

WATER QAULTY SURVEY
OF
THE HUNTSVILLE STP EFFLUENT
ON
TOWN BRANCH AND HOLMAN CREEK

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INTRODUCTION

A water quality investigation was conducted on Town Branch, the receiving stream of the Huntsville municipal wastewater treatment facility, and also on Holman Creek, the receiving stream of the Town Branch discharge, in order to determine the level of impact this discharge is having on the water quality and aquatic inhabitants of the receiving streams. This stream survey had a dual purpose--to address concerns of EPA regarding the ammonia nitrogen removal coefficient used in recent wasteload modeling, and to establish the need or value of a TMDL (total maximum daily load) for nutrients on Holman Creek. This investigation was conducted on July 20-22, 1992. A preliminary survey was completed on July 8 for the purpose of determining stream accessibility, the zone of impact from the STP effluent, and potential station locations. Another survey was conducted on September 14-15 for the purpose of collecting a second afternoon data set due to large effluent flow fluctuations encountered in the July survey. The flow variation is due to fluctuating discharges to the municipal system from the Swift poultry processing facility, which contributes a major portion of the total STP effluent volume.

GENERAL DISCUSSION

Waterway Description

Holman Creek has its origin approximately two miles south of the Huntsville city limits in the north central part of Madison County. It flows in a north-northeast direction to its confluence with War Eagle Creek three miles north of Huntsville. Holman Creek has a 27 square mile watershed at its mouth. At the confluence of Town Branch, there is approximately 16 square miles of drainage area. Town Branch originates one mile south of the city limits and flows through Huntsville to its confluence with Holman Creek one mile north of the city. This stream drains about five square miles at its mouth. The Huntsville municipal wastewater treatment facility discharges to Town Branch approximately one half mile above the Holman Creek confluence. The stream gradient for both streams at the study area is on the order of 20-25 feet/mile. The substrate composition of both streams consists predominantly of rubble and gravel. The pool/riffle ratio in the study area of Holman Creek was approximately 4 to 1, while Town Branch was closer to 2 to 1, due to the smaller watershed and higher stream gradient. There is an abundance of habitat cover available to both aquatic invertebrates and fish in both streams. At the time of the July survey, stream flow in Town Branch was measured at 0.82 cfs (cubic

feet per second), while the Holman Creek flow above the Town Branch confluence was 0.74 cfs.

Previous Studies

In October of 1982, the consulting firm of Roy F. Weston, Inc. was hired to conduct a water quality investigation for the purpose of determining the impact of the Huntsville STP on the water quality of the receiving stream and to project future effluent limitations that would maintain the water quality standards in existence at that time. At the time of this survey, the Huntsville wastewater treatment facility consisted of a two-stage trickling filter and was discharging a 0.577 MGD (million gallons per day) volume effluent averaging 35 mg/l BOD₅, 33 mg/l TSS when the poultry processing plant was in operation, and 13 mg/l BOD₅, 19 mg/l TSS when not in operation. This system was highly dynamic in terms of flow and water quality due to the poultry processing facility. Their dissolved oxygen analysis in Town Branch over the survey period revealed a minimum concentration of 5.1 mg/l with a maximum deficit of 4.2 mg/l. Stream temperatures ranged from seven degrees Centigrade at the upstream station to 15 degrees at the mouth of Town Branch Creek. Their conclusions stated that Town Branch was being impacted by the Huntsville STP effluent in terms of dissolved oxygen concentration, but that recovery was nearly complete at the Highway 23 bridge site on Holman Creek. Their recommendations were that an upgrade or replacement of the existing treatment facility would be necessary to achieve maintenance of the existing water quality standards of the receiving stream.

During October of 1985, McClelland Consulting Engineers initiated a use attainability analysis study on Town Branch Creek for the purpose of evaluating the designated beneficial uses assigned to this stream. They recommended that the primary contact use be deleted in Town Branch due to lack of continuous flow and shallow stream depth. A non-nuisance dissolved oxygen standard of 2 mg/l was proposed for the critical season, with a reclassification of this stream to a seasonal coolwater fishery, which has a dissolved oxygen standard of 6 mg/l for the seasonal period. The ADPCE water quality standards revision of 1988 reflected these proposals-not as a result of this study, but through a standards revision based on ecoregion studies, which stated that Ozark Highland streams having less than a 10 square mile watershed were assumed to have insufficient flow to support a fishery during the critical season. This revision also stated that if these streams had flows equal to one cfs during this time frame, including discharger flows, then the stream is assumed to support a fishery with the applicable dissolved oxygen standard. By 1988, the Huntsville facility design flow had surpassed the stream flow requirement; thus Town Branch was classified as a perennial fishery and the STP facility was required to provide wastewater treatment sufficient to maintain the dissolved oxygen standard of 5 mg/l at temperatures exceeding 22°C., and a 6 mg/l standard at temperatures less than 22°C.

On August 26, 1987, personnel from the ADPC&E ecology section performed a macroinvertebrate survey of Holman Creek above and below the confluence of Town Branch in order to assess the impact of the Huntsville municipal wastewater effluent on the benthic community. The Huntsville site is one of many ADPC&E biomonitoring locations designed to assess the impact of known pollutant sources on the quality of the receiving stream. The stations surveyed in 1987 coincide with two of the 1992 survey sites. The ADPC&E rapid bioassessment protocol was used in each of the surveys so a direct comparison of the benthic community can be made. The findings of each of these surveys will be addressed in the results section of this report.

Land Use

Based on aerial photographs of the study area, approximately 35 percent of the Town Branch-Holman Creek watershed has been converted to agricultural uses--predominantly pasturelands for cattle grazing. Approximately 60 percent of the watershed is still forested, but in the lower portion where the terrain is less steep, pastures border Holman Creek on both sides. Poultry production houses are scattered throughout the watershed, but there is no record of confined swine operations within the Holman Creek watershed. The waste products from poultry production are periodically applied to pasturelands. A small amount of acreage has been converted to urban usage, with the largest area in and around Huntsville.

Geology

Holman Creek and its tributaries lie within the Springfield Plateau of the Ozark Highlands ecoregion. The geology of this drainage is characterized by Pitkin Limestone, Fayetteville Shale and Batesville Sandstone. Soil types in the survey area are dominated by the Ceda-Leachville-Cleora Association. This soil association is characterized by being deep, level to gently sloping, well-drained to moderately well-drained, loamy, gravelly and cobbly soils that formed in alluvium derived mainly from sandstone, siltstone and shale.

Water Quality Standards And Beneficial Uses

Holman Creek, which drains a 16 mi² watershed above the Town Branch confluence, is classified as an Ozark Highlands mid-size watershed perennial fishery, and as such, has an applicable dissolved oxygen standard of 5 mg/l, with a 1 mg/l diurnal fluctuation being allowed for no longer than 8 hours in a 24 hour period when the stream temperature exceeds 22 degrees Centigrade. At stream temperatures of 22 degrees C. or less, a 6 mg/l standard generally applies. The exception to this is during the March through May time frame when the stream temperature is 10 degrees or less, and the stream flow exceeds 15 cfs. At these conditions, the dissolved oxygen standard

is 6.5 mg/l. The Town Branch tributary would normally be classified as a small watershed seasonal fishery with an applicable dissolved oxygen standard of 2 mg/l at temperatures above 22°C; however, due to the volume of the wastewater discharge from the Huntsville facility, the next higher watershed category applies. Thus, Town Branch has the same dissolved oxygen standard as Holman Creek.

