ARROWHEAD RIVER, RAT RIVER, DAGGETS CREEK PRIORITY WATERSHED WATER RESOURCE APPRAISAL REPORT

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I. INTRODUCTION

The purpose of this appraisal report is to summarize the conditions of water resources in the watershed and to provide preliminary water quality and water resource objectives for each important waterbody. The preliminary objectives will be combined with results of land use inventories in the watershed to produce final water resource objectives and pollutant load reduction goals for the Arrowhead River, Rat River, Daggets Creek Priority Watershed Project.

II. BACKGROUND

The entire Arrowhead River, Rat River, Daggets Creek watershed is targeted as high priority for nonpoint source controls in the Green Bay Remedial Action Plan's Nutrient and Eutrophication Technical Advisory Committee Report (Harris, V.A., J. Christie, 1987). The Winnebago Comprehensive Management Plan (WDNR, 1989) rated Arrowhead River and Daggets Creek as high priority to control nonpoint sources of pollution to the Winnebago Pool lakes (Poygan, Winneconne, Big Lake Butte Des Morts).

III. SUMMARY OF WATER RESOURCE CONDITIONS

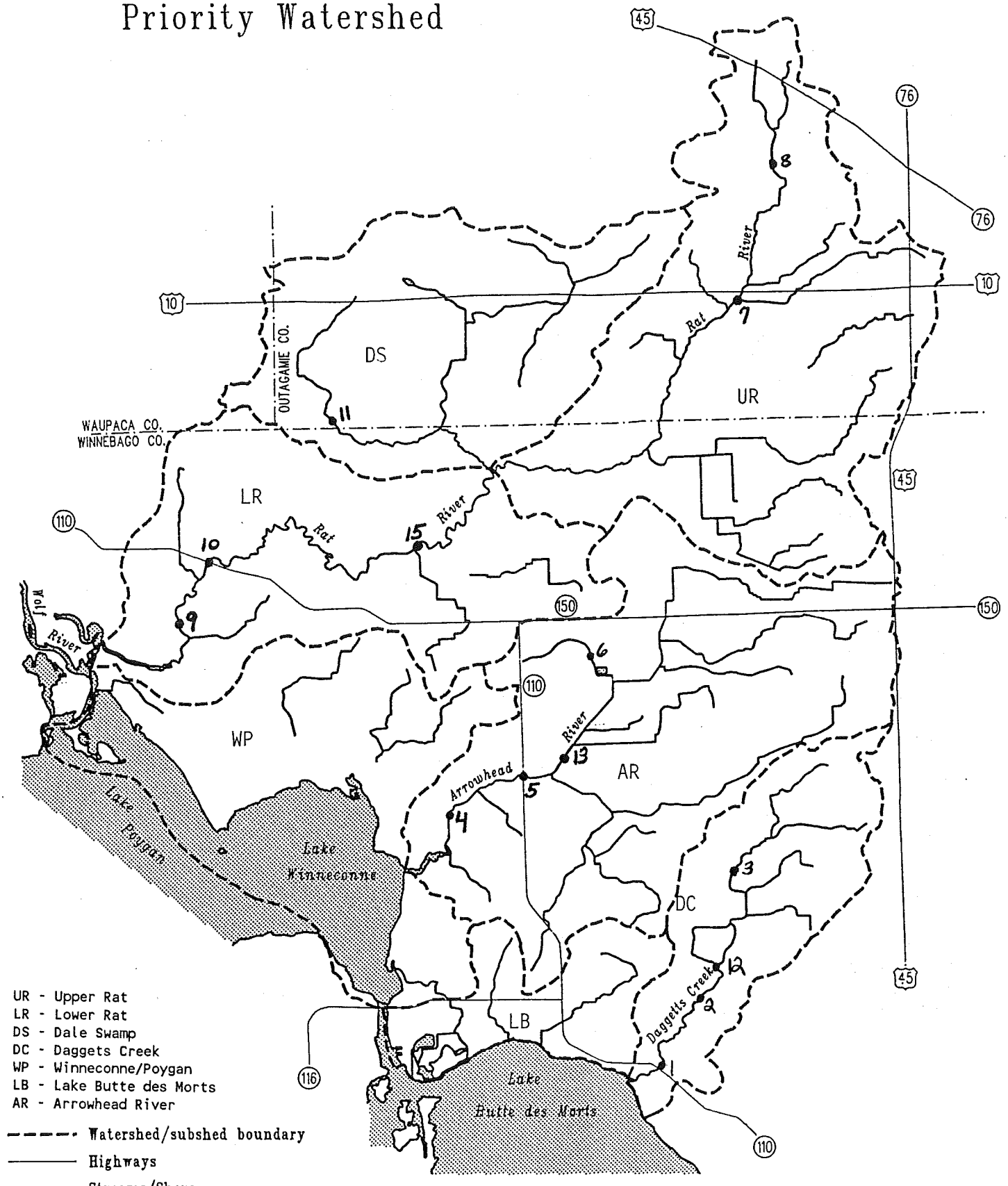
The Arrowhead River, Rat River, Daggets Creek watershed is located in the southeast most part of the Wolf River drainage basin. The Arrowhead River, Rat River, Daggets Creek watershed drainage area is 135 square miles and drains mostly flat agricultural and wetlands, with little urban areas, to the Winnebago Pool lakes. The watershed is comprised of the Arrowhead River, Rat River, and Daggets Creek, and several unnamed streams and ditches (see Figure 1). The Arrowhead River is tributary to the east shore of Lake Winneconne, the Rat River is tributary to the mainstem of the Wolf River which drains to Lake Poygan, and the lower half mile of Daggets Creek is a dredged channel that enters Lake Butte des Morts. These upriver lakes drain to Lake Winnebago which eventually drains to Green Bay via the Fox River.

