	LA	0.20	*0.0*	*na*	**0.20**	**15.2**
		summer	LA	6.19	*5.6*	*0.19*	**5.66**	**23.0**
		fall	LA	2.56	*1.9*	*na*	**2.51**	**13.1**
		annual	WLA	0.065	*71.5*		**0.019**	**0.0333**
			HSTS	0.520	*90.0*		**0.052**	**0.494**

Area of assessment (and/or AU)	Aquatic life use	Season	Type of allocation	Average of existing conditions (kg/day)	Target: average needed reduction (percent)	Explicit MOS (kg/day)	Average TMDL: average daily load (kg/day)	Maximum TMDL: maximum daily load (kg/day)
HUC - 060-010 Pike Run	WWH (head waters)	winter	LA	4.53	*72.9*	*na*	**1.23**	**13.7**
		spring	LA	0.00	*34.5*	*na*	**0.00**	**7.07**
		summer	LA	3.21	*77.8*	*0.10*	**0.616**	**11.80**
		fall	LA	1.19	*76.9*	*na*	**0.274**	**5.91**
		annual	WLA	*na*	*na*		***na***	***na***
			HSTS	0.206	*90.0*		**0.021**	**0.195**
Findlay MS4 for Eagle Creek	WWH (head waters)	winter	WLA	0.229	*0.0*	*na*	**0.229**	**0.573**
		spring	WLA	0.267	*11.6*	*na*	**0.236**	**0.602**
		summer	WLA	0.185	*0.0*	*na*	**0.185**	**0.452**
		fall	WLA	0.233	*29.1*	*na*	**0.165**	**0.522**
		annual	LA	*na*	*na*		***na***	***na***
			HSTS	*na*	*na*		***na***	***na***
Findlay MS4 for Blanchard mainstem	WWH (small river)	winter	WLA	0.213	*0.0*	*na*	**0.213**	**0.612**
		spring	WLA	0.233	*0.0*	*na*	**0.233**	**0.726**
		summer	WLA	0.155	*0.0*	*na*	**0.155**	**0.598**
		fall	WLA	0.207	*0.0*	*na*	**0.207**	**0.615**
		annual	LA	*na*	*na*		***na***	***na***
			HSTS	*na*	*na*		***na***	***na***

Table 7.2. NPDES facilities including the type of discharge, existing total phosphorus load, annual allocations, and needed total phosphorus reductions for each of the WAUs in the Blanchard River watershed.

Assessment unit	Facility	Type of Discharger[a]	Existing annual load (kg/yr)	Allowable annual load (kg/yr)	Needed reduction kg/yr	Needed reduction percent
010	Dunkirk WWTP	controlled	50.7	3.82[b]	46.9	92.5
	Forest STP	continuous	220	12.0	208	94.6
	Triumph Thermal	continuous	3.38	1.53	1.85	54.7
	Duff Quarry	continuous	0.730	2.66	0	0
020	Vanlue	controlled	73.1	-[c]	0	0
030	Findlay WWTP	continuous	11,357	15,711	0	0
	Camp Berry	continuous	seasonal			
	Arlington WWTP	continuous	598	22.2	576	96.3
	Arlington WTP	continuous	no data[d]			
	Sycamore Springs Golf Course	continuous	seasonal			
040	Tawa Ridge Estates	continuous	13.6	0.390	13.16	97.1
	ODOT I-75 Rest Area	continuous	48.4	1.11	47.3	97.7
	Cory Rawson High School	continuous	60.5	1.73	58.8	97.1
	Rawson WWTP	controlled	15.4	-[e]	0	0
050	Bluffton WWTP	continuous	1036	119	917	88.5
	Pandora WWTP	continuous	677	31.1	646	95.4
	Beaverdam WWTP/Richland Manor/Speedway Super America	controlled	73.9	3.84[b]	70.0	94.8
	Ridge Road MHP	continuous	29.0	0.387	28.7	98.7
	Mast Estates Subdivision	continuous	43.6	0.213	43.3	99.5
060	County Acres package plant, Miller City High School, & Putnam Co. Board of MRDD	continuous	232	5.31	227	97.7
	Putnam Co. Landfill	continuous	no data[d]			
	Ottawa WWTP	continuous	566	296	270	47.7

[a] Existing, allowable, and load reductions can each be represented as a daily value by dividing the annual value by 365 days/year for all of the continuous dischargers. However, daily representation of the loads for the controlled dischargers should be calculated based on what is likely to be discharged on the days discharges actually occur (i.e., not every day). Therefore these annual loads should be divided by the average annual frequency of discharges which is the following (in days/year): Dunkirk WWTP = 21.2; Vanlue WWTP = 70.4; Rawson WWTP = 7.67; Super America WWTP = 6.67.
[b] Upstream total phosphorus concentrations preclude the potential for dilution and requires discharge concentration to be at the WQS
[c] Varies based on stream flow. Potential for upstream dilution allows discharge concentration above the TMDL target when discharge occurs at a stream flow of 2.22 cfs or greater
[d] Currently no discharge data; however, this facility is an unlikely source of total phosphorus
[e] Varies based on stream flow. Potential for upstream dilution allows discharge concentration above the TMDL target when discharge occurs at a stream flow of 33.34 cfs or greater

7.2 Low flow pollutant loading

Stressors present during the summertime low flow are impairing a stretch of the mainstem of the Blanchard River in and around the City of Findlay. Elevated concentrations of nutrients, particularly phosphorus, as well as low dissolved oxygen and organic enrichment and high stream temperatures are the dominant causes. A steady state model that accounts for the instream decay of these pollutants is used to estimate the existing conditions as well as simulate changes in management that may improve water quality.

Restoration scenarios generated from Blanchard QUAL2K modeling
Calibrated model rates were used with August 2006 water chemistry data for tributaries to simulate water quality conditions for the Blanchard River (Findlay) mainstem during the critical summer-month, low flow period. It is assumed that summer critical streamflow is at 7Q10 levels, and tributary flow inputs were adjusted accordingly. Water temperature, daylight length, and sun angle reflect August conditions.

The first model scenario (S1) was constructed to match existing conditions (2007 and beyond). During the August 2006 Ohio EPA survey, the Liberty Street dam was intact. In the period following, the dam was cut in half vertically (from 8.75 ft to 4.15 ft) (Table 7.3) and an additional three riffle structures were installed on the mainstem. Physical dimensions for these four recently (Spring-Summer 2007) installed riffle structures were obtained from construction drawings for the Upper Blanchard River Watershed Project (USDA Natural Resources Conservation Service, 2001) (Table 7.3). Wooded bank vegetation was also cleared on the downstream, right edge-of-water (north bank). Thus, the S1-scenario includes the above changes but also is simulated at conservative stream conditions (Table 7.3). Critical stream conditions are defined here as a critical low flow (7Q10) for the mainstem and tributaries, effluent flow at design conditions for the Findlay WPCF, an upstream boundary water quality at background concentrations. For estimating background concentrations of total phosphorus, the average of six grab samples from 2005 was used.

Three other model scenarios (named S2, S3, and S4) were generated to explore water quality improvements. One scenario (S2) expanded the amount of riparian wooded vegetation along the entire mainstem corridor where feasible. The S2-scenario expands the area of high canopy density (>75 percent), tall (22.9 m or 75 ft) hardwood with large bank overhang (6.9 m or 22 ft) along a 15 m buffer from each bank of the Blanchard River mainstem. Some existing land uses were excluded from this riparian reforestation scenario including roads, buildings, and developed infrastructure. The hourly distribution of effective shade for reach #14 (see Figure 6.4 for schematic of model reaches) decreases slightly for the S1-scenario (bank clearing) but increases considerably for the S2-scenario. Overall, the effective shade increases substantially along the mainstem under the S2-scenario (from 15 to 50 percent).

The approach in the S3-scenario was to explore an alternative to S2-scenario (15 m forest buffer) by removing the City Park dam (RM 58.76) – thereby removing the instream reservoir and reducing upstream channel width and subsequently providing increased shading, increased flow velocity, and decreased channel depth. Like the S2-scenario, the goal in the S3-scenario is to reduce water temperature below the average and maximum criteria and increase DO above the average and minimum criteria. Hourly distribution of effective shade for reaches #5 and #6 increases considerably for the S3-scenario. Phytoplankton growth would likely be reduced when moving from a reservoir (lentic) to a channel (lotic) environment and thereby improve DO minimum concentrations. This scenario was implemented mechanistically by adjusting the QUAL2K model by setting velocity to 0.0914 m/s (0.3 fps) and water depth to 0.5791 m (1.9 ft) for reach #4 through #7. Given these changes in velocity and depth, reaeration constants for these same reaches were adjusted from 0.42-15.0 d^{-1} in S1 to 2.23-2.27 d^{-1} in S3. Hence the average of the reaeration constants for these four reaches was increased from 0.58 d^{-1} to 2.27 d^{-1}.

The S2-scenario reduces the average water temperature remarkably below the water quality criterion of 27.8 °C. The criterion is met in nearly 100 percent of the length. The S3-scenario also reduces water temperature below the criterion but, as expected, not as widespread as the S2-scenario. The reduction in water temperature is evident at the former City Park reservoir of S3-scenario (RM 60.5 to RM 58.5) and the water quality criterion is now met there.

Under critical streamflow conditions, simulated average DO remains above the average water quality criterion of 5.0 mg/L in the S1-scenario. The criterion is also met downstream of the Findlay WPCF (RM 56.42). The facility has relatively high DO and acceptable CBOD NPDES permit limits so it is unlikely any gains can be met through effluent adjustments. The biggest gain in meeting the criterion occurs with the removal of City Park dam and reservoir (S3-scenario) where, using estimated reaeration coefficients, DO concentrations fall drastically in S1 and S2 (Figure 4.16; RM 60.6 to RM 59.1). Once the dam and reservoir are removed, DO concentrations remain above the 5.0 mg/l criterion. These predictions would likely improve by incorporating a river hydraulics model, like HEC-RAS, to simulate stream velocity and depth where instream structures have been hypothetically removed.

The S2-scenario (wooded riparian) does little to improve DO concentrations as its longitudinal trace follows that of the S1-scenario. However, the S2-scenario is more effective at reducing phytoplankton growth and the subsequent diurnal variation in DO.

Based on the simulations generated in Scenario 2 and Scenario 3 to improve temperature and DO conditions in the Blanchard R mainstem, an ideal restoration scenario would include characteristics of both. Though this scenario was not simulated and thus results not presented here, the highest improvement in temperature and DO conditions would result from removing the City Park dam and subsequently reforesting the former reservoir area along with reforesting a 15 m buffer along the mainstem where ever feasible.

Scenario 4 (S4) was constructed to examine alternative concentrations of total phosphorus from the City of Findlay wastewater effluent in meeting the downstream target of 0.16 mg/L (Table 7.3). The downstream target was arbitrarily set at RM 54.05 which is just upstream of the Oil Ditch-Blanchard River confluence. The S1-scenario considers a total phosphorus effluent concentration of 1 mg/L, the current NPDES permit limit for a monthly average. S4-scenario also considers effluent concentrations of 0.5 and 0.3 mg/L, which could likely represent a monthly average permit limit. The downstream target is met only with the simulation using a 0.3 mg/L total phosphorus effluent concentration. At critical streamflow conditions, the total phosphorus load from Findlay WPCF dominates the instream load because the upstream (background) concentration is small and effluent flow is large.

Nitrate reduction scenarios were not generated because evidence of nutrient co-limitation on aquatic plant growth (including algae) was not substantiated (R Miltner, 2007, personal communication).

Table 7.3. Description of alternative scenarios for TMDL allocation employed to address ALU impairment and WQS violations for temperature, dissolved oxygen, and total phosphorus.

Scenario Description	Q (cfs)	Instream Structures	Floodplain Vegetation	Findlay (2PD0008) WWTP Effluent		Upstream Boundary	Stream Characteristics: velocity (U), depth (H), temperature, and reaeration
				Q (mad)	**Parameter Concentration (mg/L)**	**TP (mg/L)**	
Calibration	● mainstem (USGS gauge): 49 (Aug 2006) ● Eagle Ck: 4.17 (Aug 2006) ● Lye Ck: 1.23 (Aug 2006) ● other tributaries: varies (Aug 2006)	● PWS dam ● City Park dam ● Liberty St dam	● OSIP data (Mar-Apr 2006)	9.45 (14.6 cfs)	TP= 0.871 (Aug 2006)	0.127 (Aug 2006)	velocity, depth, temperature (Aug 2006)
S1: Modify instream structures; vegetation clearing; conservative stream conditions	● mainstem (USGS gauge): 8.89 ($_7Q_{10}$; 1982-2007) ● Eagle Ck: 1.57 ($_7Q_{10}$ area-yield) ● Lye Ck: 0.72 ($_7Q_{10}$ area-yield) ● tributaries: varies ($_7Q_{10}$ area-yield)	● Liberty St dam removed ● 4 riffle structures installed	● same as calibration stage but trees cleared and replaced w/ grass on N bank DST Liberty St dam; 1.84 ha (4.55 Ac) removed	15.0 (23.21 cfs) (design flow)	● TP(monthly) = 1.0 ● DO(summer) = 6.7 ● $CBOD_{20}$(summer) = 22 ● NH_3(summer)= 1.4	0.081 (Jun-Aug 2005)	● increase U and decrease H for reaches #13 and #14 (near Liberty St dam) ● velocity and depth dependent on Q as: $U=aQ^b$ (b=0.45) H=□Q□ (□=0.55) ● temperature maintained as Aug 2006 ● reaeration adjusted dependent on U, H, and Q.
S2: Increase shading near stream by tree planting (medium and tall height) ; conservative stream conditions	● same as S1	● same as S1	● same as S1 and replace non-forested floodplain w/ forest; 35.0 ha (85.4 Ac) added; 15 m setback from each bank	● same as S1	● same as S1	● same as S1	● same as S1

Scenario Description	Q (cfs)	Instream Structures	Floodplain Vegetation	Findlay (2PD0008) WWTP Effluent		Upstream Boundary	Stream Characteristics: velocity (U), depth (H),
S3: Remove City Park dam; increase shading at former reservoir; conservative stream conditions	● same as S1	● same as S1 and remove City Park dam	● replace former City Park reservoir and L/R bank for 600 m UST w/ forested floodplain; 5.0 ha (12.4 Ac) added ● reduce channel width UST of City Park dam ● all other floodplain conditions same as S1	● same as S1	● same as S1	● same as S1	● same as S1 and increase U and decrease H for reaches #6 and #7 (near City Park dam); reaeration adjusted for same
S4: Reduce total phosphorus concentration in Findlay WWTP effluent to 0.3 mg/L.	● same as S1	● same as S1	● same as S1	● same as S1	●TP(monthly)= 0.3 and 0.5 ● all other parameters same as S1	● same as S1	● same as S1

7.3 Fecal coliform

The concentrations derived from model predicted daily loads show that all WAU exceed the chronic criterion by significant margins (Figure 7.1a). The exception is the MS4 Zone where it meets the chronic criterion for each of the six months in the recreation season. In terms of meeting the acute criterion, the same exceedences appear (Figure 7.1b). The Eagle Creek WAU (-030) is only slightly above the chronic and acute criteria whereas Cranberry Creek WAU (-060) significantly exceeds both criteria. In general there is a decline in the geometric mean as the recreation season progresses from May to October; the reverse is true for the 90th percentile concentration.

For each assessment unit (WAU) and the MS4 Zone in Findlay, a TMDL was computed as a function of total streamflow generated by each unit and the chronic fecal coliform criterion (Table 7.4). For each day within the recreation season and over a seven-year period of record (2000-2006), the daily allowance (TMDL) was subtracted from the existing (model-predicted) daily load. If the TMDL was less than the existing load, a daily reduction was computed. Subsequently a geometric mean of each month of daily reductions was computed and then the median of these seven mean values (2000-2006) was compiled. The median reduction and percent reduction are shown in Table 7.4; the range of reductions is from 43 percent to 95 percent of the existing load. Aside from the MS4 Zone (which has no required reduction), the lowest percent reduction is needed for Eagle Creek WAU (-030) whereas the highest is needed for Cranberry Creek WAU (-060) (Figure 7.2). The largest range in percent reduction exists for the The Outlet/Lye Creek WAU (-020) and its subwatershed (The Outlet – lower). The percent reduction needed generally decreases as the recreation season progresses from May to October.

The median loads presented in Figure 7.4 are also shown along with corresponding distributional statistics (e.g., 75th and 25th percentiles, highest/lowest data value within 1.5 times the inter-quartile range, and upper/lower outliers) for each assessment unit.