Designated beneficial uses of these streams, in addition to the previously mentioned fishery use, consist of primary (except for Town Branch) and secondary contact recreation-which includes wading, canoeing, fishing, and swimming-as well as a source of water for domestic, industrial and agricultural uses.

DATA ACQUISITION

During the afternoon of July 8, 1992, ADPC&E personnel arrived at the Town Branch-Holman Creek area for the purpose of locating stream access and to conduct a dissolved oxygen profile for determination of the impact area and length of the zone of recovery. Preliminary sampling stations were identified as a result of this investigation. The stream survey was initiated on the afternoon of July 20, 1992 when continuous dissolved oxygen meters were installed at three of the nine stream stations. On July 21, stream flows were measured at five sites, the physical characterization and habitat availability was evaluated, the time of travel was measured, and the afternoon water sample run was completed. The morning water sample run was completed on July 22, prior to calibrating and removing the continuous dissolved oxygen meters. The water samples were returned to the central laboratory for analysis. Macroinvertebrates were collected at one site on July 21 and at three other stream stations on July 22. Fish were collected at three sites on Holman Creek-one above the Town Branch confluence, one downstream of the confluence in the mixing zone and one farther downstream at a point where little impact from Town Branch could be detected. As was noted above, a second water sampling run was conducted on September 15, 1992, as a result of a large fluctuation in effluent flow on July 21 between the time of the dye study (305 gallons per minute) and initiation of the afternoon water sampling (70 gallons per minute). In order to detect maximum impact on the stream water quality from the effluent, it was decided to conduct a follow-up afternoon sampling event during a normal effluent flow period. Additional flow and time of travel measurements were conducted during this survey.

Parameters

In addition to the biological samples, the water samples were analyzed for dissolved oxygen, temperature, pH, flow, chlorides, total organic carbon (TOC), five day biochemical oxygen demand (BOD5), total suspended solids (TSS), total dissolved solids (TDS), ammonia nitrogen (NH3N), nitrite + nitrate nitrogen (NO2+NO3),

orthophosphate, and total phosphate. The results of the water chemistry analyses for all three sampling events conducted during the 1992 survey are included as Appendix A.

Collection, Preservation And Measurements

Stream samples were collected, preserved, and analyzed according to the 16th Edition of Standard Methods for Examination of Water and Wastewater. Analysis was conducted under ADPC&E's existing Quality Assurance Program. Dissolved oxygen and stream temperature during sample collection were measured by a Y.S.I. Model 57 portable dissolved oxygen meter, which was calibrated by a Winkler titration prior to use. Three Model 56 continuous dissolved oxygen meters were used to determine diurnal variation in the dissolved oxygen concentration in Town Branch just above the Holman Creek confluence, approximately one half mile below the confluence at the Highway 23 bridge, and the third located another mile below this bridge at the last downstream station. Stream pH was analyzed by an Orion Model 230A portable pH meter, which was calibrated using buffer solutions of pH 4 and 7. Stream flow was measured using a Marsh-McBirney Model 201 meter by obtaining a representative number of velocities and depths across suitable stream locations. Flows were taken in Town Branch above and below the Huntsville STP outfall, at the mouth of Town Branch, immediately below the confluence of Holman Creek, at the Highway 23 bridge, and at the downstream location. Macroinvertebrate samples were collected at the same station locations, with the exception of the Town Branch locations above and below the STP. These samples were collected using an indestructible Turtox benthos net. An attempt was made to sample similar riffle habitats for five minutes at each site, in accordance with established protocol for rapid bioassessments. The fish community was sampled by use of a Smith-Root Model 15-A POW DC backpack electrofisher. Riffle areas were sampled by driving the fish into a seine, while the fish in the pools were collected by electroshocking favorable habitat areas.

Station Description

A total of four water chemistry stations were established on Town Branch, with an additional five stations on Holman Creek. These stations were selected for the purpose of determining any impacts from non-point source contaminants (upstream Holman Creek site), as well as assessing the impact from the Huntsville STP effluent on Town Branch and Holman Creek. Stations were spaced in order to determine any dissolved oxygen sag due to the effluent load on these streams. The station descriptions are as follows:

Station 1A. Town Branch above STP outfall

Station E. Huntsville STP outfall

Station 1B. Town Branch 50 yards below STP outfall

- Station 2.** Town Branch at STP bridge
- Station 3.** Town Branch 30 yards above Holman Creek
- Station 4A.** Holman Creek above confluence of Town Branch
- Station 4B.** Holman Creek 200 yards below confluence
- Station 5.** Holman Creek at Highway 23 bridge
- Station 6.** Holman Creek below Smyrna Branch, 1 mi. below # 5

Four stations were sampled for macroinvertebrates and three sites for fishes. These communities were analyzed on an upstream/downstream basis for determination of any adverse impacts from pollution sources on population diversity and density. Figures 1 and 2 provide the locations of water sampling stations, as well as areas sampled for aquatic life.

DATA RESULTS

Dissolved Oxygen

The dissolved oxygen profile was evaluated four times during the survey of Town Branch and Holman Creek. During the preliminary investigation the dissolved oxygen concentrations were at or above 100% saturation, with the exception of the upstream Holman Creek site (Station 4A at 79%) and the STP effluent (93%). Holman Creek above Town Branch was turbid during the preliminary survey; most likely due to runoff from an adjacent heavily grazed pasture. This D.O. profile was conducted during the early afternoon hours from 12:30 PM to 2:30 PM. Stream temperatures ranged from 27 to 29 degrees Centigrade, with the exception of Station 6 which was 24.5 degrees, indicating springwater influence. The second profile was taken during the afternoon water chemistry sampling effort on July 21. The saturation values were similar to the earlier profile, but with some reduction in saturation values between stations 2 & 3, which is a shaded portion of Town Branch. Saturation values dropped from supersaturated values just above and below the STP outfall to 93% at the mouth of this stream; indicating a reduction of photosynthetic activity in this stream region. This profile was measured in mid-afternoon during the peak photosynthetic hours. The low saturation station again was Holman Creek above Town Branch, with an 87% saturation. Stream temperatures were in the 29-31 degree range, with Station 6 measuring 24.5 degrees. The July 22 morning water sample run profile revealed a marked difference in dissolved oxygen saturation values. This run was made from 5:40 AM to 6:40 AM when dissolved oxygen concentrations are generally lowest. Saturation values in Town Branch ranged from 61% to 67%, while Holman Creek saturations were from 48% (Station 4A) to 60%. Stream temperatures ranged from 23-25 degrees

