6.0 Water Quality Assessment

North Branch Pike River, South Branch Pike River and Pike River are the primary streams in Pike River watershed. North Branch Pike River begins in the north western portion of the watershed and generally flows south for 6.9 miles before joining South Branch Pike River near the intersection of State Highway 31 and County Trunk Highway A. South Branch begins in the southwest portion of the watershed, south of the Kenosha Regional Airport and generally flows north for about 7.8 miles before joining Pike River. After the confluence of North and South Branch, Pike River flows east and then south for approximately 9.6 miles to Lake Michigan.

6.1 Point and Nonpoint Source Pollutants

Water quality can be adversely affected by both point and nonpoint source pollutants. Point sources are identified as any discharge that comes from a pipe or permitted outfall, such as municipal and industrial discharges. Municipal and industrial discharges to Pike River and tributaries are regulated by Wisconsin's stormwater runoff permits. There is one municipal wastewater treatment plant outfall in the watershed which is located on Lake Michigan in the City of Racine. Many stormwater discharges are located throughout the Pike River watershed; however, the location of each discharge is not available for this study.

WPDES Permit Program

Section 402 of the federal Clean Water Act established the National Pollutant Discharge Elimination System. This program regulates point source discharges of pollutants into United States waters and sets specific limits on discharges from point sources, establishes monitoring and reporting requirements, and establishes exceptions. The permitting program is designed to prevent storm water runoff from washing harmful pollutants into local surface waters such as streams, rivers, lakes or coastal waters. It also allows for the USEPA to authorize states to assume many of the permitting, administrative and enforcement responsibilities of the program (EPA, 2012).

The Wisconsin Department of Natural Resources (WDNR) developed the Wisconsin Pollutant Discharge Elimination System (WPDES) Storm Water Discharge Permit Program which is administered under the authority of ch. NR 216, Wis. Adm. Code. The WPDES Storm Water Program regulates the discharge of storm water from construction sites, industrial facilities, and municipal separate storm sewer systems (MS4s).

Individual WPDES permits are issued to municipal and industrial facilities discharging to surface water and/or groundwater. General permits are issued for specific categories of industrial, municipal and other wastewater discharges. Municipal Separate Storm Sewer System (MS4) permits require municipalities to reduce polluted storm water runoff by implementing storm water management programs with best management practices. The MS4 permits usually do not contain numerical effluent limits like other WPDES permits (WDNR, 2012).

WPDES Permit Sites

One municipal permit has been issued for a waste water treatment plant in the City of Racine located in the Direct Drainage portion of the watershed along Lake Michigan. However, this plant discharges directly to Lake Michigan and therefore is not a pollutant source to Pike River. Just over

thirty industrial permit sites are located throughout the watershed along Pike River, its tributaries, and the Direct Drainage area.

In 1983, Pike River's Waxdale Creek tributary experienced a spill from a point source discharge site that resulted in a documented fish kill of 14,000 fish. No subsequent fish kills have been reported on Waxdale Creek or North Branch Pike River. The source of the pollutant was never determined, but was defined as an acute toxicity.

Between 1990 and 1994, the S.C. Johnson & Son plant in Sturtevant self-reported discharging a total of 510 pounds of toxic chemicals into Waxdale Creek, 420 pounds of which were reported as glycol ethers, typically used as a solvent (Environmental Working Group, 1994). In 1998, the Department of Natural Resources removed the chronic toxicity for Waxdale Creek from the Clean Water Act Section 303(d) Impaired Waters list noting that the chronic toxicity was the result of the 1983 discharge from an unknown source, and not reflective of current conditions.

Nonpoint Source Pollutants

Nonpoint source pollutants are pollutants that enter a waterway from a source other than a pipe or permitted outfall. Historically these pollutants are the most difficult to control because tracking them back to their source is difficult. Nonpoint source pollutants can include, but are not limited to, illicit discharges into waterways, excess nutrients (such as nitrogen and phosphorus), oils and chemicals washed off of roadways (such as chlorides from deicing agents), and/or excess sediment (from construction or bank destabilization). Most nonpoint source pollutants are monitored for through physical-chemical water quality testing.

6.2 Water Quality Report, Designated Use, & Impairments for Pike River

The Federal Clean Water Act requires Wisconsin and all other states to submit to the United States Environmental Protection Agency (USEPA) a biannual report of the quality of the state's surface and groundwater resources and an updated Section 303 (d) list. The *Wisconsin Water Quality Report to Congress – Year 2012* was compiled by the Wisconsin Department of Natural Resources's (WDNR's) Water Division and is the most recent of these reports. These reports must also describe how Wisconsin assessed water quality and whether assessed waters meet or do not meet water quality standards specific to each "Designated Use" of a stream or lake as defined in chs. NR 102, 104, and 105 of the Wisconsin Administrative Code. When a waterbody is determined through biological and/or physical-chemical sampling to be impaired, WDNR must list potential causes and sources for impairment in the 303 (d) impaired waters list.