Drinking Water in the Arrowhead River, Rat River, Daggets Creek watershed is obtained from groundwater. The major aquifers supplying the watershed include from deeper to shallower units: Cambrian sandstone; ordovician dolomite; and glacial sediment. Generally, municipal wells draw water from the deeper cambrian sandstone and private wells draw from the dolomite and glacial aquifers. Artesian wells are present in the watershed and these draw water from an ordovician age sandstone aquifer called the St. Peter sandstone.

FIGURE 1

Arrowhead • Rat • Daggetts Creek

Priority Watershed



Nonpoint sources of pollution are significant contributors of sediment, nutrients, pesticides, heavy metals, bacteria, and other pollutants to the Winnebago Pool lakes and its tributary streams. These pollutants are contributing to a decline in surface water quality and degradation of aquatic and wildlife habitat. They also may have the potential to impact groundwater quality. Nonpoint pollution sources include cropland erosion, streambank pasturing and erosion, urban runoff, septic waste runoff, lake shoreline erosion, construction site erosion, barnyard and manure spreading runoff.

Problems and Pollutants

LAKES

The Winnebago Pool lakes is a highly productive warm water system that is described in the Winnebago Comprehensive Management Plan as highly eutrophic primarily due to nonpoint source loading. Excessive nutrients contribute to algal blooms on the lakes every summer. The density of these blooms varies according to the amount of nutrient loading to the lakes and the wave action. The blooms effect aesthetics, interfere with boating and swimming, occasionally contribute to fish kills, and reduce sun light penetration which in turn has a negative impact upon rooted aquatic plants. The loss of these plants further impacts other forms of life dependent upon them including aquatic insects, fish, waterfowl and other wildlife.

Excessive bacteriological levels can be a human health concern during full body contact recreational use of the waters. Fecal coliform is a non-harmful bacteria used as an indicator of other (possibly pathogenic) organisms present in the water.

Excessive sediment contributes to decreased water clarity, light penetration, fish spawning habitat, and desirable rooted aquatic plants.

Dredged side channels are common along the developed lake shores. In these deep channels, the water can become very warm, stagnant, and turbid with low dissolved oxygen levels. In these situations, waterfowl diseases, such as botulism, may occur.

In the early days, much of the Winnebago pool lakes was bordered by shallow bays and marshes. In the 1850's, two dams were built on the Fox River outlet of Lake Winnebago at Neenah and Menasha. The two dams, and subsequent improvements, raised the pool water level 2.5 - 3 feet, permanently flooding and destroying many of the marshes.

STREAMS

Water resources problems in the watershed streams include sedimentation of riffle and pool areas, nutrient loading from runoff, low dissolved oxygen and high water temperatures, excessive plant growth, channelization, and low stream flows.

Sediments have blanketed the stream bed, filling in pools and riffles, and degrading the reproductive habitat for warm water fish species and associated fauna. Cattle have extensively trampled streambanks and stream bottoms along many of the streams in the watershed. These sediments are then delivered to the Winnebago Pool lakes affecting fish and wildlife habitat and boating navigability. The lake shorelines contributes sediment through bank erosion caused primarily by storm wave action.

Nutrient loading affects water quality by promoting excessive plant growth (macrophytes and algae) in the stream and reducing dissolved oxygen conditions which stress fish and other aquatic life. Phosphorus is the most significant nutrient which promotes algae and macrophyte growth in the streams. The nutrients entering the streams are then washed into the Winnebago Pool lakes causing severe algae growths, which impact fish, wildlife and recreational opportunities.

Excessive macrophyte growth causes severe oxygen fluctuations in the stream. As plants photosynthesize in the daylight they produce abundant oxygen, but the oxygen is used during plant respiration at night. In addition, excessive macrophyte growth in streams can restrict water flow and increase sedimentation rates.

Channelization (ditching) of a majority of the streams and tributaries in this watershed has eliminated the natural meandering in the streams which destroyed sustaining pools and riffle areas needed to support a balanced biological population. Much of the agricultural land has been developed by surface drainage practices to quickly convey water off the land and dry the soils.

Stream flows are subject to large extremes. Many of the watershed streams flow intermittently. Low flows and stagnating water during dry weather periods limits the potential for major improvements in the upstream fishery populations. Even though they are shown as perennial streams on the USGS topographical maps, some upstream sites completely dry up for short periods in the summer.

GROUNDWATER

Nitrate and pesticide contamination has degraded groundwater quality in the watershed. In some cases, contaminants have rendered groundwater unsafe for human consumption.

WETLANDS

Wetlands play an important role as groundwater recharge areas, spawning, rearing, and over-wintering areas for fish and wildlife, flood water storage, and removal and retention of sediment and nutrients contained in upland runoff. Lack or loss of wetlands throughout the watershed facilitate accelerated nutrient and sediment delivery to the lakes and has had a dramatic impact on the quantity, diversity, and quality of aquatic and terrestrial habitat.

URBAN NONPOINT SOURCE

Urban runoff carries a wide array of pollutants to surface water. Problem pollutants include heavy metals, sediment, nutrients, bacteria and other pathogens, and pesticides. While acres of urban land may be small compared with rural lands, urban areas can contribute more pollutants on a per-acre basis because they are often connected to storm sewers which convey runoff directly to lakes and/or streams.

Water Quality Objectives

The overall water quality objectives for the Arrowhead River, Rat River, Daggets Creek Priority Watershed are to reduce phosphorus loading to the Winnebago Pool lakes from this watershed by 50% and to reduce sediment loading from this watershed by 50%. Specific water resource objectives for each subwatershed are described in the Results and Discussion section of this report and also summarized in Table 1.

Successful installation of Best Management Practices in this watershed would have a number of positive effects on the water resources. Reducing contaminant infiltration through encouraging nitrogen crediting and pest scouting would protect groundwater quality. Reducing sedimentation would increase fish, macroinvertebrate, and wildlife habitat. Reducing organic loading would decrease excessive macrophyte growth in the streams, improve overall dissolved oxygen conditions, and decrease algae blooms in the lakes. Reducing bacteriological loadings would reduce fecal coliform levels for recreational users of the Pool lakes.

