CHAPTER 1 - WATERSHED DESCRIPTION

1.1 Watershed Management Planning

The goal of the Belle River Watershed Management Plan (WMP) is to identify and prioritize the sources of water quality pollutants and threats to the watershed's designated uses. Citizens, non-profit agencies, and local units of government that have jurisdiction over land use and stormwater management in the watershed formed the Belle River Watershed Advisory Group (WAG) to assist with the development of this Plan.

In 2009, the St. Clair County Health Department (SCCHD) and Columbus Township developed a joint operating agreement wherein the Belle River Watershed Advisory Group was formed. Two years later, in 2011 with the Watershed Advisory Group's input, the SCCHD was successful in receiving a grant through the Michigan Department of Environment Quality's (MDEQ) Nonpoint Source Program to develop the Belle River Watershed Management Plan. This project was funded under Section 319 of the Federal Clean Water Act.

This WMP outlines the actions necessary to improve water quality and to protect, enhance, and restore the Belle River, its tributaries, and its headwaters. The WMP can help guide landowners and governmental agencies to fulfill their goals for water resources protection. Watershed planning is a process and the WMP needs to be consistently reviewed, evaluated, and revised as the local stakeholders move through the process of WMP implementation.

1.2 Geographical Scope

The Belle River Watershed covers 227 square miles in parts of Lapeer, St. Clair, Oakland, and Macomb Counties (Figure 1.1) and has 150 miles of rivers, streams and drains (Knutilla, 1969). The Belle River, 73.5 miles in length, flows southeast from Lapeer County through St. Clair County and part of northeastern Macomb County ultimately joining the St. Clair River in Marine City. St. Clair County contains the most watershed area out of the four counties (Lapeer: 80.79 sq. miles; Oakland: 0.04 sq. miles; Macomb: 23.79 sq. miles; St. Clair: 122.61 sq. miles). The Belle River is the southernmost U.S. tributary to the St. Clair River Area of Concern. The watershed borders the Pine River Watershed in St. Clair County to the north and the Clinton River (Macomb County) and Anchor Bay Watersheds (Macomb and St. Clair Counties) to the south.

The watershed of the Belle River is relatively long and narrow, particularly in the downstream half where the river flows through northeast Macomb County and central St. Clair County. The Belle River basin is typically less than 10 miles wide and often only 5 miles wide in the mid-to-lower portions; therefore, many of the tributaries are short with intermittent flow. The landscape within the Belle River Watershed is dominated by agriculture with thin, often interrupted forested riparian buffers along the main stem of the river. The majority of tributaries feeding the Belle River flow through agricultural land and have historically been straightened and dredged.

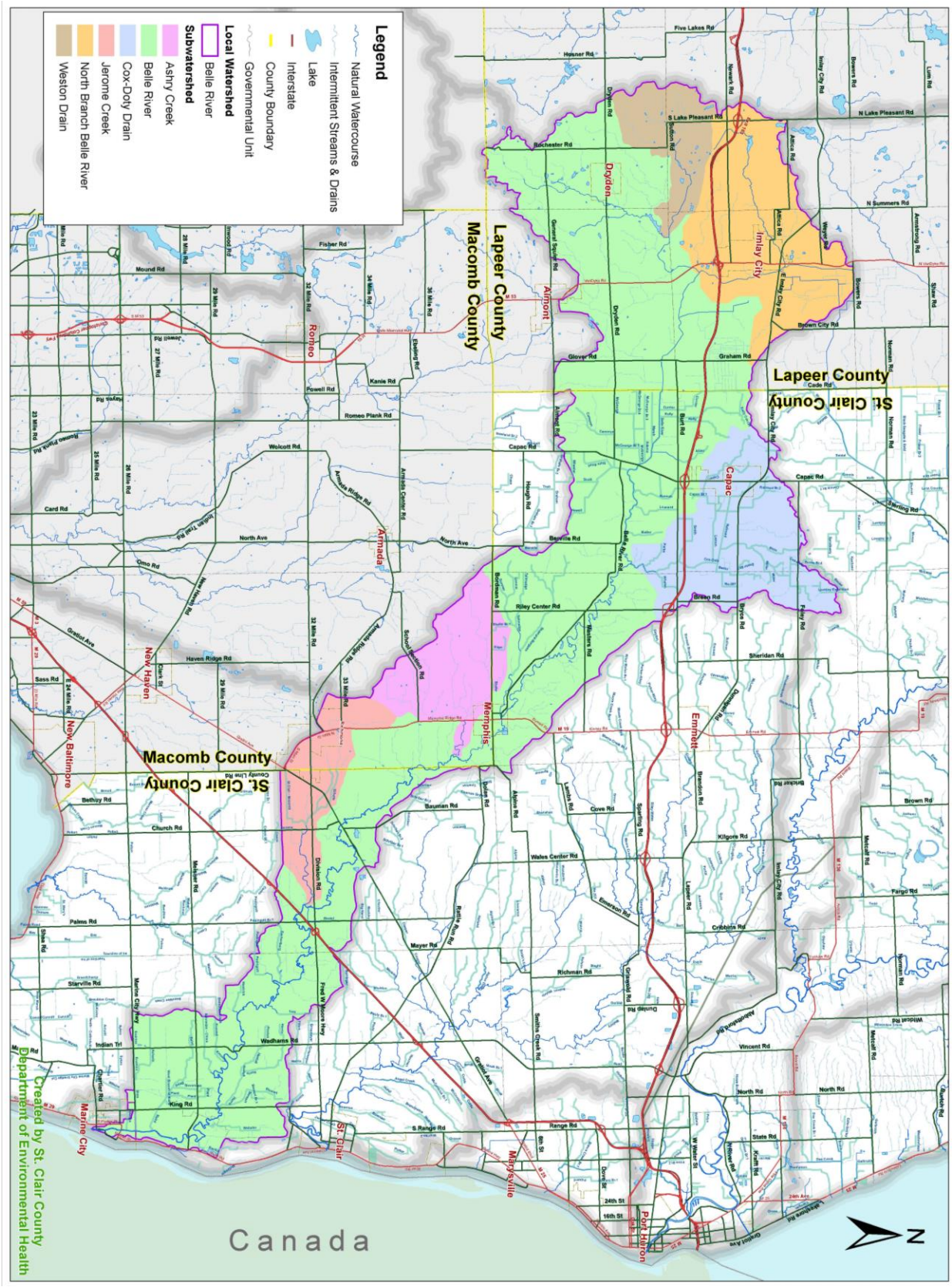

Figure 1.1 Overview of the Belle River Watershed

The North Branch of the Belle River drains out of Long Lake in Attica Township in southeast Lapeer County. It flows from the southwest to the northeast through Lions Park, near the southwest corner of Attica Road and Blacks Corners Road in Imlay City. The main branch of the Belle River flows north and east after starting in a marshy area near the boundary of Lapeer County and Oakland County. The river is joined by the North Branch in western St. Clair County and flows south and east into St. Clair County, it passes through a northeast corner of Macomb County, and returns to St. Clair County reaching the outlet at Marine City.

Based on 2009 imagery, land uses are 54% agricultural, 25% forested, 8% residential, 4% low intensity, 8% wetlands, 7.5% wooded, and 5% other. Census data from 2000 shows 687 acres of urbanized area in Marine City, East China and China Townships and 3,030 acres of urbanized clusters in the cities of Imlay City, Almont and Richmond.

1.2.1 River Zones

Schumm (1977) developed a conceptual model of a river (fluvial) system that described sediment processes in three parts (Figure 1.2). This model applies to the Belle River and provides a useful way to broadly summarize the existing physical, water quality, and ecological conditions. In terms of sediment, the upper headwaters (Zone 1) tend to produce sediment, the middle (Zone 2) moves or transfers sediment downstream, and the lower (Zone 3) area deposits sediment. The existing conditions, river processes, and sources and causes of pollutants and stressors differ in each zone.

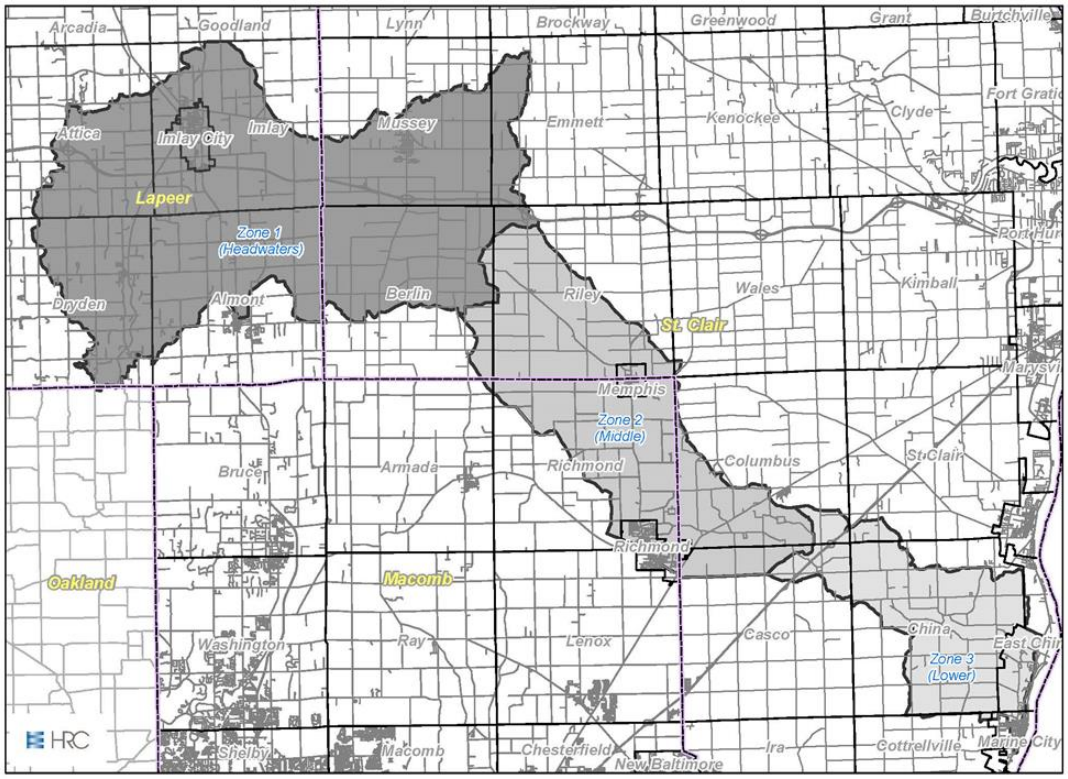

Figure 1.2 Belle River system by zones

Zone 1: This zone, the headwaters of the Belle River located in Lapeer County and western St. Clair County, has the most erosion activity based on erosion assessments completed during the development of this plan, but much of the erosion is from upland sources rather than channel erosion. Over 20 miles of the main branch of the Belle River and North Branch Belle River near Imlay City have significant and continuing nonattainment of dissolved oxygen standards due to high nutrient and fine sediment levels. Here, the Belle River and its tributaries are mostly channelized and deeply incised due to dredging. These over-wide channels accumulate silt and other debris such as leaf litter and small woody material which then are flushed downstream during rain events and redeposit after a storm ends. Many tributaries lack summertime base flow due to ditching and tile drainage. The aquatic and riparian habitat is typically degraded and ecological monitoring indicates low diversity and pollutant tolerant species. However, there are a few tributaries, such as the upper North Branch, that are of high quality or have good restoration potential. (Figure 1.3)

Figure 1.3 North Branch of the Belle River in Zone 1, Lions Park in Imlay City

Zone 2: The middle zone, located in central St. Clair County and a small portion of Macomb County, operates like a conveyor belt to move sand and gravel towards the St. Clair River (Figure 1.4). This zone has moderate slopes, a large gravel and cobble bottom, and the highest restoration potential. This zone is moderately meandering with a wide floodplain and forested buffer area. The gravel bottom and pools are subject to siltation by fine materials from Zone 1, hillslope failures, over-widening, and localized bank erosion. Where the river widens (typically due to manmade activities), it is prone to channel bar formation, pool filling, and logjams. Land use is mostly agricultural and most tributaries are short due to the narrow drainage basin in this zone. The lower parts of Ashery and Jerome Creeks, the two largest tributaries in this zone, are unstable and deeply incised due to channelized headwaters and historic dredging. Ecological monitoring generally indicates excellent species diversity with rare fish, mussels, wildlife, and aquatic insects. Degraded areas within this zone are localized with excellent recovery potential.

Figure 1.4 Belle River in Zone 2, Columbus Township Roadside Park

Zone 3: The lower zone, located in a suburban area at the mouth (Figure 1.5), is naturally prone to sediment deposition. The river mouth was a delta at the St. Clair River before settlement and dredging by the U.S. Army Corps of Engineers to improve navigable waters in 1902 (USACE, 1902). The river tends to become more incised with higher banks in this zone. A mill dam at Indianhead Trail was removed in 1967 and the banks are much higher in this area. Bank erosion is more common than in other zones and logjam densities increase due to bank collapses. The system-wide river instability problems in this zone suggest that it would be costly to restore. Water quality and ecological conditions are indicators of the degraded health of the watershed in this zone. Fine sediment, nutrient, dissolved solids, chloride (road salt), herbicides, and temperatures are periodically high and vary with flow. Ecological monitoring indicates fair-to-good conditions. However, remnant mussel populations and good fish diversity in this zone indicate good restoration potential if water quality throughout the watershed can be improved.

