Sediment & Nutrient TMDL for Parsons Creek & its East Tributary

Fond du Lac County, WI
FINAL (Revised 9-17-2007)

Wisconsin Department of Natural Resources
Bureau of Watershed Management

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Introduction

Parsons Creek (WBIC 136000) is a cold water stream in Fond du Lac County, Wisconsin. Although only the lower stretch of Parsons Creek, from its confluence with the East Branch of the Fond du Lac River to mile 2.58, is currently listed on the 303(d) Impaired Waters List, the upper reaches and the tributary entering Parsons Creek from the east (an unnamed branch referenced here as the East Tributary) are both impacted to the extent that they are not meeting their potential uses, and both contribute significantly to the impairments experienced downstream. In fact, the entire remaining upstream portion of Parsons Creek and the East Tributary will be submitted for inclusion on the 303(d) List during the upcoming 2008 listing cycle. Therefore, this TMDL Report addresses the entire Parsons Creek watershed, including the Church Road subwatershed, from which Parsons Creek's headwaters emerge, the Hobb's Woods subwatershed, which encompasses the segment that is listed as impaired, and the East Tributary subwatershed.

The entire 4.7 miles of Parsons Cr. and the 3 miles of the East Tributary to Parsons Creek are codified as Cold Water Communities, as either Class I or II trout waters (DNR, 1980). However, neither the segment in Hobb's Woods that is listed as impaired nor the East Tributary are currently meeting these codified uses, and improvements can be made to the other segments that will benefit water quality and habitat in the entire watershed.

Table 1: Parsons Creek and East Tributary Use Designations. See Appendix C for a listing of Use Designation categories.
*Note: This stretch of Parsons Creek, from the mouth of the creek (mile 0, where it joins with the East Branch of the Fond du Lac River) to mile 2.58 upstream is currently listed on the 303(d) Impaired Waters List. The remainder of the segments listed here will be added to the 303(d) Impaired Waters List in 2008. This TMDL is written to cover the entire Parsons Creek watershed, including its East Tributary, to address impacts upstream that are affecting downstream water quality.

Name	Sub-watershed	WBIC	TMDL ID	Impaired Stream Miles	Total Stream Miles	Codified Use	Current Use	Pollutant	Impairment
Parsons Creek*	Hobb's Woods Subw.	136000	611	0-2.58 (2.58 mi)	0-2.58 (2.58 mi)	Cold Water Community (Class 2 Trout)	Warm Water Forage Fish	Sediment, nutrients	Sedimentation, degraded habitat, aquatic toxicity
Parsons Creek		136000	NA	NA	2.58-3.49 (.91 mi)	Cold Water Community (Class 1 Trout)	Cold Water Community (no trout)	Sediment, nutrients	Sedimentation, degraded habitat
Parsons Creek	Church Rd. Subw.	136000	NA	NA	3.49-5.68 (2.19 mi)	Cold Water Community (Class 1 Trout)	Cold Water Community (no trout)	Sediment	Sedimentation, degraded habitat
East Tributary	East Trib. Subw.	136200	NA	NA	.01-1.89 (1.88 mi)	Cold Water Community (Class 1 Trout)	Warm Water Forage Fish	Sediment	Sedimentation, degraded habitat

A Parsons Creek watershed study was started in State FY99 and extended to FY07. Initially the Wisconsin Department of Natural Resources (WDNR) did a habitat, fish and macroinvertebrate study (Koehnke, 1999) while USGS gathered flow data at 3 sites for 1999-2001 (data used for this TMDL report were from Station ID 04083425). Further evaluations by the WDNR, Trout Unlimited, Fond du Lac County and other groups indicated more information was needed to develop a plan restore the Codified Use of Parsons Creek. Data collection for an additional TMDL study was also conducted in 2006 to address identified sediment problems in Parsons Creek that contributed to the Creek not obtaining its Codified Use.

Working with the results from the studies listed above, TMDLs were developed in this report for sediment, phosphorus, and ammonia. Modeling was conducted to determine what best management practices would need to be implemented to reach the TMDL target loads. Because Fond du Lac County is currently participating in a Priority Watershed Project for the Fond du Lac River, which Parsons Creek feeds into, implementation of BMPs in the Parsons Creek Watershed should dovetail with current Priority Watershed Project efforts.

Parsons Creek Watershed Description

Parsons Creek is a cold water stream that originates from springs that come out of an underground part of the Niagara Escarpment above and below Church Rd. in the NW1/4, NW1/4, Sec. 22, T14N-R17E, Town of Byron, Fond du Lac County, Wisconsin. Parsons Creek and the East Tributary to Parsons Creek have been delineated in the following subwatersheds (see Figure 1 and Appendix A for maps of the subwatersheds):

1. Hobb's Woods Subwatershed
2. Church Road Subwatershed
3. East Tributary Subwatershed

The entire 4.7 miles of Parsons Creek and the 3 miles of the East Tributary to Parsons Creek are listed with a potential use of either Class I or II Trout Water (DNR, 1980). Details on each segment's codified use classifications are described below.

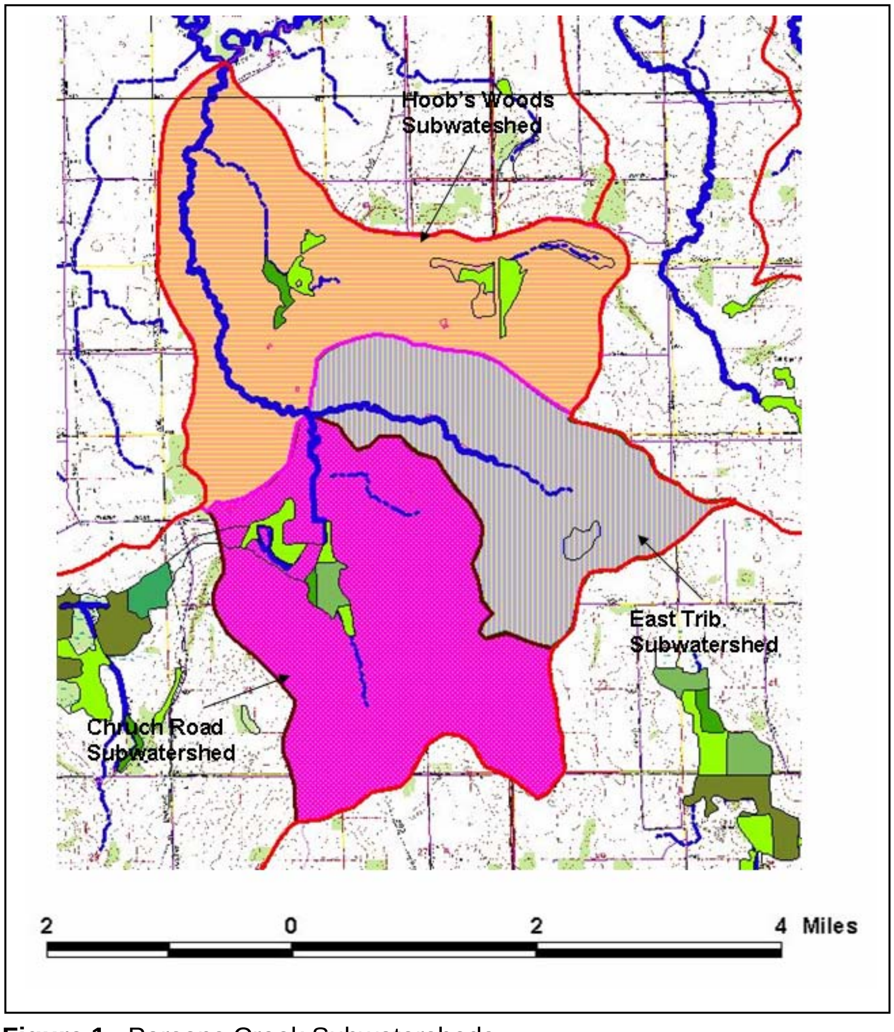

Figure 1. Parsons Creek Subwatersheds.

Hobb's Woods Subwatershed

The Hobb's Woods Subwatershed starts at the confluence with the East Tributary and extends downstream to the confluence with the East Branch of the Fond du Lac River. Parsons Creek is described here as two different segments within this subwatershed.

- The lower reach, from Hwy B to the confluence with the East Branch of the Fond du Lac River, is not meeting its codified use as a Cold Water Community (Class II Trout Water), and is currently listed on the 303(d) Impaired Waters List. This segment of the Creek is degraded due to 1) extensive ditching and resultant bottom softness and reduction in macroinvertebrate habitat; 2) significant cattle access to the Creek; and 3) much greater temperature swings daily and through the winter and summer. There has been some good restoration work done in portions of this subwatershed and we would like to build on those efforts.
- The upper stretch (from the confluence of the East Tributary to Hickory Road) is not currently listed on the Impaired Waters List, but is experiencing water quality impacts that contribute to the problems on the lower reach, and will be proposed for listing during the upcoming listing cycle. Portions of this stretch, especially those directly upstream from the currently listed segment, experienced extensive bank erosion and flashy flows through recent years, which has widened the stream from a narrow, deep run a few feet across to 15 feet wide in many areas. This has caused considerable soil loss and has had a significant impact on in-stream habitat for fish, as well as impacting downstream stretches. Slightly upstream, the segment that runs directly through Hobb's Woods is well-meandered, has a large number of gravel/rubble riffles with good gradient throughout the Woods, and appeared to provide excellent habitat for a high quality macroinvertebrate population. This stretch is codified as a Cold Water Community (Class I Trout Water), but portions of it are experiencing degraded water quality due primarily to watershed problems in the Church Road Subwatershed.

Church Road Subwatershed

Parsons Creek originates from several springs in the Church Road Subwatershed, in the NW1/4, NW1/4, Sec. 22, T14N-R17E, Town of Byron. It then flows through a wetland complex that has been significantly modified by ditching, tiling and draining. After the ditched area it enters a well meandered and wooded stretch to the confluence with an unnamed stream, called here the East Tributary to Parsons Creek. The East Tributary confluence creates a natural Subwatershed division. This stretch of Creek from the Origin to the confluence with the East Tributary is defined in this report as the Church Road Subwatershed. The primary flow of Parsons Creek and the major definition of the thermal structure of Parsons Creek occur in the Church Road Subwatershed. Therefore, how the Church Road Subwatershed is modified has a major effect on downstream Uses. Parsons Creek in the Church Road Subwatershed is codified as a Cold Water Community (Class I Trout Water) and is not currently on the Impaired Waters List, but is inhibited by ditching through the wetland below Church Road and heavy runoff from fields above (south of) Church Road. It will be proposed for addition to the 303(d) List during the upcoming listing cycle.

East Tributary Subwatershed

The main groundwater input to the East Tributary Subwatershed originates between Hwy 41 and Hwy B. This tributary has good macroinvertebrate populations and at least forage fish. It appears to lose its flow between the railroad tracks and Highway 175 during some dry parts of some years. This tributary has several limestone/dolomite quarries along it, two of which are addressed here as point source dischargers of sediment (TSS), though they are not major contributors. The quarries may also be impacting hydrologic flow, potentially causing water to drain internally within the quarries rather than discharging naturally downstream. These runoff and hydraulic problems may result in its not being able to meet its classification of Cold Water Community (Class I Trout Water). Though it is not currently on the 303(d) Impaired Waters List, currently this segment is assessed as meeting only a Warm Water Forage Fishery use (Reif, 2007), and will be submitted for listing during the upcoming listing cycle. Runoff and hydraulic problems in this subwatershed are also of concern since the East Tributary inputs into Parsons Creek and is contributing to the impaired status downstream.

Land Use

The Parsons Creek watershed is approximately 22 sq. km. All three subwatersheds are predominantly used for agriculture, evenly split between row crops (primarily corn) and alfalfa/pasturing. All three subwatersheds contain some forested and wetland areas. The Hobb's Woods subwatershed contains the most forested land, at 11.5%, with the stream running through a portion of this wooded area. The Church Road subwatershed contains approximately 8% wetlands, primarily along the headwaters of the creek, and soil types indicate that additional acreage was historically wetland but now farmed. Both the Hobb's Woods and East Tributary subwatersheds contain a significant portion of quarried land, 12.3% and 14% respectively. Less than one percent of the land is considered to be urban area, with approximately 5% in roads or railroads.

The upper part of the Church Road subwatershed contains relatively steep slopes, contributing to erosion to the stream. Three livestock operations are adjacent to or near to Parsons Creek. In many locations along Parsons Creek, heavy pasturing along shorelines and agricultural cropping practices adjacent to stream banks are causing sediment runoff to the stream.

Table 2. Land uses within the Parsons Creek watershed.

Land Use (Total Watershed Summary)	**Percent**
Agriculture: Pasture/hay/alfalfa	36.40 %
Agriculture: Row crops	35.73 %
Quarries & assoc. businesses	8.25 %
Forest	6.93 %
Wetlands	5.65 %
Roads, Railroads, Ditches	4.89 %
Shrubland/Grassland	1.57 %
Urban	0.58 %
Total	100.00 %

(Source: Great Lakes Land cover from 2001; quarries and associated businesses from 2006 air photos; DNR WISCLAND wetlands, Roads from the DNR road layer were used in place of the Tiger roads from the land cover layer.)

Figure 2. Land cover of Parsons Creek Watershed.

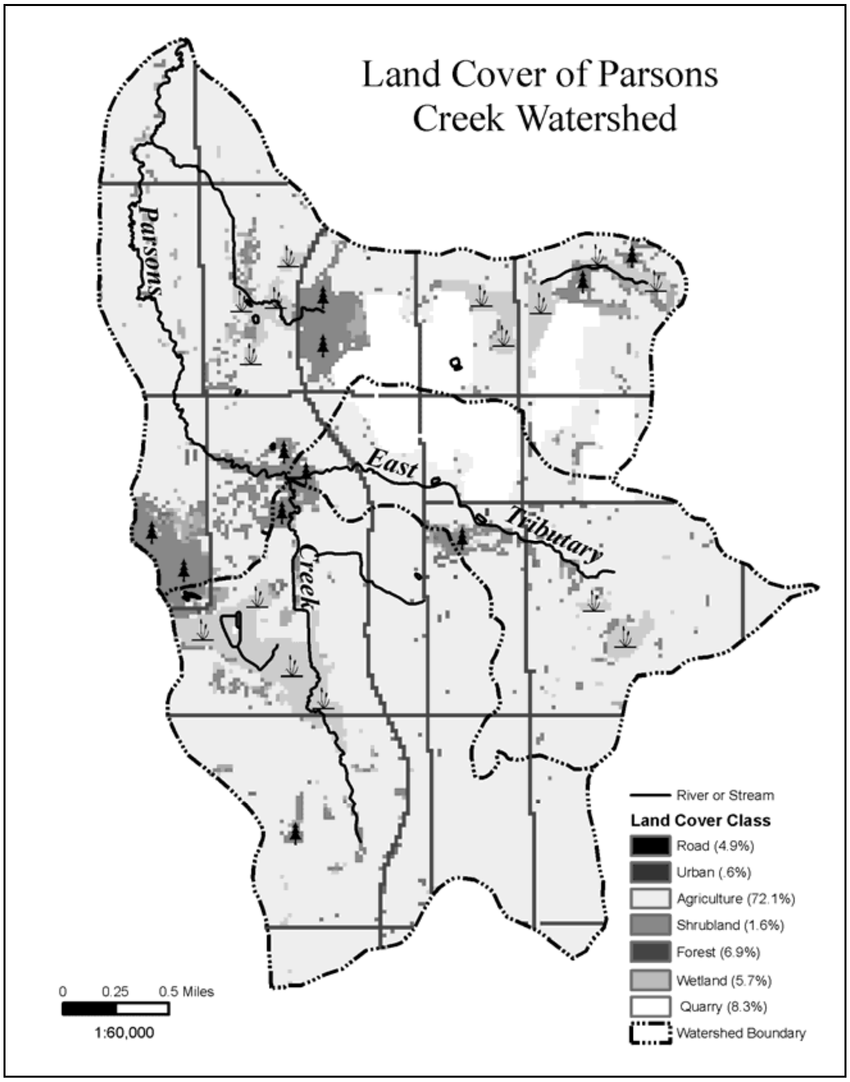

Table 3. Subwatershed summary of major land use/land covers in Parsons Creek - 2001* (sq. km). (Source: SWAT modeling)

Subwatershed	Ag**	Urban	Shrubland	Forest	Wetland	Quarry	Road & Railroad	Total
Hobbs	5.457	0.034	0.221	0.995	0.495	10.064	0.382	**8.647**
Church	6.254	0.054	0.082	0.279	0.585	0.000	0.383	**7.637**
East Trib	3.565	0.035	0.031	0.192	0.122	0.689	0.271	**4.904**
TOTAL	**15.276**	**0.123**	**0.334**	**1.465**	**1.202**	**1.752**	**1.036**	**21.189**

Table 4. Subwatershed summary of major land use/land cover proportions in Parsons Creek – 2001*. (Source: SWAT modeling)

Subwatershed	Ag**	Urban	Shrubland	Forest	Wetland	Quarry	Road & Railroad
Hobbs	63.1%	0.4%	2.6%	11.5%	5.7%	12.3%	4.4%
Church	81.9%	0.7%	1.1%	3.7%	7.7%	0.0%	5.0%
East Trib	72.7%	0.7%	0.6%	3.9%	2.5%	14.0%	5.5%
TOTAL	**72.1%**	**0.6%**	**1.6%**	**6.9%**	**5.7%**	**8.3%**	**4.9%**

* Quarry areas updated to 2006

** Equal proportions of row crops and alfalfa/hay crops (50% each)

Hydrologic alterations

The Parsons Creek watershed is impacted by several hydrologic alterations that are contributing to the stream's current inability to meet its potential uses. Although the TMDLs established in this report do not directly address these hydrologic issues, recommendations for improvements to the hydrologic condition of the stream are listed in the Implementation section of this report.

- A large amount of flow is contributed from a sizeable wetland complex (~145 acres) in the Church Road subwatershed. However, much of the former wetland acreage has been drained and tiled for farming. Restoration of some of the former wetland acreage should increase water storage during storms and provide a steadier release of baseflow during drier periods.
- Surface and groundwater hydrology appear to be impacted by limestone/dolomite quarries that are within the East Tributary subwatershed. Water may be draining internally to the quarries rather than discharging naturally via surface flow to the stream system. Further study is needed to determine the hydrologic effects of the nearby quarries and potential ways to restore stream hydrology related to these sites. It is likely that addressing this hydrologic issue will be necessary in order for the East Tributary to achieve its potential use as a trout water.
- Also in the East Tributary subwatershed, a 'connected enlargement' (constructed pond connected to the stream) exists above Co. Rd. B. This enlargement of the stream captures approximately half of the spring flow at that point, slowing the water and producing lower water temperatures in the winter and higher temperatures in the summer. The altered temperature regime affects the tributary's ability to meet its potential use as a trout stream. Methods should be considered for restoring a more natural thermal regime to the stream. In addition, residents report that there are several other private ponds within the watershed which may be capturing water that would otherwise contribute to flow within the Creek.
- The City of Fond du Lac operates two high capacity wells (Wells #24 and 25) within the town of Byron, located along River Road less than one mile west of the Parsons Creek main stem (see Figure 11 in Appendix A). These wells are being pumped continually at a rate totaling 2.8 cfs. Well #25 is located near the intersection of CTH B and River Road, and Well #24 is located along River Road approximately 1.25 miles north of Well #25. It is possible that high capacity wells may be contributing to aquifer drawdowns in the area, which may impact baseflow of Parsons Creek. The Town of Byron may be able to consider implementing limits on well usage or on construction of new wells within its jurisdiction.