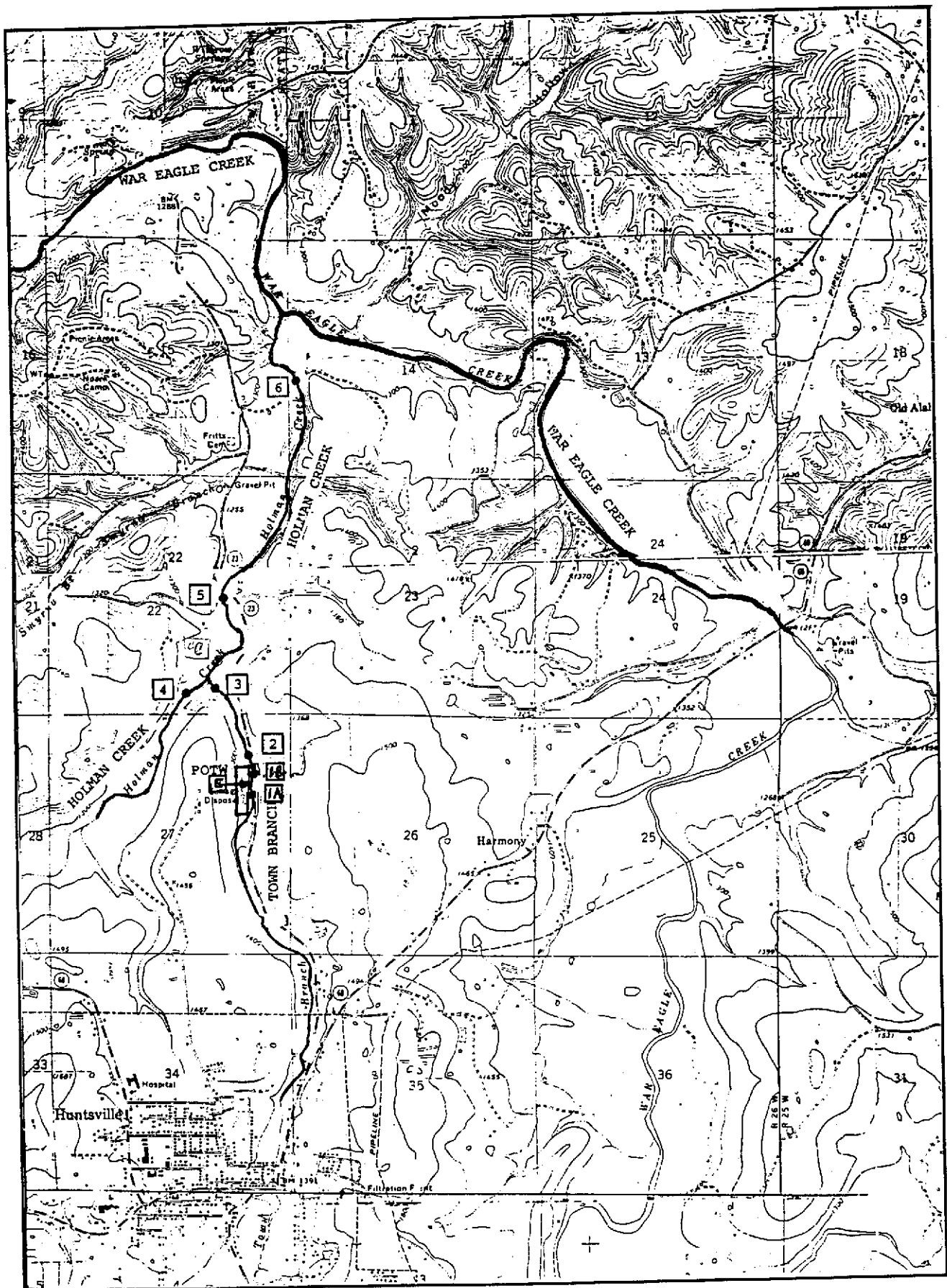
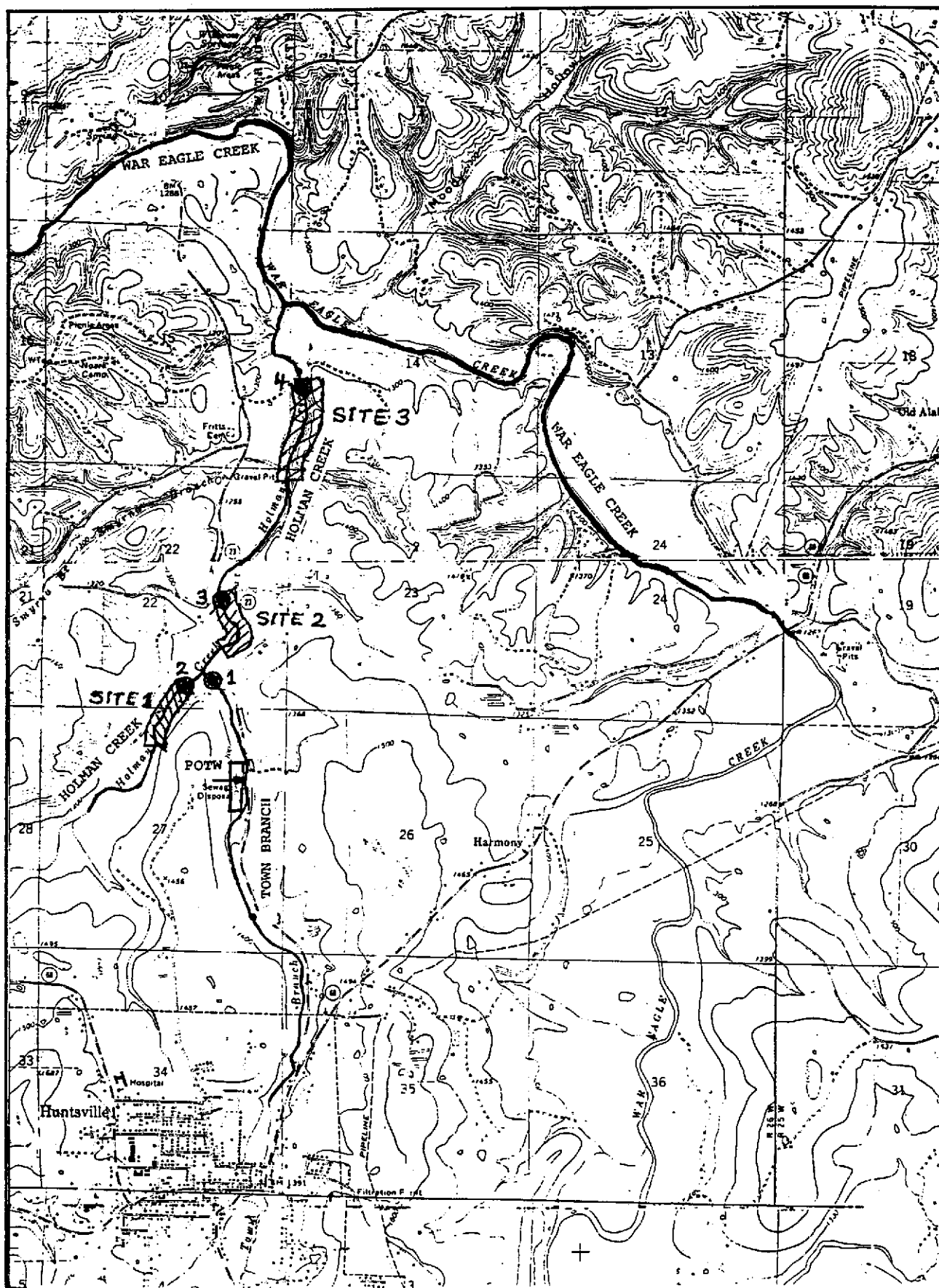


FIGURE 1 Huntsville Study Area



● Macroinvertebrate
 ▨ Fish
 FIGURE 2 Huntsville Study Area

Centigrade, except Station 6 (20.5 degrees). The fourth dissolved oxygen profile was conducted during the morning of September 15 from 9:30 AM to 12:00. Dissolved oxygen saturation values generally ranged from 90% to 100% during this time, indicating active photosynthesis. Station 4A on Holman Creek again had the lowest saturation at 67%. Stream temperatures ranged from 20 to 23 degrees Centigrade during this time frame.

