Duck/Apple/Ashwaubenon Creeks Priority Watershed

Surface Water Resource Appraisal

Report

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Duck/Apple/Ashwaubenon Creeks Priority Watershed

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I. Introduction

The function of this surface water resources appraisal is to summarize the existing condition of the surface water resources of the Duck Creek and Apple/Ashwaubenon Creeks watersheds in order to develop surface water resource goals and objectives for each subwatershed.

The surface water resources appraisal workgroup was formed to identify water quality problems associated with nonpoint source pollution, determine the potential use of the water resources, the potential for the water resources to recover, and to develop preliminary surface water resources goals and objectives. These preliminary surface water resources goals and objectives will be combined with land use inventories data (such as critical sites, barnyards, land uses and streambank cover) to produce the final water resources goals and objectives, including pollution reduction goals for the project.

The surface water resources appraisal report is designed to assist the planner in writing the Watershed Plan and is not meant to be a comprehensive document of water quality. To characterize water quality with the data gathered in one monitoring season can not be conscientiously done. Duck Creek and Apple/Ashwaubenon Creek Watersheds were ranked "high" for surface water under the Nonpoint Source (NPS) priority watershed selection process. Groundwater and lakes were not ranked for these watersheds.

II. Summary of Watershed Conditions

Duck Creek Watershed

The Duck Creek Watershed is approximately 152 square miles in surface area with about 50 square miles (33%) in Brown county and 102 square miles (66%) in Outagamie County. Duck Creek originates in Burma Swamp, a large wetland of about 2000 acres located in central Outagamie County. There are a total of 71 miles of named and unnamed streams in the watershed, all entering Green Bay at or near the mouth of Duck Creek. The land use in the upstream portions of the watershed is predominately agricultural while downstream areas are dominated by residential/urban land use near and in metropolitan Green Bay.

Trout Creek for it's entire length and Duck Creek from Green Bay to STH 55 (about 32 miles) are classified as warm water sport fisheries. Carp, bullheads, northern pike, bass, panfish and forage fish are present. Upstream of STH 55, Duck Creek is classified as warm water forage fishery. The redside dace, a threatened species, is also present in Duck Creek and some of it's tributaries.

Streams in the Duck Creek Watershed are being adversely affected by the land use activities that are taking place. Sediments, fertilizers and pesticides degrade stream habitat by siltation, low dissolved oxygen, algae blooms and muddy streams. Consistently low summer water levels also play a major role in limiting aquatic life in this watershed.

Meters were used extensively to document diel and rain event induced fluctuations in temperature and dissolved oxygen. They were placed in the streams for approximately two weeks at a time. Dissolved oxygen was typically quite poor and at levels that were low enough to stress fish and other aquatic fauna. Rain events typically cooled the stream and stabilized dissolved oxygen readings.

The streams of the watershed are very flashy when precipitation occurs, but may dry up during periods of drought. The lack of water during these dry periods may be the single most limiting factor for aquatic life in the Duck Creek system. Increasing water infiltration or retaining runoff by changing land use patterns will hopefully reduce the severity of runoff events and increase baseflow to provide more consistent water levels.

Apple/Ashwaubenon Creeks Watershed

The Apple/Ashwaubenon Creeks Watershed is 113 square miles in size with approximately 60% in Outagamie County and 40% in Brown County. There are 117 miles of named and unnamed streams in the watershed, all of which empty into the Fox River. The land use in the watershed is primarily agriculture and residential, though industrial areas do exist in the urban areas of Green Bay and north side of Appleton.

The first 12 miles of Apple Creek and the first 7.5 miles of Ashwaubenon Creek are classified as warm water sport fish community. The remaining 151.5 miles of streams are either classified as warm water forage fishery or unclassified from lack of data. Fish species present in the watershed include northern pike, carp, bullhead, panfish and non-game minnow species.

Macroinvertebrate indices indicate "fairly poor" water quality. Nonpoint source pollution, point source pollution and urban stormwater runoff singly or in combination cause sedimentation, low dissolved oxygen and high nutrient levels, all of which contribute to poor water quality. Low (or no) streamflow during critical summer months also plays a major role in limiting aquatic life in the watershed.

Dissolved oxygen and temperature were monitored in the Apple/Ashwaubenon Creeks Watershed to document swings in dissolved oxygen due to external factors like rain or plants. Violation of the 5 mg/l state dissolved oxygen standard occurred often. Dissolved oxygen levels below 5 mg/l severely limit the aquatic life that can be present.

III. Methods

Monitoring activities for the water resources appraisal were conducted from September 1994 to September 1995. The following is a summary of the methods employed to collect information for the appraisal report.

A. Macroinvertebrates

Aquatic macroinvertebrates were collected at 6 sites in the fall of 1994 and again at these same sites in the spring of 1995. They were sampled using a D-frame net as outlined by Hilsenhoff (1977, 1982). The samples were preserved in 70% isopropyl alcohol and sent to the University of Wisconsin-Stevens Point to be sorted and identified. Sample results were evaluated using the Hilsenhoff Biotic Index (HBI), which is a measure of organic loading to streams in the stream segment directly above the sample site.

B. Stream Habitat Evaluations

Stream habitat evaluations were conducted at 26 locations in the watershed using the stream habitat evaluation guidelines developed by Ball (1982). Habitat evaluations assess physical stream conditions like streamflow, width, depth, substrate composition and streambank characteristics. These evaluations rate the stream segment from "excellent" to "poor" depending on the habitat that is present.

C. Runoff Sampling

Runoff samples were collected at 7 sites in the spring and summer of 1995. The parameters monitored include: total and dissolved phosphorous, suspended solids, biochemical oxygen demand (BOD), ammonia, and nitrite/nitrate nitrogen.

D. Continuous Dissolved Oxygen (D.O.) and Temperature Monitoring

Temperature and dissolved oxygen were continuously monitored in roughly two week intervals during the summer of

1995. This was done at 12 sites in the watershed using the Hydrolab Recorder Water Quality Multiprobe Logger. The minimum dissolved oxygen level established by Wisconsin Administrative Code NR102 is 5 mg/l in order to maintain favorable aquatic life. The streams of the Duck/Apple/Ashwaubenon Creeks Watershed were often in violation of this standard. Excess nutrients affect water quality by promoting the growth of both algae and macrophytes. Plants actively photosynthesize during the day and produce abundant oxygen. At night plants use up oxygen during respiration. In this project, it is algae that promotes dramatic changes in oxygen content (often by as much as 10 mg/l in a 12 hour period). These major fluctuations stress fish and other aquatic life in the waterbody.

E. Fish Surveys

A Fisheries and Habitat Evaluation Assessment Plan (FHEAP) was designed for Duck Creek by the U. S. Fish and Wildlife Service, the WI Department of Natural Resources, and the Oneida Tribe of Indians. This project will provide information on the habitat and fish community of Duck Creek Watershed. Sampling will include fish collection and identification, population estimates and habitat evaluations. The FHEAP final report will not be available for inclusion into this report as this is only the first year of the two year project.

Index of Biotic Integrity (IBI) transects were run by Professor Phil Chochran and students from St. Norberts College. These were conducted on Lancaster Creek, Ashwaubenon Creek and Beaver Dam Creek following the guidelines set by Lyons (1992).

F. United States Geologic Survey (USGS) Stations

The USGS has a fixed monitoring station on Duck Creek at County Highway FF. This station initially gathered discharge data until May 1995 when an IsCO sampler was installed to collect nutrient, suspended solids and pesticide samples during four storm/runoff events. The USGS also has a National Water Quality Assessment (NAWQA) station located on Duck Creek at Seminary Road. This station began collecting samples in March 1993 and continued through ????. As part of the assessment, pesticides, macroinvertebrates, sediments and algae were sampled, habitat evaluations were conducted, caddisfly and fish tissue analysis was performed and vegetation plot surveys were completed.

G. University of Wisconsin-Green Bay

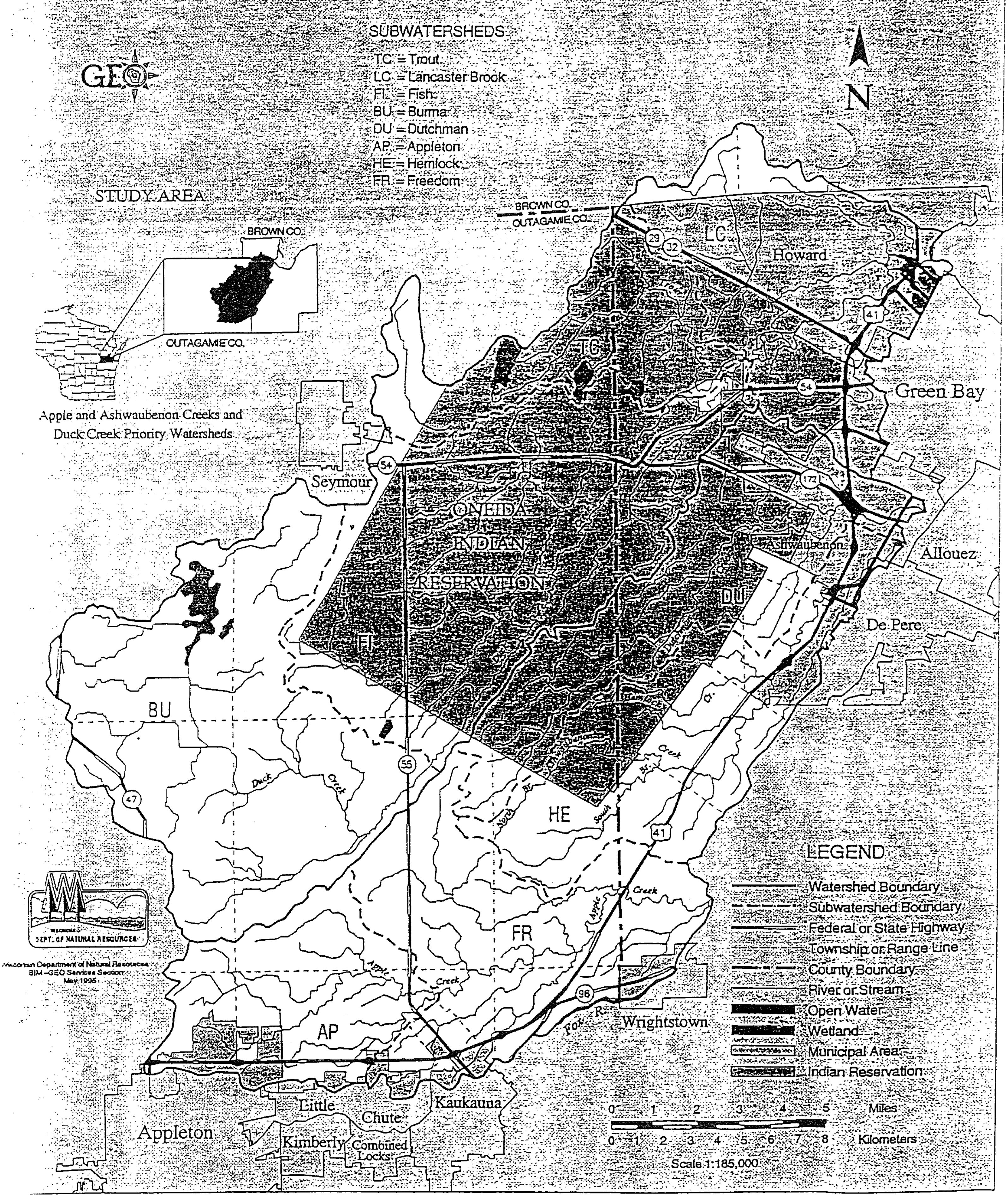
UW-Green Bay students conducted a sediment and nutrient loading study at two locations on Duck Creek, two locations on Dutchman Creek and three locations on Ashwaubenon Creek.