Problem Statement

Pollutants & Water Quality Impairments

Due to excessive inputs of sediment and nutrients, Parsons Creek is experiencing degraded habitat, sedimentation, and aquatic toxicity due to high ammonia levels. On the 2006 303(d) Impaired Waters list, Parsons Creek is listed for the following:

- **Pollutants: Sediment, Nutrients (phosphorus, ammonia)**
- **Impairments: Sediment, Degraded Habitat, Aquatic Toxicity (ammonia)**

Because of these impairments, Parsons Creek is currently not meeting applicable narrative water quality criteria for sediments or nutrients as defined in Wisconsin Administrative Code, and is not meeting numeric water quality criteria for ammonia as established by the WDNR.

Exceedance of narrative criteria (sediment, nutrients)

Narrative criteria stated in NR 102.04 (1), Wis. Admin. Code are defined in the following way:

"To preserve and enhance the quality of waters, standards are established to govern water management decisions. Practices attributable to municipal, industrial, commercial, domestic, agricultural, land development, or other activities shall be controlled so that all waters including mixing zone and effluent channels meet the following conditions at all times and under all flow conditions:

(a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state.

(c) Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state."

Excessive sedimentation is considered an objectionable deposit, as referenced in part (a). High nutrient levels (particularly phosphorus) lead to algal and plant growth producing color, odor, taste, or unsightliness as referenced in part (c).

Exceedance of numeric criteria (ammonia)

Wisconsin established numeric criteria for ammonia concentrations in 2004 (see Appendix D). Due to high nutrient inputs, ammonia levels are elevated above the acute criteria for acceptable ammonia concentrations.

Support of designated uses

Because of the impairments listed above, the segment of Parsons Creek that is listed on the 303(d) Impaired Waters List is not currently supporting its codified use as a Cold Water community (part (a) below). The lower-level use that it is currently supporting is a Warm Water Forage Fish community. In addition, the upstream segments of Parsons Creek and its East Tributary are also experiencing water quality impacts and will be submitted for 303(d) listing during the upcoming listing cycle. Specifically, the East Tributary is not meeting its codified use as a Cold Water community, instead supporting only a Warm Water Forage Fish community. The upper reach of Parsons Creek (Church Road subwatershed and upper Hobb's Woods subwatershed) is meeting the general classification as Cold Water community but is not meeting its Class 1 trout stream designation. The designated uses applicable to this stream are as follows:

S. NR 102.04 (3) intro, (a), (b), and (c), Wisconsin Administrative Code:

"FISH AND OTHER AQUATIC LIFE USES. The department shall classify all surface waters into one of the fish and other aquatic life subcategories described in this subsection. Only those use subcategories identified in pars. (a) to (c) shall be considered suitable for the protection and propagation of a balanced fish and other aquatic life community as provided in federal water pollution control act amendments of 1972, P.L. 92-500; 33 USC 1251 et. seq."

> "(a) Cold water communities. This subcategory includes surface waters capable of supporting a community of cold water fish and aquatic life, or serving as a spawning area for cold water species. This subcategory includes, but is not restricted to, surface waters identified as trout waters by the department of natural resources (Wisconsin Trout Streams, publication 6-6300 (80))."
>
> "(b) Warm water sport fish communities. This subcategory includes surface waters capable of supporting a community of warm water sport fish or serving as a spawning area for warm water sport fish."
>
> "(c) Warm water forage fish communities. This subcategory includes surface waters capable of supporting an abundant diverse community of forage fish and other aquatic life."

Trout Stream Classifications:

> "Class 1 Trout Stream: These are high quality trout waters, having sufficient natural reproduction to sustain populations of wild trout at or near carrying capacity. Consequently, streams in this category require no stocking of hatchery trout. These streams or stream sections are often small and may contain small or slow-growing trout, especially in the headwaters."
>
> "Class 2 Trout Stream: Streams having this classification may have some natural reproduction but not enough to utilize available food and space. Therefore, stocking is sometimes required to maintain a desirable sport fishery. These streams show good survival and carryover of adult trout, often producing some fish of better than average size."

Pollutant Source Assessment

Point Sources

Within the East Tributary subwatershed, there are five limestone/dolomite quarries, two of which have a general permit for process wastewater discharge which includes a standard permit limit for TSS; both are in compliance with their discharge limits. Both of these quarries are some distance from the stream (1/4 mi; 1/2 mi), but it is possible that some discharge may occasionally reach the stream during high flow periods, primarily during wet spring weather and other storm events. Overall, it is expected that they are minimal contributors to sediment in Parsons Creek, but have been given wasteload allocations corresponding to their discharge amounts. The two quarries and their wasteload allocations are described further in the Sediment TMDL Wasteload Allocation (WLA) section of this report.

It is possible that the quarries may also be altering the hydrology of the subwatershed, causing clean runoff that might naturally flow to the East Tributary to flow into the quarries rather than downstream (at least via groundwater).

Non-point Sources

Erosion and sedimentation are significant problems in Parsons Creek. Sediment transport from the watershed to Parsons Creek was determined using a model developed with the Soil and Water Assessment Tool (SWAT version 4/18/2001). Modeling results indicated that under current land management, 678 tons of sediment are delivered annually to Parsons Creek, equivalent to 1.9 tons per day (Baumgart, 2007). Stream bank erosion is also severely widening the stream and sedimentation is making it shallower, resulting in reduced cover for fish and impacting spawning ability. Sedimentation also increases phosphorus transport into the system, which may be causing some eutrophication and fluctuating dissolved oxygen levels, and is contributing to phosphorus loading in the downstream Fond du Lac River and Lake Winnebago systems.

There are a few livestock operations within the watershed, which are likely contributing nutrients to Parsons Creek. In at least one location, cattle have direct access to the stream and may be directly introducing ammonia and phosphorus from urine and manure at that site. Some barnyard practices have been installed but additional practices may be needed to limit nutrient contributions to the streams. The amount of landspreading of commercial fertilizer and manure in this watershed is unknown, but it is possible that landspread nutrients may be percolating into tile lines that run to the stream, elevating in-stream nutrient levels. This may be particularly true in the area of the Church Road subwatershed that was formerly wetland but is now cropped.

Linkage between Water Quality Targets and Pollutant Sources

Establishing a link between watershed characteristics and resulting water quality is a crucial step in TMDL development. By striving to return watershed characteristics closer to natural conditions, improvements in overall stream health can be achieved. However, determining natural conditions of the stream is challenging due to lack of historical information to represent conditions prior to human disturbance.

WDNR staff conducted a habitat assessment along Parsons Creek and determined that erosion and sedimentation are significant problems in Parsons Creek. Stream bank erosion is severely widening the stream and sedimentation is making it shallower, resulting in reduced cover for fish and impacting spawning ability. Additionally, sampling showed that the macroinvertebrate community at Site P4 is dominated by chironomids (aquatic midges), indicating unnaturally high levels of sediment in the stream (Reif, 2007). Fine sediments covering the stream substrate reduce suitable habitat for fish and other biological communities by filling in pools and reducing available cover for juvenile and adult fish. Sedimentation of riffle areas compromises reproductive success of fish communities by covering the gravel substrate necessary for spawning conditions. The filling in of riffle areas also affects some fish communities' food source, macroinvertebrates, which have difficulty thriving in areas with predominantly sand and silt substrate, as opposed to a substrate composed of clean gravel. In addition, sedimentation can increase turbidity in the water column, causing reduced light penetration necessary for photosynthesis in aquatic plants, reduced feeding efficiency of visual predators and filter feeders, and a lower respiratory capacity of aquatic macroinvertebrates due to clogged gill surfaces. Also, other pollutants (i.e. phosphorus) are bound to soil particles and delivered to the stream through runoff and stream bank erosion, increasing the concentration levels of these pollutants in the water column. Sedimentation can impact the physical attributes of the stream and act as a transport mechanism for other pollutants that will impact the water chemistry. As measures are taken to reduce sedimentation and embeddedness of the substrate, biotic integrity scores for fish and macroinvertebrate communities are expected to increase. Additionally, phosphorus transport to the stream decreases with decreased sedimentation.

Phosphorus loading in water bodies can cause eutrophication of streams and reservoirs, and is characterized by excessive plant growth, dense algal growth, and results in diurnal fluctuations in dissolved oxygen levels due to algal oxygen consumption during growth and bacterial consumption of oxygen in the decaying process of dead algae and plant material. Phosphorus enters the stream bound to soil particles that transport it during runoff from overgrazed pastures adjacent to the stream channel, and nutrient rich manure spread within close proximity of the stream. Dissolved oxygen fluctuations act as a stressor on fish communities, particularly to DO sensitive species such as trout. In addition, algal growth can reduce desirable periphyton communities that support macroinvertebrates at the base of the food chain. Because of these factors, the fish community is likely to shift from specialists such as trout to more omnivorous non-game species.

Ammonia, a form of nitrogen, may be introduced to aquatic habitats through manure or commercial fertilizer that is landspread and percolates through shallow soils or through tile lines, or manure that is deposited directly into the stream by livestock with access to the stream. The toxicity of ammonia to aquatic life is strongly correlated to pH, temperature, and the type of biota present (salmonids vs. non-salmonids). For example, the toxicity of ammonia is ten times more severe at a pH of 8 than it is at pH 7. As pH increases, exposure to chronically elevated ammonia (over 4-day or 30-day periods) results in reduced reproductive success and growth for fish, and during acute exposure events, mortality. A wide range of effects can occur, including impacts on tissue generation, osmosis, gills, and kidneys, and anatomical deformities. Salmonid species (trout and salmon) are more susceptible to ammonia toxicity than are other fish species. Additionally, invertebrates show a significant relationship of increasing toxicity with increasing temperature during chronic exposure periods.

TMDL Development

A TMDL is a quantitative analysis of the amount of a pollutant a stream or lake can assimilate before exceeding water quality standards. As part of the TMDL, pollutant loads are allocated among the various point and nonpoint sources of pollutants. Parsons Creek is currently being impacted by sediment, phosphorus, and ammonia, and TMDLs for each of these pollutants are described below. The goal of these TMDLs is to reduce sediment and nutrient loads throughout the Parsons Creek watershed to a level that narrative and numeric water quality standards will be met and the stream's codified use will be restored.

Ammonia (NH_3-N) TMDL Development

Total Load Capacity – Ammonia

Ammonia ambient concentration limit*: 1.47 mg/L of NH_3-N
Ammonia total load capacity*: 9.51 lb/d of NH_3-N

*These limits are protective during critical conditions. Other limits may be calculated during different environmental conditions as described below.

Ammonia criteria were established by the WDNR in 2004 for both acute and chronic conditions. For the majority of the time ammonia levels in Parsons Creek are well below these criteria. However, the portion of the stream near Lost Arrow Road (Site P6) does experience occasional acute (and possibly chronic) events. A primary contributor to these events may be cattle with unrestricted access to the stream that range freely in the water and on the banks. Because cattle are less likely to traverse the stream during high-flow events, it is assumed that much of the loading from manure occurs when the stream is at average or low-flow conditions. Storm events could also introduce runoff from a feedlot adjacent to Parsons Creek upstream from Site P6, or from fields that receive landspread manure or commercial fertilizers.

Additional factors may also contribute ammonia to the system through base flows. Base flows may be affected by discharge from drain tiles in portions of the watershed, including the now-farmed wetland in the Church Road subwatershed. Water flowing from the drain tiles may contain elevated nitrogen if the tiles are draining fields where nitrogen is applied as a commercial fertilizer (the extent of landspreading in the watershed is unknown, though corn and alfalfa are predominant crops). Additional monitoring of drain tiles may be useful to determine whether this is causing any impact to the stream.

Seasonality and critical conditions

Critical conditions for ammonia toxicity occur during periods of high pH and high temperature, typically in the spring, summer, and fall months. Ammonia is most toxic to biota under these conditions, resulting in mortalities during acute toxicity events. If chronically elevated conditions persist (over a 4-day or 30-day time period), impacts on fish reproduction and growth are also experienced. During low flows, the total allowable loading amount is significantly less than amounts that might be tolerated by biota during higher flows. Impacts from ammonia may be exacerbated by stress experienced by fish under low flow, high-temperature conditions.

Establishing acute ambient ammonia concentrations

According to Wisconsin Water Quality Standards, ammonia may not exceed instantaneous maximum concentrations as represented in Appendix D. The ambient ammonia concentration limits are set based on the pH of the stream site and the stream's expected biological community.

- *pH:* Ammonia limits become more stringent as pH increases, with a pH of 9 or above correlating to the most stringent acute ammonia criteria. Parsons Creek has experienced pH values of up to 8.7 periodically.
- *Stream classification (biological community):* Ammonia criteria are most stringent for the Cold Water 1 category which covers streams that should provide habitat for all coldwater fish species, warm water fish, forage fish, and invertebrates. Parsons Creek is listed in the 1980 Wisconsin Trout Streams publication (WDNR, 1980) and therefore falls within the Cold Water 1 classification.

Under WDNR's water quality standards, the acute concentration allowable for a Cold Water 1 stream at pH 8.7 is 1.47 mg/L NH_3-N (see Appendix D). At the average pH for Parsons Creek average during April through October, 8.4, the allowable acute concentration is 2.59 mg/L NH_3-N.

Establishing total load capacity

To calculate the total load capacity in pounds per day for ammonia, stream flow (cfs) and a conversion factor are used in conjunction with the ambient concentrations of 1.47 mg/L or 2.59 mg/L listed above.

To be protective of stream biota during all flow levels, an estimated low flow of 1.2 cfs was used to establish the total load capacity for the most protective limit (1.2 cfs is the 90% flow exceedance for Parsons Creek in water year 1998; USGS, 2000). By setting the allowable concentration using the highest pH experienced by the stream and a low flow value of 1.2 cfs the allowable concentration and corresponding load capacity are set at a level that is protective of in-stream biota during all conditions that the stream is likely to experience. By meeting the target set at low flow and high pH (critical condition), loads during higher flows or at lower pH will also meet target levels. The equation used to determine loading capacity, using this protective concentration value and low flow, is shown below.

Most protective load capacity:

> **NH_3-N acute load capacity = 1.2 cfs** (low flow condition) **x 1.47 mg/L NH_3-N** (maximum ambient concentration based on 8.7 pH) **x 5.39** (conversion factor*) **= 9.51 lb/day NH_3-N**
>
> * 5.396 is a conversion factor derived from:
> 1 lb / 454,000 mg x 28.32 liters/cubic foot x 86,400 seconds / day = approximately 5.39

If more flexibility is desired to determine allowable ammonia concentrations at higher flows or at average pH conditions, the above equation can be used by substituting the specific flow level in Parsons Creek on the day in question and the appropriate ambient concentration (based on pH) on that day, to determine a maximum allowed value for any given day. Table 5 provides example values demonstrating load capacities at high and average pH, and at low, medium, and high flow values in Parsons Creek, and their corresponding load allocations.

Table 5. Example acute loading capacities for ammonia for Coldwater 1 (Trout class 1-2) streams.

		Example load capacity values at varying flows			Example Wasteload & Load Allocations	
pH	**Acute Max Conc. Limit (NH3-N mg/L)**	**% Flow exceedance (low, med, high flows)**	**Flow (cfs)**	**Max daily load (lb/d)**	**Waste Load Allocation**	**Load Allocation**
8.7 (highest documented pH)	1.47	90%	1.2	9.51	0	9.51
		50%	2.6	20.60	0	20.60
		10%	5.6	44.37	0	44.37
8.4 (average pH Apr.-Oct.)	2.59	90%	1.2	16.75	0	16.75
		50%	2.6	36.30	0	36.30
		10%	5.6	78.18	0	78.18

Consideration of chronic impacts

In conjunction with the acute ammonia criteria established in 2004, WDNR established criteria for chronic ammonia impacts over 4-day and 30-day averaged time periods, with concentration levels set at a safety threshold for reproduction and growth of aquatic biota. For the Parsons Creek ammonia TMDL, an evaluation was conducted of the 4-day chronic criteria to determine whether any chronic impacts would be experienced by the stream if the TMDL value were based on acute criteria set at the most stringent level expected for the stream. This analysis addressed the question of whether, in a worst-case scenario where the in-stream ammonia level approached the maximum acute concentration of 1.47 on a daily basis, ammonia values would exceed the chronic criteria. The analysis took into account seasonal differences in pH and temperature and the associated chronic concentration limits. It was determined that because the acute level of 1.47 mg/L is set using a high pH and low flow, any in-stream measurements of ammonia meeting this standard would also be below the chronic criteria.

Because this TMDL is not expected to influence any point source permits and use of well-established agricultural best management practices is anticipated to eliminate the acute toxicity events, this TMDL for ammonia is based on a simple, conservative approach. For waterbodies under other conditions (pH, temperature, or stream classification), use of seasonally-based chronic levels in conjunction with a daily maximum may be warranted.

Load/Wasteload Allocations – Ammonia

The total loading capacity for ammonia is the sum of the wasteload allocations for permitted sources, the load allocations for non-point sources, and the margin of safety, as generally expressed in the following equation:

TMDL Load Capacity = WLA + LA + MOS
9.51 lb/day NH_3-N = 0 + 9.51 lbs/day + (implicit)

WLA = Wasteload Allocation = 0 tons/day (no point sources)
LA = Load Allocation = 9.51 pounds/day
MOS = Margin of Safety = implicit

Wasteload Allocation (WLA)
Because there are no point sources of ammonia in the watershed, the waste load allocation is zero. If a point discharge were proposed, one of the following would need to occur:

- An effluent limit of zero sediment load would be included in the WPDES permit.
- An offset would need to be created through some means, such as pollutant trading.
- A re-allocation of sediment load would need to be developed and approved by EPA.
- Any revised WLAs or LAs must result in the attainment of water quality standards.
- Any changes in the WLA would require an opportunity for public participation.

Load Allocation (LA)
The load allocation for ammonia from nonpoint sources is equivalent to the total load capacity each day, because the waste load allocation is zero and the margin of safety is implicit. For instance, in the most protective scenario described above, the load allocation for nonpoint sources would be 9.51 lbs/day of NH_3-N. Additional examples of load allocation amounts at varying seasons and flow conditions are found in Table 5.