Three continuous dissolved oxygen meters were used to get an accurate measurement of the diurnal fluctuation in both dissolved oxygen and stream temperature. A meter was placed near the mouth of Town Branch at Station 3, one was installed at Station 5 above the Highway 23 bridge, and the third meter was used at Station 6. Figures 3 and 4 show the dissolved oxygen fluctuation at Stations 3 and 5 during the July 20-22 survey. The Town Branch meter indicated a diurnal fluctuation of approximately 2 mg/l, while the Holman Creek site at Highway 23 had a fluctuation of 4 mg/l. Temperature fluctuations were similar at both stations--approximately 7 degrees. Figures 5 and 6 graphically depict the temperature variation at these two sites. The Station 6 meter malfunctioned, but portable meter readings indicated a diurnal fluctuation of 3.0 mg/l. The lower fluctuations at Stations 3 and 6 are likely due to depressed photosynthetic activity, but for different reasons. Station 3 receives flow that has been shaded during most of the daylight hours, resulting in lower maximum dissolved oxygen concentrations than at upstream and downstream stations. Station 6 receives a substantial flow supplement from groundwater via Smyrna Branch, thereby producing cooler stream temperatures at this station, again with lower maximum dissolved oxygen concentrations than at upstream stations. The Town Branch-Holman Creek diurnal fluctuation values are within the range of fluctuations recorded in the ecoregion study of the Ozark Highlands. Diurnal fluctuations of this magnitude generally reflect the land use patterns of this ecoregion--the predominance of pasturelands, poultry production, and subsequent land application of waste products from these activities. The increase in the diurnal fluctuation at Station 5 reflects the presence of optimum conditions for maximum photosynthetic activity--the presence of a nutrient source (both point and non-point), a location that receives ample sunlight and a substrate suitable for periphyton attachment.

pH And Temperature

Stream pH values measured during this survey were typical for streams in the Ozark Highlands ecoregion. The values ranged from 7.8 to 7.9 in Town Branch and averaged 7.6 in Holman Creek during the morning sample run, and were generally 8.0 to 8.7 during the afternoon run. The rise in pH is associated with the photosynthetic activity during this time frame. The lowest pH values were at Station 4A--the upstream Holman Creek site. This station remained turbid throughout the survey--a condition that