WDNR developed four general Designated Uses which define the goals for a waterbody for all Wisconsin surface waters: Fish and Aquatic Life, Recreational Use, Public Health and Welfare, and Wildlife. Each designated use is associated with particular water quality criteria that are either numeric or narrative in nature and set the standards a waterbody must meet in order to protect the intended use.

The Fish and Aquatic Life use designation is appropriate for the protection of fish and other aquatic life and is subdivided into further categories – coldwater, warmwater sport fish, warmwater forage fish, limited forage fish, and limited aquatic life. The recreational use designation means a stream is appropriate for recreational use unless a sanitary survey has been completed to show that humans are unlikely to participate in activities requiring full body immersion. The Public Health and Welfare

use designation means it is appropriate to protect for incidental contact and ingestion by humans. Finally, the Wildlife use designation means it is appropriate to protect wildlife that relies directly on the water to exist or rely on it to provide food for existence (WDNR, 2012). The highest attainable use for the Pike River is Fish and Aquatic Life – warmwater sport fish. The highest designated use for Waxdale Creek is Fish and Aquatic Life – limited forage fish.

Wisconsin also utilizes an anti-degradation policy as a component of protecting waters. This policy is aimed at ensuring that high quality waters are prevented from being degraded by identifying them as either Outstanding Resource Waters or Exceptional Resource Waters. No waterbodies within Pike River watershed have been classified as either Outstanding or Exceptional Resource Waters.

The overall condition of Pike River is poor. According to WDNR's Draft 2012 303(d) list, Pike River and Waxdale Creek are 303(d) listed, as well as Alford Park Beach and Pennoyer Park Beach along Lake Michigan. The main stem of the Pike River from the mouth at Lake Michigan to the junction of Pike River and South Branch is proposed to be newly 303(d) listed because of excessive amounts of phosphorus resulting in a degraded biological community. The North Branch Pike River from the junction of South Branch to the headwaters of Pike River is 303(d) listed for an unknown pollutant and for sediment/total suspended solids resulting in chronic aquatic toxicity and degraded habitat. Waxdale Creek is 303(d) listed for an unknown pollutant that has since been removed as well as sediment/total suspended solids resulting in chronic aquatic toxicity and degraded habitat.

In Wisconsin, a Total Maximum Daily Load (TMDL) analysis must be completed for all impaired waters. WDNR is currently conducting TMDLs throughout the state on a prioritized basis. While a TMDL will eventually need to be done for Pike River once it is 303(d) listed, it is not currently a high priority at the state level.

Table 23 includes a summary of Designated Use Impairments for Pike River, South Branch Pike River, North Branch Pike River, and Waxdale Creek. The Pike River refers to the Pike River from the mouth at Lake Michigan to the junction of Pike River and South Branch Pike River and Pike River North Branch refers to the Pike River from the junction of the Pike River and South Branch Pike River up to the headwaters of Pike River.

Table 23. Designated Use Impairments for Pike River and tributaries.

Designated Use	Assessment	Impaired Status	Pollutant	Impairment
Pike River				
Fish & Aquatic Life	Not Supporting	Proposed to be 303(d) listed	Phosphorus	Degraded biological community
Recreational Use	Full Body Contact	-	-	-
Public Health & Welfare	General Advice	-	-	-
Wildlife	NA	-	-	-
North Branch Pike River				
Fish & Aquatic Life	Not Supporting	303(d) listed	Unknown Pollutant, Sediment/Total Suspended Solids	Chronic Aquatic Toxicity, Degraded Habitat
Recreational Use	Full Body Contact	-	-	-
Public Health & Welfare	General Advice	-	-	-
Wildlife	NA	-	-	-
South Branch Pike River				
Fish & Aquatic Life	Not Assessed	NA	-	-
Recreational Use	Full Body Contact	-	-	-
Public Health & Welfare	General Advice	-	-	-
Wildlife	NA	-	-	-
Waxdale Creek				
Fish & Aquatic Life	Not Supporting	Pollutant Removed, 303d Listed	Unknown Pollutant, Sediment/Total Suspended Solids	Chronic Aquatic Toxicity, Degraded Habitat
Recreational Use	Full Body Contact	-	-	-
Public Health & Welfare	General Advice	-	-	-
Wildlife	NA	-	-	-

Source: Draft 2012 WDNR 303(d) list

6.3 Water Quality Monitoring

In Wisconsin, biological monitoring, habitat monitoring, and chemical monitoring are all used to assess the health of a stream and to determine water quality condition and/or impairment. Fish Indices of Biological Integrity and Macroinvertebrate Indices of Biological Integrity are used to assess the biological health of streams. Biological data is augmented by the physical-chemical sampling results obtained in the field. Several fish IBI surveys have been completed and many of the nonpoint source pollutants have been tested for via physical-chemical water quality samples conducted at various sites along Pike River.

Table 24 lists all known physical-chemical and biological data collected in the watershed from 2006 to late 2012 while Figure 56 displays the location of each sample site where the data was collected. In general, the most recent data is analyzed and averaged so that recommendations and management strategies are based on the most current depiction of the water quality and biological conditions.