Margin of Safety (MOS)
The margin of safety accounts for the uncertainty about the relationship between the sediment loads and the response in the water body. The MOS for the Parsons Creek ammonia TMDL is implicit, because the method used to develop the ammonia TMDL is conservative in three regards:

- *WDNR ammonia criteria:* Conservative safety factors were built into the development of WDNR's chronic and acute ammonia water quality standards. The method used to set WDNR's ammonia criteria represent a threshold safe level. Acute levels were set for little or no mortality, based on a two to one safety factor to determine LC1 levels from the standard LC50 data. This inherent safety margin ensures protectiveness of the TMDL even during varying environmental conditions.
- *Setting the target limit:* Ammonia toxicity is highly dependent on pH. Based on a high pH of 8.7 documented during stream sampling, the ammonia target limit for Parsons Creek is set at a conservative criteria level specified by the WDNR for acute ammonia toxicity. However, this high pH occurred only infrequently. Once best management practices are implemented to reduce phosphorus and algae that likely cause higher pH, the pH in the stream may decrease to a more moderate level*. At lower pH levels, significantly higher levels of ammonia can be tolerated by stream biota.

  *Because the dolomite in the watershed may also contribute to higher pH levels, it is difficult to predict whether pH will decrease significantly or not.
- *Calculating total load capacity:* In setting the load capacity for critical conditions, a low flow value was used. Because the circumstances of the observed acute impacts include direct cattle access to the stream, which could occur at any time rather than just during runoff events, a low flow estimate was used to determine the total load capacity. This results in a conservative total loading capacity figure to be used for critical conditions.

Sediment (TSS) TMDL Development

Sediment 'Normal Flow' Median Target Concentration:	**8 mg/L TSS**
Sediment 'Normal Flow' Maximum Target Concentration:	**28 mg/L TSS**
Sediment 'High Flow' Median Target Concentration:	**59 mg/L TSS**
Sediment 'High Flow' Maximum Target Concentration:	**230 mg/L TSS**

(for Sediment 'Normal flow' and 'High flow' Load Capacities, see calculations and load duration curves)

Erosion and sedimentation are significant problems in Parsons Creek. Stream bank erosion is severely widening the stream and sedimentation is making it shallower, resulting in reduced cover for fish and impacting spawning ability. Additionally, sampling showed that the macroinvertebrate community at Site P4 is dominated by chironomids (aquatic midges), indicating unnaturally high levels of sediment in the stream (Reif, 2007).

Seasonality and critical conditions

Parsons Creek is most susceptible to sediment loading in late winter and early spring snow melt and heavy rain events. During these time periods the soils are exposed because it's early in the growing season and plants haven't established cover to protect the soil. Increased sediment loading also occurs as the result of heavy rainfall events during the summer. Increased sediment loading is dependant on flow conditions, not seasonality. The spectrum of flow conditions that would be expected during any season are represented by using load duration curves to set the TMDL. The load duration curves for Parsons Creek were created using three years worth of daily flow data, thereby accounting for variations in flow among different years as well as seasonal differences.

In this circumstance there is no critical condition in the sedimentation of this stream. Although greater sediment delivery to the stream occurs during storm events, sediment is a "conservative" pollutant and does not degrade over time or during different critical periods of the year. EPA acknowledges this in its 1999 Protocol for Developing Sediment TMDLs, saying "the critical flow approach might be less useful for the sediment TMDLs because sediment impacts can occur long after the time of discharge and sediment delivery and transport can occur under many flow conditions". Sedimentation generally produces year-round effects.

Modeling of current loading and potential load reduction scenarios

Modeling was conducted to a) determine current loading in the watershed through identification and quantification of current sources, and to b) assess the effectiveness of various land management scenarios for reducing sediment loads to Parsons Creek. This modeling was done using the Soil and Water Assessment Tool (SWAT version 4/18/2001). SWAT is a distributed parameter, daily time step model that was developed by the USDA-ARS to assess non-point source pollution from watersheds and subwatersheds. SWAT simulates hydrologic and related processes to predict the impact of land use management on water, sediment, nutrient and pesticide export. Crop and management components within the model permit reasonable representation of the actual cropping, tillage and nutrient management practices typically used in Northeastern Wisconsin. Major processes simulated within the SWAT model include: surface and groundwater hydrology, weather, soil water percolation, crop growth, evapotranspiration, agricultural management, urban and rural management, sedimentation, nutrient cycling and fate, pesticide fate, and water and constituent routing. SWAT also utilizes the QUAL2e submodel to simulate nutrient transport. In the case of Parsons Creek, three years of daily data for sediment, phosphorus, and flow were available for use in the SWAT model, along with the necessary land use information, making this detailed modeling approach a good match for the high level of available watershed data.

The SWAT modeling done for this project identified and quantified sources of sediment and phosphorus export using watershed model simulations and other techniques, to predict the impact of land use management on these exports. Daily stream flow, suspended sediment, and total phosphorus loads from non-point sources within the Parsons Creek watershed were simulated, and numerous scenarios were run including (1) baseline 2000 conditions, and (2) alternative management or policy scenarios, which were compared to the baseline 2000 conditions. The model was validated with daily discharge and computed TSS and phosphorus loads from two USGS-WDNR monitoring stations that were located within the Parsons Creek watershed, which were operated from USGS water year 1998 to 2001 (Baumgart, 2007). Modeling results indicated that under current land management, 678 tons of sediment are delivered annually to Parsons Creek, equivalent to 1.9 tons per day (Baumgart, 2007).

Setting target levels for TSS

The target levels set in the Parsons Creek sediment TMDL draw on a study published by USGS, which uses a large data set of streams to determine TSS concentrations and loads that would be expected under 'reference' conditions (USGS, 2006 "Present…"). USGS staff conducted statistical analysis on 964 streams in the Great Lakes, Ohio, Upper Mississippi, and Souris-Red-Rainy River Basins from 1951 to 2002. These data were then used to calculate median TSS concentrations, loads, yields, and volumetrically (flow) weighted concentrations. Watersheds in the study were classified into five zones based on soil properties and other environmental factors, and TSS concentrations within each watershed were plotted according to the percent agricultural land use in each watershed. Extrapolation was used to estimate the TSS concentrations that would be expected within each zone under conditions of zero percent agriculture, under the assumption that zero percent agriculture would approximate 'reference' conditions, or conditions where agricultural best management practices were 100% effective in preventing agricultural runoff from reaching streams. The resulting 'reference' conditions were compared to observed values in Parsons Creek to determine whether they were appropriate targets to aim for in this sediment TMDL.

Once target concentrations were established, these were converted into load duration curves to account for changes in flow and how those affect total load capacity each day. This is described in more detail below.

Establishing the 'normal flow' target concentration for TSS

The Parsons Creek sediment TMDL is divided into two components: a 'normal flow' target and a 'high flow' target, expressed in both concentrations and loads. This was done in accordance with the 2006 USGS study referenced above, which established recommended target levels associated with base flows (expressed as concentrations) and with storm flows (expressed as volumetrically (flow) weighted concentrations). For Parsons Creek, a threshold was established at 5% flow exceedance (i.e. at the highest 5% of storm flows, those at or greater than 8.0 cfs), beyond which different concentrations will be used to establish loading targets.

In the portion of the USGS study regarding base flow concentrations, Parsons Creek fell into Zone 3, for which USGS set reference levels at a median concentration of 17 mg/L TSS. However, the Parsons Creek current median concentration for 95% of flows is already below that, at 8 mg/L. In order to set a protective limit at Parsons Creek's current level during the majority of flows, 8 mg/L was established as its median target load for 95% of flows, or all flows below 8.0 cfs (8.0 cfs correlates to a 5% exceedance threshold in Parsons Creek, which means that the 'normal flow' target would apply for flows from 6% to 100% exceedance*; see Appendix E for a flow duration curve for Parsons Creek). In addition to the median 'normal flow' target concentration, a maximum 'normal flow' concentration was set at 28 mg/L following methodology outlined by USEPA (2007).

* "X" percent exceedance flow is the flow that is equaled or exceeded X percent of the time. For instance, 5% exceedance flow is a high flow that is only exceeded 5% of the time. 100% exceedance flow is the lowest flow for a stream; 100% of flows are greater than this volume.

Establishing 'normal flow' load capacity for TSS

The 'normal flow' load capacity (median and maximum) was determined using a load duration curve (see Figure 3). Sediment and flow data from the daily USGS dataset (1997-2001, Station ID 04083425) was used to plot current loads on the load duration curve, and target load curves were then created using the median and maximum target concentrations described above. Total load capacity for sediment in Parsons Creek depends on the flow on any given day; thus the load duration curves are calculated using the following equation:

Flow (ave. for a given day) x TSS 'normal flow' target concentration x conversion factor = Total Load in lbs/day

Median 'normal flow' load capacity:

X.XX cfs x 8 mg/L TSS x 5.39* = Total load capacity (lb/d TSS)

Maximum 'normal flow' load capacity:

X.XX cfs x 28 mg/L TSS x 5.39* = Total load capacity (lb/d TSS)

* 5.39 is a conversion factor derived from:
1 lb / 454,000 mg x 28.32 liters/cubic foot x 86,400 seconds / day = approximately 5.39

Establishing the 'high flow' target concentration for TSS

During the highest 5% of storm flows, those of 8 cfs or above, Parsons Creek currently has a median of 79.18 mg/L. It is at these high flows that sediment loading is most problematic. The 2006 USGS study on volumetrically weighted concentrations, which approximate storm flows, indicates a median concentration value of 59 mg/L for reference conditions in Zone 4 (Parsons Creek falls within Zone 4 for this portion of the study). Therefore, a median target concentration of 59 mg/L was set for the top 5% of flows that are at 8 cfs or above. In addition to the median 'high flow' target concentration, a maximum 'high flow' concentration was set at 230 mg/L TSS following methodology outlined by USEPA (2007).

Establishing 'high flow' load capacity for TSS

The 'high flow' load capacity (median and maximum) was determined using a load duration curve (see Figure 3). Total load capacity for sediment in Parsons Creek will depend on the flow on any given day, and is calculated using the following equation:

Flow (ave. for a given day) x TSS ‘high flow’ target concentration x conversion factor = Total Load in lbs/day

Median ‘high flow’ load capacity:

X.XX cfs x 59 mg/L TSS x 5.39* = Total load capacity (lb/d TSS)

Maximum ‘high flow’ load capacity:

X.XX cfs x 230 mg/L TSS x 5.39* = Total load capacity (lb/d TSS)

* 5.39 is a conversion factor derived from:
1 lb / 454,000 mg x 28.32 liters/cubic foot x 86,400 seconds / day = approximately 5.39

Modeling results and predicted TSS load reductions

Modeling indicates that a load reduction of slightly over 50% of sediment to the stream can be achieved through implementation of cropping and tilling practices, stream bank stabilization, and vegetated buffer strips. Each type of best management practice that was modeled and its predicted load reduction are presented in Table 9 under the “Implementation Considerations” section of this report.

Wisconsin does not currently have numeric water quality standards for TSS. However, in the best professional judgment of WDNR staff, the 50% predicted reduction in sediment will achieve the *water quality goals* of meeting the narrative water quality criteria, and improving Parsons Creek’s habitat and the corresponding trout fishery. Though we expect to meet water quality goals, it is difficult to assess with certainty whether the predicted load reduction averages will result in meeting the specified load capacity medians. Because the target load capacity is based on a reference study that expresses the target as *medians*, and the modeling expresses the expected load reductions as *averages*, the two types of values are not directly comparable. Post-implementation monitoring will be used to determine whether the load capacity target medians are being met.

Load duration curves

To create the load duration curves, the 'normal flow' and 'high flow' calculations above were utilized. Sediment and flow data from the daily USGS dataset (1997-2001, Station ID 04083425) was used to plot current loads on the load duration curve (scatterplot), and target load curves were then created using the appropriate median and maximum target concentrations. For regular flows between 6% and 100% exceedance, flow data and the 'normal flow' target concentrations of 8 mg/L (median) and 28 mg/L (maximum) were used to determine the target load capacities throughout the range of flow levels. For storm flows between 0% and 5% exceedance, flow data and the 'high flow' target concentrations of 59 mg/L (median) and 230 mg/L (maximum) were used to determine the target load capacities. This provides a graphical illustration of median and maximum load capacities at varying flow levels.

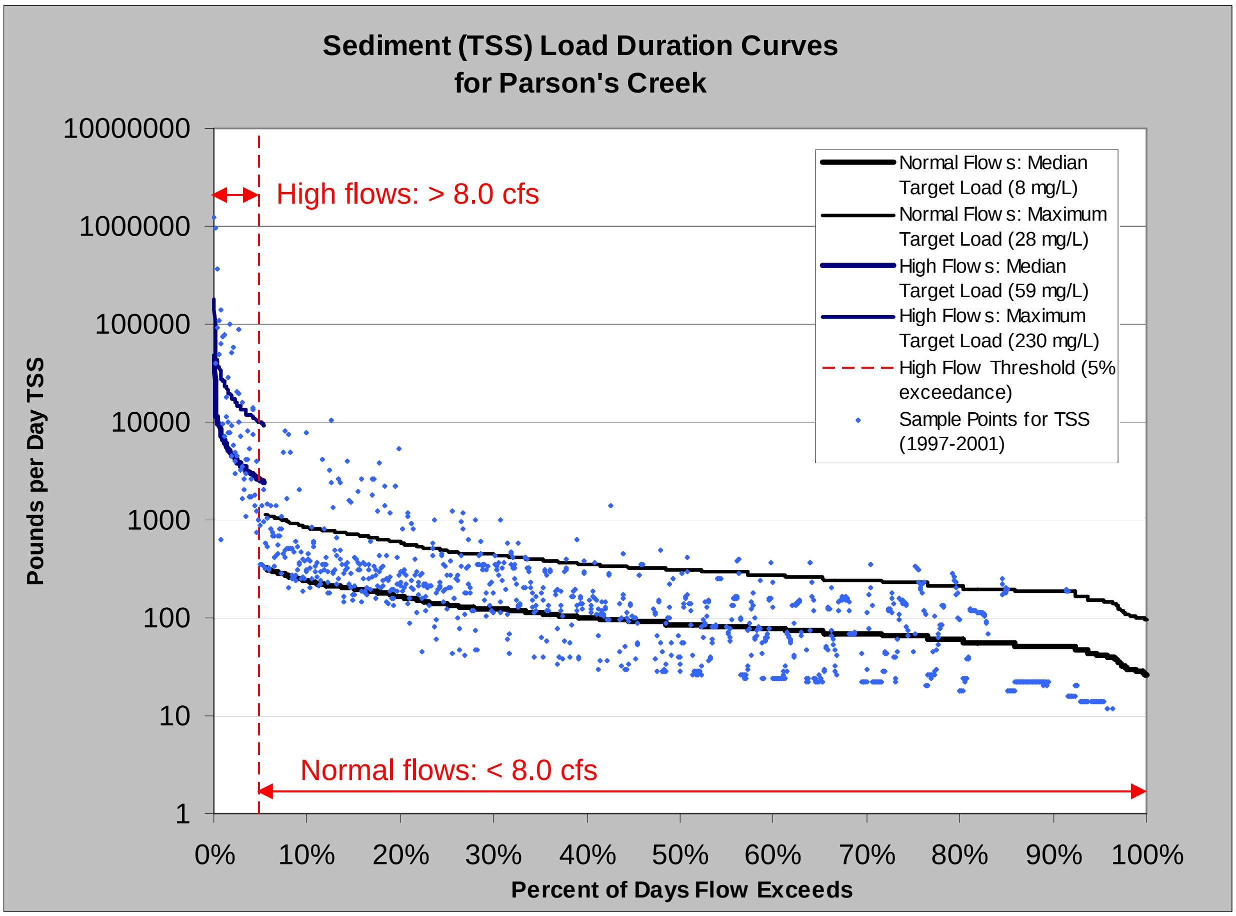

Figure 3. Sediment (TSS) load duration curves for Parsons Creek, showing target load capacities during normal flows (95% of all flows—those <8.0 cfs) and high flows (5% greatest flows—those at or above 8.0 cfs). Both median and maximum capacities are shown. Load capacity curves are shown here with a scatterplot of pre-BMP sample loads from 1997-2000. It is expected that with implementation of BMPs, loads can be decreased by approximately 50% to meet the target load capacities.

Load/Wasteload Allocations – Sediment

The total annual loading capacity for sediment is the sum of the wasteload allocations for permitted sources, the load allocations for non-point sources, and the margin of safety, as generally expressed in the following equation:

TMDL Load Capacity	=	WLA	+	LA	+	MOS	
X lb/day TP	**=**	**Y lb/d**	**+**	**Z lbs/day**	**+**	**(implicit)**	

WLA = Wasteload Allocation = Y pounds/day TSS
LA = Load Allocation = Z pounds/day TSS
MOS = Margin of Safety = (implicit)

Wasteload Allocation (WLA)
There are five quarries in the East Tributary subwatershed, two of which have a general permit for process wastewater which includes a standard limit for TSS of 40 mg/L. These two quarries are Michel's Materials (Hamilton #84 Quarry) and Oakfield Stone Company, Inc. (Byron Quarry).

Michel's Materials – Hamilton #84 Quarry

Michel's Materials has a settling pond receiving process wastewater from stone washing and stormwater, from which discharge is pumped when the pond reaches a certain capacity. The discharge flows via a drainage way and a railroad grade approximately ½ mile to Parsons Creek. Water is generally pumped only during very wet weather in the spring or following storm events, at a maximum of 140,000 gallons per day (based on quarterly data for 2006 provided by the quarry). During these wet weather times, which generally correspond to the 'high flow' time frames discussed in this document, it is expected that some level of discharge does reach the Creek. Using their TSS permit limit of 40 mg/L, this would be equivalent to a maximum of 47 lb/d TSS potentially entering Parsons Creek. During non-storm ('normal flow'), conditions, discharges from the facility are occasional and observations indicate that these discharges do not reach the Creek. In fact, during major rain events in August 2007, observations provided by the quarry indicated that no discharge was reaching Parsons Creek. However, to allow for discharges from the quarry, the equation provided above will be used for their WLA during 'normal flow' periods, resulting in limits down to 3.5 lb/d TSS during the lowest flow conditions.