IV. APPRAISAL METHODS

Monitoring activities for the water resources appraisal were initiated in the watershed in September 1990 and completed in September 1991. Historical information for this report was gathered from WDNR, Lake Michigan District's water quality files. Following is a brief description of monitoring conducted to collect information for the streams, and groundwater water quality resource appraisal. Monitoring procedures followed are outlined in the "Field Procedures Manual" (FPM, DNR 1988).

Stream Monitoring

Macroinvertebrate

Aquatic macroinvertebrates were collected throughout the watershed and sent to UW-Stevens Point for sorting and identification. Sample results were evaluated using the Hilsenhoff Biotic Index (HBI) which provides a relative measure of organic loading to the streams.

Habitat Evaluations

Stream habitat conditions were evaluated throughout the watershed in the spring, concurrently with fish surveys, in mid-summer, and in the fall. A matrix was used to numerically rank physical habitat characteristics that may limit the quantity and quality of aquatic life (see Stream Habitat Rating Form - Appendix E).

Dissolved Oxygen/Temperature

Continuous dissolved oxygen and temperature meters were placed in the Arrowhead River, Daggets Creek, and the Rat River during critical low flow, high temperature conditions. Wisconsin Administrative Code NR 102 establishes a 5 mg/L dissolved oxygen water quality standard for fish and aquatic life classified streams to maintain favorable aquatic life.

Bacteria

Bacteriological samples were collected twice in Spring and once every week in summer at several locations throughout the watershed. The samples were collected by the Winnebago and Outagamie County Land Conservation Departments and sent to the State Lab of Hygiene for fecal coliform and fecal streptococcus analysis. Wisconsin Administrative Code NR 102 establishes bacteriological guidelines to determine

suitability of surface waters for recreational use. Fecal coliform count should not exceed 200 per 100 ml as a geometric mean based on not less than 5 samples per month.

Fisheries Resource Assessment

Fisheries surveys were conducted during the summer 1991 to determine fish communities in the basin. A backpack shocker, streamshocker and a mini-boomshocker were used depending upon water depth and accessibility to the stream. Fish were collected and counted from a stream reach approximately 35 to 40 times the site channel width. Species not readily recognized in the field were kept on ice for later identification. Habitat evaluations were conducted concurrently with fish surveys.

Groundwater Monitoring

In 1990, the Wisconsin DNR began offering free nitrate+nitrite analysis of private wells samples located in new priority watersheds. Nitrate+nitrite was chosen because of the many potential sources of this contaminant. With development of an inexpensive atrazine screening test, DNR offered both nitrate+nitrite and atrazine analysis in watershed projects started in 1991. Atrazine is an herbicide widely used on Wisconsin corn crops. Sample analysis for nitrate was done using SLOH method 240.1 (colormetric, automated, cadmium reduction). The procedure for the immunoassay method for the Atrazine screen has not been written up yet.

The primary objective of private well sampling was to provide well owners with information and education on well testing and groundwater. A secondary objective of sampling was to provide DNR with information on groundwater quality within priority watersheds. Wells were sampled by the county staff as part of the barnyard inventory. All testing was voluntary.

V. RESULTS AND DISCUSSION

Surface Water

A summary of the perennial streams in each of the seven subwatersheds in the Arrowhead River, Rat River, Daggets Creek Priority Watershed, including some of the monitoring results, stream use classifications, limiting factors, observed or potential pollutant sources, and surface water quality and water resource objectives are presented in Table 1. A map of the Arrowhead River,

Table 1. Water Resource Conditions and Objectives for Streams in the Arrowhead River, Rat River, Daggets Creek Watershed

Subwatershed (Stream)	Length (Miles)	HBI[1]	Habitat Rating[2]	Use Classification Use/Miles[3]	Limiting Factors[4]	Observed or Potential Sources[5]	Preliminary Water Quality Objectives[6]	Water Resource Objective[7]
Entire Watershed							1, 2	
Arrowhead (Arrowhead)	0-3.4 3.4-5.2 5.2-9	poor poor ---	fair to poor fair to poor ---	WWSF/3.4 WWFF/1.8* LFF/3.8*	SED, NUT, HAB, CH, DO, FLO	SPE, CR, BY, CE		3, 4
Daggets (Daggets)	0-0.7 0.7-4.3	poor poor	good to fair fair to poor	WWSF/0.7 LFF/3.6*	SED, NUT, HAB, CH, DO, FLO	SPE, CR, BY, LE, CE		3, 4, 5
Lower Rat (Rat)	0-12	poor	fair to poor	WWSF/12	TEMP, NUT, FLO, SED, DO	SPE, BY, CE, CR		3, 4
Upper Rat (Rat)	12-13.5 13.5-18 18-23	--- poor fair	--- good to poor fair	WWSF/1.5 WWFF/4.5 LFF/5*	SED, NUT, HAB, CH, FLO	SPE, CR, CE, BY		3, 4
Dale Swamp (Little Rat)	0-1.2 1.2-3	--- ---	--- ---	LFF/1.2 LAL/1.8	SED, NUT, HAB	SPE, CR, BY, CE		3, 4
Winneconne/Poygan (Direct drainage)					SED, NUT, HAB, CH, FLO	LE, SPE, CR, BY, UR, CE		3, 4, 5, 6
Lake Butte des Morts (Direct drainage)					SED, NUT, HAB, CH, FLO	LE, SPE, UR, BY, CR, CE		3, 4, 5, 6

1. Hilsenhoff Biotic Index (HBI):

Water Quality	Degree of Organic Pollution
Excellent	No apparent organic pollution
Very good	Possible slight organic pollution
Good	Some organic pollution
Fair	Fairly significant organic pollution
Fairly poor	Significant organic pollution
Poor	Very significant organic pollution
Very poor	Severe organic pollution