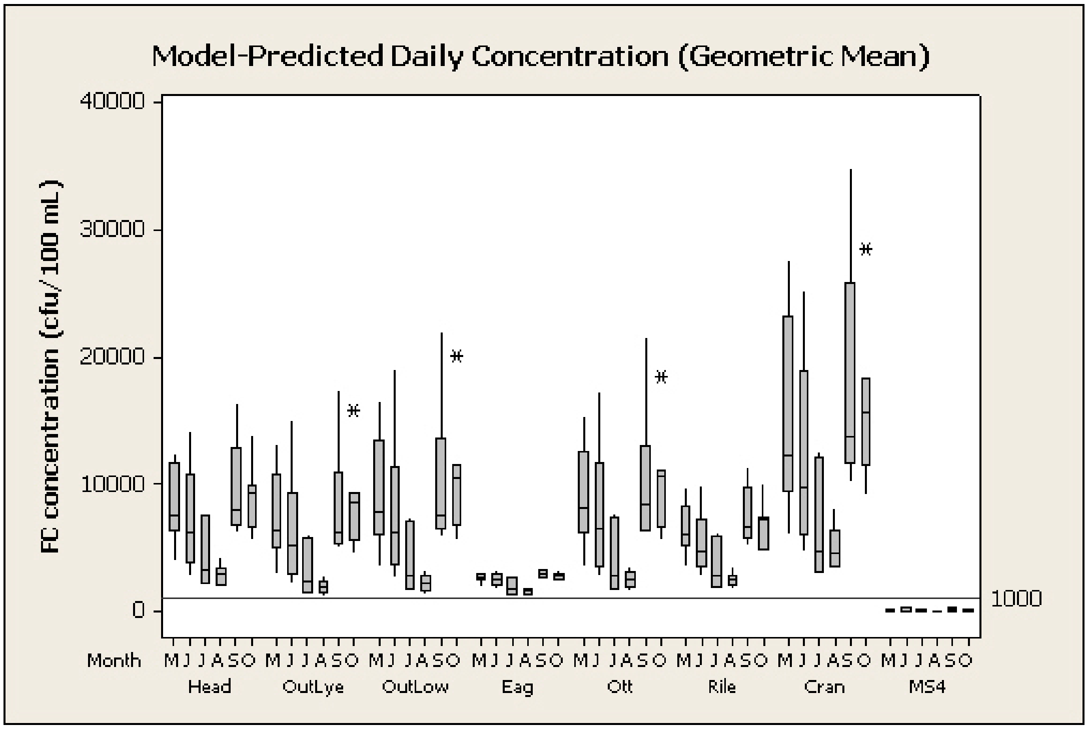


Figure 7.1(a) Distribution of **geometric mean (a)** model-predicted fecal coliform concentrations by month of recreation season. The sequence "M J J A S O" represents May 1 through October 15 by month (e.g., M = May). Water quality criteria are depicted by horizontal line for both chronic (1000 cfu/100 ml) and acute (2000 cfu/100 ml) conditions. The distribution is composed of seven monthly geometric means for the period 2000-2006 and portrayed by assessment unit: Head=The Headwaters, OutLye=The Outlet/Lye Ck, OutLow=The Outlet (lower), Eag=Eagle Ck, Ott=Ottawa Ck, Rile=Riley Ck, Cran=Cranberry Ck, and MS4=MS4 Zone (Findlay). For each icon, the central bar represents the median value (n = 6), the upper grey and lower grey box edges represent the 75th and 25th percentiles, respectively, and the whiskers represent the highest/lowest data value within 1.5 times the inter-quartile range. Asterisks represent upper and lower outliers.

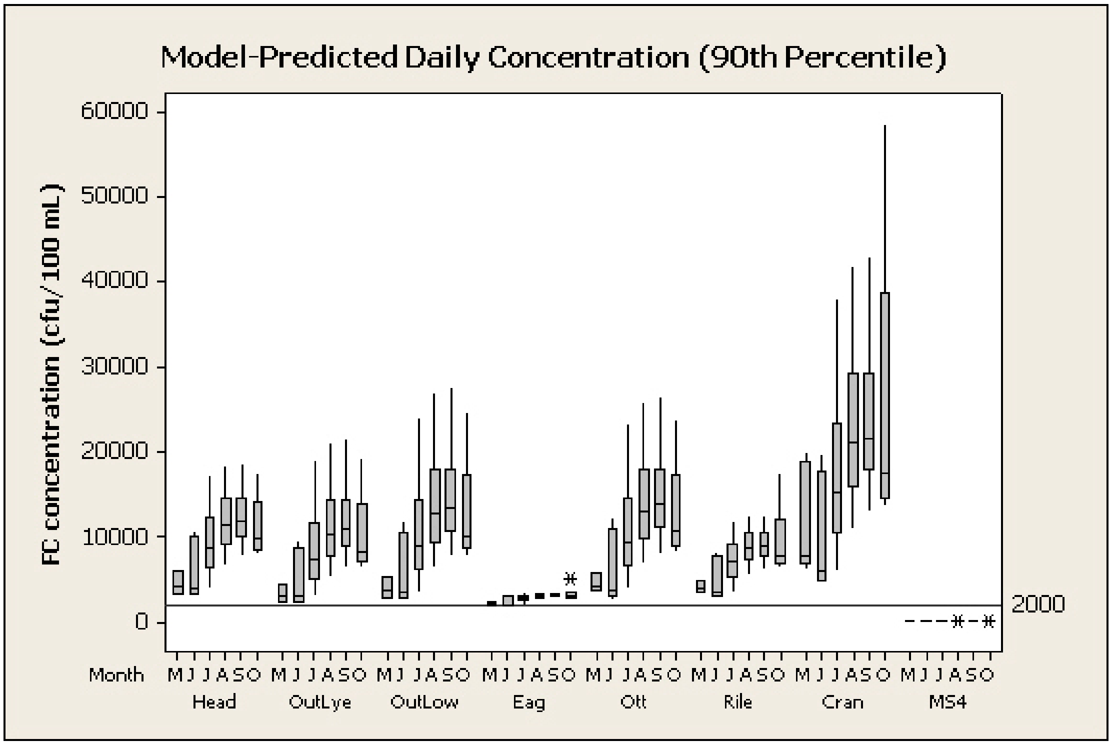


Figure 7.1(b) Distribution of **90th percentile (b)** model-predicted fecal coliform concentrations by month of recreation season. The sequence "M J J A S O" represents May 1 through October 15 by month (e.g., M = May). Water quality criteria are depicted by horizontal line for both chronic (1000 cfu/100 ml) and acute (2000 cfu/100 ml) conditions. The distribution is composed of seven monthly geometric means for the period 2000-2006 and portrayed by assessment unit: Head=The Headwaters, OutLye=The Outlet/Lye Ck, OutLow=The Outlet (lower), Eag=Eagle Ck, Ott=Ottawa Ck, Rile=Riley Ck, Cran=Cranberry Ck, and MS4=MS4 Zone (Findlay). For each icon, the central bar represents the median value (n = 6), the upper grey and lower grey box edges represent the 75th and 25th percentiles, respectively, and the whiskers represent the highest/lowest data value within 1.5 times the inter-quartile range. Asterisks represent upper and lower outliers.

Table 7.4. Quantification of daily model-predicted Fecal Coliform existing load, NPDES load (WLA), TMDL, required load reduction and equivalent percent, and maximum allocated load (cfu/day). The maximum allocated load applies to the LA for all assessment units excluding the MS4 Zone (Findlay). For the MS4 Zone, the maximum allocated load applies to the WLA only. Existing load values represent the median of seven geometric means for each month during the recreation season for the period 2000-2006. October geometric means are based on a 15-day period of record.

Month	N	Exist Total	Exist NPDES	TMDL	MOS	Reduction	Percent Reduction	Max Allocation
		median (10^9 cfu/day)						
The Headwaters (04100008-010)								
May	7	4,129	13	1,431	57	2,254	67%	1,418
Jun	7	3,477	13	1,074	43	2,429	73%	1,061
Jul	7	3,911	13	667	27	2,934	87%	654
Aug	7	3,781	13	489	20	2,994	88%	476
Sep	7	3,949	13	412	16	3,029	91%	399
Oct	7	3,331	13	538	22	2,915	88%	524
The Outlet / Lye Ck (04100008-020)								
May	7	2,555	3	1,363	55	1,165	55%	1,360
Jun	7	2,420	3	1,024	41	1,359	64%	1,020
Jul	7	2,407	3	508	20	1,813	85%	505
Aug	7	2,443	3	387	15	1,895	89%	384
Sep	7	2,446	3	306	12	1,907	90%	303
Oct	7	2,232	3	430	17	1,803	85%	427
The Outlet (lower) (04100008-020-030)								
May	7	876	0	389	16	451	62%	389
Jun	7	833	0	293	12	507	69%	293
Jul	7	829	0	144	6	639	87%	144
Aug	7	843	0	109	4	664	91%	109
Sep	7	838	0	85	3	666	92%	85
Oct	7	766	0	122	5	636	87%	122
Eagle Ck (04100008-030)								
May	7	2,968	575	1,814	73	1,085	43%	1,240
Jun	7	2,843	575	1,564	63	1,235	49%	989
Jul	7	2,812	575	1,216	49	1,623	64%	641
Aug	7	2,818	575	1,051	42	1,693	68%	477
Sep	7	2,852	575	1,086	43	1,705	68%	511
Oct	7	2,768	575	1,020	41	1,614	64%	445
Ottawa Ck (04100008-040)								
May	7	4,022	7	1,641	66	1,995	64%	1,634
Jun	7	3,590	7	1,283	51	2,243	72%	1,276
Jul	7	3,451	7	591	24	2,762	88%	584
Aug	7	3,531	7	441	18	2,834	90%	434
Sep	7	3,579	7	388	16	2,871	92%	381
Oct	7	3,135	7	498	20	2,750	88%	491
Riley Ck (04100008-050)								
May	7	2,359	90	964	39	1,231	63%	874
Jun	7	2,100	90	830	33	1,215	62%	740

Month	N	Exist Total	Exist NPDES	TMDL	MOS	Reduction	Percent Reduction	Max Allocation
		median (10^9 cfu/day)						
Jul	7	2,118	90	520	21	1,663	84%	430
Aug	7	2,370	90	391	16	1,731	88%	301
Sep	7	2,353	90	341	14	1,738	88%	251
Oct	7	1,967	90	378	15	1,667	85%	288
Cranberry Ck (04100008-060)								
May	7	8,154	2	1,597	64	3,961	78%	1,595
Jun	7	6,385	2	1,432	57	4,113	82%	1,431
Jul	7	6,436	2	737	29	4,628	92%	735
Aug	7	6,220	2	468	19	4,719	93%	466
Sep	7	6,500	2	454	18	4,727	95%	452
Oct	7	4,970	2	471	19	4,603	93%	469
MS4 Zone (City of Findlay)								
May	7	1	0	75	3	0	0%	75
Jun	7	2	0	67	3	0	0%	67
Jul	7	4	0	53	2	0	0%	53
Aug	7	4	0	50	2	0	0%	50
Sep	7	3	0	46	2	0	0%	46
Oct	7	3	0	51	2	0	0%	51

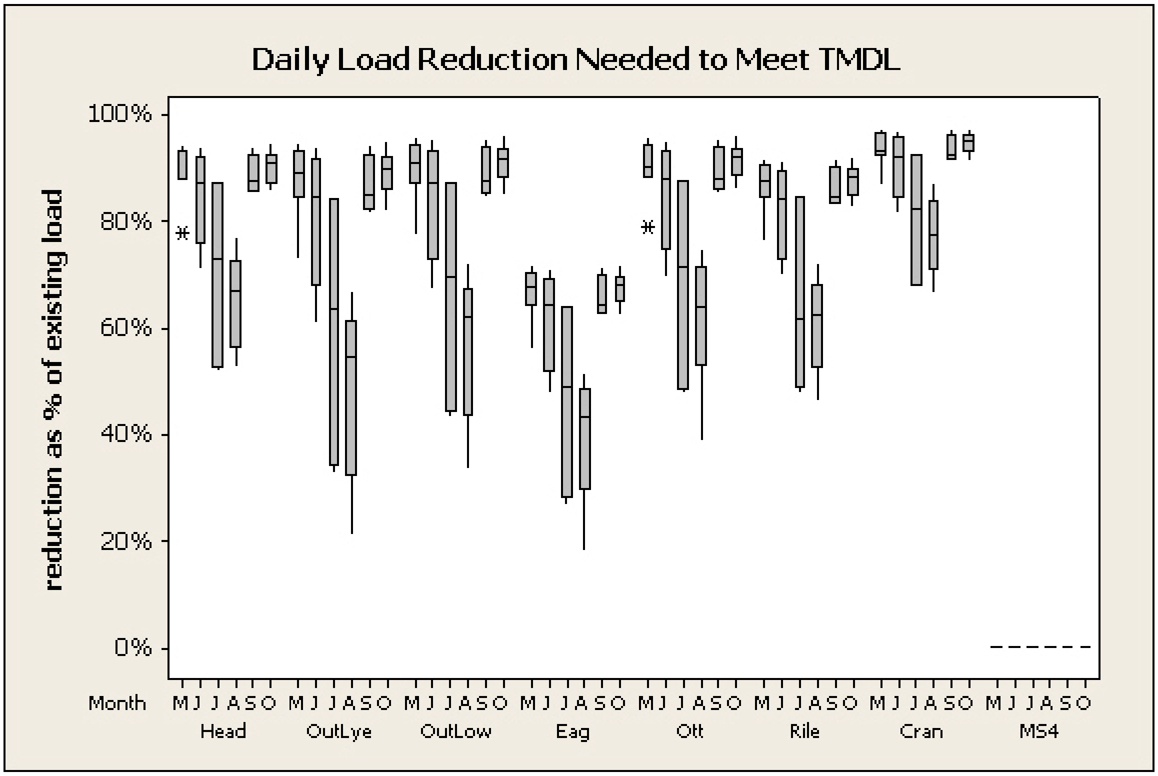


Figure 7.2. Distribution of percent load reduction needed to meet chronic TMDL target (1000 cfu/100 ml) by month of recreation season. The sequence "M J J A S O" represents May 1 through October 15 by month (e.g., M = May). The distribution is composed of 7 monthly geometric means for the period 2000-2006 and portrayed by assessment unit; assessment unit codes defined in Figure 7.1 above. Icons are identified in Figure 7.1 (above).

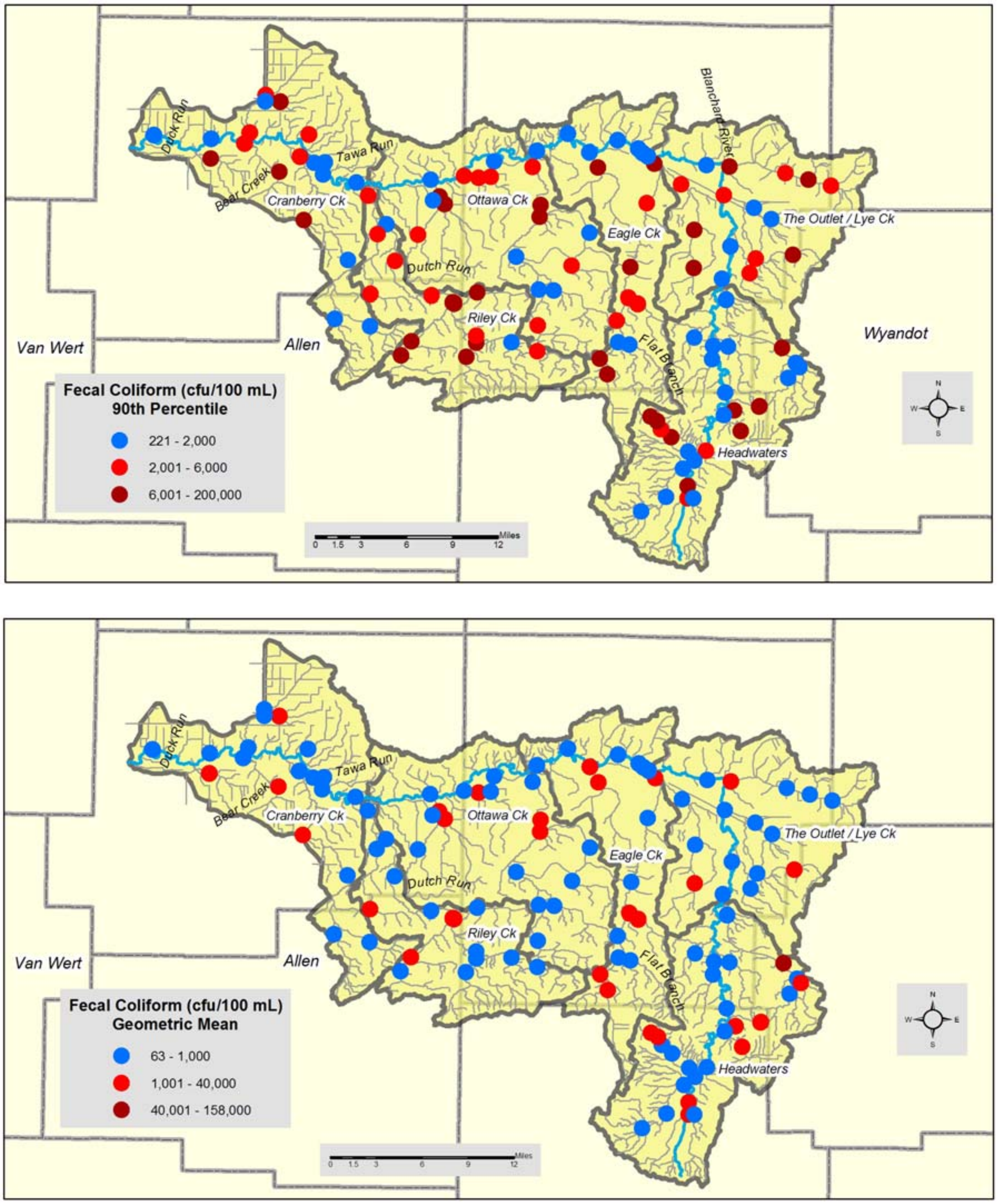
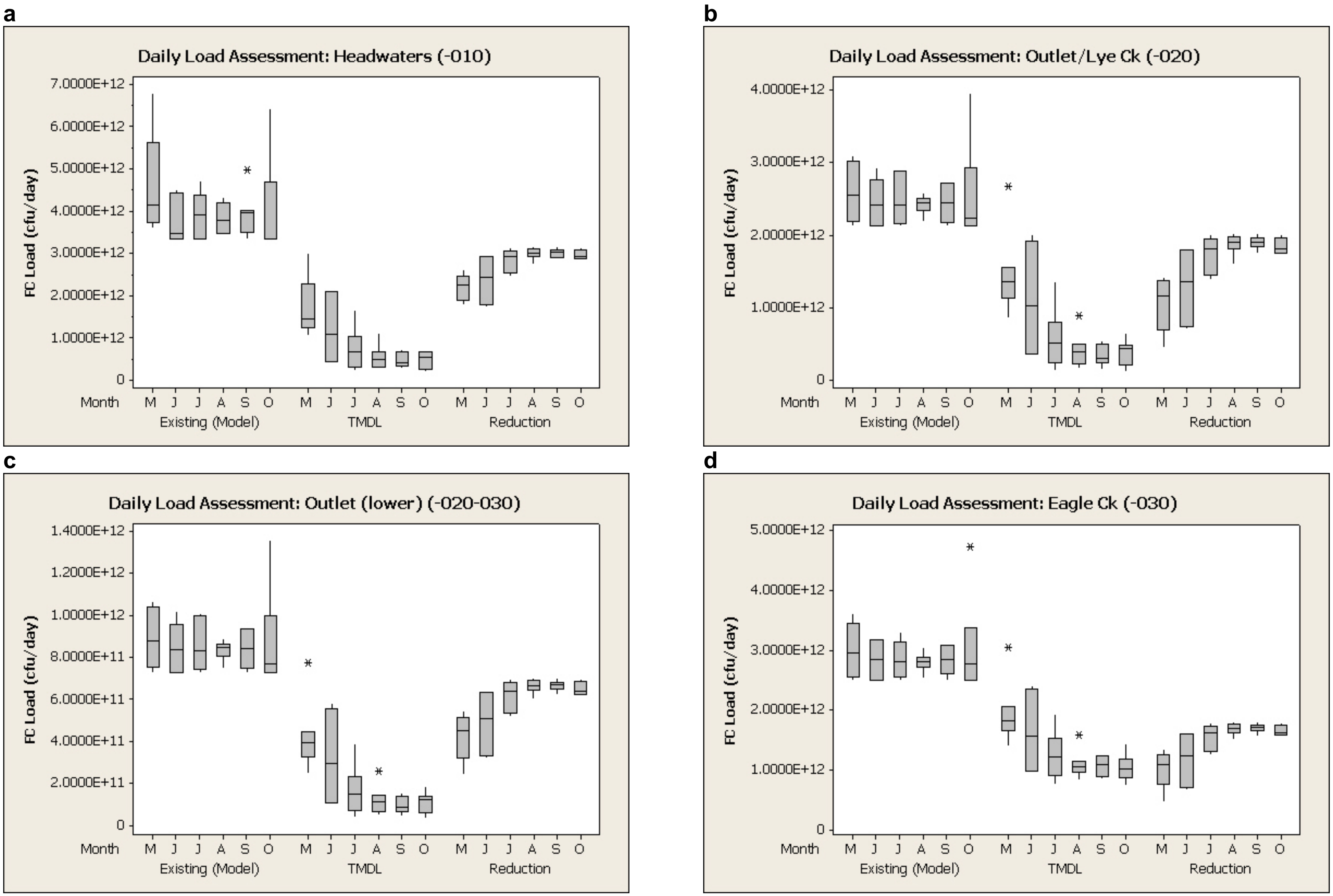


Figure 7.3. Map showing geometric mean (upper) and 90th percentile (lower) fecal coliform concentrations (in units of cfu/100 ml) at sampling locations monitored in 2005. Internal lines refer to WAU boundary.