Oakfield Stone Company, Inc. – Byron Quarry

Oakfield Stone has a settling pond receiving process wastewater from stone washing and stormwater, from which discharge overflows when the pond reaches capacity. The discharge flows via an outlet to a dug channel approximately 1/5 mi to the East Tributary. There are currently no monitoring data available to indicate the discharge amount from this settling pond, but DNR staff estimate that during wet weather in the spring or following storm events, the Oakfield settling pond discharges an approximately equal amount to that discharged by the Michel's Materials pond, i.e. a maximum of 140,000 gallons per day. Using Oakfield's TSS permit limit of 40 mg/L, this would be equivalent to a maximum of 47 lb/d TSS potentially entering Parsons Creek. During these wet weather times, which generally correspond to the 'high flow' time frames discussed in this document, it is expected that some level of discharge does reach the Creek. Based on field observations of WDNR staff, it is estimated that during 'normal' conditions, water flows from the pond at a rate of approximately 0.025. However, this amount of water does not appear to reach the stream, as its flow ceases about 1/3 of the way down the channel. To allow for discharges from the quarry, the equation provided above will be used for their WLA during ‘normal flow’ periods. Therefore, the WLA for Oakfield Stone is set at the same rates as Michel’s Materials: 47 lb/d TSS during ‘high flow’ conditions, and equation-based during ‘normal flows’ down to 3.5 lb/d TSS during the lowest flow conditions.

Setting the WLA

The wasteload allocation for these quarries is expressed using an equation similar to that used to determine the overall loading capacity. Based on the volume currently being discharged from the quarries, they have been allocated up to 27.5% of the TSS load capacity amount for Parsons Creek during ‘normal flow’ conditions. As the above descriptions of each quarry indicate, however, most of the discharge from each of these facilities does not reach the Creek, except under very wet conditions, so it is highly unlikely in this particular circumstance that the quarries will contribute their entire wasteload allocation to the Creek. The combined WLA from both of these sources is capped at 94 lb/d TSS under ‘high flow’ conditions (47 lb/d each), while under ‘normal flow’ conditions the following formula is used to set their combined WLA, to allow discharge on a continuum that is consistent with the total load capacity (see Figure 4, Table 6 and Table 7 for examples).

‘High flow’ WLA (includes both sources): 94 lb/d

‘Normal flow’ WLA (includes both sources):
X.XX cfs (in Parsons Creek) x 8 mg/L x 5.39* x 0.275 = combined WLA (lb/d)

* 5.39 is a conversion factor derived from:
1 lb / 454,000 mg x 28.32 liters/cubic foot x 86,400 seconds / day = approximately 5.39

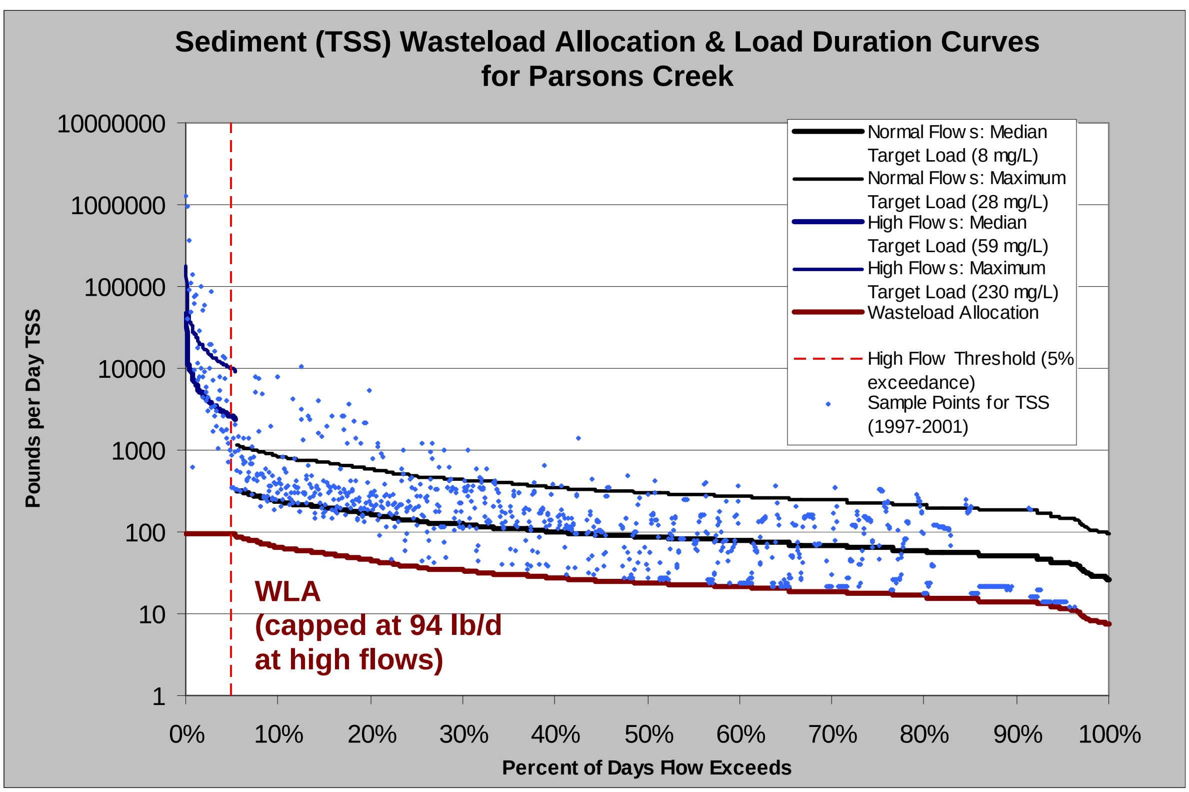

Figure 4. Wasteload allocation for TSS in Parsons Creek watershed, shown against the total load capacity. The WLA is capped at 94 lb/d TSS during the highest 5% of flows, and is calculated with an equation at normal flows.

Table 6. Individual Wasteload Allocations (WLAs) for quarries in the Parsons Creek Watershed with WPDES process wastewater permits.

Wastewater Source	FIN # (Site ID)	WPDES Permit #	TSS Conc. Permit Limit (mg/L)	Parsons Creek Flow Level*	Individual WLA (amount discharged) (lb/d TSS)
Michel's Materials (Hamilton #84 Quarry)	3644	WI-0046515-04-01	40	Normal Flows	Ranges from 3.5 to 47
				High Flows	47
Oakfield Stone Co., Inc. (Byron Quarry)	33311	WI-0046515-04-01	40	Normal Flows	Ranges from 3.5 to 47
				High Flows	47

* 'Normal' and 'High' flows refer to the level of flow in Parsons Creek, which corresponds to storm events. 'High flows' refer to those time periods with the 5% of highest flows, usually in the spring or during summer storms. 'Normal flows' refer to the remaining 95% of the time.

Permitting implications

Because of their location within a watershed covered by a TMDL, these two facilities will likely require an individual permit rather than a general permit at end of their current permit term*. Permit limits that correspond to the limits in this TMDL will be set for these facilities at the time of permit issuance. Some example permitting options and flow data that may be pertinent to this TMDL are discussed in Appendix E.

Permit limits must be met at the property boundary. In the event that permit limits are exceeded, the operation must notify the WDNR and investigate the cause of the exceedance.

Additional monitoring will be conducted at each of these quarries in the future. As additional data is collected, the WLAs may be adjusted accordingly if needed.

* The individual permits should be issued before the end of the current permit term to ensure a smooth transition when the general permit expires.

New discharges

If any additional point discharges are proposed, one of the following would need to occur:

- An effluent limit of zero sediment load would be included in the WPDES permit.
- An offset would need to be created through some means, such as pollutant trading.
- A re-allocation of sediment load would need to be developed and approved by EPA.
- Any revised WLAs or LAs must result in the attainment of water quality standards.
- Any changes in the WLA would require an opportunity for public participation.

Load Allocation (LA)

The load allocation for sediment from nonpoint sources corresponds to the total load capacity minus the waste load allocation (the margin of safety is implicit). Some example load capacities are calculated in Table 7 below.

Table 7. Example loading capacities (median and maximum) and corresponding wasteload and load allocations for sediment in Parsons Creek. Specific load allocations for each day at specific flows should be determined using the load capacity calculations provided above.

	Example load capacity values at varying flows				Example Wasteload & Load Allocations		
					WLA	LA	
	% Flow exceedance (low, med, high flows)	Flow (cfs)	Median daily load (lb/d)	Max daily load (lb/d)	Max. (lb/d)	Median (lb/d)	Max. (lb/d)
'Normal flow' target (for flows <8 cfs) (use 8 mg/L median and 28 mg/L max. target conc.)	100%	.62	27	94	7	20	87
	90%	1.2	52	181	14	38	167
	50%	2.0	86	302	24	62	278
	10%	5.6	242	845	66	176	779
'High flow' target (for flows >8 cfs) (use 59 mg/L median and 230 mg/L max target conc.)	5%	8.0	2544	9918	94	2450	9824
	2%	14.6	4643	18100	94	4549	18006

Margin of Safety (MOS)

The margin of safety accounts for the uncertainty about the relationship between the sediment loads and the response in the water body. For the sediment TMDL for Parsons Creek, the MOS is implicit in the modeling. During the modeling process, the following conservative assumptions were made that justify an implicit margin of safety:

- With implementation of sediment-related reduction scenarios, the simulated reduction in suspended sediment ought to be greater for the combined bedload and suspended sediment load because the larger particles associated with bedload are more easily trapped with most BMP's. The model was calibrated for the suspended sediment load, and the associated simulated reductions from the implementation of most BMPs are based on the finer particles associated with suspended sediment rather than the coarse particles associated with bedload.
- Conservation tillage and residue levels under current (baseline) conditions are likely lower than estimated in the model, because Fond du Lac County levels were assumed. Parsons Creek watershed has much less cash crop operations where conservation tillage was more likely to be adopted in the past. This would make the percent reduction of TSS from conservation tillage practices greater within Parsons Creek watershed than the model predicts.
- Contour strip cropping should have a larger impact than demonstrated with the model, since a conservative approach was used whereby the USLE P factor was not fully adjusted across the watershed to account for high rates of soil erosion where strip crops were placed.
- No grassed waterways were simulated. Installing them would increase the actual reduced load of sediment and phosphorus to the stream. These will result in greater reductions of TSS loading than predicted.
- One of the potential implementation measures may be restoration of the wetlands at the head of the Church Road subwatershed. If these wetlands are restored, they will trap additional sediment not currently accounted for in the model.

Phosphorus (Total P) TMDL Development

Total Load Capacity – Total Phosphorus (TP)

Phosphorus 'Normal Flow' Median Target Concentration: 0.06 mg/L TP
Phosphorus 'Normal Flow' Maximum Target Concentration: 0.19 mg/L TP

(for Phosphorus 'Normal flow' and 'High flow' Load Capacities, see calculations and load duration curves)

High phosphorus levels in Parsons Creek are evident through sampling of total phosphorus (TP) and dissolved oxygen (DO) (USGS dataset, 1997-2001, Station ID 04083425; DNR dataset, 2005). Although algae problems related to phosphorus are not visibly apparent in Parsons Creek, the effects on algae growth are notable in diurnally fluctuating DO levels on the stretch of Parsons Creek between Highway B and Lost Arrow Road in the Hobbs Woods Subwatershed. Fluctuations in DO are generally attributed to algal growth and are indicative of instream photosynthesis, causing a nocturnal sag in DO. Monitoring shows a typical daily fluctuation with highs of around 11 mg/L and lows of 5 or 6 mg/L, with lows sometimes reaching 3.79 mg/L (DNR dataset, 2005). Trout streams should have a minimum DO of 7 (per Wis. Admin. Code NR 104), so impairment in this stretch is evident. Phosphorus impacts have not yet been documented on upstream reaches of the Creek, but could potentially become an issue if sedimentation and phosphorus loading continue.

Of significant concern, phosphorus loading to Parsons Creek is very high during storm events. Storm event loadings of up to 5.4 mg/L, equivalent to 2064 lb/day, have been recorded (USGS TP dataset, 1997-2001, Station ID 04083425). These high loads are of concern due to impacts on water quality in the Lake Winnebago and Lower Fox River systems downstream, both of which are currently on the 303(d) Impaired Waters List for phosphorus. On a per unit area basis, Parsons Creek is a significant contributor of phosphorus loads to these systems.

Seasonality and critical conditions

The potential for Parsons Creek to display eutrophic conditions as a result of TP concentrations occurs in the summer during low flow conditions, when phosphorus is actively taken up by aquatic plants and algae, causing diurnal fluctuations in dissolved oxygen. However, Parsons Creek is most susceptible to TP loading in late winter and early spring snow melt and heavy rain events. During these time periods the soils are exposed because it's early in the growing season and plants haven't established cover to protect the soil. Increased phosphorus loading also occurs as the result of heavy rainfall events during the summer. Increased TP loading is dependant on flow conditions rather than seasonality. The spectrum of flow conditions that would be expected during any season are represented by using load duration curves to set the TMDL. The load duration curves for Parsons Creek were created using three years worth of daily flow data, thereby accounting for variations in flow among different years as well as seasonal differences.

Modeling of current loading and potential load reduction scenarios

Modeling was conducted to a) determine current loading in the watershed through identification and quantification of current sources, and to b) assess the effectiveness of various land management scenarios for reducing phosphorus loads to Parsons Creek. This modeling was done using the Soil and Water Assessment Tool (SWAT version 4/18/2001). SWAT is a distributed parameter, daily time step model that was developed by the USDA-ARS to assess non-point source pollution from watersheds and subwatersheds. SWAT simulates hydrologic and related processes to predict the impact of land use management on water, sediment, nutrient and pesticide export. Crop and management components within the model permit reasonable representation of the actual cropping, tillage and nutrient management practices typically used in Northeastern Wisconsin. Major processes simulated within the SWAT model include: surface and groundwater hydrology, weather, soil water percolation, crop growth, evapotranspiration, agricultural management, urban and rural management, sedimentation, nutrient cycling and fate, pesticide fate, and water and constituent routing. SWAT also utilizes the QUAL2e submodel to simulate nutrient transport. In the case of Parsons Creek, three years of daily data for sediment, phosphorus, and flow were available for use in the SWAT model, along with the necessary land use information, making this detailed modeling approach a good match for the high level of available watershed data.

The SWAT modeling done for this project identified and quantified sources of sediment and phosphorus export using watershed model simulations and other techniques, to predict the impact of land use management on these exports. Daily stream flow, suspended sediment, and total phosphorus loads from non-point sources within the Parsons Creek watershed were simulated, and numerous scenarios were run including (1) baseline 2000 conditions, and (2) alternative management or policy scenarios, which were compared to the baseline 2000 conditions. The model was validated with daily discharge and computed TSS and phosphorus loads from two USGS-WDNR monitoring stations that were located within the Parsons Creek watershed, which were operated from USGS water year 1998 to 2001 (Baumgart, 2007).

Several of the BMPs identified in the modeling scenarios for sediment reduction in the Parsons Creek watershed will also address phosphorus. Additional BMPs were also identified through modeling to specifically target phosphorus reduction, which, when implemented, would be beneficial to reducing loading to the downstream systems (see Table 9 in the “Implementation Measures” section).

Setting target levels for TP

The numeric target concentration value for phosphorus for waters listed as Class 1 trout streams is 0.06 mg/L TP, which represents a median value of random samples taken during the growing season of May through October. This value was chosen based on research conducted in Wisconsin that studied biotic responses to a range of nutrient concentrations in varying environmental settings of 240 wadeable streams (USGS, 2006, “Nutrient…”). The goal of this study was to guide development of regionally-based nutrient criteria for Wisconsin streams. The study indicated that the threshold at which small changes in nutrient concentrations resulted in relatively large changes in biotic communities (as measured by diatom and fish indices) is 0.06 -.07 mg/L TP. Based on this finding, WDNR technical experts recommend a threshold of 0.06 for Class 1 trout streams and other outstanding or exceptional resource waters.

Monitoring and modeling results indicate that Parsons Creek and its East Tributary currently meet the median target concentration of 0.06 mg/L on an annual basis, including storm flows measured during November through April. However, although Parsons Creek itself meets criteria for TP, a "protective" phosphorus TMDL has been established reduce storm loads of TP in order to stabilize and increase DO levels to the point needed for trout reproduction, and to reduce loads to the downstream impaired systems of Lake Winnebago and the Lower Fox River.

This protective phosphorus TMDL was split into two components: a 'normal flow' target and a 'storm flow' target load. This was done in recognition of the fact that major storm events are the key timeframes during which phosphorus loading needs to be reduced. However, it is not reasonable to expect that storm concentrations can be reduced to the 'normal flow' target concentration; this would not be achievable unless the entire watershed were returned to pre-settlement conditions. Instead, a more realistic target is set for storm flows which should still greatly reduce the amount of phosphorus entering the Creek.

Establishing the 'normal flow' target concentration for TP

The 'normal flow' target concentration was set at 0.06 mg/L TP, in accordance with the USGS 2006 study described above. The 'normal flow' target of 0.06 mg/L was determined to be appropriate for 95% of flows in Parsons Creek—all those less than 8.0 cfs (8.0 cfs correlates to a 5% exceedance threshold in Parsons Creek, which means that the 'normal flow' target would apply for flows from 5% to 100% exceedance*; see Appendix E for a flow duration curve for Parsons Creek). In addition to the median 'normal flow' target concentration, a maximum 'normal flow' concentration was set at .19 mg/L following methodology outlined by USEPA (2007).

* "X" percent exceedance flow is the flow that is equaled or exceeded X percent of the time. For instance, 5% exceedance flow is a high flow that is only exceeded 5% of the time. 100% exceedance flow is the lowest flow for a stream, which is exceeded nearly 100% of the time.

Establishing total 'normal flow' load capacity for TP

The 'normal flow' load capacity (median and maximum) was determined using a load duration curve (Figure 5). Total load capacity for phosphorus in Parsons Creek will depend on the flow on any given day, and is calculated using the following equation:

Flow (ave. for a given day) x TP 'normal flow' target concentration x conversion factor = Total Load in lbs/day

Median 'normal flow' load capacity:

X.XX cfs x 0.06 mg/L TP x 5.39* = Total load capacity (lb/d TP)

Maximum 'normal flow' load capacity:

X.XX cfs x 0.19 mg/L TP x 5.39* = Total load capacity (lb/d TP)

* 5.39 is a conversion factor derived from:
1 lb / 454,000 mg x 28.32 liters/cubic foot x 86,400 seconds / day = approximately 5.39

Establishing total 'high flow' load capacity for TP

During the highest storm flows, USGS data shows phosphorus levels increasing by three orders of magnitude (USGS, 2000). It is evident through modeling that during the highest 5% of flows (storm events) the 'normal flow' concentration of 0.06 mg/L would not be achievable unless the entire watershed were returned to pre-settlement conditions. A threshold was established at 5%

flow exceedance (i.e. at the highest 5% of storm flows, those > 8.0 cfs), beyond which a separate calculation will be used to establish loading targets. Rather than basing this equation on a specific concentration, a graphical curve fitting process was used to describe the data and to reduce TP loading by 50% from current conditions, producing a loading capacity calculation based on a polynomial function.

