Legler School Branch and Pioneer Valley Creek Targeted Watershed Assessment: A Plan to restore Wisconsin Waters, 2020

Green County, Post Watershed Project Evaluation

In fulfillment of the Water Resources Targeted Watershed Assessment Project South_TWA_6_2017

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Legler School Branch, Green County, Wisconsin
Photo by James Amrhein, Water Quality Biologist, DNR.

Wisconsin Water Quality Monitoring and Planning

This Targeted Watershed Assessment Monitoring Report was created under the state's Water Resources Monitoring, Assessment and Planning Programs. The document reflects water quality monitoring priorities and Wisconsin's Water Resources Monitoring Strategy 2015-2020 and fulfills Wisconsin's Areawide Water Quality Management Program requirements under Section 208 of the Clean Water Act. Condition information and resource management recommendations support and guide program priorities in the Water Quality Bureau. This TWA/Monitoring Report is approved by the Wisconsin DNR and is a formal update to Sugar Pecatonica Basin Quality Management Plan and Wisconsin's statewide Areawide Water Quality Management Program Plan (AWQMP Plan). This Report will be forwarded to USEPA for certification as a formal update to Wisconsin's AWQM Program Plan.

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Basin/Watershed Partners

- Green County Land and Water Conservation Department

Report Acknowledgements

- James Amrhein, Author and Investigator, South District, Wisconsin DNR

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Legler School Branch and Pioneer Valley Creek are two streams that originate west of the Village of New Glarus and flow through north central Green County to join the Little Sugar River (Figure 1).

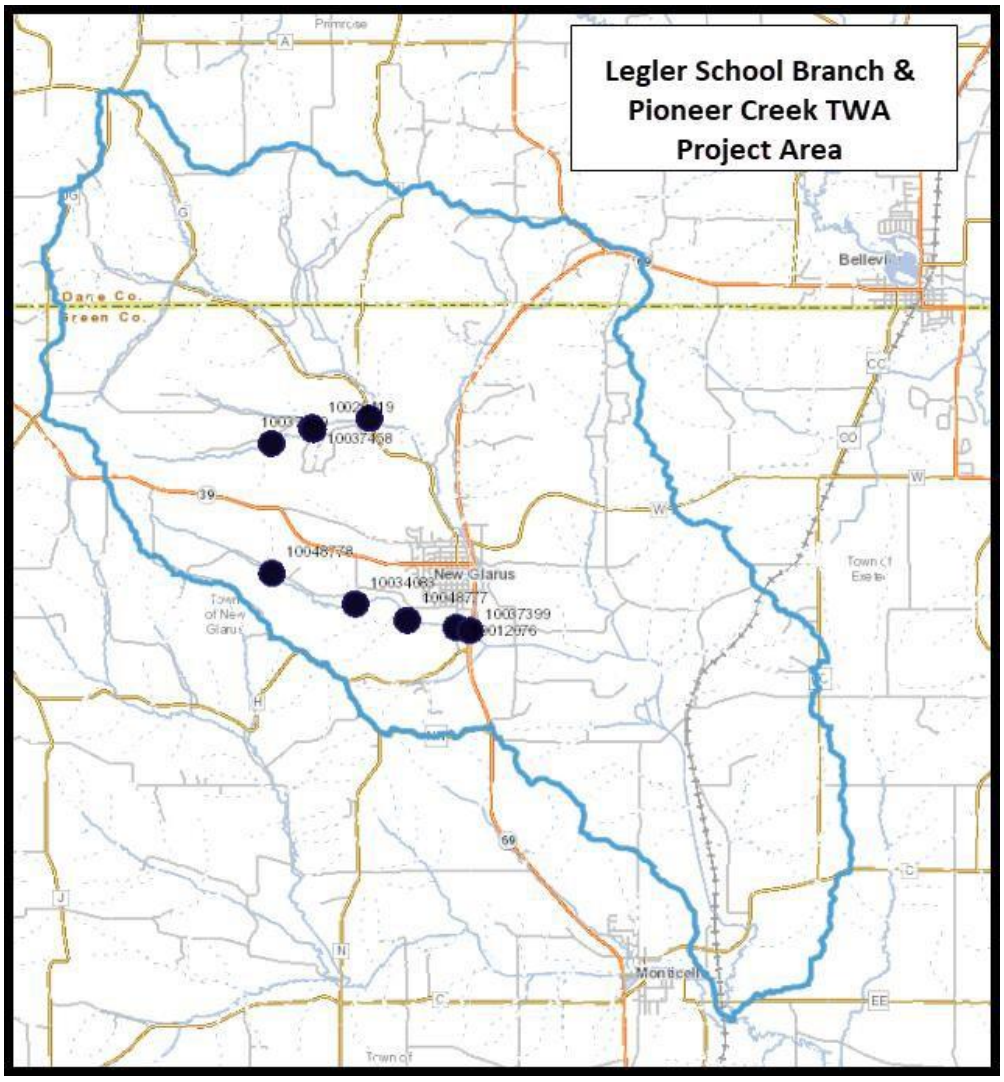

Figure 1: Legler School Branch and Pioneer Valley Creek Watersheds

Both creeks have similar sized watersheds and land uses (Table 1). Both are currently on the state's 303(d) list of impaired waters because of habitat loss due to sedimentation. Krieg Valley Creek is a tributary of Pioneer Valley Creek. It is not on the impaired waters list. Prior to this project, very few surveys were conducted on these streams. A 2004 survey of 1 site on Legler School Branch showed the presence of large numbers of mottled sculpin – a coldwater indicator species, as well as several specimens of brown trout. According to a 2003 basin report (WDNR, 2003), Pioneer Valley Creek contained only small numbers of non-game (forage) species. Despite these limited surveys, the department felt both systems would respond favorably to watershed and riparian stream work. Both streams were tributaries to the Little Sugar River, which is a Class II trout stream, and both receive a majority of their water from spring flow and groundwater seepage.

Table 1: Land Use Data

Watershed	Total Area	Agriculture	Grassland/Pasture	Forest
Legler School	2584 acres	24%	48%	21%
Pioneer Valley	2163 acres	20%	47%	29%

In 2010, the Green County Land Conservation Department approached the department about conducting projects to address issues within the riparian corridor and the sub-watersheds as a whole. They received a state Targeted Runoff Management (TRM) grant address non-point source pollution issues in the watersheds. They also received a companion grant from the Environmental Protection Agency to address nutrient loading to both systems as well as funding from the Natural Resources Conservation Service's (NRCS) inaugural National Water Quality Initiative (NWQI) program.