FIGURE 3

DISSOLVED OXYGEN, JULY 20, 21, 22, 1992 TOWN BRANCH, SITE #3

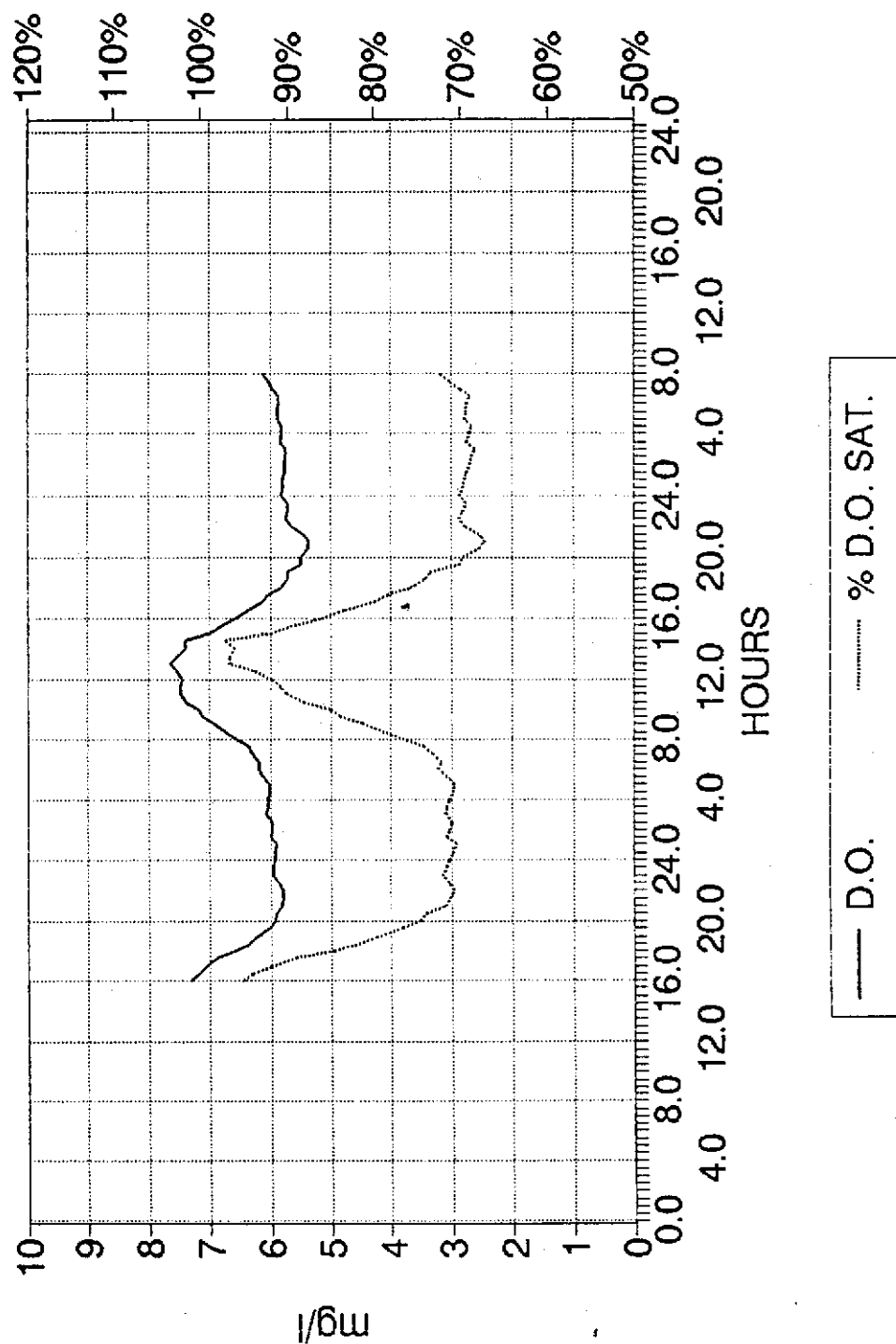


FIGURE 4

DISSOLVED OXYGEN, JULY 20, 21, 22, 1992
HOLMAN CREEK, SITE #5

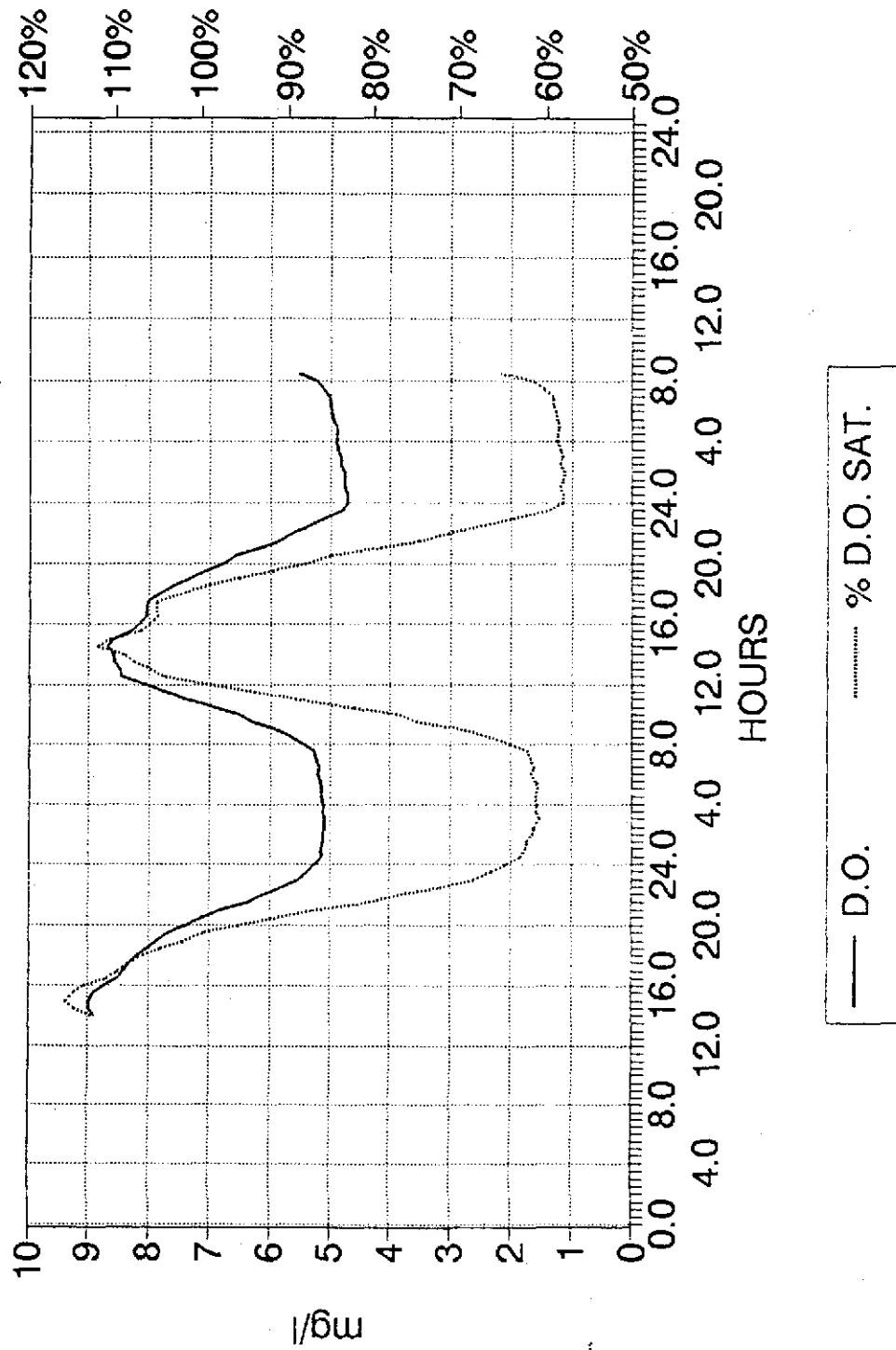


FIGURE 5

TEMPERATURE, JULY 20, 21, 22, 1992
TOWN BRANCH, SITE #3

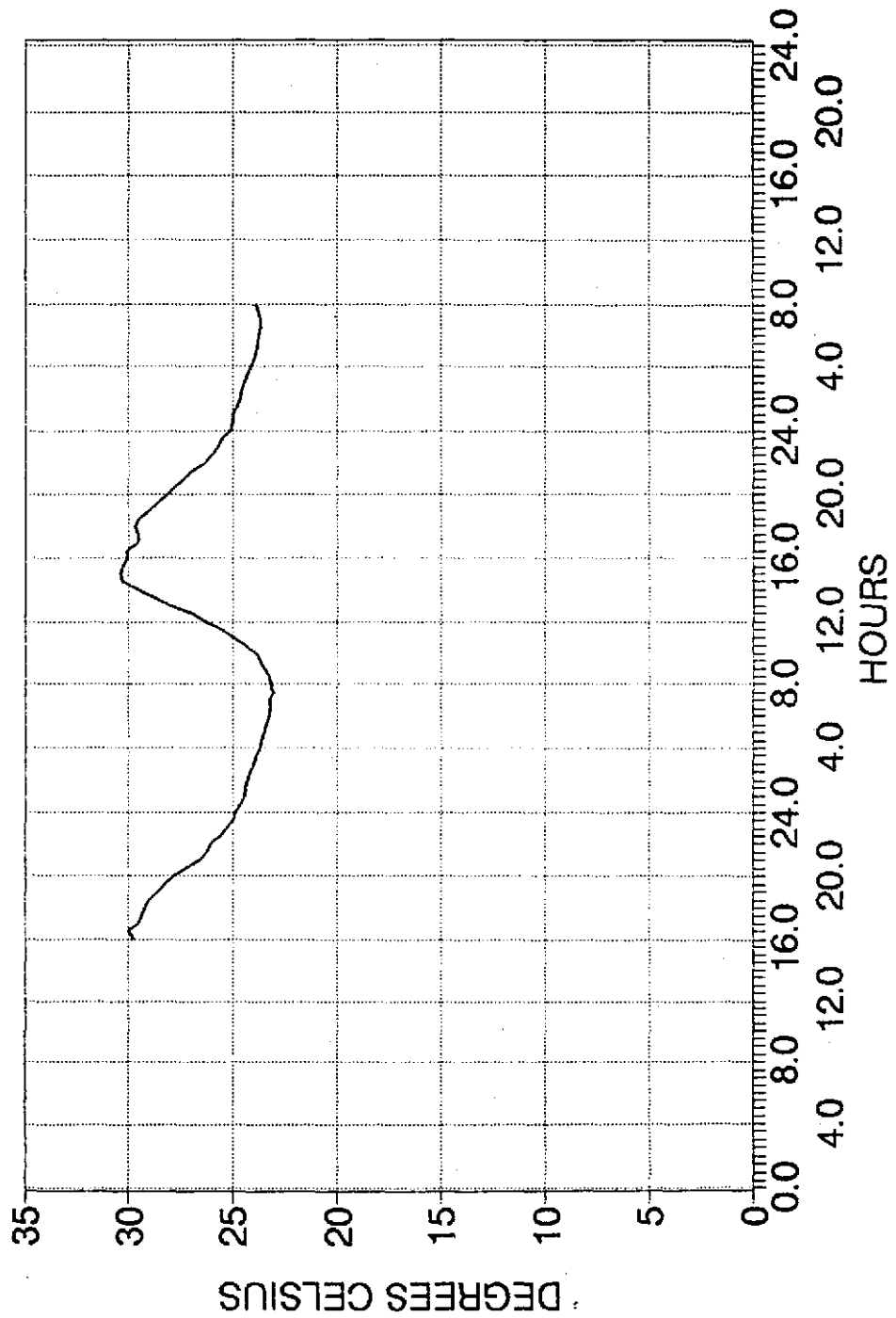
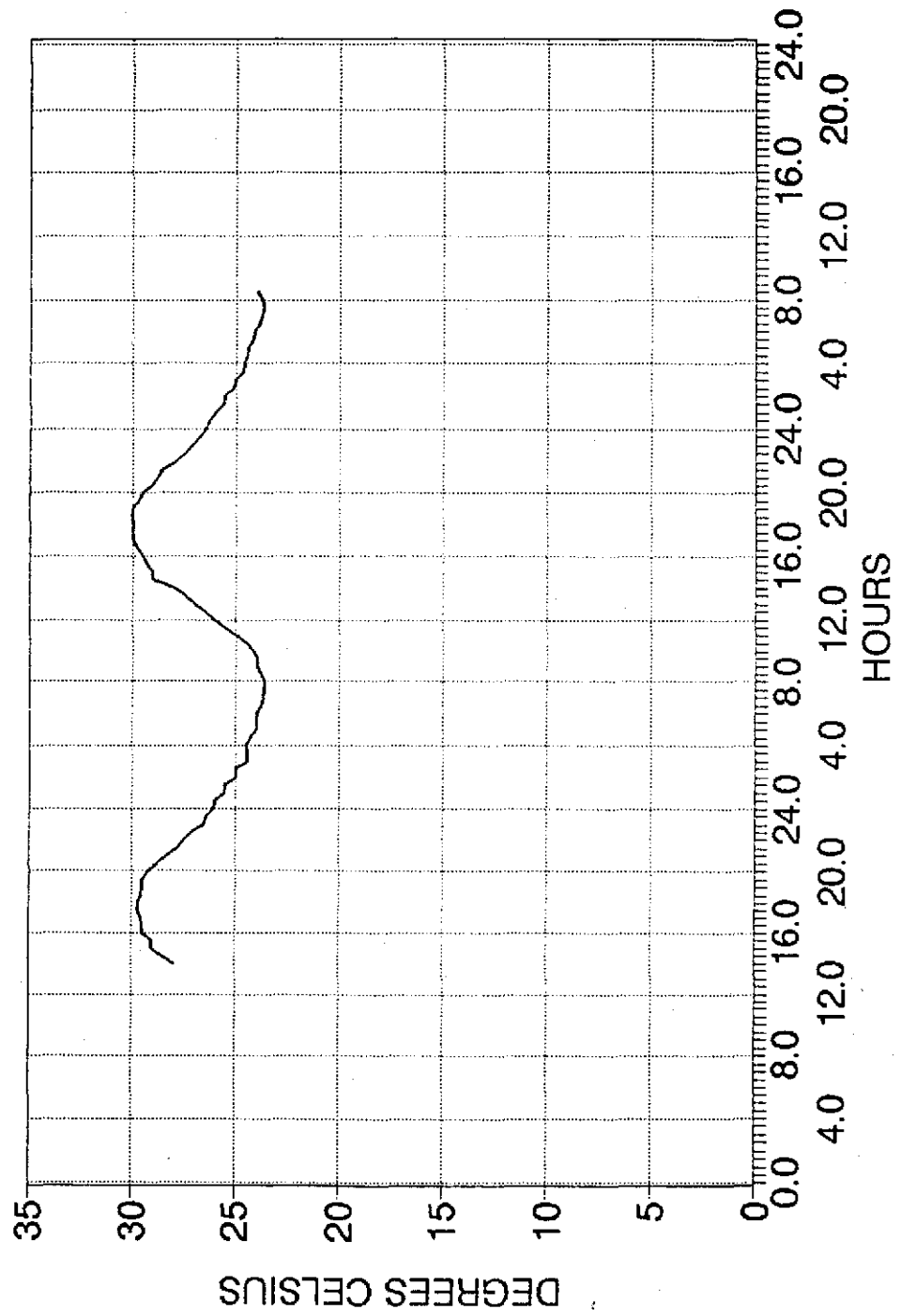