See next page for explanation of **Figure 7.4 graphs a through h**

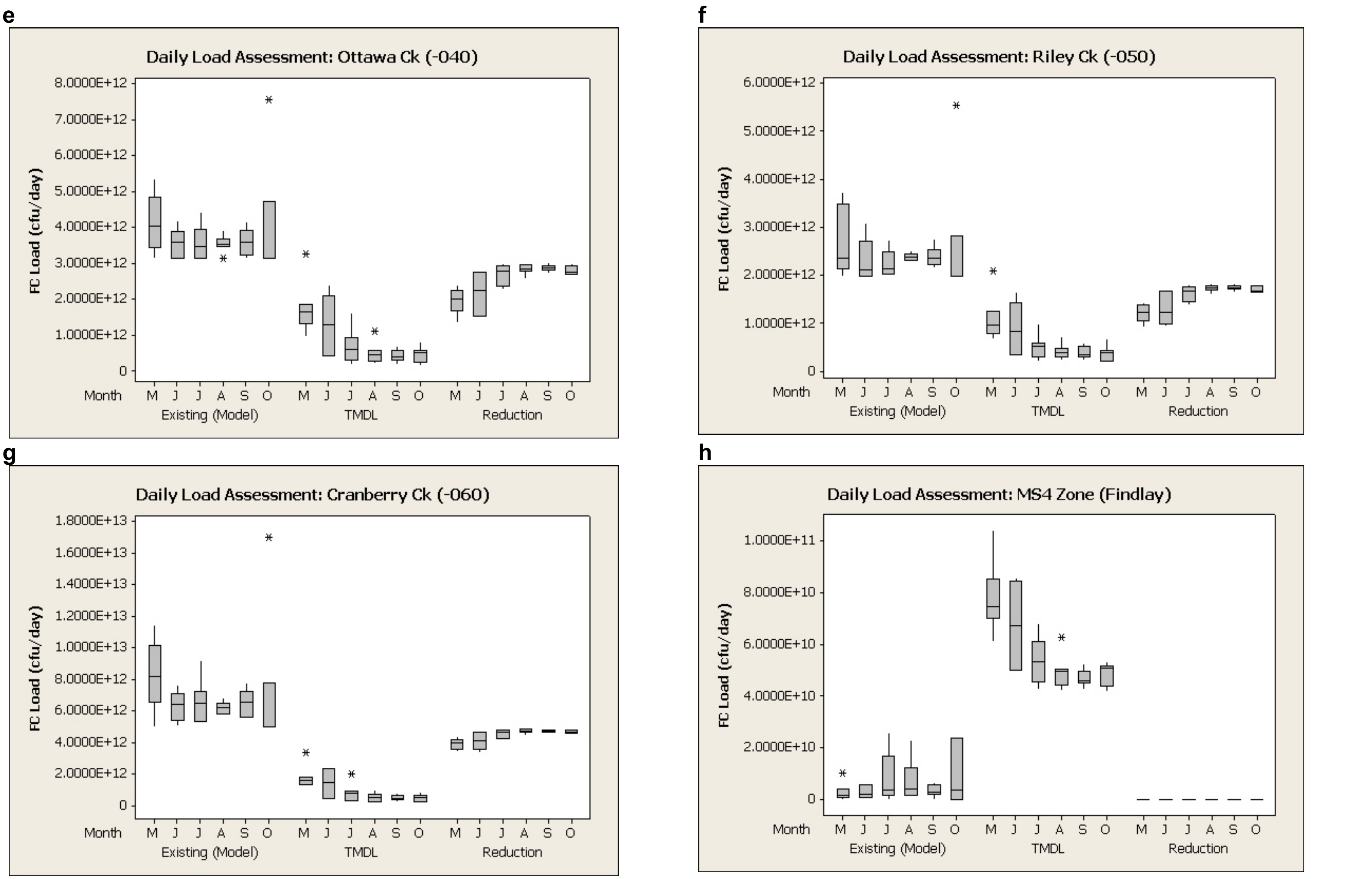


Figure 7.4. Distribution of model-predicted fecal coliform loads, allowable load (TMDL), and required load reduction (all in cfu/day) by month of recreation season. The distribution is composed of 7 monthly geometric means for the period 2000-2006 and portrayed by

assessment unit: The Headwaters (a), The Outlet/Lye Ck (b), The Outlet (lower) (c), Eagle Ck (d), Ottawa Ck (e), Riley Ck (f), Cranberry Ck (g), and MS4-Findlay Zone (h). Icons are identified in Figure 7.1 (above).

Table 7.5. Existing and allocated fecal coliform loads for NPDES dischargers (organized by assessment unit and facility).

Facility Name	OEPA#	Existing Load (cfu/day)	Percent Reduction	Allocated Load (cfu/day)
The Headwaters 04100008-010				
Claradan Count Sr Housing Complex	2PW00008	6.81E+07	0	6.81E+07
Mt Blanchard WWTP	2PA00045	*under construction*		
Dunkirk WWTP	2PB00061	5.19E+09	0	5.19E+09
Forest WWTP	2PB00044	7.57E+09	0	7.57E+09
Hardin Northern School	2PT00043	3.79E+08	0	3.79E+08
Shelly Materials (Forest Quarry)	2IJ00046	na		
Triumph Thermal Systems	2IS00001	na		
Duff Quarry	2IJ00022	na		
The Outlet / Lye Ck 04100008-020				
Vanlue WWTP	2PA00016	2.65E+09	0	2.65E+09
Heritage Springs Campgrounds	2PR00182	4.73E+08	0	4.73E+08
The Outlet (lower) 04100008-020-030				
none				
Eagle Ck 04100008-030				
Findlay WWTP	2PD0008	5.68E+11	0	5.68E+11
National Lime & Stone	2IJ00081	na		
BP Oil Findlay Bulk Plant	2IN00176	5.72E+06	0	5.72E+06
Eagle Ck Utility Co	2PU00004	*tie-into Findlay WWTP*		
Camp Berry	2PR00146	5.68E+08	0	5.68E+08
Arlington WWTP	2PA00050	6.36E+09	0	6.36E+09
Arlington WTP	2IZ0000	na		
Sycamore Springs Golf Course	2PR00098	1.51E+08	0	1.51E+08
Ottawa Ck 04100008-040				
Tawa Ridge Estates	2PW00003	1.06E+08	0	1.06E+08
Ohio DOT I-75 Rest Area	2PP00019	3.79E+08	0	3.79E+08
Rawson WWTP	2PA00039	5.75E+09	0	5.75E+09
Cory Rawson High School	2PT00031	4.73E+08	0	4.73E+08

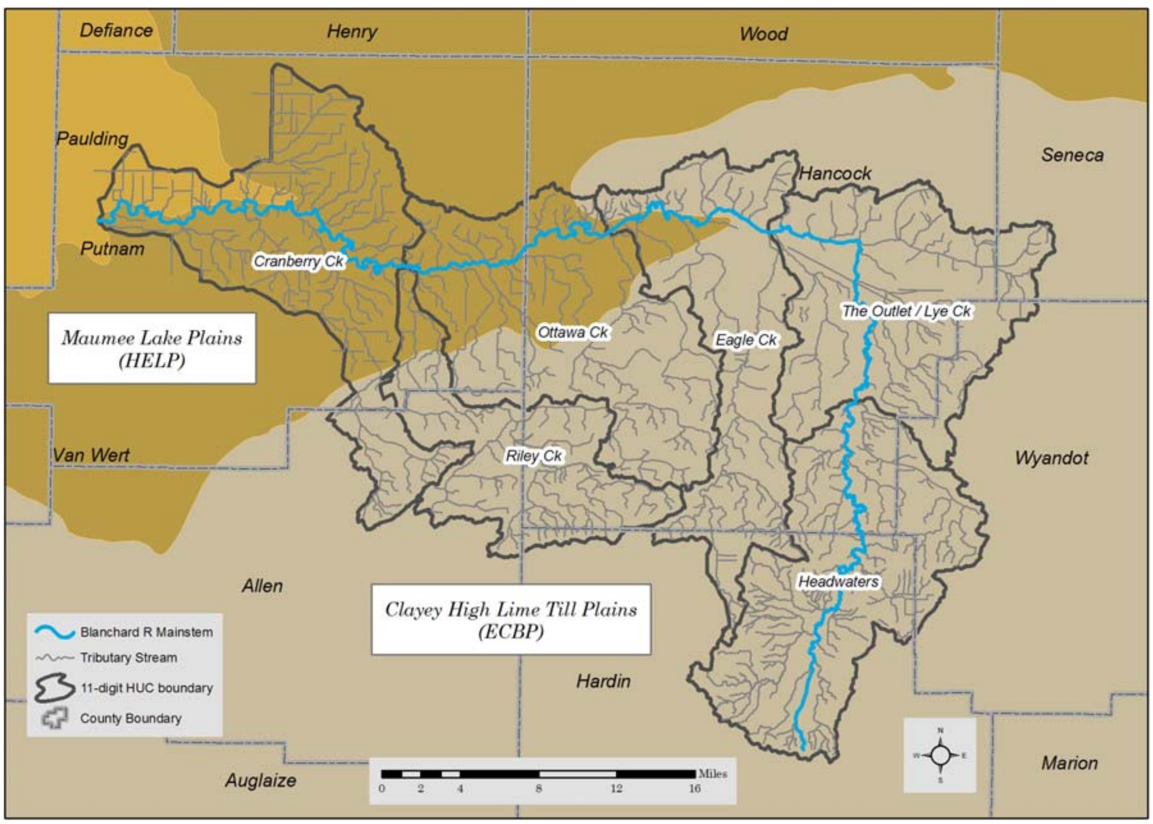
Facility Name	OEPA#	Existing Load (cfu/day)	Percent Reduction	Allocated Load (cfu/day)
Riley Ck 04100008-050				
Putnam Stone	2IJ00057	na		
Pandora WWTP	2PB00029	1.27E+10	0	1.27E+10
Bluffton WWTP	2PC00005	7.19E+10	0	7.19E+10
Ridge Rd MHP	2PY00046	1.32E+08	0	1.32E+08
Mast Estates	2PG00038	3.41E+08	0	3.41E+08
Beaverdam WWTP	2PB00018	3.79E+09	0	3.79E+09
Richland Manor	2PR00199	7.04E+08	0	7.04E+08
Speedway Super America (#3547)	2PR00109	5.68E+08	0	5.68E+08
Cranberry Ck 04100008-060				
Country Acres	2PG00083	1.14E+09	0	1.14E+09
Miller City High School	2PT00025	3.03E+08	0	3.03E+08
Putnam Co Landfill	2IN00122	na		
Putnam Co Board of MRDD	2PG00112	3.79E+08	0	3.79E+08
MS4 Zone (City of Findlay)				
Enelco, Inc Quarry (Tarbox-McCall)	2IJ00064	na		

7.4 Sediment and stream habitat

Tables 7.6 and 7.7 reflect a quantification of sediment induced and habitat induced cause of impairment. Every site should be considered in a strata consisting of the same ALU designation (i.e., EWH vs. WWH vs. MWH) and ecoregion. Based on existing ALU designation, all sites with QHEI assessments were WWH though proposed ALU designation would relegate some of the sites to MWH. Currently, no targets exist for the MWH ALU designation. Sediment and habitat TMDL targets for the WWH ALU designation appear at the bottom of Tables 7.6 and 7.7

Two major ecoregions – ECBP and HELP – exist in the Blanchard River watershed (Figure 7.5). However, stratification by ecoregion was not performed because the ECBP Level-4 subregion 55a (Clayey High Lime Till Plains) within the Blanchard watershed is very similar to the HELP Level-4 57a subregion (Maumee Lake Plains), especially along the northern edge of the 55a ecoregion boundary (R. Miltner 2007, personal communication).

Figure 7.5. Distribution of Level-4 ecoregions (subregions) in the Blanchard River watershed along with boundaries of watershed assessment units.



In quantifying the bedload and habitat TMDLs for the Blanchard River watershed, only sites with either ALU partial- or nonattainment were considered. Sites having full attainment or those with insufficient data (i.e., no attainment status defined) were excluded and hence do not appear in Tables 7.6 and 7.7. Further, of these sites, only those with causes identified as siltation and sedimentation were considered for a bedload TMDL (Table 7.6). Correspondingly, only those sites with habitat alteration or flow alteration were considered for a habitat TMDL (Table 7.7). These causes were assigned by site in Tables 1a-7a in the 2007 TSD (Ohio EPA 2007).

By far the Riley Creek assessment unit (0410008-050) contains the greatest frequency of sites below the sediment target of 32 (Table 7.6; Figure 7.6). In particular the upper portions of mainstem Riley Creek (at river mile 24.9, 22, and 19.5) have significant deviations from the sediment target owing to low scores on the substrate and riparian/bank erosion metrics. When considering tributaries within this assessment unit, Little Riley Creek (both upper and lower sub-watersheds bearing the same name) also has significant deviations from the sediment target. Here low channel morphology and substrate metrics are responsible for the deficit. The Ottawa Creek assessment unit (0410008-040) contains a few tributaries that are below the sediment target – at the lower length of Dukes Run and Tiderishi Creek. Both deviations were caused by low metric scores for channel morphology. Concluding the sediment TMDL analysis is one site each within the Eagle Creek (0410008-030) and Cranberry Creek (0410008-060) assessment units. The mainstem Blanchard River (river mile 57.8) has a significant deviation from the target (40.6 percent) and mainly due to substrate issues. Within the Cranberry Creek assessment unit, Caton Ditch has not met the sediment target (low substrate metric).

Figure 7.6. Depiction of <u>bedload scores</u> at QHEI assessment sites for impaired sites having sedimentation or siltation causal factors.