IV. Results and Discussion

The following is a discussion of the appraisal monitoring results for each subwatershed in the Duck/Apple/Ashwaubenon watersheds (Figure 1). The subwatershed descriptions provide a summary of the available information on each stream evaluated, a discussion of the present water resource conditions, the factors affecting the resource and the preliminary water resources goals and objectives. The goals are listed first followed by the objectives needed to achieve the goals.

Current biological use, limiting factors, observed or potential sources of pollutants, and surface water resource goals and objectives for each subwatershed are listed in Table 1. Monitoring results are presented in Table 2.

Apple and Ashwaubenon Creeks and Duck Creek Priority Watersheds



How to Use Table 1

Name of Stream: All named and some unnamed streams are listed. Stream names are those found on U.S. Geological Survey (USGS) quadrangle maps unless the Wisconsin Geographic Names Council established a different name. Unnamed streams are identified by township, range and section.

Length: Stream length is either the total length of the stream or the starting and ending mile of the portion of the stream described based on data from the Fish Distribution Study conducted by the Bureau of Research (DNR Research Report 126, 1984). The stream mile at the mouth is zero ("0") and increases as one moves upstream.

Classification: This column indicates a particular stream's formal classification listed in NR 102 and NR 104. The following abbreviations for stream classifications are used in the table:

COLD - cold water community; includes surface waters capable of supporting a community of cold water fish and other aquatic life or serving as a spawning area for cold water fish species.

- Class I - Trout populations that are sustained entirely by natural reproduction.
- Class II - Some natural reproduction of trout, but stocking is needed to maintain a desirable fishery.
- Class III - No natural reproduction of trout, stocking is required for desirable fishery.

WWSF - warm water sport fish community; includes surface waters capable of supporting a community of warm water sport fish or serving as a spawning area for warm water sport fish.

WWFF - warm water forage fish community; includes surface waters capable of supporting an abundant diverse community of forage fish and aquatic organisms.

LFF - limited forage fishery; includes surface waters of limited capacity because of low flow, naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of forage fish and aquatic life.

LAF - limited aquatic life; includes surface waters severely limited because of very low or intermittent flow and naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of aquatic life.

UNK - unknown.

Use Problems, Limiting Factors/Sources: This column indicates the probable sources of pollution in the stream and the types of water quality problems present.

Sources
- NPS - Unspecified nonpoint sources
- CON - Construction site runoff
- BY - Barnyard or exercise yard runoff
- DCH - Ditching
- PSB - Streambank pasturing
- URB - Urban runoff
- CL - Cropland erosion

Factors
- SED - Sedimentation
- NUT - Nutrient enrichment
- DO - Dissolved oxygen
- TURB - Turbidity
- HAB - Habitat (lack of cover, sedimentation, scouring, etc.)
- NH3 - Ammonia toxicity
- FLOW - Stream flow fluctuations caused by unnatural conditions
- TEMP - Temperature (fluctuations or extreme high or low)

SUBWATERSHED	STREAM NAME	LENGTH (MILES)	BIOLOGICAL USE CLASSIFICATION (MILES)	LIMITING FACTORS	OBSERVED OR POTENTIAL SOURCES	SURFACE WATER RESOURCE GOALS	SURFACE WATER RESOURCE OBJECTIVES
Burma Swamp	Duck Creek	30 - 42	WWSF / 2 WWFF / 10	SED, NUT HAB, DO FLOW, TEMP	NPS-PSB, CON, BY, CL, URB, DCH	-Improve aquatic life habitat and water quality -Increase infiltration of precipitation -Increase stream baseflow	-Create or maintain wetland and woodland buffers -Promote conservation tillage -Remove or break up drain tile to allow more groundwater recharge -Limit livestock access to the stream
Fish Creek	Duck Creek	6 - 30	WWSF	SED, NUT, HAB, DO, FLOW, TEMP	NPS-PSB, CON, BY, CL, URB, DCH	-Improve aquatic life habitat and water quality -Increase stream base flow -Enhance wildlife habitat -Improve fisheries	-Create and maintain wetland and woodland buffers -Restrict livestock access to the stream -Control construction site erosion -Promote agricultural practices that foster infiltration of precipitation -Maintain, create and enhance wetlands for water storage and fish spawning areas -Decrease sedimentation of spawning areas
Trout Creek	Trout Creek	8	WWSF	SED, NUT, HAB, DO, FLOW	NPS-PSB, CON, BY, CL	-Improve aquatic life habitat and water quality -Increase stream baseflow -Preserve the habitat of the redside dace -Enhance wildlife habitat -Improve fisheries	-Create and maintain wetland and woodland buffers -Control construction site erosion -Maintain, create and enhance wetlands for water storage and fish spawning areas -Encourage good urban planning -Decrease sedimentation of spawning areas
Lancaster Creek	Duck Creek	0 - 6	WWSF	SED, NUT, HAB, DO, FLOW	NPS-PSB, CON, BY, CL, URB	-Improve aquatic life habitat and water quality -Increase stream baseflow -Enhance wildlife habitat -Improve fisheries	-Create and maintain wetland and woodland buffers -Restrict livestock access to the stream -Control construction site erosion -Maintain, create and enhance wetlands for water storage and fish spawning areas -Encourage good urban planning -Decrease sedimentation of spawning areas
	Lancaster Creek	8	UNK.				
	Beaver Dam Creek	4	WWFF / 4				
	Unn. Creek (T24N,R20E,S10)	2	UNK.				
	Unn. Creek (T25N,R20E,S36)	6	UNK.				
	Unn. Creek (T25N,R20E,S34)	1	UNK.				
Appleton	Apple Creek	12 - 24	WWFF / 12	SED, NUT, HAB, DO, FLOW, TEMP	NPS-PSB, CON, BY, CL, URB, DCH	-Improve aquatic life habitat and water quality -Increase stream baseflow -Enhance wildlife habitat -Improve fisheries	-Create and maintain wetland and woodland buffers -Restrict livestock access to the stream -Control construction site erosion -Promote agricultural practices that foster infiltration of precipitation -Maintain, create and enhance wetlands for water storage and fish spawning areas -Decrease sedimentation of spawning areas
	Unn. Creek (T21N,R19E,S01)	1	UNK.				
	Unn. Creek (T21N,R19E,S02)	4	UNK.				

able 1: Surface Water Resources Conditions, Goals and Objectives for the Duck/Apple/Ashwaubenon Watershed.

UBWATERSHED	STREAM NAME	LENGTH (MILES)	BIOLOGICAL USE CLASSIFICATION (MILES)	LIMITING FACTORS	OBSERVED OR POTENTIAL SOURCES	SURFACE WATER RESOURCE GOALS	SURFACE WATER RESOURCE OBJECTIVES
reedom	Apple Creek	0 - 12	WWSF / 12	SED,NUT, HAB, DO, FLOW, TEMP	NPS-PSB, CON, BY, CL, URB, FLOW	-Improve aquatic life habitat and water quality -Increase stream baseflow -Enhance wildlife habitat	-Create and maintain wetland and woodland buffers -Restrict livestock access to the stream -Control construction site erosion -Promote agricultural practices that foster infiltration of precipitation -Maintain, create and enhance wetlands for water storage and fish spawning areas -Encourage good urban planning
	Unn. Creek (T22N,R19E,S25)	4	UNK.				
	Unn. Creek (T22N,R19E,S27)	1	UNK.				
	Unn. Creek (T22N,R19E,S28)	4	UNK.				
	Unn. Creek (T22N,R19E,S31)	4	UNK.				
	Unn. Creek (T22N,R19E,S32)	4	UNK.				
lemlock	Ashwaubenon Creek	15	WWSF / 7.5 WWFF / 7.5	SED, NUT, HAB, DO, FLOW, TEMP	NPS-PSB, CON, BY, CL, URB, FLOW	-Improve aquatic life habitat and water quality -Increase stream baseflow -Enhance wildlife habitat -Improve fisheries	-Create and maintain wetland and woodland buffers -Restrict livestock access to the stream -Control construction site erosion -Encourage land use that promotes increased infiltration of precipitation -Maintain, create and enhance wetlands for water storage and fish spawning areas -Decrease sedimentation of spawning areas
	Hemlock Creek	7	UNK.				
	North Branch Ashwaubenon Cr.	7	UNK.				
	South Branch Ashwaubenon Cr.	6	UNK.				
	Unn. Creek (T23N,R20E,S21)	4	UNK.				
	Unn. Creek (T23N,R20E,S31)	2	UNK.				
	Unn. Creek (T22N,R20E,S06)	3	UNK.				
	Unn. Creek (T22N,R19E,S12)	1	UNK.				
	Unn. Creek (T22N,R19E,S12)	2	UNK.				
	Unn. Creek (T22N,R19E,S11)	2	UNK.				
Dutchman	Dutchman Creek	0 - 17	WWSF / 10 WWFF / 7	SED, NUT, HAB, NH3, FLOW, DO, TEMP	NPS-PSB, CON, BY, CL, URB, FLOW	-Improve aquatic life habitat and water quality -Increase base stream flow -Enhance wildlife habitat -Improve fisheries	-Create and maintain wetland and woodland buffers -Restrict livestock access to the stream -Control construction site erosion -Promote agricultural practices that foster infiltration of precipitation -Maintain, create and enhance wetlands for water storage and fish spawning areas
	Unn. Creek (T23N,R20E,S09)	2	UNK.				
	Unn. Créek (T23N,R20E,S09)	3	UNK.				

atershed	Stream Name	Habitat Rating (Location)	HBI Rating (Date)	Continuous D.O. and Temperature (location and dates monitored)
a Swamp	Duck Creek	176-Fair (Abv. CTH S)		CTH S 8/28/95-9/21/95
Creek	Unn. Trib. Duck Creek	151-Fair (Blw. Ranch Rd.)		Center Valley Rd. 6/12/95-6/26/95
	Duck Creek	97-Good (Abv. CTH FF)		CTH FF 6/12/95-6/21/95
		192-Fair (Abv. Tip Rd.)		
		154-Fair (Abv. Center Valley Rd.)	5.39-Good (10/94) 2.99-Excellent (4/95)	
t Creek	Trout Creek	196-Fair (At Oneida Farm)		Trout Creek Road 7/12/95-7/26/95
		137-Fair (Blw. CTH VV)		
		155-Fair (Blw. Trout Creek Rd.)		
		231-Poor (Abv. Western Dr.)	4.64-Good (10/94) 5.25-Good (4/95)	
ster Creek	Lancaster Creek	171-Fair (Blw. STH 29)		STH 29/32 6/27/95-7/11/95
		227-Poor (Abv. Glendale Ave.)	4.63-Good (10/94) 5.24-Good (4/95)	
	Beaver Dam Creek	199-Fair (Blw. Memorial Dr.)	7.87-Poor (10/94) 7.07-Fairly Poor (4/95)	Memorial Drive 8/28/95-9/20/95
leton	Apple Creek	250-Poor (Abv. Greiner Rd.)		STH 55 5/22/95-6/12/95
		237-Poor (Abv. CTH JJ)		
		227-Poor (Abv. Holland Rd.)		
		254-Poor (Abv. French Rd.)		
		159-Fair (Blw. STH 55)		
eedom	Apple Creek	249-Poor (Blw. McCabe Rd.)		Rosin Road 7/11/95-7/26/95
		248-Poor (Abv. Greiner Rd.)		
		200-Poor (Abv. CTH J)		
		202-Poor (Blw. Rosin Rd.)		
		165-Fair (Abv. CTH D)	6.76-Fairly Poor (10/94) 6.87-Fairly Poor (4/95)	
mlock	Ashwaubenon Creek	179-Fair (Abv. CTH F)		CTH G 9/20/95-10/2/95
		219-Poor (Blw. Grant St.)	7.22-Fairly Poor (10/94) 7.78-Poor (4/95)	CTH F 5/22/95-6/12/95
tchman	Dutchman Creek	206-Poor (Blw. Circle Dr.)		Circle Drive 6/27/95-7/11/95
		230-Poor (Abv. CTH G)		CTH G 9/21/95-10/2/95

Water Resources Goals and Objectives for the Duck/Apple/Ashwaubenon Watershed

Overall Water Resources Goal

Enhance the water quality of the streams of the subwatersheds in order to improve the water quality of all the subwatersheds and ultimately the receiving water (Green Bay).