FIGURE 6

TEMPERATURE, JULY 20, 21, 22, 1992
HOLMAN CREEK, SITE #5



contributed to both depressed dissolved oxygen and pH values. The 1984 ecoregion evaluation indicated a summertime average pH of 7.6 for all size watersheds studied. The stream temperatures noted above were generally higher than those values measured in the ecoregion study. The ecoregion streams were surveyed in September, as opposed to this July survey. Also, karst geology is more prevalent in the ecoregion sites, with the exception of Station 6 on Holman Creek--the only groundwater influenced site noted in this survey. The small watershed and shallow depths are more conducive to greater temperature fluctuations, as noted earlier by the 7 degree variation between the dawn and mid-afternoon measurements.

Flow

According to USGS data Town Branch and Holman Creek at Huntsville have a Q7-10 of 0 cfs; however, small stream flows are generally present in these streams during the summer months. The October 1982 Weston survey measured 0.3 cfs above the STP. The 1985 McClelland study indicated upstream flow present during October. Stream flow was present during all visits during the 1992 survey--early and mid-July, and again in September. Town Branch above the STP had a flow of 0.82 cfs on July 21 and a flow of 1.43 cfs on September 15. Holman Creek above Town Branch had similar flows on both dates (0.75 and 2.5 cfs, respectively). The September flows were elevated due to rainfall in the watershed a few days prior to the sampling event. Stream flows encountered in the Town Branch-Holman Creek survey were also similar to flows measured in the ecoregion survey for small watersheds. A September 1983 flow of 1.4 cfs was measured below an 18 mi² South Fork Spavinaw Creek watershed. Effluent flows during the 1992 survey, though fluctuating at times, generally ranged from 1 to 1.5 cfs.

Chlorides, Sulfates, And Total Dissolved Solids

ADPC&E's routine water monitoring network has established one station on Holman Creek--at the Highway 23 bridge (WHI 70), located about 0.5 miles below the Town Branch confluence. This station, which was established for the purpose of monitoring the effects of the Huntsville STP effluent on water quality, corresponds to the 1992 survey station # 5. The 1992 biennial Water Quality Inventory Report (305-b) summarized two years of monthly samples from this site. The mean value for chlorides at this station was 52.8 mg/l, with a range from 6 mg/l to 297 mg/l. The 1983 ecoregion data indicates a "background" level of 8 mg/l for chlorides for small watershed streams. The three 1992 survey samples collected at this station had a mean value of 51.2 mg/l. In contrast, the upstream Holman Creek station (4A) averaged 5.6 mg/l, while the upstream Town Branch site (1A) averaged 9.3 mg/l. The three analyses from the STP samples averaged 134 mg/l--a 14-fold increase over background Town Branch concentrations.

Similar increases were noted in total dissolved solids. Storet data at WHI 70, listed as a two year summary in the 1992 305-b report, indicated a TDS range from 82 to 1125 mg/l, with a mean of 268.2 mg/l. TDS data at Station 5 averaged 283 mg/l for the three samples, while Station 4A averaged 127 mg/l. Station 1A was somewhat higher, with a mean value of 173 mg/l. Ecoregion data indicated an average value of 161 mg/l for all Ozark Highland watersheds studied. During the 1992 survey, the average TDS concentration of the STP effluent was 594 mg/l.

Sulfate concentrations in the Town Branch-Holman Creek watershed were relatively high as compared with background ecoregion data. The summertime ecoregion average for all watersheds surveyed was only 5 mg/l, with the small watersheds averaging only 1.5 mg/l. Contrasting these low numbers is the upstream Town Branch value of 16.8 mg/l and the upstream Holman Creek concentration of 14.6 mg/l. These high sulfates may reflect the nature of the watersheds drained--urban dominated for Town Branch, and pasture dominated for Holman Creek. The STP effluent averaged 30 mg/l during the survey, with dilution reducing the concentration to 20 mg/l at Station 5. The 1992 305-b data indicates an average concentration of 17.7 mg/l at WHI 70, with a range from 8 to 31 mg/l.