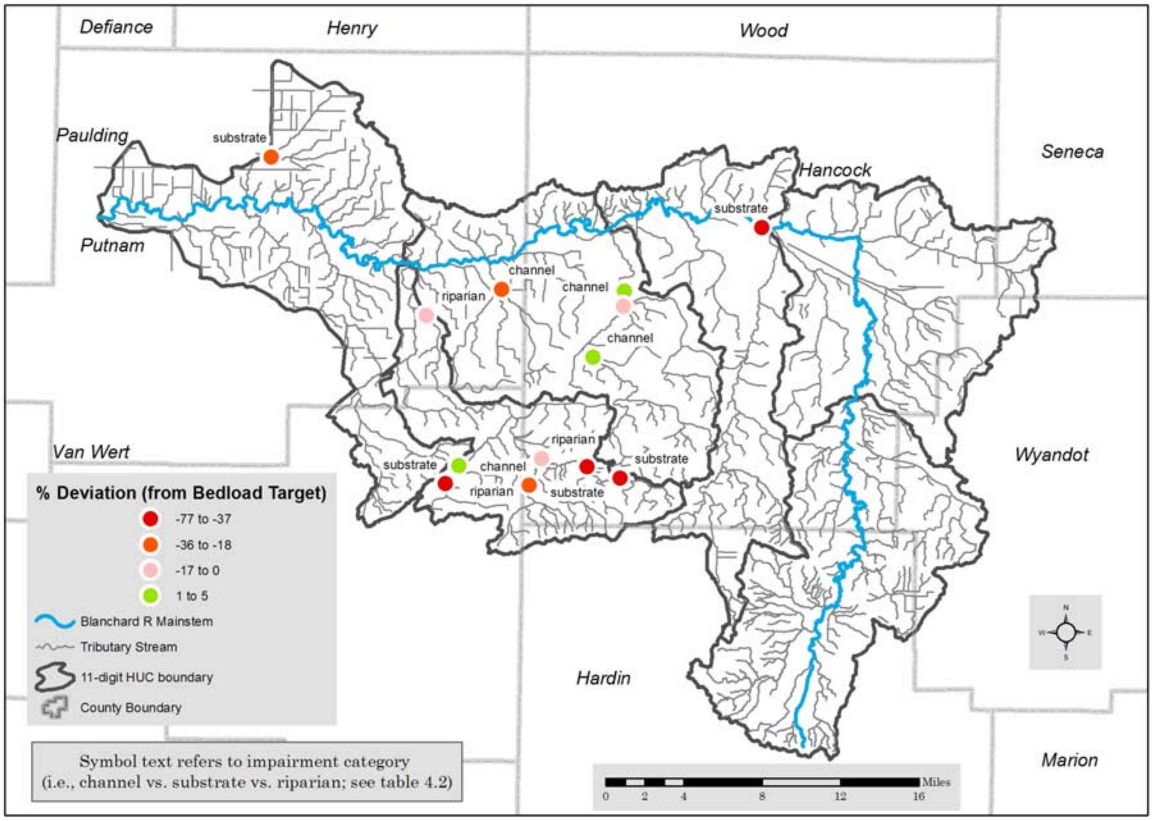
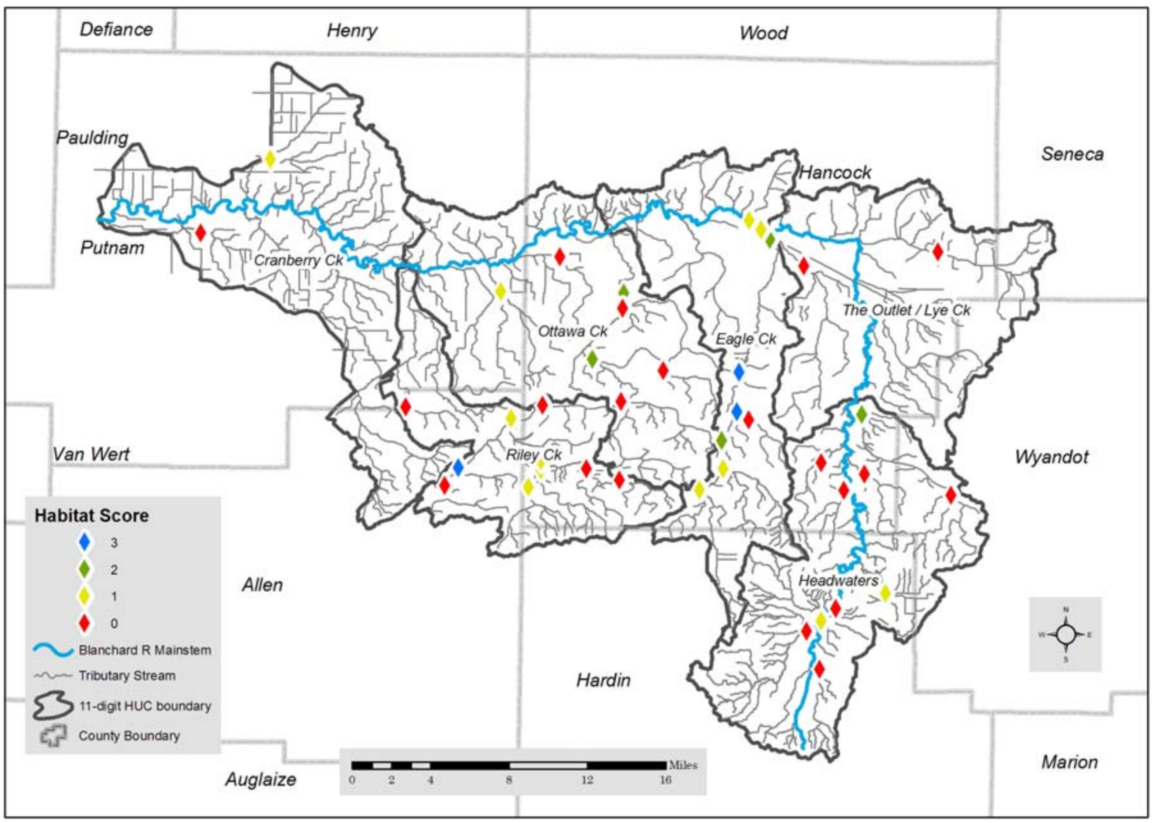


Table 7.6. Characterization of the sediment TMDL using QHEI metrics for impaired sites with sedimentation and siltation causes in the Blanchard River watershed. All sites are ALU-designated as WWH.

Stream/River (-0n0 = HUC 14)	River Mile	QHEI Categories			Total Sediment Score	Deviation from target (percent)	Main impairment category
		Substrate	Channel	Riparian			
WAU: Eagle Creek (04100008-030)							
-030 Blanchard River (below Eagle Creek to above Aurand Run)							
Blanchard River	57.8	6.5	8.5	4	19	40.6	substrate
WAU: Ottawa Creek (04100008-040)							
-010 Ottawa Creek (except Tiderishi Creek)							
Ottawa Creek	10.1	14	12	6.5	32.5	meets	channel
Ottawa Creek	4.8	13.5	13	7	33.5	meets	channel
-020 Tiderishi Creek							
Tiderishi Creek	0.1	13.5	11.5	4.5	29.5	7.8	channel
-060 Dukes Run							
Dukes Run	1.9	12	7.5	4.5	24	25.0	channel
WAU: Riley Creek (04100008-050)							
-010 Riley Creek (headwaters to above Little Riley Creek [upper])							
Riley Creek	24.9	3	9	4.5	16.5	48.4	substrate
Riley Creek	22	6	7.5	5.5	19	40.6	substrate
-020 Little Riley Creek (upper)							
Little Riley Creek (upper)	2.6	10	10.5	5	25.5	20.3	channel
-030 Riley Creek (below Little Riley Creek [upper] to above Little Riley Creek [lower])							
Riley Creek	19.5	13	11.5	3	27.5	14.1	riparian
-040 Little Riley Creek (lower)							
Little Riley Creek (lower)	5.4	1	4	2.5	7.5	76.6	substrate
Little Riley Creek (lower)	4.2	13.5	15	4.5	33	meets	riparian
-050 Riley Creek (below Little Riley Creek [lower] to Blanchard River [except Cranberry Run])							
Riley Creek	4.4	16.5	11	3.5	31	3.1	riparian
WAU: Cranberry Creek (04100008-060)							
-040 Miller City Cutoff							
Caton Ditch	3	5	12	4	21	34.4	substrate
Target (WWH)		**≥ 13**	**≥ 14**	**≥ 5**	**≥ 32**		

As described in Chapter 6, the habitat TMDL considers the final QHEI score and the frequency of modified attributes for a given site. For the Blanchard River watershed both the headwaters (04100008-010) and Riley Creek (04100008-050) assessment units have the greatest frequency of habitat related impairment. Specifically, the upper Blanchard River mainstem and several single sites on smaller tributaries have low habitat scores (Table 7.7; Figure 7.7). These smaller tributaries include Ripley Run, The Outlet (upper sub-watershed), and Cessna Creek. Two sites on Potato Run fail to meet the habitat target and one of these fails miserably. For the Riley Creek assessment unit, both upper and lower sub-watersheds named Little Riley Creek have multiple failure sites (Table 7.7). The upper part of the Riley Creek mainstem fails significantly in meeting the habitat target.

Figure 7.7. Depiction of habitat scores at QHEI assessment sites for impaired sites having flow alteration or habitat alteration causal factors.



The Eagle Creek (04100008-030) and Ottawa Creek (04100008-040) assessment units contain the second highest frequency of sub-target habitat scores. The entire length of Eagle Creek mainstem falls below the target – besides agricultural-related habitat destruction, the lower portion of the mainstem is impaired by urbanization as it enters the City of Findlay. The Blanchard River mainstem is also below the habitat target and, in this section, induced by reservoir impoundment, dam tailrace, and urban development (Table 7.7). With the removal of the Liberty Street dam in the summer of 2007 and subsequent installation of four riffle structures in the near area, it is possible that the target could be reached at river mile 56.9. At the upper river mile (57.8), there is small likelihood of improvement as long as the City Park (Findlay) dam and upstream impoundment remain intact. In the Ottawa Creek assessment unit, the mainstem

Ottawa Creek barely fails at the lower reach but, in contrast, fails significantly towards its upper segment (Table 7.7; Figure 7.7). Two sites on Tiderishi Creek fail miserably.

The Outlet/Lye Creek (04100008-020) and Cranberry Creek (04100008-060) assessment units have the fewest sub-target habitat scores. One site in each of the lower portions of Lye Creek and The Outlet sub-watersheds fail miserably. Two sites in the Cranberry Creek assessment unit, Caton Ditch and Deer Creek also have significant below target habitat scores.

Table 7.7. Characterization of the habitat TMDL using QHEI metrics for impaired sites having causes of either habitat alteration or flow alteration (or both) in the Blanchard River watershed. All sites have warmwater aquatic life use designations. UNT = unnamed tributary with mainstem river mile at confluence in parenthesis.

Stream/River (-0n0 = HUC 14)	River Mile	QHEI Score	# of High Influence Attributes	Total # of Modified Attributes	Subscore[1]			Total Habitat Score
					QHEI	High Influence	Modified	
WAU: Headwaters (04100008-010)								
-010 Blanchard River: headwaters to above Cessna Creek								
UNT to Blanchard River (RM 100.38)	0.7	34.5	4	10	0	0	0	0
-020 Cessna Creek								
Cessna Creek	0.5	42	2	11	0	0	0	0
-030 Blanchard River: below Cessna Creek to below The Outlet (upper)								
Blanchard River	97.5	46	1	8	0	1	0	1
Blanchard River	96	46	2	8	0	0	0	0
The Outlet (Blanchard R RM 90.94)	3.6	52	1	8	0	1	0	1
-040 Blanchard River: below The Outlet (upper) to above Potato Run								
UNT to Blanchard River (RM 79.75)	2.2	40	4	9	0	0	0	0
UNT to Blanchard River (RM 80.53)	1.8	33.5	4	11	0	0	0	0
Ripley Run	0.1	50	2	9	0	0	0	0
-050 Potato Run								
Potato Run	9.6	39	3	10	0	0	0	0
Potato Run	1.8	63.5	0	6	1	1	0	2
WAU: The Outlet / Lye Creek (04100008-020)								
-030 The Outlet (lower)								
The Outlet (Blanchard R RM 63.63)	4.5	38.5	2	9	0	0	0	0

Stream/River (-0n0 = HUC 14)	River Mile	QHEI Score	# of High Influence Attributes	Total # of Modified Attributes	Subscore[1] QHEI	Subscore[1] High Influence	Subscore[1] Modified	Total Habitat Score
-050 Lye Creek								
Lye Creek	2.6	39.5	2	8	0	0	0	0
WAU: Eagle Creek (04100008-030)								
-010 Eagle Creek: headwaters to below Flat Branch								
Eagle Creek	17.7	55.5	1	7	0	1	0	1
Flat Branch	0.1	54	1	7	0	1	0	1
-020 Eagle Creek: below Flat Branch to Blanchard River								
Eagle Creek	14	66	0	5	1	1	0	2
Eagle Creek	11.6	60.5	0	3	1	1	1	meets
Eagle Creek	9.1	64.5	0	2	1	1	1	meets
Buck Run	0.6	47	2	6	0	0	0	0
Eagle Creek	0.5	62.5	0	5	1	1	0	2
-030 Blanchard River: below Eagle Creek to above Aurand Run								
Blanchard River	57.8	46	1	8	0	1	0	1
Blanchard River	56.9	56.5	0	7	0	1	0	1
WAU: Ottawa Creek (04100008-040)								
-010 Ottawa Creek: except Tiderishi Creek								
Ottawa Creek	14.7	52	2	8	0	0	0	0
Ottawa Creek	10.1	62.5	0	7	1	1	0	2
Ottawa Creek	4.8	67	0	5	1	1	0	2
-020 Tiderishi Creek								
Tiderishi Creek	7.3	40	3	9	0	0	0	0
Tiderishi Creek	0.1	58	2	7	0	0	0	0
-040 Moffitt Ditch								
Moffitt Ditch	2.4	21	4	9	0	0	0	0
-060 Dukes Run								
Dukes Run	1.9	51	2	4	0	0	1	1
WAU: Riley Creek (04100008-050)								
-010 Riley Creek: headwaters to above Little Riley Creek (upper)								
Riley Creek	24.9	32.5	3	10	0	0	0	0
Riley Creek	22	22	3	10	0	0	0	0
-020 Little Riley Creek (upper)								
Little Riley Creek (upper)	2.6	50	1	8	0	1	0	1
Little Riley Creek (upper)	1	53.5	0	7	0	1	0	1

Stream/River (-0n0 = HUC 14)	River Mile	QHEI Score	# of High Influence Attributes	Total # of Modified Attributes	Subscore[1]			Total Habitat Score
					QHEI	High Influence	Modified	
-030 Riley Creek: below Little Riley Creek [upper] to above Little Riley Creek (lower)								
Riley Creek	19.5	55.5	0	7	0	1	0	1
Marsh Run	1.7	33	4	11	0	0	0	0
-040 Little Riley Creek (lower)								
Little Riley Creek (lower)	5.4	25.5	5	10	0	0	0	0
Little Riley Creek (lower)	4.2	64.5	0	3	1	1	1	meets
Little Riley Creek (lower)	0.1	61	2	6	1	0	0	1
-060 Cranberry Run								
Cranberry Run	6.7	31.5	4	10	0	0	0	0
WAU: Cranberry Creek (04100008-060)								
-040 Miller City Cutoff								
Caton Ditch	3	47.5	1	7	0	1	0	1
-060 Deer Creek								
Deer Creek	1.6	32	5	11	0	0	0	0

[1] Habitat TMDL points are assigned to WWH streams based on achieving the following minimum targets: QHEI = 60 points; total number of modified attributes < 5; number of high influence modified attributes < 2. One point is assigned if these targets are met.

8.0 RECOMMENDED STRATEGIES FOR ACHIEVING WATER QUALITY GOALS

This section provides a strategy for improving water resources in the Blanchard watershed to the full attainment of applicable water quality standards (WQS). The actions recommended are aimed at reaching the water quality goals and load reductions discussed in this report and address the documented sources of impairment (Ohio EPA, 2007). Additionally, protections are recommended for sustaining water quality in areas currently meeting the applicable WQS. Some recommendations would bear regulatory authority, while others are based on voluntarily action.

In evaluating the recommended actions the following factors were considered:

- Water quality problems addressed
- Effectiveness
- Relative costs
- Potential barriers to success
- Resources available for assistance
- Locations where activities should take place
- Participation needed for successful implementation
- Timeframe under which actions should occur.

A process for validating that the recommended actions are achieving the water quality goals is provided in Chapter 9. Details include a recommended monitoring strategy, conditions sufficient to warrant revising the existing recommendations, and a methodology for selecting alternative actions.

The remainder of this chapter is organized by the following:

- Implementation through regulatory programs
- Implementation approach and rationale for other abatement mechanisms
- Recommendations for each of the subwatersheds (assessment units)
- Reasonable Assurances that recommended actions are carried out

8.1 Regulatory measures

NPDES permit limits for phosphorus at the Findlay and Ottawa WWTPs will remain at 1.0 mg/l. The moderate impact from Findlay will be addressed by more intense management of wet weather flows and CSO elimination. In Section 7.2.3 we recommend that the City of Findlay continue to abate CSO impacts and achieve a 30 percent phosphorus reduction in the designated MS4 storm water area in an effort to reduce phosphorus discharges to the river. The goal is to meet an instream target of 0.16 mg/L approximately two miles downstream. If these interim measures are not sufficient to reduce nutrient loads, then Findlay may receive a phosphorus permit limit below the current 1.0 mg/l monthly average. Such action will be based on future evaluation of the Blanchard River.

Continuous discharging lagoon systems and treatment plants over 100,000 gpd design flow will receive a phosphorus permit limit of 1.0 mg/l, unless improvements are currently being implemented which are expected to result in a reduction of phosphorus concentrations in the future. Controlled discharge lagoon systems may need to institute voluntary phosphorus reduction measures with their users or face permit limits in a renewal permit.

Table 8.1 displays the regulated facilities that discharge wastewater in this watershed with the current and proposed NPDES permit conditions.

Table 8.1. Summary of NPDES permit recommendations for total phosphorus in the Blanchard River watershed.

Entity (Ohio EPA permit no.)	**Receiving Stream (RM of discharge)**	**Current Permit Condition**	**Proposed Average Permit Limit/Condition**
Blanchard River Headwaters Watershed Assessment Unit (04100008-010)			
Mt Blanchard WWTP 2PA00045 (under construction)	Blanchard River	monitoring	**Monitoring**
Dunkirk WWTP 2PB00061	Shallow Run (4.08)	monitoring	**Monitoring**
Forest WWTP 2PB00044	Forest-Simpson Ditch (1.50)	monitoring	**Monitoring**
Outlet/Lye Creek Watershed Assessment Unit (04100008-020)			
Vanlue WWTP 2PA00016	Brights Ditch (3.87)	NA	**Monitoring**
Eagle Creek Watershed Assessment Unit (04100008-030)			
Findlay WWTP 2PD00008	Blanchard River (56.42)	1.0 mg/l	**1.0 mg/l**
Arlington WWTP 2PA00050	Buck Run Creek (0.75)	monitoring	**1.0 mg/l**
Ottawa Creek Watershed Assessment Unit (04100008-040)			
Ohio DOT I-75 Rest Area 2PP00019	Tiderishi Creek (3.82)	NA	**Monitoring**
Jenera WWTP 2PA00096 (under construction)	Ottawa Creek	monitoring	**Monitoring**
Rawson WWTP 2PA00039	Ottawa Creek (7.20)	monitoring	**Monitoring**
Riley Creek Watershed Assessment Unit (04100008-050)			
Pandora WWTP 2PB00029	Riley Creek (5.35)	monitoring	**1.0 mg/l**
Bluffton WWTP 2PC00005	Riley Creek (15.40)	1.0 mg/l	**1.0 mg/l**
Beaverdam WWTP 2PB00018	Lower Little Riley Creek Tributary (5.55/0.4)	monitoring	**Monitoring**
Cranberry Creek Watershed Assessment Unit (04100008-060)			
Miller City Schools 2PT00025	Miller City Cutoff	NA	**Monitoring**

Table 8.1. Summary of NPDES permit recommendations for total phosphorus in the Blanchard River watershed.