Modeling indicates that the target loads indicated by the 'high flow' calculation can be met with a suite of best management practices established throughout the watershed, which should result in a 50% reduction in phosphorus loading as compared to current conditions (Baumgart, 2007). In fact, during these high flows, the level of reduction due to BMP implementation will likely be quite a bit higher than 50% as most BMPs are most effective during runoff events.

Parsons Creek is already meeting numeric water quality criteria for phosphorus. A 50% reduction at high flows is predicted to improve water quality further by reducing algal and plant growth and associated color, odor, taste, or unsightliness as referenced in the narrative criteria in NR 102.04 (1), Wis. Admin. Code. Additionally, reduced algal growth may in turn increase dissolved oxygen levels and decrease the amount of dissolved oxygen diurnal fluctuation. The phosphorus reductions that can be achieved through BMPs should result not only in much lower phosphorus levels within Parsons Creek, but also in reductions of phosphorus loading downstream to Lake Winnebago and the Lower Fox River.

Total 'high flow' load capacity:

0.2* x $flow^2$ (ave. flow for a given day, squared) x 0.5 = Total 'high flow' load capacity (lb/d TP)

* 0.2 is the factor used to describe the shape of the parabolic curve at high flows, as determined through a graphic curve fitting process.

Load duration curve

To create the load duration curve shown in Figure 5, the 'normal flow' and 'high flow' calculations above were utilized. For regular flows between 5% and 100% exceedance, flow data and the normal target concentration of 0.06 mg/L were used to determine the target load capacities throughout the range of flow levels. For storm flows between 0% and 5% exceedance, the polynomial function was used to determine high flow load capacities.

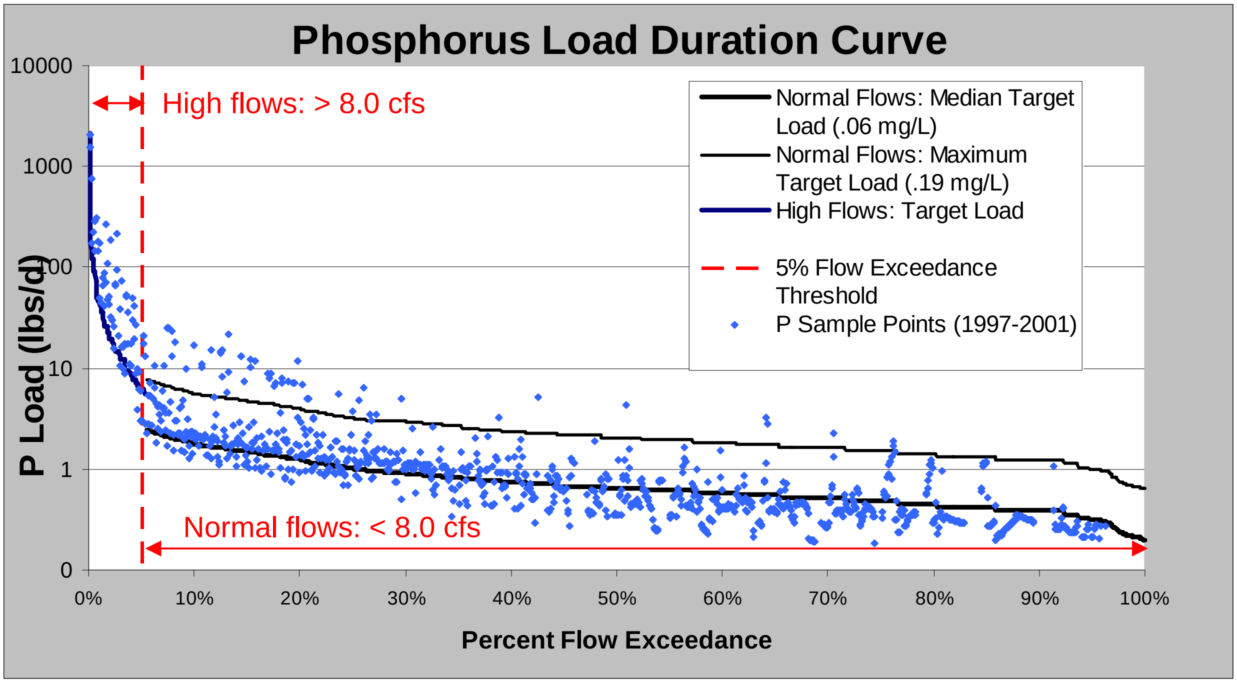

Figure 5. Phosphorus (TP) load duration curve for Parsons Creek, showing median and maximum target load capacities during regular flows (95% of all flows—those <8.0 cfs) and targets during high flows (5% greatest flows—those >8.0 cfs). Load capacity curves are shown here with a scatterplot of pre-BMP sample loads from 1997-2000. It is expected that with implementation of BMPs, loads can be decreased by approximately 50% to meet the target load capacities.

Load/Wasteload Allocations – Total Phosphorus

The total loading capacity for phosphorus is the sum of the wasteload allocations (WLA) for permitted sources, the load allocations (LA) for non-point sources, and the margin of safety (MOS), as generally expressed in the following equation:

TMDL Load Capacity	=	WLA	+	LA	+	MOS
X.XX lb/day TP	**=**	**0**	**+**	**X.XX lbs/day**	**+**	**(implicit)**

WLA = Wasteload Allocation = 0 pounds/day (no point sources)
LA = Load Allocation = X.XX pounds/day TP
MOS = Margin of Safety = (implicit)

Wasteload Allocation (WLA)

Because there are no point sources of phosphorus in the watershed, the waste load allocation is zero. If a point discharge were proposed, one of the following would need to occur:

- An effluent limit of zero phosphorus load would be included in the WPDES permit.
- An offset would need to be created through some means, such as pollutant trading.
- A re-allocation of phosphorus load would need to be developed and approved by EPA.
- Any revised WLAs or LAs must result in the attainment of water quality standards.
- Any changes in the WLA would require an opportunity for public participation.

Load Allocation (LA)

The load allocation for phosphorus from nonpoint sources corresponds to the total load capacity because the waste load allocation is zero and the margin of safety is implicit. Some example load capacities are calculated in Table 8 below.

Table 8. Example loading capacities and corresponding wasteload and load allocations for phosphorus in Parsons Creek. Specific load allocations for each day at specific flows should be determined using the load capacity calculations provided above.

	Example load capacity values at varying flows				**Example Wasteload & Load Allocations**		
					WLA	**LA**	
	% Flow exceedance (low, med, high flows)	**Flow (cfs)**	**Median daily load (lb/d)**	**Max daily load (lb/d)**	**Median & Max (lb/d)**	**Median Load Allocation (lb/d)**	**Max. Load Allocation (lb/d)**
'Normal flow' target (for flows <8 cfs)	90%	1.2	0.4	1.2	0	0.4	1.2
(use 0.06 mg/L median and .19 mg/L max. target conc.)	50%	2.6	0.8	2.7	0	0.8	2.7
	10%	5.6	1.8	5.7	0	1.8	5.7
'High flow' target (for flows >8 cfs)	5%	8	6.4	NA	0	6.4	NA
(use high flow calculation)	2%	14.6	21.3	NA	0	21.3	NA

Margin of Safety (MOS)

The margin of safety accounts for the uncertainty about the relationship between the phosphorus loads and the response in the water body. Because Parsons Creek is already meeting its numeric water quality criteria for phosphorus, and any reductions in TP gained will result in additional benefits for the creek and downstream systems, the MOS for the Parsons Creek phosphorus TMDL is implicit. Additionally, conservative factors were built into the modeling that will result in even greater protection of the waterway than predicted by the modeling outputs:

- No grassed waterways were simulated. Installing them would increase the actual reduced load of sediment and phosphorus to the stream. These will result in greater reductions of TSS loading than predicted.
- Soil phosphorus could be reduced, not just stabilized, through nutrient management (more evenly distribute manure and use to replace commercial P fertilizer as mush as possible, lower commercial P fertilizer, transport manure to cash-crop fields, etc.)
- Conservation tillage and residue levels under current (baseline) conditions are likely lower than estimated in the model, because Fond du Lac County levels were assumed. Parsons Creek watershed has much less cash crop operations where conservation tillage was more likely to be adopted in the past. This would make the percent reduction of TSS (and thus phosphorus) from conservation tillage practices greater within Parsons Creek watershed than the model predicts.
- Contour strip cropping should have a larger impact than demonstrated with the model, since a conservative approach was used whereby the USLE P factor was not fully adjusted across the watershed to account for high rates of soil erosion where strip crops were placed.

Implementation Considerations

Implementation Measures

Modeling for this TMDL assessed several different best management practices (BMPs) to assess their effectiveness in reducing sediment (TSS) and phosphorus (TP) load to Parsons Creek. It was determined that the following BMPs would need to be implemented in order to see load reductions of ~50% of sediment and phosphorus to the creek, and reduce the occurrence of elevated ammonia levels. See Table 9 for information about the extent to which each practice is predicted to reduce sediment and/or phosphorus loads (refer to Baumgart, 2007 for more detailed information about these practices and the modeling conducted to predict effects of each).

- Establishing conservation tillage: 70% mulch-till, 20% zone or no-till, 10% conventional till.
- Installing barnyard/feedlot BMPs on all, or the most important, sources. This includes restricting cattle access to Parsons Creek and controlling feedlot runoff.
- Incorporating 85% of landspread manure (15% may be left unincorporated).
- Reducing phosphorus in livestock feed rations by 25%, assuming 90% implementation.
- Increasing strip cropping along contours to 20% in all subwatersheds.
- Installing vegetated buffer strips to all portions of the stream network that are adjacent to agricultural areas.
- Establishing stream bank erosion controls to decrease erosion from stream banks to minimal levels.

Additional projects related to hydrology and overall stream health and habitat include the following.

- In-stream fish habitat improvements would be beneficial through the entire watershed.
- The hydrologic and habitat functions of the main wetland complex in the Church Road subwatershed should be restored to allow for sufficient water storage and release, producing more stable flows, recreate habitat, and potentially trap sediment and nutrients more effectively. Re-establishment of meanders and staged removal of certain tile lines should be considered as restoration mechanisms.
- Methods of restoring natural streamflow in the area of the connected enlargement (i.e., pond) should be considered to re-establish temperature and flow regimes needed for trout. The impact of other private ponds in the watershed and ways to reduce those impacts could also be assessed.
- Further study is needed on the hydrologic effects of the nearby quarries and potential ways to restore stream hydrology related to these areas.
- The Town of Byron could consider whether it has authority to implement limits on high capacity well usage or to restrict construction of new high capacity wells within its jurisdiction.
- Reconstruction of the Church Road culvert may help fish passage upstream.

Table 9. Predicted effects of BMP installation in the Parsons Creek Watershed expressed as percent reduction of sediment (TSS) and phosphorus (TP), and resulting mean concentrations. (Baumgart, 2007)

NOTE: Percent reductions and concentrations shown for each BMP reflect results expected from installation of each single BMP. The total effect of all BMPs combined does not equal a cumulative total of the individual BMP reductions.

	Percent Simulated Reductions (vs 2000 Baseline)		**Mean concentrations with installation of each BMP**	
	TSS	**Phosphorus**	**TSS** (mg/L)	**Phosphorus** (mg/L)
BASELINE 2000 CONDITIONS			135	0.359
Conservation Tillage: 70% mulch-till, 20% zone or no-till, 10% conventional till	-28.8%	-9.8%	96	0.322
Barnyard/feedlot BMPs: install on all or most important sources*	0.0%	-15.1%	135	0.305
Manure incorporation: 85% incorporated, 15% unincorporated	-0.4%	-10.5%	135	0.321
Reduce phosphorus in feed ration: reduce by 25%; assume 90% implementation	0.0%	-9.2%	135	0.326
Strip cropping along contours: increase to 20% in all subwatersheds	-8.9%	-4.6%	123	0.342
Vegetated buffer strips: install to 100% of stream network adjacent to agricultural areas	-8.4%	-6.3%	124	0.336
Stream bank erosion controls: decrease erosion from stream banks to minimal levels	-8.1%	0.0%	124	0.359
Stabilize phosphorus levels in soil so no longer increasing; implement on 90% of acres; including reducing total amount of manure applied by 16.7%	0%	15.7%		
Total with ALL of Above Scenarios & associated BMPs	**-51.7% Reduction**	**-54.0% Reduction**	**65 mg/L**	**0.181 mg/L**

* Ammonia reductions were not modeled but restricting cattle access to the creek is one of the primary measures needed to address elevated ammonia levels.

Reasonable Assurance

To ensure the reduction goals of this TMDL are attained, management measures must be implemented and maintained to control sediment and nutrient loadings from nonpoint source pollution. (There are currently no point sources discharging sediment or nutrients to Parsons Creek.) Many of these measures require local participation to properly implement.

The WDNR and Fond du Lac County will implement the agricultural and non-agricultural performance standards and manure management prohibitions listed in ch. NR 151, Wisconsin Administrative Code., to address sediment and nutrient loadings in the Parsons Creek watershed. Many landowners voluntarily install BMPs to help improve water quality and comply with the performance standards. Cost sharing is available for many of these BMPs. In most cases, farmers cannot be required to comply with the agricultural performance standards and prohibitions, unless they are offered at least 70% cost sharing.

Fond du Lac County has a solid history of cost sharing water quality restoration projects through the Priority Watershed Program. The county currently has a Priority Watershed project underway for the Fond du Lac River Watershed, which includes Parsons Creek (WDNR, 1997). This project began in 1998 and is scheduled to close in December 2009. The WDNR provides $587,799 annually to the county to be used for cost sharing BMP implementation in the watershed. The county has also participated in Priority Watershed projects for the East, West and North Branches of the Milwaukee River, the Sheboygan River, and Lake Winnebago.

The Fond du Lac County Land & Water Conservation Department (LWCD) and other local units of government may apply for WDNR's Targeted Runoff Management (TRM) grants. The TRM Grant Program provides competitive cost-sharing grants to support small-scale, 2-year projects to reduce nonpoint source pollution. TRM grants fund up to 70% of eligible project costs, with the grant amount capped at $150,000 per grant. The Village of North Fond du Lac received a TRM grant in 2004 and an Urban Nonpoint Source & Storm Water Management-Construction grant (another cost-sharing program specifically for urban areas) in 2005 to rehabilitate nearby Mosher Creek. The combined grant total of $300,000 was used for shoreline easements and streambank stabilization projects.

The Fond du Lac County Land & Water Conservation five-year workplan for 2008-2012 includes goals that address reductions for sedimentation and nutrient loadings. The county's Land and Water Resource Management Plan also includes a strategy to implement the NR 151 performance standards and prohibitions.

In the event that the Fond du Lac County LWCD targets Priority Watershed cost-sharing funds in the Parsons Creek area and/or receives additional TRM grants, installation of streambank stabilization and cattle restriction practices would greatly reduce sedimentation and benefit habitat. Riparian buffers and contour planting in upland areas in the Church Road Subwatershed would also benefit stream health and reduce sedimentation.

There are additional programs that individual landowners may participate in to help achieve the goals of this TMDL. Farmers will be encouraged to enroll in the Conservation Reserve Enhancement Program (CREP) or similar programs to establish riparian buffers on cropland. Riparian buffers could assist in making CREP a viable program for this impaired stream. A similar program available to farmers is CRP, which takes highly erodible land out of agricultural use.

The Environmental Quality Incentive Program (EQIP) is another option available for landowners in the watershed. EQIP is a federal cost-share program administered by the Natural Resources Conservation Service (NRCS) that provides landowners with technical and financial assistance. Landowners may receive up to seventy-five percent reimbursement for installation and implementation of certain runoff management practices. Projects include, but are not limited to, terraces, waterways, diversions, and contour strips. These practices help manage agricultural waste, promote stream buffers, and control erosion on agricultural lands.

Post-Implementation Monitoring

The WDNR intends to monitor Parsons Creek based on the participation levels of implementation of the TMDL, including sites where implementation of Priority Watershed projects or Targeted Runoff Management (TRM) grants are aimed at removing the stream from the impaired waters list. Monitoring will continue until it is deemed that the stream has responded to the point where it is meeting its codified use or until funding for these studies are discontinued. In addition, the stream will be monitored on a 5 to 6 year interval as part of a baseline monitoring strategy to assess temporary conditions and note trends in overall stream quality. The monitoring will consist of metrics contained in WDNR's baseline protocol for wadeable streams, such as the Index of Biotic Integrity (IBI), the Hilsenhoff Biotic Index (HBI), the current habitat assessment tool, and sampling of water quality parameters at a subset of sites.

Public Participation

This TMDL was subject to public review from July 24th, 2007 through August 22nd, 2007. On July 24th, 2007 a news release was sent to newspapers, television stations, radio stations, interest groups, and interested individuals. The news release indicated the public comment period and how to obtain copies of the public notice and the draft TMDL. The news release, public notice, and draft TMDL were also placed on the DNR's website.

A public informational session was also held on the evening of July 26, 2007, at Moraine Park Technical College. Twenty four citizens attended and discussed the TMDL and implementation practices; approximately thirty questions and comments were received during this public informational session. In addition, EPA Region 5 submitted comments during the public comment period. All comments were documented, considered, and addressed, with many incorporated into the final report or held for further consideration during implementation planning discussions. The "Public Comments and Response Log" is included in this report in Appendix F.

