Chapter 3 – Watershed Conditions

3.0 WATERSHED CONDITIONS

OBJECTIVES

- What are the designated and desired uses of our surface waters?
- What standards are used to judge water quality?
- What is the current condition of the Watershed?
- What are the impacts of pollutants on the Watershed?

3.1 DESIGNATED AND DESIRED USES

Water bodies have designated uses that are defined by the State of Michigan (State), as well as certain desired uses that vary from location to location. Local residents, industries, tourists, and recreational users involved with that particular water body will decide these desired uses.

3.1.1 Designated Uses

The State has developed Water Quality Standards (WQS) under Part 4 of the Administrative Rules issued pursuant to Part 31 of the Natural Resources and Environmental Protection Act (1994 PA451, as amended). Rule 100 (R323.1100) of the WQS states that all surface waters of the State are designated for, and shall be protected for, all of the following uses:

- Agricultural use
- Other indigenous aquatic life and wildlife
- Warmwater fishery
- Coldwater fishery (where designated)
- Partial body contact recreation
- Total body contact recreation between May 1 and October 31
- Navigation
- Industrial water supply
- Public water supply at the point of intake

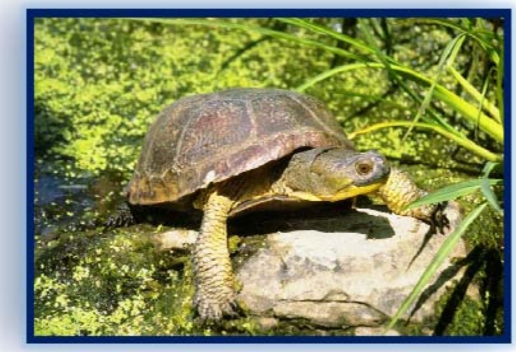
Current water quality impairments and specific threats to water quality have been identified and noted to create a focused Watershed Management Plan (WMP) for addressing nonpoint source (NPS) pollutants. The status of a designated use in a Watershed can be impaired, threatened, met or under review/unknown. Designated uses are considered impaired if the water does not meet the State's WQS. Designated uses are considered threatened when WQS may not be met in the future. Based upon data review and field assessments, the Steering Committee was able to determine the status of each designated use within the Watershed. Table 3.5 in Section 3.5 summarizes the status of each designated use.

Provided below is a brief description of each of the State's authorized designated uses.

<u>Agricultural</u>
Surface waters used for irrigation, livestock watering, and produce spraying must be consistently available and safe. In addition to water use on farms, agricultural water supply includes irrigation for maintaining vegetative growth in nurseries, parks, and golf courses. Water resources should be free of pathogens and chemicals that could pose a health risk to livestock and humans.

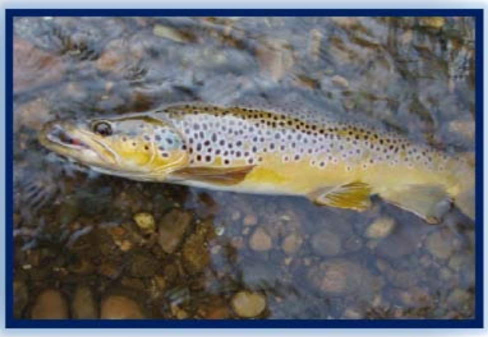
Other Indigenous Aquatic Life and Wildlife

In addition to fish, other aquatic life and wildlife in the ecosystem should be considered in all management strategies. A stable and healthy habitat supports populations of wildlife that provide outdoor recreational opportunities like bird watching and hunting. Healthy habitats have water conditions that are capable of supporting native plant and animal species.



Warmwater Fishery

A warmwater fishery is defined by the Michigan Department of Natural Resources and Environment (MDNRE) as a water body that is capable of supporting fish species that thrive in relatively warm water, including bass, pike, walleye, and panfish, with temperatures not exceeding a monthly limit of 77°F in July and August and a dissolved oxygen (DO) level of >5 mg/L (milligrams per liter) (Creal and Wuycheck, 2002).



Coldwater Fishery

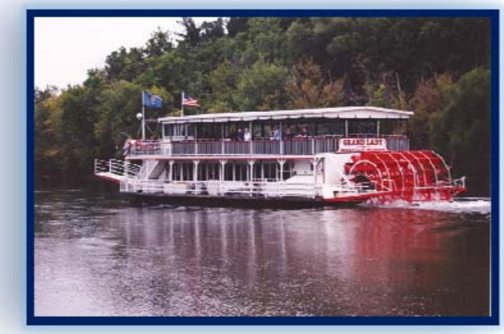
A coldwater fishery is able to support natural or stocked populations of trout and has summer water temperatures between 41°F and 55°F, with a DO >7 mg/L, and a maximum temperature of 68°F. Several designated trout streams are in the Watershed, as indicated in the Fisheries section in Section 2.6 of Chapter 2.

Partial Body Contact Recreation

Water-related activities, like fishing and boating, that do not require full body immersion are referred to as partial body contact recreation. Water quality must meet standards of less than 1,000 counts of *Escherichia coli (E. coli)* 100 mL for recreational uses (MDNRE, 1999).

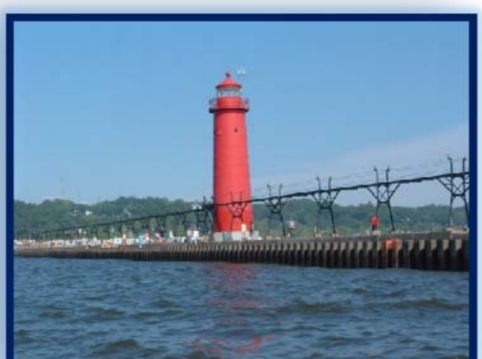
Total Body Contact Recreation

Total body contact recreation refers to any activity that will result in the submersion of the head (e.g., swimming). Safety concerns arise when the eyes and nose are submerged, and the possibility of ingesting the water exists. WQS for total contact body recreation must be met between May 1 and October 31. During this time, *E. coli* must be below 130 counts per 100 mL, as a 30-day geometric mean (MDNRE, 1999).