Entity (Ohio EPA permit no.)	**Receiving Stream (RM of discharge)**	**Current Permit Condition**	**Proposed Average Permit Limit/Condition**
Putnam County Board of MRDD 2PG00112	Unnamed Trib of the Blanchard River	NA	**Monitoring**
Country Acres 2PG00083	Deer Creek (1.58)	NA	**Monitoring**
Large River Assessment Unit (04100008-001)			
Ottawa WWTP 2PD00028	Blanchard River (22.16)	1.0 mg/l	**1.0 mg/l**

8.2 General approach to abate water quality stressors

TMDLs are developed for ***pathogens*** to address impairment of recreational uses and also for ***total phosphorus***, ***habitat and sediment*** to address impairment of aquatic life uses. Recreational use impairment is pervasive throughout most of the basin while aquatic life use impairment occurs more discretely on a segment by segment basis. The recommendations that follow provide a basic approach for addressing each of these causes of impairment and their respective sources. Also included are recommendations regarding ***stream geomorphology, floodplain connectivity and stormwater management*** that are intended to provide further enhancement and protection of aquatic life uses**.**

It is possible that some stream segments not surveyed are impaired by sources that have been identified in surveyed segments. A broad application across the watershed of some of the recommendations is likely to abate those sources as well.

The discussion in this section is organized by subwatershed. The display of maps and tables provides an overview of what is necessary for meeting and maintaining water quality standards and is followed by explanations of technical or scientific rationale. A detailed discussion of the causes and sources and how these water quality stressors lead to impairment can be found in Chapter 5 of this report as well as the Technical Support Document for the Blanchard River (Ohio EPA, 2007).

8.2.1 Pathogens

Recreation use impairments in the Blanchard River watershed are primarily attributable to point sources such as CSOs, failing home sewage treatment systems (HSTS), and manure from livestock operations. Livestock farming is not intense in the watershed, however improper land application of manure during the winter is a source of impairment. Future expansion of existing livestock operations, or the potential for new operations to locate in the watershed will increase the amount of manure in the watershed therefore the development of and strict adherence to nutrient and manure management plans is critical. Wildlife is believed to make a relatively small contribution to the pathogen load. In urban areas pathogen contamination is primarily the result of inadequate wastewater treatment and combined sewer overflows (CSOs) and illicit connection of wastewater drains to storm sewer systems. In developing areas, failing HSTS, improperly designed, installed and maintained home sewage systems and lack of centralized sewage collection/treatment can be a significant source of pathogens. Identification of these inadequate treatment systems and appropriate corrective actions such as new installation, replacement or upgrade of failed systems is critical for protecting water quality from these sources of pollution. Table 3.5 in Chapter 3.3 includes the location and the population of the sources identified as being particularly problematic.

8.2.2 Habitat

In the Blanchard watershed degraded stream habitat is primarily the result of channelization and ongoing maintenance activities carried out to improve water conveyance. These activities are related to agricultural drainage improvements however, there is channelization in urban areas where buildings and other infrastructure lie in close proximity to the streams such as the mainstem Blanchard River as it flows through Findlay. Most channelization is found on small to medium sized tributaries. The highest frequency of habitat induced impairment was found in the Headwaters (010) and Riley Creek (050) assessment units. Eagle Creek (030) and Ottawa Creek (040) assessment units had the second highest rate of habitat impaired sites.

Habitat is also impaired or threatened by channel instability resulting from altered hydrology. In agricultural areas, practices specifically designed to increase drainage efficiency (e.g., subsurface drainage, channelization) as well as unintended impacts of farming (e.g., soil compaction, poor vegetative cover) increase storm flows. Efficient drainage also results in low flow conditions that are more extreme and occur more frequently. This diminishes the capacity of the system to assimilate pollutants and support diverse aquatic communities. In urban and developing areas, impervious surfaces create substantial increases in runoff which increases channel erosion and decreases stability.

Other habitat impairments include impounded flows from lowhead dams and sedimentation. The following three sub-sections discuss habitat improvements that address channelization, stream instability, and impoundments respectively.

Channelization

Channelization creates deeply incised and straight ditches or streams. This disconnects waterways from floodplains which have damaging impacts on the quality of the system. Channelized streams change little along their length, lack features such as riffles and pools and have minimal variation in flow characteristics. This homogenous configuration reduces biological diversity (Hahn, 1982, Mathias and Moyle, 1992). Additionally, in-stream cover important for diverse aquatic communities is often absent. These practices are sanctioned through Ohio’s drainage laws (ORC 6131 and OAC 1511) for valid socio-economic reasons. However, these laws and the commonly employed drainage improvement practices were created long before current State and federal water quality laws and, more significantly, before today's understanding of water quality sciences. A challenge is to carry out actions that improve water quality while maintaining adequate drainage for profitable agriculture.

In terms of drainage related to agriculture, a primary function of a stream or ditch is to provide an outlet for subsurface drainage infrastructure (i.e., drain tiles). This requires that the elevation of the channel bottom be far below (usually several feet) the elevation of the surrounding crop fields, which results in floodplain disconnections. Adequate outlets can be provided and habitat improvements achieved through stream restoration and a two-stage ditch approach.

The following three minor sub-sections discuss stream restoration, two-stage ditch management, and bio-engineering techniques as a means to improve habitat and water quality in channelized streams and ditches.

<u>Stream restoration</u>

The stream restoration recommended will create or lead to the development of well connected floodplain areas, channel sinuosity, and also riffle and pool habitats where appropriate. The detention and temporary storage of high flows in created floodplains will likely mitigate downstream impacts associated with flooding. Ohio EPA recommends that the newly organized Northwest Ohio Flood Mitigation partnership (NWOFMP) consider enhanced floodplain connection and floodplain storage capacity as a means for long-term flood mitigation.

Another benefit of stream restoration related to water quantity is that it provides greater capacity to accommodate subsurface drainage and enhances that use of the system. Although land drainage is not a goal of the Clean Water Act, this may provide some compensatory benefits that make landowners more willing to take this approach.

To provide the maximum benefit of stream restoration (i.e., suitable physical habitat), the location of prospective projects should be considered from the perspective of the sub-basin scale or larger. Higher priority should be given to locations that facilitate upstream migration of high quality fish communities to areas with good habitat and adequate water quality. In essence restored stream segments should bridge gaps between segments of high quality habitat. Generally speaking, downstream areas of degraded habitat should be addressed first in order to maximize continuous (or nearly continuous) high quality habitat, providing the greatest opportunity for upstream re-colonization by downstream source populations.

Additional information regarding natural channel design can be accessed at **http://www.nrcs.usda.gov/technical/stream_restoration/newgra.html**.

<u>Two-stage approach</u>

Stream restoration that employs natural channel design is superior to a two-stage ditch approach when strictly considering environmental benefits, but since stream restoration entails more earth moving and is considerably more expensive, a two-stage approach may be practical for addressing channelization on a large scale.

A two-stage ditch is similar to a typical drainage ditch (i.e., one-stage) but differs in some key ways. Two-stage ditches are wider at the top of their banks which increases the overall capacity of the ditch and out of bank flooding occurs less often. The bottom of a two-stage ditch has low elevation benches that are inundated during moderately high and higher flow events. The low flow channel is narrower than a typical ditch bottom and often develops a low-amplitude, sinusoidal pattern within the larger ditch. More information regarding two-stage ditches can be found at **http://streams.osu.edu/naturalchannel.php**. See Figure 8.1 for depictions of a two-stage ditch.

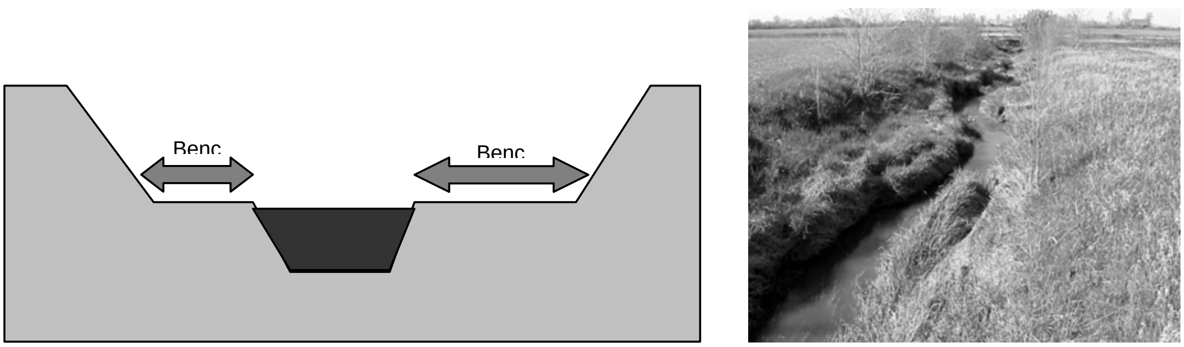


Figure 8.1. Graphical depiction of a two-stage ditch (left) and photo (right) which was taken in Wood County, Ohio. Notice the slight meander pattern along the ditch bottom in the picture.

Two-stage channels yield modest improvements to stream habitat as compared to one-stage ditches. These benefits are realized because benches function to some degree like floodplains and the channels undergo more stable erosion and deposition processes. Bank erosion is less likely to occur because the toe is protected by vegetated bench deposits and flow depths are lower, which results in lower shear stress. Less bank erosion in these fairly unstable systems is beneficial to immediate and downstream reaches because in-stream sources of sediment are reduced (**http://streams.osu.edu/streams_pdf/2stage(ward).pdf**).

Ohio EPA recommends that the NWOFMP consider alternatives to current drainage maintenance that are consistent with the principles of two-stage ditches when drafting and implementing a flood mitigation plan. The increased capacity of the two-stage channel may mitigate some localized flooding. Additionally, for certain stream flows, two-stage ditches may have a larger hydraulic retention time which may offset downstream flooding.

<u>Bio-engineering techniques</u>

Bank stabilization and channel erosion controls that use "hard engineering" techniques (e.g., placement of concrete and/or rock) have little to no value in terms of aquatic habitat. Bio-engineering techniques promoted by the Ohio Department of Natural Resources (**http://www.dnr.state.oh.us/water/pubs/fs_st/streamfs/tabid/4178/Default.aspx**) use more natural materials and construction techniques that provide bank habitat structure. When bank erosion control is necessary, bio-engineering approaches should be promoted by local conservation authorities (e.g., NRCS and SWCD) and used by private and public entities as a means for abatement. However, it should be noted that channel erosion and lateral migration occurs naturally even in stable streams. If property loss is not an issue, abating bank erosion should be considered in light of whether it is occurring under stable stream conditions, and avoided if unnecessary.

Stream stability

Stream stability is related to habitat quality and sedimentation in streams and can have a significant impact on stream biota. Floodplains are important for maintaining stream stability and provide additional water quality benefits. For this reason, it is recommended that throughout the entire Blanchard River watershed an effort should be made to maintain, create, or facilitate the development of floodplains such that they are at least three times the bankfull width, which is considered the minimum needed for a stream to maintain stability. Floodplains widths that fall below this threshold are expected to become unstable and undergo excessive erosion. The flood plain width is the total width including the flood plain on both sides of the stream and the bankfull width.

Water table management (NRCS Practice Standard 554) is a means to reduce the discharge of subsurface drainage water (**http://ohioline.osu.edu/aex-fact/0321.html**). Water table management requires the use of controlled drainage structures (e.g., Agri-Drain or Hancor types) that are installed within new or retrofitted to existing subsurface tile systems. Benefits of water table management are reductions in annual drainage water discharges. These reductions have been estimated over several years of research to be approximately 40 percent (Fausey, 2004). The use of water table management may be limited in some areas.

Wetlands provide detention capacity for runoff and increase infiltration. Numerous studies have shown that wetlands improve water quality and watershed hydrology as well as provide excellent wildlife habitat (Mitsch and Gosselink, 2000, Vellidis, 2003).

The placement of wetlands adjacent to or near streams or ditches allows for treatment just prior to entering those waters. Depressions on the landscape with appropriate soils are ideal locations for creating or enhancing wetlands, since it is likely that they were wetlands prior to land use conversions. The NRCS standards for wetland creation (NRCS Practice Standard 658) and wetland enhancement (NRCS Practice Standard 659) provide details regarding size and site condition considerations.

Conversion from crop fields to grassland or forest also increases the retention and/or detention of rainwater. These land covers result in greater infiltration and a higher degree of storage through initial abstraction compared to row crops and/or barren ground and may help restore a more suitable hydrology. Such improvement may take several years to reach their full benefits, especially when land returns to forest cover. The conservation Reserve Program compensates producers for land set-asides.

Numerous scientific studies show that increasing impervious surfaces (roofs and parking lots) through development, decreases stream stability and degrades water quality and biological communities in the watershed (Booth et al., 2005, Brabec et al., 2002, Roy et al., 2003, Roy et al., 2006, Morgan and Cushman, 2005). Higher runoff volume increases pollutant loading to the stream. Temperature increases reduce dissolved oxygen concentration and create stressful conditions for aquatic biota (Ward, 1992, Cossins and Bowler, 1987). Controlling runoff associated with development typically consists of end of pipe measures such as storm water detention and retention. These controls may reduce flooding and erosion which provides some water quality protection.

Floodplains minimize the impacts of development on stream systems. The reduction of the erosive power of storm flows, temporary flood storage, and sediment assimilation all act to mitigate the damage caused by increased runoff volume during flood events. Wetlands also provide storm water retention, increase infiltration and reduce the erosion potential of surface flows. These important environmental areas should be protected through zoning, setbacks and conservation easements. It is recommended that the newly organized NWOFMP consider this approach in their comprehensive flood study and implementation plan.

Assimilative capacity

Increasing the assimilative capacity of the stream system itself is a viable means to help achieve water quality goals. Such an increase can help abate pollutant loads in the event that controls for landscape based and point sources are inadequate. One of the most important ways to increase the assimilative capacity of the system is to provide and/or preserve floodplain connection. Other means include ensuring high quality substrate (i.e., an adequate hyporheic zone), and appropriate channel morphology (e.g., sinuosity, width depth relationships). A sufficient source of carbon is needed to support many of the organisms that are critical for in-stream biological processing therefore detritus from riparian trees and floodplains is important (Wallace et al., 1997, Baer et al., 2001, Crenshaw et al., 2002).

Impoundments

Four lowhead dams impound waters in the Blanchard River watershed. Two lowhead dams located in the City of Findlay at Liberty Street and Riverside Park are listed as a source of impairment. Dam removal or modification immediately and permanently eliminates the source and associated causes of impairment. The primary benefits of dam removal are the increase in flow velocities and turbulence that corresponds to increased air entrainment and dissolved oxygen concentrations. Increased flow facilitates the movement of nutrients that are otherwise stagnated in the deep, still pool that exists immediately upstream of the dam.

The Liberty Street dam has been removed on the Blanchard River in Findlay since the time of the 2005 biological survey carried out by the Ohio EPA. It was removed in 2007 to aid in flood damage reduction. The project also included the addition of several riffle structures resulting in dramatic improvement of the dissolved oxygen level in the water. The Ohio EPA recommends that the Riverside Park dam owned by the City of Findlay also be evaluated for potential flood mitigation and water quality improvement. Currently the dam pool is an emergency water supply for Findlay. The combined effect of removing both Liberty Street and Riverside Park dams will very likely allow the river to attain WWH use designation.

8.2.3 Nutrient and sediment

Sources of nutrient and sediment loads in the Headwater area, Outlet/Lye Creek, Riley, Ottawa and Eagle Creek subwatersheds are primarily runoff from row crop agriculture, point source discharges, and channel degradation. The TMDL assessment indicated the Riley Creek WAU had the most sites impacted by sediment and degraded riparian habitat, especially the upper portions of mainstem Riley Creek and both the upper and lower Little Riley Creek segments. There were also significant deviations from the sediment target in the Ottawa Creek WAU on Dukes Run and Tiderishi Creek.

NPDES permit revisions to address CSOs and phosphorus impacts from point source dischargers will be carried out according to recommendations in Section 8.1 of this report. Other sources of nutrients include failing HSTS and livestock manure. Abatement strategies are identical to those discussed earlier in Section 8.2.1.

Point source discharges
Permit modifications are the most straight forward means to achieve the necessary reductions in nutrients. It is therefore recommended that permits be modified to reflect the load limits prescribed by this TMDL (see Table 8.1). Most subwatersheds showed more reductions are needed for non-point sources than point sources of phosphorus. However, the opposite is the case in the Cranberry creek subwatershed, where the load reduction is almost completely allocated to the point sources, unpermitted discharges and the unsewered area.

Sources from agricultural runoff and drainage infrastructure
Many management practices abate sediment and nutrient loading to surface waters from crop fields. Examples include vegetated buffer strips, grassed waterways, nutrient management, conservation tillage, conservation crop rotations, wetland restoration, and water table management. For decades conservation professionals have researched these practices, improved their effectiveness, and worked with private landowners to implement them. Programs currently funded under the Farm Bill provide cost share and dollar incentives for land set asides, and structural and management conservation practices.

Riparian trees or grass filter strips slow the velocity of overland surface flow allowing sediment particle to fall out of suspension. Buffers also increase infiltration of surface water due to better soil structure, macropores created by roots and soil invertebrates, and reduced surface crusting (Prichard, 1998). Greater infiltration reduces surface discharges and the associated sediment and nutrient loads (Prichard, 1998). However, the effectiveness of buffers decreases dramatically when small concentrated flow paths allow water to rapidly move across them. Such flow paths typically develop at low points along the fields/buffer border or where the vegetation of the buffer is disturbed. These situations should be corrected as they are identified by landowners, farm operators, and conservation professionals (e.g., NRCS/SWCD staff). Subsurface drainage creates a by-pass to the buffer strips where there is no contact between the vegetation and the drainage water and flow is not slowed. However, water table management (e.g., NRCS practice 554) is a means to reduce the volume and/or rate of discharging subsurface drainage water thereby counteracting the short circuiting that occurs through buffer strips.