As part of the project, the department agreed to monitor habitat, biology, and nutrient concentrations in each subwatershed prior to, and after, implementation of best management practices (BMPs). It would have been desired to collect multiple years of pre-implementation data to establish a better baseline and increase the statistical robustness of the dataset. Unfortunately, because implementation of BMPs was set to begin in fall of 2012, this was not possible.

During the months of May through October 2012 the department monitored stations on Legler School Branch, Pioneer Valley Creek and Krieg Valley Creek. Details can be found in the methods section.

Beginning in fall, 2012 and continuing over the next 2 years, the Green County Land Conservation Department (LCD) spent nearly $630,000 on installation of BMPs throughout the 2 sub-watersheds (Tables 2 and 3). Nearly 6500 feet of livestock fencing, 320 feet of stream crossing, and 17 acres of critical area stabilization were implemented. Additionally, over 16,500 feet (3.12) miles of stream was rehabilitated: 8500 feet on Legler School Branch; 3325 feet on Pioneer Valley; and 4700 feet on Krieg Valley Creek. This rehabilitation included removal of dense stands of nuisance (box elder) trees which tend to shade out grasses and forbs and destabilize the banks as they fall in the stream. After tree removal, the banks were sloped, shaped and seeded in native grasses. Habitat structures such as Little Underwater Neighborhood Keepers Encompassing Rheotactic Salmonids (LUNKERS) were placed in bends on the stream and rock weirs were used on straight sections to create plunge pools for generating deeper water areas.

Methods

A site had already been sampled on Legler School Branch (Private 3) in 2011 for fish and qualitative habitat (Figure 2). For the 2012 survey, biologists conducted fish and quantitative habitat monitoring on 2 sites on Legler School Branch - at STH 69 and upstream of 2nd Avenue on private property (Private 1). Fish and quantitative habitat monitoring was conducted at CTH O and Pioneer Valley Road on Pioneer Valley Creek. An additional site (off Klassy Road) was sampled on Pioneer Valley in 2012 for fish and qualitative habitat. A site on Krieg Valley several hundred meters upstream of its confluence with Pioneer Valley Creek was also sampled. Grab water chemistry samples were taken at CTH O on Pioneer Valley and 2nd Street in the Village of New Glarus on Legler School Branch. Samples were collected bi-monthly beginning in the middle of May until the end of October and analyzed for total phosphorus and nitrogen. This meets and exceeds the requirements for determining phosphorus impairment as outlined in the most recent update of the Wisconsin Consolidated Assessment and Listing Methodology (WisCALM) (WDNR, 2017). Flow data was not collected for this study. It is imperative to note that a region wide drought occurred during the summer of 2012. Cumulative rainfall for the study period was approximately 8 inches below average (Wisconsin State Climatology Office, 2018).

The 2017 study was conducted by water resources biologists at the same sites as in 2011/12 as well as at 2 additional sites on Legler School Branch where stream rehabilitation had taken place. These sites were sampled for fish and qualitative habitat.

For all sites, the fisheries assemblage was determined by electroshocking a section of stream with a minimum station length of 35 times the mean stream width (Lyons, 1992). A stream tow barge with a generator and two probes was used at most sites. A backpack shocker with a single probe was used at sites generally less than 2 meters wide. All fish were collected, identified, and counted. All gamefish were measured for length. At each site, qualitative notes on average stream width and depth, riparian buffers and land use, evidence of sedimentation, fish cover and potential management options were also recorded. The quantitative and qualitative habitat surveys were conducted according to Simonson, et. al. (1994). Macroinvertebrate samples were obtained at 7 sites by kick sampling and collecting using a D-frame net in fall, 2017 and sent to the University of Wisconsin-Stevens Point for analysis.

Table 2: Best Management Practices Implemented in the Watersheds

Practice	Number	Units	Cost ($)	Sediment Reduction (Tons/yr)	Phosphorus Reduction (lbs/yr)
Livestock Fencing	1194	Feet	2,920	16.5	
Stream Crossing	48	Feet	1,835	0.67	
Stream Crossing	111	Feet	2,100	4	
Critical Area Stabilization	0.4	Acres	10,000	30	
Streambank Rip-Rapping	212	Feet	4,073	8	
Streambank Rip-Rapping	386	Feet	5,550	14	
Critical Area Stabilization	0.9	Acres	23,655	96	
Well Decomissioning	1	Each	349		
Critical Area Stabilization	0.3	Acres	6,020	30	
Well Decomissioning	1	Each	285		
Well Decomissioning	1	Each	105		
Streambank Rip-Rapping	160	Feet	4,000	6	
Critical Area Stabilization	0.9	Acres	22,700	93	
Stream Crossing	111	Feet	2,100	4	
Livestock Fencing	600	Feet	1,215	22	
Critical Area Stabilization	1.4	Acres	25,950	152	
Streambank Rip-Rapping	374	Feet	9,350	10	
Streambank Shaping/Seeding	4798	Feet	9,350	133	
Critical Area Stabilization	4.25	Acres	2,550	9	
Critical Area Stabilization	0.6	Acres	9,250	45	
Streambank Rip-Rapping	30	Feet	750	1.1	
Streambank Shaping/Seeding	233	Feet	4,100	9	
Critical Area Stabilization	0.6	Acres	10,000	60	
Access Road	50	Feet	1,485	1.4	
Streambank Shaping/Seeding	375	Feet	3,425	14	
Livestock Fencing	396	Feet	3,425	14.5	
Heavy Use Protection	0.02	Acres	2,000		25
Critical Area Stabilization	7.5	Acres	88,340	1726	
Waterway System	0.6	Acres	32,684	74	
Stream Crossing	50	Feet	2,493	0.9	
Streambank Shoreline Protection	150	Feet	4,420	14	
Trail and Walkways	675	Feet	18,194	63	
Livestock Fencing	4294	Feet	9,682	75	
Sediment Basin	2	Each	107,131		177
Heavy Use Protection	0.1	Acres	27,615		
Underground Outlets	680	Feet	10,800		
Filter Strips	0.08	Acres	12,015		
Roof Runoff Systems	2	Each	4,960		
Totals			486,876	2726.07	202