Navigation

Waterways that provide adequate depth and width for recreational canoeing and kayaking must maintain open, navigable conditions.



Industrial Water Supply at Point of Intake

Industry depends on large quantities of cool, clean water for material washing or as a coolant. The Watershed contains 21 industrial water intakes. Intakes are for industrial, power generation, and irrigation uses.

Public Water Supply at Point of Intake

Municipal water supplies must have safe and adequate supplies of surface water. Water quality must be sufficient for conventional water treatment to produce safe and palatable water for human consumption and food processing. The Watershed contains no intakes for public water supply.

3.1.2 Desired Uses

Resources that are not listed as a designated use in the Part 4 Rules may still have significant local importance. These uses for the Watershed's resources have been included in this WMP as desired uses.

Part of the mission of LGROW is to maintain social and economic viability in the Watershed while supporting a healthier environment. Table 3.1 depicts desired uses identified by the Steering Committee.

Table 3.1 – Desired Uses

Desired Use	Goals
Recreation	Improve sport fisheries through stocking and habitat restoration and protection. Promote recreation within the river: canoeing, fishing, limited motor driven boating, restaurants and bars, and potentially connection to Lake Michigan. Increase the number of recreational (boating, swimming, fishing) access points and trails. Encourage linkages between trail systems. Provide for aesthetic viewscapes in the Watershed.
Habitat Preservation	Restore and protect habitat for native wildlife and aquatic species. Promote and support the "City Green" initiative to increase stream buffers and canopy cover. Restore and protect wetland areas. Establish riparian corridors and connections. Restore and protect natural stream morphology and floodplains.
Use of Natural Resources	Promote and apply alternative energy technologies. Encourage residents to reduce, reuse, and recycle. Promote energy conservation and efficiency. Promote the West Michigan Sustainable Purchasing Consortium to encourage the use of recycled paper products.
Planning and Development	Increase accessibility to natural features, in part by, connecting the public transit system to green spaces. Reduce urban/suburban heat islands through "greening" of the Watershed. Encourage urban planning and environmentally friendly development guidelines. Preserve Green Space in undeveloped adjacent areas. Promote development in commercial areas facing and along the river rather than backing up to river, the desired use of the river would be as a focal point. Incorporate flood protection into master recreation and access plan
Education	Encourage citizen awareness and stewardship. Target key Watershed stakeholders, including the agricultural community, local governments, and schools.
Other	Promote efforts to buy and produce locally grown food. Promote the arts in coordination with fundraising opportunities. Develop regional indicators to evaluate our progress at meeting desired uses. Change public perception of the Grand River. Make it a highly desired amenity.

3.2 WATER QUALITY STANDARDS

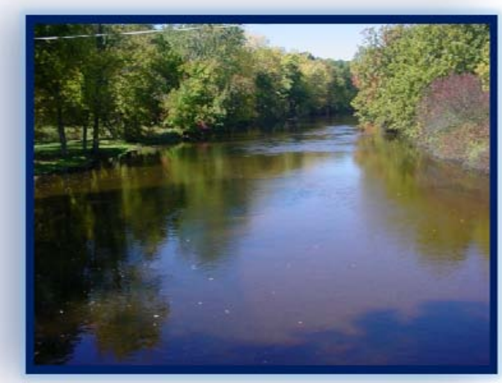
For purposes of defining water quality within this WMP, the following standards were applied:

- **Temperature:** Heat load cannot cause exceedance of monthly limits (maximum 68°F in June, July, and August for coldwater streams; and maximum 77°F in July and August [Creal and Wuycheck 2002]).
- **DO:** For coldwater streams, a 7 mg/L minimum applies and in warmwater streams a 5 mg/L minimum applies. Also, no water body can be lowered more than an additional 1 mg/L DO during warm weather seasons.
- **Total Suspended Solids:** MDNRE accepts an informal target of 80 mg/L total suspended solids for wet weather events
- **Pathogens:** Geometric daily mean of 130 count/100 mL for total body contact recreation (May 1 to October 31), Geometric daily mean of 1,000 count/100 mL for partial body contact recreation, single grab sample of 300 count/100 mL at beaches.
- **Total Phosphorus**: Total Phosphorus Water Quality Standards are 1 mg/L as a maximum monthly average from point source discharges. MDNRE may set higher or lower limits in order to meet narrative standard, which states "Nutrients shall be limited to the extent necessary to prevent stimulation of growth of aquatic rooted, attached, suspended, and floating plants, fungi, or bacteria which are or may become injurious to the designated uses of the surface waters of the state." Target nutrient values for Morrison Lake, located in the Lake Creek Subwatershed Management Unit, are based on the Total Maximum Daily Loads (TMDL): "Spring turnover period meets the target value of 0.030 mg/L over a sustained period of time and under various flow regimes". Other water bodies in the Watershed that are on the 303(d) list as having excessive nutrients, phosphorus, algal blooms, or other impairments related to nutrients will have specific standards set with the development of a TMDL Table 3.2 includes a list of those waterbodies.
- **pH:** 6.5 to 9 s.u. (standard unit).

Water quality standards, and the MDNRE rules by which they are determined, as applied to designated uses for all waters of the state can be found in Appendix 3.1.

3.3 WATERSHED INVENTORY AND CONDITIONS

An assessment of the Watershed's overall health was completed to determine water quality conditions and to identify potential pollutants entering the Lower Grand River Watershed (LGRW). Existing documents and data were reviewed for the entire LGRW, as cited in the following sections. In addition, NPS inventories were conducted in Deer Creek and Bass River to characterize water quality conditions.



