WRM files

# Fox River - Appleton Watershed

# Nonpoint Source Assessment Report

Submitted by Mary Gansberg

Wisconsin Department of Natural Resources

March, 1995

## I. INTRODUCTION

As recommended in the *Lower Fox River Basin Water Quality Management Plan (1991),* monitoring was conducted in 1992 in the Fox River - Appleton watershed (Figure 1) to determine the present status of water quality and the potential impacts of nonpoint source pollution. Kankapot, Garners, and Mud Creek are the tributaries to the Fox River in this watershed that were monitored.

## II. METHODS AND PROCEDURE

Water samples were collected and preserved following "Sample Handling and Preservation Handbook" protocol (1988). Samples were analyzed for total and dissolved phosphorus, total and volatile suspended solids, nitrate-nitrogen, total kjeldahl nitrogen, ammonia, biochemical oxygen demand, fecal coliform and fecal streptococcus bacteria. Garners and Mud Creek were also monitored for chlorides due to their urban location. All samples were chilled on ice and sent to the State Lab of Hygiene for analysis. All chemistry samples, except July 29 on Mud Creek, were taken during runoff events.

Dissolved oxygen (D.O.) and temperature were measured with a YSI Model 54 D.O./Temperature meter. pH was measured with a Fisher-Scientific Accumet Model 1001 pH meter. Flows were obtained using a Marsh-McBirney Model 201 flow meter.

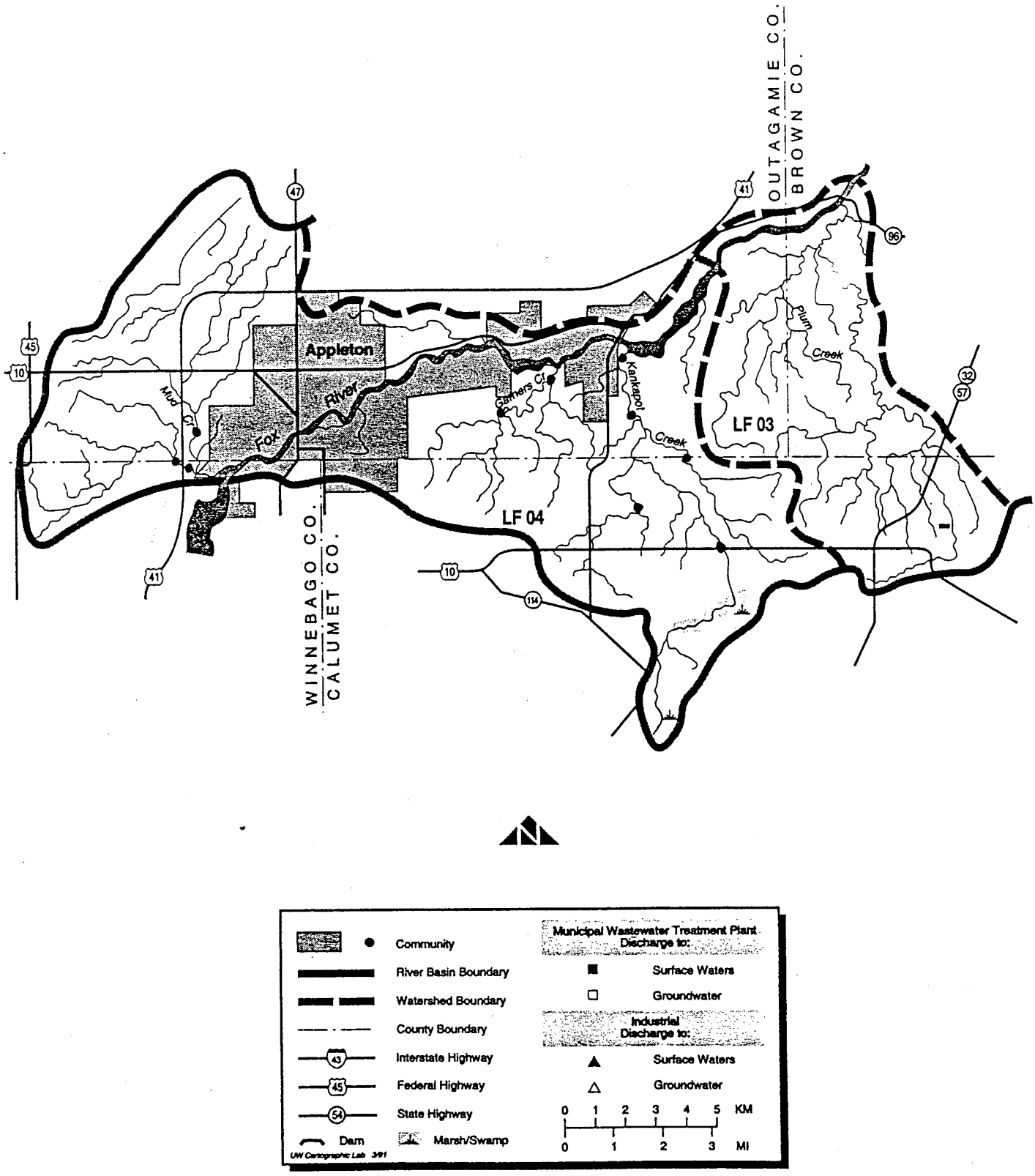
Stream habitat conditions were evaluated throughout the watershed in the spring, summer, and fall and recorded on the Stream Habitat Evaluation Form (Ball, 1982).