Table 3: NRCS NWQI Practices and Costs

Legler School Branch 303(d) Section						
Code	**Practice Name**	**Units**	**Quantity**	**Status**	**Payment**	**Notes**
342	Critical Area Planting	ac	1.0	Certified	$13,047.82	2594' of streambank shaping
342	Critical Area Planting	ac	0.5	Certified	$2,841.95	565' of streambank shaping
342	Critical Area Planting	ac	0.5	Certified	$2,515.00	500' of streambank shaping
395	Stream Habitat Improvement and Management	ac	0.5	Certified	$13,520.00	25 weirs/deflectors/barbs, 15 lunkers, 1 hibernaculum
580	Streambank and Shoreline Protection	ft	386.0	Certified	$6,562.00	
580	Streambank and Shoreline Protection	ft	869.0	Certified	$14,773.00	
					$53,259.77	
Pioneer Valley 303(d) Section						
Code	**Practice Name**	**Units**	**Quantity**	**Status**	**Payment**	
575	Animal Trails and Walkways	ft	525.0	Certified	$2,777.25	
342	Critical Area Planting	ac	1.3	Certified	$41,114.20	9,140' of streambank shaping
382	Fence	ft	1,194.0	Certified	$489.54	
561	Heavy Use Area Protection	ac	0.1	Certified	$20,860.00	
558	Roof Runoff Structure	no	2.0	Certified	$2,304.00	
350	Sediment Basin	no	2.0	Certified	$7,365.00	
578	Stream Crossing	no	1.0	Certified	$1,580.80	
578	Stream Crossing	no	1.0	Certified	$1,167.36	
580	Streambank and Shoreline Protection	ft	150.0	Certified	$1,777.50	
620	Underground Outlet	ft	545.0	Certified	$5,050.10	
635	Vegetated Treatment Area	ac	1.0	Certified	$5,805.00	
					$90,290.75	

Figure 2: Sample sites on Legler School Branch, Pioneer Valley and Krieg Valley Creeks

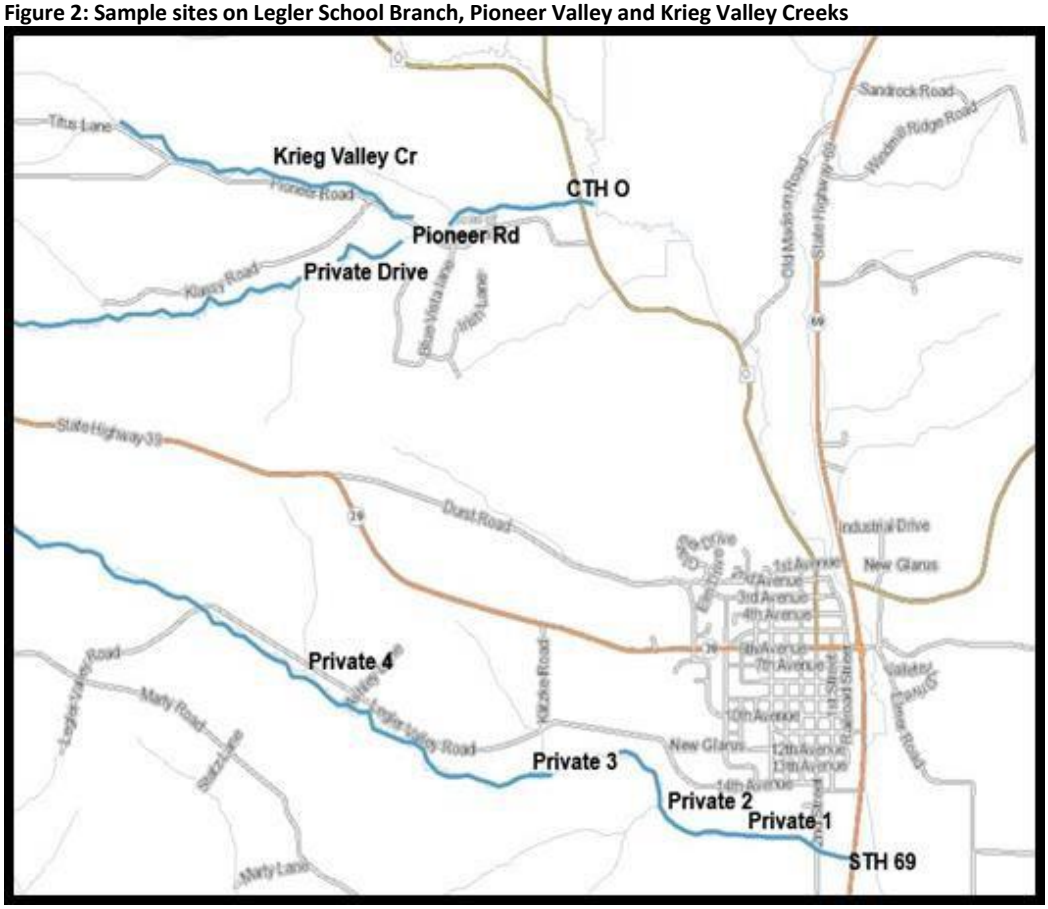

Table 4: Sample sites on Legler School Branch, Pioneer Valley and Krieg Valley Creeks

	Parameter [Year(s) sampled]				
Site	Fish	Bugs	Quantitative Habitat	Qualitative Habitat	Water Chemistry
Legler School - STH 69	2012, 2017, 2018	2017	2012, 2017		2012
Legler School - Private 1	2012, 2017, 2018		2012, 2017		
Legler School - Private 2	2017			2017	
Legler School - Private 3	2011, 2017	2017		2011, 2017	
Legler School - Private 4	2017	2017		2017	
Pioneer Valley - CTH O	2012, 2017	2017	2012, 2017		2012
Pioneer Valley - Pioneer Road	2012, 2017	2017	2012, 2017		
Pioneer Valley - Private Drive off Klassy Rd	2012, 2017	2017		2012, 2017	
Krieg Valley Creek	2012, 2017	2017		2012, 2017	

Results

The results of the fish surveys are summarized in Table 5. Because the Wisconsin Stream model (Lyons, 2008) predicted the entirety of all three waters to be cold systems, the coldwater index of biotic integrity (IBI) developed by Lyons, et. al. (1996) was applied to all sites. In the 2011 and 2012 surveys, brown trout and mottled sculpin, both coldwater indicator species, were the predominant species at all sites on Legler School and Pioneer Valley. The coldwater IBI reflected this assemblage and was consistently 60 (good) at most sites. The site on Krieg Valley did not yield any fish. In 2017, white suckers, a thermally transitional and tolerant species, became a predominant at the STH 69 and "Private 1" sites on Legler School Branch. They were also present in moderate numbers at another site upstream (Private 2). Several other species were also noted in 2017, but in low numbers or individual specimens. The exception was brook stickleback which was the major species at a Legler Road site (Private 4) on Legler School Branch. The species assemblage remained essentially unchanged on Pioneer Valley Creek. Krieg Valley now had mottled sculpin in addition to the stickleback, whereas it contained no fish in 2012. Coldwater IBIs for the 2017 surveys were more variable, ranging from 20 (Poor) to 60 (good).