3.3.1 303(d) Listed Waters

Section 303(d) of the Clean Water Act requires the Michigan Department of Environmental Quality to assess all water resources, and prepare a biennial Integrated Report on the quality of its water resources as the principal means of conveying water quality protection/monitoring information to the U.S. Environmental Protection Agency (USEPA). The Integrated Report satisfies the listing requirements of Section 303(d) and the reporting requirements of Section 305(b) and 314 of the Clean Water Act. The Section 303(d) list includes Michigan water bodies that are not attaining one or more designated use and require the establishment of TMDLs) to meet and maintain Water Quality Standards. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet applicable water quality standards. The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide a basis for determining the pollutant reductions necessary from both point and NPS pollution to restore and maintain the quality of their water resources. Table 3.2 includes a list of stream reaches in the Watershed having an approved TMDL or scheduled for the development of a TMDL. Municipal Separate Storm Sewer System (MS4) Communities required to address the TMDLs in waterbodies within their jurisdiction are also listed. This WMP focuses on TMDLs listed in the MDNRE 2010 Integrated Report concerning sedimentation/siltation (SS), dissolved oxygen (DO), phosphorus (PHOS), *E. coli*, and bacterial slimes (BS). Figure 3.1 A-D depicts the location of these stream reaches within the Watershed. All waterbodies on the 303(d) list within the Watershed, including those with polychlorinated biphenyls (PCBs) and mercury, can be found in Appendix 3.2.

Table 3.2 – Summary of 2010 Integrated Report for Waterbodies in the LGRW

Subwatershed Management Units	Waterbody (MS4 Communitiy)	Impacted Miles/ Acres	Other Indigenous Aquatic Life & Wildlife	Other TMDL Date	Warmwater Fishery	Warmwater TMDL Date	Cold Water Fishery	Cold Water TMDL Date	Partial Body Contact Recreation	Partial TMDL Date	Total Body Contact Recreation	Total TMDL Date
Bass River	Bass River	45.3 M			NS - SS	2005			NS - E. coli	2005	NS - E. coli, SS	2005
	Bass Creek, Bass River, Bear Creek, and Little Bass Creek (Allendale Twp., George-town Twp.)	55.6 M			NS - SS	2005			NS - E. coli	2005	NS - E. coli, SS	2005
Buck Creek	Buck Creek and Pine Hill Creek (Grandville, Kentwood, Wyoming, KCDC)	11.4 M							NS - E. coli	2006	NS - E. coli	2006
Coldwater River	Little Thornapple River and Woodland Creek	24.6 M	NS - Unknown	2016								
	Tyler/Bear Creek	18.5 M							NS - E. coli	2005	NS - E. coli	2005
	Coldwater River	39.3 M							NS - E. coli	2005	NS - E. coli	2005
Coopers, Clear, and Black Creeks	Lincoln Lake Pine Resort Beach- NW of Greenville	0.2 M							NS - E. coli	2006	NS - E. coli	2006
Crockery Creek	Rio Grande Creek	31.8 M							NA		NS - E. coli	2003

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Deer Creek	Beaver Creek, Deer Creek, and Little Deer Creek	63.6 M			NS - PHOS, DO	2012			NS - E. *coli*	2012	NS - E. *coli*	2012
Direct Drainage to Lower Grand River	York Creek (Walker, KCDC)	5.9 M					NS-AWH & SS	2005				
	Grand River (Grand Rapids, Grand Rapids, Twp., Grandville, Plainfield Twp., Walker, Wyoming, KCDC, OCDC, OCRC)	4.0 M							NS - E. *coli*	2006	NS - E. *coli*	2006
	Unnamed Tributary to Grand River	7.2 M					NS-OASA, OFRA	2016				
	Unnamed Tributary to Grand River (Grand Rapids Twp., KCDC)	3.0 M					NS - SS	2005				
	Grand River (Grand Rapids, Grand Rapids, Twp., Grandville, Plainfield Twp., Walker, Wyoming, KCDC, OCDC, OCRC)	3.0 M							NS - E. *coli*	2006	NS - E. *coli*	2006

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Direct Drainage to Lower Grand River (cont.)	Maplewood Lake Park Beach	0.2 M							II		NS - E. *coli*	2021
	Ottawa Creek	7.7 M	NS - BS	2016								
	Grand River Grand Haven Boaters Park Beach	1.0 M							NS - E. *coli*	2016	NS - E. *coli*	2016
Indian Mill Creek	Indian Mill Creek	2.4 M	NS - SS	2016								
Lake Creek	Morrison Lake	294.5 A	NS- Excess Algae and PHOS	2008	NS - PHOS	2008						
Lower Thornapple River	Unnamed Tributary to Thornapple River	3.6 M	NS - BS	2016								
Mill Creek	Strawberry Creek (KCDC)	3.6 M					NS- OASA, OFRA, SS	2005				
	Mill Creek	17.6 M	NS- OASA, OFRA	NA			NS- OASA, OFRA	NA				
Mud Creek	Gravel Brook, Hagar Creek , and Mud Creek	44.1 M			NS - OASA, OFRA	NA						
Plaster Creek	Plaster Creek (Cascade Twp., Grand Rapids, Grand Rapids, Twp., Kentwood, Wyoming, KCDC	42.6 M	NS - SS	2002					NS - E. *coli*	2002	NS - E. *coli*	2002
	Little Plaster Creek, Plaster Creek, and Whisky Creek	32.5 M	NS - SS	2002					NS - E. *coli*	2002	NS - E. *coli*	2002

Table 3.2 – Summary of 2010 Integrated Report for Waterbodies in the LGRW

Subwatershed Management Units	Waterbody (MS4 Communitiy)	Impacted Miles/ Acres	Other Indigenous Aquatic Life & Wildlife	Other TMDL Date	Warmwater Fishery	Warmwater TMDL Date	Cold Water Fishery	Cold Water TMDL Date	Partial Body Contact Recreation	Partial TMDL Date	Total Body Contact Recreation	Total TMDL Date
Rush Creek	Rush Creek	35.0 M	NS- OASA, OFRA	NA								
Sand Creek	East Fork Sand Creek and Unnamed Tributaries to East Fork Sand Creek (Walker)	22.4 M					NS- OFRA & SS	2005				
	Sand Creek (Walker)	38.0 M					NS- OFRA & SS	2005				
	Sand Creek (Walker)	24.3 M					NS- OFRA & SS	2005				
Upper Thornapple River	Unnamed Tributary to Butternut Creek	3.5 M	NS- Unknown	2016								
	Little Thornapple River	34.0 M	NS- OASA, OFRA	NA								
	Thornapple River	27.0 M			NS - DO	2023						