Figure 1.5 Belle River in Zone 3, Marine City

1.2.2 Subwatersheds

For the purposes of land use and hydrologic analysis, the Belle River Watershed, based on drainage area and major watercourse in each location, is divided into 24 subwatersheds (Figure 1.6; Table 1.1) as defined in the Belle River Watershed Hydrologic Study in 2012 (Fongers, 2012).

Zone 1: Subwatershed 1 and 3 are drains in the headwaters—Talmadge Drain and Weston Drain, respectively—that flow into the main stem of the Belle River. The upstream portion of Subwatershed 2 contains the headwaters of the Belle River. Subwatershed 5 and 6 contain the headwaters of the North Branch Belle River. Subwatershed 7 contains the North Branch and most of Imlay City; the North Branch meets the main stem of the Belle River at the subwatershed boundary. The river flows through Subwatershed 8, 9, 10, and 11 with various drains and tributaries flowing into the river. Near the boundary of Subwatershed 9, the river flows from Lapeer County into St. Clair County. The Cox County Drain begins in Subwatershed 13 and flows through Subwatershed 14 and 15 until meeting the Belle River in Subwatershed 12. Surveys conducted in 2002 showed that DO standard nonattainment continues to occur in the Belle and North Branch Belle Rivers near and below Imlay City. Subwatersheds 1, 2, 3 and parts of subwatersheds 4, 5, 6, 8, 13, and 16 are listed as source locations to the DO TMDL areas.

Zone 2: The river meanders through Subwatershed 16 with small streams flowing into the main stem. Sage Creek and the Sharrad-Burgess Drain originate in Subwatershed 17 and meet the Belle River at the Subwatershed 18 upstream boundary. Subwatershed 19, located in Macomb County, contains the major tributary of Ashery Creek. Subwatershed 18 and 19 also contain the City of Memphis.

Zone 3: The city of Richmond is near the headwaters of Jerome Creek in Subwatershed 21. Jerome Creek and the Belle River meet at the downstream boundary of Subwatershed 20. The Belle River flows through Subwatershed 22, 23, and 24 before meeting the St. Clair River at Marine City.

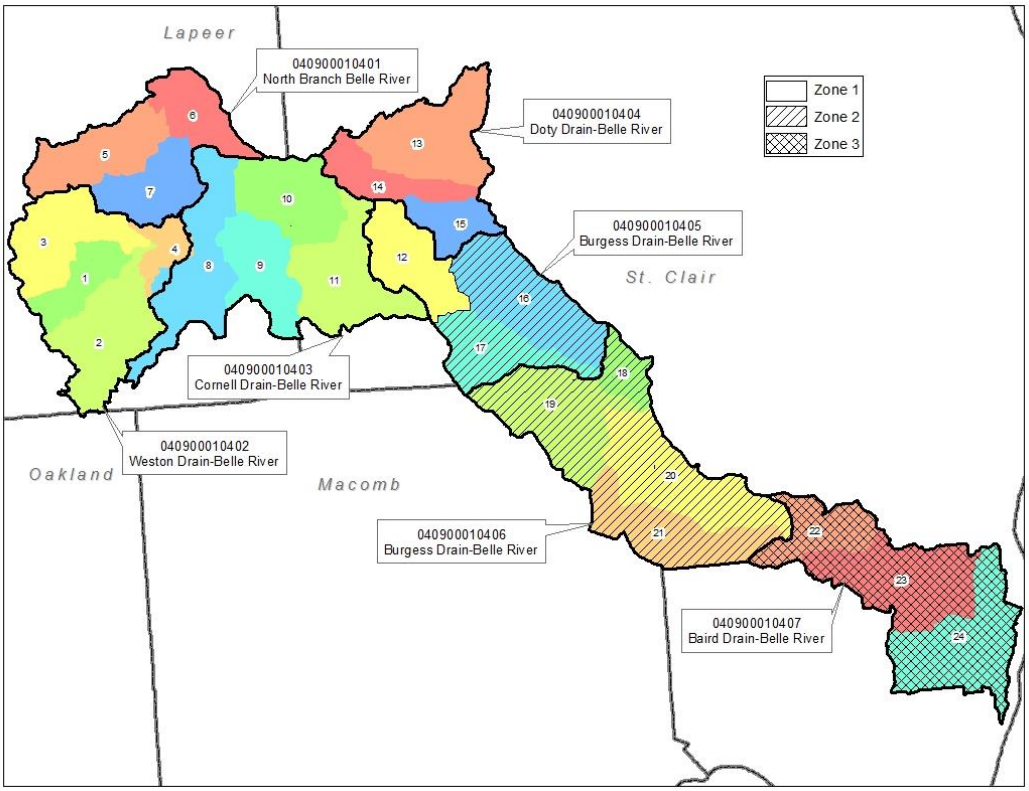

Figure 1.6 Belle River subwatersheds

Table 1.1Belle River subwatersheds

Subwatershed	Watercourse	Outlet	Area (mi^2)	HUC-12	Zone
1	Talmadge Drain	Confluence with Belle River	5.1	040900010402	1
2	Belle River	Confluence with Weston Drain	12.33	040900010402	
3	Weston Drain	Confluence with Belle River	10.53	040900010402	
4	Belle River	Confluence with North Branch	3.19	040900010402	
5	N. Branch Belle River	Van Dyke Road	9.49	040900010401	
6	N. Branch Belle River	USGS Gage #04160570	6.6	040900010401	
7	N. Branch Belle River	Confluence with Belle River	7.64	040900010401	
8	Belle River	Below Corneil Drain	12.98	040900010403	
9	Belle River	County Line	9.67	040900010403	
10	Belle River	Below tributary from the north	9.69	040900010403	
11	Belle River	Below tributary from the southwest	11.89	040900010403	
12	Belle River	Confluence with Cox Doty Drain	8.75	040900010405	
13	Cox Doty Drain	Below Beehr Drain	12.45	040900010404	
14	Cox Doty Drain	Koehn Road	6.08	040900010404	
15	Cox Doty Drain	Confluence with Belle River	4.59	040900010404	
16	Belle River	USGS Gage #04160600	13.64	040900010405	2
17	Sage Creek	Confluence with Belle River	7.91	040900010405	
18	Belle River	Confluence with Ashery Creek	3.47	040900010406	
19	Ashery Creek	Confluence with Belle River	13.47	040900010406	
20	Belle River	Confluence with Jerome Creek	14.22	040900010406	
21	Jerome Creek	Confluence with Belle River	10.64	040900010406	
22	Belle River	St. Clair Highway	6.66	040900010407	3
23	Belle River	USGS Gage #04160625	13.65	040900010407	
24	Belle River	Mouth	13.8	040900010407	

1.2.3 Belle River Intercounty Drain

Much of the North Branch Belle River and the headwaters of the Belle River are part of a large Intercounty Drain system (Figure 1.7). Since this is a drain that flows between two counties, pursuant to the Michigan Drain Code it is managed by an Intercounty Drainage Board, which consists of the Lapeer County Drain Commissioner, the St. Clair County Drain Commissioner, and a chairperson from the Michigan Department of Agriculture and Rural Development. All work that is done on the Intercounty Drain is assessed by the Drain Commissioners to all lands and municipalities in the drainage district. The Belle River Intercounty Drain (ICD) extends approximately 16.1 miles from the North Branch of the

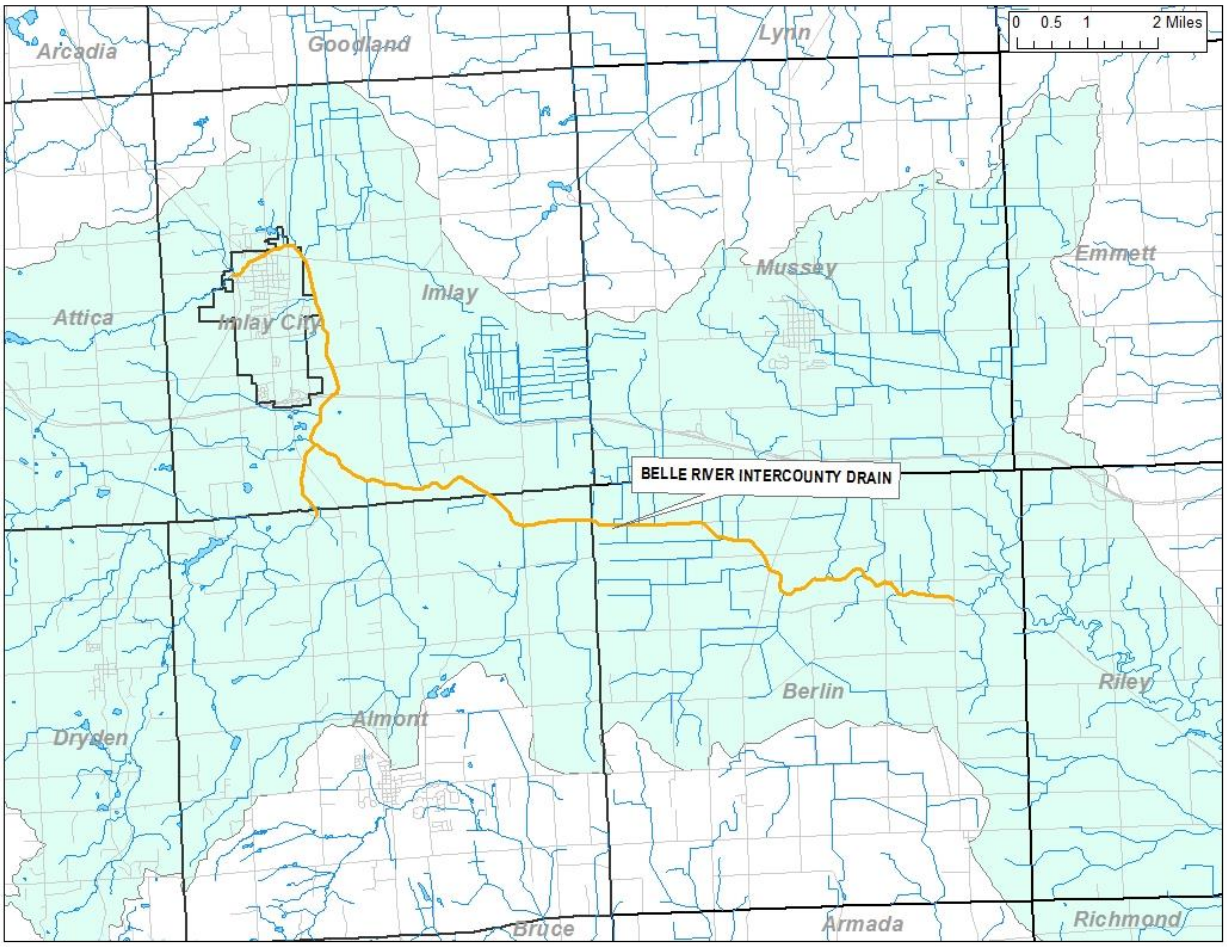

Figure 1.7 The Belle River Intercounty Drain

Belle River at N. Blacks Corners Road in Imlay City in Lapeer County downstream to Berville Road in Berlin Township in St. Clair County. This area of the watershed, covering approximately 73 square miles of drainage area, is made up of the headwater tributaries and is mostly channelized to support agricultural land use. According to historic files, the ICD has had problems over time with localized erosion, under-sized road crossings, cattle grazing the banks, brush spraying, debris dumping, siltation, aquatic macrophyte growth, and beaver activity. The following provides a detailed timeline of the Belle River ICD beginning in 1900.

Snapshot of ICD History

- 1900: The Belle River ICD was established.
- 1901: $18,200 was loaned for project construction.
- 1916: Application to deepen, widen, straighten, or extend the drain. Work completed in 1918.
- 1920: Application to extend the drain to the Hunt Drain. Work completed in 1922.
- 1944: The entire Belle River ICD was dredged following a 1943 flood.
- 1968: A report entitled the *Belle River Study* was completed.
- 1973: Lapeer County residents petitioned to have the Belle River ICD dredged following a January flood.
- 1975: April flooding occurred along the Belle River.
- 1978: U.S. Soil Conservation Service prepared a study of the Belle River ICD. The recommendations were not implemented due to a lack of local support.
- 1980: Extensive flooding occurred in the fall.
- 1981: The Belle River ICD was petitioned for maintenance and the project was found to be 'practical' in 1982. Bridges were replaced at Berville and Miller Roads.
- 1983: The Belle River ICD Board approved $417,000 for dredging, widening, and debris removal along 6.4 miles of the drain from Imlay City to Glover Road in Lapeer County. In November, the ICDB decided to extend the work downstream to Schultz Road (a total of 8 miles). The Michigan Youth Corps conducted a 4 week work program to cut brush and remove fallen trees in the Belle River ICD from Terry Road (west of Capac Road) to Schultz Road.
- 1984: Maintenance work was conducted along 4.5 miles of drain, from Schultz Road to Berville Road, in Berlin Township.
- 2003: The banks of the Belle River ICD were generally stable, but the drain had problems with mid-channel bars such as at Sperry Road. Fallen trees were removed.
- 2004: Maintenance dredging was completed.
- 2005: Flooding complaints at Berville Road in Berlin Township (SCC). Wood was removed downstream of Berville Road.
- 2008: Wood removed from the Belle River ICD.