Secondary Goals: The letters following the goals correspond to the appropriate objectives listed below.

1. Increase stream baseflow to reduce the occurrence and severity of low flow conditions by: a,b,c,e,f

2. Improve aquatic life habitat (including fisheries) and water quality by: a,b,c,d,e,f,g,h,i,j,l,m,n

3. Improve the water quality of Green Bay by: a,b,c,d,e,f,g,h,i

4. Reduce sediment and nutrient loading by: a,b,c,d,e,f,g,h,i

5. Improve wildlife habitat by: a,b,c,d,j,k

Objectives: Below is a list of objectives that could be used to reach the goals listed above. This list is <u>not</u> in priority order and is <u>not</u> at all inclusive.

a. maintaining, enhancing and creating wetlands to slow the release of water to provide consistent flow.
b. encouraging good land use planning.
c. promoting agricultural best management practices BMP's.
d. creating and maintaining buffers that filter sediments and pollutants, provide shading and stabilize streambanks.
e. promoting alternatives to tiling and ditching.
f. improving infiltration.
g. controlling construction site erosion.
h. reducing nutrient and sediment loading by 50% as identified in the RAP.
i. limiting livestock access to the streams.
j. preserving, enhancing and creating wetlands for northern pike spawning areas.
k. preserving, enhancing and creating wetland, woodland and grassland corridors.
l. decreasing the sedimentation of spawning areas to improve seasonal runs of walleye and perch.
m. preserving the habitat of the redside dace.
n. conducting an assessment of the need for the sill (Dam) structure on Dutchman Creek.

These goals and objectives are applicable to all the subwatersheds. See attached table to determine which are the most relevant in each subwatershed.

Secondary Water Resources Goals and Objectives and Subwatersheds

SUBWATERSHEDS→ GOALS ↓	Burma Swamp	Fish Creek	Trout Creek	Lancaster Creek	Appleton	Freedom	Hemlock	Dutchman
Increase stream baseflow	**X**	X	X	X	**X**	X	X	X
Improve aquatic life habitat and water quality	X	**X**	**X**	**X**	X	**X**	**X**	**X**
Improve the water quality of Green Bay	X	X	X	X	X	X	X	X
Reduce sediment and nutrient loading	X	X	X	X	X	X	X	X
Improve wildlife habitat	X	X	X	X	X	X	X	X
Objectives↓								
Wetlands to provide more baseflow and water retention	X	X	X	X	X	X	X	X
Encourage good land use planning	X	X	X	X	X	X	X	X
Promote agricultural best management practices	X	X	X	X	X	X	X	X
Better buffers	X	X	X	X	X	X	X	X
Promote alternatives to tiling and ditching	X	X	X	X	X	X	X	X
Improve infiltration	X	X	X	X	X	X	X	X
Control construction site erosion	X	X	X	X	X	X	X	X
Reduce sediment and nutrient loading by 50% as identified in the RAP	X	X	X	X	X	X	X	X
Limit livestock to streams	X	X	X		X	X	X	X
Wetlands for fish spawning	X	X	X	X	X	X	X	X
Preserve wildlife corridors	X	X	X	X	X	X	X	X
Reduce sedimentation of spawning areas		X		X		X	X	X
Determine status of sill (Dam) on Dutchman Creek								X
Preserve the habitat of the redside dace		X	X					

X -Indicates the single most important goal for the subwatershed

Burma Swamp Subwatershed

The Burma Swamp subwatershed (Table 1) consists of Duck Creek from its headwaters to approximately a quarter mile south of Center Valley Road near the town of Freedom. This 12.8 mile stretch of Duck Creek drains 49.6 square miles of land. Duck Creek is identified as the only perennial stream in the subwatershed and is classified as a warm water forage fish community (Lower Fox River Basin Plan, 1991). In summer, this section of Duck Creek and its tributaries and drainages normally dry up. Flow occurs only after runoff events. According to longtime residents of the town of Freedom, this is a common occurrence in most summers. One 30 year resident could remember only 3 years in the last thirty when Duck Creek flowed throughout the summer.

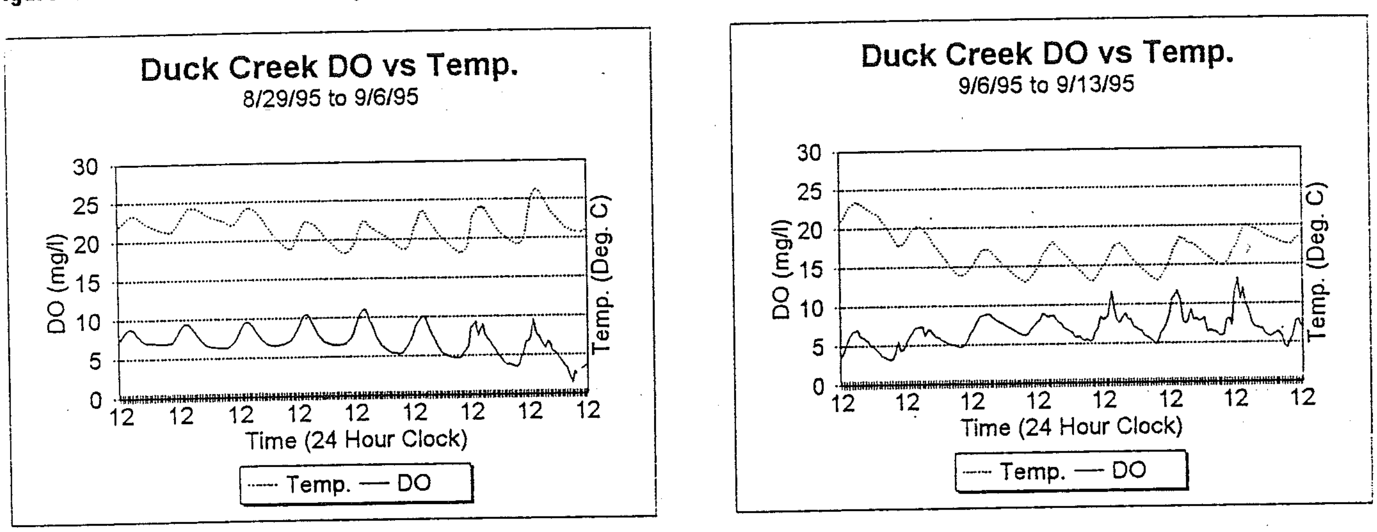
Land use in the subwatershed is mostly agriculture though most of the Village of Freedom lies within its boundaries. 78% of the land use in the subwatershed is agricultural, 13% is woodland and wetland and 9% is urban or developed.

Surface Water Resource Conditions

The existing conditions of the surface water in this subwatershed were hard to determine due to the lack of water during most of the monitoring season. From mid-June through mid-August no flow was observed in Duck Creek at Highway 55 (the farthest downstream road crossing in this subwatershed). Ponded areas did exist upstream of Highway 55 and they were characterized by low dissolved oxygen and turbid water. Bullheads and rusty crayfish were the only aquatic life observed.

Stream habitat ratings indicate "fair" water quality at County Highway S. Dissolved oxygen was monitored August 29 - September 13, at County Highway S west of Freedom (Table 2). In general, oxygen concentrations were good and only rarely dropped below 5 mg/l (Figure 1).

Figure 1: Duck Creek at County Highway S



Fishery resources in this subwatershed are limited to species that are able to migrate upstream from perennial portions of Duck Creek and species that can tolerate low dissolved oxygen levels. According to Fish Management (Personal Communication, 11/95) if water flowed into early June, it is probable that northern pike would be able to spawn and have good recruitment of the young in the subwatershed.

Streambank buffers are rare in this watershed, livestock pasturing and farming practices occur right up to the stream in many cases. Substrate is composed primarily of soft sediments though some in-stream habitat does exist, usually in areas of higher velocity where scouring occurs. The high number of drainage channels cause the streams of this subwatershed to be extremely flashy in nature and dramatic water fluctuations occur often.

The lack of flow year-round is the most limiting factor in this subwatershed: however, during the times when water is present better habitat and water quality is attainable if sediment and nutrient loading was reduced. Ditching and warm water temperatures prevent the water resources from meeting its potential.

Fish Creek Subwatershed

The Fish Creek subwatershed contains a portion of Duck Creek, and many unnamed tributaries. There are 30 miles of stream draining 53.3 square miles of land. Duck Creek is the only perennial stream in this subwatershed and it is classified as a warm water sport fishery. All the tributaries are intermittent and unclassified (Table 1).

Land composition is 75% agriculture, 14% wetland and woodland, and 11% urban or developed. The Village of Oneida falls in this subwatershed.

Surface Water Resources Conditions

The condition of the surface water resources of the Fish Creek subwatershed were difficult to ascertain. In many places Duck Creek was dry for most of the summer and only flowed after rain events. The stream was basically a string of stagnant pools separated by dry streambed.

Duck Creek flows sluggishly through this subwatershed even during periods of high precipitation. Streambank buffering is sparse and bank erosion is common. Substrate is composed primarily of soft sediments though significant areas of bedrock exist. The stream is turbid and carries a high load of suspended material.

Limited numbers of northern pike and smallmouth bass were found in this subwatershed. Their occurrence peaked nearest to the mouth and rapidly decreased as one traveled upstream. Forage minnow species were also present in the subwatershed.

The habitat evaluations for the subwatershed ranked the Duck Creek from "fair" to "good". HBI macroinvertebrate results from Center Valley Road rated this stream segment as "good" in October 1994 and "excellent" in April 1995 (Table 2). The data suggests that the large change in the HBI result was due to the presence of *Prosimulium mysticum*, a relatively intolerant Dipteran. EPT values for this reach were 81% in October and 1% in April. Dissolved oxygen was monitored from June 13 - June 26 at Center Valley Road (Figure 2) and from June 12 - June 20 at CTH "FF" (Figure 3). Both runs showed classic diel D.O. swings indicating high primary production (photosynthesis) during the day and high respiration rates at night. The low dissolved oxygen levels combined with high water temperatures were likely stressful to the aquatic life present.