Notes:
NA = Not Assessed, NS = Not Supporting, II = Insufficient Data, OASA = Other anthropogenic substrate alterations, OFRA = Other flow regime alterations, SS = Sedimentation/Siltation, PHOS = Phosphorus, AWH = Alterations in wetland habitats, DO = Dissolved Oxygen, BS = Bacterial Slimes

3.3.2 Water Chemistry

Sixteen subwatershed management units within the Watershed contain stream reaches that require TMDLs. Pollutants identified as impacting these waterbodies include: sediment, *E. coli*, phosphorus, PCBs, and mercury. Bacterial slimes, alterations to wetland habitats, reduced DO, other anthropogenic substrate alterations, and other flow regime alterations were also noted as concerns. These water quality impairments have resulted in the degradation of fish and macroinvertebrate communities.

In 2005, the MDNRE collected water quality samples from 44 locations along the Lower Grand River and its tributaries. Up to 34 parameters were assessed, including total dissolved solids, total phosphorus, and nitrogen (various forms). Water quality standards were not exceeded in samples collected from the Lower Grand River. Samples from several tributaries to the Lower

Grand River, however, were elevated. Nutrient levels (i.e., ammonia, total phosphorus) at 28 locations exceeded average reference values established for the ecoregion. Elevated nutrient concentrations in Libhart, Tibbets, and Crooked Creeks were attributed to storm water runoff inputs. Agriculture practices were suspected of elevating nutrient levels in Deer Creek (MDNRE 2003).

In 2005 to 2007, monitoring teams collected water samples from Buck Creek, Plaster Creek, and Coldwater River Watersheds to conduct *E. coli* testing. The Kent County Health Department performed the analysis and several samples were also sent to MSU for Molecular Source Tracking to determine the source of *E. coli.* The results in the Coldwater River Watershed identified human sources near the Village of Freeport. Samples from other areas identified bovine sources. More information can be found in the WMPs for those watersheds.

Additional water quality data can be found at www.michigan.gov/deq by searching "water quality monitoring". Information is available on beach water monitoring, inland lakes monitoring, surface water assessments, and the MiSWIM Information Management System.

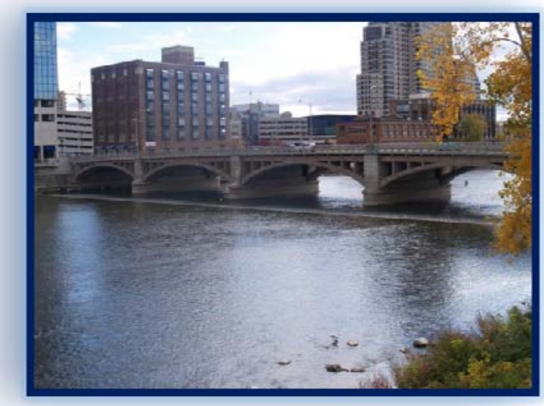
3.3.3 Biological Communities (Procedure 51)

The MDNRE conducts biological sampling using the Procedure 51 sampling protocol, typically, every five years in major Watersheds. This assessment includes a survey of the macroinvertebrate community, fishery, and habitat. The purpose of these assessments is to characterize the quality of the watercourses and to provide information necessary for making recommendations for improvements in water quality. The biological conditions of the major Subwatersheds within the Watershed are described below.

<u>Flat River</u>

According to the 2009 report (Walterhouse 2009), "Water quality throughout the Flat River Watershed was adequate to support excellent to acceptable biological communities at locations with suitable riparian and in-stream habitat. Compared to other Watersheds in southern Michigan, the degree of historic channelization and dredging of many of the streams, particularly the headwater streams, and the draining of wetlands is limited in the Flat River Watershed. The Flat River Natural River Plan (MDNR, 1979) provides an outline for preservation of the Watershed and contains suggested management controls and guidelines for management of the Flat River and tributaries."

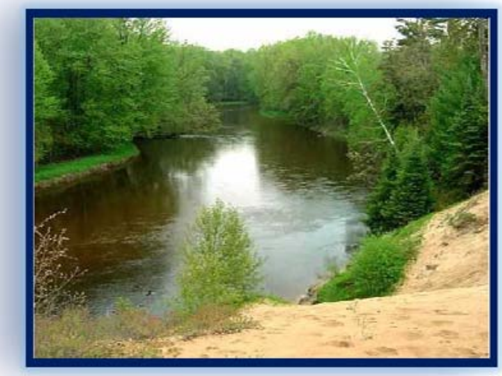
<u>Grand River</u>



In 2005, the MDNRE conducted biological assessments of the Lower Grand River and 29 of its tributaries (Rockafellow 2005). Assessments focused on watercourses from Portland downstream to Grand Haven, excluding the Rogue River, Flat River, and Thornapple River. NPS sites Nonpoint source sites of pollution were documented, such as unrestricted cattle access was observed in Libhart Creek, Sessions Creek, and Red Creek; a septic system discharge and barnyard runoff were observed to be degrading Plaster Creek at 68th Street; road stream crossing impacts were also noted in Plaster Creek; gully erosion along M-21 was contributing excessive sediment to Timberland Creek; steep gravel roads adjacent to Toles Creek were contributing sediment loads; rapid development within the Honey Creek Subwatershed was noted as increasing the potential for sediment loading; an unstable hydrologic regime was documented in York Creek and attributed to the high percentage of impervious surfaces, and as a result, gully and streambank erosion were evident in York Creek; the highest nutrient concentrations were documented in Deer Creek and sources were attributed to dairy operation, manure runoff, and agricultural practices.

In 2009, the MDNRE collected macroinvertebrate samples at 35 stations along the Lower Grand River and its tributaries. Only the north branch of Crockery Creek (24th Avenue) was found to have a poor macroinvertebrate community. Other stations were rated as acceptable or excellent based on this data. The final biosurvey report was not available for this plan, but is due for completion in 2010.