Quantitative habitat surveys conducted at 2 sites on Legler School Branch and 2 on Pioneer Valley Branch showed an increase in overall score on the 2 Legler School sites and at 1 site on Pioneer Valley (Table 6). It should be kept in mind that no habitat work was done on the Pioneer Valley sites. The Legler School Branch showed improvement in mean bank erosion at both sites and in width-to-depth ratio at the "Private 1" site. Fish cover dramatically improved at both Legler sites. Pioneer Valley sites improved, most substantially at the Pioneer Valley Road site, which had increased scores for mean buffer width and percent fish cover. Both increases were likely coincidental and not due to any management actions.

Qualitative habitat assessments were repeated at 3 sites, 1 each on Legler School, Pioneer Valley, and Krieg Valley Creek. There were also 2 other sites qualitatively assessed in 2017 on Legler School Branch (Table 7). Legler School at Private 3 improved, even though no habitat work was done. This was mainly due to an increase in buffer width score owing to the fact that cattle have been taken out of the wet meadow adjacent to the stream. The site on Pioneer Valley was essentially unchanged with slight difference in the riffle score, likely due to the subjective nature of this type of habitat assessment. Krieg Valley had the biggest improvement – 15 (poor) to 50 (good) because substantial work was done to shape, slope, and stabilize the banks of the creek. Two other sites on Legler School that were not previously assessed (Private 3 and 4) showed similar overall scores and individual metrics as other sites in these systems.

Nutrient monitoring conducted in 2012 (Tables 8 and 8) was not repeated in 2017 due to the fact weather conditions were markedly different. As previously mentioned, 2012 was a drought year that presented few opportunities for runoff, and thus nutrient loads were suppressed. One problem this presents is that the pre-implementation concentrations may not represent a normal situation, thereby making comparisons with post-implementation measurements difficult, especially in the absence of flow data. In other words, although implementation of BMPs will possibly improve water quality over the long-term, concentration-based data may not reflect these improvements because of differences in flow. In 2017, the months of May, June, July, and October were wetter than average (Wisconsin State Climatology Office, 2018), making any comparison to 2012 data irrelevant in the context of improvements in the watershed.

Table 5: Fisheries Assemblage, Natural Community Analysis, and IBI for sites in the Legler School Branch and Pioneer Valley Creek Watersheds

Stream	Location	Year	Species												NC Verification	Cold IBI[1]	Brown Trout CPE (trout/mile)
			Brown Trout	Mottled Sculpin	White Sucker	Green Sunfish	Green Sunfish x Bluegill	Brook Stickleback	Bluegill	Fathead Minnow	Black Bullhead	Central Mudminnow	Rainbow Trout	Largemouth Bass			
Legler School Branch	STH 69	2012	14	17											Cold	60 (Good)	104
		2017	58	282	330		1		1	1	1				CCMS	20 (Poor)	422
		2018*	34	103	50	2		18				2		1	CCHW	30 (Fair)	604
	Upstrm 2nd Ave (Private 1)	2012	13	17											Cold	60 (Good)	158
		2017	39	165	55	1	2								CCHW	40 (Fair)	380
		2018*	18	116	8	1		1		1					Cold	40 (Fair)	192
	Private 2	2017	10	46	22	2	1	2							CCHW	20 (Poor)	71
	Private 3 (Wooded)	2011	24	60											Cold	60 (Good)	256
	Private 3 Pasture	2011	32	70		1									Cold	60 (Good)	394
		2017	11	14											Cold	60 (Good)	88
	Private 4	2017		7	1	1		16							CCHW	30 (Fair)	0
Pioneer Valley	CTH O	2012	15	45											Cold	60 (Good)	152
		2017	22	56									1		Cold	60 (Good)	213
	Pioneer Valley Road	2012	5	2											Cold[2]	70 (Good)[2]	53
		2017	2	46											Cold	50 (Fair)	27
	Driveway off Klassy Rd	2012	10										1		Cold[2]	60 (Good)[2]	100
		2017	12	2				3							Cold[2]	60 (Good)[2]	132
Krieg	Upstrm confl. w/ Pioneer Valley Crk	2012	No Fish Captured												N/A	N/A	0
		2017		10				27							CCHW	50 (Good)[3]	0

* Special study as follow up in 2018

Stenothermal Coldwater Species

Stenothermal Coldwater Species - also intolerant

Tolerant Species

Species names in italics indicate warmwater species

1) Coldwater IBI: Poor < 20; 21-50 = Fair; 51 - 80 = Good; Excellent > 81

2) Technically not enough fish collected for verification or IBI

3) Cold Transitional IBI (Lyons, 2012)

Table 6: Quantitative Habitat Analysis of Selected Sites on Legler School Branch and Pioneer Valley Creek

Station Name	Date	Width (m)	Mean Buf Width	Mean Buf Width Score	Mean Bank Eros	Mean Bank Eros Score	% Pool	% Pool Score	Width Depth Ratio	Width Depth Ratio Score	Riffle Riffle Ratio	Riff Riff Ratio Score	Bend Bend Ratio	Bend Bend Ratio Score	% Fine Sed	% Fine Sed Score	% Fish Cover	% Fish Cover Score	Habitat Score	Habitat Rating
LEGLER SCHOOL BRANCH - Private 1	05/23/2012	2.53	10	15	0.7	5	0.0	0	10.3	10	0.0	0	13.4	10	88.3	0	0.0	0	40	Fair
LEGLER SCHOOL BRANCH - Private 1	06/13/2017	2.75	10	15	0.0	15	0.0	0	4.8	10	0.0	0	11.1	10	67.4	0	58.3	15	65	Good
LEGLER SCHOOL BRANCH AT STH 69	05/23/2012	3.28	10	15	0.7	5	2.1	0	9.9	10	34.1	0	17.5	5	88.3	0	0.0	0	35	Fair
LEGLER SCHOOL BRANCH AT STH 69	06/13/2017	3.65	10	15	0.0	15	3.9	0	7.8	10	28.5	0	26.7	0	65.8	0	23.3	15	55	Good
PIONEER VALLEY CREEK - PIONEER VALLEY	06/04/2012	1.8	9.58	10	0.4	10	0.0	0	9.3	10	0.0	0	11.3	10	86.3	0	0.9	0	40	Fair
PIONEER VALLEY CREEK - PIONEER VALLEY	06/15/2017	1.93	10	15	0.4	10	0.0	0	7.8	10	0.0	0	11.9	10	87.9	0	14.3	10	55	Good
PIONEER VALLEY CREEK AT CTH O	06/01/2012	1.5	10	15	0.5	10	0.0	0	4.3	10	0.0	0	15.6	5	83.3	0	23.4	15	55	Good
PIONEER VALLEY CREEK AT CTH O	06/15/2017	1.48	10	15	0.4	10	0.0	0	3.5	10	0.0	0	14.7	10	93.8	0	29.7	15	60	Good