Figure 2: Duck Creek at Center Valley Road

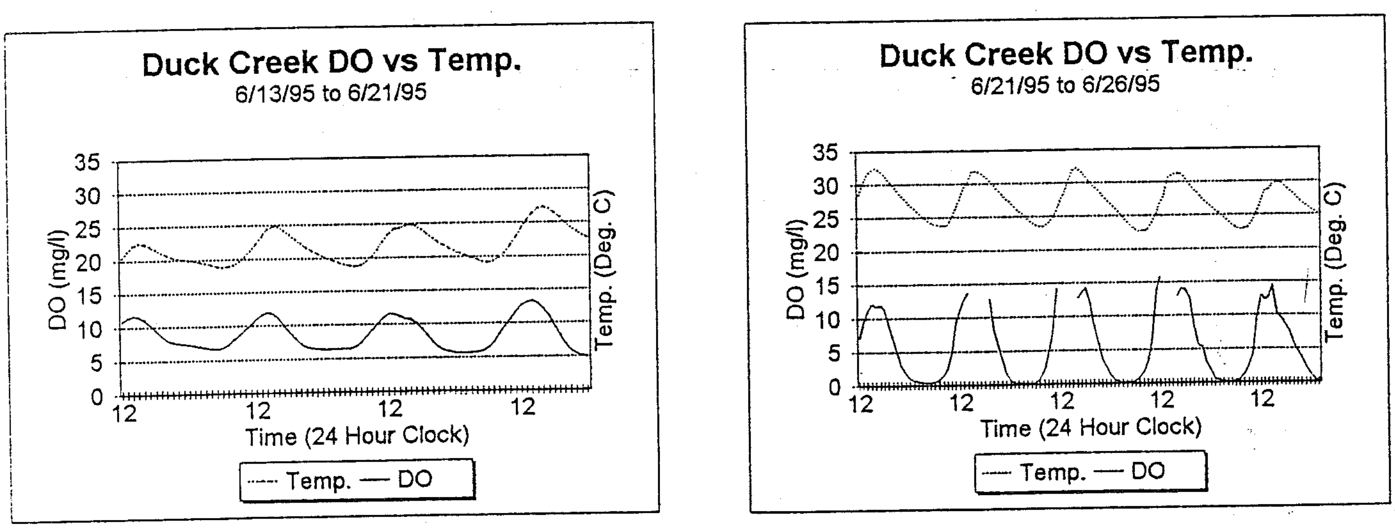
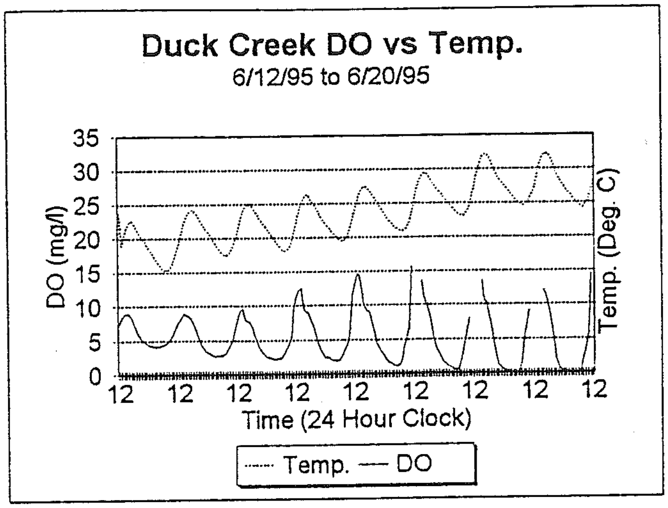


Figure 3: Duck Creek at County Highway FF



Triazine monitoring was conducted at the USGS gaging station located at CTH "FF". Results show that triazine levels ranged in value from 0.1 to 0.8 ppb. Triazine levels greater than 6 ppb have been found to reduce algae growth (La Liberty, 1984).

Water chemistry sampling was conducted by students from UW-Green Bay at CTH "FF". Data was gathered to compare urban and rural concentrations of phosphorus and suspended solids and their loads to the stream. The samples were analyzed for suspended solids, ortho-phosphorus and total phosphorus. Combined with flow data, nutrients and sediment loadings were then determined. Out of the first three runoff events of the year monitored, the concentrations and loads were highest during the first two runoff events of the year (University of Wisconsin - Green Bay, May 1995)(Table 3).

Table 3: Duck Creek at County Highway FF-Suspended Solids and Nutrient Loadings Data

Location	Date	Time	Sus. Solids Concentration (ppm)	Ortho-P Concentration (ppm)	Total-P Concentration (ppm)	% Ortho-P	Flow Rate (m^3/s)	Suspended Solids Load (kg/day)	Ortho-P Load (kg/day)	Total-P Load (kg/day)
Duck At Cty FF	3/14/95	10:35	52.5	0.452	0.69	65.5	9.3	42184.8	363.19	554.43
Duck At Cty FF	3/14/95	13:50	100.9	0.390	0.67	58.2	6.7	58409.0	225.76	387.85
Duck At Cty FF	3/14/95	17:30	57.5	0.352	0.58	60.8	5.64	28019.5	171.72	282.63
Duck at Cty FF	3/20/95	17:10	81.1	0.166	0.44	37.7	4.38	30683.7	52.78	166.51
Duck at Cty FF	3/20/95	21:35	101.2	0.248	0.58	42.8	5.77	50464.5	123.68	289.15
Duck at Cty FF	3/21/95	6:10	86.3	0.138	0.44	31.3	11.03	82218.9	131.32	419.32
Duck at Cty FF	3/21/95	10:15	91.3	0.180	0.48	37.5	12.86	101416.2	199.89	533.33
Duck at Cty FF	3/21/95	14:00	86.3	0.176	0.48	36.6	14.38	107159.8	218.54	596.37
Duck at Cty FF	4/10/95	19:00	3.1	0.018	< 0.18	-	0.188	51.1	0.29	-
Duck at Cty FF	4/11/95	8:00	7.3	0.015	< 0.18	-	0.55	370.3	0.73	-
Duck at Cty FF	4/11/95	12:00	3.4	0.018	< 0.18	-	0.69	202.8	1.06	-
Duck at Cty FF	4/11/95	16:00	3.8	0.018	< 0.18	-	0.46	149.0	0.71	-
Duck at Cty FF	4/11/95	19:15	4.0	0.013	< 0.18	-	1.94	670.5	2.25	-
Duck at Cty FF	4/12/95	8:00	27.8	0.020	< 0.18	-	-	-	-	-

Duck Creek would benefit from reduced sedimentation of pools and riffles and stabilized streambank and flow conditions. Low summer stream flow and high summer water temperatures do not provide good aquatic life habitat and water quality. The high level of nutrient loading needs to be reduced in order to limit algae growth and stabilize dissolved oxygen levels.

Trout Creek Subwatershed

The Trout Creek subwatershed consists of the mainstem of Trout Creek and a number of small unnamed intermittent tributaries. According to the Lower Fox River Basin Plan (1991), the perennial portion of Trout Creek is 8 miles long and drains 19.5 square miles of land. Trout Creek is classified as warm water sport fishery (Table 1) and there is some history of a marginal trout fishery (Surface Water Resources of Brown County, 1972).

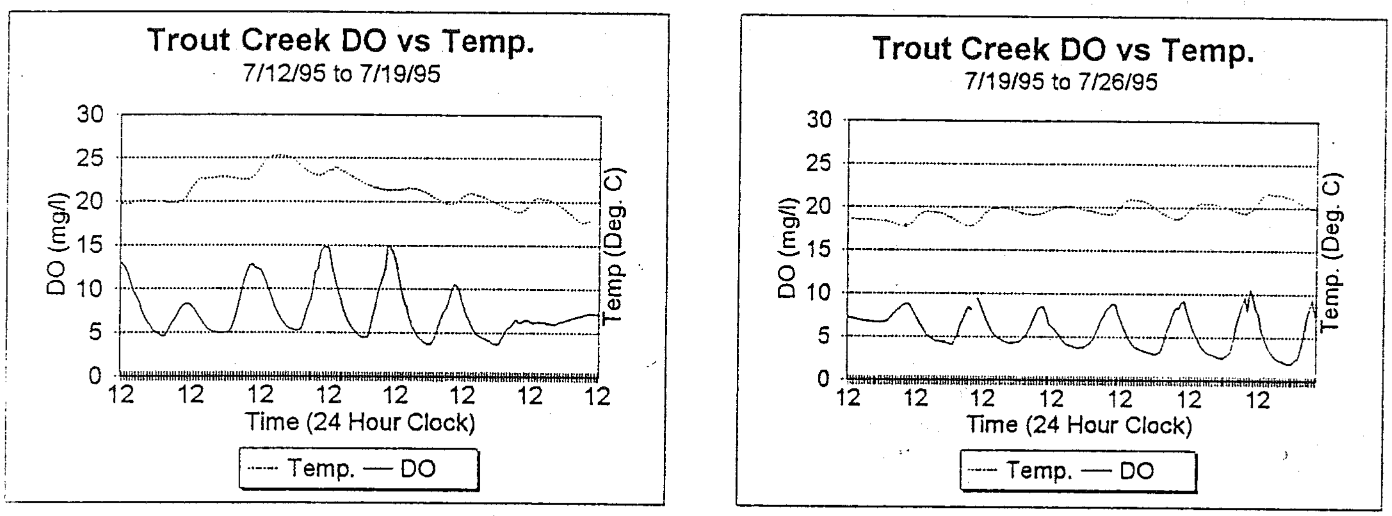
This subwatershed is mostly rural, though residential areas are quite common. Land composition is 74% agricultural, 22% wetland and woodland, and 4% developed or urban.

Surface Water Resource Conditions

Trout Creek was one of the few streams in the project to have good flow throughout the year. This is probably due to the sandier soils present in northern Brown County that allow water to infiltrate and move through the ground easier than the heavy clay soils farther south. The lower and mainstem reaches have relatively steep topography, are well buffered by woodlands, and have few nonpoint source impacts. The headwaters originate in areas with more gentle topography, poor buffering and lots of agricultural nonpoint impacts. Substrate is composed primarily of soft sediments, though gravel, rubble and boulders are also present.

Trout Creek had four habitat evaluations conducted on it, three of which ranked the stream as "fair" and one ranked the stream as "poor". HBI's conducted at Western Drive indicated "good" water quality both in October 1994 and April 1995. Ept values were 83% and 38% respectively. Dissolved oxygen readings taken at Trout Creek Road from July 12 - July 26 showed dissolved oxygen swings and quite a few standards violations (Table 2). It is likely that intolerant aquatic life was being stressed in this section of the stream (Figure 4).

Figure 4: Trout Creek at Trout Creek Road



The fishery of Trout Creek is composed of the redside dace (a threatened species in WI), white suckers, johnny darters, and other forage species. It is unlikely that a resident or native population of trout exists. Presumably other species like northern pike and perch migrate out of Duck Creek to spawn and feed.

Two areas on Trout Creek were used as IBI reference site locations for the Sheboygan River Priority Watershed Study. They were: 90 meters downstream of Trout Creek Road, and 179 meters downstream from Brookwood Drive. The first stream reach received a "fair" rating, the other was rated as "poor" (Fish Station Summary, 1995).

Water chemistry samples were collected from Trout Creek at CTH J after spring snowmelt and two other runoff events. The snowmelt sample was taken on 3/13/95 and the only parameter that had a high reading was suspended solids at 78 mg/L. The next sample was taken on 4/19/95 and again suspended solids were very high (138 mg/L). The final sample was taken on 3/9/95 and showed no exceedingly high values.

Trout Creek would benefit from reduced sedimentation and nutrient loading rates especially in the upper reaches of the subwatershed. Buffering of the stream in these sections would help improve overall water quality and aquatic life habitat.

Lancaster Creek Subwatershed

The Lancaster Creek subwatershed consists of a stream locally known as Lancaster Creek, Beaver Dam Creek, a portion of Duck Creek, and three unnamed tributaries. There are 23 miles of stream draining 29.8 square miles of land. Duck Creek, Beaver Dam Creek and Lancaster Creek are all perennial streams. Duck Creek is classified as a warm water sport fishery, Beaver Dam Creek is classified as a warm water forage fishery, Lancaster Creek and the other tributaries are unclassified (Table 1).

Land use in the subwatershed is approximately half agricultural and half developed. The entire Village of Howard and a large portion of the City of Green Bay are in this subwatershed. It is important to note that the entire Village of Howard has been platted and may experience rapid growth in the near future. Land composition is approximately 53% agriculture, 12% wetland and woodland, and 35% urban or developed.

Surface Water Resources Conditions

The condition of the surface water resources was much better than in some of the other subwatersheds due to the presence of water throughout the summer. The aquatic life in these streams is very dependant on Green Bay and mainstem Duck Creek as an escape refuge when the water quality conditions in the streams get critical.