Rogue River



According to the 2009 report (Walterhouse 2009), "Water quality throughout the Rogue River Watershed was adequate to support excellent to acceptable biological communities at locations with suitable riparian and in-stream habitat. Compared to other Watersheds in southern Michigan, the degree of historic channelization and dredging of the main stem and its tributaries is limited, with the major exception of the headwaters of the Rogue River in Newaygo County. The draining of wetlands is also limited in the Rogue River Watershed compared to other Watersheds in southern Michigan." The approved includes more in-depth information about the condition of the watershed.

Thornapple River

According to the 2008 report (Rippke 2009), "Habitat scores ranged from poor at one site (Station 16) to excellent at three sites (Stations 5, 13, and 24). In general, flow flashiness, low frequency of riffles and bends, lack of channel sinuosity, and high sediment deposition were noted as problems at poor and marginal sites. All of these are symptoms caused by the channelization and straightening of the water bodies, particularly in headwaters. At stations where habitat was determined to be marginal, channel alteration was consistently noted as a problem and was often accompanied by a narrow or absent vegetated riparian buffer." Habitat at the three locations with excellent habitat scores was characterized by ample exposed cobble and woody debris. The 2008 report also stated that "Macroinvertebrate communities were sampled at 36 sites and scored excellent at 5 sites, acceptable at 27 sites, marginal at 1 site, and poor at 3 sites." The poor macroinvertebrate community ratings indicate that those 3 stream reaches, Little Thornapple River at M-43, Little Thornapple River at Vermontville Hwy, and Church Drain at Stewart Road, may not be attaining the "other indigenous aquatic life and wildlife" designated use. The approved Coldwater River Watershed Management Plan includes more in-depth information about the condition of the watershed.

Subwatershed Management Units

Biological assessments for Subwatershed Management Units in the Watershed can be found at http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728-54941--,00.html. The approved Watershed Management Plans for Buck Creek, Plaster Creek, and Sand Creek provide more information for those watersheds.

Additional information on studies and reports for each Subwatershed Management Unit can be found in the Watershed Assessment Matrix (http://www.gvsu.edu/wri/isc/lower-grand-watershed-interactive-tool-wit-create-a-watershed-management-plan-32.htm) and in the Subwatershed Management Unit Summary Sheets in Appendix 4.1.

3.3.4 Stream Inventory

As part of this project, the Annis Water Resources Institute completed NPS pollution inventories of Deer Creek and Bass River during the summer of 2009. The data sheet template, as well as detailed results of the inventory, can be found in Appendix 3.3. A number of additional stream inventories have been completed in the Watershed by the MDNRE and other environmental organizations. Stream assessments completed within the past 10 years are illustrated in Figure 3.2. The specific locations of NPS sites can be found on the Subwatershed Management Unit Summary Sheets in Appendix 4.1. Table 3.3 indicates the number and categories of NPS pollutant sites that were identified. The greatest sources of NPS pollution were the debris/trash/obstructions and urban/residential categories.

Table 3.3 – NPS Inventory Summary

Pollutant Source	Number of Sites per Subwatershed Management Unit										
	Plaster Creek[1]	Buck Creek[2]	Coldwater River[3]	Indian Mill Creek[4]	Sand Creek[5]	Upper and Lower Rogue River[6]	Upper and Lower Thornapple River[7]	Spring Lake[8]	Deer Creek[9]	Bass River[9]	Total
Nonpoint Agriculture Source	2		1	9	3	9	127		9	16	**176**
Streambank Erosion	8	16	1	16	19	1	42	7	2		**112**
Tile Outlet	2	2		5	3			62	4	2	**80**
Livestock Access		1	15	1	5	7	14		4		**47**
Debris/Trash/Obstructions	41	60	60	37	6		122				**326**
Urban/Residential	14	12	2	59	39		42		7	19	**194**
Construction	6	4		1					2		**13**
Other	4					6					**10**
Gully Erosion	1	3	4	1	6						**15**
Rill Erosion				3							**3**
Downcutting					1	4					**5**
Stream Crossing/Road Stream Crossing	6	1			13	5	170	13	2	1	**211**
Total NPS Sites	**84**	**99**	**83**	**132**	**95**	**32**	**517**	**82**	**30**	**38**	**1,192**

[1] Grand Valley Metropolitan Council (GVMC), Plaster Creek Watershed Management Plan, 2008

[2] GVMC, Buck Creek Watershed Management Plan, 2004.

[3] GVMC, Coldwater River Watershed Management Plan, April 2009.

[4] Sievert, Mary & Janice Tompkins. 2010. Summary of Indian Mill Creek Watershed Assessment. MNDRE, Field Operation Section, Water Division, Grand Rapids, MI.

[5] GVMC, Sand Creek Watershed Management Plan, July 2004.

[6] Annis Water Resources Institute, Rogue River Watershed Management Plan, December 2000.

[7] Barry Conservation District, Thornapple River Watershed Management Plan Draft, July 2009.

[8] Progressive AE. *Spring Lake Watershed Management Plan*. 2001

[9] Inventory of main branches of Deer Creek and Bass River was completed for this project.

3.3.5 Hydrologic Study

As part of this project, a hydrologic report for the LGRW was completed, including Michigan state-wide rating curves for extended detention control of the stream protection volume (Appendix 3.4). The focus of this study was to evaluate the impact urban development has on the stability of stream channels in the Watershed. More specifically, the intent was to compare the erosion potential of several common storm water management approaches for stream protection, to ensure that effective controls are being requested by local units of government within the Watershed. Several conclusions and recommendations were made as a result of this study.

This study concluded that both low impact development (LID) based retention practices and extended detention of storm water runoff can be effective tools for maintaining the stability of receiving stream channels in the Watershed. Since LID based retention practices seek to return the site hydrology to pre-developed conditions, it should be considered the preferred approach. If site or soil conditions do not allow full implementation of LID based practices, then extended detention, or a combination of LID and extended detention, should be used. The report also provided a set of rating curves which can be used to size extended detention basins. The report recommends that:

- LID based retention practices be the first priority for local storm water rules and ordinances for site development,
- Communities can choose to include extended detention as an alternative when site or soil conditions preclude effective use of LID based practices, and
- Communities adopt the rating curves to size extended detention basins.