Aquatic macroinvertebrates were collected in spring and fall 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 (Hilsenhoff, 1987).

Fish surveys were conducted to determine fish communities in Garners and Mud Creeks. Using a backpack shocker, fish were collected and counted from a stream reach approximately 35 to 40 times the site channel width. Fish species were evaluated using United States Environmental Protection Agency "Rapid Bioassessment Protocols for use in Stream and Rivers: Benthic Macroinvertebrates and Fish" (1989) which gives the species relative ability to tolerate environmental degradation.

# Plum Creek (LF 03) and Fox River - Appleton (LF04) Watersheds

Figure 1



## III. RESULTS AND DISCUSSION

A summary of habitat evaluation results, biotic index results, and existing and potential stream classifications for the major streams in the Fox River - Appleton watershed are presented in Table 1. Event nutrient loading results are presented in Tables 2 through 4. Stream monitoring locations are indicated on Figure 1 and fish survey results are shown in Table 5. Following is a discussion of results for each of the major watershed streams.

Kankapot Creek and its tributaries:

Stream habitat in these creeks were rated as fair to poor. The heavy clay soils that cover the stream bottom provide very little habitat for fish and other aquatic life. Pools are generally filled in and riffles are uncommon. The stream banks are eroded and slumping in many places probably due to flooding. Gully erosion is common from roadway drainages.

Macroinvertebrate samples indicate fair to poor water quality with fairly significant to very significant organic pollution. Lack of suitable habitat is the most significant limiting factor for abundance and diversity of macroinvertebrates in these streams.

Kankapot Creek receives a considerable amount of nutrients, suspended solids, and bacteria as indicated by the high concentrations during each of the five runoff sampling periods (Table 2).

Based on these results and the streams characteristics, I do not believe Kankapot Creek's present stream classification of limited forage fish community could be upgraded with management practices. Low stream flow is a major limiting factor for aquatic life in Kankapot Creek.

Garners Creek and its tributaries:

Stream habitat in these creeks were rated as fair to poor. Streambank erosion and failure is common with frequent slumping and raw areas from bank flooding. Gravel, rubble, and other stable habitat lie under a layer of clay sediment and many of the pools are filled in. Filamentous algae covers the rocks and bottom substrate in shallow exposed areas.

In rural portions of the watershed, row crops border stream banks. Garners Creek travels a short distance through an urban area before entering the Fox River.

Macroinvertebrate samples indicate fair to poor water quality with organic pollution fairly significant to very significant.

Garners Creek watershed streams are very flashy. During rain events the creek flow increases and recedes very fast. Stream flows were practically non-existent in July and August (flows approximately 0.2 cfs). The water is generally not as turbid as Kankapot Creek.

A very brief fish survey was conducted in August in a stretch of creek near Hartjes Road. One large pollution tolerant rough fish (Carp) was found in a deep pool area and one tolerant sportfish (Green Sunfish) was present, but by far, the most abundant fish present was tolerant forage species such as Emerald Shiners, White Suckers, Bluntnose Minnows, and Creek Chubs (Table 5).