1.2.4 Topography

The Belle River basin has a relatively flat topography with glacial morainal features along the headwater areas and part of its boundaries. Morainal ridges extend in a north to south direction west of Richmond. Beach lines traverse the lower basin in a southwest to northeast direction (Knutilla, 1969).

Headwaters in the western part of the basin are steeper with coarser substrate, but rarely exceed 20 feet drop per mile. The longitudinal profile of the Belle River is somewhat "S-shaped" with a high gradient area of the main branch in the middle of the river. This high gradient reach is located between Riley Center Road and Gratiot Avenue (middle section of the river) and averages 8.4 feet of drop per mile. Most tributaries are small with gradients of 10 feet per mile or less. Figure 1.8 depicts a long profile of the topography of the Belle River.

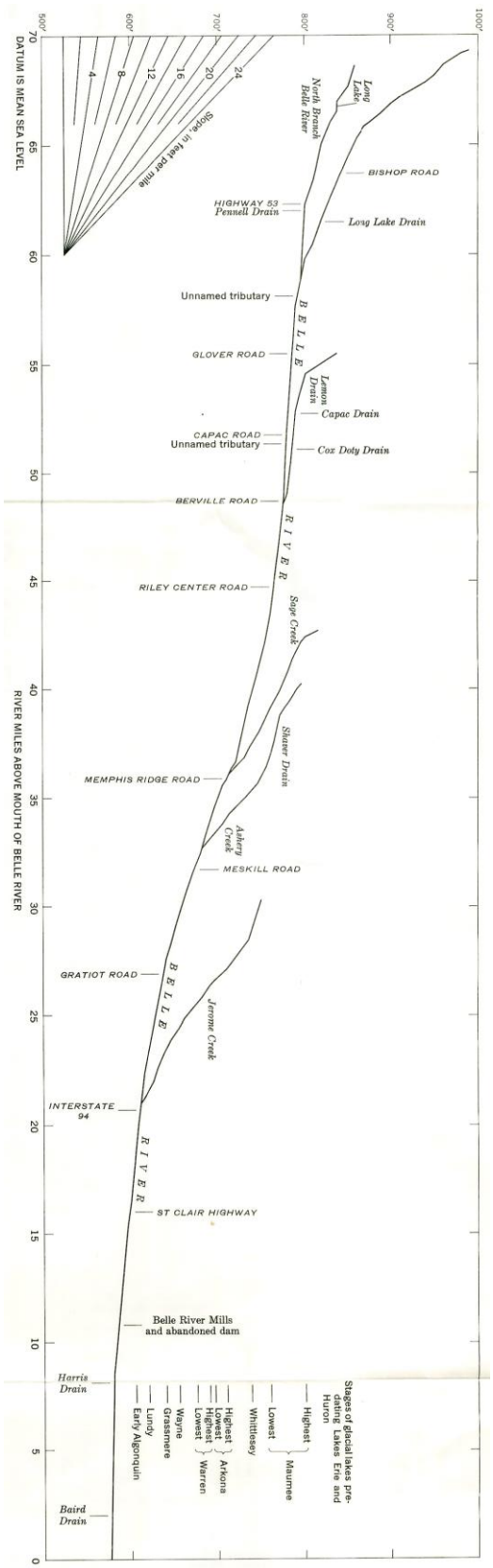

Figure 1.8 Long topographical profile of the Belle River

1.2.5 Soils

Soils in the northwestern portion of the Belle River basin consist of sand, loamy sand, sandy loam, silt loam, limy loam, clay, muck, and peat. Soils west of M-53 in Lapeer County are mostly well to somewhat poorly drained loamy soils in group B. Adjacent to the Belle River and east of M-53, the soils are very poorly drained muck soils in groups A, C, and D. In the central region, Zone 2, of the watershed, upland soils are mostly poorly drained, loamy soils in groups B, C, and D. Maps of the hydrologic soils groups are provided in Figure 1.9 with Table 1.2 as reference.

In the Belle River basin, approximately 75 feet of clay overlays glacial sand and gravel deposits (Apple and Reeves, 2007). The eastern part of St. Clair County consists of lacustrine deposits with lenses of sand and gravel closer to the St. Clair River. Most of the Belle River bottom, between Riley Center Road and Gratiot Avenue, consists of sand, gravel, and cobble alluvium over a hard till. Beneath the glacial drift are bedrock formations consisting mainly of sedimentary shale (Twenter, 1975).

The soil groups determine the runoff potential and infiltration rate of an area. For example, soil group A has a low runoff potential and a high infiltration rate when saturated, while soil group D has a high runoff potential and low infiltration rate when saturated. Areas with soil groups with high runoff potential are more likely to contribute stormwater runoff and increase peak flows, and these areas are typically not suitable for infiltration Best Management Practices (BMPs).

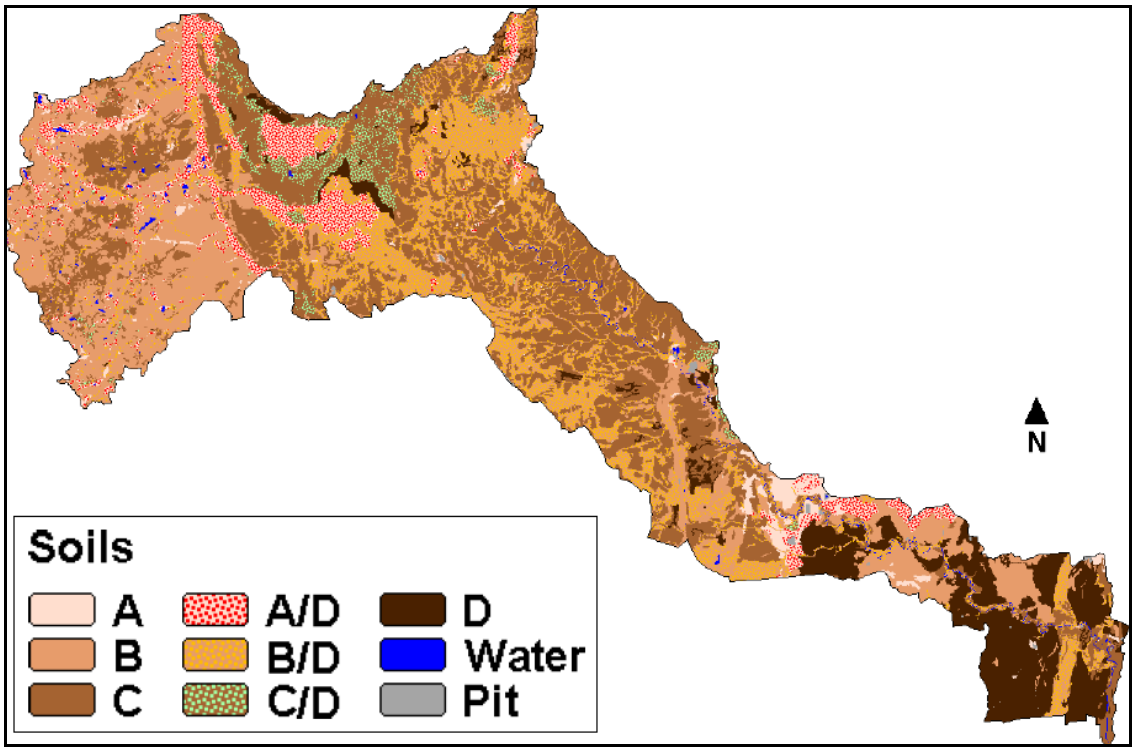

Figure 1.9 Soil hydrogroups in the Belle River Watershed

Table 1.2 Explanation of soil hydrogroups

Hydrologic Soil Group	Infiltration Rate when thoroughly wet	Description
A	High	• Sand • Gravelly sand
B	Moderate	• Moderately fine textured to moderately coarse textured soils
C	Slow	• Moderately fine textured to fine textured soils • Soils with a soil layer that impedes downward movement of water
D	Very Slow	• Clays • Soils with a clay layer near the surface • Soils with a permanent high water table

1.3 Hydrology

The Belle River begins in the wetlands south of Dryden in southeastern Lapeer County and flows in a generally southeasterly direction through the City of Memphis, which borders Macomb and St. Clair Counties, to discharge into the St. Clair River at Marine City (Exhibit 1 in Appendix B) (Figure 1.10). Along its route, the river is fed by many small creeks and agricultural drains, the largest ones being the North Branch Belle River which flows through Imlay City, the Lemon Drain in the Village of Capac, Ashery Creek located in Richmond Township south of Memphis, and Jerome Creek in the City of Richmond. Along its lower reaches, the river is entrenched 30 ft. below the surrounding countryside (Knutilla, 1969). The surficial geology of the basin is mainly glacial lakebed in the east and central parts and predominantly morainal features in the west (Knutilla, 1969). The North Branch drains out of Long Lake in Attica Township in southeast Lapeer County. Long Lake is fed by the Long Lake Drain which drains marshy areas to the south of the lake. Besides the Long Lake Drain, the North Branch of Belle River has several other county drains flowing into it. A detailed analysis of Belle River hydrology is provided in the MDEQ study in Appendix D.

Figure 1.10 Belle River circa 1900, Marine City (Source: Marine City Historical Society)

1.3.1 Dams and Barriers

Dams and barriers along a river pose issues with recreational use, fragmentation of habitat and restrict movement of fish. Major dams along the main stem of the Belle River have been removed for several decades. This allows migratory steelhead, suckers, and other fish from the St. Clair River to reach many of the headwaters to spawn (Table 1.3, Figure 1.11). The Memphis dam was removed in the 1950s and the Radike Dam was removed in 1967 (Figure 1.12). Legacy impacts, particularly localized streambank erosion and hillslope failures, exist at the site of the former Memphis Dam.

One private dam exists on the upper Belle River in Dryden, Lapeer County that, during the 500-year flows of 2008, overtopped the earthen embankment at a low point near Hall Road. The overtopping allegedly occurred because debris was blocking the primary spillway outlet (MDEQ, email, 2012). The dam received a permit in 2011 from the MDEQ to be reconstructed and now has adequate spillway capacity in order to pass the flood of record with adequate freeboard so that overtopping does not occur again.

Table 1.3 Existing and historic dams and hydraulic structures in the Belle River Watershed

Name	Tributary (Subwatershed)	Drainage Area (mi^2)	Latitude	Longitude	Description
Unnamed (above Walker Rd)	Indian Creek	3.5	42.981568	-83.133953	Unknown
Foltz Dam on Lady Lake	Weston Drain	n/a	42.971667	-83.091389	Dam modified and maintained in 2011
Memphis	Belle River	151	42.903571	-82.775609	**Removed** in 1950s – 45 ft wide spillway dam with 5 bays and 8 ft head
Unknown	Unnamed tributary (16)	0.2	42.933097	-82.809234	Farm pond
Belle River Golf & Country Club	Unnamed tributary (16)	0.6	42.929547	-82.816787	In-line irrigation pond
Rattle Run Golf Course	Eschenburg Drain (23)	1.0	42.796802	-82.599077	In-line irrigation pond
Radike	Belle River (23)	208	42.774771	-82.552171	**Removed** by county in 1967. Concrete and timber dam.
Rattle Run Golf Course	Eschenburg Drain (23)	1.05	42.796621	-82.595354	In-line irrigation pond