Table 24. List of most recent chemical (H2O) and biological (BIO) water quality sample sites. All samples listed below were conducted by WDNR. In some cases only the most recent testing dates are listed.

AES Site ID	Location	Date(s)	Water Quality and other Parameters
H2O01	Pike River - Downstream Sth 32 Pr6	2/3/12, 12/2/11, 3/12/12, 11/4/11, 9/28/11, 10/5/11, 2/17/12, 2/29/12, 3/5/12, 3/7/12	Temp, chloride, Spec. Cond.
H2O02	PIKE RIVER - NORTH BRANCH	7/22/12, 6/28/12, 6/7/12, 5/16/12, 10/18/11, 9/29/11	Temp, DO, dissolved oxygen saturation, pH, Turb.
H2O03	Pike River - Pike River3at Hwy E	4/23/07, 3/29/07, 2/27/07, 1/24/07, 12/13/06, 11/28/06	NH3, CaCO3, DO, Flow, N, TKN, pH, P, Spec. Cond., Temp, TSS, Turb.
H2O04	Pike River Along Pike River Pathway at the intersection of Lannon Terrace and Oakes Road. North of bridge about 50 ft	3/12/12, 3/7/12, 3/5/12, 2/29/12, 10/5/11, 9/28/11	Temp, chloride, Spec. Cond.
H2O05	Pike River Along the lake shore adjacent to Carthage College	3/12/12, 3/5/12, 2/17/12, 2/3/12, 12/2/11, 11/4/11	Temp, chloride, Spec. Cond.
H2O06	Pike River Along the Pike River Pathway on the south side of the first walking bridge crossing the river	3/12/12, 2/29/12, 10/5/11, 9/28/11	Temp, chloride, Spec. Cond.
H2O07	Pike River at County Highway E	11/18/09, 10/27/09	DO, dissolved oxygen saturation, flow, pH, Spec. Cond., stream stage, Temp, Turb
H2O08	PIKE RIVER AT USGS STATION, UW PARKSIDE	7/22/12. 6/28/12, 6/7/12, 5/11/12, 10/18/11, 9/29/11	Temp, DO, dissolved oxygen saturation, pH, Turb.
H2O09	Pike River Downstream Of Campus Dr	5/18/10, 9/30/09/ 8/21/09, 7/22/09, 7/15/09	Temp, DO, dissolved oxygen saturation, pH, Turb.
H2O10	Pike River north of mouth to Lake Michigan	3/12/12, 2/29/12, 2/3/12, 12/2/11, 11/4/11, 10/5/11	Temp, chloride, Spec. Cond.
H2O11	Pike River north of the parking lot, opposite entrance	3/12/12, 3/7/12, 2/29/12, 2/17/12, 2/2/12, 12/2/11, 11/4/11	Temp, chloride, Spec. Cond.
H2O12	Pike River South side of first bridge at northern entrance to Carthage College	3/12/12, 3/7/12, 3/5/12, 2/29/12, 2/17/12, 2/3/12, 12/2/11, 11/4/11	Temp, chloride, Spec. Cond.
H2O13	Pike River south side of walking bridge	3/12/12, 3/7/12, 3/5/12, 2/29/12, 2/2/12, 12/2/11, 11/4/11	Temp, chloride, Spec. Cond.
H2O14	Pike River West Side of First Bridge on HWY Y north of HWY E	3/12/12, 3/7/12, 3/5/12, 2/29/12, 2/17/12, 2/2/12, 12/2/11, 11/4/11	Temp, chloride, Spec. Cond.
H2O15	Pike River West side of HWY E Bridge between HWY Y and Sheridan Road	5/10/12, 3/12/12, 3/7/12, 3/5/12, 2/29/12, 2/17/12, 2/2/12, 12/2/11, 11/4/11	Temp, chloride, Spec. Cond.
H2O16	Pike River West side of walking bridge at middle entrance to Carthage College	3/12/12, 3/7/12, 3/5/12, 2/29/12, 2/17/12, 2/3/12, 12/2/11, 11/4/11	Temp, chloride, Spec. Cond.
H2O17	Pike River, South Branch at Sth 31 (Bi Sur)	7/23/12, 6/28/12, 6/7/12, 5/16/12, 10/18/11, 9/29/11, 9/6/11, 8/15/11	Temp, DO, dissolved oxygen saturation, pH, Turb.
H2O18	Pike River, Unnamed Tributary - Un Trib To Reclamation Landfill	5/10/12, 3/12/12, 3/7/12, 3/5/12, 2/29/12, 2/17/12, 2/2/12, 12/2/11, 11/4/11	Temp, chloride, Spec. Cond.
H2O19	Trib To Pike River Near 16th	5/18/10, 9/30/09, 8/21/09, 7/22/09, 7/15/09, 6/24/09, 6/17/09, 5/29/09	Temp, DO, dissolved oxygen saturation, pH, Turb.
BIO01	Upstream of Hwy 32	7/29/1999	Water quality using Index of Biotic Integrity (IBI)
BIO02	Upstream of Hwy E	9/9/2003, 9/15/10	Water quality using Index of Biotic Integrity (IBI)
BIO03	Pike River @ Hwy A (downstream of Kenosha Country Club)	8/26/2003, 9/2/2010	Water quality using Index of Biotic Integrity (IBI)
BIO04	Pike River Upsteam of Hwy A, near UW-Parkside Campus	7/19/1999, 8/26/2003, 8/11/2009, 9/2/2010	Water quality using Index of Biotic Integrity (IBI)
	KEY:	NH3 = ammonia	CaCO3= calcium carbonate
	DO = dissolved oxygen	N = inorganic nitrogen (nitrate and nitrite as N)	Turb = turbidity
	P = phosphate-phosphorus as P	TKN = kjeldahl nitrogen	TSS = total suspended solids
	IBI = Index of Biotic Integrity	Spec. Cond.= specific conductivity	pH=acid/base scale

