down to mouth of Garfoot Creek. Each of these management areas have slightly different concerns.

A. Mouth of Brewery Creek to CTH KP. At the sampling station at CTH P at the upstream extreme of this section, dissolved oxygen levels decreased to 5 mg/l in 19 out of 21 days in June 1985. A similar situation occurred the next year. During one major storm event, dissolved oxygen dropped to 3 mg/l.(15) The BOD concentration during this storm was 5.5 mg/l. On February 22, 1985, USGS collected a BOD sample at the CTH P automated monitoring site during a runoff event. At that time, rain fell on frozen ground with manure visible on fields and barnyards. The level of BOD in this sample was 16 mg/l. Department staff are concerned that this level of BOD in spring runoff could adversely impact the trout hatch in Black Earth Creek.

Water quality impacts associated with inputs to the stream from Brewery Creek are evident in this stream segment. Elevated stream temperatures, suspended solids loads, and organic enrichment from Brewery Creek may account for the increased macrophyte growth and the appearance of sago pondweed and filamentous algae in this stream segment.

Phosphorus monitoring at three sampling sites on Black Earth Creek above the Cross Plains WWTP revealed a mean total phosphorus concentration of 0.06 mg/l. Soluble phosphorus upstream of the WWTP was 0.02 mg/l. Monitoring was also conducted at 3 sites downstream on Black Earth Creek below the WWTP. Levels of both total phosphorus and soluble phosphorus were substantially higher. The mean total phosphorus concentration was 0.13 mg/l while the mean soluble phosphorus concentration was 0.10 mg/l. (1,11,12,13)

Aquatic insect populations in Black Earth Creek from its confluence with Brewery Creek downstream to CTH KP are dominated by chironomids. Chironomids are small aquatic worms that are more adapted to living in sediment covered substrate than other types of aquatic insects. The abundance of chironomids favors smaller trout. Larger trout need more food energy from larger and more varied types of aquatic insects.(13)

Significant sediment deposition occurs in the lower end of this stream segment. Channelization, sedimentation and organic enrichment contribute to habitat for aquatic organisms that is less than optimum in this stream segment.

B. CTH KP through the "Horseshoe". The "Horseshoe" is the nickname given to the section of Black Earth Creek downstream of CTH KP. Here Black Earth Creek flows north of State Highway 14 in a loop that looks very much like a horseshoe on a map.

Within a mile and a half traveling west on State Highway 14, the creek has changed orientation and flows south of the highway. The Cross Plains sewage treatment plant effluent enters the creek in this stream segment.

Historically, this segment experienced numerous fish kills (starting in July of 1963) due to the poor effluent quality of the old Cross Plains wastewater treatment plant.(4) A dramatic improvement in levels of dissolved oxygen occurred after Cross Plains upgraded its sewage treatment plant.

Levels of dissolved phosphorus significantly increase in the stream below the Cross Plains wastewater treatment plant discharge (see discussion of phosphorus monitoring results above). A discussion of the Cross Plains wastewater treatment plant and the phosphorus levels upstream and downstream of the plant is included in Chapter 4 of this plan.

Habitat in this stream segment is good for trout and the macroinvertebrates trout like to eat. Gravel substrate predominates and the aquatic vegetation is rooted versus filamentous algae found in the previous segment.(13)

C. "Horseshoe" Downstream to mouth of Garfoot Creek. An unnamed tributary (1250100) draining 5.8 of the 7.6 square miles in the subwatershed enters Black Earth Creek in the lower section of this stream segment. The unnamed tributary appears to support trout in its lower reaches. Habitat for trout is less than optimum in this segment of Black Earth Creek. Resuspension of sediment in the water column occurs all summer long and negatively impacts feeding for trout. Also, covering of the bottom substrate decreases food production (macroinvertebrates) and decreases suitable sites for reproduction.

Water Resources Objectives

A. Mouth of Brewery Creek to CTH KP.

1. Maintain a class I trout fishery (FALT (A) Class I) in this stream segment by:

- increasing dissolved oxygen levels
- reducing sedimentation

Water Resources Objectives (cont.)

- decreasing organic loading

2. Improve habitat to reduce macrophyte-caused dissolved oxygen sags and to reduce sedimentation.

3. Reduce sediment and oxygen demanding substances by 50%.

B. CTH KP through the "Horseshoe"

1. Maintain a class I trout fishery (FALT (A) Class I) in this stream segment by:

   - reducing sedimentation

   - decreasing organic loading

2. Reduce sediment and oxygen demanding substances by 50%.

C. "Horseshoe" Downstream to mouth of Garfoot Creek

1. Maintain a class I trout fishery (FALT (A) Class I) in this stream segment by:

   - reducing sedimentation

   - decreasing organic loading

2. Reduce sediment and oxygen demanding substances by 50%.

Pollutants from Nonpoint Sources

Eroding Croplands (sediment and nutrients). Nearly all (80-to-90%) of the sediment reaching Black Earth Creek from this subwatershed is from eroding croplands. Based on soil erosion estimates, Table 6 shows about 87% is from croplands with very high erosion rates (greater than about 10-to-15 tons/acre/year) and about 2% is from croplands with high erosion rates (greater than about 7-to-10 tons/acre/year). Table 6 also shows that

these very high/high erosion cropland fields comprise about 35% of the croplands. Locations of these critical croplands are shown on Figure 8. Overall, they comprise about 20% of the area of the subwatershed.