Benefits of buffer strips that go beyond improving chemical water quality of surface runoff are related to channel stability, structural habitat, light availability, stream temperature, and food resources. Providing a stream buffer may reduce the need and/or importance for stream bank management and erosion control as crop losses would not be occurring. In some cases armoring stream banks to minimize erosion prevents the naturalization of the stream’s geomorphology (i.e., channel evolution) and perpetuates stream instability. Additionally, tree cover shades streams which may limit algal growth and reduce stream temperatures. Temperature is inversely proportional to the stream’s capacity to hold dissolved oxygen and high temperatures can severely impact aquatic life. Woody debris and detritus contributed to the stream system by riparian trees also have a significant role in the quality and diversity of habitat and food resources of the aquatic ecosystem (Ward, 1992, Wallace et al., 1997, Baer et al., 2001). These factors have a significant impact on the aquatic biological community and therefore the capacity for the system to attain its designated aquatic life use.

Sources from urban and residential runoff

The relatively high volume of runoff generated in urban and high density residential areas increases the potential for pollution. Sediment and nutrient residues on surfaces that are impervious or poorly pervious (e.g., compacted lawns, gravel drives, etc.) are more easily transported in this higher volume of runoff and negligible attenuation of the loading occurs due to infiltration. Reducing imperviousness and improving on-site retention and infiltration can abate sediment and nutrient loading by reducing the runoff discharge.

Management that limits the application of nutrients and increases the likelihood of uptake and retention are recommended. This includes reducing the amount and/or frequency of fertilizer applications. The timing of application should be such that it is unlikely to immediately precede a runoff event (e.g., precipitation or irrigation). More stable alternatives to chemical fertilizers should be adopted such as organic based materials (e.g., composts and manures). Organic materials also provide carbon which improves soil structure and increases permeability (i.e., leads to greater stormwater infiltration).

The NRCS in collaboration with the National Association of Conservation Districts (NACD) and the Wildlife Habitat Council (WHC) developed a backyard conservation manual that highlights ten activities that collectively are designed to improve water and soil quality and wildlife habitat. This document can be found on the world-wide web at **http://www.nrcs.usda.gov/feature/backyard/**

8.2.4 Source water protection

Source water protection efforts for the Village of Ottawa and the City of Findlay should focus on controlling agricultural runoff and runoff from cattle grazing pastures, with particular attention to sources of pesticides, nitrates, phosphorus, and microorganisms such as fecal coliform bacteria. This can be accomplished via educational efforts. County extension agents are an excellent resource for assisting the agricultural community with controlling agricultural runoff, and staff from local and county health offices can instruct homeowners in proper maintenance of their septic systems.

Both the village of Ottawa and the City of Findlay could employ additional protective strategies including the following:

- Education and Outreach
  - Inform people who live, work, or own property within the protection area about the benefits of drinking water protection.
- Coordinating with Existing Activities
  - Work with the NRCS, SWCD, Ohio Farm Bureau, Local watershed planning organizations
- Oil and Gas Production
  - Provide education on proper operation and maintenance
- Agricultural Activities
  - Provide education to local farmers
- Transportation Routes
  - Prevent spills from transportation routes reaching the Blanchard
- Emergency Response Planning
  - Develop early warning procedures and coordination of response and remediation activities for spills
- Water Quality Monitoring
  - Provide for periodic monitoring of raw water quality and quantity from the Blanchard River.
- Zoning Ordinances
  - Place a regulatory control that restricts activities conducted in protection areas
- Regulatory Compliance
  - Monitor compliance with existing regulations through inspections and/or contact with regulatory agencies.

More details on these additional protective strategies are presented in the Source Water Assessment for the Village of Ottawa and the City of Findlay. These reports are available by linking to a secure web page off of the following web page:
http://www.epa.ohio.gov/ddagw/swap_assessments.aspx

Ohio EPA is offering Source Water Protection Planning workshops across the state to assist public water supply operators and their team in developing their source water protection plan. In a series of five workshops, Ohio EPA outlines the guidance for

developing a source water protection plan and facilitates the development of portions of the plan at each workshop. Water supply operators may receive up to five contact hours for participating in the five workshops. Operators interested in participating in a workshop can contact Linda Merchant-Masonbrink at **linda.merchant-masonbrink@epa.state.oh.us**. The guidance for developing a source water protection plan for systems using inland surface waters can be found here:
http://www.epa.ohio.gov/portals/28/documents/swap/swap_sw_protplan.pdf

There was Section 319 grant money available to assist communities in the development of source water protection plans. The Village of Ottawa was awarded a 2005 grant to reduce nitrates in the watershed.

8.2.5 Summary

The diverse sources of impairment in the Blanchard River watershed require various implementation actions. The basic principles of providing floodplain connectivity, stable stream morphology and watershed hydrology that approximates natural conditions (i.e., there is adequate infiltration) are applicable to the agricultural, developing, and urban areas of the watershed. Likewise stream buffers are appropriate for all land use types in the watershed.

Point source permit modifications for phosphorus reductions are needed at some facilities in the basin. Home Sewage Treatment Systems (HSTS) must be addressed in rural, urban, and developing areas. Overland sediment loading is primarily a concern in conventionally-tilled cropland and where residential and commercial development is rapid. Nutrient loading from agro-chemicals and residential sewage and a couple of manure sources is pervasive throughout all of the subwatersheds and conservation and management practices promoted by NRCS are recommended to abate these sources. Residential, commercial and otherwise urban areas can reduce overland loading by reducing the application rate of fertilizers and improved timing. Reduction in runoff volume through onsite storm water management will also reduce loading from urban areas and improve watershed hydrology and subsequently stream stability.

In addition to decreasing the input load of nutrients and sediment, efforts to improve the habitat quality will increase the assimilative capacity of the stream to treat non-point source and surface runoff pollution entering the system. Providing more floodplain connections with wetland areas and drainage alternatives such as two-stage or over-wide drainage ditches may also reduce damaging flows throughout the watershed.

8.3 Recommended implementation strategy and priority locations

Actions recommended to address the causes and sources of impairment are arranged according to the subwatersheds (assessment units) discussed earlier in this report. The major causes and sources of impairment are listed for each subwatershed. Locations are given for areas that are known to have impairment or are threatened by the presence of sources of impairment. Included with the implementation actions are the organizations important for successful implementation. When possible, attention was given to issues of timeframe, resource availability to assist implementation, and potential barriers to success. The technical support document for the Blanchard River watershed (Ohio EPA, 2007) and Chapter 5 of this report provide more information regarding causes and sources of impairment.

Table 8.2. Summary of the strategies for addressing each listed cause of impairment in the Blanchard River watershed.

PATHOGENS	
• *Reduce point sources* o Eliminate Separate Sewer Overflows and remaining Combined Sewer Overflows o Provide centralized collection and treatment for unsewered communities • *Reduce loading from HSTS* o Identify and repair/replace failing home sewage systems o Protect against future failures through training and education on system maintenance o Central sewerage (where feasible)	• *Reduce loading from livestock operations* o Eliminate or reduce livestock access to streams o Improve manure storage and handling operations o Implement BMPs included in NRCS 633 standards for winter application of manure and application of liquid manure on tile-drained fields o Plant winter cover (green manure) crops to provide manure application sites
HABITAT	
<u>*Channelization*</u> • *Increase heterogeneity of channel morphology and flow conditions* o Natural Channel design and stream restoration o Two-stage or over-wide construction on maintained drainage ditches • *Create and protect in-stream habitat* o Stream restoration and bio-engineering techniques o Increase floodplain connection	<u>*Stream Stability*</u> • *Approximate natural hydrology of watershed* o Increase natural vegetative cover o Permanent riparian protection o Wetland creation and restoration • *Create or restore floodplain connections* • *Reduce urban runoff* o Minimize imperviousness of landscape o Increase storm water infiltration o Promote bioretention for storm water
NUTRIENTS	
• *Reduce point source loads* o Permit restrictions and/or monitoring • *Increase assimilative capacity of stream system* o Increase floodplain connection o Improve stream bed substrate o Increase stream detention time ▪ Increase sinuosity ▪ Increase riffle-pool development • *Reduce overland sources* o Improved nutrient management plans for livestock operations o Develop CNMPs on a regional/ watershed level o Monitor extent to which CNMPs are fully implemented	• *Reduce overland sources (cont.)* o Conduct regular soil testing and follow agronomist nutrient recommendations o Drainage water management or tile plugs on drained fields that receive manure application o Improve timing of fertilizer application o Plant winter cover crops to uptake soil and manure nutrients o Adjust feed nutrients based on animal nutritionist recommendations • *Install wetlands at outlets of headwater tile mains* • *Install water table management structures on tile systems*
SEDIMENT	
• *Reduce overland sediment loading* o Reduce potential for surface erosion ▪ Protective cover ▪ Conservation tillage o Establish filter strips on all tributaries o Permanent protection of stream side buffers o Adopt and implement storm water controls on construction sites o Implement Storm Water Pollution Prevention Plan post-construction controls	• *Reduce in-stream erosion* • *Create or restore floodplain connections* • *Reduce urban runoff* o Minimize imperviousness of landscape o Increase storm water infiltration o Promote bioretention for storm water • *Increase assimilative capacity of stream system (see nutrients above)*

FLOW ALTERATION	

• *Remove dams*
• *Increase streamside tree plantings*
• *Create or restore floodplain connections*
	• *Reduce urban runoff*
	  o Minimize imperviousness of landscape
	  o Increase storm water infiltration
	  o Promote bioretention for storm water
	• *Increase assimilative capacity of stream system (see nutrients above)*

8.3.1 Blanchard River headwaters (HUC-04100008-010)

The headwaters area had many small streams impacted by a combination of non-point source pollutants associated with certain agricultural practices and inadequate wastewater treatment from Forest and Dunkirk, and from Wharton and Patterson, which are unsewered. Excess discharge of ammonia and phosphorus from municipal wastewater treatment facilities and from combined sewer overflows contributes to organic overload and the growth of algae in streams. Excess algae and high water temperatures from direct sunlight and lack of tree cover are stressful for aquatic wildlife.

<u>Pathogens/bacteria</u>

- *The Outlet (upper)* is impaired by bacteria from the unsewered community of Patterson.
- *Blanchard River* downstream of Mt. Blanchard is impacted by this unsewered village.
- *Potato Run* has excessive bacteria level from the unsewered village of Wharton
- *Shallow Run* is impacted by CSOs in the village of Dunkirk.
- *Forest-Simpson Ditch* receives inadequately treated effluent from the village of Forest wastewater treatment plant.

These impacts should be addressed by improvements to existing wastewater collection and treatment systems or investments in new infrastructure. More specific information is discussed under the “Nutrient and organic enrichment” subsection.

<u>Nutrients and organic enrichment</u>

TMDL Load reductions for total phosphorus

NPS Reductions: 9.26-84%

PS reductions: 15.4%

- Forest will retain phosphorus monitoring in their NPDES permit
- Dunkirk will retain phosphorus monitoring in their NPDES permit

The following phosphorus reduction measures should meet the point source wasteload reductions prescribed in the TMDL report:

- Mt Blanchard is constructing a wastewater collection/treatment system and will have a phosphorus monitoring requirement in their NPDES permit.
- Forest continues implementation of their CSO Long Term Control Plan, which involves a five-phase project to construct new sanitary sewers and eliminate all CSOs.

- Dunkirk continues implementation of their CSO elimination schedule, which also involves construction of new sanitary sewers and elimination of all CSOs beginning in 2009.

The above two measures will increase detention time in Forest and Dunkirk's lagoon systems and more effectively treat ammonia and reduce phosphorus in the discharges.

- Centralized wastewater collection and treatment is recommended for the unsewered villages of Wharton, and Patterson.

Non-point sources of nutrients are primarily related to land applied fertilizers and manures. Controls to these sources are discussed in Section 8.2.3. Farming conservation practices that seem particularly well-suited to abate nutrient runoff include cover cropping, stream-side buffering, and manure and nutrient management that is based on soil needs and appropriate planning for land application.

Other non-point sources include homes where septic treatment systems are not functioning properly. See also discussion in Section 8.2.3 for possible steps to abate these sources.

Habitat alteration

There was a high frequency of deficient habitat characteristics in this subwatershed due to past channelization and removal of stream-side vegetation. Several unnamed tributaries to the headwaters of Blanchard River had habitat scores below 60. Habitat impairment also was noted in Ripley Run, The Outlet (upper), Cessna Creek, and Potato Run. A modified approach to drainage maintenance is recommended to allow a more natural channel to form and tree growth on one side of the stream.

Source water protection for Findlay

As reported in Section 4.3 Source Water Uses, nutrient levels in the Blanchard River exceeded criteria in the spring which ultimately led to algae blooms in the summer as water temperatures increased. Reducing nutrients in spring runoff from the upper watershed may eliminate these late summer algae blooms. In addition, herbicides such as atrazine and metolachlor detected in the source water indicate that non-point source runoff in agricultural areas is a source of herbicides to the river.

Source water protection efforts for the City of Findlay should focus on controlling agricultural runoff and runoff from cattle grazing pastures, with particular attention to sources of pesticides, nitrates, phosphorus, and microorganisms such as fecal coliform bacteria. Integrated pest management and nutrient management are recommended for crop producers and conservation professional are encouraged to promote these types of practices.

8.3.2 Lye Creek/ The Outlet (04100008-020)

The Outlet/Lye Creek (020) is impaired by excess nutrients, habitat and flow alteration and high bacteria. Agricultural fertilizer, pesticides and failing home sewage systems have overloaded streams with nitrates and phosphorus. Excess nutrients and herbicides such as atrazine and metolachlor detected in Findlay's drinking water are attributed to non-point source agricultural runoff. Bacteria levels are high downstream of the unsewered village of Houcktown. Finally, three dams on the Blanchard River around Findlay slow the local stream flow leading to low dissolved oxygen and high water temperature. Lack of shade and channelization exacerbates these problems.

Pathogens/bacteria
Lye Creek is impacted by untreated sewage from the unsewered area of Houcktown.
Stahl Ditch has high bacteria levels that appear to be coming from failing home sewage systems and livestock manure. Centralized wastewater collection and treatment facilities are recommended for the unsewered village of Houcktown (see also "Nutrients" subsection).

Nutrients
TMDL Load reductions for total phosphorus
NPS Reductions: 16.7-72.1%
PS reductions: 52.6%

- Vanlue will receive a phosphorus monitoring requirement in their NPDES permit.

The following phosphorus reduction measures should be adequate to meet the point source wasteload reductions prescribed in the TMDL report:
- Vanlue have a compliance schedule in their permit to determine the source(s) of excess inflow to the sewer system. The inflow/infiltration study should be followed by a program which is expected to reduce hydraulic loads and excess phosphorus in the discharge.
- Centralized wastewater collection and treatment facilities are recommended for the unsewered village of Houcktown.

Habitat and flow alteration
Modification of the Riverside Park dam is recommended to improve the quality of aquatic habitat and stream flow conditions. Such modifications could be studied by the Army Corps of Engineers during the flood damage risk assessment.

8.3.3 Eagle Creek (HUC-04100008-030)

Eagle Creek (030), which includes part of the City of Findlay, is impaired by nutrients from upstream sources, altered flow from dams and lack of stream shading. These sources contribute to lower dissolved oxygen and high water temperature of the Blanchard River in Findlay. Excessive phosphorus and nitrates have been observed in Eagle Creek and the Blanchard River, especially during high flows. Load reductions are needed from both agricultural and urban runoff during spring and fall.

Pathogens/bacteria
- *Eagle Creek* is impaired by inadequately treated wastewater from Eagle Creek Utilities and failing home sewage systems in the subwatershed area.

- *Flat Branch* contains high bacteria levels from untreated sewage in the unsewered area of Williamstown.
- *Buck Run* has high bacteria from unknown source(s).
- The village of Arlington WWTP, which discharges to Buck Run, disinfects treated wastewater with chlorine and is addressing problems with infiltration to the sewer system.

<u>Nutrients</u>

TMDL Load reductions for total phosphorus

NPS Reductions: 3.2-66.8%

PS reductions: 41.1%

The following phosphorus reduction measures should be adequate to meet the point source wasteload reductions prescribed in the TMDL report.

- Arlington will receive 1.0 mg/l phosphorus limit in their NPDES permit
- Arlington has a compliance schedule in their permit to remove inflow and infiltration to their sewer collection system
- Findlay will maintain the current phosphorus limits of 1.0 mg/l in their permit but will continue to implement a CSO long term control plan to reduce bacteria and phosphorus. Findlay is encouraged to keep their effluent phosphorus concentration below 1.0 mg/l, especially in warm dry weather conditions.

The City of Findlay is designated as a Phase 2 storm water community and parts of it drain to the lower segment of Eagle Creek and the Blanchard River. The total phosphorus wasteload allocation for the MS4 calls for reductions of 11.6 percent in the spring and 30 percent reduction in the fall. Phase 2 communities must develop a storm water management plan that addresses the six minimum control measures outlined by the US EPA. The City of Findlay and parts of the adjoining townships have begun to develop storm water pollution prevention plans.

<u>Habitat and flow alteration</u>

The entire length of Eagle Creek has poor habitat due to multiple impacts from agricultural and also urbanization as it approaches Findlay. Restoration of active floodplains and riparian vegetation along the streams will improve the habitat scores and help mitigate flood damage.

Blanchard River mainstem in Findlay is negatively affected by the reservoir impoundment of Riverside Park Dam. Removal of the Liberty Street dam in 2007 increased oxygen levels and eliminated problems associated with high water temperature. The removal also resulted in the river meeting the habitat QHEI goal of 60 at that location (RM 56.9), but not upstream where the two dams, which include the Riverside Park dam, remain intact.