3.3.6 Landscape-Level Wetland Functional Assessment

The MDNRE and AWRI completed a Landscape Level Wetland Functional Assessment (LLWFA) of all existing and historically lost wetlands in the Watershed. This methodology inventoried existing wetlands and determined what functions they are performing based on a possible list of 13 functions. Wetland functions include storing floodwater, providing wildlife habitat, and capturing sediment and nutrients, among others. In addition, historically lost wetlands were reviewed to determine the functions they once provided. The status and trends of wetland functions in the Watershed could then be determined. Appendix 3.5 includes a summary of the status and trends of wetland functions in the Watershed.

Results from the LLWFA indicated that 42% of wetlands have been lost in the Watershed since European settlement. Average wetland size has been reduced from 17 acres to 4.5 acres. The functions of shoreline stabilization (-62%) and sediment and other particulate retention (-59%) have experienced the largest losses in acreage. Other highlights of the project are as follows (AWRI, 2010):

- The greatest loss of wetland acreage occurred in the following Subwatershed Management Units:
  1) Direct drainage to the Grand River
  2) Upper Thornapple River
  3) Crockery Creek
  4) Coldwater River
  5) Bass River
- The highest percent loss of wetlands occurred in the following Subwatershed Management Units:
  1) Bass River
  2) Libhart Creek
  3) Rush Creek
  4) Buck Creek
  5) Spring Lake/Norris Creek

- In terms of the loss of wetland acreage by ecosystem function, the most impacted ecological services are:
  1) interior forest bird habitat
  2) floodwater storage
  3) nutrient transformation
  4) sediment and other particulate retention
  5) stream shading
- In terms of the loss of functional capacity, the most impacted ecological services are:
  1) sediment and other particulate retention
  2) interior forest bird habitat
  3) stream shading
  4) floodwater storage
  5) nutrient transformation
- The most abundant vegetated wetlands today are the forested wetlands (108,274 acres or 56% of all vegetated wetlands). The watershed has lost 233,545 acres of forested wetlands, a 68% reduction from Pre-European settlement times
- Emergent marsh (27%) and scrub shrub wetlands (16%) account for 53,183 and 30,476 acres, respectively, of current day vegetated wetlands in the watershed
- The topographic location or geomorphic setting of today's wetlands are terrene (i.e. surrounded by uplands: 45%), lotic stream (i.e., small creeks: 41%), lotic river (i.e.,large rivers: 9%), and lentic (i.e., lakes: 5%)
- Approximately 36% of terrene wetlands, 86% of lotic stream wetlands, and 57% of lentic wetlands are in a headwater position
- Since Pre-European settlement times, wetlands within a headwater position have been reduced from 242,533 acres to 120,297 acres, a reduction of 102%
- Overall, considering open water and vegetated wetlands, approximately 51% of all wetlands are in a headwater position
- Approximately 62% of all vegetated wetlands are in a distinct depression or basin, 25% are flat or nearly level, 8% are within a floodplain, and 3% are fringe wetlands within the banks of a river or stream, or within the shallow water zone of a lake
- In regards to hydrodynamics or water flow path, 51% of all wetlands (open water and vegetated) have water that flows into and passes through it (throughflow), 24% are isolated and have no obvious surface water connection to other wetlands or waters, 18% have water out flowing only, and 7% have bidirectional water flow where water levels fluctuate within a lake or river
- Of all lotic river or stream wetlands, 18,258 acres or 19% are impacted by draining and ditching. Of all terrene wetlands, 3,100 acres or 3.5% are impacted by draining and ditching
- Lotic stream wetlands have been reduced by 35% since Pre-European settlement times, losing approximately 43,341 acres. The mean size of the wetlands also has decreased from 37.2 acres to 12.8 acres
- Terrene wetlands have been reduced by 62% since Pre-European settlement times, losing approximately 142,536 acres. The mean size of the wetlands also has decreased from 12 acres to 3 acres

AWRI's website has the report posted that provides a description of all of the terms and more detailed information (http://www.gvsu.edu/wri/isc/lower-grand-river-watershed-wetlands-initiative-project-overview-313.htm)

Wetland Action Plans were completed for the Rogue River, Spring Lake/Norris Creek, and Dickerson Creek Subwatershed Management Units, and are included in Appendix 6.3.

3.3.7 Sewer Service Areas

Municipal sewer services are available within the metropolitan areas located in the Watershed. Outlying regions rely on individual septic systems. Historically, sanitary and storm water sewers were combined within the City of Grand Rapids. As a result, raw sewage overflowed into the Grand River during periods of heavy precipitation. In the late 1980s, the City of Grand Rapids (City) embarked on a comprehensive program to eliminate all combined sewer overflows (CSO) in the City. The result of these efforts has been over a 99% reduction in CSOs to date with less combined sewer overflow every year. Overflows are reported as two types as part of the State of Michigan CSO reporting requirements. In-system overflows occur when a sanitary sewer becomes overloaded due to storm water. The sanitary sewer overflows to a nearby storm sewer, and the untreated mixture of storm water and sanitary sewage flows to the Grand River. The Market Avenue Retention Basin (MARB) receives overflows when the wastewater plant reaches its treatment capacity of 90 million gallons per day. This flow is a mixture of storm water and sanitary sewage. MARB can store 30 million gallons, which is sufficient for most wet weather events. When volumes exceed 30 million gallons, MARB provides settling, floatable removal, disinfection using Sodium Hypochrite, and dechlorination utilizing Sulfer BiSulfate. The overflow to the river is designated as "partially treated" and is typically comparable to the wastewater plant effluent quality. The disinfection process typically results in fecal coliform (*E. coli* is a subset of fecal coliform) counts of less than 200 colonies per 100 milliliters. Only six in-system overflow points remain in the City, and the three that overflow most often will be eliminated by the end of 2010.