Garners Creek receives a considerable amount of suspended solids and bacteria during runoff events as indicated in each of the five runoff samples collected. Dissolved phosphorus and chlorides were slightly elevated on two occasions (Table 3).

Based on these results, I believe Garners Creek's existing and potential biological use should be classified as limited forage fish community.

Mud Creek and its tributaries:

The headwaters of Mud Creek originate in rural area but the creek travels a significant distance through urban area before discharging into the Fox River.

Stream habitat in these creeks were rated as fair to poor. Streambank erosion is infrequent, however there are some raw areas with high erosion potential during high flows. The stream substrate is mostly rubble, gravel or other stable habitat but covered with a layer of fine clay sediment.

Construction activities near the creek mouth appear to be contributing a significant amount of sediment to the creek. In July, a plume could be seen in the receiving waterbody from a particular construction site.

Macrophytes are abundant but generally not over abundant. Filamentous algae is common on the rocky bottom substrate where exposed to sunlight.

Macroinvertebrate samples indicate fair to poor water quality with fairly significant to very significant organic pollution.

A brief fish survey was conducted in August in a stretch of creek near Spencer Road. One tolerant sportfish (Green Sunfish), two intermediate tolerance fish (Johnny Darter), and abundant tolerant forage species (Emerald Shiners, White Suckers, and Brook Stickleback) were present.

Mud Creek receives a considerable amount of suspended solids during three of the five runoff events sampled. Chlorides are slightly elevated but ammonia and biochemical oxygen demand are within acceptable ranges (Table 4).

Based on these results, I believe these streams are currently meeting their potential biological use.

## IV. CONCLUSION

Aquatic life is limited in the Fox River - Appleton watershed because of several factors. Flashy streams and very low flows in the summer prevent high quality habitat for aquatic organisms. The soil type in the area cause turbid waters and limits desirable rooted aquatic plants. Although nutrient runoff has contributed to the algae problems in the streams and sediment has blanketed the stream bed, I believe nonpoint source management practices would not significantly improve the aquatic life habitat because of the streams existing characteristics. However, a reduction of sediment, nutrients, and bacteria loading to the watershed streams would significantly decrease the pollutant loading to the Fox River.

## V. REFERENCES

Ball, Joe. (1982). Stream Classification Guidelines for Wisconsin. Wisconsin Department of Natural Resources.

Wisconsin Department of Natural Resources. (1988). Field Procedures Manual: Sample Handling and Preservation Handbook. Draft 2nd Edition.

Wisconsin Department of Natural Resources, Lake Michigan District Water Quality Files.

Hilsenhoff, William. (1987). An Improved Biotic Index of Organic Stream Pollution.

Wisconsin Department of Natural Resources. (1991). Lower Fox River Basin Water Quality Management Plan.

United States Environmental Protection Agency. (1989). Rapid Bioassessment Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish.

## Table 3. Garners Creek Event Nutrient Loadings -- 1992

| Date | Flow cfs | Tot-P mg/l | Ortho-P mg/l | Sus. Solids mg/l | Vol. SS mg/l | $NH_3$-N mg/l | $NO_2+NO_3$ mg/l | TKN mg/l | BOD mg/l | Chloride mg/l | MFCC /100 ml | Fecal Strep /100 ml | Temp °C | D.O. mg/l | pH su |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13/92 | 0.81 | 0.24 | 0.051 | 111 | 13 | 0.106 | 1.47 | 0.9 | 2.7 | 43 | 3600 | 14000 | 17.7 | 8.2 | 7.88 |
| 7/14/92 | 5.97 | 0.35 | 0.188 | 83 | 10 | 0.214 | 2.87 | 2.2 | 4.4 | 150 | 16000 | 10000 | 17.0 | 9.3 | 7.9 |
| 9/10/92 | 0.56 | 0.17 | 0.046 | 44 | 8 | 0.048 | 1.48 | 0.8 | 2.6 | 33 | n/a | n/a | 14.1 | 9.4 | 7.90 |
| 9/15/92 | 2.76 | 0.32 | 0.195 | 53 | 7 | 0.100 | 1.13 | 1.1 | 2.8 | 54 | 22000 | 6700 | 17.9 | 8.4 | 7.78 |
| 11/02/92 | n/a | 1.00 | 0.41 | 430 | 48 | 0.128 | 2.26 | 2.6 | 11.0 | 22 | 16000 | 52000 | 4.5 | n/a | n/a |