Table 7: Qualitative Habitat Surveys of Sites on Legler School Branch, Pioneer Valley Creek and Krieg Valley Creek

Station Name	Swims Station Id	Date Time	Ave Width (m)	Ave Depth (m)	Riparian Buffer Score	Bank Erosion Score	Pool Area Score	Width Depth Score	Riffle Riffle Ratio Score	Fine Sediments Score	Fish Cover Score	Hab Score	Hab Rating
LEGLER SCHOOL BRANCH ALONG LEGLER VALLEY ROAD - Private 3 (Wooded)	10034083	09-Aug-11	2.5	0.1	10	0	0	5	5	0	10	30	Fair
LEGLER SCHOOL BRANCH ALONG LEGLER VALLEY ROAD - Private 3 (Pasture)	10034083	09-Aug-11	1.25	0.45	0	15	7	15	10	10	10	67	Good
LEGLER SCHOOL BRANCH ALONG LEGLER VALLEY ROAD - Private 3 (Pasture)	10034083	17-Jul-17	1.5	0.6	15	15	3	15	10	5	15	78	Excellent
Legler School Br - Private 2	10048777	17-Jul-17	3.5	0.4	10	15	3	10	10	5	10	63	Good
Legler School Br - Private 4	10048778	17-Jul-17	3	0.3	15	15	0	10	10	0	10	60	Good
PIONEER VALLEY CREEK - DRIVEWAY ALONG KLASSY ROAD	10037459	01-Jun-12	1.5	0.2	15	15	0	15	10	0	15	70	Good
PIONEER VALLEY CREEK - DRIVEWAY ALONG KLASSY ROAD	10037459	14-Jun-17	1	0.2	15	15	0	15	5	0	15	65	Good
KRIEG VALLEY CREEK UPSTRM FROM CONFLUENCE WITH PIONEER VALLEY CRK	10037458	01-Jun-12	1	0.05	10	0	0	5	0	0	0	15	Poor
KRIEG VALLEY CREEK UPSTRM FROM CONFLUENCE WITH PIONEER VALLEY CRK	10037458	14-Jun-17	0.8	0.3	10	15	0	15	0	0	10	50	Good

Station Name	Date Time	Comments
LEGLER SCHOOL BRANCH ALONG LEGLER VALLEY ROAD - Private 3 (Wooded)	09-Aug-11	YOY TROUT EVEN W/ LACK OF HABITAT, WOODED CORRIDOR; RAW BANKS; WIDE/SHALLOW; WOOD DEBRIS FOR HABITAT
LEGLER SCHOOL BRANCH ALONG LEGLER VALLEY ROAD - Private 3 (Pasture)	09-Aug-11	PASTURED WET MEADOW; SEDGES ON EDGE OF STREAM PROVIDE OVERHEAD COVER, STREAM IS NARROW/DEEP, SOME GRAVEL
LEGLER SCHOOL BRANCH ALONG LEGLER VALLEY ROAD - Private 3 (Pasture)	17-Jul-17	USED TO BE PASTURED IN 2012. NO LONGER HAS CATTLE AND HAS TURNED INTO A NICE WET MEADOW AND WETLAND.
Legler School Br - Private 2	17-Jul-17	TREES CLEARED AND BANKS SLOPED/STABILIZED IN 2013. ONLY MINIMAL HABITAT ENHANCEMENT DONE.
Legler School Br - Private 4	17-Jul-17	RIPARIAN CORRIDOR WORK DONE CIRCA 2013. TREES/SHRUBS REMOVED, PRAIRIE RESTORATION. NO INSTREAM HABITAT.
PIONEER VALLEY CREEK - DRIVEWAY ALONG KLASSY ROAD	01-Jun-12	SAND & SILT; BANKS STABLE GRASSES, SEDGES, & RUSHES; SED HIGH; WATERCRESS; UNDERCUT BANKS, OVERHANGING VEG, WATER CRESS
PIONEER VALLEY CREEK - DRIVEWAY ALONG KLASSY ROAD	14-Jun-17	NICE MEADOW, SAND BOTTOM. OVERHANGING VEG, BENDS SCATTERED WOOD FOR COVER.
KRIEG VALLEY CREEK UPSTRM FROM CONFLUENCE WITH PIONEER VALLEY CRK	01-Jun-12	BOTTOM SAND/CLAY; BANKS 3-7 FT, STEEP, RAW; SHRUBS/WOODED RIPARIAN; SEDIMENTATION HIGH
KRIEG VALLEY CREEK UPSTRM FROM CONFLUENCE WITH PIONEER VALLEY CRK	14-Jun-17	THIS SITE HAD TREE/BRUSH CLEARING AND BANK STABILIZATION DONE ON IT IN 2012.

Table 8: Legler School Branch Water Chemistry Results: May – October 2012

Date	Temp (°C)	Total P (mg/l)	NH3 (mg/l)	NO3/NO2 (mg/l)	TKN (mg/l)	D.O. (mg/l)	Transp (cm)	Conductivty (umhos/cm)
5/15/2012 9:33	11.7	0.063	-			10.9	53	618
6/1/2012 13:32	13.3	0.063	-	-	-	11.5	>120.0	579
6/14/2012 9:25	12.2	0.055	-	-	-	10.7	>120.0	473
6/27/2012 10:06	14.2	0.066	-	-	-	10.1	105	601
7/16/2012 9:22	17.2	0.065	-	-	-	9.6	61	627
7/27/2012 14:18	20.2	0.087	-	-	-	8.9	100	659
8/6/2012 10:15	15.1	0.061	ND	4.18	*ND	10.7	>120.0	622
8/27/2012 12:23	17.4	0.06	0.022	3.87	*0.27	10	>120.0	650
9/17/2012 9:22	11.5	0.054	0.015	2.92	*0.16	10.3	>120.0	614
9/26/2012 11:55	11.8	0.053	0.025	4.07	*ND	10.5	-	570
10/16/2012 11:16	9.6	0.081	0.037	4.18	0.41	9.6	80	622
10/30/2012 0:00	7.3	0.054	0.026	4.23	0.27	12	-	-