2. Stream Habitat Rating: See Appendix A and Appendix E.

3. Use Classification:
   - WWSF - Warm Water Sport Fish Communities
   - WWFF - Warm Water Forage Fish Communities
   - LFF - Limited Forage Fish Communities
   - LAL - Limited Aquatic Life
   - * - Based on best professional judgement

4. Limiting Factors:
   - SED - Sedimentation
   - NUT - Nutrient enrichment
   - HAB - Instream habitat
   - FLO - Low flow
   - TEMP - Water temperature
   - CH - Channelization
   - DO - Dissolved oxygen

5. Observed or Potential Sources:
   - SPE - Streambank pasturing and erosion
   - BY - Barnyard runoff
   - CR - Cropland erosion
   - LE - Lakeshore erosion
   - CE - Construction erosion
   - UR - Urban runoff

6. Water quality objectives:
   1. Reduce sediment loading by a high level (50%)
   2. Reduce phosphorus loading by a high level (50%)

7. Water resources objectives:
   3. Increase aquatic life by improving overall habitat conditions
   4. Protect and enhance wildlife by improving wetland and grassland habitat
   5. Control lake shoreline erosion
   6. Reduce urban nonpoint source pollution

Rat River, Daggets Creek priority watershed with subwatershed boundaries and monitoring locations is shown in Figure 1. Results of the habitat assessments are presented in Appendix A, HBI results in Appendix B, bacteriological results in Appendix C, and fish survey results in Appendix D.

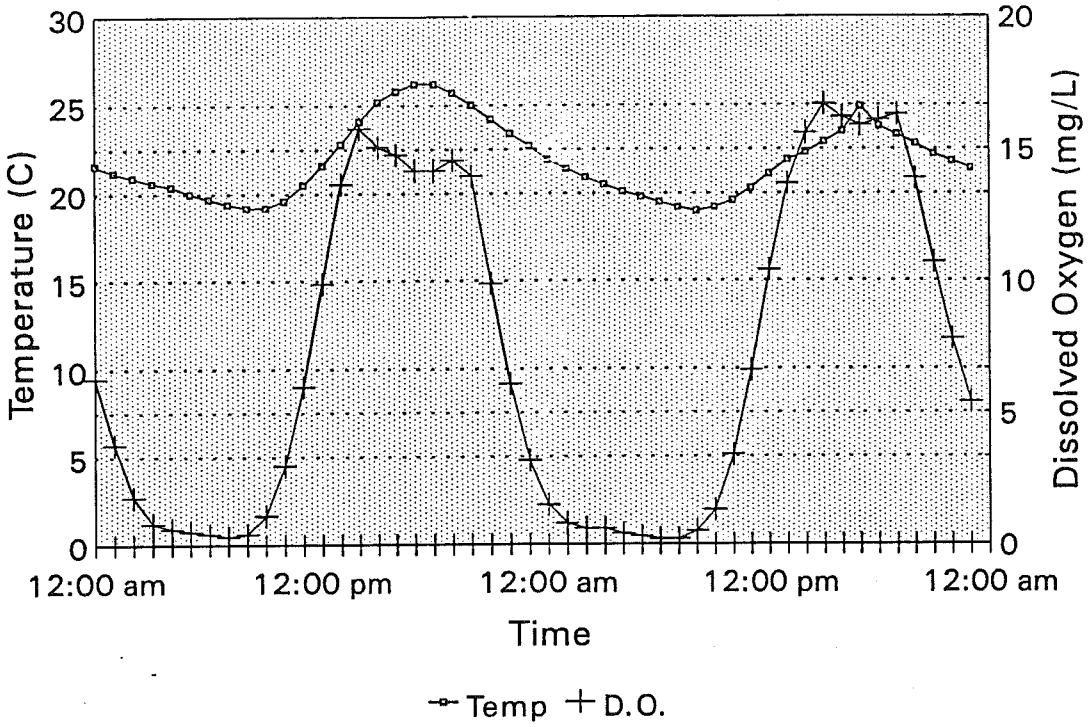
Following is a discussion of surface water appraisal monitoring results for each subwatershed. The subwatershed descriptions provide a discussion of water resource conditions, problems affecting the resource, and surface water resource management objectives.

ARROWHEAD RIVER SUBWATERSHED

The Arrowhead River subwatershed is located in Winnebago county. The Arrowhead River is the only significant river in this subwatershed. A large system of intermittent tributary streams and channelized ditches drain to the Arrowhead River which itself is channelized for several miles. The lower portion of the river (below CTH 'M') is in reality a backwater of Lake Winneconne and contains a similar fishery.

Habitat evaluations rated the Arrowhead River as fair to poor habitat. Sediment has filled in the stream bed riffle and pool areas. The bottom substrate type is silt and muck with little sand and rubble. Stream bank erosion is common in this subwatershed. Aquatic plants have rooted in the silt deposition. With a over abundance of macrophytes, dissolved oxygen levels fluctuate dramatically diurnally. Dissolved oxygen monitoring documented water quality standard violations in the summer of 1991. Oxygen dropped practically to zero at night and as high as 17 mg/L in the daylight. An example of these diurnal swings is shown in Figure 2 below.

Figure 2. Diurnal Dissolved Oxygen and Temperature conditions. Arrowhead River. August 22 & 23, 1991.



The stream HBI indicates poor water quality with very significant organic pollution. Bacteriological monitoring documented high fecal coliform and fecal streptococcus levels.

Sportfish were present throughout much of the Arrowhead River. Several Bluegills and Yellow Perch taken at the Highway 110 site (#5) exceeded six inches in length. The farthest upstream fish population was limited to Mudminnows, a very tolerant forage species. Shallow water, low stream flows, and lack of cover limit the reaches at Lakeview Road (#13) to very tolerant species.