| Date | Flow cfs | Tot-P lb/day | Tot-P $lb/mi^2$ | Tot-P g/hect | Ortho-P lb/day | Ortho-P $lb/mi^2$ | Ortho-P g/hect | Sus. Sol. lb/day | Sus. Sol. $lb/mi^2$ | Sus. Sol. g/hect | O-P as % of T-P | Vol SS as % of TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13/92 | 0.81 | 1.05 | 0.09 | 0.16 | 0.22 | 0.02 | 0.03 | 485.51 | 42.97 | 75.26 | 21.25 | 11.71 |
| 7/14/92 | 5.97 | 11.28 | 1.00 | 1.75 | 6.06 | 0.54 | 0.94 | 2,675.75 | 236.79 | 414.78 | 53.71 | 12.05 |
| 9/10/92 | 0.56 | 0.51 | 0.05 | 0.08 | 0.14 | 0.01 | 0.02 | 133.06 | 11.78 | 20.63 | 27.06 | 18.18 |
| 9/15/92 | 2.76 | 4.77 | 0.42 | 0.74 | 2.91 | 0.26 | 0.45 | 789.91 | 69.90 | 122.45 | 60.93 | 13.21 |
| 11/2/92 | n/a | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 41.00 | 11.16 |

Garners Creek at Hartjes Road drains approximately 11.3 square miles or 7232 acres.[1]

[1]Source: *Drainage Area Data For Wisconsin Streams*, USGS Open-File Report 83-933, pg 83.

## Table 4. Mud Creek Event Nutrient Loadings -- 1992

| Date | Flow cfs | Tot-P mg/l | Ortho-P mg/l | Sus. Solids mg/l | Vol. SS mg/l | $NH_3$-N mg/l | $NO_2+NO_3$ mg/l | TKN mg/l | BOD mg/l | Chloride mg/l | MFCC /100 ml | Fecal Strep /100 ml | Temp °C | D.O mg/l | pH su |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13/92 | 2.85 | 0.20 | 0.044 | 48 | 10 | 0.113 | 0.400 | 1.1 | 3.2 | 56 | 4100 | 9200 | 18.8 | 7.4 | 7.90 |
| *7/29/92 | 0.84 | 0.07 | 0.021 | 10 | 6 | 0.049 | 0.143 | 0.4 | <1 | 48 | n/a | n/a | 19.0 | 7.2 | 8.1 |
| 9/10/92 | 1.89 | 0.08 | 0.017 | 17 | 5 | 0.091 | 0.284 | 0.5 | 2.3 | 51 | n/a | n/a | 16.0 | 8.7 | 7.87 |
| 9/15/92 | 13.57 | 0.19 | 0.087 | 49 | 9 | 0.083 | 0.403 | 0.8 | 2.3 | 49 | 5400 | 5600 | 18.4 | 7.8 | 7.73 |
| 11/02/92 | 87.52 | 0.36 | 0.189 | 112 | 18 | 0.077 | 1.00 | 1.2 | 5.7 | 36 | 4500 | 21000 | 5.5 | 11.0 | n/a |

| Date | Flow cfs | Tot-P lb/day | Tot-P lb/mi$^2$ | Tot-P g/hect | Ortho-P lb/day | Ortho-P lb/mi$^2$ | Ortho-P g/hect | Sus. Sol. lb/day | Sus. Sol. lb/mi$^2$ | Sus. Sol. g/hect | O-P as % of T-P | Vol SS as % of TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13/92 | 2.85 | 3.08 | 0.30 | 0.52 | 0.68 | 0.07 | 0.11 | 738.72 | 71.03 | 124.42 | 22.00 | 20.83 |
| *7/29/92 | 0.84 | 0.32 | 0.03 | 0.05 | 0.10 | 0.01 | 0.02 | 45.36 | 4.36 | 7.64 | 30.00 | 60.00 |
| 9/10/92 | 1.89 | 0.82 | 0.08 | 0.14 | 0.17 | 0.02 | 0.03 | 173.50 | 16.68 | 29.22 | 21.25 | 29.41 |
| 9/15/92 | 13.57 | 13.92 | 1.34 | 2.34 | 6.38 | 0.61 | 1.07 | 3,590.62 | 345.25 | 604.77 | 45.79 | 18.37 |
| 11/2/92 | 87.52 | 170.14 | 16.36 | 28.66 | 89.32 | 8.59 | 15.04 | 52,932.10 | 5,089.63 | 8,915.40 | 52.50 | 16.07 |