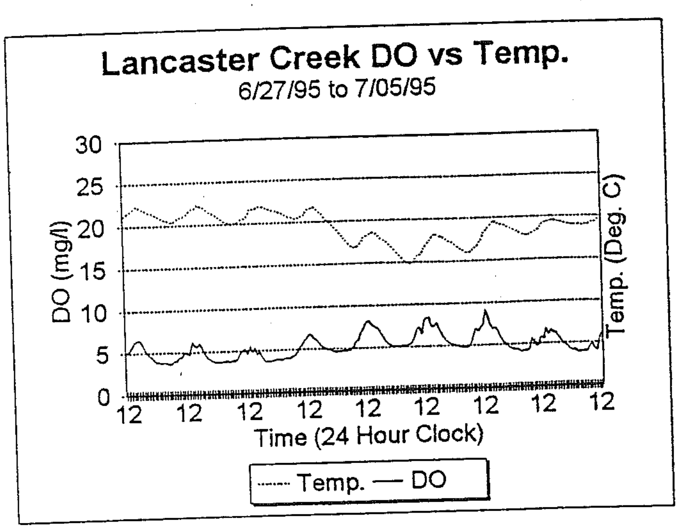
Students from Southwest High School, with their teacher, Trina Fluur, participated in the Water Action Volunteer Program by monitoring the water quality of Lancaster Creek. They assigned each sample a Water Quality Rating (WQR) based on the number and type of aquatic insects collected (Appendix A). Samples were taken at Meadowbrook Park in the Village of Howard on October 14, 1995. Twenty one samples were collected, 5 indicated "good " water quality, 14 were "fair", and 2 designated "poor" water quality.

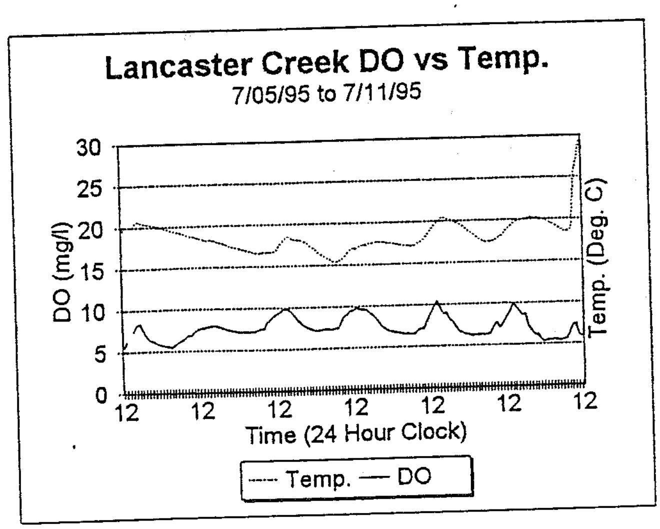
Participants of the Water Action Volunteer Program monitored Duck Creek at Pamperin Park from fall of 1991 to the spring of 1995. In that time the Water Quality Index ranking has shown a drop in water quality from good to medium. The WQR fell from good to barely fair at Brown County Park and went from excellent to fair at Pamperin Park over the sampling period. (Water Action Volunteer Program, 1994-1995 Progress Report)

A tributary to Lancaster Creek, locally known as Thornberry Creek, had some fish surveys conducted on it in the early 1980's. This area was located in one of the headwater areas south of HWY 29/32 and west of CTH FF. Brook trout were found and no surveys have been completed since (LMD Fish Management Files, 1995).

Monitoring in Lancaster Creek indicated "fair" to "poor" habitat ratings. HBI values taken at Glendale Avenue indicate "good" water quality in both spring and fall sampling. EPT values were 12% and 23% respectively. Dissolved oxygen monitoring at STH 29/32 from June 27 - July 11 rarely fell below the state standard and was sufficient to support intolerant aquatic life (Table 2). See Figure 5 for dissolved oxygen summaries.

Figure 5: Lancaster Creek at State Highway 29/32



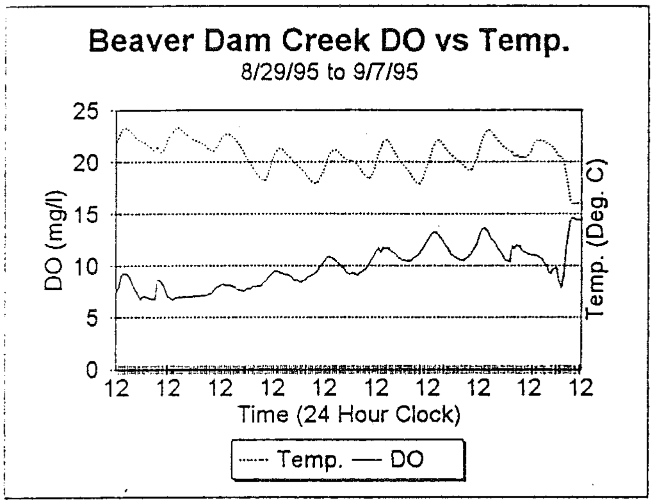


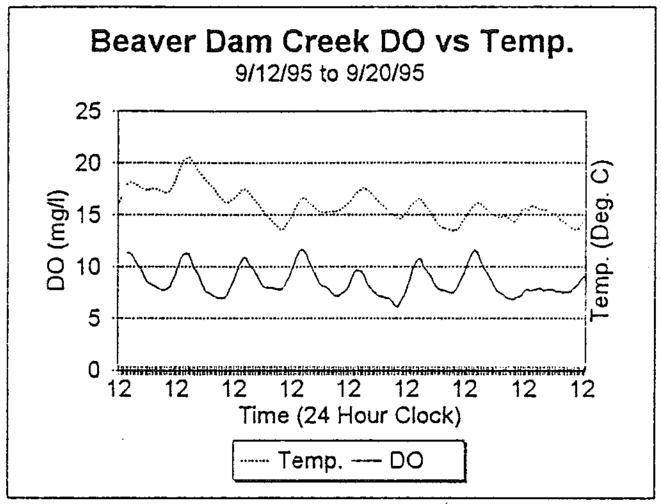
An IBI transect was conducted on Lancaster Creek by students from St Norberts College at the first bridge crossing downstream from STH 29/32. Eleven species were discovered, with the most common being creek chubs, longnose dace and johnny darters. The overall warmwater IBI rating was "fair" (Cochran, 1996).

Beaver Dam Creek is almost entirely located in an urban setting, it starts as an intermittent drainage near Southwest High School and meanders it's way north until it hits Duck Creek near Velp Avenue. The stream is very flashy and carries a considerable sediment load. Substrate is made up of gravel, cobble and some soft sediments.

Beaver Dam Creek had a "fair" habitat rating below Memorial Drive. Macroinvertebrates collected there in October 1994 rated water quality as "poor", in April 1995 water quality was rated as "fairly poor". EPT values at this site were 0% for both sampling times indicating that none of the insects collected were in the Ephemeroptera, Plecoptera, or Tricoptera orders. Dissolved oxygen monitoring took place at Memorial Drive August 29 - September 20 (Table 2). Oxygen levels in Beaver Dam Creek never fell below 6 mg/l (Figure 6).

Figure 6: **Beaver Dam Creek at Memorial Drive**





Beaver Dam Creek has had a history of fish kills occurring every 2-3 years since the 1970's. They have been caused by ammonia spills, discharges of blood (very high BOD) from a rendering plant and other, mostly industrial practices. Fish kills are not normally severe in Beaver Dam Creek because there are not many resident fish present and most of the fish that are there can migrate downstream to Duck Creek and Green Bay. No fish surveys have been conducted in Beaver Dam Creek though it is presumed that any fish species living in Duck Creek can travel up Beaver Dam Creek.

Students from St. Norberts College in De Pere conducted an IBI run on Beaver Dam Creek at Firemans Park. They found 6 species with creek chubs and johnny darters being the most common. The overall warmwater IBI rating for this site was "poor"(Cochran, 1996).

One interesting note on Beaver Dam Creek is that the Surface Water Resources book of Brown County (1972) states that "it flows through pasture and agricultural lands and that cattle are causing considerable damage to the banks of this stream". In 23 years Beaver Dam Creek has gone from being an agriculturally impacted stream to an urban affected stream.

Water chemistry samples were taken during three runoff events at Memorial Drive in Green Bay. They all showed increased levels of suspended sediments, nitrates and total phosphorus. A number of sewers drain into Beaver Dam Creek and have a tremendous impact on the surface water.

Beaver Dam Creek at Memorial Drive was sampled once in 1993 and several times in 1994 as part of a statewide Cryptosporidium spp. and Giardia spp. monitoring effort. In addition to the two protozoans, turbidity, suspended solids and E. coli bacteria were also monitored. Results are summarized in table 4 below (DNR PUBL-WR429-95, August 1995).

Table 4: Beaver Dam Creek Cryptosporidium spp. Monitoring Data

Date	Crypto / L	Giardia / L	Turbidity (NTU)	Susp. Solids (mg / L)	E. coli (CFU's)
11/29/93	ND	ND	2.9	-	110
01/12/94	ND	0.2	5.3	-	<10
02/16/94	ND	ND	4.8	5	60
03/15/94	ND	3.5	9.0	18	140
04/19/94	ND	ND	3.1	6	<10
*04/26/94	ND	ND	18.0	31	<10
05/25/94	ND	ND	8.6	14	48,000
06/21/94	ND	ND	6.3	9	1700
07/20/94	ND	ND	6.0	21	600
08/22/94	ND	9.0	3.5	8	630
09/20/94	ND	7.4	3.0	12	370
10/13/94	ND	2.9	4.2	<5	180

* Runoff Event

With the potential for the population in this subwatershed to grow rapidly in the next few years it is important to have a stormwater management plan in place as well as a plan to control growth and protect aquatic life habitat and water quality. The land use change from agriculture to residential/urban will stress not only the land ecosystem, but the aquatic ecosystem as well.

Appleton Subwatershed

The Appleton subwatershed is made up of the headwaters of Apple Creek and two intermittent tributaries. Apple Creek begins on the north side of Appleton and runs easterly to the subwatershed boundary located less than a mile downstream of STH 55. There are 17 miles of streams in the subwatershed that drain 20.8 square miles of land. Only the first 8 miles of Apple Creek are considered perennial, the last 4 miles are intermittent. Apple Creek is classified as a warm water forage fish community that has the potential to be a warm water sport fish community. The two intermittent streams in the subwatershed are unclassified (Table 1).

The subwatershed is primarily rural, though the southern edge is a rapidly urbanizing area of Appleton and Little Chute. Land composition is 64% agricultural, 3% woodland and wetland, and 33% urban or developed.

Surface Water Resource Conditions

The condition of the surface waters in the subwatershed are very degraded. Water was present in small, isolated pools that were characterized by low dissolved oxygen levels and abundant algae growth. The only fauna observed were bullheads and crayfish.

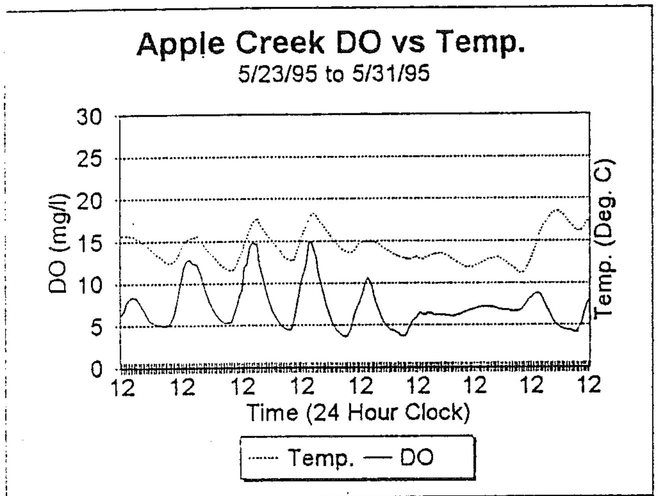
Streambanks in this subwatershed are often cropped or pastured right up to the stream with little or no buffering present.

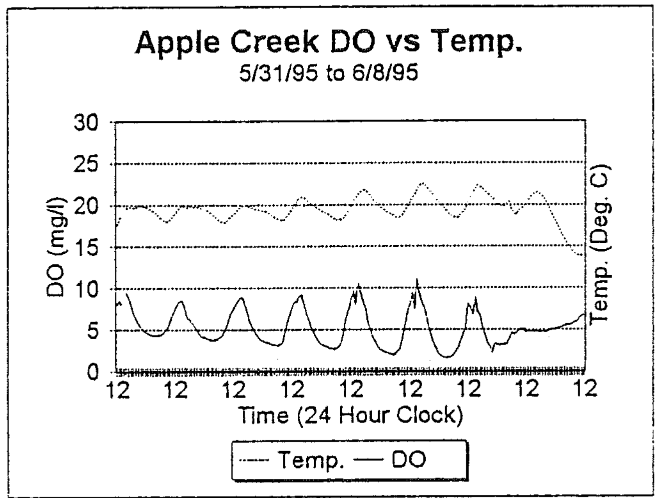
They are in poor shape due to erosion and sloughing. Substrate is primarily soft sediments though rubble rip-rap areas exist near bridges and culverts. There is also a fair amount of exposed bedrock on the bottom of the stream, this in part contributes to the flashiness of the stream. There seems to be little scouring of the substrate even during periods of high flows.