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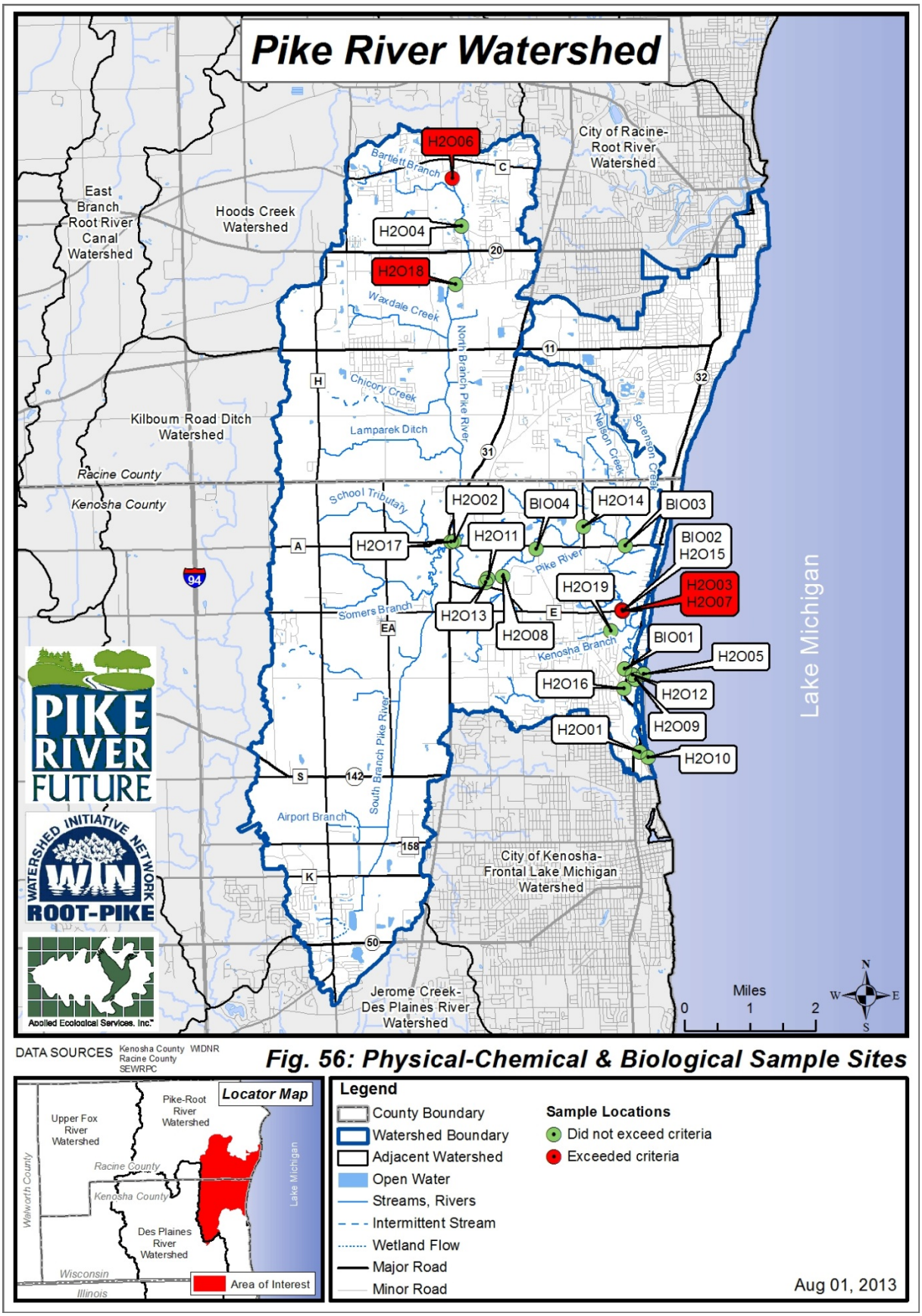

Fig. 56: Physical-Chemical & Biological Sample Sites

Water Chemistry Monitoring

WDNR lists Pike River as being impaired for several Designated Uses. According to WDNR's Draft 2012 303(d) list, Pike River, North Branch Pike River, and Waxdale Creek are all considered non-supporting for the Fish and Aquatic Life designated use. Pike River is non-supporting of the Fish and Aquatic Life designated use due to excessive amounts of phosphorus resulting in a degraded biological community. North Branch Pike River and Waxdale Creek both fail to support the Fish and Aquatic Life designated use due to an unknown pollutant and for sediment/total suspended solids resulting in chronic aquatic toxicity and degraded habitat.