Mud Creek at Spencer Road drains 10.4 square miles or 6656 acres.[1]

[1]Source: *Drainage Area Data For Wisconsin Streams*, USGS Open-File Report 83-933, pg 83. Note: Value is approximate as the source lists the nearest site as CTH "V" draining 10.4 mi$^2$.

*Note: Results from 7/29 can be considered non-event data.

Table 1. Water Resource Conditions for Stream in the Fox River - Appleton Watershed

| Stream | Location | Habitat Rating[1] | | | Biotic Index[2] | | Stream Class[3] | Potential use class[4] | Meeting Stream Class[5] |
|---|---|---|---|---|---|---|---|---|---|
| | | Spring | Summer | Fall | Spring | Fall | | | |
| Kankapot Creek | CTH CE | fair/194 | poor/217 | poor/228 | fairly poor/7.44 | poor/7.98 | LFF | LFF | yes |
| Kankapot Creek | CTH KK | fair/181 | ____ | ____ | poor/7.98 | ____ | LFF | LFF | yes |
| Kankapot Creek | CTH Z | fair/178 | ____ | ____ | ____ | ____ | LFF | LFF | yes |
| Trib to Kankapot Creek | Military Road | fair/199 | ____ | ____ | fair/6.42 | ____ | Unknown | LFF | n/a |
| Trib to Kankapot Creek | Schmidt Road | poor/212 | ____ | ____ | poor/7.70 | ____ | Unknown | LFF | n/a |
| Garners Creek | Brookhaven Road | fair/198 | poor/227 | poor/239 | fair/6.49 | poor/7.96 | Unknown | LFF | n/a |
| Garners Creek | Hartjes Road | poor/200 | ____ | poor/223 | fairly poor/7.12 | fairly poor/7.17 | Unknown | LFF | n/a |
| Mud Creek | Spencer Road | fair/177 | fair/199 | fair/197 | fairly poor/7.14 | fair/6.50 | WWSF | WWSF | yes |
| Mud Creek | CTH BB | poor/209 | ____ | ____ | ____ | ____ | WWSF | WWSF | yes |
| Trib to Mud Creek | Upstream of CTH BB | poor/213 | ____ | fair/193 | poor/7.91 | poor/7.98 | Unknown | LFF | n/a |

1. Habitat Rating:
   - <70 ..... excellent habitat
   - 71 - 129 ..... good habitat
   - 130 -200 ..... fair habitat
   - >200 ..... poor habitat

2. Hilsenhoff Biotic Index (HBI):

| Biotic Index | Water Quality | Degree of Organic Pollution |
|---|---|---|
| 0-3.50 | Excellent | No apparent organic pollution |
| 3.51-4.50 | Very good | Possible slight organic pollution |
| 4.51-5.50 | Good | Some organic pollution |
| 5.51-6.50 | Fair | Fairly significant organic pollution |
| 6.51-7.50 | Fairly poor | Significant organic pollution |
| 7.51-8.50 | Poor | Very significant organic pollution |
| 8.51-10.0 | Very poor | Severe organic pollution |

3. Stream Class: This indicates the formal stream classification as listed in NR102 and NR104.
   - WWSF - warm water sport fish communities
   - WWFF - warm water forage fish communities
   - LFF - limited forage fish communities
   - FAL - fish and aquatic life stream not formally classified, but assumed to be meeting Federal Clean Water Act goals

4. Potential Use Class: This indicates the biological use a stream could achieve if it was well managed and pollution sources were controlled.