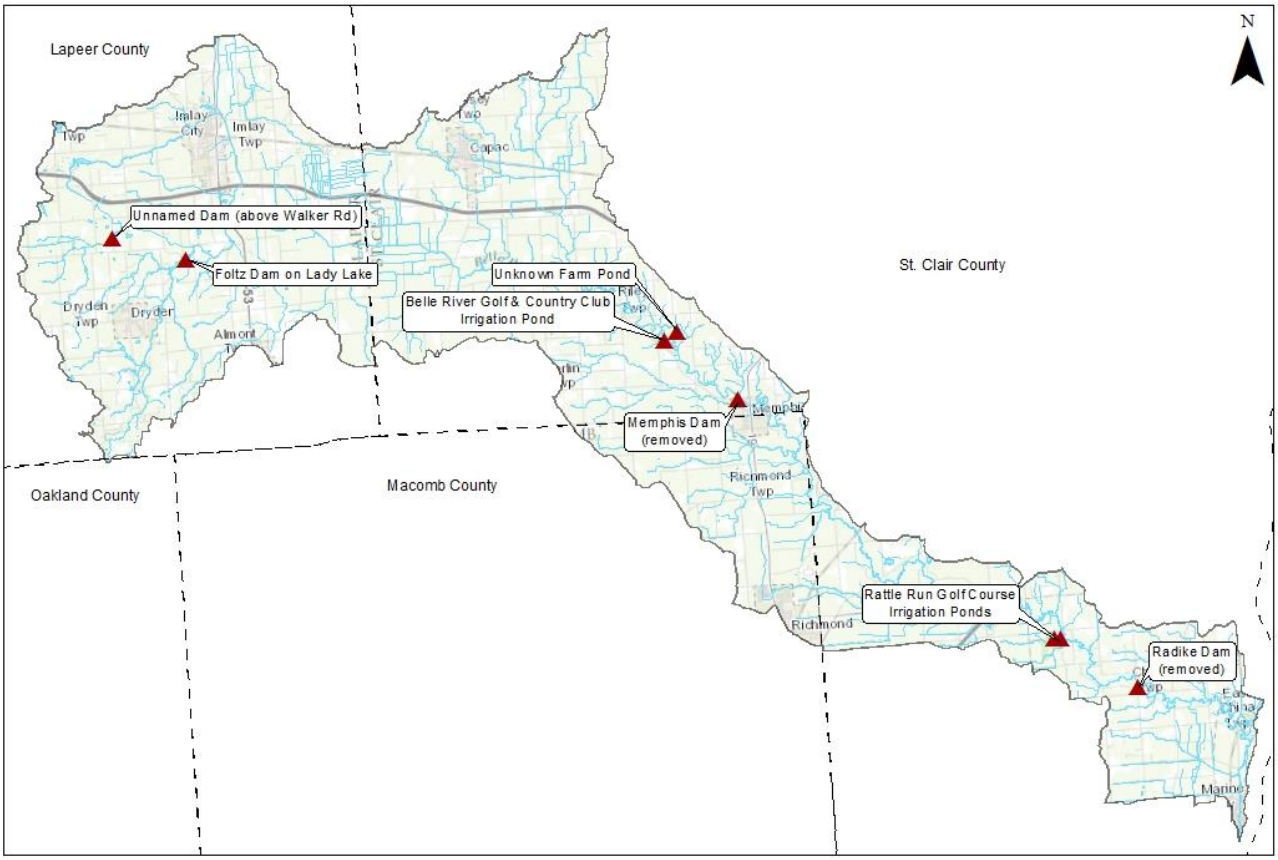

Figure 1.11 Map of existing and historic dams and hydraulic structures

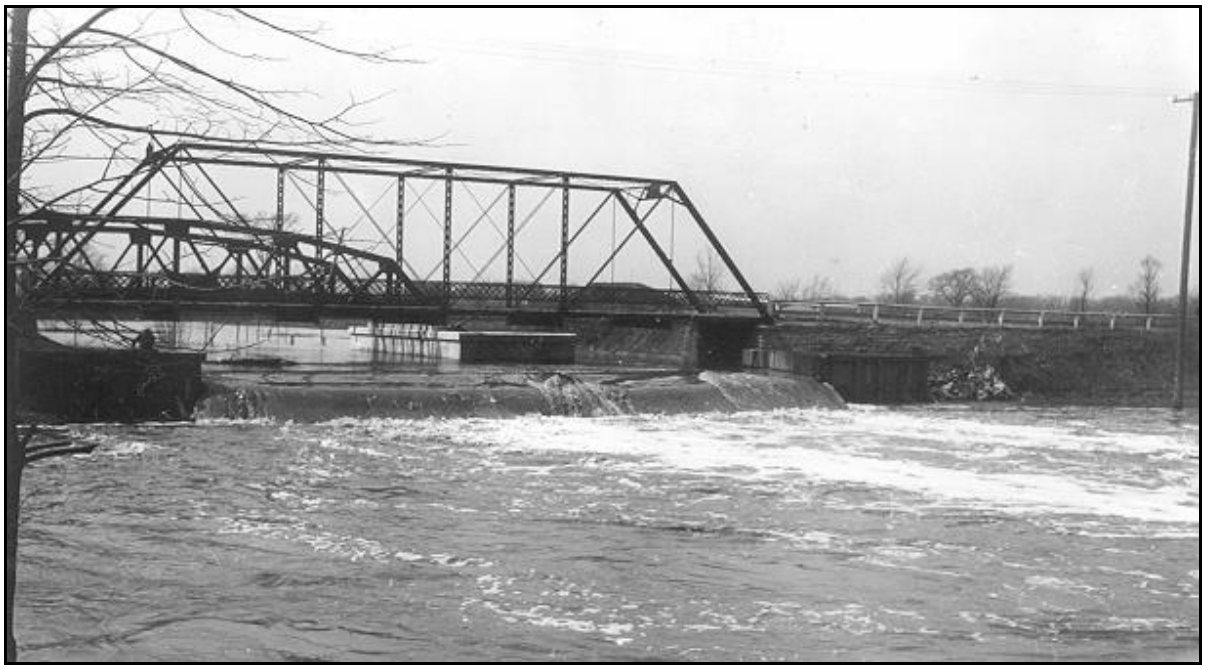

Figure 1.12 Former Radike Dam looking upstream at Indianhead Trail in 1937

1.3.2 Wetlands

Wetlands are increasingly appreciated for the functions, values, and ecosystem services that they provide to society. As a result of the recognition of the importance of wetlands, a variety of federal and state legislation has been enacted to protect these ecosystems. Michigan has lost more than half of its wetlands to land drainage and conversion to agricultural, suburban, and urban uses. Widespread wetland destruction has resulted in increased flood damages, increased soil erosion, degraded fisheries, degraded water quality, and losses of wildlife and recreational opportunities. Wetlands play an important role in the maintenance of good water quality.

To better understand the status and trends of wetland areas and their associated functions, the MDEQ conducted a Landscape Level Wetland Functional Assessment (LLWFA) in 2012 (Appendix E). The assessment compared pre-settlement conditions to current wetland conditions and estimated the number, size, and functions of the wetlands for each timeframe. Since pre-settlement, the Belle River Watershed has lost over 54,000 acres (79%) of its wetlands. Only 21% of original wetland acreage remains in the watershed (Figure 1.13). The loss of these ecosystems has negatively impacted many important functions that were provided by intact wetland areas (Table 1.4).

Figure 1.13 Existing wetland area near the N. Branch Belle River in Imlay City

Wetland alteration, degradation, and removal have led to a loss in the hydrological and ecological functional capacity of the watershed. The lost wetlands provided cleaner and cooler water through increased natural filtration of nutrients and pollutants and increased groundwater recharge, and they helped reduce flood levels and provided flood control. In addition, these lost wetlands provided important wildlife and fisheries habitat, often for threatened or endangered species.

Table 1.4 Predicted change in functional capacity due to loss of wetlands since pre-settlement

Function	Change in Functional Capacity
Flood water storage	-84%
Streamflow maintenance	-77%
Nutrient transformation	-68%
Sediment retention	-64%
Shoreline stabilization	-75%
Fish habitat	-86%
Stream shading	-74%
Amphibian habitat	-90%
Carbon sequestration	-66%
Ground water surface influence	-57%

Wetlands are considered essential to one or more parts of the life cycles of many fish. For example, northern pike utilize wetlands for spawning and nursery areas for their young (Page and Burr, 1991). Figure 1.14 illustrates wetlands that still provide fish habitat as of 2005 (green) and lost habitat (red). Historical wetland loss has caused an 86% loss in the functional capacity of wetlands to provide fish habitat in the Belle River watershed (Appendix E). The large loss of wetlands means that there is a major decrease in fish habitat, particularly for reproduction and feeding, for fish species in the Belle River Watershed.

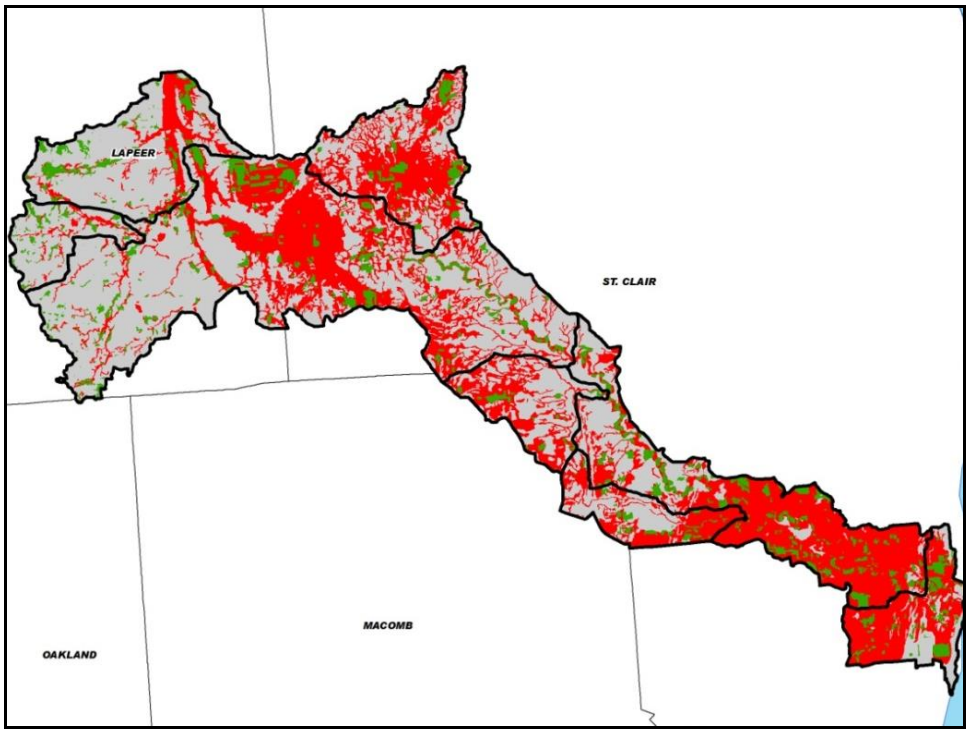

Figure 1.14 Pre-settlement vs. 2005 wetland areas providing fish habitat

1.3.3 Baseflows

River baseflows are considered the flows in a river that come from groundwater. Baseflows are the primary source of running water in streams during dry or drought conditions. This measure is important because flow is a major determinant of physical habitat in streams which in turn determines biotic composition. Low flows can lead to a loss of aquatic connectivity, warm water temperatures, changes in species composition, and decreased recreational opportunities. Summertime baseflows are highly impacted and degraded in the Belle River (Figure 1.15). Since the 1960s, agricultural land reverted to open space, woods, or wetland and flows began to recover. However, as commodity prices have increased in recent years, agricultural land uses have experienced regrowth. Conventional agricultural practices impact river baseflows due to tile drainage, irrigation, soil compaction, ditching, channelization, and loss of forest and wetland cover. These practices affect baseflows by altering groundwater recharge rates, diverting water from instream uses (e.g. water for irrigation, consumptive uses by crops), increasing conveyance, and impacting natural infiltration areas (forests and wetlands). Other factors contributing to lower baseflows include increased impervious areas such as roofs, roads and parking lots. Impervious cover continues to remain relatively low in the Belle River Watershed, but, can cause localized problems in some areas of the watershed. If development increases in the future, then a loss of pervious surfaces may further alter baseflows.

Figure 1.15 Butler Drain (Berlin Twp. between Sperry & Berville Rd.) with no flow (Source: SCCDC)

Determining a reasonable target for low flow conditions is important in order to set preliminary management goals. Flow requirements increase with drainage area along the Belle River. The Tennant method is the most commonly used hydrologic method and considers wetted width, depth, and velocity. Based on this method, a minimum discharge of $10ft^3/s$ is necessary to support recreation, fish, and wildlife for the Belle River at Memphis (Table 1.5). However, canoeing and kayaking may be limited to the spring season because it requires >30 ft^3/s in the Memphis area based on preliminary field surveys. The discharge in the Belle River was below 10 ft^3/s 13.6% of the time at Memphis in 2012 (Figure 1.16).

Table 1.5 Critical minimum Belle River dry season flows based on the Tennant Method

Description of Flows	Discharge (ft^3/s)
Outstanding	20
Excellent	15
Good	10
Degrading	5
Severe Degradation	<5

LimnoTech, Inc. developed flow duration curves for each decade available at the former North Branch Belle River and Belle River gage stations (Figure 1.17 and Figure 1.18). The duration curves indicate an increase in baseflow until recently. This increase may be due to a decrease in agricultural land use of 67.4% in 1978 to 57.5% in 2005 (Fongers, 2012; Appendix D). As cropland has begun to increase again in the recent past, tile drain control structures and other practices will become critical to protecting low flow conditions in the Belle River.