BOD, TSS, And Nutrients

As noted earlier, the 1982 Weston report recorded five day BOD's averaging 35 mg/l and total suspended solids of 33 mg/l when the Swift turkey processing plant was discharging to the municipal treatment facility. The Swift facility is currently generating 600,000 to 700,000 gallons of wastewater each day, which constitutes 85 to 90 percent of the total volume at the municipal treatment facility. While this poultry processor is operating 24 hours a day, seven days per week, occasional volume fluctuations are evident at the Huntsville STP. Shift changes and clean up operations are contributors to these flow changes. Periodic overloads from the processing plant create problems with treatment efficiency at the STP. An analysis of the BOD data from WHI 70 for the last ten years shows periodic high BOD values occurring at this site from 1983 to 1990. Although the average BOD5 for this time frame is 7 mg/l, several high values have been recorded, up to 77.7 mg/l in one instance. From 1990 to mid-1992, the BOD5 averaged 3 mg/l, with a high value of 8.4 mg/l. The 1992 survey data for Station 5 shows BOD₅'s of less than 1 mg/l, and an effluent BOD₅ averaging 1.1 mg/l. This data indicates obvious treatment improvement in BOD removal has occurred since 1990.

Total suspended solids data has generally been fairly low over the ten year record at WHI 70. Occasional high fluctuations can be attributed to rainfall events because high turbidity values occur simultaneously. Effluent TSS values during the 1992 survey were 2 mg/l. Station 5 TSS data averaged 5 mg/l during the survey. An

analysis of the nutrient data at the WHI 70 station indicated the occurrence of ammonia nitrogen and nitrate trends from 1984 to 1992. From 1984 to the last of 1989, ammonia nitrogen at this station averaged around 3 mg/l, with several values exceeding 10 mg/l. During the same time frame the nitrate nitrogen averaged 2.5 mg/l, again with occasional high values recorded (18.9 mg/l in one instance). In contrast to these values, the 1990 to 1992 concentrations at this station averaged 0.09 mg/l for ammonia nitrogen and 7.8 mg/l for nitrate nitrogen. A concentration of 36.8 mg/l nitrate nitrogen was recorded from the October, 1991 sample from this site. Although there are exceptions, generally when ammonia nitrogen concentrations are low, the nitrate values are elevated. This is evidenced by the 1990-1992 data from the WHI 70 station. The 1992 survey data also verifies this assumption. Effluent ammonia nitrogen averaged 0.2 mg/l for the three samples analyzed, while nitrate nitrogen averaged 19.2 mg/l. Stream dilution and utilization by vascular plants, algae and periphyton reduced these nutrients to less than 0.05 mg/l and 2.8 mg/l, respectively, for ammonia nitrogen and nitrate nitrogen at Station 5. Figures 7 and 8 provide the nitrate nitrogen concentrations and loadings from upstream in Town Branch down to Station 6 on Holman Creek.

There doesn't appear to be any definable pattern in phosphorus concentrations at WHI 70 over the ten year data base. Values range from 0.04 mg/l up to 5.0 mg/l at this stream site. The 5.0 mg/l concentration, measured in July 1991, also coincided with very high chlorides and total dissolved solids. This may reflect one of several untreated "slug" discharges entering the municipal treatment system from the poultry processor. These events continue to be a problem in that the the city plant is not designed to treat wastewater having pollutant loads of the magnitude encountered during these situations. The 1992 survey data indicated normal background levels of phosphorus (<0.05 mg/l) and also effluent concentrations generally representative of advanced treatment municipal systems, with an average of 6.8 mg/l for the three samples. Station 5 phosphorus concentrations averaged just over 1 mg/l during the survey period. Figures 9 and 10 gives an indication of the total phosphorus stream concentrations and loadings for the 1992 survey and indicates the rate of uptake and utilization from the effluent down to Station 6.

Macroinvertebrates

A total of four macroinvertebrate stations were established in the Town Branch-Holman Creek watershed for purpose of determining any impact on the benthic community from the Huntsville wastewater treatment plant effluent discharge. One site was located near the mouth of Town Branch, in the vicinity of Station 3. Another site was sampled on Holman Creek above the Town Branch confluence in order to assess the benthic community that receives no impact from the STP effluent. Two additional sites were established downstream

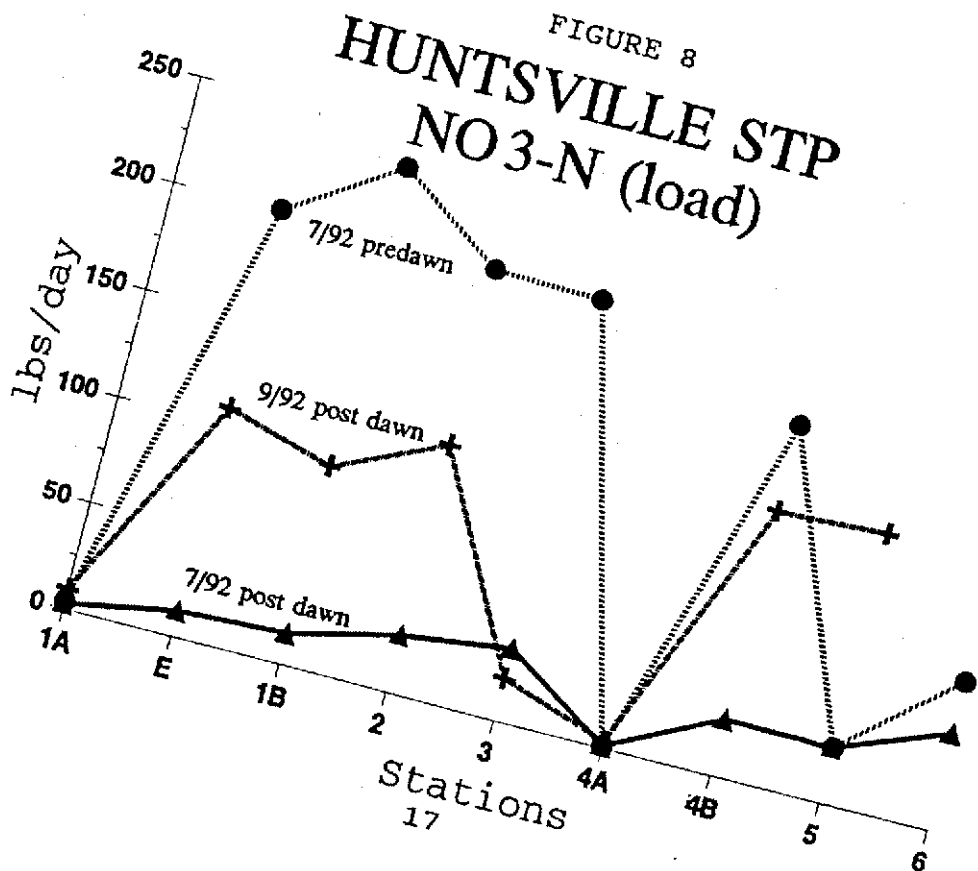
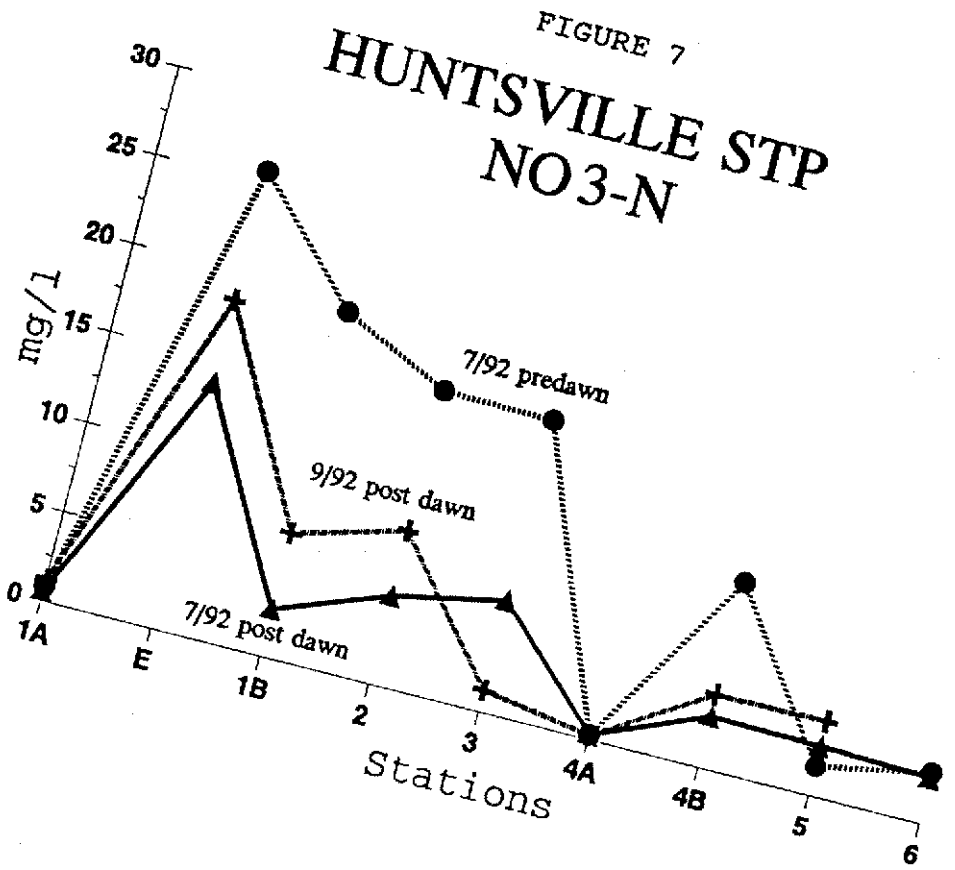