A water chemistry sample was taken at STH 55 on 4/19/95. It had high nitrate/nitrite levels of over 5 mg/L and suspended solid levels of 80 mg/l. On 8/9/95 another runoff event was captured at CTH JJ. Parameters were normal except for a high suspended solids level of 52 mg/L.

Apple Creek habitat evaluations ranked the stream from "fair" to "poor". No macroinvertebrate data was collected in this subwatershed. Dissolved oxygen readings were taken at STH 55 from May 23 - June 8 (Table 2). They show state dissolved oxygen standards violations occurred nearly every day (Figure 7).

Figure 7: Apple Creek at State Highway 55





The southern edge of the subwatershed contains the rapidly urbanizing areas of North Appleton and a small portion of Little Chute. The majority of the recent development has occurred in the headwater areas that are often dry during the summer. Because they are dry during the time when most construction takes place, erosion control measures are often neglected and water quality suffers when rain does come. Good land use planning in this subwatershed is vital to improving the water quality of Apple Creek.

Reducing nutrients and sediments reaching the surface water as well as increasing stream baseflow would have a positive effect on water quality in the whole stream. Maintaining flow for longer periods into the summer allows more fish the opportunity to spawn. Ditching and subsequent warm water temperatures also limit the aquatic life in the subwatershed.

Freedom Subwatershed

The Freedom subwatershed consists of 12 miles of Apple Creek and 5 unnamed tributaries. There are 29 miles of streams in the subwatershed that drain 33.2 square miles of land. Apple Creek is the only perennial stream in the subwatershed, all others are intermittent. Apple Creek is classified as warm water sport fish, the tributaries are unclassified (Table 1).

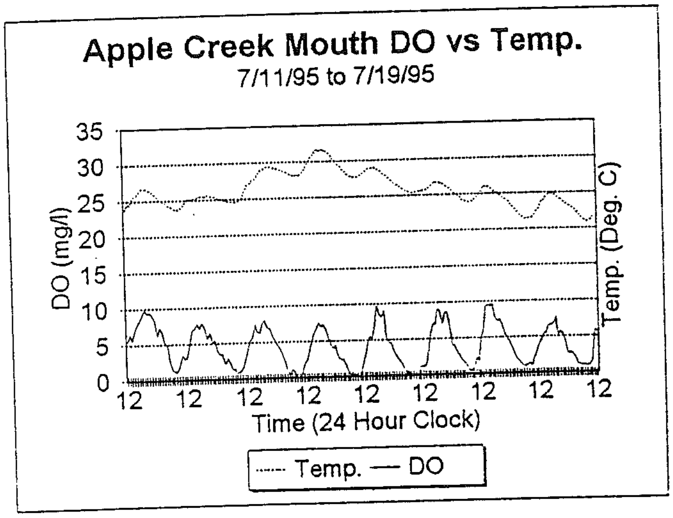
Land composition is approximately 63% agriculture, 4% woodland and wetland, and 33% urban or developed areas. This subwatershed contains the rapidly developing areas of Kaukauna and Little Chute and the Village of Wrightstown.

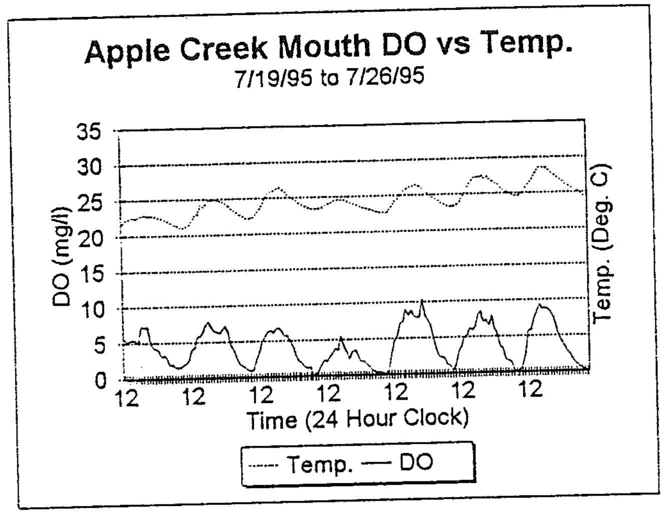
Surface Water Resources Conditions

Low flow was again a problem in this subwatershed. Reaches closest to the Fox River were the only places that had water during the summer. Due to the high degree of ditching in this subwatershed the streams are very flashy after rain events. Water chemistry samples were conducted during or right after precipitation events at CTH U on April 19, 1995 and at CTH D on August 9, 1995. Elevated nitrate levels and suspended solids were found in the spring sample. The August sample had a slightly higher than average total phosphorus result.

Apple Creek habitat ratings were mostly "poor" with a few that were "fair". Macroinvertebrate data from CTH D indicated "fairly poor" water quality when sampled in the fall of 1994 and the spring of 1995. EPT values were 49% in fall and 13% in spring. Dissolved oxygen data for this subwatershed was limited to a site downstream from Rosin Road near the mouth of the river. The meter was in the water from July 11 - July 26 during a period when there was no precipitation (Figure 8). Dissolved oxygen fell below 1 mg/l every night of the sampling run (Table 2). This condition would not allow intolerant species of aquatic life to exist in this stream segment.

Figure 8: Apple Creek at Rosin Road





A water chemistry sample was taken at CTH U on April 19, 1995. This sample showed high amounts of nitrate plus nitrite, high phosphorus and very high suspended solids. Another sample was taken at CTH D on August 8, 1995. This sample had very high total phosphorus and only moderately high suspended solids.

The upper reaches of the subwatershed are characterized by low streambanks, poor buffering, clay soils and high erosion rates. The lower reaches have higher banks that are well vegetated due to their unsuitability for pasturing and cropping. Bank slumping and high erosion rates are common in this subwatershed.

High turbidity from suspended materials as well as high amounts of nutrients result in poor dissolved oxygen and excessive sedimentation. A reduction in these would increase dissolved oxygen and result in better water quality and habitat for aquatic organisms. Ditching and high water temperatures also limit the aquatic life in this subwatershed.

Hemlock Subwatershed

The Hemlock subwatershed is made up of mainstem Ashwaubenon Creek, the North Branch Ashwaubenon Creek, the South Branch Ashwaubenon Creek, a tributary locally known as Hemlock Creek and six unnamed tributaries. There are 49 miles of streams in this subwatershed and they drain 29.4 square miles of land. The mainstem of Ashwaubenon Creek is the only perennial stream, all others are intermittent. The first half of Ashwaubenon Creek's 15 mile length is classified as a warm water sport fishery, the last half is classified as a warm water forage fishery. The remaining streams in the subwatershed are unclassified (Table 1).

Rural land practices in the subwatershed contribute to surface water resource problems by causing streambank erosion, organic loading, and sedimentation. Low stream flow during critical mid-summer periods stress aquatic life. Also a problem is the loss of stream habitat due to livestock activities at the stream.

Urban land use activities contribute sediment, nutrients, heavy metals like lead, copper and zinc, pesticides, and toxins like

Polycyclic Aromatic Hydrocarbons (PAH's) and Volatile Organic Compounds (VOC's) (Bannerman, 1990).

The Hemlock subwatershed is mostly rural, though a significant urban portion does exist (cities of De Pere and Ashwaubenon). Approximately 87% of it is agricultural, 10% is woodland and wetland, and 3% is developed or urban.

Surface Water Resource Conditions

Once again it was hard to determine the conditions of the resource because of the lack of water during most of the monitoring season. Enough water was present in early and late summer to collect water quality data. Habitat ratings for Ashwaubenon Creek ranged from "fair" at CTH "F" to "poor" at Grant Street. The HBI macroinvertebrate results at Grant Street indicated "fairly poor" water quality in the fall of 1994 and "poor" water quality in the spring of 1995 (Table 2). EPT values were 225 in fall and 5% in spring. A continuous dissolved oxygen meter was placed in Ashwaubenon Creek at CTH "F" from May 23 - June 11 (Figure 9) and at CTH "G" from September 21 - October 2 (Figure 10). State dissolved oxygen standard violations did not occur very often in the fall sampling but in the early summer sampling there were times when dissolved oxygen did not get above the state standard for days.

Figure 9: Ashwaubenon Creek at County Highway F

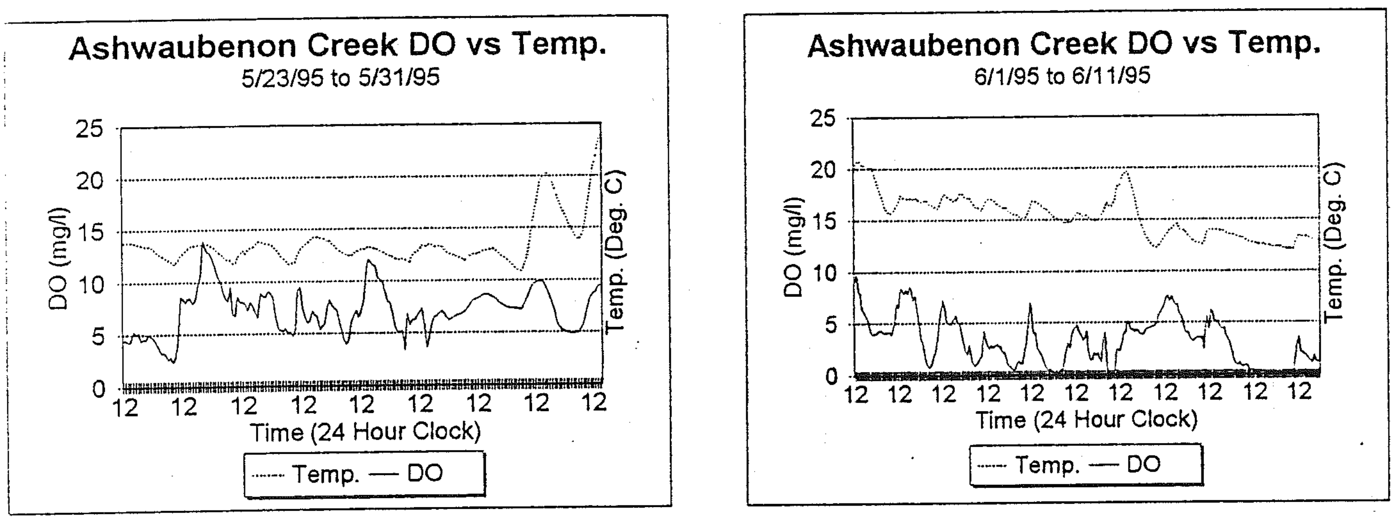
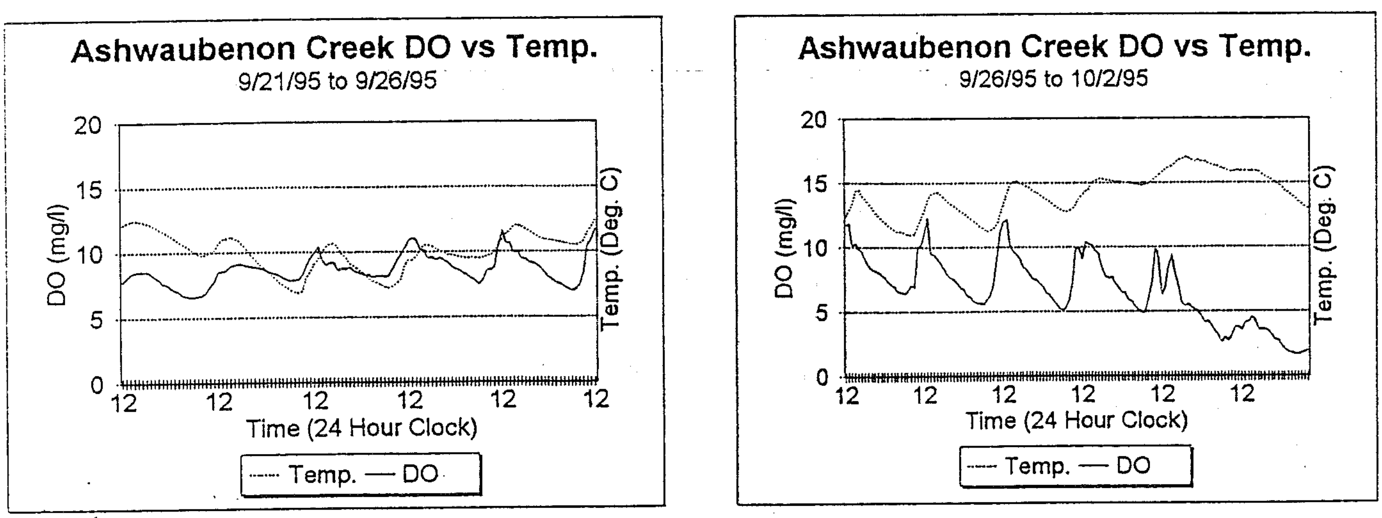