Table 25 summarizes the WDNR water quality sample results for Pike River watershed from 2006 to late 2012 and also provides statistical and numerical guidelines for the various criteria. This data was included because it meets the data quality guidelines as determined by "WDNR Quality Management Program" and are equivalent to the EPA Quality Assurance Program Plan, including sampling techniques and use of qualified laboratories (WisCalm, 2012). Wisconsin provides numeric guidelines within its administrative code for temperature, dissolved oxygen, pH, and phosphorus within NR 102. Wisconsin has not yet derived their own guidelines for the remaining criteria so national standards were utilized. Criteria for chlorides, specific conductivity, turbidity, inorganic nitrogen, kjeldahl nitrogen, and ammonia reference general guidelines set forth by the USEPA for the nation or relevant ecoregion where applicable. The United States Geological Survey provided the reference conditions for total suspended solids.

Baseline water quality monitoring data is being collected by the Racine Health Department and funded by the City of Kenosha through two grants (Coastal Management and Fund for Lake Michigan), under the direction of Dr. Julie Kinzelman, and began in May of 2012 and will be completed in 2014. A preliminary summary of the work to date and related test locations was completed in March of 2013. Data collected included air temperature, water temperature, dissolved oxygen, pH, conductivity, turbidity, *E. coli*, and total phosphorus. Preliminary results demonstrate that at the testing point closest to where the waters of the Pike River leave the watershed, the average phosphorus reading was .22 mg/L and well over the recommended standard of 0.075 mg/L. A full report will be available from the City of Racine in 2014.

Immediately prior to plan completion, the City of Racine Health Department released an additional dataset containing *E.coli* results for Alford Park Beach, Pennoyer Park Beach, and the Mouth of Pike River between May 30th and July 29th, 2013. These results are included in Appendix C, but show multiple recreational advisory readings for Alford Park Beach and multiple advisory and beach closing readings for Pennoyer Park Beach and the Mouth of Pike River.

Additional water quality monitoring of chloride levels in Pike River has also been conducted by Carthage College. Dr. Christine Blaine, a member of the chemistry department, has produced ongoing research entitled "Monitoring Chloride Concentrations of the Pike River in Southeastern Wisconsin" since 2007. This project is part of a long-term study to quantify dissolved chloride levels from season to season, especially over the winter months due to road salt use. The 2012-13 dataset for this study was released just prior to plan completion and is included in Appendix C. It corroborates the earlier findings, depicting chloride as an ongoing concern within the watershed. The dataset shows that average chloride values between January and May at site H2O18 exceed the target and also show a one-time acute toxicity at site H2O11.

Table 25. WDNR water quality sample results for Sites H2O1-H2O19. Temperature is shown as a maximum value while all other testing results are displayed as an average of all available testing data from 2006 to September 2012.

Parameter	Statistical, Numerical, or General Use Guidelines	Site H2O 1	Site H2O 2	Site H2O 3	Site H2O 4	Site H2O 5	Site H2O 6	Site H2O 7	Site H2O 8	Site H2O 9	Site H2O 10	Site H2O 11	Site H2O 12	Site H2O 13	Site H2O 14	Site H2O 15	Site H2O 16	Site H2O 17	Site H2O 18	Site H2O 19
Temp (F)	<90° F*	MAX 65.7	77.2	76	66.6	65.1	66.2	52.1	76.1	75.3	65.7	54.5	64.7	64.6	65.3	65.3	65.1	78.8	69.6	74.8
Chlorides (Jan-May only)	<230 mg/L**	AVG 189.4	-	-	204.9	48.5	404.2	-	-	-	47.5	20.3	187.2	169.5	178.5	186.8	186.4	-	230.2	-
Specific Conductivity	<1,500 µmhos/cm***	AVG 941.7	-	799.8	1073.3	417.5	1686.7	677.2	-	-	516.7	645	1032.5	965	1036.7	1035	985	-	1272.5	-
Dissolved Oxygen (DO)	>5.0 mg/l*	AVG -	7.8	10.2	-	-	-	10.2	7.93	8.5	-	-	-	-	-	-	-	8.5	-	11.3
pH	>6.0 or <9.0*	AVG -	7.8	8	-	-	-	7.8	7.7	7.7	-	-	-	-	-	-	-	7.8	-	7.9
Phosphate-Phosphorus as (P)	<0.075 mg/L*	AVG -	-	0.1432	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turbidity (converted from cm)	<14 NTU****	AVG -	13	<8	-	-	-	15	13	-	-	-	-	-	-	-	-	<8	-	<8
Inorganic Nitrogen (nitrate & nitrite as NO2 + NO3)	<1.798 mg/L****	AVG -	-	4.672	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Suspended Solids (TSS)	<19 mg/l*****	AVG -	-	20.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kjeldahl nitrogen (TKN)	<.663 mg/L****	AVG -	-	0.734	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia as NH3	<2.3 mg/l******	AVG -	-	0.0558	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

-Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines
* Water Quality Standards for WI Surface Waters NR 102 (2012); temperature listed as the maximum value available for each site, but testing was not always conducted during summer months. Data does not necessarily reflect the warmest actual values of each site.
** USEPA Ambient Water Quality Criteria for Chloride (USEPA 1988)
*** USEPA Conductivity general range for the United States (USEPA 2012)
**** Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI (USEPA 2000)
***** Present and Reference Concentrations and Yields of Suspended Sediment in Streams in the Great Lakes Region and Adjacent Areas (USGS 2006)
****** USEPA Draft 2009 Update - Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater (USEPA 2009)

Noteworthy- Numeric Water Quality Standards

USEPA has tasked states to establish *numeric* water quality standards for nutrients (phosphorus and nitrogen) in lakes and streams. Currently, Wisconsin has a numeric phosphorus standard and is working on developing nitrogen criteria for streams by 2015. To date, Wisconsin has not developed *numeric* standards for chlorides, specific conductivity, turbidity, total suspended solids, inorganic nitrogen, kjeldahl nitrogen, and ammonia in streams. *Numeric* criteria have been proposed by USEPA for nutrients based on a reference stream method for the Corn Belt and Northern Great Plains Ecoregion (VI) which includes Pike River watershed and the USEPA has also established general national guidelines for other criteria. The USGS has published a document outlining recommended *numeric* criteria for sediment in streams for Ecoregion VI. These reference criteria are used in this report to assess the quality of Pike River and tributaries to develop pollution reduction targets and measure future successes, even though Wisconsin has not adopted these criteria as standards.

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An averaging of six testing sample results for Pike River at Highway E (Site H2O 3) taken in 2006 and 2007 shows that Pike River exceeds the recommended guidelines for phosphorus, inorganic nitrogen, total suspended solids, and kjeldahl nitrogen. Site H2O 6 (Pike River along the Pike River pathway on the south side of the first walking bridge crossing the river) was tested 5 times in 2011 and 2012 and the average of those results exceeded the guidelines for both chlorides and specific conductivity. Site H2O 7 located at County Highway E was sampled twice in 2009 and the average of those samples exceeded the recommended guideline for turbidity. This data supports the designated use impairments, both proposed and existing, for Pike River and demonstrates that nutrients, total suspended solids, and chlorides are pollutants of concern for the watershed.

Nutrients such as phosphorus and nitrogen, both exceeding recommended criteria for the Pike River, are a necessary component of plant growth and are therefore included in many fertilizers. Unfortunately, both have adverse effects on water quality, with phosphorus being particularly detrimental to aquatic systems in excess quantities. These nutrients are applied as fertilizer, either in an agricultural setting or by applicators or residents and the excess nutrients not absorbed by plants are then washed into waterways. Excess nutrients can cause algal blooms, accelerated plant growth, decreasing oxygen levels, and can lead to fish kills.

The ability to control erosion and excess sediment, and thereby total suspended solids, in waterways can be linked to the control of how development is handled. The construction process generally involves quite a bit of land disturbance and ecosystem destruction. The grading of sites, removal of vegetation, rerouting of natural drainage systems, and the addition of impervious surfaces, such as roads and parking lots, all interfere with water quality both in the short and long term. Removing vegetation and trees near the stream or floodplain removes the stability of the soil and increases bank erosion and sedimentation to nearby waterways. Alteration of natural drainage patterns can also significantly reduce the ability of the ecosystem to compensate for such increase in contaminants and sedimentation. High suspended sediment levels are problematic when light penetration is reduced, oxygen levels decrease, fish and macroinvertebrate gills are clogged, visual needs of aquatic organisms is reduced, and when sediment settles out in streams and lakes.

Finally, excess chlorides are also a concern for Pike River. A common practice in snowy states such as Wisconsin is the application of road salts and deicers as a means to protect public safety on roadways. Typical deicers contain chloride ions that can affect the reproduction of fish and other aquatic animals. Waters with a high salinity also are denser, sinking to the bottom of water bodies and impairing water circulation and effecting oxygen levels. As deicers are spread, those chemicals are also harmful to the adjacent vegetation along those roads.

Biological Monitoring

Biological data can be used alone or in conjunction with physical-chemical data to make an impairment assessment on a waterbody in Wisconsin. A Fish Index of Biotic Integrity (Fish IBI) is one method of assessing biological health and water quality through several attributes of fish communities found in streams. These attributes fall into such categories as species richness and composition, trophic composition, and fish abundance and condition. After data from sampling sites has been collected, values for the metrics are compared with their corresponding expected values for a high quality reference stream and a rating is assigned to each metric based on whether it deviates strongly from, somewhat from, or closely approximates the reference values. The sum of these ratings gives a total Fish IBI score for the site. Table 26, below, depicts the Fish IBI scoring criteria appropriate for Pike River.