Average P concentration = 0.064 mg/l; Median P concentration = 0.062 mg/l

Table 9: Pioneer Valley Creek Water Chemistry Results: May – October 2012

Date	Temp (°C)	Total P (mg/l)	NH3 (mg/l)	NO3/NO2 (mg/l)	TKN (mg/l)	D.O. (mg/l)	Transp (cm)	Conductivty (umhos/cm)
05/15/2012 9:19	11.7	0.144	-	-	-	10.9	34	553
06/01/2012 9:28	10.9	0.086	-	-	-	11.5	67	523
06/14/2012 9:07	11.8	0.089	-	-	-	10.8	50	536
06/27/2012 9:53	13.5	0.084	-	-	-	10	63	565
07/16/2012 9:10	15.1	0.075	-	-	-	9.3	96	600
07/27/2012 13:58	17.1	0.081	-	-	-	8.5	>120.0	622
08/06/2012 10:00	13.5	0.066	0.017	2.78	*ND	9.52	>120.0	567
08/27/2012 12:08	14.4	0.062	0.024	2.9	*0.38	9.4	>120.0	534
09/17/2012 9:10	10.8	0.059	0.016	4.01	*0.16	10.1	>120.0	588
09/26/2012 12:08	10.9	0.057	0.021	3.06	*0.26	10.2	-	-
10/16/2012 11:03	8.9	0.076	0.052	2.96	0.44	10	>120.0	122
10/30/2012 13:45	7.2	0.059	0.029	3.02	0.17	12	-	-

Average P concentration = 0.078 mg/l; Median P concentration = 0.076 mg/l

Macroinvertebrate sampling was not conducted in 2011/2012; however, previous macroinvertebrate data collected on both Legler School and Pioneer Valley showed the stream to be in good condition (WDNR, unpublished data). The historic macroinvertebrate IBIs (Weigel, 2007) were in the good to excellent range, while the Hilsenhoff Biotic Index (HBI) (Hilsenhoff, 1987) showed no to only slight possible organic loading. The 2017 data was very similar (Table 9).

Discussion

Legler School Branch and Pioneer Valley Creek have been on the state's 303(d) list of impaired waters since 1998 because of habitat degradation caused by sedimentation. Pre-rehabilitation quantitative habitat sampling revealed percent fines made up over 80% of the stream channel. Despite this, both systems supported a coldwater fishery, including some evidence of natural reproduction given the presence of young-of-the year (YOY) fish. However, one could surmise that numbers of fish were limited because of the sediment and overall lack of fish cover and spawning habitat in the creeks.

Table 10: 2017 Macroinvertebrate Data for the Legler School Branch and Pioneer Valley Watershed

Station Name	Station ID	MIBI (Rating)	HBI (Rating)
Legler School Branch at STH 69	10037399	4.41 (Fair)	4.67 (Good)
Legler School Branch - Private 3	10034083	7.77 (Excellent)	2.69 (Excellent)
Legler School Br - Private 4	10048778	5.38 (Good)	3.82 (Very Good)
Pioneer Valley Creek at CTH O	10037209	6.31 (Good)	3.95 (Very Good)
Pioneer Valley Creek at Pioneer Valley Road	10029419	8.40 (Excellent)	3.31 (Excellent)
Pioneer Valley Creek at driveway off Klassy Road	10037459	7.19 (Excellent)	4.52 (Good)
Krieg Valley Creek upstream of confluence with Pioneer Valley Crk	10037458	4.56 (Fair)	3.79 (Very Good)

The riparian stream rehabilitation portion of the project enhanced over 3 miles of stream – 1.6 miles on Legler School Branch; 0.6 miles on Pioneer Valley Creek and 0.9 miles on Krieg Valley Creek. Some general observations can be made about the systems as a whole. While soft sediment was reduced, quantitative habitat surveys show it still makes up over 50% of the streams' bottom. Qualitative habitat monitoring revealed similar results. The stream projects did improve fish habitat and reduced bank erosion. The fisheries are still made up majorly of brown trout and mottled sculpin.

A comparison of pre-and post-biological conditions was difficult because there was essentially only 1 year of opportunity to measure baseline conditions. Also, because participation was voluntary, it was unknown exactly where stream and watershed work would be done. Therefore, there are only a limited number of sites where riparian stream work could be directly compared and both of those (STH 69 and Private 1) are on the lower reaches of Legler School Branch. While one can compare the effects of the habitat rehabilitation on the fishery of those particular stretches of stream, it is difficult to determine if the project had an impact on trout populations in the streams overall.

Water Condition Summaries

Legler School Branch

Fish cover was improved at the Legler School sites where riparian work was done. As shown in Table 3, this has likely resulted in a dramatic increase in trout numbers as based on the catch-per-unit-effort (CPE). The 2 sites on Legler School Branch which had work done and for which a pre/post comparison could be made did show a 100 to 400% increase in numbers. However, the health of the coldwater fishery as measured by the IBI decreased due to the presence of substantial numbers of white suckers, a thermally transitional and tolerant species. Whether the presence of white suckers, which were absent in the 2011/12 surveys, is because of the riparian project providing more habitat for all fishes, differences in weather conditions between the survey years, or just happenstance is unknown. Either way, they represented a major difference in the population dynamics between the two periods.

There were 2 sites on Legler School Branch that were subject to stream improvement but were only sampled in 2017 and therefore no comparison could be made. The site referred to as the "Private 2" had streambank improvement done, but little in the way of habitat structure put in place. While brown trout were present, they were in numbers lower than the 2 downstream sites. White suckers were also one of the predominant species at this site. Several other tolerant species were present and thus the IBI was depressed to 20 (poor). "Private 4" likewise had only streambank improvement done. No trout were captured in the 2017 survey even though biologist noted that the habitat could support them. No comparisons could be made as this was the first time this site was surveyed on this stream.

The Private 3 pasture site could serve in a capacity as a "control" site in that it was originally in rather good condition. No work was performed on the stream or banks. The stream was pastured during the 2011 survey but is no longer in pasture. In 2017, the biologists noted that the stream has good, stable banks, with overhanging vegetation, an excellent width-to-depth ratio; and undercut banks. However, there were fewer trout and sculpin captured. This could possibly be due to the fact there was so much overhanging vegetation that the biologist's sight lines were obscured and therefore capture efficiency was limited.