As seen in the Belle River at Memphis hydrograph, dry season baseflows are problematic and drop below critical minimums. More detailed baseflow assessments may be necessary to protect particular recreational activities or target species and are recommended in the Data Gap Analysis (Appendix F). However, this method provides an initial basis for watershed planning. The flow-related WMP goals and designated uses outlined in Chapters 4 and 5 may be achieved with sustainable development and agricultural practices.

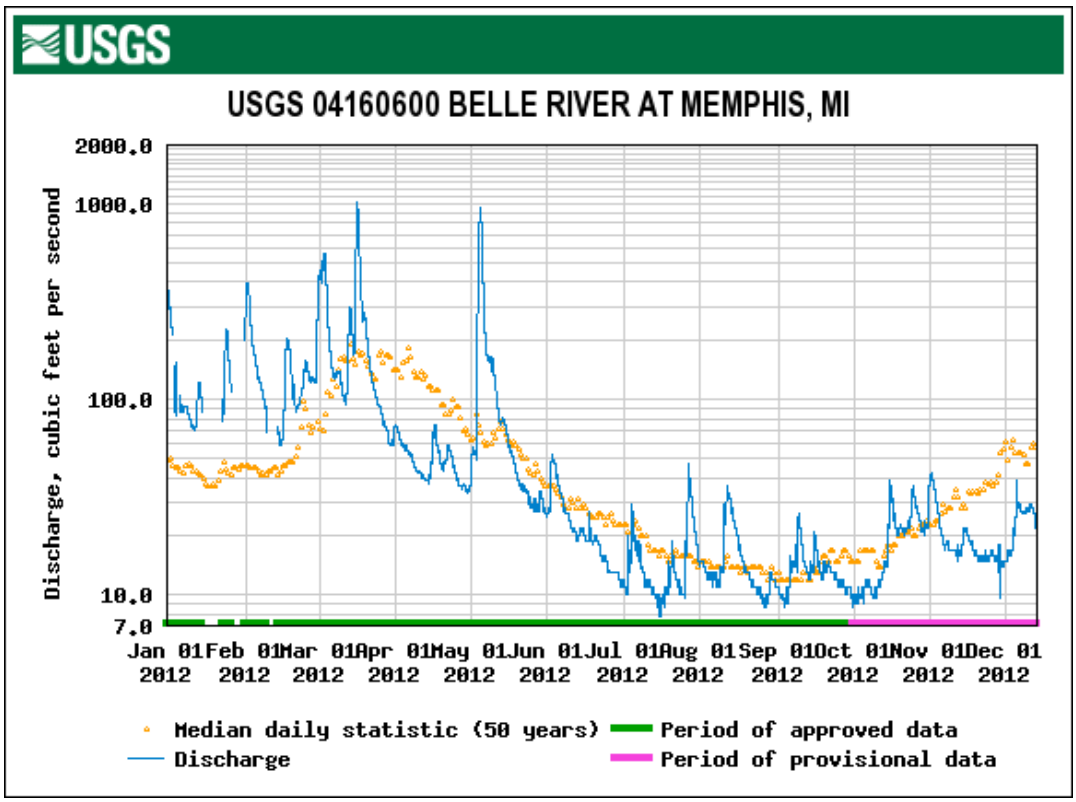

Figure 1.16 Discharge data for the Belle River at Memphis (USGS, 2013)

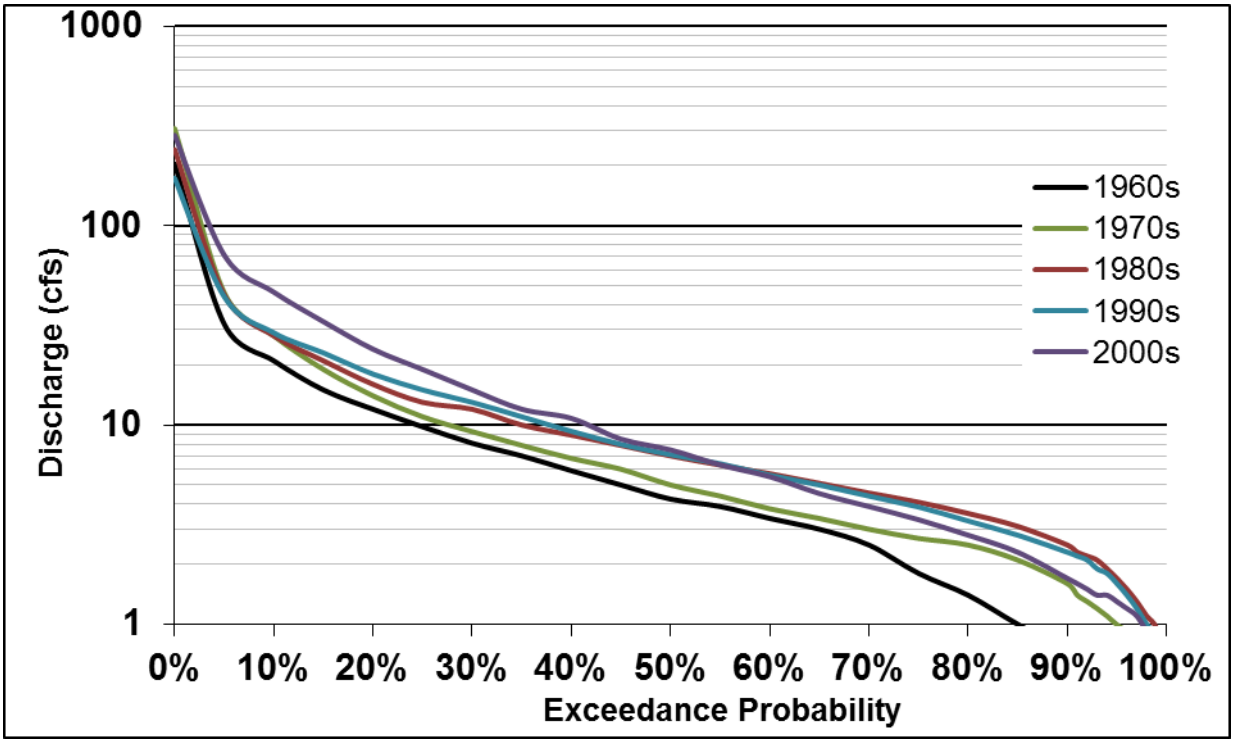

Figure 1.17 Decadal flow duration curves for North Branch Belle River at Imlay City, MI

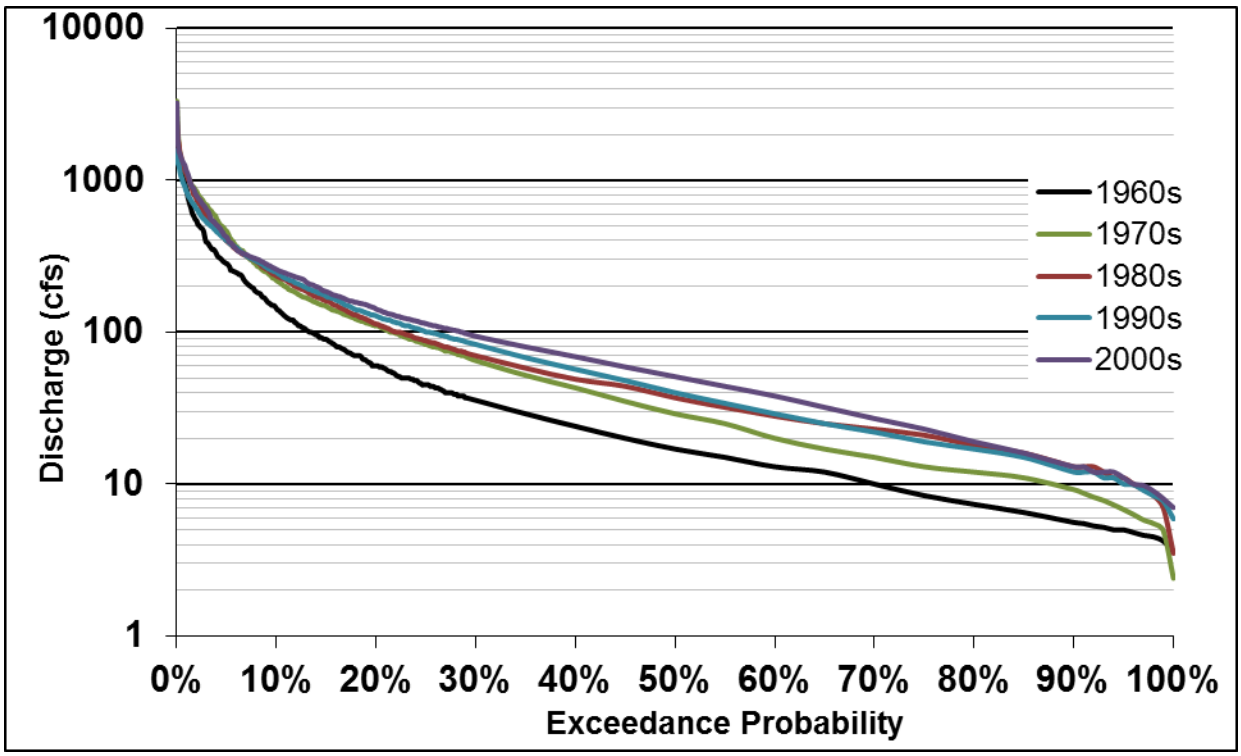

Figure 1.18 Decadal flow duration curve analysis for Belle River at Memphis

1.3.4 Flashiness and Flood Flows

In 2012, MDEQ modeled the Belle River Watershed to assess changes in flashiness and peak flood flows due to land use changes over time (Appendix D).

Flashiness refers to the frequency and rapidity of short-term changes in stream flow (Fongers, 2012; Baker et al. 2004). Flashy streams rise and fall quickly as a result of rainfall. A stream considered not flashy usually obtains most of its flows from groundwater, thus it rises and falls less for an equivalent rainfall in comparison to a flashy stream (Fongers, 2012). Flashiness changes are often a result of hydrologic alterations such as changes in impervious surfaces, channelization, dam operation, and urbanization.

One technique to quantify flashiness is the Richards-Baker Flashiness Index (R-B Index), which is based on United States Geological Survey (USGS) gage values and quantifies the frequency and amplitude of short term stream flow changes in response to runoff events (Fongers, 2012). If the R-B Index trend is increasing over time at a gage, channel erosion problems in the vicinity of the gage station may have large scale causes (e.g. a watershed-wide increase in impervious area) and will require a large scale solution (e.g. regionally distributed stormwater management practices) (Fongers, 2012). Based on hydrologic studies in the Belle River Watershed, there is no trend in flashiness for the USGS gage on the North Branch Belle River at Imlay City. However, flashiness appears to be increasing at the USGS gage on the Belle River at Memphis (Fongers, 2012). This increasing trend may indicate large-scale watershed changes, such as urbanization and changes from pervious to impervious surfaces.

In 1978, all of the subwatersheds contributed higher peak flows than in 1800. Peak flows from four of the subwatersheds in 2005 were higher than 1978 flows. Increased flows affect the morphology of the Belle River and its tributaries; increased channel-forming flows may cause channel enlargement as the Belle River adapts to the higher flows.

Based on the analysis of hydrologic criteria, MDEQ identified the subwatersheds most influenced by watershed characteristics such as runoff volume per area, runoff volume increase per area, peak flood flow yields, and peak flood flow yield change. Change was calculated for two time periods: 1800-1978 and 1978-2005. Subwatershed 7 (located in the headwaters) and Subwatersheds 22 and 24 (located in the lower reach) had the highest hydrologic impact scores in the watershed (Figure 1.19). These three subwatersheds have the highest hydrologic change, likely due to changes in road density, cropping practices, land use, and/or riparian continuity.