Other cities in the LGRW have separate sewer systems that were built after the era of combined sewer systems. However, the Cities of Jackson and Lansing, which are upstream from the Lower Grand River Watershed, both have combined sewer overflow problems that are being addressed with sewer separation projects similar to the City of Grand Rapids.

Although sanitary sewers sometimes overflow and spill untreated wastewater into the Grand River tributaries, connections to the sanitary sewer system do eliminate chronic pathogen and nutrient problems associated with failing septic systems. A number of tributaries in the Watershed have been placed on the state 303(d) list for nonattainment of state water quality standards for pathogens, as listed in Table 3.2. This problem can be partially attributed to the high rate of septic system failure in a number of communities. Figure 3.3 illustrates the approximate number of septic systems located within the Watershed. Many more problems may exist in areas where the water is not tested for the presence of disease-causing organisms.

3.3.8 Point Source

The MDNRE provides lists of NPDES storm water and industrial permits active within the Watershed's hydrologic boundary. A complete list of point source permittees can be found at http://www.deq.state.mi.us/owis/Page/main/Home.aspx. National Pollutant Discharge Elimination System (NPDES) MS4 Storm Water permittees located in the Watershed are listed in Table 3.4.

Table 3.4 – NPDES MS4 Storm Water Permitees

County	Permittee	
Ottawa County	Allendale Charter Township	Ferrysburg
	Georgetown Charter Township	Grand Haven
	Hudsonville	Spring Lake
Kent County	Cascade Charter Township	Plainfield Township
	East Grand Rapids	Rockford
	Grand Rapids	Sparta
	Grand Rapids Charter Township	Walker
	Grandville	Wyoming
	Kentwood	

3.4 WATERSHED POLLUTANT SUMMARY

Seven impairments have been identified as having an impact on designated uses of the Watershed. Provided below is a brief description of these impairments and the degradation they impose on the designated uses.

Impacts of Sediment on Designated Uses

The deposition of an excessive amount of sediment in a stream covers spawning habitat and generally degrades the aquatic habitat of fish and macroinvertebrate species. Excessive sediment also carries and deposits nutrients, impedes navigation of the watercourse, and degrades industrial water supplies.

Impacts of Nutrients on Designated Uses

Nutrients, including phosphorus and nitrogen, are necessary for the growth and reproduction of aquatic plants and for a healthy river. When not in balance, however, excessive nutrients can cause dense algal growths known as algal blooms. After the elevated nutrient source has been depleted, an algal bloom will die and decompose, reducing DO levels. Healthy warmwater fish and macroinvertebrate populations require DO levels to remain around 5 mg/L, while coldwater fish require DO levels of 7 mg/L. When lower DO levels are sustained for a period of time, fish and macroinvertebrate communities change to more tolerant species, and the stream or lake will no longer support a diverse species population.

Impacts of Unstable Hydrology on Designated Uses

Unnatural changes in stream flow or discharge (volume rate of water flow) can alter a stream's hydrologic regime. Aquatic habitats can subsequently become modified, resulting in degraded fish and invertebrate communities. These communities can be dominated by species tolerant to degraded conditions and, therefore, lack diversity and richness.

Impacts of Thermal Pollution on Designated Uses

Thermal pollution occurs when a waterbody is greatly influenced by an influx of water above or below its natural temperature, usually making the waterbody warmer. Thermal pollution can result in both increased water temperatures and reduced DO levels. This is detrimental to the aquatic life, especially if the water temperature historically supports a coldwater fishery and can no longer do so because of temperature increase. Extended or frequent detention of storm water could potentially create shallow ponds that heat up and have thermal impacts to streams.

Impacts of Chemicals on Designated Uses

Chemicals, such as pesticides, herbicides, and road salts, can leach through the soil and enter the groundwater and surface water, and may have negative impacts on wildlife. Certain chemicals also cause other environmental problems such as increased health risks or drinking water problems. Storm water runoff causes large concentrations of chemical contaminants to enter the water within a short time period.

Impacts of Habitat Fragmentation on Designated Uses

Habitat loss is a major concern for restoring and protecting wildlife and aquatic life. As wetland habitats become fragmented they lose their assimilative functions. Destruction and loss of habitat greatly impede plant and animal species, and can ultimately leave them without shelter or food sources. As habitat continues to degrade, populations will decrease and may cease to exist.

Impacts of Pathogens/Bacteria on Designated Uses

Bacterial pollution impairs the watercourse’s designated uses of partial and total body contact recreation. Pathogens and bacteria are present in manure and septic runoff, and high concentrations in surface water may pose severe health risks. The impact of *E. coli* pollution is a public health and safety issue. Fecal coliform bacteria, found in manure or septic waste, is also a serious health problem and an indicator of other serious pathogens and disease-carrying organisms. For this reason, surface waters utilized for agricultural uses (e.g., irrigation, livestock watering, and produce spraying) should not contain elevated levels of pathogens.

3.5 DESIGNATED USE SUMMARY

The Integrated Report determined the impairment status of the designated uses for all 31 Subwatershed Management Units. Field assessments, data reviews, and pollution assessments, as described previously in this WMP, were used by the Steering Committee to determine if a designated use was threatened. Table 3.5 depicts the status of each designated as either met (M), impaired (I) or threatened (T) and identifies the pollutant causing the impairment or threat.