TABLE 6. Cropland Soil Erosion in Black Earth Creek Brewery to Garfoot Subwatershed.

Erosion Rate		Tons/year	%
> 10	tons/acre/yr.	30,864	87
7-to-10	tons/acre/yr.	589	2
4-to-7	tons/acre/yr.	989	3
< 4	tons/acre/yr.	2,928	8
totals		35,370	100
Erosion Rate		**Acres**	**%**
> 10	tons/acre/yr.	881	33
7-to-10	tons/acre/yr.	56	2
4-to-7	tons/acre/yr.	157	6
< 4	tons/acre/yr.	1,546	59
totals		2,640	100

Eroding and Trampled Stream Banks (sediment and direct habitat impairment). Generally, there is little stream bank erosion on Black Earth Creek in this subwatershed. Eroding sites are scattered. A slumping bank was identified near the old dam site in the Village of Cross Plains. Slumping banks also were identified just downstream of the second STH 14 bridge west of the Village of Cross Plains.

Animal Lots (oxygen demand and nutrients). Manure from animal lots and winter spread fields are the most probable source of oxygen demanding substances. Table 7 shows the number of animal

lots and pollutant loads by range of phosphorus load. Locations of these animal lots are shown on Figure 8.

TABLE 7. Animal Lot Pollutant Loads for Black Earth Creek - Brewery to Garfoot subwatershed.

Phosphorus Load Range	Operations	Lbs. *	%
> 20 lbs. phosphorus **	3	114	80
15-to-20 lbs. phosphorus	0	0	0
10-to-15 lbs. phosphorus	0	0	0
5-to-10 lbs. phosphorus	2	15	10
< 5 lbs. phosphorus	6	14	10
Total	11	143	100

* Pounds for a 10-year, 24-hour storm

** Phosphorus is used as an indicator of the amount of manure reaching streams. The amount of BOD or COD is proportional to the amount of phosphorus.

Winter Spread Manure (oxygen demand and nutrients). Winter spread manure was not analyzed. However, based on the erodibility of the soils and the steepness of slopes, it is likely a number of the 11 livestock operations in this subwatershed are sources of manure to the stream from winter spread sites.

Construction Sites (sediment and nutrients). Construction in this subwatershed during 1986, 1987 and 1988 consisted primarily of new homes in the village of Cross Plains. About 5-to-6 years ago, subdivision development within the village near Brewery Creek caused substantial amounts of sediment to reach Black Earth Creek. On an average, about 5 acres per year are developed in the Village of Cross Plains within this subwatershed. Given an average rate of sediment delivery of 28 tons per disturbed area, between 5 and 10% of the sediment reaching Brewery Creek is from construction sites.

Urban Lands (sediment and nutrients). Most of the Village of Cross Plains within this subwatershed is in medium density residential development. The amount of nutrients carried in runoff from these medium density residential lands is probably not significant to the water quality of Black Earth Creek if the streets are swept regularly.

Nonpoint Source Control Needs to meet the Water Resources Objectives

To achieve the water resources objectives identified for Black Earth Creek, the nonpoint sources identified below must be controlled. Each type of source and its control need is briefly described and discussed.

1. Cropland Management Needs:

   Erosion needs to be controlled on an estimated 937 acres of cropland.

The cropland analysis estimated about 80-to-90% of the tons of erosion occurs on fields with very high or high erosion rates (greater than 10-to-15 tons/acre/year and 7-to-10 tons/acre/year). These very high/high erosion rates occur on about 937 acres.

2. Stream Bank Management Needs:

   Slumping stream banks should be controlled to protect fish habitat.

The stability of the stream banks varies from year to year. Generally, there are few sites in this subwatershed. However, slumping banks result in widening of the stream and degradation of the fish habitat.

3. Animal Lot Management Needs:

   The amount of manure from animal lot runoff needs to be reduced on 5 of the 11 operations.

Based on the simulation of runoff controls, it is estimated that a 75% reduction can be achieved by reducing the amount of phosphorus on the 5 of 11 operations with estimated amounts of 5 or more pounds.

4. Manure Spreading Management Needs:

   Manure spreading management plans need to be prepared for the 11 livestock operations to minimize the amount of manure entering the stream.

Although the amount of manure from this source and significant sites could not be identified, the existence of the very high oxygen demand levels during trout hatch periods warrants control of this type of nonpoint source.

5. Construction Site Management Needs:

Sediment and other pollutants from construction sites need to be controlled.