Table 26. Scoring Criteria for Wisconsin fish Index of Biotic Integrity (IBI).

Score	Rating	Fish Community Attributes
100-65	Excellent	Comparable to the best situations with minimal human disturbance; all regionally expected species for habitat and stream size, including the most intolerant forms, are present with a fuji array of age and size classes; balanced trophic structure.
64-50	Good	Species richness somewhat below expectation, especially due to the loss of the most intolerant forms; some species, especially top carnivores, are present with less than optimal abundances or size/age distributions; trophic structure shows some signs of imbalance.
49-30	Fair	Signs of additional deterioration include decreased species richness, loss of intolerant forms, reduction in simple lithophils, increased abundance of tolerant species, and/or highly skewed trophic structure (e.g., increasing frequency of omnivores and decreased frequency of more specialized feeders); older age classes of top carnivores rare or absent.
29-20	Poor	Relatively few species; dominated by omnivores, tolerant forms, and habitat generalists; few or no top carnivores or simple Iithophilous spawners; growth rates and condition factors sometimes depressed; hybrids sometimes common.
19-0	Very poor	Very few species present, mostly exotics or tolerant forms or hybrids; few large or old fish; DKLT fish (fish with deformities, eroded fins, lesions, or tumors) sometimes common.
No score	Very poor	Thorough sampling finds few or no fish; impossible to calculate IBI.

(Lyons 1992)

For a wadeable stream with a designated use of Warm Water Sport Fish (WWSF) such as Pike River, the threshold to consider 303(d) listing is a Fish IBI of 0-29, based on two Fish IBI values. Those values can be determined either through one value per two consecutive field seasons or two or more values within one field season with corroborating data (WisCALM 2012).

WDNR conducted a total of nine Fish IBI surveys across four locations on the Pike River between 1999 and 2010. The dates and results of these surveys are detailed in Table 27. Of the nine surveys, one (from 1999) was ranked as Fair, two were ranked as Poor, and six were ranked as Very Poor. Existing biological data does not point to any clear trends or obvious causes for the low Fish IBI scores for Pike River. Factors contributing to these low rankings could include any combination of the following: the pollutants identified in the physical-chemical surveys, stream habitat changes, riparian vegetation changes, and/or the water quality of Lake Michigan affecting lower reaches of the Pike River.

Table 27. Fish Index of Biotic Integrity (IBI) scores at WDNR survey sites, 1999-2010.

Site	Date	Location	IBI Score	IBI Ranking
BIO 1	7/29/1999	Upstream of Highway 32	0	Very Poor - Too few fish
BIO 2	9/9/2003	Upstream of Highway E	15	Very Poor
BIO 2	9/15/2010	Upstream of Highway E	17	Very Poor
BIO 3	8/26/2003	Pike River @ Highway A (Downstream of KCC)	10	Very Poor
BIO 3	9/2/2010	Pike River @ Highway A (Downstream of KCC)	20	Poor
BIO 4	7/19/1999	Pike River Upstream of Hwy A, near UW-Parkside	30	Fair
BIO 4	8/26/2003	Pike River Upstream of Hwy A, near UW-Parkside	20	Poor
BIO 4	8/11/2009	Pike River Upstream of Hwy A, near UW-Parkside	10	Very Poor
BIO 4	9/2/2010	Pike River Upstream of Hwy A, near UW-Parkside	6	Very Poor

WDNR also utilizes macroinvertebrate samples to measure the biological condition of streams using the Macroinvertebrate Index of Biological Integrity (M-IBI) developed by Weigel in 2003 (see Table 28 for M-IBI rating). An M-IBI score of 0-2.5 is considered grounds for 303(d) listing a stream. WDNR macroinvertebrate sampling between 1999 and 2010 at various points along the Pike River resulted in two Good, five Fair, and three Poor assessments, with an average score of 3.5, or fair condition (Table 29).

Table 28. Macroinvertebrate Index of Biological Integrity (IBI). Source: WisCALM, 2012.

Macroinvertebrate IBI Rating	
7.5-10	Excellent
5.0-7.4	Good
2.6-4.9	Fair
0-2.5	Poor

Table 29. Macroinvertebrate Index of Biologic Integrity (M-IBI) scores at WDNR survey sites, 1999-2010.