Water resource problems include severe instream sedimentation, limited habitat, excessive macrophyte growth from nutrient enrichment, low dissolved oxygen levels, channelization of the river and its tributaries, high bacteriological levels, and low stream flows during dry weather periods.

Water Resource Objectives

The following water resource management objectives are recommended for the Arrowhead River subwatershed:

1. Increase aquatic life in the Arrowhead River by improving overall habitat conditions.

    a. Reduce sedimentation of gravel and rubble.
    b. Increase available cover using streambank stabilization.
    c. Reduce nutrient loading to reduce macrophyte growth and improve overall dissolved oxygen levels.

2. Protect and enhance wildlife by improving wetland and grassland habitat through reduction of sediment and phosphorus loadings.

DAGGETS CREEK SUBWATERSHED

The Daggets Creek subwatershed is located in Winnebago county. Daggets Creek, which drains to Lake Butte des Morts, is the only significant stream in this subwatershed. The headwater area is made up of several unnamed intermittent tributaries and channelized ditches. The lower portion of the stream is a wide and deep channel off Lake Butte des Morts. The channel is predominantly bordered by development. There is some erosion occurring along the lake shore.

Habitat evaluations rated Daggets Creek as fair to poor. HBI indicate poor water quality with very significant organic pollution. Dissolved oxygen levels were severely depressed below the 5 mg/L standard in Daggets Creek. The creek has an abundance of filamentous algae and periphyton growth on the bottom substrate. The bottom substrate type in the creek is sand and rubble with muck and silt common. There is some significant streambank erosion along Daggets Creek.

Bacteriological sampling conducted in summer 1991 found fecal coliform levels consistently high with extreme levels during runoff events as shown in Table 2 below.

Table 2. Daggets Creek Bacteriological Sample Results

	Maxwell Rd.		Hwy. GG		Brooks Rd.	
Date	MFFCC[1]	Strep[2]	MFFCC	Strep	MFFCC	Strep
07/01/91	400	180	1900	750	1200	930
07/08/91	400	100	980	560	850	660
07/15/91	400	60	270	110	380	420
07/22/91	14,000	19,000	160	150	960	2,200
07/29/91	600,000	30,000	700,000	400,000	600,000	40,000

1. MFFCC = Fecal coliform colonies/mL water
2. Strep = Fecal streptococcus colonies/mL water

Daggets Creek fish populations primarily consisted of young sportfish near the River mouth at Brooks Road site (#1) and tolerant forage fish at the farthest upstream site (#12). Much of this stream, including Highway "GG" site (#2), consisted of intermittent dry sections. The reach upstream from this site was completely dry, apparently due to evapotranspiration of water through mature willow trees lining the stream banks.

Water resource problems include sedimentation of the tributaries and sediment loading directly to the lakes, limited habitat, channelization, excessive filamentous algae and periphyton growth from nutrient loading, low dissolved oxygen levels, high bacteriological levels, and low to no stream flows during dry weather periods in some sections.

Water Resource Objectives

The following water resource management objectives are recommended for the Daggets Creek subwatershed:

1. Increase aquatic life in Daggets Creek by improving overall habitat conditions.
    a. Reduce sedimentation of gravel and rubble.
    b. Increase available cover using streambank stabilization.
    c. Reduce nutrient loading to reduce macrophyte growth and improve overall dissolved oxygen levels.

2. Protect and enhance wildlife by improving wetland and grassland habitat through reduction of sediment and phosphorus loadings.

3. Control lake shoreline erosion.

UPPER RAT RIVER SUBWATERSHED

The Upper Rat River subwatershed consists of the mainstem of the Rat River and several unnamed intermittent headwater tributaries. Many of the intermittent tributaries are dredged channels which drain extensive agricultural lands. In this subwatershed, the lower portion of the mainstem of the Rat River flows through a large marsh.

Habitat evaluations rated the mainstem of the Rat River as good, fair, and poor. The HBI's indicate poor water quality with very significant organic pollution. Bacteriological monitoring documented high fecal coliform and fecal streptococcus levels during runoff events. Sediment has accumulated in the rivers riffle and pool areas. Near Island Road, the substrate type is mainly silt and muck. The River has an abundance of macrophyte and cattail growth. Aerial spraying of the cattail marsh is opening up the channel for flow through the area.

The Upper Rat River fish populations primarily consisted of tolerant forage fish. Water depth appears to be a limiting factor for sport fish populations. Stream reaches between Highway "W" (sites #15) and Island Road (site #7) may have even contained intermittent dry areas.

Water resource problems include instream sedimentation of riffle and pool areas, limited habitat, excessive macrophyte and cattail growth from nutrient loading, channelization, and low to no stream flows during dry weather periods in some sections.

Water Resource Objectives

The following water resource management objectives are recommended for the Upper Rat River subwatershed:

1. Increase aquatic life in the Rat River by improving overall habitat conditions.

a. Reduce sedimentation of gravel and rubble.
b. Increase available cover using streambank stabilization.
c. Reduce nutrient loading to reduce macrophyte growth and improve overall dissolved oxygen levels.

2. Protect and enhance wildlife by improving wetland and grassland habitat through reduction of sediment and phosphorus loadings.

LOWER RAT RIVER SUBWATERSHED

The Lower Rat River subwatershed consists of the Rat River and several unnamed intermittent tributaries. Many of these tributaries are dredged channels. Much of this subwatershed consists of a cattail marsh and therefore, has a low gradient. Much of the river bottom is covered with silt and muck. The river lies within the Rat River Wildlife area, a publicly owned hunting and fishing area. Because the Lower Rat River subwatershed is essentially a large wetland type system, water quality monitoring techniques described in the methods section are not as applicable for this watershed.