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APPENDIX A. WATERSHED AND SAMPLING MAPS

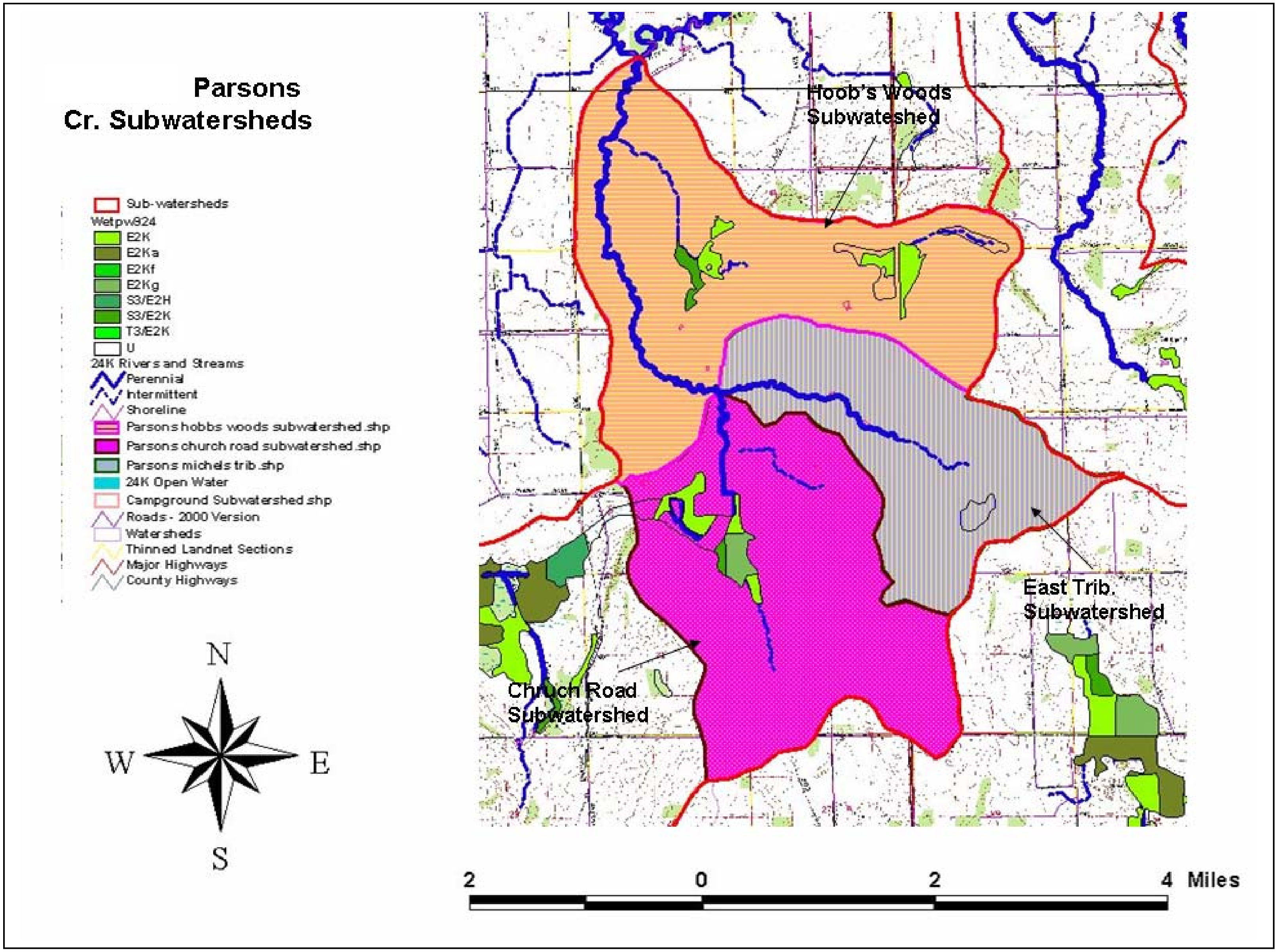
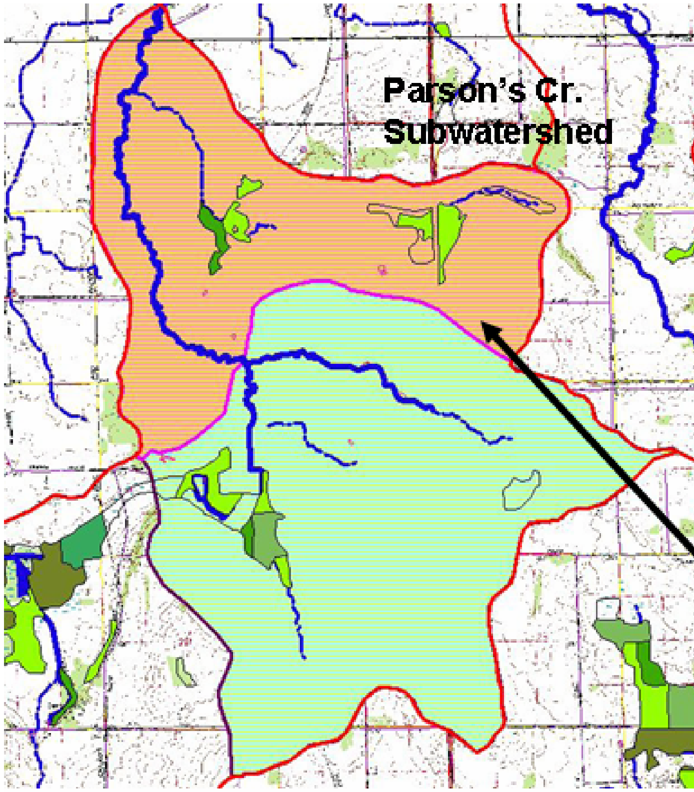


Figure 6. Parsons Creek subwatershed map, showing Hobb's Woods subwatershed, Church Road subwatershed, and East Tributary subwatershed.



Hobb's Woods Subwatershed.

The upper stretch of Parson's Cr. in this Subwatershed, from Site P3 to P4, has a Use Potential of CWA-Class IIn. It cannot meet this Use Potential due primarily to watershed problems in the Church Rd. subwatershed. The stretch of Parson's Cr. from Hickory Rd. to HWY B, Site P4 to P5, has a Use Potential of CWB-Class IIx. This stretch cannot completely meet its Use Potential because of problems in the Church Rd. Subwatershed. The stretch from HWY B to the confluence with the E. Br. of the Fond du Lac R., Sites P5 to P7, has a Use Potential of CWB-MIG. It has significant local problems of bank erosion, extensive widening and lack of depth and fish habitat.

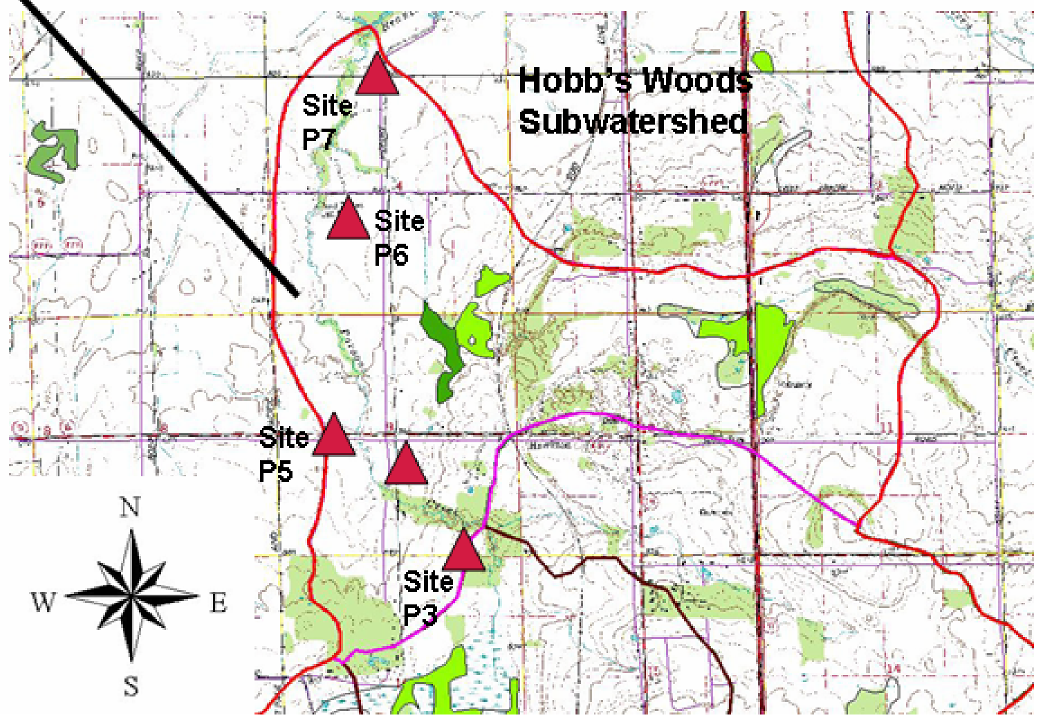


Figure 7. Hobb's Woods subwatershed and sampling points.

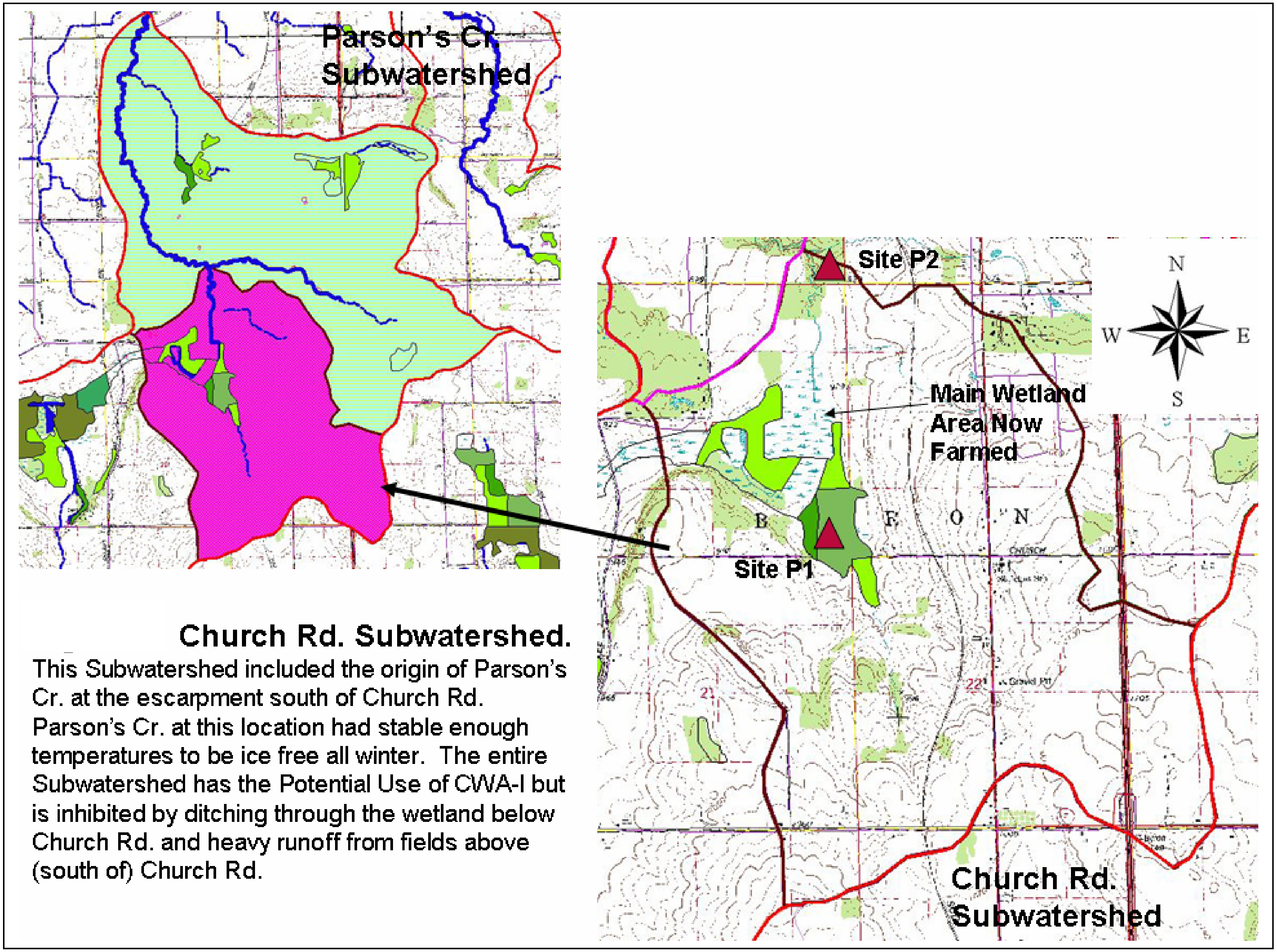
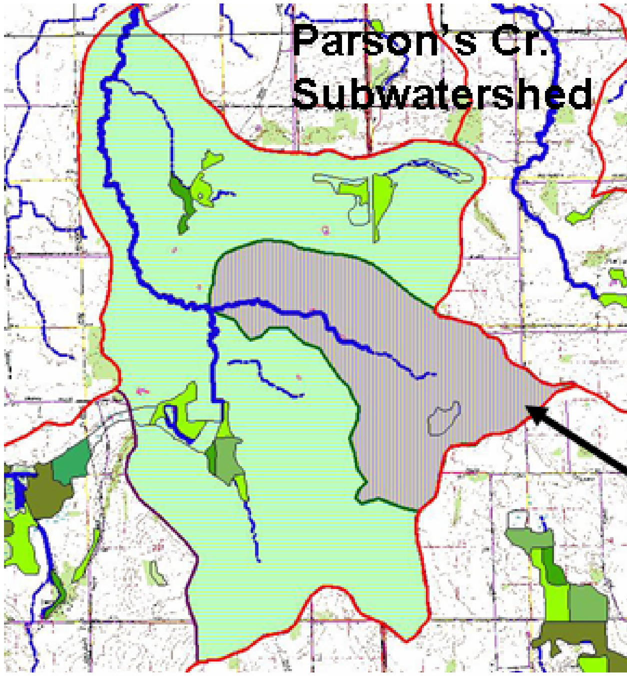


Figure 8. Church Road subwatershed map and sampling sites.



East Trib. Subwatershed. The main groundwater input to the East Trib. Subwatershed Trib. originates between HWY 41 and HWY B. This Trib. has good macroinvertebrate populations and at least forage fish. It appears to lose its flow above Site M3 during some dry parts of some years which along with other runoff and hydraulic problems may result in its not being able to meet its Use Potential of seasonal CWB-MIG and may be a concern since it inputs into Parson's Creek where Parson's Creek has the Use Potential of CWA-1.

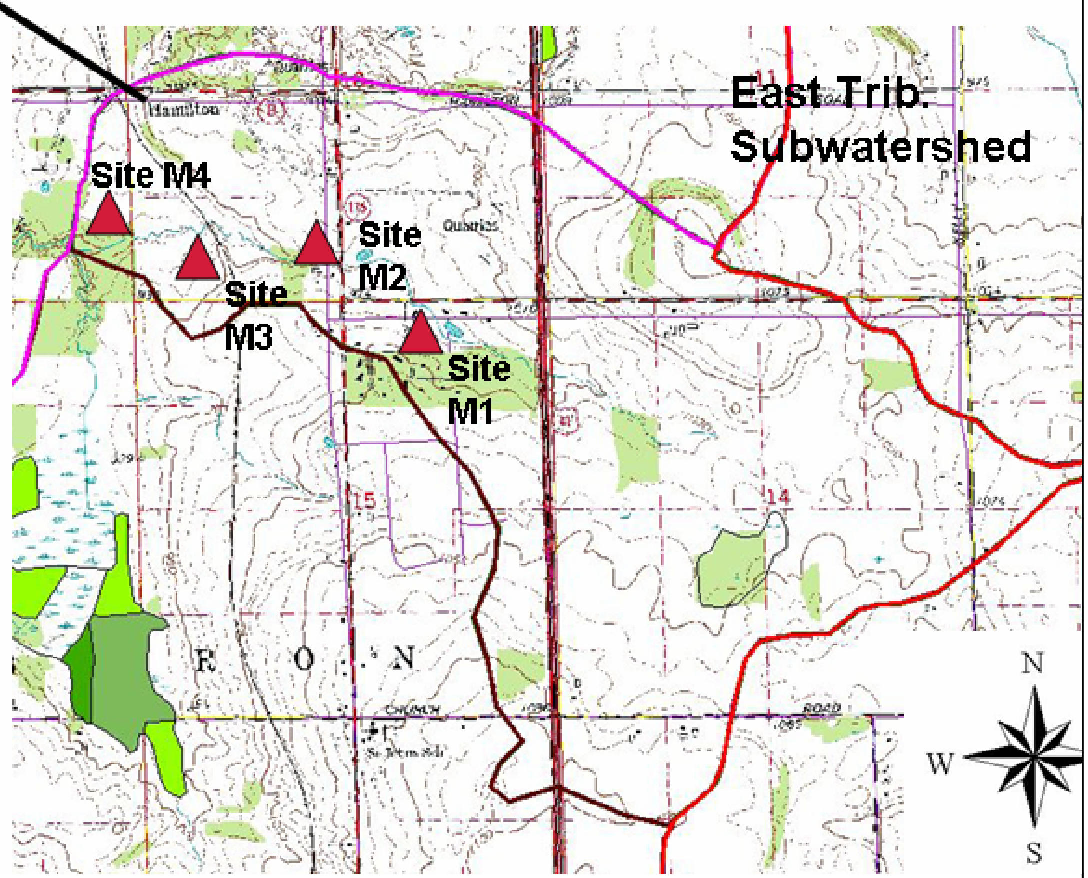


Figure 9. East Tributary subwatershed and sampling sites.

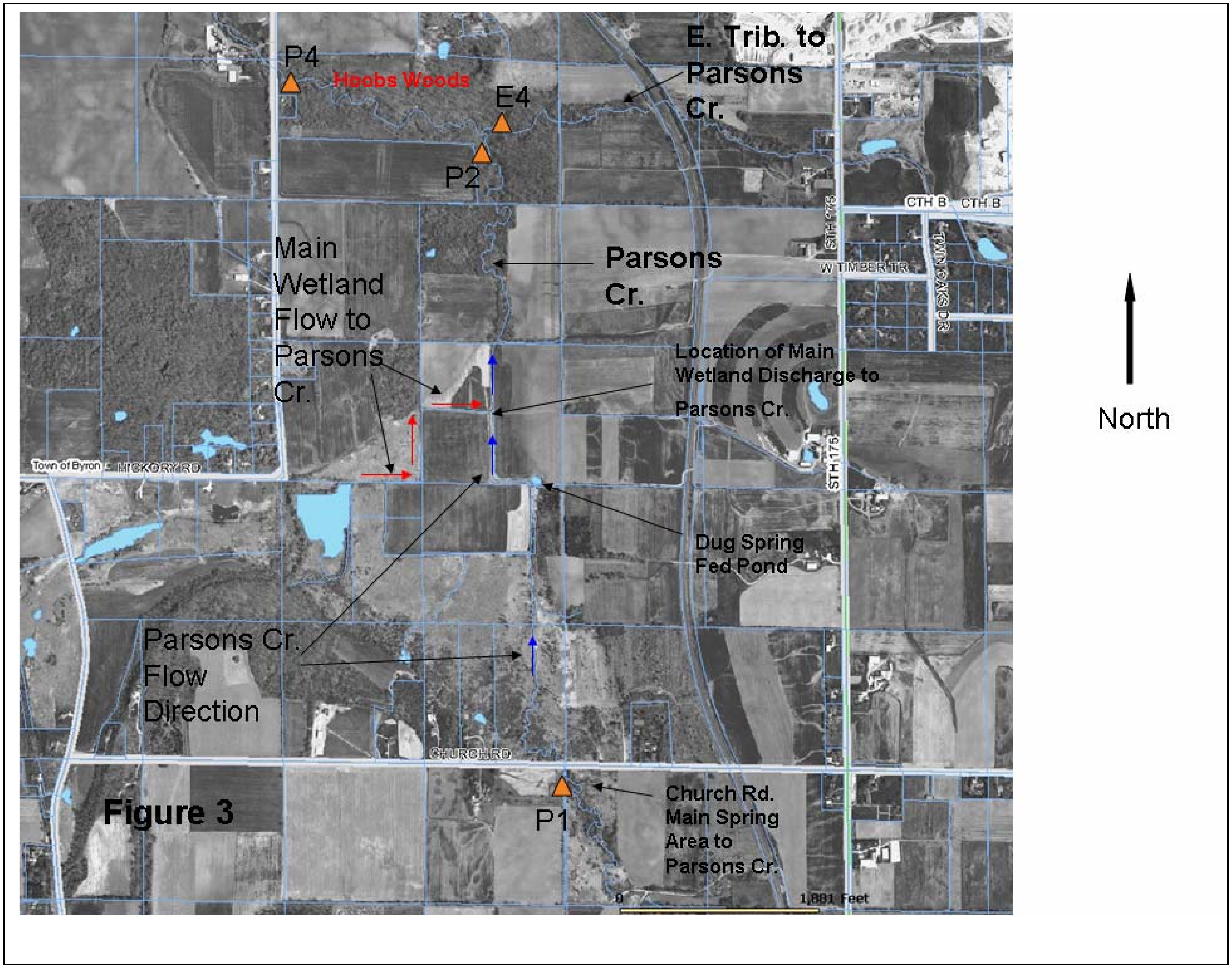


Figure 10. Aerial map showing portions of the Church Road, East Tributary, and Hobb's Woods subwatersheds with hydrologic features identified.