The Riverside Park dam serves as an emergency reservoir pool for drinking water, however it is recommended that the dam be considered for modification or removal to improve the stream habitat and provide storage for flood water. The NW Ohio Flood Mitigation Partnership is entering into a cooperative agreement with the Army Corps of

Engineers to conduct a study on the River to help identify and mitigate flood damage. We encourage the Blanchard River Watershed Partnership and this new effort of the NWOFMP to consider alternatives to common ditch maintenance, such as two-stage ditches, that would increase hydraulic retention time and flood storage capacity. We also recommend that local ordinances be considered aimed at preservation of the existing floodplains, creation of natural wetlands and other water quality and flood protection practices or structures in the watershed.

Sediment/siltation
Blanchard River mainstem has excessive sediment impairment where the channel is affected by the dams in City of Findlay. Removal of the dams would increase flow and sediment transport capacity, which will reduce the impact of sediment on the local aquatic community.

8.3.4 Ottawa Creek (HUC-04100008-040)

Ottawa Creek (040) is impaired by habitat and flow alteration and nutrients. Most tributary steams have been extensively modified for agricultural drainage. Routine ditch clean-outs and removal of riparian streambank vegetation makes it hard for pollutants to be absorbed and treated by natural processes in these small streams. Livestock operations that allow cattle access to Ottawa Creek contributes to water quality problems associated with bacteria, nutrients and erosion of stream banks.

Pathogens/bacteria
- Higbie-Redick Ditch was impacted by high bacteria from the unsewered village of Jenera, which is in the process of constructing sewers and a wastewater treatment system.
- Ottawa Creek is receiving bacteria from unrestricted livestock access to the stream.

Nutrients
TMDL Load reductions for total phosphorus

NPS Reductions:	54.5-88.4% for Ottawa and Tiderishi
	34.5-77.8% for Dukes Run
PS reductions:	71.5%

- Jenera will have phosphorus monitoring requirement in their first round NPDES permit.
- ODOT I-75 Rest Area will have a phosphorus monitoring requirement added to their NPDES permit.

Habitat alteration and sediment/siltation
- Ottawa Creek had poor habitat in the upper segments of the watershed
- Tiderishi Creek had very poor habitat throughout the length of the stream including a low channel morphology score indicating sedimentation problems
- Moffit Ditch also had very poor habitat the entire length of the stream
- Dukes Run had low channel morphology score indicating sedimentation problems

A modified approach to drainage maintenance that allows a more natural channel to form, and retains vegetation on one side of the stream is recommended for all of these streams.

8.3.5 Riley Creek (HUC-04100008-050)

Riley Creek, which includes the villages of Bluffton and Pandora, is impaired by nutrients, habitat/flow alteration and siltation. Several lowhead dams near Pandora impede the natural flow in Riley Creek, and cattle access leads to erosion, and elevated nutrient and bacteria concentrations. Lower Little Riley Creek has multiple point source discharges that degrade water quality and contribute to high bacteria. Low stream flows in headwater streams, especially in summer, makes it difficult to support good aquatic life communities.

<u>Pathogens/bacteria</u>
Lower Little Riley Creek had two poorly operated package wastewater treatment facilities at Richland Manor and Speedway America Truck stop that have recently been connected to the Beaverdam wastewater system. However there may still be failing home sewage systems in that area affecting the creek.

<u>Nutrients</u>
TMDL Load reductions for total phosphorus
NPS Reductions: 13 -75.7%
PS reductions: 38.5%

- Bluffton will continue with a 1.0 mg/l total phosphorus limit in their NPDES permit.
- Beaverdam will continue to monitor phosphorus.

The following phosphorus reduction measures should be adequate to meet the point source wasteload reductions prescribed in the TMDL report.

- Pandora will receive a permit limit of 1.0 mg/l total phosphorus if it continues operation as a continuous discharging lagoon system. If they convert to a controlled discharge lagoon, as discussed in meetings with Ohio EPA, total phosphorous will continue to be monitored with implementation of phosphorus reduction programs.
- Pandora will continue to implement a Long Term Control Plan, which involves construction of new sanitary sewers and elimination of all CSOs.
- Beaverdam, which receives wastewater from several truck stops and a truck wash facility, is recommended to implement BMPs for phosphorus reduction programs.

<u>Habitat alteration and sediment/siltation</u>

- Riley Creek and its tributaries had multiple habitat impairments.
- Removal of stream side vegetation for drainage practices and several low head or man made dams near Pandora alter the habitat and natural flow patterns of the stream.
- Riley Creek mainstem at all three locations had poor substrate and riparian erosion scores. The lack of vegetation led to more bank erosion.

- Little Riley Creek had significant sedimentation due to widened and straightened flat channels which altered the ability of the stream to transport sediment.

A modified approach to drainage maintenance that allows a more natural channel to form, and retains vegetation on one side of the stream is recommended. Dams or other stream flow obstructions should be removed.

8.3.6 Cranberry Creek (HUC-04100008-060)

The Cranberry Creek watershed has poor habitat along most of the tributary streams due to extensive channel modification and drainage maintenance under the County's agricultural drainage program. A flood abatement project removed the trees and reconstructed the channel from Rockport to the mouth of Cranberry Creek in 2005. This subwatershed had the highest level of bacteria impairment and high organic loads from inadequately treated wastewater. In Miller City Cutoff and Deer Creek small wastewater treatment plants and an unsewered community are contributing a higher nutrient load to these headwater streams than agricultural runoff.

<u>Pathogens/bacteria</u>

- Miller City Cutoff is impacted by the unsewered village of Miller City.
- Pike Run, Caton Ditch and Bear Creek may have bacteria impairment from several small package plants and failing home septic systems

These impacts should be addressed by improvements to existing wastewater collection and treatment systems or investments in new infrastructure. More specific information is discussed under the "Nutrient and organic enrichment" subsection.

<u>Nutrients and organic enrichment</u>

TMDL Load reductions for total phosphorus

NPS Reductions:	34.5-77.8% for Pike Run, negligible for other tributaries
PS reductions:	71.5% for Miller City Cutoff
	71.5% for Deer Creek (Country Acres)

- Country Acres, Miller City Schools, and the Putnam County Board of MRDD treatment plants will have total phosphorus monitoring requirements added in their NPDES permits.

The following phosphorus reduction measures should be adequate to meet the point source wasteload reductions prescribed in the TMDL report.

- Miller City should begin planning and constructing wastewater treatment facilities.
- All unpermitted point source discharges in the Cranberry Creek subwatershed, particularly in Caton Ditch, Pike Run and Bear Creek should apply for and receive NPDES permits with phosphorus monitoring requirements.

<u>Habitat alteration and sediment/siltation</u>

Caton Ditch had a low substrate score which indicates stream bottom was embedded with silt from runoff. Cranberry Run and Deer Creek are managed by the county for routine agricultural drainage maintenance. A modified approach to drainage maintenance that allows a more natural channel to form, and retains vegetation on one side of the stream is recommended.

8.3.7 Blanchard River in Findlay

The Blanchard River mainstem is not attaining aquatic life use standards from RM 97.5 to 55.2 due to a suite of causes defined as organic enrichment and dissolved oxygen, nutrients, thermal modification, and habitat alteration. For the segment of mainstem flowing through the urban corridor of the City of Findlay from the water supply dam to Hancock CR 139, an instream-kinetics water quality model (QUAL2K) was constructed to simulate critical stream conditions and compare strategies for remediation. For more details on the model see Chapter 6. Three restoration scenarios were modeled to improve water quality conditions and the following recommendations are made to the City of Findlay.

<u>Water temperature</u>
Increase the amount of woody vegetation in the form of tall, high canopy density deciduous trees along the entire course of the study area where feasible to reduce water temperature below the water quality standard of 27.8 °C. Further, temperature reductions will also be encouraged by the removal of the Findlay City Park dam and subsequent reforestation of the former reservoir basin.

<u>Dissolved oxygen</u>
Average dissolved concentrations are above the average criterion for the entire stretch of the study area with the exception of a very large drop at the City Park dam pool. By removing the Findlay City Park dam and reservoir, the average criterion is then met for the entirety of the study area. Along with Dam removal, the expansion of woody riparian vegetation along the length of the study area would reduce algae growth and thus increase the minimum dissolved oxygen values.

<u>Total phosphorus</u>
In Section 7.2.3 it is recommended that the City of Findlay continue to abate CSO impacts and achieve a 30 percent phosphorus reduction in the designated MS4 storm water area in an effort to reduce phosphorus discharges to the river. The goal is to meet an instream target of 0.16 mg/L approximately two miles downstream. If these interim measures are not sufficient to reduce nutrient loads, then Findlay may receive a phosphorus permit limit below the current 1.0 mg/l monthly average.

8.3.8 Large river unit

The Blanchard Large River Unit is meeting water quality standards as it flows west from Gilboa to join the Auglaize River in Dupont. However, excessive nutrient inputs from each subwatershed and elevated sediment delivery from Riley and Cranberry creeks threaten to impact the health of the river mainstem and contribute to a high level of organic material that is expensive to remove from the raw drinking water supply for Ottawa. The formation of trihalomethanes, a byproduct of disinfection for drinking water, is a human health concern. There is not any stream water quality impairment from nutrients so a waste load allocation for phosphorus was not calculated for the city of Ottawa. Their permit limit will remain at 1.0 mg/l total phosphorus.

Pathogens/bacteria
The unsewered area of Gilboa and failing septic systems near the mouth of the Ottawa and Riley Creek subwatersheds cause isolated recreational use (bacteria) impairment on the mainstem of Blanchard River.

Source water protection
The village of Ottawa drinking water source protection area is susceptible to agricultural runoff, industrial and commercial sources, home construction, feedlot runoff, unsewered areas, wastewater treatment discharges, combined sewer overflows, junk yard runoff, transportation related spills, pesticide and fertilizer tank farms and gas line rupture. Nitrate and several pesticides (alachlor, atrazine, metolachlor, metribuzin, simizine, cyanazine and acetochlor) have been detected in the finished water, indicating an impact on the source water from land use within the watershed. Atrazine was detected at levels above the maximum contaminant level (MCL) of 3.0 ug/l, but the drinking water standard is based on a running average of the quarterly sampling and historically the Village of Ottawa has not exceeded the MCL for this contaminant.

Source water protection efforts for the Village of Ottawa should focus on controlling agricultural runoff and runoff from cattle grazing pastures, with particular attention to sources of pesticides, nitrates, phosphorus, and microorganisms such as fecal coliform bacteria.

8.4 Status of water quality improvement efforts

The ***Blanchard River Watershed Partnership*** and its partners in four counties are serving as community advocates for the watershed, and have become important forces to maintain momentum and sponsor improvement efforts. The mission of the BRWP is to create partnerships that will promote watershed awareness, and responsible land use and management decisions to restore and preserve water quality, and to protect and enhance watershed functions.

The group is currently focusing on efforts to develop as a formal organization while simultaneously attempting to gain funding for a Source Water Protection Plan from the Ohio EPA, a Watershed Coordinator Grant from Ohio Department of Natural Resources, other sources of funding for Best Management Practices (BMP's) that will enhance the efficiency of the watershed and create a Watershed Action Plan. With partners in the watershed, they are providing educational programs and stream monitoring in the Lye Creek/Outlet subwatershed. More information about local planning and stakeholder outreach is available at **http://www.blanchardriver.com/**

The ***Hancock Park District*** is cofounder and provides ongoing support to the Blanchard River Partnership through stewardship of recreation resources and public education in Hancock County. The Hancock Park District is also active in preservation and enhancement of natural and recreational areas. For more information on the parks visit the website at **http://www.hancockparks.com/**

More recently, the ***Northwest Ohio Flood Mitigation Partnership*** has been formed to expedite the development of a flood reduction plan to be implemented in coordination with public authorities in the Blanchard River watershed. The NWOFM Partnership is a private/non-profit organization working with consultants, local government, the Blanchard River Watershed Partnership, the Ohio Dept. of Natural Resources, the Natural Resource Conservation Service, the U.S. Dept. of Agriculture, state and federal legislators to design and fund a feasible solution to flooding. For more information, visit our website at **www.floodpartnership.org**

The ***Western Lake Erie Basin Partnership*** is a tri-state partnership dedicated to enhancing multi-purpose projects that improve land and water resource management in the basin and promote a healthy, productive watershed. The WLEB Partnership is committed to sharing resources and knowledge to link land use to water quality, support ongoing efforts and identify new opportunities to enhance and improve the watershed. The WLEB is currently working with the Blanchard River Partnership and their local partners to develop outreach programs. A grant from Environmental Defense is providing seed money for a water quality monitoring project in Lye Creek/Outlet, and personnel support for outreach to increase enrollment in the Lake Erie CREP and other conservation programs.

The WLEB Partnership will provide the structure necessary to coordinate public and private resources across political boundaries to accelerate achievement of environmental goals and support for local conservation initiatives. Visit the Web site to learn more about implementation projects and funding opportunities at **http://www.wleb.org/**

8.5 Reasonable assurances

The recommendations made in this TMDL report will be carried out if the appropriate entities work to implement them. In particular, activities that do not fall under regulatory authority require that there be a committed effort by state and local agencies, governments, and private groups to carry out and/or facilitate such actions. The availability of adequate resources is also imperative for successful implementation.

The following discusses organizations and programs that have an important role or can provide assistance for meeting the goals and recommendations of this TMDL. This section establishes why it is reasonable to be assured of successful implementation.

8.5.1 Local watershed groups

The Blanchard River Watershed Partnership, the Hancock Park District, the Northwest Ohio Flood Mitigation Partnership and Western Lake Erie Basin Partnership are active local groups that are advocating for the watershed resources. See section 8.4 above for more information on the mission and status of each local group.

8.5.2 Local health departments

Under OAC 3701-29, local health departments are responsible for code enforcement, operational inspections, and nuisance investigations of household sewage treatment systems serving 1, 2, or 3 family dwellings. The Ohio Department of Health works with locals health departments and provides technical assistance and training.

8.5.3 Local zoning and regional planning

The Hancock Regional Planning Commission (HRPC) provides professional planning services for the City of Findlay and Hancock County. HRPC is responsible for enforcement of the Hancock County Subdivision Regulation, lot splits, assistance to village and township zoning codes, zoning advisory and city planning reviews.

Also provided are professional grant writing services for the cities of Findlay, Fostoria and for Hancock County. This includes administration for the Community Development Block Grant (CDBG) Program, Economic Development Grants, Revolving Loan Fund Dollars, review and reporting of the Enterprise Zone and TIF. **http://www.hancockrpc.org/**

8.5.4 Easements and land preservation

The preservation and protection of high quality riparian acres is advanced by multiple private and public entities throughout the watershed. The Hancock Park District is active in preservation and enhancement of natural and recreational areas in the watershed.

8.5.5 Education and outreach program

Educational materials can be updated to include information on causes, sources and solutions to non-point pollution in the Blanchard River watershed. 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 non-point source education is available through competitive grants from ODNR Division of Soil and Water Conservation and the Ohio Environmental Education Fund (**http://www.epa.state.oh.us/oeef/**).

Hancock Park District provides naturalist and conservation education programs and comprehensive recreational opportunities for residents and visitors at their ten parks.
http://www.hancockparks.com/

8.5.6 Ohio EPA

Several programs that Ohio EPA Division of Surface Water (DSW) administers are designed to control pollution from point sources and certain storm water discharges as well as provide assistance for abating non-point sources of pollution. Other divisions within the Ohio EPA provide assistance such as funding, technical assistance, and education for water resource related issues. Information regarding the specific programs within the Ohio EPA DSW can be found on the web at **http://www.epa.state.oh.us/dsw/**, and information about the Division of Environmental and Financial Assistance (DEFA) at **http://www.epa.state.oh.us/defa/**. What follows are programs within the agency that are especially important for the implementation of this TMDL.

NPDES Program
National Pollution Discharge Elimination System (NPDES) permits authorize the discharge of substances at levels that meet the more stringent of technology- or water-based effluent limits and establish condition requirements related to combined sewer overflows, pretreatment, and sludge disposal. All entities that wish to discharge to the waters of the state must obtain a NPDES permit and both general and individual permits are available for coverage. Through the NPDES program (**http://www.epa.state.oh.us/dsw/permits/permits.aspx**), the Ohio EPA will use its authority to ensure that recommended effluent limits are applied to the appropriate permit holders within the Blanchard River watershed. Ohio EPA staff in the NPDES program can provide technical assistance for permitted entities when needed.

Combined Sewer Overflow Program
Ohio EPA implements CSO controls through provisions included in NPDES permits and by using orders and consent agreements when appropriate. The NPDES permits for CSO communities require the implementation of nine minimum control measures (**http://www.epa.gov/npdes/pubs/owm0030.pdf**). Requirements to develop and implement Long Term Control Plans are also included where appropriate

Storm Water Program
Ohio EPA implements the federal regulations for storm water dischargers (**http://cfpub1.epa.gov/npdes/home.cfm?program_id=6**). Under OAC 3745-39, Ohio EPA has designated the City of Findlay to obtain NPDES permit coverage as an Appendix 7 Small MS4. Findlay meets the criteria for size and population density and 303(d) listed impaired surface waters in the Blanchard River which receive urban runoff from City of Findlay. The storm water management program plan was submitted to Ohio EPA on April 27, 2007 and is undergoing review.

Besides the City of Findlay, other dischargers covered under the storm water program are those facilities that meet the definition of industrial activity, including construction, in the federal regulations (**http://www.epa.state.oh.us/dsw/storm/index.aspx**). Both general and individual permits can be used for coverage of storm water effluent. To protect a receiving stream's physical, chemical, and biological characteristics and maintain stream functions, 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. To this end, appropriate BMPs are to be considered and implemented that address the causes of impairment for this watershed, including habitat alteration, nutrient enrichment, siltation, flow alteration, and bacteria. 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 **http://www.epa.state.oh.us/dsw/storm/construction_index.aspx** and **http://www.epa.state.oh.us/dsw/storm/CGPPCQA.aspx**.

Staff in the Storm Water Program provides technical assistance to permitted entities when needed. District Office staff within the Storm Water Program respond to and investigate complaints received by individuals and organizations. Through the Storm Water Program, the Ohio EPA will ensure that the storm water permit-related recommendations of this TMDL are applied.

401 Water Quality Certification Program

In Ohio, anyone wishing to discharge dredged or fill material into the waters of the U.S., regardless of whether on private or public property, must obtain a Section 404 permit from the U.S. Army Corps of Engineers and a Section 401 Water Quality Certification from the state.