Fisheries surveys found the downstream site (#9) in the Lower Rat River subwatershed supported sport fish as well as rough fish populations. Few small fish were collected at this site, probably due to an inability to effectively maneuver and sight fish in the deeper, heavily vegetated water. The presence of yearling sport fish at the Highway "W" site (#15) suggests that conditions may be favorable for sport fish at certain times of the year (e.g. spring spawning), although mudminnows were the most abundant species found and water depth and temperatures were not very favorable.

Water resource problems include high water temperatures that hold less oxygen and are not favorable to fish, low stream flows, excessive cattail and macrophyte growth from nutrient enrichment and sediment deposits.

Water Resources Objectives:

The following resource management objectives are recommended for the Lower Rat River subwatershed:

1. Increase aquatic life in the Rat River by improving overall habitat conditions.

a. Reduce sedimentation of gravel and rubble.
b. Reduce nutrient loading to reduce macrophyte growth and improve overall dissolved oxygen levels.

2. Protect and enhance wildlife by improving wetland and grassland habitat through reduction of sediment and phosphorus loadings.

DALE SWAMP SUBWATERSHED

The Dale swamp subwatershed is located in Winnebago and Outagamie Counties. A perennial tributary (known locally as "Little Rat") drains to the Rat River in Section 2, T20N, R15E, Winnebago County. A large wooded wetland makes up a considerable portion of this subwatershed. Considerable logging occurs in the swamp during ice covered winter months. Sedimentation and nutrient enrichment of the tributary and wetlands has decreased the diversity of habitat. The gentle rolling upland areas consists mostly of agricultural lands with some homesteads.

Water resource problems include sedimentation of the tributary and wetlands, nutrient enrichment, and limited habitat.

Water Resources Objectives

The following water resource management objectives are recommended for the Dale Swamp subwatershed:

1. Increase aquatic life by improving overall habitat conditions.

    a. Reduce sedimentation of gravel and rubble.
    b. Reduce nutrient loading to reduce macrophyte growth and improve overall dissolved oxygen levels.

2. Protect and enhance wildlife by improving wetland and grassland habitat through reduction of sediment and phosphorus loadings.

WINNECONNE/POYGAN SUBWATERSHED

Surface waters in the Winneconne/Poygan subwatershed drains directly to Lake Winneconne and Lake Poygan. The small community of Winneconne is located on the Wolf River. There are no major tributaries located in this subwatershed. Many of the intermittent and perennial streams are ditched channels to Lake Poygan and Lake Winneconne. There is significant development along the northeast shore of Boom Bay. Dredged side channels are common along the developed lakeshore. Much of the developed lakeshore is rip rapped. Where it is not rip rapped or rip rap is failing, lakeshore erosion is common. Undeveloped lake shoreline areas are mostly wetlands. Relatively flat agricultural lands with some homesteads make up the upland subwatershed area.

The water resource problems include sedimentation of the tributaries and sediment loading directly to the lakes, nutrient loading to the lakes, channelization of the tributaries and side channels, low flows, and limited habitat in the tributaries.

Water Resources Objectives

The following water resource management objectives are recommended for the Winneconne/Poygan subwatershed:

1. Increase aquatic life by improving overall habitat conditions.

    a. Reduce sedimentation of gravel and rubble.
    b. Reduce nutrient loading to reduce macrophyte growth and improve overall dissolved oxygen levels.

2. Protect and enhance wildlife by improving wetland and grassland habitat through reduction of sediment and phosphorus loadings.

3. Control lake shoreline erosion.

4. Reduce urban nonpoint source pollution.

LAKE BUTTE DES MORTS SUBWATERSHED

The Lake Butte des Morts subwatershed drains several intermittent streams directly to Lake Butte des Morts and the Wolf River. The communities of Winneconne and Butte des Morts are small urban areas located on the Wolf River and Lake Butte des Morts. The lake shores are developed with homesteads except where extensive wetland areas restrict development. Dredged side channels are common along the developed lakeshore. Much of the developed lakeshore is rip rapped. Where it is not rip rapped or rip rap is failing, lake shoreline erosion is common. Undeveloped lakeshore areas are mostly wetlands. The upland area is primarily agricultural lands with some homes.

Water resource problems include sedimentation of the tributaries and sediment loading directly to the lakes, nutrient loading to the lakes, channelization of the tributaries and side channels, low flows, and limited habitat in the tributaries.

Water Resources Objectives

The following water resource management objectives are recommended for the Lake Butte des Morts subwatershed:

1. Increase aquatic life by improving overall habitat conditions.
    a. Reduce sedimentation of gravel and rubble.
    b. Reduce nutrient loading to reduce macrophyte growth and improve overall dissolved oxygen levels.
2. Protect and enhance wildlife by improving wetland and grassland habitat through reduction of sediment and phosphorus loadings.
3. Control lake shoreline erosion.
4. Reduce urban nonpoint source pollution.

Groundwater - Private Well Sampling

Within the Arrowhead River, Rat River, Daggets Creek watershed 179 samples were analyzed for nitrate+nitrite and 170 samples were analyzed for Triazine. Thirty samples (16 percent) of the samples exceeded the State of Wisconsin's groundwater quality enforcement standard (ES) for nitrate+nitrite of 10 mg/L; 46 (25.7 percent) exceeded the preventative action limit (PAL) of 2 mg/L. The mean concentration 3.8 mg/L and the median was 0.66 mg/L. Values for samples ranged from not detected to 24 mg/L.

The atrazine plus metabolites ES of 3.0 ug/L was exceeded in 5 samples (3 percent) and the PAL of 0.3 ug/L was exceeded in 21 samples (12.3 percent). The mean concentration was 0.4 ug/L and the median was not detected. Sample concentrations ranged from not detected to 23.2 ug/L.