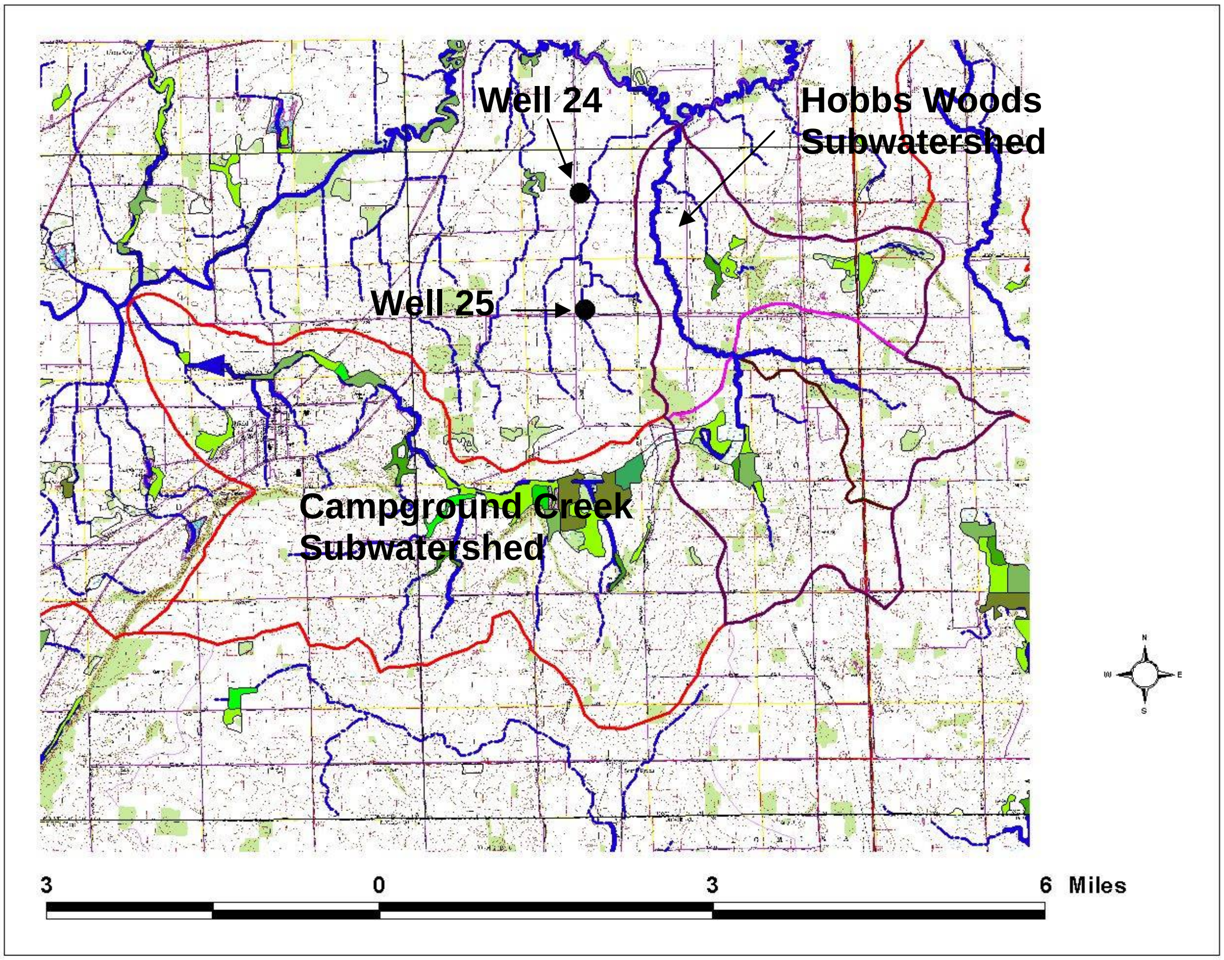


Figure 11. Municipal wells (Wells #24 and 25) operated by the City of Fond du Lac within the Parsons Creek Watershed, in the Town of Byron.

APPENDIX B. PHOTOGRAPHS OF PARSONS CREEK

Figure 12. Parsons Creek at Site P4, looking upstream from the downstream end of the site. This site is located at the downstream end of Hobb's Woods. (Spring 2006)

Figure 13. Parsons Creek above Site P1 and Church Rd. looking upstream. This photo was still in the spring area but above many of the springs near Church Rd. The area was found to have more gradient than below Church Rd. Note the heavy erosion on the right banks. (April 14, 2006).

Figure 14. Parsons Creek above Church Rd. above the major spring area. A farm bridge over the Creek can be seen in the lower center of the photo. This photo is included to illustrate the steep slopes to Parsons Creek in this area that apparently add to the erosion problems and sediment runoff (especially in the spring. (April 14, 2006).

Figure 15. Close-up of manure in the Trib. to Parsons Cr. located adjacent to farm field above Site P2 (SE1/4, NE1/4, NE1/4, Sec. 16, TN of Byron. (April 14, 2006).

Figure 16. Confluence of Wetland Trib. between P1 and P2 with Parsons Creek. Looking west while standing on the east side of the Main Stem of Parsons Creek. Note the clearness of the Main Stem water at bottom contrasting with the stained water from the Wetland Trib. (April 14, 2006).

Figure 17. Draintile to Parsons Creek. This submerged draintile was observed (along with many others) in the ditched Main Stem of Parsons Creek near the confluence with the Wetland Tributary. April 14, 2006.

Figure 18. Spring 2006 runoff observed in Parsons Creek below Site P4. The Hickory Rd. Bridge can be seen in the background. Note the cream color to the sediment loaded stream. This cream color was typical of Parsons Cr. runoff and was caused by the calcareous contents of the adjacent watershed soils. (April 3, 2006).

Figure 19. Parsons Creek looking downstream toward Hickory Rd. Bridge. This was the downstream end of Hobb's Woods. South of this point was Cottonwood Farms (May 5, 2005).

Figure 20. Parsons Creek Site P5 above HWY B. Note the Stream is well grassed along the bank and is much narrower and deeper than in Hobbs Woods. (June 13, 2006).

Figure 21. Parsons Creek erosion problems below HWY B. April 1, 2004.

East Tributary

Figure 22. Parsons Creek East Tributary feeder below the railroad track culvert looking downstream from inside the culvert. The probe was attached to a rerod at the base of the concrete that can be seen at the bottom of this photo (Sept. 14, 2005)

Figure 23. East Tributary Feeder to Parsons Creek looking downstream from HWY 175. This location was about ¼ mile above the probe site. (September 14, 2005).

APPENDIX C. STREAM CLASSIFICATIONS AND DESCRIPTION

Table 10. Stream use classifications. Parsons Creek is not currently supporting its codified use as a Cold Water community. The lower-level use that it is currently supporting is Warm Water Forage Fish community.

Stream Use Classification	Description
Cold	Cold water community; includes surface waters that are capable of supporting a cold water fishery and other aquatic life and serving as a spawning area for cold water species. This includes three levels of cold water classification (Class I, II, or III Trout Stream Classifications; see Table 11 below).
WWSF	Warm water sport fish communities; includes surface waters capable of supporting a community of warm water sport fish or serving as a spawning area or nursery for warm water sport fish.
WWFF	Warm water forage fish communities; includes surface waters capable of supporting an abundant and diverse community of forage fish and other aquatic life.
LFF	Limited forage fishery; (intermediate surface waters (INT-D)) includes surface water of limited capacity because of low stream flow, naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of tolerant forage fish and aquatic life.

Table 11. Trout stream classifications within the Cold Water Community stream use classification.

Trout Stream Classification	Description
Class I	These are high quality trout waters, having sufficient natural reproduction to sustain populations of wild trout at or near carrying capacity. Consequently, streams in this category require no stocking of hatchery trout. These streams or stream sections are often small and may contain small or slow-growing trout, especially in the headwaters.
Class II	Streams having this classification may have some natural reproduction but not enough to utilize available food and space. Therefore, stocking is sometimes required to maintain a desirable sport fishery. These streams show good survival and carryover of adult trout, often producing some fish of better than average size.
Class III	These waters have marginal trout habitat with no natural reproduction occurring. They require annual stocking of legal-size fish to provide trout fishing. Generally, there is no carryover of trout from one year to the next.

APPENDIX D. ACUTE TOXICITY CRITERIA (AMMONIA)

Table 12. Wisconsin's Acute Toxicity Criteria (in mg/L) for ammonia at example pH values.

This table shows the ammonia concentration limits not to be exceeded at given pH values for each stream classification.

pH (s.u.)	CW1 CW4	CW2 CW3	CW5 WWSF LFF	LAL
6.0	36.72	45.85	54.99	84.71
6.1	36.17	45.17	54.17	83.45
6.2	35.51	44.34	53.17	81.92
6.3	34.71	43.34	51.97	80.06
6.4	33.74	42.14	50.53	77.84
6.5	32.61	40.72	48.83	75.22
6.6	31.28	390.06	46.84	72.17
6.7	29.76	37.16	44.57	68.66
6.8	28.05	35.02	42.00	64.70
6.9	26.15	32.65	39.16	60.33
7.0	24.10	30.10	36.09	55.60
7.1	21.94	27.40	32.86	50.62
7.2	19.73	24.63	29.54	45.51
7.3	17.51	21.86	26.21	40.38
7.4	15.34	19.16	22.97	35.39
7.5	13.28	16.59	19.89	30.64
7.6	11.37	14.20	17.03	26.24
7.7	9.64	12.04	14.44	22.25
7.8	8.11	10.12	12.14	18.70
7.9	6.77	8.45	10.13	15.61
8.0	5.62	7.01	8.41	12.95
8.1	4.64	5.79	6.95	10.70
8.2	3.83	4.78	5.73	8.82
8.3	3.15	3.93	4.71	7.26
8.4	2.59	3.24	3.88	5.98
8.5	2.14	2.67	3.20	4.93
8.6	1.77	2.21	2.65	4.08
8.7	1.47	1.84	2.20	3.40
8.8	1.23	1.54	1.84	2.84
8.9	1.04	1.30	1.56	2.40
9.0	0.88	1.10	1.32	2.04

APPENDIX E. PARSONS CREEK FLOW INFORMATION AND MONTHLY DATA (options for permitting dischargers in the Parsons Creek watershed)

The following information may be considered while establishing permit limits on TSS for the quarries located within the Parsons Creek watershed. Daily flow data used in this report may also be obtained from the WDNR Water Evaluation Section or USGS, to conduct further analysis needed for permitting.

Several options may be explored in setting permit limits for TSS. Some examples are briefly described below. These scenarios do not encompass all possible methods for setting appropriate permit limits in accordance with the TMDL.

Scenario A: Limits based directly on the Load Duration Curve equation
If permittees wish to have the full range of discharge limits available to them under this TMDL, they may need to install a flow gaging system on Parsons Creek to track daily flow conditions and determine their discharge limits accordingly. In this scenario, the stream flow would be measured on a daily basis (or on whichever days the facility wishes to discharge), and the calculation provided in the TMDL report would be used to determine allowable total load, which would be divided in half for an individual quarry's wasteload. The permittee could determine how many gallons of discharge would be allowed, given the discharge's TSS concentration (up to 40 mg/L) and the allowable load for the day based on stream flow.

Scenario B: Limits based on Flow Categories
Divide the range of flows into Flow Categories based on percent flow exceedance, such as those listed in the table below. Set the permit limit for each flow category to be the average lb/d allowed for that flow category. This simplifies the permit limits by setting only four different limits, but still requires the permittee to determine what flow category Parsons Creek is in at the time it wishes to discharge.

Table 13. Example Flow Categories that could be constructed for Parsons Creek, and the corresponding WLAs based on averages within each Flow Category.

Flow		Combined WLAs based on ave. flow conditions in each Flow Category	Individual WLAs for each quarry based on ave. flow conditions in each Flow Category
Flow Category	**% Flow Exc.**		
High Flow	0%-5%	94	47
Moist	6%-39%	46	23
Mid-Range	40%-59%	24	12
Dry	60%-89%	18	9
Low Flow	90%-100%	11	5.5

Scenario C: Limits based on monthly low flows or monthly average flows
Monthly low flows and monthly average flows have been calculated for Parsons Creek using the USGS daily flow data from 1997-2001. Permit limits could be set according to these values for each month of the year. However, it should be noted that if monthly low flows are used, the highest combined WLA allowable, in April, is only 34 lb/d (17 lb/d each), not the 94 lb/d (47 lb/d each) that would otherwise be allowable under the TMDL at high flows. Using average monthly flows, a maximum combined WLA of 74 lb/ is

allowed in April (37 lb/d each). This is closer to, but still below, the 94 lb/d (47 lb/d each) allowable in the TMDL.

Table 14. Parsons Creek monthly minimum flows and monthly average flows, and the corresponding total wasteload allocations (i.e. both sources combined). (from USGS daily flow data, 1997-2001)

Month	MONTHLY MINIMUMS			MONTHLY AVERAGES		
	Monthly Minimum flow (cfs)	~% Flow Exc.	Combined WLA (lb/d)	Monthly Average flow (cfs)	~% Flow Exc.	Combined WLA (lb/d)
Jan	1.0	94%	12	**1.4**	79%	17
Feb	1.1	93%	13	**3.0**	27%	36
Mar	1.9	55%	23	**5.5**	10%	66
Apr	2.9	29%	34	**6.2**	8%	74
May	2.7	33%	32	**4.6**	15%	56
Jun	2.5	36%	30	**4.1**	18%	50
Jul	1.8	60%	21	**3.1**	26%	37
Aug	1.7	63%	20	**2.2**	42%	26
Sept	1.6	68%	19	**2.4**	38%	29
Oct	1.4	79%	17	**1.7**	63%	20
Nov	1.4	79%	17	**1.7**	63%	20
Dec	1.1	93%	13	**1.3**	83%	15

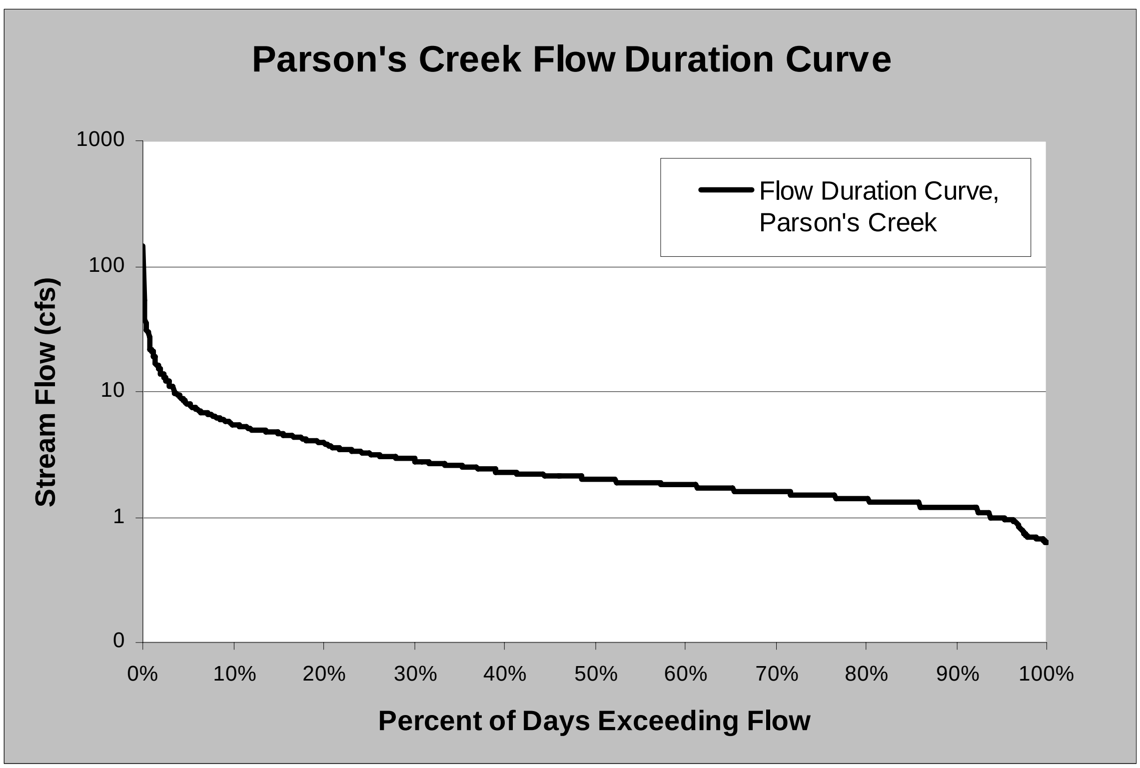


Figure 24. Flow duration curve for Parsons Creek, based on USGS data from 1997-2001.

* "X" percent exceedance flow is the flow that is equaled or exceeded X percent of the time. For instance, 5% exceedance flow is a high flow that is only exceeded 5% of the time. 100% exceedance flow is the lowest flow for a stream, which is exceeded nearly 100% of the time.

APPENDIX F. PUBLIC COMMENTS AND WNDR RESPONSES

Public Comments & Response Log
Parsons Creek TMDL

Public Comment Period July 24-Aug. 22, 2007
Compiled by Kristi Minahan and Carolyn Betz, WDNR

This comment and response log contains four sections:

- EPA's comments, submitted 8/7/2007
- Additional EPA comments, submitted 9/17/2007
- Comments/questions received at the public informational session on 726/2007
- Additional comments received during the public comment period

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EPA's Comments on the Parson's Creek TMDL
Submitted by Dave Werbach   8/7/07

1. **Page 2:** It would be helpful to add another table here with the info from the 303d list, or add a couple more columns for the pollutant and impairment (unless it makes it too cumbersome).
   Response: Added two columns listing pollutants & impairments for each segment.