Date	Location	IBI Score	IBI Ranking
11/2/2010	Pike River @ County Highway A/7th Street	3.08	Fair
11/2/2010	Pike River @ Cty Hwy A (Parkside)	3.16	Fair
11/16/2009	Pike River @ Cty Hwy E	2.24	Poor
10/6/2003	Pike River @ Cty Hwy E	3.78	Fair
10/6/2003	Pike River @ Cty Hwy A (Parkside)	4.46	Fair
10/6/2003	Pike River @ County Highway A/7th Street	5.92	Good
10/15/2001	North Branch Pike River @ Hwy 20	0.42	Poor
11/22/2000	South Branch Pike River - Hwy S and EA	1.31	Poor
11/2/1999	North Branch Pike River @ County Line Road	7.22	Good
10/22/1999	Pike River @ County Highway A/7th Street	3.24	Fair

Additionally, in 2004 a dam was removed at the Kenosha Country Club just upstream of Site BIO 3 and work to remove a dam at Petrifying Springs Park was completed in 2012. Existing data is as of yet inconclusive in regards to the effects of either dam removal on fish passage for Pike River.

The University of Wisconsin – Milwaukee (UWM) under the direction of Dr. Tim Ehlinger has also been conducting monitoring work on the Pike River since 2000 and reporting on habitat and biological monitoring along the North Branch Pike River where stream restoration has been occurring in phases since 2001 under the Pike River Improvements Project. Goals of the project include flood control, removal of properties and structures from the floodplain, ecological and habitat restoration, and recreational corridor development. Phases 1 through 5, which include the first seven reaches of Pike River and extend to State Highway 11, have been completed with subsequent phases ongoing.

In 2009 and again in 2012, interim annual reports authored by Ehlinger, Ortenblad, and Schmitz and published through UWM entitled "Monitoring of Stream Habitat & Aquatic Biotic Integrity: Pike River North and South Branches, Racine and Kenosha Counties, Wisconsin" and "Monitoring of Stream Habitat & Aquatic Biotic Integrity: Pike River - North Branch, Racine County, Wisconsin" were published, providing additional biological monitoring results. Fish IBI surveys and family biotic index (FBI) surveys were taken across thirteen sites located along the north branch of Pike River as part of this monitoring. FBI provides a water quality assessment for invertebrates based on tolerances to organic pollution. Fish IBI scores across the restored sites have progressively increased over time relative to the unrestored reaches between 2004 and 2011. FBI scores across most of these sites showed significant improvement from 2006 to 2008 and the study concludes that this increase is most likely "a reflection of the floodplain and stream channel restoration" that had occurred previously (Ehlinger 2009). While this monitoring and restoration work has been confined to the North Branch Pike River, the results of this study bode well for future restoration efforts elsewhere in the watershed.

Specific restoration methods were also tested in Ortenblad's research regarding in stream and stream bank structures which resulted in positive changes to invertebrate communities. Conclusions from this research should be considered in future restorations. Additional research regarding Ecotoxitiy in the Pike River was completed by Jesse Jenson, "Sediment Toxicity and the Recovery of Biological Integrity in a Restored Stream Channel." This research addressed the need for water quality sampling to be completed at the subwatershed level and indicated tributaries have a greater impact on invertebrates than main stem toxicity measurement. Additionally the link between fish assemblages is directly related to in stream substrate and land cover in the subwatershed. In this watershed report, water quality pollutant models and targets will be completed at the subwatershed level, taking into account land use. The result relating to in stream substrate materials should be considered for future restoration projects in the watershed.

6.4 Impaired Beaches in Pike River Watershed

Many beaches along Lake Michigan are routinely monitored for *Escherichia coli* (*E. coli*) according to federal criteria set for open waters of the Great Lakes. *E. coli* tests are used as an indicator that fecal matter may be present in the water, thereby suggesting an elevated risk to people due to harmful bacteria, viruses, or protozoans. When including beaches on the Impaired Waters List, WDNR relies on long-term data defined as long-term geometric mean maximum of 126 colony forming units (cfu)/100 mL, which is consistent with EPA-established criteria and a valid method of recognizing where recreational activities in water might pose chronic risk to human health (WisCALM 2012).

Alford Park Beach and Pennoyer Park Beach, both on Lake Michigan, are 303(d) listed and under recreational restrictions due to elevated *E.coli* levels (Table 30). These beach impairments do not directly affect the water quality of the Pike River. Beach impairments are difficult to determine causes for since the elevated *E.coli* levels can stem from multiple sources. *E. coli* found on beaches can be a result of stormwater runoff, sewage overflows from wastewater treatment plants along the lake, illegal sewage discharges to Lake Michigan, bird or animal droppings as well as other sources. A source tracking study is beyond the scope of this watershed plan.

Table 30. Designated use impairments for beaches in Pike River watershed.

Designated Use	Assessment	Impaired Status	Pollutant	Impairment
Alford Beach Park				
Fish & Aquatic Life	NA	-	-	-
Recreational Use	Recreational Restrictions	303(d) listed	E. coli	Recreational Restrictions - Pathogens
Public Health & Welfare	General Advice	-	-	-
Wildlife	NA	-	-	-
Pennoyer Park Beach				
Fish & Aquatic Life	NA	-	-	-
Recreational Use	Recreational Restrictions	303(d) listed	E. coli	Recreational Restrictions - Pathogens
Public Health & Welfare	General Advice	-	-	-
Wildlife	NA	-	-	-

Source: Draft 2012 WDNR 303(d) list

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