The Village of Cross Plains is expanding in this subwatershed south of Black Earth Creek along Bourbon Road. With the very high rates of sediment delivery to the stream, construction sites will continue to be a significant source of pollutants. The construction site erosion control on anticipated sites will fall within the jurisdictions of the Village of Cross Plains.

Fishery Management and Other Resource Needs

1. Habitat Improvement Needs:

The stream habitat from above CTH P downstream to CTH KP within the Village of Cross Plains needs improvement.

As stated above, this stream segment has problems caused by sediment and aquatic vegetation. The aquatic vegetation is causing dissolved oxygen levels to go below water quality standards. This segment is a part of one of two stretches identified by fish managers as most in need of habitat improvement. The objective of the habitat improvements is to decrease the amount of sediment on the stream bed and the aquatic vegetation density.

The Department should consider demonstrating and evaluating the tree planting in selected locations for shading areas of dense aquatic vegetation growth.

Studies of aquatic vegetation conducted by University of Wisconsin graduate students found lower densities of vegetation in stream segments shaded by trees.

2. Land Acquisition Needs:

Lands adjoining Black Earth Creek within this subwatershed need to be acquired to protect the trout waters.

Land acquisition along Black Earth Creek within this subwatershed has been an ongoing activity for many years. Substantial lands have been acquired by fee simple purchase or

by easement. Additional lands need to be acquired by purchase, rent or easement to further protect the trout waters. Seventeen parcels have been identified in this subwatershed and the next subwatershed downstream. Lands in this subwatershed rank second highest for acquisition in the Black Earth Creek watershed.

See also the discussion of base flow protection in Chapter 5 of this plan.

GARFOOT CREEK SUBWATERSHED - GC

Subwatershed Description

The Garfoot Creek subwatershed consists of a 6.0 square mile drainage area. Garfoot Creek (Master Waterbody ID # 1249900) and its unnamed tributaries are the major water resources of concern in this subwatershed. Garfoot Creek flows northerly for 3.8 miles before it meets Black Earth Creek about a half mile east of Salmo Pond. Land use in this subwatershed is entirely rural.

The whole subwatershed is under A-1 exclusive agricultural zoning. Overall the land use is:

agriculture	48%
woodlands	45%
wetlands	2%
incorporated (urban)	0%
other	5%

The other category includes roads and scattered residences.

Water Resources Conditions

As shown in Figure 9, currently the entire 3.8 stream miles of Garfoot Creek are classified as a Class II trout stream (FALT (A) Class II).(17) It has been suggested that the upper 1.8 stream miles are currently supporting a Class I trout stream.(7,16) Macroinvertebrate samples indicate very good water quality. However, on February 22, 1985, USGS collected a BOD sample at the Garfoot Creek automated monitoring site during a runoff event. At the time, rain fell on frozen ground with manure visible on fields and barnyards. The level of BOD in this sample was 22 mg/l. During a major storm on July 25, 1985, a water sample collected by USGS at the same site has a BOD concentration of 7.4 mg/l. The dissolved oxygen level during this storm dropped to 4.5 mg/l. The water quality standard for trout waters is 6 mg/l. Department staff are concerned that these levels of BOD in spring and summer runoff could adversely impact the trout in Garfoot Creek.(15)

The stream has a good gradient and optimum water temperatures to maintain good natural reproduction of trout. Habitat is limited by hydrologic modifications.(12) Many small farm ponds are

located along this stream. Department water resources and fisheries management staff are concerned these impoundments discharging to Garfoot Creek may decrease trout habitat and increase water temperatures. The actual temperature impact of these ponds needs to be determined before any management needs can be determined relative to the ponds. Currently, the DNR stocks 1500 fingerling brown trout in Garfoot Creek each year. Present fisheries management staff do not feel the lower 2.0 miles of Garfoot Creek can practically be upgraded from Class II to Class I because of the extent of habitat lost from stream bank trampling.

Water Resources Objectives

To maintain the Class II trout fishery in the lower 2.0 stream miles of Garfoot Creek and to maintain and improve conditions in the upper 1.8 stream miles to support a FALT (A) Class I classification by:

maintaining the baseflow of springs which sustain Garfoot Creek,

decreasing sedimentation of the stream, primarily in the lower 2.0 stream miles, and

decreasing the oxygen demand in the stream.

A 50% reduction in sediment and oxygen demanding (manure) substances is estimated as a target to meet these objectives.

Pollutants from Nonpoint Sources

Eroding Croplands (sediment and nutrients). Over 90% of the sediment reaching Garfoot Creek (and subsequently Black Earth Creek) from this subwatershed is from eroding croplands. Based on soil erosion estimates, Table 8 shows that about 89% is from croplands with very high erosion rates (greater than about 10-to-15 tons/acre/year) and about 2% is from croplands with high erosion rates (greater than about 7-to-10 tons/acre/year). Table 8 also shows these very high/high erosion cropland fields comprise about 37% of the croplands. Locations of these critical croplands are shown on Figure 9. Overall, they comprise about 18% of the area of the subwatershed.