2. **Page 11:** Good discussion of impacts TSS, TP, and ammonia have of the fish community. May want to add a final sentence to the TP section on how this impacts the fish – lowers the water quality, shift from specialist feeders (sportsfish, trout) to generalist/omnivores (forage fish)(sorry, not a biologist, inset correct terms here.)
   Response: Explanatory text added.

3. **Page15:** Good inclusion of these bullets. I will likely pass this on to other states as an example.
   Response: Thank you.

4. **Page 15, MOS:** Regarding the second bullet, how will pH be reduced in the stream? Will the pH lower more towards 8.4, or do you expect the overall average to lower as well as the maximum?
   Response: After speaking with a technical expert at DNR, I modified this paragraph to use more cautious wording. It now reads (in part):
   "…Once best management practices are implemented to reduce phosphorus and algae that likely cause higher pH, the pH in the stream may decrease to a more moderate level*. *Because the dolomite in the watershed may contribute to higher pH levels as well, it is difficult to predict whether pH will decrease significantly or not."

5. **Page 16:** To clarify, was the SWAT model used to determine the effect of the sediment reduction scenarios? If it was used to determine loadings, then more information on how and why SWAT was used needs to be submitted. Discussion on how SWAT was used in the phosphorus TMDL is needed, either here or in the phosphorus section.
   Response: Additional language was added to the text to address this, in both the sediment section and the phosphorus section. In both cases, the SWAT model was used to assess & quantify *current* loading to the creek. *Target loads* were set for sediment using the USGS study, and for phosphorus using a DNR nutrient study. The SWAT modeling was also used to predict the effectiveness of different reduction scenarios using various BMPs within the watershed.

6. **Page 16:** A short description of how this TMDL for sediment was developed is needed. It should explain what process was chosen (load duration curve), why it was chosen, what data was used to develop it (where the flow data came from, where the sample data came from), and a brief summary of how to interpret it. I will look for a good example to send.
   Response: Language was added to explain these aspects of the load duration curve. See also

the subheader "*Load duration curves*" at the end of the Sediment TMDL section.

7. **Page 17, Seasonality and critical condition:** This is actually a good description of critical condition. Suggest adding a sentence or two about Seasonality, stating that Seasonality is also accounted for in the LDC process, where 2 years of flow data and sampling data account for variations in flow over the year.
   Response: Language was added to both the sediment and phosphorus sections explaining that by using load duration curves based on 3 years of daily flow data, differences among flow during different seasons and years was accounted for.

8. **Page 20:** typo in the first paragraph, TP is in the LA description.
   Response: Fixed.

9. **Page 21, MOS:** There seems to be discussion of the phosphorus TMDL in this section. The discussion of Otter Creek seems out of place here.
   Response: This was a mistake in this section; the reference to Otter Creek has been removed. Earlier in the TMDL development process, we'd tried using Otter Creek as a reference stream. However, we later decided to use the USGS study because it was based on over 900 streams to extrapolate to reference conditions, rather than a single stream. The reference to Otter Creek in the draft was language from an earlier version that should have been removed.

10. **Page 22:** The first paragraph needs to have more discussion on how the TP is (or could be) affecting Parson's Creek. The first sentence in the Seasonality discussion seems to indicate that even if TP is not directly causing an impairment in the waterbody, it may be happening very shortly (could this be considered "threatened"?) and reinforces the need to develop TP load limits to prevent an imminent problem.
    Response: Additional information has been added to clarify the documented impacts of phosphorus in the creek and its effects on downstream systems.

11. **Page 23:** The target of 0.06 mg/l needs some further explanation. Is that a documented target? Some further discussion is needed on where that target came from, and that it is based upon meeting the designated use for cold-water streams.
    Response: Text was added to the report to clarify the source of the 0.06 threshold that was chosen. This threshold was selected based on USGS research evaluating nutrient concentrations of 240 Wisconsin streams under varying environmental conditions. 0.06 is the threshold at which small changes in concentration result in large changes in fish community indices, and is the recommended threshold for Class 1 trout streams and other outstanding/exceptional resource waters.

12. **Page 24:** The reduction for the high flow is a bit confusing. For phosphorus, is it that phosphorus is a problem at the higher (>5%) flows, but not at the lower flows?
    Response: Additional clarification has been added to the Phosphorus TMDL section. The main goal of the phosphorus TMDL is to reduce storm loadings, which are contributing to instream DO problems in the Hobbs Woods Subwatershed and also are causing loading downstream in the Lake Winnebago and Lower Fox River systems, which are impaired by phosphorus.

Additional EPA Comments on the Parson's Creek TMDL
Submitted by Dave Werbach 9/17/07

1. **The load duration curve for ammonia is missing.**
   There is no load duration curve for the ammonia TMDL. The ammonia TMDL was created using much of the same process as one would use to develop a load duration curve, but example tables were used in place of an actual curve.

2. **Was the same USGS gage used for each pollutant? Which USGS gage was used? (The USGS site lists three possible gage numbers)**

The downstream gage, USGS Station ID 04083425, was used for all of the Parsons Creek TMDL data. This has been clarified in the final document.

3. **I would like to discuss exactly how the median and maximum values were developed for TSS.**
   I discussed the process used with Dave Werbach at EPA to provide clarification (phone conversation on 9-19-2007).

4. **There appears to be some confusion on the WLAs. Table 6 has lowest WLA as 3.5 pounds/day, while pg 22 and App E have 5.5, while Table 7 has 14 for both, which equates to 7 each.**
   Good catch on this discrepancy—the numbers are 'correct' but confusing, and it should be changed to provide simplicity. Keep in mind that the WLA is based on an equation that is dependant on flow, so the WLA changes depending on what level of flow it is being calculated for.
   - Table 7's combined WLA of 14 is correct. Note that Table 7 is providing an example value at 90% flow exceedance, not the lowest flow possible (which would be at 100% flow exceedance).
   - Page 22 and Appendix E list individual WLAs of 5.5. This value was taken from an attempt to put ranges of flows into categories, as shown in Table 13 in Appendix E. The 'Low Flow' range is from 90-100% flow exceedance. If you use the average flow in that range (corresponding roughly to 95% flow exceedance), the value for the combined WLA equals 11, and thus the individual WLAs are each 5.5. However, again, this is not the lowest possible WLA, which would be based on 100% flow exceedance.
   - Table 6 lists 3.5 lb/d for individual WLAs. This represents the lowest possible flow conditions, at 100% exceedance flows. 100% flow exceedance in the USGS data set I used corresponds to .62 cfs, which calculates out to a combined WLA of 7.4 (rounded down to 7 in Table 6, consistent with the other numbers), or an individual WLA of 3.5 lb/d.

   To remedy these confusing numbers, I recommend discarding the 5.5 individual WLA and focusing on the lowest possible WLA of 3.5. To do this, I added an additional row to Table 7 to demonstrate 100% flow exceedance, with a combined WLA of 7 (i.e. individual WLA of 3.5). I kept Table 6 as-is, with the lowest flow individual WLA set at 3.5. I changed Pages 21-22 correspondingly to represent the lowest possible flow (100% flow exceedance), with a combined WLA of 7 and individual WLAs of 3.5.

5. **Are "erosion" and "hydrologic problems" normally something listed for on the 303d list? To give credit for "impairments addressed", we need to tie impairments to a pollutant. Since flow (or lack thereof) is not a pollutant, "hydrologic problems" will not cont, and we need to discuss "erosion.**
   'Erosion' and 'hydrologic problems' have now been removed from Table 1 in the final version. Erosion is covered by the 'sedimentation' impairment already listed, and though Wisconsin DNR may discuss creating a new category for flow, we have not done so yet in a formal way and do not anticipate doing so before the next 303(d) listing cycle.

Comments/Questions received during the public informational session on July 26, 2007 (arranged by subject)

303(d) Listing

Comment: Why is only the lower segment on the 303(d) list?
Response: The whole watershed will be covered in the 2008 list. The Church Road segment & the East Tributary will be proposed for listing in 2008.

Comment: Why is the part of the stream where a lot of restoration work is done and where there are lunker structures on the 303(d) list but the other part isn't?

Response: The other segments of the stream will be listed in 2008. Those portions where work has already been done are now a lot closer to being de-listed because of restoration efforts that have already been undertaken.

Comment: There are trout in the stream already.
Response: According to Bob Hasse of Trout Unlimited, Parsons Creek used to be a world class trout fishery. The numbers have declined sharply. Some of the fish currently in the stream may be due to occasional restocking by watershed residents. In order to meet its potential as a stable, naturally reproducing fishery, improvements need to be made.

TMDL Target Levels

Comment: Why are we doing this if the waterbody is already meeting water quality standards? What are the averages?
Response: In both the cases of sediment and phosphorus, the amounts of sediment and phosphorus entering the stream during normal flow conditions are reasonable amounts. However, during storms, the levels of these pollutants entering the stream are extremely high and need to be reduced. Because of these high loads, habitat is degraded with too much sediment, eroded banks, and low dissolved oxygen levels. They are also impacting Lake Winnebago and the Lower Fox River downstream. The goal of both of these TMDLs for Parsons Creek is to reduce the pollutant levels during storm flows to improve water quality and habitat to acceptable levels.

Comment: Why are they using Otter Creek as a reference stream?
Response: The draft TMDL that was posted on the web contained an error on p. 21 in the Sediment Margin of Safety (MOS) section. It incorrectly refers to Otter Creek as a reference stream. In an earlier version of the report, DNR staff considered using Otter Creek as a reference stream, but then decided to use reference values from a USGS study based on a large group of streams instead. This error has been fixed in the final report.

Load & Wasteload Allocations

Comment: Fond du Lac Stone does discharge to the river.
Response: To follow up on this comment, Mike Reif (WDNR Water Quality Biologist and Wastewater Specialist) conducted site visits to all the quarries in the watershed to gain a better understanding of quarry operations regarding wastewater and stormwater management. It was determined that two sites do have discharges that occasionally reach Parsons Creek. These are Michel's Materials – Hamilton Hill Quarry, which dewaters the quarry with pumping occasionally, and Oakfield Stone –Byron Quarry. The Michel's Materials – Fond du Lac Stone Quarry site (mentioned in the original comment, above) does not discharge to the creek; it is internally drained. WDNR staff assessed the amount of discharge expected from the two sites with a process wastewater discharge, incorporated that information in the TMDL report, and assigned Wasteload Allocations for the quarries in the Sediment TMDL section.

Comment: What if there were 6 point sources, would their permit limit have to be lowered?
Response: Yes, if necessary. For instance, the Lower Fox TMDL project has all kinds of point sources, and is a much more complex system. Parsons Creek is a more simple process; and currently only very minimal amounts of discharge come from point sources (in this case, quarries). In cases where pollutant is contributed from both point and nonpoint sources, implementation planning addresses how much reduction will be expected from each type of source.

Comment: Is this paving the way for pollutant trading?
Response: That is one possibility. We are also looking at where the gaps are and funding is a gap. We are asking for money from the legislature.

Implementation Planning

Comment: What are you looking for in the river—the conditions that are in Hobb's woods (i.e. significantly widened stream & bank erosion), or making the stream 3-4-5 feet wide?
Response: We want to put in restoration practices that will result in a narrower stream, for better fish habitat. There is a lot of work to be done in Hobb's Woods to restore that segment.

Comment: Parsons Creek is a place that Trout Unlimited wants to put restoration effort into. Would like to reroute hiking trails so that they are not immediately adjacent to the stream & causing so much erosion. Would like to have Hobb's Woods be a place that schools can use, but they don't want people trampling near banks. Also want to do some selective tree cutting (to let in light so that vegetative ground cover can grow to stabilize banks) and do some restoration work. Don't want decreased stream flow or increased stream width. Would like to contact property owners where people are willing to partner with them. Trout Unlimited used to only work with public access property but now would like to work with landowners.
Additional Note: There may also be interesting partnerships available for stakeholders for easements etc.
Response: This type of work would be excellent. We are very appreciative of ongoing efforts of Trout Unlimited and others who have been hard at work already on restoring the Creek. We look forward to partnering with you on these projects.

Comment: Willow trees are blocking the light; hard bottom. TU would like to do work with landowners to remove trees to improve habitat.
Response: On-farm site analyses may be a good way to determine which types of improvements are needed in which locations. TU and county staff may be able to conduct these types of site visits.

Comment: Request for additional information on the Fond du Lac River Priority Watershed.
Response: Paul Tollard and Lynn Mathias (FDL Co. Land Conservation Dept.) can be contacts to landowners. Landowners must meet certain requirements like giving access to the county to come onto the farm or property and make suggestions. Some information the county has is old and should be updated. Landowners who install practices must provide maintenance of the BMPs. Most of the Priority Watershed money for 2007 has already been allocated, so plan for 2008. There are other sources of funding, like through the Land & Water Resource Management Plan.

- Fond du Lac River Priority watershed project is very large, Parsons Creek is only one small part of the entire watershed.
- County looks forward to working with landowners and to talk with them about cost-sharing and getting practices on the land.
- Contact the county as soon as possible because there is only so much money to go around and there may not be enough staffing to go around to help everyone. Need time to plan ahead to survey, design and implement the practices.
- DNR is looking to develop a package to help counties.
- There are other opportunities like EQIP, so there are other ways to get funding. Need to piece the right program together and find the right options to help each landowner.

Comment: A lot of the stream in Hobb's Woods is washed out.
Response: Impacts in Hobb's Woods are described in the "Parsons Creek Watershed Description" section. It is recognized that there are some significant issues in that area with streambank erosion and resulting sedimentation, and flashy flows within Hobb's Woods. A bit more language was added in this section.

Comment: The TMDL report claims that tile drains can have a negative impact on trout streams. The water will come off the land regardless; it cannot be held back. Tile drains can improve the water quality.
Response: Not all tile lines are bad; it depends on the land characteristics and land use practices, such as how much fertilizer is applied and how much the crop takes up. We are recommending that tile lines in the watershed are investigated further to determine if they are causing impacts to water quality.

Comment: What part of Parsons Creek is considered navigable?
Response: All of it. East Branch as well has been considered navigable. There is a point at the headwaters at which any stream would be no longer considered navigable. Usually a field investigation would be needed to determine where that point is.

Comment: Is it navigable if there are cows in the creek? Will you put the farmer out of business?
Response: Having cows in the stream is a violation of the performance standards if there is not sufficient vegetative cover on the banks to prevent erosion. The county can help landowners to fix this problem.

Hydrologic Issues

Comment: Trout streams are drying up, like the Little Plover River. Part of the reason is aquifers are going down. Water quantity is an issue.
Response: Water quantity is certainly an issue. Some of this may be from municipal wells (see question below), some may be from private wells and ponds, and some may be from natural conditions. A certain level of quantity is needed to meet the Creek's potential as a trout stream.

Comment: How many people here remember when Parsons Creek was a trout-rearing stream? The City of Fond du Lac has lowered the water table for the Town of Byron. There is hope to restore the stream with habitat restoration.
Response: In response to this comment, Michael Reif (WDNR) conducted site visits to the two City of Fond du Lac wells in the Town of Byron, and documented their locations and withdrawal rates. It is possible that these or other wells in the watershed may be impacting Parsons Creek, but the extent of impact is unknown at this time. There may be authority within the Town of Byron to put limits on how much water may be withdrawn from these wells, and to restrict construction of new city wells in the watershed. This information has been added to the TMDL report in the sections on hydrologic impacts and implementation considerations.

Comment: Isn't there a place in Madison where they withdraw water from one watershed and have effluent going into another watershed, but the effluent water is being pumped back into the original watershed?
Response: Yes; there is a project like this in Madison. This can be an effective way to maintain baseflows in a more natural state but it can also be very costly to construct.

Comment: What restrictions are there for a person drilling a well near springs?
Response: The Department has regulatory authority in the new groundwater law (Act 310) to protect springs that produce at least one CFS at least 80% of the time from impacts that may be caused due to the installation of high capacity wells.

Comment: We need to look at how we use water.
Response: Agreed—this is important for all of us.

Comment: The flow rate on the stream has gone way down over the last 30 years. What is going to happen with the flow if the wetlands are restored?
Response: Between Church Road and Hobbs Woods, the wetland acreage has been reduced & converted to agricultural uses. Wetlands store water during wet periods and slowly release it downstream during dryer periods, helping to maintain baseflow of the stream. If wetlands are restored, it is hoped that this will improve baseflow and also help capture sediment.

Comment: Some people have put in ponds in the watershed and this may have affected the hydrology.
Response: We can look into this as part of the implementation plan and consider BMPs regarding ponds.

Comment: In 2006, in lower end of Parsons Creek, there was watercress—an indication that the water quality has improved—but the water quantity is a real issue. The landowner making this statement has land in the CREP program and he has seen major improvements in the water quality.
Response: This watershed was selected in part because there are so many restoration efforts already going on and momentum in a positive direction. We hope to build on that to restore the complete potential of the waterway.

Opportunities for additional public comment

Comment: Would like to see another draft before the final is submitted to EPA.
Response: We will look into an interim draft but it is unlikely that we will have another draft for public comment.

Comment: What if someone else sends in a comment and the report changes significantly, how would people know?
Response: Leave your mailing address or e-mail address and Kristi Minahan can mail another draft to you.

Comment: Is it possible to have another public meeting before the next draft is released?
Response: At the meeting, we indicated that it might be possible to do this and that we would consider it, but that it would be more likely that we will hold our next public meetings during the implementation planning process. WDNR staff did discuss this further in the following week and determined that rather than holding a second public meeting at this time on the TMDL report, we would like to hold one or more meetings in the watershed about implementation planning at a future date. This should be more directly related to the types of questions and concerns that residents were asking about at this first public info session.

Comment: There are a lot of people from the Town of Byron that are not here tonight. A lot of people may want to know about this. Maybe have a meeting in the Town of Byron and have it at the town hall.
Response: Thank you for the invitation. We'll look into it, especially for our implementation planning meetings.

General Program Questions

Comment: Is this part of the Clean Water Act of 1972? Is there a sunset clause on the CWA?
Response: Yes, it is part of the Clean Water Act. The CWA has been updated periodically, but there is no sunset to the law. Nationally, there is a lot of work to be done.

Comment: How many streams are being addressed? How far can the money go?
Response: In Wisconsin, we are aiming for 15 TMDLs this year. Changes in that number are anticipated next year. A TMDL needs to be written for each impaired water.

Comment: I thought the DNR knows everything. I'm not smiling.
Response: We don't know everything; we value the input of people in the watershed who are more familiar with the specifics of this area.

Other comments

Comment: Parsons Creek does not have an apostrophe; remove throughout document.
Response: Fixed.

Comment: Found a typo on page 4 East Tributary Subwatershed, Hwy 135 should be 175.
Response: Fixed.