In 2017, the appearance of white suckers and several other species at certain sites on Legler School Branch tilted those natural communities toward cold transitional (cool-cold). Even though the percentage of tolerant fish was higher than the guidelines for cold systems, the test for tolerance was passed because of the presence of the intolerant mottled sculpin. Because of the pre-project data confirming that these systems represent cold water natural communities, all the sites were evaluated as cold systems and thus the cold IBI applied. It could be argued that there may be a transition between cold and cold transitional somewhere along Legler Road, between Private 3 and Private 4. However, biologist noted that conditions such as flow/habitat at the uppermost (Private 4) site were satisfactory for the presence of trout. The poor and fair IBI scores do not necessarily raise cause for alarm. As previously mentioned, the presence of the white suckers caused the depressed scores, yet it was adequately demonstrated that the rehabilitation dramatically improved trout

numbers. Whether the presence of the suckers was an anomalous, temporary eruption of the species is difficult to say and needed further evaluation.

In response to these changes in fish assemblage at the lower 2 stations on Legler School Branch, biologists again surveyed these sites in 2018. There were fewer total fish collected at STH 69, but the station length was shorter. The coldwater IBI improved a bit as the relative number of which suckers dropped from 49% to 24%, thereby increasing the relative percentage of top level carnivores. The Private 1 site had fewer total fish in 2018 than in 2017, but the IBI remained the same and the percentage of white suckers dropped from 21% to 6% of the total fish captured. Whether the trend of fewer suckers continues will remain to be seen.

Pioneer Valley

The 3 sites on Pioneer Valley had no work done in the riparian corridor. Trout populations were relatively low to begin with and the modest increases in trout population were likely due to chance. As one would expect, habitat scores between years were similar. Any differences in habitat scores were likely due to small variations in transect spacing, some subjective decisions between biologists as well as differences in weather (drought in 2012 vs. wetter conditions in 2017) which may have influenced things like water level and thus fish cover and width-to-depth ratio.

Pioneer Valley contains coldwater species throughout its length. Although trout numbers were very low, cold IBI scores remained stable, albeit at some sites, the populations were generally considered too low to calculate an IBI (Lyons, et. al., 1996). It would have been desirable to survey portions of the stream where rehabilitation had taken place.

Krieg Valley Creek

Krieg Valley Creek is modeled to be cold, but it verifies as a cold transitional headwater. Observations from biologists, particularly on the size and flow of this stream, indicate that this verified natural community would be a more appropriate classification. The cold transitional IBI for this site was 50 (good). This is quite an improvement from the 2012 survey in which habitat was deemed poor and no fish were captured.

Trout Population and Size Structure

Analysis of trout populations and size structure (Table 9) for Legler School and Pioneer Valley sites again showed that the most dramatic improvement occurred where habitat work was done on Legler School Branch. The habitat work appeared to most favor adult fish (> 8 inches). Again, pre/post analysis was limited to 2 stations. There were no YOY (< 4 inches) at those 2 stations. However, YOY were present at some of the upstream stations. The presence of more adult fish could preclude good populations of YOY fish, especially where habitat is limited thus causing competition for shelter. It is also possible that YOY trout populations are affected by predation by adult brown trout as they are known to cannibalistic. In most cases, however, biologists noted abundant macrophyte growth which often serves as cover for young fish. Therefore, the lack of adequate spawning substrate is a very likely factor in the absence of YOY fish at certain sites.

In the follow up 2018 surveys on Legler School Branch, the density of trout in both the 4-8” and >8” size classes were reduced at Private 1 but remained stable in proportion to one another. At STH 69, the 4-8” size class decreased, but the density of large fish (>8”) increased. Once again, neither station yielded any YOY trout.

The Pioneer Valley Creek sites also showed wide variation in CPE for all size classes and between the years surveyed, but densities at most sites were low. The most dramatic increase in YOY trout occurred in the upper reaches of Pioneer Valley, which had no habitat work done and is likely due to natural (weather) conditions and variation.

Despite some increases in trout numbers, overall trout populations in both systems were below the 50th percentile in comparison to all brown trout streams in the driftless area of Wisconsin (WDNR, unpublished data). Some of this could be due to the relatively small size of both streams where flow is generally below 3 cubic feet per second, but undoubtedly, some is due to the impacts of historic and even contemporary agricultural practices which have resulted in excessive sediment loads and high legacy sediment on the streams’ bottoms.

The macroinvertebrate data for the watershed continued to look good. In fact, MIBI scores above 7 are rare in the Grant/Platte and Sugar/Pecatonica basins (WDNR, unpublished data). It is surprising that the macroinvertebrate community is of such high quality given the lack of riffles, the high level of sediment in the creeks, and considering the overall intensity of agriculture (cropping and grazing) in the watershed is on par with many watersheds in the area. However, there is generally a good buffer along many stretches of the creeks. While agriculture is commonplace, there is a lower amount of row cropping in the watershed relative to other areas.

Table 11: Trout Population and Size Structure for Legler School Branch and Pioneer Valley Creek in Comparison to other Driftless Area Trout Streams

Stream	Site	Size (inches)	CPE (Trout/mile) 2011/12	2017	2018
Legler School Branch	STH 69	<4	0	0	0
		4-8	30	182	160
		>8	74	240	444
	Private 1	<4	0	0	0
		4-8	121	117	53
		>8	36	263	139
	Private 2	<4	N/A	21	
		4-8	N/A	14	
		>8	N/A	42	
	Private 3 (Pasture) *	<4	246	16	
		4-8	123	8	
		>8	25	56	
Pioneer Valley Creek	CTH 0*	<4	0	0	
		4-8	100	87	
		>8	51	125	
	Pioneer Road*	<4	0	14	
		4-8	42	0	
		>8	10	14	
	Drive off Klassy Rd*	<4	0	99	
		4-8	90	22	
		>8	10	11	

Driftless Area Brown Trout Statistics (Trout/mile)			
	Size		
Quartile	< 4"	4 - 8"	> 8"
75th %	100	425	551
50th %	12	198	267
25th%	0	52	83

< 25th percentile
26th - 50th percentile
51st - 75th percentile
> 75th percentile

* No riparian work done

Conclusions and Recommendations

Riparian stream corridor improvement had the desired result of reducing streambank erosion and improving fish habitat. While wide variation in trout population and size structure was observed at various sites in both systems where riparian stream work was not done, it was consistently evident that the rehabilitation project was successful in increasing numbers of trout for those areas where the work was done. The numbers of yearling and adult trout in these rehabilitated sections was comparable (26th to 50th percentile) to other streams in the driftless region. However, it is difficult to determine the long-term effects of the watershed and riparian projects on the water quality and fishery of these streams, especially given the scattered nature of the work.