In watershed projects started in 1991, 1,317 nitrate+nitrite and 1,220 triazine samples were collected. The mean nitrate+nitrite concentration for all these samples was 4.8 mg/L; the mean concentration for triazine samples was 0.31 ug/L. Of the samples analyzed for nitrate+nitrite, 216 or 16.4 percent exceeded the groundwater quality ES. The nitrate+nitrite PAL was exceeded in 565 or 42.9 percent of the samples. Samples collected from 16 or 1.3 percent of the wells exceeded the ES for triazine and 157 or 12.8 percent of the samples exceeded the PAL.

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APPENDIX A. HABITAT ASSESSMENT RESULTS[1]

Stream	Location	Site #[2]	Fall 1990 score / rating	Spring 1991 score / rating	Summer 1991 score / rating	Fish Survey Summer 1991 score / rating
Daggets Creek	Brooks Road	1	127 / Good	137 / Fair	193 / Fair	172 / Fair
Daggets Creek	Hwy "GG"	2	132 / Fair	195 / Fair	207 / Poor	203 / Poor
Daggets Creek	Maxwell Rd.	12	--- ---	202 / Poor	187 / Fair	192 / Fair
Arrowhead River	Breezewood Rd.	4	157 / Fair	213 / Poor	199 / Fair to poor	141 / Fair
Arrowhead River	Hwy "110"	5	175 / Fair	215 / Poor	208 / Poor	138 / fair
Arrowhead River	Lakeview Rd.	13	168 / Fair	219 / Poor	199 / Fair to poor	164 / Fair
Rat River	Island Rd.	7	182 / Fair	211 / Poor	227 / Poor	122 / Good
Rat River	Spring Road	8	139 / Fair	--- ---	--- ---	--- ---
Rat River	South Road	9	146 / Fair	173 / Fair	235 / Poor	176 / Fair
Rat River	Hwy "110"	10	189 / Fair	--- ---	--- ---	--- ---
Rat River	Cedar Road	11	127 / Good	--- ---	--- ---	--- ---
Rat River	Hwy "W"	15	--- ---	173 / Fair	230 / Poor	161 / Fair

KEY

Score	Rating
<70	Excellent habitat
71-129	Good habitat
130-200	Fair habitat
>200	Poor habitat

1. See Appendix E for Stream Habitat Rating Form
2. Site numbers indicated on Figure 1

APPENDIX B. Macroinvertebrate Biotic Index Rating Results

Stream	Site #[1]	Location	5/5/80	11/6/80	Fall'90	Spring '91
Daggets Creek	1	Brooks Road	poor	very poor	poor	poor
Daggets Creek	2	Hwy "GG"	poor	poor	poor	poor
Daggets Creek	12	Maxwell Road			---	poor
Arrowhead River	4	Breezewood Road			poor	poor
Arrowhead River	5	Hwy "110"			poor	poor
Arrowhead River	13	Lakeview Road			---	poor
Rat River	7	Island Road			poor	poor
Rat River	8	Spring Road			fair	---
Rat River	9	South Road			poor	poor
Rat River	10	Hwy "110"			poor	---
Rat River	15	Hwy "W"			---	poor

KEY

Water quality	Degree of pollution
Excellent	No organic pollution
Very good	Possible slight organic pollution
Good	Some organic pollution
Fair	Significant organic pollution
Poor	Very significant organic pollution
Very poor	Severe organic pollution

1. Site numbers indicated on Figure 1.

APPENDIX C. Bacteriological Monitoring Results

Name of River Location	Date	Fecal coliform Colonies/100ml	Fecal Streptococcus Colonies /100ml	
Rat River CTH "W" Site # 15	7-27-78	540	900	
	8-17-78	270	260	
	9-21-78	70	440	
	3-19-91	20	20	
	5-09-91	60	160	
	6-10-91	290	170	
	7-01-91	70	40	
	7-08-91	230	60	
	7-15-91	30	150	
	7-22-91	130	150	
	7-29-91	1100	-	rained 2-3"
	8-05-91	310	60	
	8-12-91	500	160	
	8-15-91	-	-	
Rat River South Road Site # 9	01-01-75	420	-	
	02-01-75	90	-	
	05-01-75	40	-	
	06-01-75	210	-	
	07-01-75	20	-	
	08-01-75	20	-	
	09-01-75	50	-	
	11-01-75	110	-	
	12-20-75	20	-	
	07-27-78	10	200	
	08-17-78	20	360	
	09-21-78	900	620	
	09-19-90	190	40	
	03-19-91	20	10	
	05-09-91	210	510	
	6-10-91	170	80	
	7-1-91	15000	25000	
	7-8-91	320	30	
	7-15-91	30	10	
	7-22-91	20	110	
	7-29-91	200	200	
	8-5-91	40	10	
	8-12-91	50	<10	
	8-15-91	110	90	

Name of River Location	Date	Fecal coliform Colonies/100mL	Fecal Streptococcus Colonies/100mL
Rat River Island Road Site # 7	07-27-78	90	180
	08-17-78	600	440
	09-18-90	380	240
	03-19-91	70	310
	05-09-91	870	570
	6-10-91	300	390
	7-1-91	40	30
	7-8-91	30	<10
	7-15-91	<10	20
	7-22-91	2000	1500
	7-29-91	4200	- rained
	8-5-91	<10	40
	8-12-91	350	280
	8-15-91	120	250
Daggets Creek Maxwell Road Site # 12	3-19-91	100	300
	5-02-91	50	20
	6-10-91	2200	1280
	7-1-91	400	180
	7-8-91	400	100
	7-15-91	400	60
	7-22-91	14000	19000
	7-29-91	600000	30000
	8-5-91	1500	1300
	8-12-91	1300	580
	8-15-91	170	60
Daggets Creek CTH "GG" Site # 2	9-17-90	460	420
	3-19-91	30	90
	5-02-91	220	10
	6-10-91	290	380
	7-1-91	1900	750
	7-8-91	980	560
	7-15-91	270	110
	7-22-91	160	150
	7-29-91	700000	400000 rained
	8-5-91	1400	170
	8-12-91	3700	350
	8-15-91	1400	200