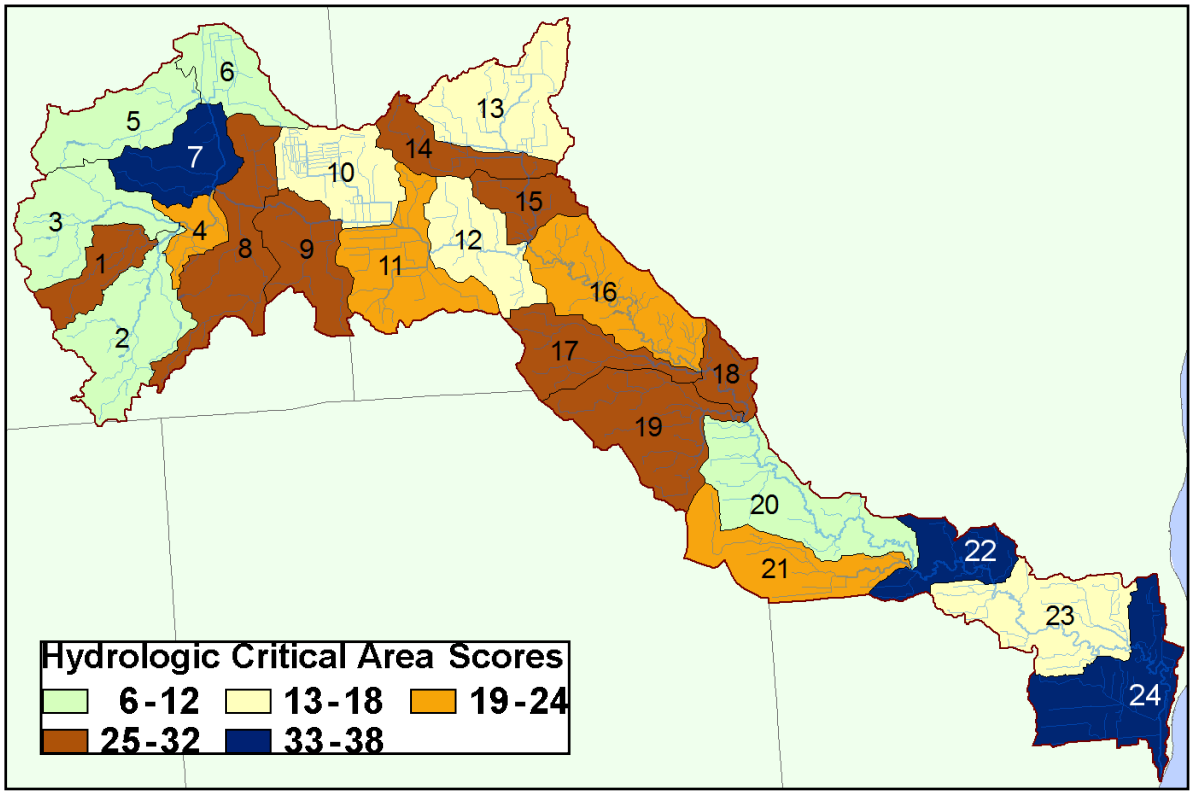

Figure 1.19 Hydrologic critical areas (MDEQ, 2012 in Appendix D)

1.3.5 Channelization

Dredging, straightening, clearing and snagging, and vegetation spraying have been used to effectively drain most of the Belle River Watershed (Figure 1.20). Historically, drainage channels were stripped of riparian vegetation, straightened, widened, and excavated down to a clay bottom. These drainage practices can contribute to downstream flashiness and water quality impacts. The bottom of open drains is typically covered with fine sediments which become re-suspended following every precipitation event. The result is perpetually muddy, warm, nutrient-laden water being discharged to the Belle River from drainage channels. Aquatic vegetation or algae often grow to nuisance conditions once the canopy is cleared. The constant disturbance required by frequent maintenance encourages invasive vegetation like phragmites and narrow-leaf cattail.

Most channelized tributaries to the Belle River have stable grass banks but tend to be depositional. Exceptions include the McGeorge Drain in Subwatershed 11 and the Cox-Doty Drain in Subwatershed 14 which have more erosive soils (Exhibit 13 in Appendix B). The lower portions of larger natural tributaries, such as the Sharrard-Burgess Drain in Subwatershed 17, Ashery Creek in Subwatershed 19, and Jerome Creek in Subwatershed 21 appear to have significant bank erosion due to historic dredging.

Figure 1.20 Example of historic dredging practices in St. Clair County

1.4 Significant Natural Features

1.4.1 Existing Parks and Conservation Areas

The Belle River contains some of the highest quality riverine and floodplain habitat areas in southeast Michigan. The middle reach of the Belle (Zone 2) from Memphis in Riley Township downstream to Kronner Road in Columbus Township has very high quality habitat areas unlike the downstream portion of the Belle River in Zone 3, which has many high, unstable bank areas, but a wide wooded floodplain.

Public parks and green spaces adjacent to the Belle River throughout St. Clair County include Broadway Park and Lighthouse Park in Marine City, 12-acre Musiel Park in City of Memphis (Figure 1.21), Columbus Township Roadside Park, and a 25-acre rustic park in China Township with public access to the river (Figure 1.22). In addition to East China Township's River Park, an additional 5 acres of land was recently purchased by the township at the end of Springborn Road for canoe/kayak access to the Belle River. This park will be further developed in 2016. St. Clair County's only county park in the watershed, Columbus County Park, is situated on 385 acres on the Belle River in Columbus Township. It has a rustic two-mile looped trail for hiking, a looped equestrian trail for horseback riders, and allows hunting in certain areas. The park includes a lodge, picnic pavilion and lighted sledding hill. Lapeer County parks include Lions Park in Imlay City, Riseman Refuge, a 10-acre park held by the Lapeer Land Conservancy

adjacent to the Belle River and the Polly Ann Trail, and General Squier Memorial County Park in Dryden which includes a lodge, picnic pavilions, a pond, splashpad, and nature trails.

The Polly Ann Trail, a greenway corridor that transects Lapeer and Oakland Counties, had its beginnings as a railroad. In 1993 the Michigan Department of Natural Resources purchased the corridor and the conversion into a linear park became a reality. In Lapeer County the trail extends approximately 6 miles from Bordman Road to Kings Mill and is managed by Lapeer County Parks and Friends of the Polly Ann Trail of Lapeer County. Existing parks and greenspaces are depicted in Exhibit 2 in Appendix B.

Figure 1.21 Musiel Park in City of Memphis, St. Clair County

Figure 1.22 China Township Park public access site, St. Clair County

As part of the watershed management planning process, Six Rivers Land Conservancy (SRLC) led the effort to identify land conservation priorities to support and improve water quality. A prioritization model using a ranking system to score parcels based on key natural resource and water quality values was developed. Once the model was completed, volunteers helped complete "windshield surveys" to field verify the conclusions of the model. When complete, the process identified three distinct regions: Headwaters Region, Middle Reach (Zone 2), and Lower Reach (Zone 3). In the Headwaters Region, the area is characterized by larger parcel lands and priority conservation lands falling along stream corridors. The Middle Reach has priority lands that line the main branch of the Belle River. The riparian buffer areas here are vitally important to land conservation and water quality. In the Lower Reach, priority lands are more scattered, indicating that the riparian zone is highly developed and fragmented; the most important lands in this region are public parks. Maps for each region and more details are located in Appendix K and Section 3.2.1.4.

1.4.2 Wetlands

As discussed in Section 1.3.2, 79% of wetlands have been lost in the Belle River Watershed. Thus, the existing wetlands in the watershed are significant natural features and provide important ecological functions including floodwater storage, nutrient transformation, fish habitat, amphibian habitat, and stream shading, among others. The remaining wetlands and functional capacity of wetlands in the watershed are detailed in the Landscape Level Wetland Functional Assessment (LLWFA) in Appendix E.

1.4.3 Threatened and Endangered Species

Though the St. Clair River has been designated an Area of Concern (AOC) by the U.S. EPA, it's tributary, the Belle River, supports several species that are listed on the State Threatened and Endangered list which indicates that portions of the river are still providing adequate habitat conditions for aquatic species.

Fish

The eastern sand darter (Figure 1.23) was found at two sites by the Michigan Department of Natural Resources (MDNR) in 2008 near the Westrick Drain in China Township and at Indian Trail Road Bridge in China Township. The eastern sand darter is on the State Threatened list, with southeast Michigan being the northern edge of its range (Scott and Crossman, 1973). The eastern sand darter is found in streams and rivers with sandy substrates and lakes with sandy shoals. They are often found in slow moving waters where fine sand is deposited, often immediately downstream of a bend (Daniels, 1993). Siltation is a major factor in the decline of this species.

Figure 1.23 An eastern sand darter from the Belle River (MDNR, 2009)

Mussels

The Belle River continues to support high unionid mussel diversity and rare species. The Belle River is one of the few watersheds in Michigan with high mussel species richness that is still free of zebra mussels (*Dreissena polymorpha*). A survey by Michigan Natural Features Inventory in 2003 documented a total of 27 species in 11 sample points, including live individuals of the now federally endangered rayed bean and snuffbox (Badra and Goforth, 2003). Threatened and endangered species include the state and federal endangered rayed bean and snuffbox, the state endangered roundnut hickory, and state threatened slipershell. More information about mussels is available in Section 2.2.4 (Figure 1.24).

Figure 1.24 Federally endangered and state endangered mussels in the Lower Belle River (MDNR, 2011)

1.4.4 Farmland

Surface waters of the State are protected for agricultural uses. Most of the land within the Belle River Watershed still consists of small family farms. Much of the "muck soils" along and east of M-53 in Lapeer County are former wetland areas that are used to grow root crops, but the soils are being stripped and sold on some parcels. The percentage of cropland began to decline in the watershed in past decades, but has begun to increase again due to commodity prices. The major crops include corn, soy, carrots, potatoes, celery, sod, and onions.

Even though agricultural lands can produce water quality problems because of poorly implemented Generally Accepted Agricultural Management Practices (GAAMPs), Townships find preservation of agriculture to be important to maintain the rural character of their communities. Figure 1.25 outlines the prime agricultural areas that have been delineated by the St. Clair County Metropolitan Planning Commission, and it also shows the status of farmland acreage enrolled in the Farmland Preservation Act.

In 2004, the SCC Board of Commissioners approved an ordinance allowing SCC agricultural lands to enter into a federal protection program, but funding is needed to buy the farm development rights. It is logical that the most productive agricultural land in the county should be prioritized for development rights acquisition. Farmlands in these areas require minimal soil enhancement measures such as irrigation and fertilizer, and crops grown on these soils will produce the highest yields with the smallest input of energy and economic resources.

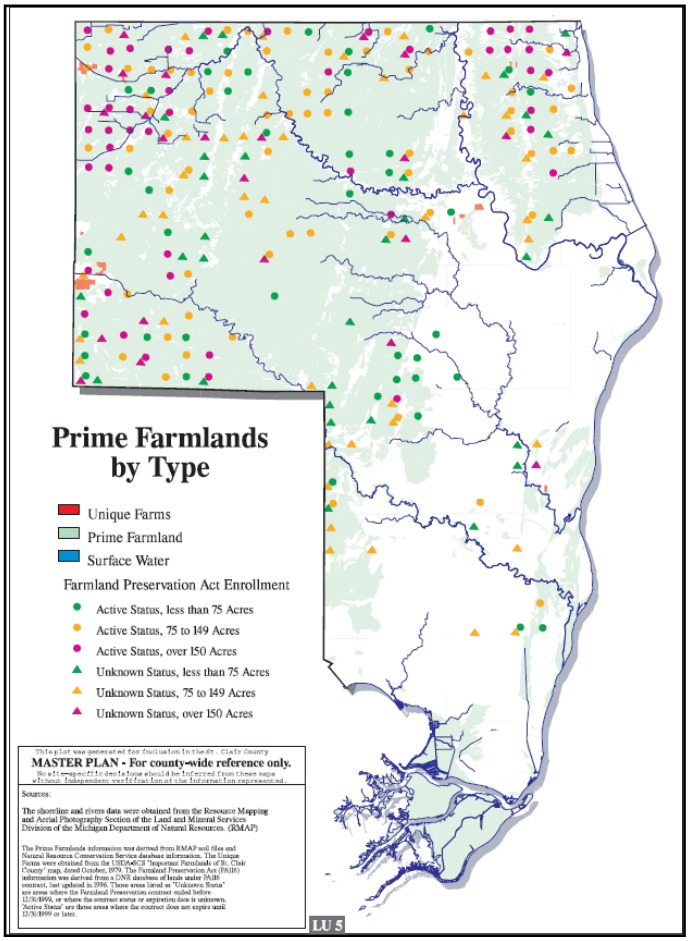

Figure 1.25 Prime agricultural lands in St. Clair County

Preservation of smaller family farms combined with increased implementation of GAAMPs are important means to protecting the water quality of the Belle River Watershed. Currently, many of the Belle River's agricultural sites have erosion problems and lack vegetative buffer strips along drain corridors based on observations during Nonpoint Source Identification Inventory completed in the summer of 2013 by Lapeer County Conservation District staff and consultants for the county. In addition, many of the waterways in agricultural areas are channelized drains which contribute to the degradation of natural waterways.

1.5 Land Use, Growth Trends, and Master Plan Analysis

1.5.1 Land Use Analysis

In 2012, the Michigan Department of Environmental Quality (MDEQ) prepared the *Belle River Watershed Hydrologic Study* (Fongers, 2012; Appendix D). The purpose of the study was to better understand the watershed's hydrologic characteristics in order to assist with stormwater management planning. The study incorporates three (3) scenarios that correspond to the years 1800, 1978, and 2005 (Table 1.6; Figures 1.26-1.28) and how the watershed changed during this time. Exhibit 6 in Appendix B breaks down the portions of the watershed that are urban, agricultural, natural areas, and water or wetland.