The full potential of these streams with regards to trout biomass may be limited by natural factors such as size and flow. It may also be limited by the residual effects of habitat degradation. Excessive sedimentation continues to be an issue in all the surveyed streams, with fine sediments making up well over 50% of the stream bottom. Given relatively low flow and gradient of the streams, it is unknown how long these legacy sediments will remain – especially since reduction of inputs from fields and pastures was not emphasized and bank erosion was mitigated at a minority of stream miles and only along the mainstem. The scattered nature of BMP implementation in watershed projects such as these makes it difficult to determine if these had any impact on the water quality. As was noted during an evaluation of Priority Watershed Projects from 20 to 30 years ago by Kroner et. al., (1992), localized improvements were noted where specific practices were implemented, but overall stream improvements were less than successful due to the relative lack of participation, the scattered nature of implementation, and masked by uncontrolled non-point pollution sources.

While quantitative habitat surveys can help track the level of fine sediment on the stream bottom, the proper way to determine if implementation of BMPs had significant impact on streams would be by determining loads during base flow and runoff events. This could only be achieved by installation of a USGS flow gage which could monitor flows and automatically sample at given interval during baseflows and throughout a hydrologic curve during events. It is only through this robust sampling that one can determine if there has

been significant reduction in nutrient and sediment loads. In the absence of this data, resource managers will have to rely on more subjective outcomes to determine if conditions and water quality have improved.

One might think this would be case for keeping the streams on the impaired waters list. However, the compendium of evidence from both a biological and habitat sense suggests that both Legler School Branch and Pioneer Valley Creek are meeting their attainable use. As evaluated as the coldwater systems they are purported to be, the IBIs are favorably in the fair to good category. IBI scores are consistently in the 40 to 60 range, keeping in mind that brown trout streams can only achieve a maximum score of 80 (not 100) in the absence of brook trout. The macroinvertebrate community is healthy and indicates good water quality. Habitat assessments for sites that were rehabilitated, as well as for those that were not, are consistently in the "good" range. Therefore, **the department recommends that both Legler School Branch and Pioneer Valley Creek be removed from the state's 303(d) list of impaired waters.**

The department should return to Legler School Branch and Pioneer Valley Creek as part of the fisheries trout stream rotation scheduled for 2021. Some sites should be repeated, while sites where stream corridor work has been conducted should be surveyed, especially on Pioneer Valley Creek. **Fisheries can then decide if these systems meet the criteria for classifications as trout water.**

The natural communities of Legler School and Pioneer Valley should be confirmed as cold systems.

The designation for Krieg Valley Creek should be updated to reflect its status as a cold-transitional (cool-cold) headwater.

If they so desire, **the Green County Land Conservation department should seek opportunities to work with more riparian landowners to improve habitat or protect the riparian corridor.** It would be likewise desirable to complete the watershed project, keeping in mind that whole-sale projects like these should be made from the ground up with a full watershed approach, and buy-in from landowners beforehand. There are examples of projects that were very successful at achieving true water quality improvements throughout the system. In those cases, sediment and nutrient loads were significantly reduced and the fishery showed great improvement at all sites in the streams (Carvin, et. al., 2018; TNC, 2014).

For systems like Legler School Branch and Pioneer Valley Creek, which have the potential to be a quality cold water resources (i.e. a trout stream), work in both the riparian corridor and in the watershed is important. As this and other projects have demonstrated, riparian work will result in more immediate improvement in the fishery, which is visible to the public and will garner more support for such efforts. Work in the watershed protects the investments made in the riparian corridor. Implementation of BMPs and promotion of soil health practices can improve infiltration, which reduces sediment and nutrient runoff. Work in barnyards, and pastures along with proper manure management can prevent catastrophic losses of the fishery due to runoff events.

References

Carvin, Rebecca, L.W. Good, C. Diehl, K. Songer, K.J. Meyer, J.C. Panuska, S. Richter, and K. Walley. 2018. Testing a two-scale focused conservation strategy for reducing phosphorus and sediment loads from agricultural watersheds. Journal of Soil and Water Conservation. 73(3): 298-309.

Hilsenhoff, William L. 1987. An Improved Biotic Index of Organic Stream Pollution. The Great Lakes Entomologist. 20: 31-39.

Kroner, Ron, J. Ball, and M. Miller. 1992. The Galena River Priority Watershed Project: Bioassessment Final Report. Wisconsin Department of Natural Resources Publication WR-306-92. May 1992.

Lyons, John. 1992. Using the Index of Biotic Integrity (IBI) to Measure Environmental Quality in Warmwater Streams of Wisconsin. United States Department of Agriculture. General Technical Report NC-149.

Lyons, John, L. Wang, and T. Simonson. 1996. Development and Validation of an Index of Biotic Integrity for Coldwater Streams in Wisconsin. North American Journal of Fisheries Management. 16:241-256.

Lyons, John. 2008. Using the Wisconsin Stream Model to Estimate the Potential Natural Community of Wisconsin Streams (DRAFT). Wisconsin Department of Natural Resources Fish and Aquatic Life Research Section. November 2008.

Lyons, John. 2015. Methodology for Using Field Data to Identify and Correct Wisconsin Stream "Natural Community" Misclassifications. Version 5. May 29, 2015.

Simonson, Timothy D., J. Lyons, and P.D. Kanehl. 1994. Guidelines for Evaluating Fish Habitat in Wisconsin Streams. U.S. Department of Agriculture. Forest Service. General Technical Report NC-164.

TNC. 2014. Targeting Conservation Practices Within a Watershed: Lessons Learned from the Pleasant Valley Project. The Nature Conservancy. Pecatonica Webinar Final. By Steve Richter and Laura Ward Good. http://cswea.org/wp-content/uploads/2017/09/4_Richter-and-Good-Pecatonica-webinar-final-1-1.pdf

WDNR. 2003. The State of the Sugar and Pecatonica River Basins. Wisconsin Department of Natural Resources.

WDNR. 2017. Wisconsin 2018 Consolidated Assessment and Listing Methodology (WisCALM). Clean Water Act Section 305(b), 314, and 303(d) Integrated Reporting. Wisconsin Department of Natural Resources. Bureau of Water Quality Program Guidance. September 2017.

Weigel, Brian. 2003. Development of Stream Macroinvertebrate Models That Predict Watershed and Local Stressors in Wisconsin. Journal of the North American Benthological Society. 22(1): 123-142.

Wisconsin State Climatology Office. 2018: http://www.aos.wisc.edu/~sco/clim-history/7cities/madison.html#Precip