5. Meeting Stream Class: This indicates if the stream is or is not meeting its formal stream classification. N/A means not applicable since the stream has not been formally classified.

## Table 2. Kankapot Creek Event Nutrient Loadings -- 1992

| Date | Flow cfs | Tot-P mg/l | Ortho-P mg/l | Sus. Solids mg/l | Vol. SS mg/l | $NH_3$-N mg/l | $NO_2+NO_3$ mg/l | Tot Kjel-N mg/l | BOD mg/l | MFCC /100 ml | Fecal Strep /100 ml | Temp °C | D.O. mg/l | pH su |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13/92 | 0.36 | 0.44 | 0.154 | 72 | 12 | 1.04 | 0.624 | 1.7 | 4.0 | 5400 | 7400 | 18.4 | 6.5 | 7.66 |
| 7/14/92 | 6.12 | 1.16 | 0.73 | 122 | 18 | 0.362 | 10.8 | 4.2 | 7.2 | >40000 | 27000 | 16.5 | 8.8 | 7.8 |
| 9/10/92 | 0.15 | 0.78 | 0.139 | 70 | 20 | 0.502 | 0.090 | 2.7 | 6.3 | n/a | n/a | 14.0 | 7.0 | 7.38 |
| 9/15/92 | 1.37 | 2.31 | 1.80 | 130 | 22 | 0.184 | 0.837 | 2.6 | 4.9 | 67000 | 17500 | 17.7 | 6.7 | 7.61 |
| 11/02/92 | n/a | 1.87 | 1.06 | 408 | 68 | 1.00 | 4.42 | 5.9 | 9.0 | 3900 | 400000 | 4.5 | 11.0 | n/a |

| Date | Flow cfs | Tot-P lb/day | Tot-P $lb/mi^2$ | Tot-P g/hect | Ortho-P lb/day | Ortho-P $lb/mi^2$ | Ortho-P g/hect | Sus. Sol. lb/day | Sus. Sol. $lb/mi^2$ | Sus. Sol. g/hect | O-P as % of T-P | Vol SS as % of TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/13/92 | 0.36 | 0.86 | 0.03 | 0.06 | 0.30 | 0.01 | 0.02 | 139.97 | 5.60 | 9.81 | 35.00 | 16.67 |
| 7/14/92 | 6.12 | 38.34 | 1.53 | 2.69 | 24.13 | 0.97 | 1.69 | 4,031.86 | 161.27 | 282.50 | 62.93 | 14.75 |
| 9/10/92 | 0.15 | 0.63 | 0.03 | 0.04 | 0.11 | 0.00 | 0.01 | 56.70 | 2.27 | 3.97 | 17.82 | 28.57 |
| 9/15/92 | 1.37 | 17.09 | 0.68 | 1.20 | 13.32 | 0.53 | 0.93 | 961.74 | 38.47 | 67.39 | 77.92 | 16.92 |
| 11/2/92 | n/a | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 56.68 | 16.67 |

Kankapot Creek at County Trunk "CE" drains approximately 25.0 square miles or 16000 acres.[1]

[1]Source: *Drainage Area Data For Wisconsin Streams*, USGS Open-File Report 83-933, pg 83. Note: Value is approximate as the source lists the nearest site as CTH "Z" draining 25.4 $mi^2$ which is 1.5 miles downstream from CTH "CE".

**Table 5.**

FISH ASSESSMENT RESULTS

| Species | Number Present Garners[1] | Mud[2] | Tolerance[3] |
|---|---|---|---|
| Emerald Shiner | 55 | 40 | tolerant forage fish |
| White Sucker | 19 | 4 | tolerant forage fish |
| Bluntnose Minnow | 1 | -- | tolerant forage fish |
| Brook Stickleback | -- | 3 | tolerant forage fish |
| Creek Chub | 1 | -- | tolerant forage fish |
| Green Sunfish | 1 | 1 | tolerant sportfish |
| Carp | 1 | -- | tolerant rough fish |
| Johnny Darter | -- | 2 | intermediate tolerance fish |

1 Garners Creek at Hartjes Road.
2 Mud Creek at Spencer Road.
3 Ability of species to tolerate environmental degradation and severe environmental conditions.