Table 1.6 Belle River Watershed land cover comparison

Land Cover	1800	1978	2005
Urban	NA	7.7%	16.9%
Agricultural	NA	67.4%	57.5%
Natural Areas, Upland	61.4%	23.1%	23.5%
Water, Wetland	38.6%	1.8%	2.1%

Source: MDEQ, Belle River Watershed Hydrologic Study, Sep. 2012

In 1800, the Belle River Watershed was undergoing settlement so the land cover at the time was dominated by water, wetland, and natural areas. After settlement occurred and the increasing population developed agricultural land and created urban areas, the water, wetland, and natural areas drastically decreased in area. Water, wetlands, and natural areas decreased from 100% of the watershed in 1800 to only 25.6% in 2005. The dominant cover shifted to 57.5% agriculture and 16.9% urban area in 2005. The shift from natural areas and wetlands to agricultural and urban areas has altered water quality by reducing areas for infiltration (i.e. wetlands and forested land), increasing nutrient inputs, channelizing streams, increasing impervious surfaces, and altering groundwater and surface water hydrology.

Table 1.7 further breaks down the watershed into more specific land cover categories. Between 1978 and 2005 the land cover for residential, commercial, industrial, roads, utilities, cemeteries, and outdoor recreation increased while croplands, orchards, and pasture decreased. This change is likely due to an increase in population during that period and the resulting need for the development of natural areas.

Table 1.7 More specific land uses from 1800 to 2005

Land Cover	1800	1978	2005
Residential	N/A	4.3%	12.5%
Commercial	N/A	0.5%	0.8%
Industrial	N/A	0.7%	0.8%
Roads, Utilities	N/A	1.1%	1.3%
Open Pit	N/A	0.8%	0.5%
Cemeteries, Outdoor Recreation	N/A	0.4%	0.9%
Cropland	N/A	65.0%	56.4%
Orchards	N/A	0.8%	0.7%
Pasture	N/A	1.6%	0.3%
Herbaceous Openland	1.8%	11.2%	11.8%
Forest	59.7%	11.9%	11.8%
Water	0.3%	0.2%	0.6%
Wetland	38.3%	1.5%	1.5%
Bare	N/A	0.0%	0.0%

Source: MDEQ, Belle River Watershed Hydrologic Study, Sep. 2012

Figure 1.26 Land cover in the Belle River Watershed in 1800

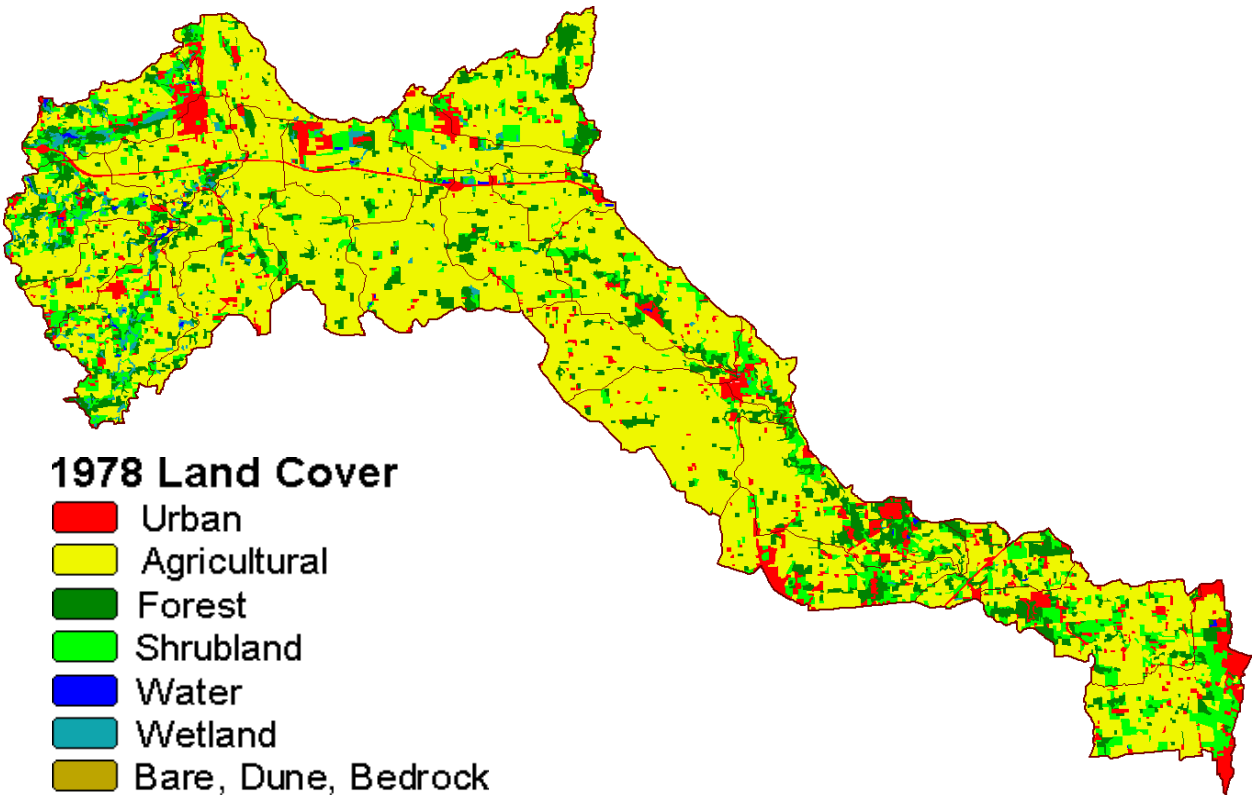

Figure 1.27 Land cover in the Belle River Watershed in 1978

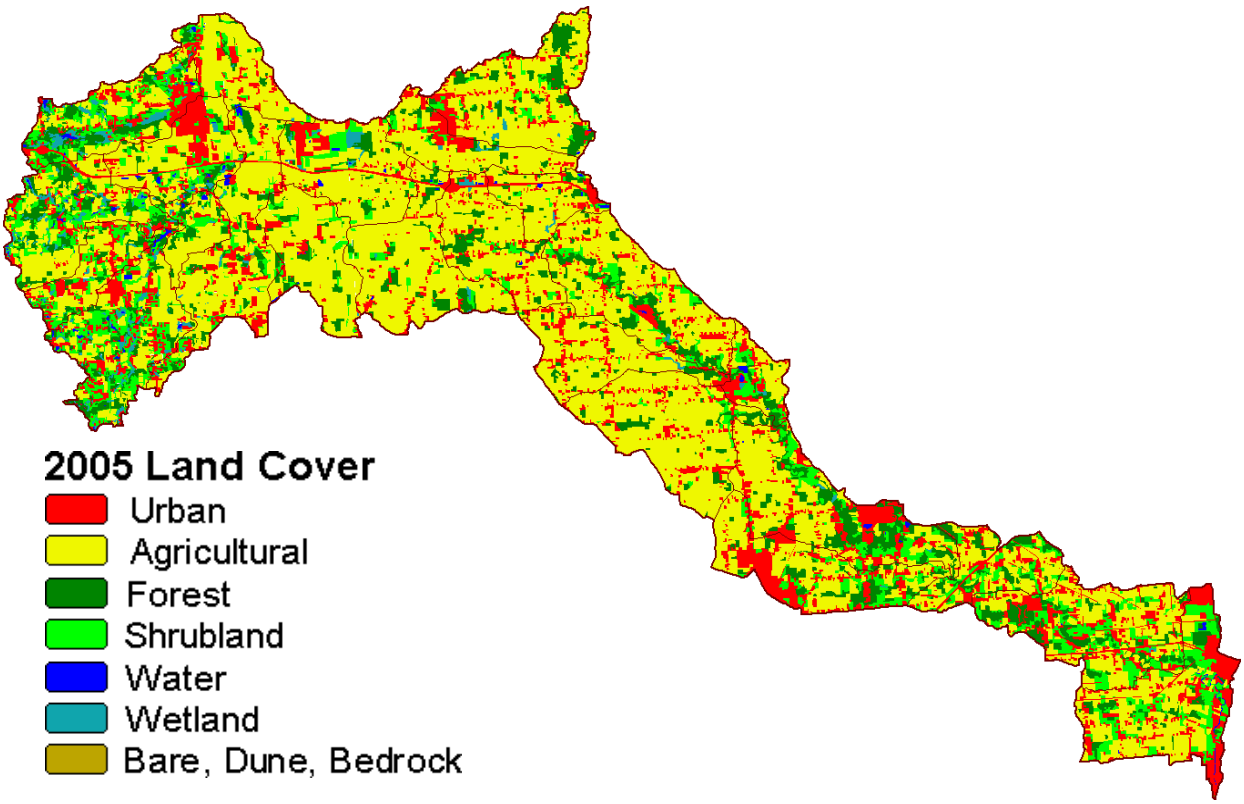

Figure 1.28 Land cover in the Belle River Watershed in 2005

In June 2013, SEMCOG released figures on the land cover of Southeast Michigan and the counties and watersheds within it. Table 1.8 breaks down the acreage of land cover of the portion of the Belle River Watershed that is within the SEMCOG Region (Macomb and St. Clair Counties). Note that the categories of land cover differ depending on the time of year and if leaves are on or off the trees. When leaves are not on the trees, tree cover decreases in acreage and impervious, open, bare, and water covers increase. Due to the negative effects of impervious surfaces on the surrounding landscape, many communities put policies and regulations in place to control development or require other features to help mitigate the runoff. (Note: Since Lapeer County does not lie within the SEMCOG region, the data in Tables 1.8 and 1.10 only include the portions of the watershed that lies within Macomb and St. Clair Counties).

Table 1.8 Acres of land cover

Land Cover	Leaf Off	Leaf On
Impervious	3,931	3,839
Tree	24,495	26,046
Open	65,131	63,720
Bare	845	842
Water	1,214	1,170
Total	95,616	95,616

Source: Southeast Michigan Council of Governments May, 2013

1.5.2 Growth Trends

The Belle River Watershed is primarily rural with some urban areas within downtown clusters like Marine City, East China, China Township, Imlay City, Almont, and Richmond. However, as population grows, rural areas are more likely to be developed. Table 1.9 shows the populations for each community within the Belle River Watershed at the time of 2000 and 2010 United Stated Census (U.S. Census Bureau, 2015). A few of the communities within the Belle River Watershed decreased in population between 2000 and 2010, but the majority of the communities increased in population. At a county level, St. Clair County overall decreased in population while Lapeer and Macomb Counties increased in population.

Table 1.9 Population change from 2000 to 2010

Area	2000	2010	2000 - 2010 Change
Lapeer County	**87,904**	**88,319**	**0.5%**
Attica Twp.	4,678	4,755	1.6%
Almont	2,803	2,674	-4.6%
Almont Twp.	6,041	6,583	9.0%
Dryden	815	951	16.7%
Dryden Twp.	4,624	4,768	3.1%
Imlay	3,869	3,597	-7.0%
Imlay Twp.	2,713	3,128	15.3%
Macomb County	**788,149**	**840,978**	**6.7%**
Armada Twp.	3,673	3,649	-0.7%
Lenox	5,362	5,828	8.7%
Memphis	807	823	2.0%
Richmond	4,896	5,733	17.1%
Richmond Twp.	3,406	3,655	7.3%
St. Clair County	**164,235**	**163,040**	**-0.7%**
Berlin Twp.	3,162	3,285	3.9%
Capac	1,775	1,890	6.5%
Casco Twp.	4,748	4,107	-13.5%
Columbus Twp.	4,615	4,070	-11.8%
Emmett Twp.	2,255	2,385	5.8%
Memphis	322	360	11.8%
Mussey Twp.	1,965	2,316	17.9%
Riley Twp.	3,046	3,353	10.1%
St. Clair Twp.	6,423	6,817	6.1%
China Twp.	3,340	3,551	6.3%
East China Twp.	3,630	3,788	4.4%
Marine City	4,652	4,248	-8.7%

In 2002, SEMCOG prepared a 2030 regional forecast of the watersheds within the SEMCOG region. The report, *Comparing 2000 Census and 2030 Regional Development Forecast by Watershed*, forecasts the population, number of households, and employment (job growth) in 2030

The forecast from SEMCOG indicates that the portion of the watershed that lies within Macomb County and St. Clair County will see an increase of 9,000 people, 5,000 households, and 4,000 new jobs from 2010 to 2030 (Table 1.10) (SEMCOG, 2002). This kind of growth may pressure some of the rural areas of the watershed to develop. As outlined in the forecast prepared by SEMCOG, the population, number of households, and employment of the area is to grow further by 2030. Therefore, additional natural areas may be converted to urban areas to address the increase in housing and infrastructure needs of a larger population.

An increase in development typically increases the amount of impervious surfaces. A natural area allows precipitation to infiltrate into the landscape prior to runoff. However, the development of natural landscapes into surfaces that is impervious to infiltration (e.g. rooftops, roads, parking lots) results in an increase in storm water runoff. An increase in storm water runoff increases flows into waterways and can causes overbank floods and create erosive velocities. Additionally, water quality can be negatively impacted from increased development, as more runoff from roadways, landscaped areas, and sewer systems can increase toxic pollutant, nutrient, and pathogen loads into waterways. Currently, water quality is largely impacted by agricultural runoff in the watershed, but a shift toward urbanization could possibly change pollutant sources and quantities.