Table 3.5 – Status of Designated Uses

Subwatershed Management Units	Agriculture	Other Indigenous Aquatic Life & Wildlife	Warmwater Fishery	Coldwater Fishery	Partial Body Contact Recreation	Total Body Contact Recreation	Navigation	Industrial Water Supply*	Public Water Supply
Bass River	Met	Threatened by Sediment, Nutrients	Impaired by Sediment; Threatened by Nutrients	Not Assessed	Impaired by *E. coli*	Impaired by *E. coli*, Sediment	Met	Not a Use	Not Assessed
Bear Creek	Met	Met	Not Assessed	Met	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Bellemy Creek	Met	Met	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Buck Creek	Met	Threatened by Sediment	Threatened by Sediment, Nutrients	Threatened by Sediment, Nutrients, Road Salt	Impaired by *E. coli*	Impaired by *E. coli*	Met	Not a Use	Not Assessed
Cedar Creek	Met	Met	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Coldwater River	Met	Impairment Unknown; Threatened by Sediment, Nutrients, Hydrology	Threatened by Sediment, Hydrology	Threatened by Sediment, Nutrients, Temperature, Hydrology	Impaired by *E. coli*	Impaired by *E. coli*	Met	Not a Use	Not Assessed
Coopers, Clear, and Black Creeks	Met	Met/Not Assessed	Not Assessed	Not Assessed	Impaired by *E. coli*	Impaired by *E. coli*	Met	Not a Use	Not Assessed
Crockery Creek	Met	Threatened by hydrology	Not Assessed	Not Assessed	Not Assessed	Impaired by *E. coli*	Met	Not a Use	Not Assessed

Table 3.5 – Status of Designated Uses

Subwatershed Management Units	Agriculture	Other Indigenous Aquatic Life & Wildlife	Warmwater Fishery	Coldwater Fishery	Partial Body Contact Recreation	Total Body Contact Recreation	Navigation	Industrial Water Supply*	Public Water Supply
Deer Creek	Met	Threatened by Sediment, Nutrients	Impaired by Phosphorus and Low Dissolved Oxygen; Threatened by Sediment	Not Assessed	Impaired by *E. coli*	Impaired by *E. coli*	Met	Not a Use	Not Assessed
Dickerson Creek	Met	Met	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Direct Drainage to Lower Grand River	Met	Impaired by Bacterial Slimes; Threatened by Hydrology	Threatened by Hydrology	Impaired by Altered Wetland Habitat, Sediment, OASA, OFRA; Threatened by Hydrology	Impaired by *E. coli (except insufficient Info for Maplewood Lake)*	Impaired by *E. coli*	Met	Met	Not Assessed
Fall Creek	Met	Met	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Glass Creek	Met	Met	Not Assessed	Met	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
High Bank Creek	Met	Met	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Indian Mill Creek	Met	Impaired by Sediment	Not Assessed	Threatened by Sediment	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Lake Creek	Met	Impaired by Excess Algae and Phosphorus	Impaired by Phosphorus	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed

Table 3.5 – Status of Designated Uses

Subwatershed Management Units	Agriculture	Other Indigenous Aquatic Life & Wildlife	Warmwater Fishery	Coldwater Fishery	Partial Body Contact Recreation	Total Body Contact Recreation	Navigation	Industrial Water Supply*	Public Water Supply
Libhart Creek	Met	Met	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Lower Flat River	Met	Met/Insufficient Information	Met/Not Assessed	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Lower Rogue River	Met	Met/Not Assessed	Threatened by Sediment, Nutrients, Hydrology	Threatened by Sediment, Nutrients, Temperature, Hydrology	Threatened by *E. coli*	Threatened by *E. coli*	Met	Met	Not Assessed
Lower Thornapple River	Met	Impaired by Bacterial Slimes; Threatened by Hydrology	Met/Not Assessed/Insufficient Information	Not Assessed	Threatened by *E. coli*	Threatened by *E. coli*	Met	Not a Use	Not Assessed
Mill Creek	Met	Impaired by OASA, OFRA	Not Assessed	Impaired by OASA, OFRA, & Sediment	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Mud Creek	Met	Met	Impaired by OASA, OFRA	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Plaster Creek	Met	Impaired by Sediment; Threatened by Nutrients, Temperature, Hydrology	Threatened by Sediment, Nutrients, Temperature, Hydrology	Not Assessed	Impaired by *E. coli*	Impaired by *E. coli*	Met	Not a Use	Not Assessed

Table 3.5 – Status of Designated Uses

Subwatershed Management Units	Agriculture	Other Indigenous Aquatic Life & Wildlife	Warmwater Fishery	Coldwater Fishery	Partial Body Contact Recreation	Total Body Contact Recreation	Navigation	Industrial Water Supply*	Public Water Supply
Prairie Creek	Met	Met/Insufficient Information	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Rush Creek	Met	Impaired by OASA, OFRA; Threatened by Hydrology	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Sand Creek	Met	Threatened by Sediment, Nutrients, Temperature, Hydrology	Not Assessed	Impaired by OFRA & Sediment, Threatened by Nutrients, Temperature, Hydrology	Threatened by *E. coli*	Threatened by *E. coli*	Met	Not a Use	Not Assessed
Spring Lake / Norris Creek	Met	Threatened by Sediment, Nutrients	Threatened by Sediment, Nutrients	Not Assessed	Threatened by *E. coli*	Threatened by *E. coli*	Met	Met	Not Assessed
Upper Flat River	Met	Met	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed
Upper Rogue River	Met	Met/Insufficient Information	Threatened by Sediment, Nutrients, Hydrology	Threatened by Sediment, Nutrients, Temperature, Hydrology	Threatened by *E. coli*	Threatened by *E. coli*	Met	Not a Use	Not Assessed

Table 3.5 – Status of Designated Uses

Subwatershed Management Units	Agriculture	Other Indigenous Aquatic Life & Wildlife	Warmwater Fishery	Coldwater Fishery	Partial Body Contact Recreation	Total Body Contact Recreation	Navigation	Industrial Water Supply*	Public Water Supply
Upper Thornapple River	Met	Impaired by OASA, OFRA; Threatened by Hydrology	Impaired by Low Dissolved Oxygen; Threatened by Hydrology	Not Assessed	Threatened by *E. coli*	Threatened by *E. coli*	Met	Not a Use	Not Assessed
Wabisis and Beaver Dam Creek	Met	Met/Insufficient Information	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Met	Not a Use	Not Assessed

Notes: OASA = Other anthropogenic substrate alterations, OFRA = Other flow regime alterations
* Source = withdrawals registered with the MDNRE Water Use Program per correspondence with Mr. Andrew LeBaron (2/25/2010)