Figure 10: Ashwaubenon Creek at County Highway G



Ashwaubenon Creek has small seasonal runs of some gamefish species. Perch and walleye runs are limited by the suitable substrate available for spawning. Since northern pike are more tolerant of low dissolved oxygen, they normally have good runs and there is some evidence of a resident population in the stream. A fish kill occurred upstream of CTH "F" in 1992 and turned up forage species and a few northern pike. Good sucker runs still occur in the spring when dissolved oxygen is higher. Large numbers of rusty crayfish have been harvested from Ashwaubenon Creek for sale to local baitshops. (Fish Management Pers. Comm., 1995)

Sampling was conducted on Ashwaubenon Creek by students from UW-Green Bay at Creamery Road, Parkview Road and a frontage road off HWY 41. Data was gathered to compare urban and rural concentrations of phosphorus and suspended solids and their loads to the stream. Water samples were analyzed for suspended solids, ortho-phosphorus and total phosphorus. Combined with flow data, nutrient and sediment loading were then determined. The first three samples of the year indicated concentrations and loads were highest during the first two runoff events of the year. A summary of the data is outlined in Table 5 below (University of Wisconsin - Green Bay, May 1995).

Table 5: Ashwaubenon Creek, Nutrient and Sediment Loadings

Location	Date	Time	Sus. Solids Concentration (ppm)	Ortho-P Concentration (ppm)	Total-P Concentration (ppm)	% Ortho-P	Flow Rate (m^3/s)	Suspended Solids Load (kg/day)	Ortho-P Load (kg/day)	Total-P Load (kg/day)
Ashwaubenon at Creamery	3/11/95	20:30	81.4	0.709	1.03	68.8	2.46	17296.7	150.67	218.92
Ashwaubenon at Creamery	3/12/95	3:30	42.0	0.727	0.92	79.0	4.46	16184.4	279.99	354.52
Ashwaubenon at Creamery	3/12/95	12:05	61.9	0.660	0.93	71.0	3.37	18023.3	192.23	270.79
Ashwaubenon at Creamery	3/20/95	17:00	231.3	0.330	0.91	36.3	3.02	60487.9	36.18	237.44
Ashwaubenon at Creamery	3/20/95	21:05	196.0	0.296	0.79	37.5	2.76	46732.5	70.63	188.39
Ashwaubenon at Creamery	3/21/95	5:55	111.1	0.314	0.72	43.7	4.53	44448.0	125.73	288.02
Ashwaubenon at Creamery	3/21/95	10:17	77.3	0.316	0.69	45.8	4.64	31002.5	126.80	276.62
Ashwaubenon at Creamery	3/21/95	14:15	61.3	0.288	0.63	45.7	3.51	18587.1	87.40	191.06
Ashwaubenon at Creamery	4/10/95	19:00	21.3	0.162	0.34	47.7	0.13	239.6	1.82	3.82
Ashwaubenon at Creamery	4/11/95	8:00	8.9	0.114	0.22	51.9	0.108	82.7	1.06	2.05
Ashwaubenon at Creamery	4/11/95	12:15	10.3	0.101	0.22	46.0	0.13	115.4	1.14	2.47
Ashwaubenon at Creamery	4/11/95	16:15	8.6	0.092	0.21	43.8	0.195	144.1	1.55	3.54
Ashwaubenon at Creamery	4/11/95	20:15	13.3	0.121	0.28	43.2	0.043	49.5	0.45	1.04
Ashwaubenon at Creamery	4/12/95	8:00	19.5	0.158	0.33	47.8	0.249	419.1	3.39	7.10
Ashwaubenon at Creamery	4/12/95	12:40	12.3	0.100	0.22	45.7	0.238	253.7	2.07	4.52
Ashwaubenon at Frontage	3/12/95	13:52	78.3	0.685	0.96	71.3	4.17	28206.8	246.65	345.88
Ashwaubenon at Frontage	3/12/95	18:04	104.9	0.680	0.94	72.4	3.84	34801.7	225.64	311.87
Ashwaubenon at Frontage	3/20/95	17:00	244.9	0.262	0.82	32.0	3.77	79782.7	85.37	267.10
Ashwaubenon at Frontage	3/20/95	21:00	276.4	0.270	0.85	31.8	5.27	125830.5	122.98	387.03
Ashwaubenon at Frontage	3/21/95	6:00	169.6	0.293	0.75	39.0	6.81	99786.7	172.16	441.29
Ashwaubenon at Frontage	3/21/95	10:00	126.7	0.315	0.67	47.0	5.55	60761.1	150.90	321.28
Ashwaubenon at Frontage	3/21/95	14:00	95.3	0.266	0.6	44.3	4.61	37971.6	105.95	238.98
Ashwaubenon at Frontage	4/10/95	19:00	11.0	0.082	0.32	25.7	0.107	101.3	0.76	2.96
Ashwaubenon at Frontage	4/11/95	8:00	19.5	0.064	0.31	20.7	0.125	210.2	0.69	3.35
Ashwaubenon at Frontage	4/11/95	12:00	12.0	0.078	0.19	41.2	0.1125	116.6	0.76	1.35
Ashwaubenon at Frontage	4/11/95	16.00	11.3	0.065	0.19	34.1	0.1334	135.6	0.75	2.19
Ashwaubenon at Frontage	4/11/95	20:00	63.1	0.055	0.23	23.8	0.251	1368.1	1.19	4.99
Ashwaubenon at Frontage	4/12/95	8:00	34.4	0.049	0.23	21.2	0.3	890.5	1.26	5.96
Ashwaubenon at Parkview	3/20/95	17:15	215.3	0.108	0.49	22.0	7.2	133925.5	67.00	304.82
Ashwaubenon at Parkview	3/20/95	21:10	376.2	0.158	0.76	20.8	8.14	264573.3	110.98	534.50
Ashwaubenon at Parkview	3/21/95	5:15	353.7	0.256	0.86	29.8	3.56	108805.2	78.77	264.52
Ashwaubenon at Parkview	3/21/95	10:00	274.7	0.260	0.81	32.1	6.91	163992.7	155.29	483.59
Ashwaubenon at Parkview	3/21/95	14:10	215.5	0.282	0.74	38.0	0.504	9385.8	12.26	32.22
Ashwaubenon at Parkview	4/10/95	19:00	40.5	0.028	0.27	10.2	0.518	1814.4	1.23	12.08
Ashwaubenon at Parkview	4/11/95	8:00	34.6	0.031	0.31	10.0	1.39	4160.2	3.72	37.23
Ashwaubenon at Parkview	4/11/95	12:00	28.9	0.038	0.31	12.1	2.078	5197.2	6.75	55.66
Ashwaubenon at Parkview	4/11/95	16:00	30.3	0.018	< 0.18	-	2.475	6488.9	3.83	-
Ashwaubenon at Parkview	4/11/95	20:00	31.2	0.025	< 0.18	-	2.734	7372.4	5.87	-
Ashwaubenon at Parkview	4/12/95	8:11	63.5	0.025	0.23	10.7	4.21	23102.7	8.92	83.66
Ashwaubenon at Parkview	4/12/95	12:00	66.9	0.033	0.22	15.2	2.81	16240.3	8.10	53.41

An IBI transect was run on Ashwaubenon Creek by students from St. Norberts College on August 24, 1995. Eight different species and 61 individuals were discovered. White suckers and creek chubs were the most common. The overall warmwater IBI rating was "very poor".

A number of fish kills have occurred on Ashwaubenon Creek in recent years. White suckers and a few northern pike have normally been the victems of these kills. Causes have been linked to probable spawning stress, low dissolved oxygen and ammonia spills (Fish Management Fish Kill Files, 1996)

Creamery Road on Ashwaubenon Creek was sampled once in 1993 and several times in 1994 as part of a statewide

Cryptosporidium spp. and Giardia spp. monitoring effort. In addition to the two protozoans; turbidity, suspended solids and E. coli bacteria were also monitored. There were no detects (ND) of Cryptosporidium spp. and only three detections of Giardia sp. Results gathered are summarized in Table 6 below (WI DNR PUBL-WR429-95, August 1995).

Table 6: Ashwaubenon Creek at Creamery Road, Cryptosporidium spp. Monitoring

Date	Crypto / L	Giardia / L	Turbidity (NTU)	Susp. Solids (mg / L)	E. coli (CFU's)
11/29/93	ND	ND	15.0	-	940
01/12/94	ND	0.2	5.7	-	10
02/16/94	ND	0.6	8.2	16	10
03/15/94	ND	1.1	22.0	24	10
04/19/94	ND	ND	52.0	107	10
*04/26/94	ND	ND	310	438	5700
05/25/94	ND	ND	16.0	78	6600
06/21/94	ND	ND	49.0	88	2800
07/20/94	ND	ND	35.0	62	78,000
08/22/94	ND	ND	17.0	25	3500
09/20/94	ND	ND	12.0	40	960
10/13/94	ND	ND	10.0	24	320

* Runoff Event

The streams of this subwatershed are low gradient slow moving streams. A high amount of ditching and channelization has taken place in the subwatershed. Turbidity and nutrients are a severe problem as well as low dissolved oxygen levels. Headwater areas are dry for much of the summer. The whole subwatershed would benefit from the reduction of sediment and nutrients. This would improve the habitat for aquatic life and the low dissolved oxygen levels.

Dutchman Subwatershed

Dutchman subwatershed consists of all of Dutchman Creek and two tributaries. A total of 22 miles of streams drain 30 square miles of land. Dutchman Creek is 17 miles long. The first 7 miles of it are classified as a warm water forage fishery and the remainder is classified as a limited forage fishery. Both tributaries are unnamed, intermittent and unclassified (Table 1). During mid-summer low-flow conditions, most of Dutchman Creek and all of its tributaries dry up.

Land composition in the subwatershed is 87% rural, 3% woodland and wetland, and 5% urban or developed. This subwatershed contains most of the city of Ashwaubenon and Austin Straubel Airport.

Surface Water Resource Conditions

Like the majority of the subwatersheds in this project, this one had little or no flow for most of the summer. The only time there was flow in the upper reaches during the summer (June-early August) was after major rain events. The heavy ditching heavy ditching and draining of farm fields cause extreme fluctuations in water levels as well as provide a convenient way for sediment and nutrients to be transported.