Stream and wetland mitigation is used as a condition for granting 401 certificates and is the means of ensuring that water resources do not experience net decline in quality. When a wetland or stream segment is impacted, an appropriate compensation is required such that there is no net loss of wetlands or unimpaired stream length. Restoration, creation, or other forms of enhancement are required at a level that depends upon the original quality of the resource.

Currently there are proposed rules changes to the 401 Program that are designed to provide a more scientific basis for determining appropriate criteria for 401, wetland and stream permit decisions as well as mitigation stipulations for the respective projects (**http://www.epa.state.oh.us/dsw/401/index.aspx**). Ohio EPA staff will conduct reviews and issue permits to provide the most reasonable protections and improvements, where possible, of surface waters in the Blanchard River watershed.

Wetland Protection Program

House Bill 231 established a permanent permitting process for isolated wetlands. Reviewers in the 401 Water Quality Certification Section are responsible for the isolated wetland permits required by this State law. Ohio EPA staff will conduct reviews and issue permits to provide the most reasonable protections and improvements of surface waters in the Blanchard River watershed.

Enforcement Program
In cases that Ohio EPA is unable to resolve continuing water quality problems, DSW may recommend that enforcement action be taken. The enforcement and compliance staff works with Ohio EPA attorneys, as well as the Attorney General's Office, to resolve these cases. Where possible, an added emphasis and priority is given to actions in sensitive watersheds. All completed enforcement actions are posted on the Division of surface Water web page.

208 Program (State Water Quality Management Plans)
Ohio EPA oversees the State Water Quality Management (WQM) Plan. The State WQM Plan is like an encyclopedia of information used to plan, direct and evaluate actions that abate pollution and preserve clean water. All types of water quality issues may be addressed and potential solutions framed within the context of both voluntary incentive-based programs and regulation of pollution sources through applicable laws and rules. Where existing laws and regulations fall short of being able to achieve the clean water standards in a particular water body the State's 208 Plan provides a process to set forth procedures and methods that would control sources of pollution. This process might employ existing legal authorities in a different fashion, or the process might require new legal authorities granted by the appropriate State and local governmental bodies. Normally the State's Plan is reviewed and updated as needed on an annual basis.

The Blanchard River TMDL will become a part of the State WQM Plan when it is approved by U.S. EPA. Recommended TMDL targets for nutrients are established in the Blanchard River watersheds. The reductions in nutrient loadings that are necessary to achieve the water quality standards may be beyond the reach of existing voluntary incentive-based programs and regulation. Progress in this effort should be closely tracked and documented. The State 208 planning process provides a mechanism for local stakeholders to seek additional authorities should it prove necessary for achieving the water quality standards in the drinking water source water protection area and other water bodies.

Nonpoint Source Program
The Ohio Nonpoint Source (NPS) program focuses on identifying and supporting implementation of best management practices (BMPs) and measures that reduce pollutant loadings, control pollution from non-point sources and improve the overall quality of these waters. Ohio EPA receives federal Section 319(h) funding to implement a statewide NPS program, including offering grants to address non-point sources of pollution. Staff from the NPS program work with state and local agencies, governments, watershed groups, and citizens.

In addressing sources of impairment related to agricultural activities, NPS staff will correspond with Ohio DNR to promote BMPs as well as cost-share and incentive based conservation programs. In particular, Ohio EPA will encourage the Ohio DNR to continue to work with Farm Service Agency personnel and staff from local SWCD and NRCS offices. NPS staff will also provide assistance to agencies and groups actively promoting conservation as well as direction to other appropriate resources within the Ohio EPA.

NPS staff will continue to work with the watershed group that is active in the Blanchard River basin, which is developing a watershed management plan (see watershed groups below). Local NPS implementation is a key to achieving state environmental targets. Additionally, there is a reliance on watershed management plans to identify and outline actions to correct water quality problems caused by NPS pollution.

Section 319(h) grants are expected to be directed to projects that eliminate or reduce water quality impairments caused by non-point sources of pollution. Applicants may apply for a maximum of $400,000 for a three year period. Each project funded must provide an additional 40 percent matching share and the total federally funded share of project costs may not exceed 60 percent. Since a TMDL has been initiated, grant proposals for work within the Blanchard River watershed will receive special consideration for funding.

Division of Environmental and Financial Assistance

The Division of Environmental and Financial Assistance (DEFA) provides incentive financing, supports the development of effective projects, and encourages environmentally proactive behaviors through the Ohio Water Pollution Control Loan Fund (WPCLF). Municipal wastewater treatment improvements—sewage treatment facilities, interceptor sewers, sewage collection systems and storm sewer separation projects—are eligible for financing. Non-point pollution control projects that are eligible for financing include:

- Improvement or replacement of on-lot wastewater treatment systems
- Agricultural runoff control and best management practices
- Urban storm water runoff
- Septage receiving facilities
- Forestry best management practices

The Water Resource Restoration Sponsor Program (WRRSP) is a part of the WPCLF and directs funding towards stream protection and restoration projects. The primary focus of this program is to improve and protect stream habitat. Like Section 319 (h) grants, proposals for stream improvements within the Blanchard River watershed will receive special consideration.

8.5.7 Ohio Department of Natural Resources

The Ohio Department of Natural Resources (Ohio DNR) works to protect land and water resources throughout Ohio. A specific objective in regards to water resources is to *"Lead in the development and implementation of stream and wetlands conservation initiatives, applying advanced science, technology and research to restore and protect stream and wetlands habitats"* (Ohio DNR web site). This commitment attests that the Ohio DNR will be a reliable partner in addressing causes and sources of impairment in the Blanchard River watershed.

The following are programs within the Ohio DNR that are particularly instrumental in protecting and improving water resources within the Blanchard River watershed.

Pollution Abatement Program

Under Ohio's Pollution Abatement Rules (OAC 1501), the Ohio DNR is required to respond to written and non-written complaints regarding agricultural pollution. As defined by OAC 1501, agricultural pollution is the "failure to use management or conservation practices in farming or silvicultural operations to abate wind or water erosion of the soil or to abate the degradation of waters of the state by animal waste or soil sediment including substances attached thereto." In cooperation with SWCDs, an investigation is begun within 5 days of receipt of the complaint and a Pollution Investigation Report (PIR) is generated within 10 days. Resource management specialists from Ohio DNR within the Division of Soil and Water Conservation (DSWC) typically become involved with pollution abatement cases in their respective areas of the state.

If it is determined necessary, an operation and management plan will generated to abate the pollution. This plan is to be approved by the SWCD or Ohio DNR and implemented by the landowner. Cost share funding may be available to assist producers in implementing the appropriate management practices to abate the pollution problems and such practices may be phased in if necessary. If a landowner fails to take corrective action within the required timeframe, the Chief of the Division of Soil and Water Conservation (Ohio DNR) may issue an order such that failure to comply is a first degree misdemeanor. This program will provide safeguards against chronic problems that lead to the degradation of water quality within the Blanchard River watershed.

SWCD Program

Ohio DNR-DSWC has a cooperative working agreement with the Soil and Water Conservation Districts throughout Ohio and the NRCS. According to the agreement, Ohio DNR-DSWC is responsible to "provide leadership to Districts in strategic planning, technical assistance, fiscal management, staffing, and administering District programs." The Division also provides "training and technical assistance to District supervisors and personnel in their duties, responsibilities, and authorities." Program Specialists from Ohio DNR work with the SWCDs to identify program needs and training opportunities. Ohio DNR also ensures that program standards and technical specifications are available to SWCDs and NRCS personnel. State matching dollars from the Ohio DNR constitute roughly half of the annual operating budgets of SWCDs.

Through the partnership established by the working agreement and their history of collaboration, Ohio DNR can communicate the goals and recommendations highlighted in this TMDL to SWCDs and provide guidance to actively promote conservation efforts that are consistent with those goals.

8.5.8 Agricultural services and programs

Local SWCD, NRCS, and Farm Service Agency (FSA) offices often work to serve the county's agricultural community. Staffs from these offices establish working relationships with private landowners and operators within their county, which are often based on trust and cooperation.

SWCD and NRCS staffs are trained to provide sound conservation advice and technical assistance (based on standard practices) to landowners and operators as they manage and work the land. Sediment and erosion control and water quality protections make up a large component of the mission of their work. SWCD and NRCS activities also include outreach and education in order to promote stewardship and conservation of natural resources. The close working relationships that SWCD and NRCS staffs typically have with local land owners and producers make them well suited for promoting both widely-used conservation practices as well as some that are more innovative.

Federal Farm Bill programs are administered by the local NRCS and FSA offices. NRCS is responsible for the Environmental Quality Incentives Program (EQIP), while FSA is responsible for set-aside programs such as the Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), and the Wetland Reserve Program (WRP).

Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) is an incentive-based, voluntary program designed to increase the use of agriculturally-related best management and conservation practices. EQIP is available to operators throughout the entire Blanchard River watershed, irrespective of whether they own or rent the land that they farm. Through this program, operators receive cost share and/or incentive payments for employing conservation management practices. Contracts are five years in length.

Eligible conservation practices cover broad categories such as nutrient and pesticide management, conservation tillage, conservation crop rotation, cover cropping, manure management and storage, pesticide and fertilizer handling facilities, livestock fencing, pastureland management, and drainage water management, among others. However, funding for these practices is competitive and limited to the allocations made to any respective county in Ohio. Each county in receives a minimum of $100,000 per year and may receive more depending on state priorities for that year. More information on this program is available on the NRCS website at **www.nrcs.usda.gov**.

Conservation Reserve Program and Wetland Reserve Program

The Conservation Reserve and Wetland Reserve Programs (CRP and WRP, respectively) are set aside programs much like the Conservation Reserve Enhancement Program (CREP, see below), which is the enhanced version of CRP. The goals of these programs are to protect environmentally sensitive lands (e.g., highly erodible soils) and improve water quality and wildlife habitat.

Set-aside programs are voluntary and incentive-based and provide compensation to farmers for establishing and maintaining buffers, wetlands, grasslands or woodlands on land that would otherwise be used for agricultural production. Compensation is restricted to the timeframe established in the contract agreement. Incentive payments for these two programs are lower than the enhanced versions (i.e., CREP and WREP), which are limited to areas that have been approved by the USDA for the additional funding. These programs can assist in creating land use changes that improve water resource quality in the Blanchard River watershed.

Ohio Lake Erie Conservation Reserve Enhancement Program

CREP is a voluntary program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water. These conservation practices will target environmentally sensitive areas in the Lake Erie Watershed to reduce sediments and nutrients, prevent water pollution and minimize the risk of flooding and enhance wildlife habitat. The Lake Erie CREP is available in 27 counties that includes; Allen, Ashland, Auglaize, Crawford, Defiance, Erie, Fulton, Hancock, Hardin, Henry, Huron, Lucas, Lorain, Marion, Medina, Mercer, Ottawa, Paulding, Putnam, Richland, Sandusky, Seneca, Shelby, Van Wert, Williams, Wood and Wyandot. The entire Blanchard River falls within the program.

The Ohio Lake Erie CREP officially began in May of 2001. There are no acreage limits per county, so it is hard to predict the extent at which the program's conservation practices will be installed in any given area. The program will run on a continuous basis, meaning eligible land may be enrolled at any time until 67,000 acres have been enrolled or until funding expires, whichever comes first. Currently, 25,500 acres are enrolled in the program. With the changes in this amendment, farmers and landowners will have thirteen different Lake Erie CREP practices to choose from, including grass filter strips, wetlands, riparian buffers and develop wildlife habitats. The cleaner watered filtered through the streamside buffers will directly benefit landowners, farmers, aquatic and upland wildlife, as well as help maintain the lucrative Great Lakes tourism and water sports economy. Information for this program is available on the web **http://www.dnr.state.oh.us/soilandwater/programs/crep/lecrep/tabid/8867/Default.aspx**

8.5.9 Extension and development services

Each county in Ohio has an extension agent dedicated to agricultural and natural resource issues. The primary purpose of extension is to disseminate up-to-date science and technology so it can be applied for the betterment of the environment and society. Like SWCD and NRCS staff, extension agents provide technical advice to landowners and operators and often develop strong relationships with the local community. Local extension agents are particularly well suited for promoting innovative conservation measures that have not yet been established in the standard practices developed by NRCS.

The Maumee Valley Resource Conservation and Development Service (RC&D) works to facilitate sustainable uses of natural and economic resources. For more information, see **http://www.oh.nrcs.usda.gov/programs/RCD/maumeevalleyhome.html**. RC&Ds are non-profit organizations that receive technical support from the NRCS. The Maumee Valley RC&D is available to the public for assistance in developing water quality improvements initiatives in the Blanchard River watershed.

8.5.10 Agricultural organizations and programs

Agricultural organizations are working to address water quality problems associated with traditional farming practices. The Ohio Farm Bureau Federation (OFBF) seeks to improve water quality through the employment of economically sound conservation management practices (**http://www.ofbf.org/**). In order to pursue this mission, OFBF initiated programs aimed at engaging producers in voluntary water quality protection and improvement efforts. At the local level county Farm Bureau Public Policy Action Teams have the opportunity to administer OFBF programs related to environmental quality. The Public Policy Action Team leader works with the county's Organizational Director, who is a staff member of the OFBF, to implement program initiatives.

OFBF's Agricultural Watershed Awareness and Resource Evaluation (AWARE) program promotes water quality monitoring and education so that producers have more information when making resource conservation decisions regarding their operations. In collaboration with other conservation and commodity organizations OFBF led the development of a producer self-assessment program designed to evaluate the potential for off-site environmental impact and develop strategies to reduce those risks. OFBF also offers assistance to producers to better understand and comply with new and existing environmental regulations.

To help Ohio's livestock, poultry and equine producers identify and address key management issues affecting environmental quality, the Ohio Livestock Coalition (OLC) developed the Livestock Environmental Assurance Program (LEAP). LEAP is a voluntary and confidential environmental assurance program which provides producers the opportunity to take a proactive approach in blending sound production economics with concern about environmental quality. LEAP helps producers profitably manage environmental challenges that are critically important to the success of the business, and effectively assess how farmstead practices affect water quality.

9.0 PROCESS FOR EVALUATION AND REVISION

The effectiveness of actions implemented based on the TMDL recommendations should be validated through ongoing monitoring and evaluation. Information derived from water quality analyses can guide changes to the implementation strategy to more effectively reach the TMDL goals. Additionally, monitoring is required to determine if and when formerly impaired segments meet applicable water quality standards.

This section of the report provides a general strategy for continued monitoring and evaluation and mentions parties who can potentially carry out such work. It highlights past efforts and those planned to be carried out in the future by the Ohio EPA and entities external to the agency. It also outlines a process by which changes to the implementation strategy can be made if needed.

Evaluation and analyses
Aquatic life and recreational uses are impaired in the watershed, so monitoring that evaluates the river system with respect to these uses is a priority to the Ohio EPA. The degree of impairment of aquatic life use is exclusively determined through the analysis of biological monitoring data. Recreational use impairment is determined through bacteria counts from water quality samples. Ambient conditions causing impairment include high phosphorus and sediment concentrations (or loads) and degraded habitat. This report sets target values for these parameters such as instream concentrations and loads which should also be measured through ongoing monitoring.

A serious effort should be made to determine if and to what degree the recommended implementation actions have been carried out. This should occur within an appropriate timeframe following the completion of this TMDL report and occur prior to measuring the biological community, water quality or habitat.

Past and ongoing water resource evaluation
The Ohio EPA has conducted water quality surveys within the Blanchard River watershed in 1999, and in 2005 and 2006. The Ohio EPA is scheduled to re-assess biological, water quality, habitat, and sediment chemistry monitoring in the six HUC-11 assessment units and the large river unit in 2020 (Ohio EPA, 2008).

Past and continued monitoring in the watershed includes analysis of raw water by the Findlay and Ottawa water treatment departments and monitoring of water supply reservoirs by Ohio EPA. Effluent quality is monitored by the municipal or commercial WWTPs in the watershed. These data are included in the monthly operating reports (MORs) that are submitted to the Ohio EPA by these facilities.

The City of Findlay has recently begun a storm water sampling program to support its Phase 2 Storm Water Pollution Prevention Program. Institutions that have actively monitored water resources in the Blanchard River watershed for either research-based initiatives or educational purposes are University of Findlay, Owens Community College and local high schools. The USGS also maintains a flow gaging station at CR 140 in Findlay, and several new flow gauges installed during 2007 at various locations in Hancock County to monitor stream flow during high storm events.

Potential and future evaluation

BRWP plans to begin a volunteer monitoring program in 2008, and the watershed leadership is currently developing a plan to train volunteers and find funding for equipment and sample analysis to sustain the program. The chairperson also intends to become a qualified data collector under the credible data program implemented by Ohio EPA.

Recommended approach for gathering and using available data

Early communication should take place between the Ohio EPA and the potential collaborators mentioned above to discuss research interests and objectives. Through such communication, areas of overlap should be identified and ways to make all parties' research efforts more efficient should be discussed. Ultimately, important questions can be addressed by working collectively and through pooling resources, knowledge, and data.

Citizen monitoring of the watershed will also prove useful. Tools such as the use of sediment sticks and the ODNR stream survey method, or other methods recommended by Environmental Defense will help to further increase our understanding of the Blanchard River watershed. In addition to providing data, more frequent stream observations can help to alert Ohio EPA and other regulatory agencies to observed water quality impacts, enabling quicker response times to potential impacts.

Revision to the implementation approach

An adaptive management approach will be taken in the Blanchard River watershed. Adaptive management is recognized as a viable strategy for managing natural resources (Baydack et al., 1999) and this approach is applied on federally owned lands. An adaptive management approach allows for changes in the management strategy if environmental indicators suggest that the current strategy is inadequate or ineffective. The recommendations put forth for the Blanchard River watershed largely center on improving failing HSTS (by repair or connecting to sewer systems), improving instream habitat, increasing floodplain connectivity, removing dams and the abatement of nutrients loads. 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 would be initiated. The Ohio EPA would initiate the revision if no other parties wish to do so.

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