Name of River Location	Date	Fecal coliform Colonies/100ml	Fecal Streptococcus Colonies /100ml	
Daggets Creek	9-17-90	550	370	
Brooks Road	3-19-91	40	220	
Site # 1	5-02-91	10	10	
	6-10-91	880	760	
	7-1-91	1200	930	
	7-8-91	850	660	
	7-15-91	380	420	
	7-22-91	960	2200	
	7-29-91	600000	40000	rained
	8-5-91	1100	340	
	8-12-91	300	370	
	8-15-91	380	440	
Arrowhead River	3-19-91	30	220	
Lakeview Road	5-09-91	70	20	
Site # 13	6-10-91	110	100	
	7-1-91	750	20	
	7-8-91	20	50	
	7-15-91	40	10	
	7-22-91	1300	610	
	7-29-91	670	1100	
	8-5-91	270	70	
	8-12-91	3400	5400	
	8-15-91	10	50	
Arrowhead River	9-18-90	400	170	
HWY 110	3-19-91	60	180	
Site # 5	5- 9-91	490	90	
	6-10-91	230	160	
	7-1-91	20	60	
	7-8-91	20	40	
	7-15-91	<10	20	
	7-22-91	110	240	
	7-29-91	20	130	
	8-5-91	40	10	
	8-12-91	20	470	
	8-15-91	100	20	
Arrowhead River	9-18-90	460	230	
Breezewood Road	3-19-91	40	280	
Site # 4	5-09-91	110	40	
	6-10-91	120	70	
	7-1-91	10	10	
	7-8-91	160	40	
	7-15-91	20	<10	
	7-22-91	120	220	
	7-29-91	550	-	
	8-5-91	30	20	
	8-12-91	40	40	
	8-15-91	50	40	

APPENDIX D. FISH ASSESSMENT RESULTS

SPECIES	SITE								
	DAGGETS			ARROWHEAD			RAT		
	01	02	12	04	05	13	09	15	07
SPORTFISH									
Bluegill	8		1	4	14		3	2	
Yellow Perch	1			10	14		10		
Pumpkinseed Sunfish	4		1	2	22		4		
Green Sunfish				3				1	2
Northern Pike					2			1	2
Black Bullhead	3		1					62	
Largemouth Bass	4			10	2		1	15	
Rock Bass	1			2	2				
Smallmouth Bass						1a			
INTOLERANT FORAGE									
Blacknose Dace									6
Blacknose Shiner *	2								
S. Redbelly Dace									24
TOLERANT FORAGE									
Lake Emerald Shiner				44					
Bluntnose Minnow				21					
Pugnose Minnow					1				
Brook Stickleback	11		19						170
Golden Shiner							3	1	
Creek Chub									39
Common Wht. Sucker	6		10	7					7
VERY TOLERANT FORAGE									
Mudminnow						13		282b	68c
Fathead Minnow			8						31
ROUGH FISH									
Bowfin					1		6		
Gizzard Shad				1					
Carp							6		

* These may have been Bluntnose Minnows
a in part
b collected in 20 ft. reach
c found dead

Table 2. Habitat data.

	SITE								
	01	02	12	04	05	13	09	15	07
WATER TEMP. (F)	?	dry	70	75	79	76	?	93	78
HABITAT SCORE	172	203	192	141	138	164	122	176	161

Good = (71-129) Fair = (130-200) Poor = (> 200)

Department of Natural Resources Appendix C. Form 3200-68 1-85

Stream _____ Reach Location _____ Reach Score/Rating _____

County _____ Date _____ Evaluator _____ Classification _____

Rating Item	Category			
	Excellent	Good	Fair	Poor
Watershed Erosion	No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion. 10	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	Heavy erosion evident. Probable erosion from any run off. 16
Watershed Nonpoint Source	No evidence of significant source. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). 10	Moderate sources (small wetlands, tile fields, urban area, intense agriculture). 14	Obvious sources (major wetland drainage, high use urban or industrial area, feed lots, impoundment). 16
Bank Erosion, Failure	No evidence of significant erosion or bank failure. Little potential for future problem. 4	Infrequent, small areas, mostly healed over. Some potential in extreme floods. 8	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 16	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20
Bank Vegetative Protection	90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally healthy. 9	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18
Lower Bank Channel Capacity	Ample for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. 10	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 16
Lower Bank Deposition	Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars. 15	Heavy deposits of fine material, increased bar development. 18
Bottom Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. 20
Bottom Substrate/ Available Cover	Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 17	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 22
Avg. Depth Riffles and Runs	Cold >1' 0 Warm >1.5' 0	6" to 1' 6 10" to 1.5' 6	3" to 6" 18 6" to 10" 18	<3" 24 <6" 24
Avg. Depth of Pools	Cold >4' 0 Warm >5' 0	3' to 4' 6 4' to 5' 6	2' to 3' 18 3' to 4' 18	<2' 24 <3' 24
Flow, at Rep. Low Flow	Cold >2 cfs 0 Warm >6 cfs 0	1-2 cfs 6 2-5 cfs 6	.5-1 cfs 18 1-2 cfs 18	<.5 cfs 24 <1 cfs 24
Pool/Riffle, Run/Bend Ratio (distance between riffles ÷ stream width)	5-7. Variety of habitat. Deep riffles and pools. 4	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 16	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 20
Aesthetics	Wilderness characteristics, outstanding natural beauty. Usually wooded or unpastured corridor. 8	High natural beauty. Trees, historic site. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered area. 14	Stream does not inhance aesthetics. Condition of stream is offensive. 16
Column Totals:	_____	_____	_____	_____

Column Scores E _____ +G _____ +F _____ +P _____ = _____ = Score

<70 = Excellent, 71-129 = Good, 130-200 = Fair, >200 = Poor