Substrate is mostly made up of soft sediments. Riffle areas are rare and there seems to be little scouring of the stream bottom. Streambanks are generally in poor condition and buffering is limited or absent. Crops and livestock dominate the riparian zone in the upper reaches, while residential, commercial and industrial land uses dominate near the mouth. Dutchman Creek is channelized near the HWY 41 and HWY 172 interchange and also upstream and downstream from Oneida Street in Ashwaubenon.

Habitat ratings taken at Circle Drive and CTH "G" both assessed the stream as "poor". Dissolved oxygen measurements taken June 27 - July 11 at the Circle Drive location showed that conditions were favorable for tolerant species of aquatic life to exist as dissolved oxygen never got above 2.5 mg/l (Figure 11). Upstream of Circle Drive at CTH "G" from September 21 - October 2, dissolved oxygen dipped below the state standard only a few times (Figure 12). Dissolved oxygen was much improved due to the cooler water temperatures allowing more oxygen to be held in solution.

Figure 11: Dutchman Creek at Circle Drive

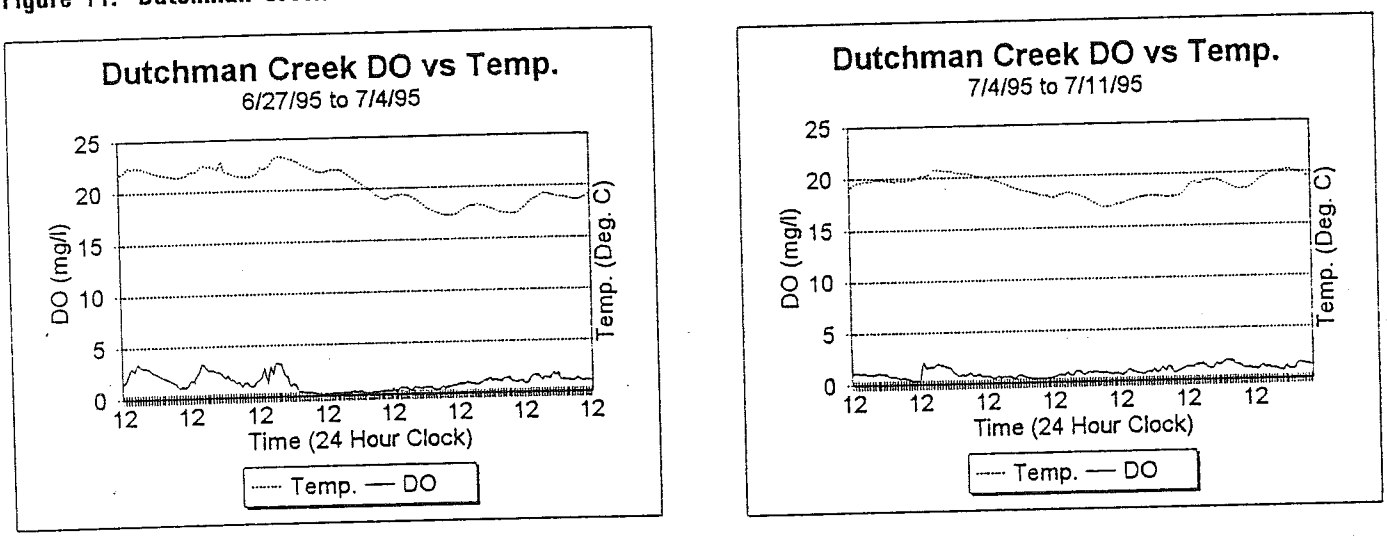
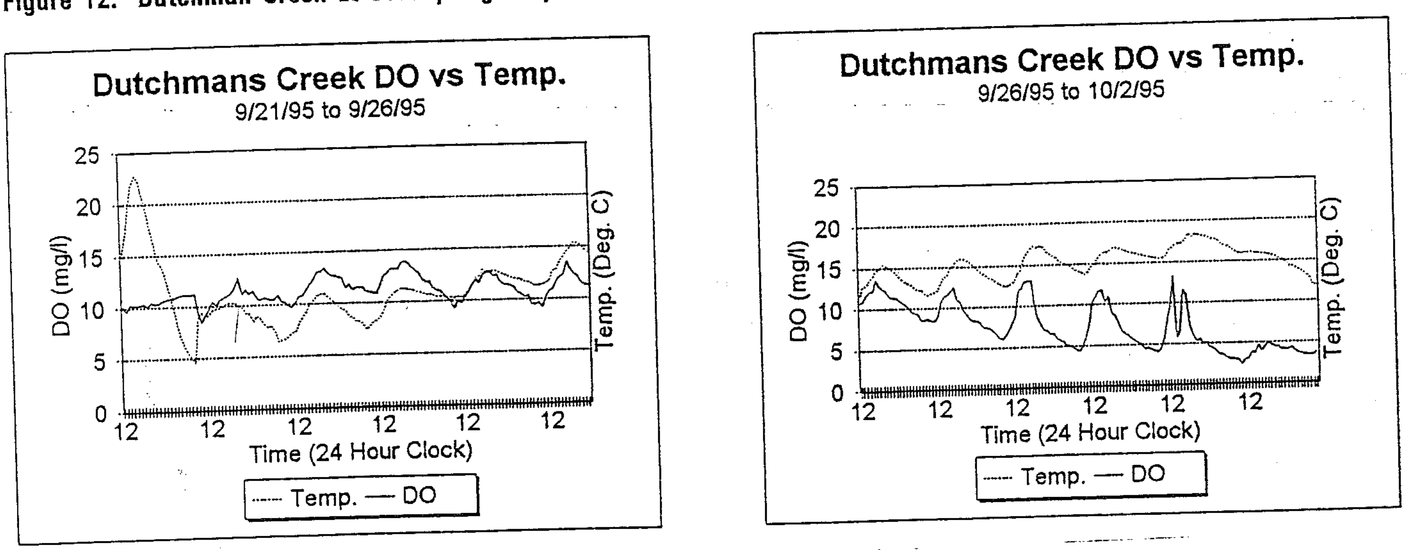


Figure 12: Dutchman Creek at County Highway G



Fisheries resources in the subwatershed are limited to the downstream reaches of Dutchman Creek by a sill (dam) structure located on the west (upstream) side of Packerland Avenue. This structure is a definite barrier to upstream migration of fish. It is unknown what function the sill serves. It is probable that if the structure was removed, spring spawning runs of suckers and northern pike would occur.

The streams of the Dutchman subwatershed are primarily low gradient. Flow is a problem in mid-summer when the stream virtually comes to a halt. Stagnation occurs and low dissolved oxygen levels are a concern. Ditching in rural areas and channelization in urban areas lead to rapid runoff rates and increased summer temperatures. The entire subwatershed would benefit from better flows as well as decreased levels of sediments and nutrients.

Sampling was conducted at Dutchman Creek by students from UW-Green Bay at Hanson Road and Broadway. Data was gathered to compare urban and rural concentrations of phosphorus, suspended solids and their loadings to the stream. Water samples were analyzed for suspended solids, ortho-phosphorus and total phosphorus. Combined with flow data, nutrient and sediment loading were then determined. Results indicated concentrations and loads were highest during the first two runoff events of the year. A summary of the data is outlined in Table 7 below (University of Wisconsin - Green Bay, May 1995).

Table 7: **Dutchman Creek Nutrient and Sediment Monitoring**

Location	Date	Time	Sus. Solids Concentration (ppm)	Ortho-P Concentration (ppm)	Total-P Concentration (ppm)	% Ortho-P	Flow Rate (m^3/s)	Suspended Solids Load (kg/day)	Ortho-P Load (kg/day)	Total-P Load (kg/day)
Dutchman at Hansen	3/11/95	20:10	36.7	0.494	0.74	66.8	4.21	31541.4	179.73	269.17
Dutchman at Hansen	3/12/95	8:30	37.0	0.554	0.81	68.4	2.31	8979.7	134.48	196.66
Dutchman at Hansen	3/12/95	16:52	94.4	0.468	0.74	63.2	6	48960.0	242.35	383.62
Dutchman at Hansen	3/20/95	17:00	166.9	0.124	0.52	23.8	4.36	62867.2	46.60	195.89
Dutchman at Hansen	3/20/95	21:00	134.2	0.126	0.51	24.6	4.9	56826.8	53.22	215.91
Dutchman at Hansen	3/21/95	6:00	115.5	0.204	0.56	36.4	5.15	51385.7	90.77	249.18
Dutchman at Hansen	3/21/95	10:15	81.3	0.222	0.53	41.9	4.51	31660.2	86.51	206.52
Dutchman at Hansen	3/21/95	15:30	53.0	0.230	0.48	47.9	3.16	14475.8	62.80	131.05
Dutchman at Hansen	4/10/95	19:15	4.1	0.021	0.26	8.2	0.063	22.1	0.12	1.42
Dutchman at Hansen	4/11/95	8:15	4.0	0.027	0.27	10.0	0.072	24.9	0.17	1.68
Dutchman at Hansen	4/11/95	12:00	6.6	0.015	< 0.18	-	0.068	38.7	0.09	-
Dutchman at Hansen	4/11/95	16:00	2.7	0.024	< 0.18	-	0.066	15.4	0.13	-
Dutchman at Hansen	4/11/95	20:00	12.3	0.019	< 0.18	-	0.181	191.7	0.29	-
Dutchman at Hansen	4/12/95	8:00	27.7	0.022	< 0.18	-	0.536	1282.9	1.04	-
Dutchman at Hansen	4/12/95	12:00	15.8	0.021	< 0.18	-	0.469	641.2	0.86	-
Dutchman at Broadway	3/11/95	21:15	94.8	0.352	0.62	56.8	4.47	36627.5	136.10	239.45
Dutchman at Broadway	3/12/95	9:15	32.6	0.583	0.82	71.1	2.79	7867.8	140.46	197.67
Dutchman at Broadway	3/12/95	17:30	163.1	0.379	0.74	51.2	9.81	138230.1	321.15	627.21
Dutchman at Broadway	3/20/95	17:00	161.1	0.088	0.48	18.3	6.92	96347.6	52.37	286.99
Dutchman at Broadway	3/20/95	21:00	122.8	0.104	0.45	23.0	7.33	77761.1	65.67	284.99
Dutchman at Broadway	3/21/95	6:35	117.9	0.142	0.55	25.8	7.41	75470.1	90.78	352.12
Dutchman at Broadway	3/21/95	10:45	84.6	0.210	0.52	40.4	6.1	44595.7	110.68	274.06
Dutchman at Broadway	3/21/95	16:00	51.4	0.211	0.48	43.9	3.65	16194.2	66.41	151.37
Dutchman at Broadway	4/10/95	20:00	3.1	0.012	0.26	4.5	0.35	93.3	0.36	7.86
Dutchman at Broadway	4/11/95	8:45	3.3	0.013	0.26	5.0	0.2	56.5	0.22	4.49
Dutchman at Broadway	4/11/95	12:00	5.9	0.011	< 0.18	-	0	0.0	0.00	-
Dutchman at Broadway	4/11/95	16:20	7.1	0.011	< 0.18	-	0	0.0	0.00	-
Dutchman at Broadway	4/11/95	20:00	47.3	0.010	< 0.18	-	1.147	4682.8	1.02	-
Dutchman at Broadway	4/12/95	8:30	23.8	0.025	< 0.18	-	0.888	1822.2	1.92	-
Dutchman at Broadway	4/12/95	12:30	20.5	0.016	< 0.18	-	0.557	987.2	0.76	-

Conclusion

The surface water resources and the aquatic life in this watershed would benefit most from more consistent steamflow year-round. Extensive tiling of agricultural land and the ditching and channelizing of streambeds causes rapid removal of runoff and precipitation from the system. Nutrients and sediments are another big concern because of their affect on dissolved oxygen levels and turbidity of the streams. Land use planning is critical in this watershed because of its proximity to rapidly growing urban areas like Green Bay and Appleton. Erosion control and stormwater management plans are two key components that should be built into all development plans for the improvement of water quality.

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