Table 1.10 Watershed growth - 2000 to 2030 forecast

Area	Population		Households		Employment	
	2000	2030	2000	2030	2000	2030
Entire Watershed	24,000	33,000	9,000	14,000	8,000	12,000
Macomb County	6,000	9,000	2,000	4,000	2,000	4,000
St. Clair County	18,000	25,000	7,000	10,000	6,000	8,000

1.5.3 Master Plan Analysis

1.5.3.1 Summary

A review of the Master Plans of the counties and communities within the Belle River Watershed was conducted to determine the extent that these documents include protection of the watershed.

The analysis revealed that the development plans in St. Clair County, Lapeer County, and Macomb County take into consideration local waterways and water resources. St. Clair County has goals and defined strategies to protect surface water, groundwater, and other water resources on a watershed scale. Lapeer County has goals to improve storm water management and move toward the adoption of floodplain ordinances. While Lapeer County has goals to increase recreation, the plan does not explicitly mention recreation in terms of increasing public access to water resources. Macomb County focuses on protecting water resources and increasing water-specific recreation, but the plan focuses more on the Clinton River and Lake St. Clair, as opposed to the Belle River. In general, the county master plans are comprehensive in considering the protection of waterbodies and other natural resources. There is room for improvement in the Lapeer County and Macomb County plans, as these plans do not specifically mention protection of the Belle River Watershed.

Master plans of communities within St. Clair County were analyzed. Most of the communities' development plans include language and goals for recreational opportunities and consider the environment, but most plans do not specifically mention the Belle River or state how these goals are to be accomplished. The risks of not explicitly including the Belle River in planning are that development activities may result in degradation or destruction of the existing high quality ecosystems or may further

degrade water quality in the region. A solution, as explained in more detail in Chapter 6, is to amend existing plans to include the goals and strategies of the watershed management plan.

Master plans were not analyzed in communities in Macomb and Lapeer Counties because the St. Clair County community master plans cover the greatest geographical area of the Belle River Watershed and provide an adequate picture of the current goals and planning strategies in relation to water resources.

There are opportunities for counties and communities to generate policies, programs, and regulations to guide future development toward more sound water quality practices in the Belle River Watershed. Communities need to put proper policies and regulations in place to protect the watershed during future development that may occur according to the forecasted increase in population, households, and employment

1.5.3.2 County Master Plans

St. Clair County 2030 Master Plan – June, 2009
St. Clair County's Master Plan was adopted June 2009 and includes projected changes through 2030. The ultimate goal of the Master Plan is to revitalize the County's economy, improve the overall quality of life, manage growth, and create a sustainable countywide community.

Chapter 2 of the Master Plan covers the environmental goals and strategies of the Master Plan that were desired by the residents of St. Clair County. Nine environmental goals were identified. Some of the goals include:

- Goal #1: Sustain the health, diversity, and extent of natural resources.
- Goal #2: Increase environmental awareness of citizens and government officials.
- Goal #3: Pursue environmental goals and comply with environmental regulations.
- Goal #4: Protect surface water and groundwater.
- Goal #5: Protect and preserve the environment from a watershed perspective, rather than only within jurisdictional boundaries.
- Goal #8: Protect viable farmland while accommodating nearby land-use change.

The Master Plan then identifies in-depth strategies and policies that can be used to achieve each of the goals, and potential sources for funding. In addition, this chapter clearly recognizes and defines types of natural features (e.g. wetlands, watersheds, woodlots, etc.) and identifies the important watercourses running through the county.

Lapeer County Comprehensive Development Plan – August 2006
Lapeer County's most recent Comprehensive Development Plan was drafted in August 2006. As of 2000, the majority (53%) of Lapeer County's land use is agriculture. Twelve percent of all of the agricultural land was enrolled in the Farmland Development Rights Agreement tax abatement program. This highlights how important the preservation of agriculture is to Lapeer County residents.

Chapter 3 of the Master Plan outlines the types of the natural features that are within Lapeer County, including soils, wetlands, floodplains, inland lakes and streams, and agricultural land. Chapter 9 lists seven goals and objectives for the protection of natural features. Three of the goals were focused on environmental protection. They are:

Goal: Farmland Preservation

Objectives:

1. Continue to play a leadership role on techniques and tools to effectively deal with agricultural preservation
2. Encourage the adoption of zoning standards that allow for related agricultural support services
3. Promote the use of PA 116 that designates farmland areas for preservation and the Purchase of Development Rights (PDR) program
4. Educate and assist in creating Transfer of Development Rights (TDR)
5. Encourage the concentration of residential development density and commercial uses in closer proximity to population centers to preserve rural character and protect agricultural areas

Goal: Open Space and Natural Features Protection

Objectives:

1. Identify environmentally sensitive areas and help ensure their protection by compliance with State and Federal environmental regulations
2. Encourage and promote the formation of open space and woodlands ordinances within the communities of the County
3. Encourage and promote the roadside vistas while ensuring the safety and maintainability of roads under County jurisdiction
4. Educate the County units of government on storm water management
5. Lessen reliance on landfills for solid waste disposal
6. Move toward the adoption of model floodplain regulations`

Goal: Recreational Uses

Objectives:

1. Encourage all communities and townships to protect parklands by the use of low impact facilities. Regardless, there needs to be a balance with active recreational facilities, i.e. tennis courts, ball fields, etc.
2. Encourage all communities and townships to provide, if possible, local vest parks and open areas within developments for the use and enjoyment of the residents of that neighborhood.
3. Work with the communities and townships to encourage an interconnecting non-motorized bike path or trail system for County residents.
4. Create a Long Term Recreational Plan.
5. Promote community parks and recreation facilities to enhance community attractiveness, provide knowledge of healthy recreation activities, and encourage citizen use

Macomb County Blue Economy Strategic Development Plan - 2012

Macomb County's Blue Economy Strategic Development Plan was adopted in 2012 to address the enhancement of water quality, water access, and water attraction of the Clinton River and Lake St. Clair regions.

The plan identified recommendations in five categories. The first two categories involved recreational and environmental quality:

- Increase accessibility to Lake St. Clair and the Clinton River:
  1. Increase number of boat launches/kayak launches, piers, public parks/beaches on Lake St. Clair
  2. Seek opportunities to open more parks for public use
  3. Seek opportunities for additional acquisition of land open to the public through the foreclosure process
- Continue to enhance and improve environmental quality:
  1. Increase and restore habitat to offset impacts of development
  2. Develop strategy for each beach to ensure beaches are open as much as possible
  3. Seek opportunities to manage storm water runoff through the use of green infrastructure
  4. Look for funding opportunities to retrofit pollution issues
  5. Implement aquatic invasive control programs such as phragmites control
  6. Increase the number of entertainment & recreational development opportunities
  7. Increase opportunities to "see and touch" Lake St. Clair and Clinton River
  8. Increase commercial development oriented to the $1.7 billion boating industry, or the nearly $1.4 billion angler/hunting industry.
  9. Seek opportunities to link recreation and entertainment into hubs (e.g. Lake St. Clair Metropark, Nautical Mile, Salt River Marsh, Mount Clemens, North and South River Roads, and downtown New Baltimore)

1.5.3.3 St. Clair County – Municipal Master Plans

Berlin Township – July 1991

The Environmental Factors section of the Berlin Township Plan identifies the high water table, rivers, streams, wetlands, and groundwater supplies as the prime concerns. It also identifies the education of the public as imperative. While it does not reference the Belle River Watershed specifically, it does outline their environmental goals and objectives.

1. Avoid inappropriate and undesirable increases in land use densities to sensitive areas and farm land.
2. Facilitate the adoption of more rigorous requirements for the installation of any form of septic or other drainfields in any portion of the Township.
3. Develop more rigorous and comprehensive requirements for the collection and discharge of storm water.
4. Enhance the open space and landscape requirements for the collection and discharge of storm water.
5. Promote ongoing public information programs to educate residents on environmental issues.

Village of Capac – 2009

While the Village of Capac Master Plan outlined the Goals and Objectives for the following aspects: Community Character, Residential, Commercial, and Industrial. Environmental goals and objectives or the protection of the Belle River Watershed were not covered.

Casco Township – February 2005

The Casco Township Master Plan does not mention the Belle River Watershed specifically. However, it does contain several environmentally related goals and objectives that are important to the protection of the watershed. They include:

1. Protecting the Township's natural features and environmental assets by establishing buffer zones around wetlands, lakes and rivers.
2. Implementing standards on fertilizers and pesticides to protect surface and ground water.
3. Management of wooded areas, and supporting the use of land trusts or conservancies for donation for designated open spaces.
4. Requiring developments to preserve the natural features of each site and encourage open space to be implemented.
5. Continue agricultural activities wherever possible and encourage managed growth to avoid premature conversation of agricultural land.

Columbus Township – 2007

The Columbus Township Master Plan does mention the Belle River Watershed and its fragility, and outlines some principles related to the environmental resources. The primary component of the master plan is the preservation of agricultural land and open spaces. However, if development occurs, the environmental resources state the following:

- Future development must recognize that the environmental resources are fragile and must be respected;
- Waterways should be maintained in their natural states and natural buffer areas along the Belle River and its tributaries must be provided;
- Preservation of natural and constructed wetlands; and
- Require County approval for well and septic systems for the protection of natural groundwater.

Emmett Township – February 1999

The Master Plan identifies the natural features in the Township as watercourses, wetlands, and woodlands, and some of the goals of the master plans (Goals, Objectives and Policies Chapter) calls for the conservation of agricultural lands and that new development conserves natural features and environmentally sensitive areas. However, the proposed policies do not specifically state how the natural features are to be protected other than through open space agreements and encouraging new development to incorporate natural features within its design.

City of Memphis – February 2013

The City of Memphis Master Plan identifies the Belle River corridor as the primary open space cluster in the City, and its importance for recreational opportunities. One of the goals the plan puts forth is to "Uphold the beauty and tranquility of the City's natural environment." The objectives to achieve this

goal were indicated as identifying areas of environmental significance in the City, establish relationships with environmental agencies and stakeholders, protect the City's natural features through sound planning development procedures, incorporating natural features in future development, and increasing the number of public access points along the Belle River.

Mussey Township – October 2011

The Mussey Township Master Plan appears to place extra emphasis on the preservation of agricultural lands, which currently make up about half of the Township area. However, in its implementation strategies it also has in depth sections outlining open space preservation through land acquisition and conservation easements, and water quality through storm water management. The Master Plan also provides detail on the importance of protecting wetlands, floodplains and woodlands for water quality and wildlife habitat purposes.

St. Clair Township – October 2006

The Master Plan for St. Clair Township outlines the natural features within the Township like wetlands, floodplains, and woodlands, and their importance. In the Visions and Strategies section of the Master Plan, the mechanisms for environmental quality protection are outlined in greater detail. This section calls for open space and farmland preservation, and policies and practices for the preservation of drainage system and floodways, storm water quality through filtering, ordinance regulations for buffer areas along natural areas, and education on the use of fertilizers and the storage of materials.

China Township – December 2003

Like many communities in this area, the Master Plan for China Township emphasizes agricultural land and open space preservation. In its implementation strategies the Plan has an in depth section outlining open space preservation through land acquisition, conservation easements, and open space agreements. The plan does not mention the Belle River Watershed specifically, but does outline the wetlands, floodplains, woodlands, agricultural land, and groundwater in the Natural Resources section, and the importance of protecting them.

East China Township – February 1998

The East China Township Master Plan does not provide much information on the watershed preservation or the protection of the environment within the community. In the background section of the plan it is stated that East Chins does lie within the floodplains of the St. Clair, Belle, and Pine Rivers. It then continues to state that efforts should be made to maintain the 100-year floodways in their natural state. The only other floodplain or environmental component of the Master Plan is a section regarding the importance of open space and how it should be encouraged during residential planning. The plan does not contain any sections regarding the protection of natural areas like wetlands, woodlands, floodplains, etc. or programs or policies to implement it.

Marine City – November 2011

The Marine City Master Plan indicates the St. Clair River and Belle River as important features in the community. In the Vision and Planning Objectives portion of the Plan several recreation opportunities that include the rivers are outlined, and it is stated that all future development must be environmentally acceptable so that it preserves the natural features of the area. However, the Plan does not state or

provide detail on what practices or programs are in place or proposed to protect the environment and promote water quality.

Cottrellville Township – June 2002

The Cottrellville Master Plan provides information on the importance of wetlands, woodlands, and the Belle River and its subwatersheds in Chapter 4. The Plan states that the effects of development on woodlands should be minimized but does not provide details on practices or programs to protect these areas. Chapter 4 also discusses the soils in the Township and restrictions to new development due to the soil's ability or inability to support septic tanks. Chapter 8, Goals and Objectives, explicitly provides strategies for natural resource protection, including updating the Zoning Ordinance to preserve and protect woodlands and wetlands, developing a set of guidelines to ensure future development along the river is compatible with scale and character with the surrounding area, and establishing appropriate buffer zones around wetlands, lakes, and river edges. The Plan also has recreation strategies, including exploring opportunities for land acquisition along the riverfront for the purpose of developing a Township park with river access.