FIGURE 9

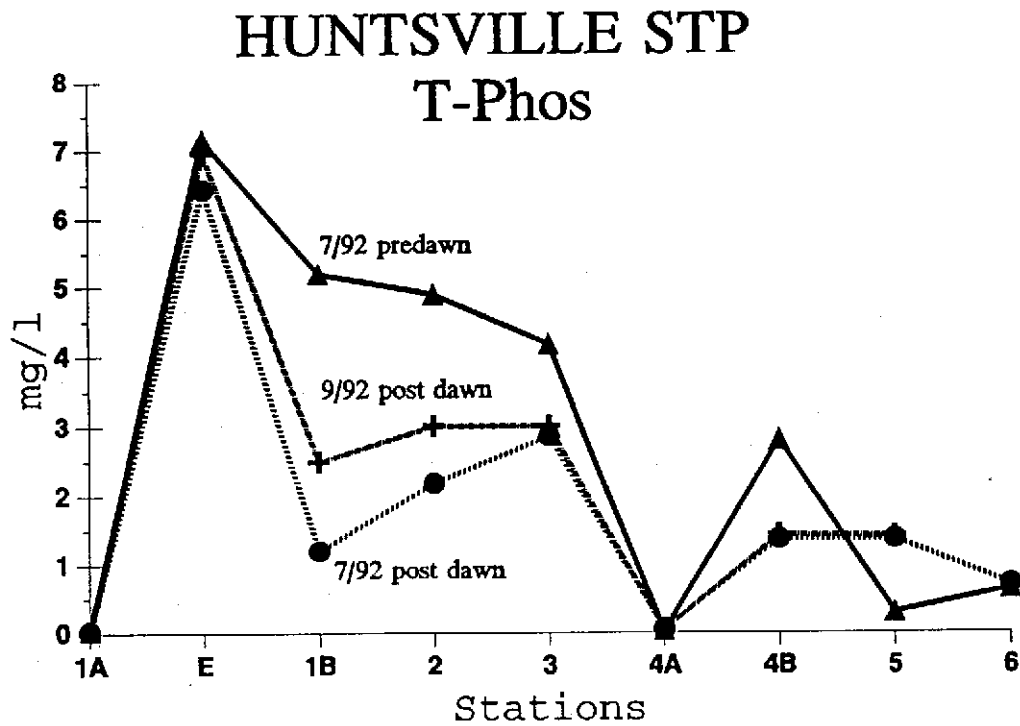
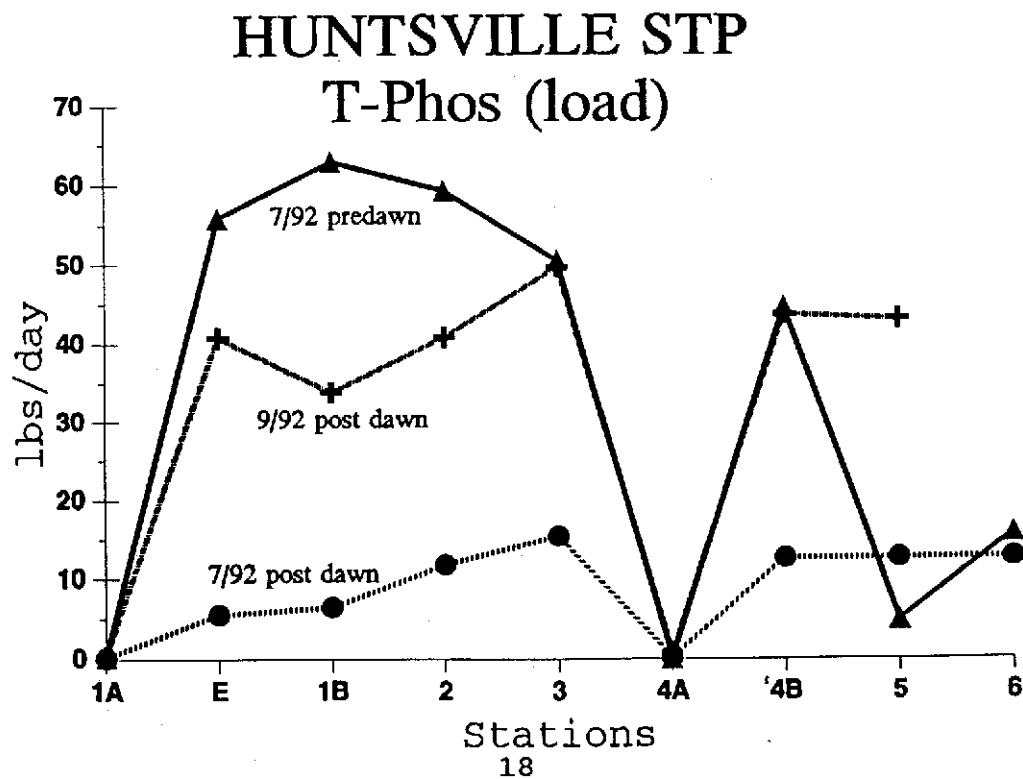


FIGURE 10



of Town Branch, at stream stations 5 and 6. As was noted previously, these sites were sampled according to established rapid bioassessment protocol, with a five minute riffle search performed at each location. One hundred organisms were randomly selected and preserved at each site, then identified in the central laboratory.

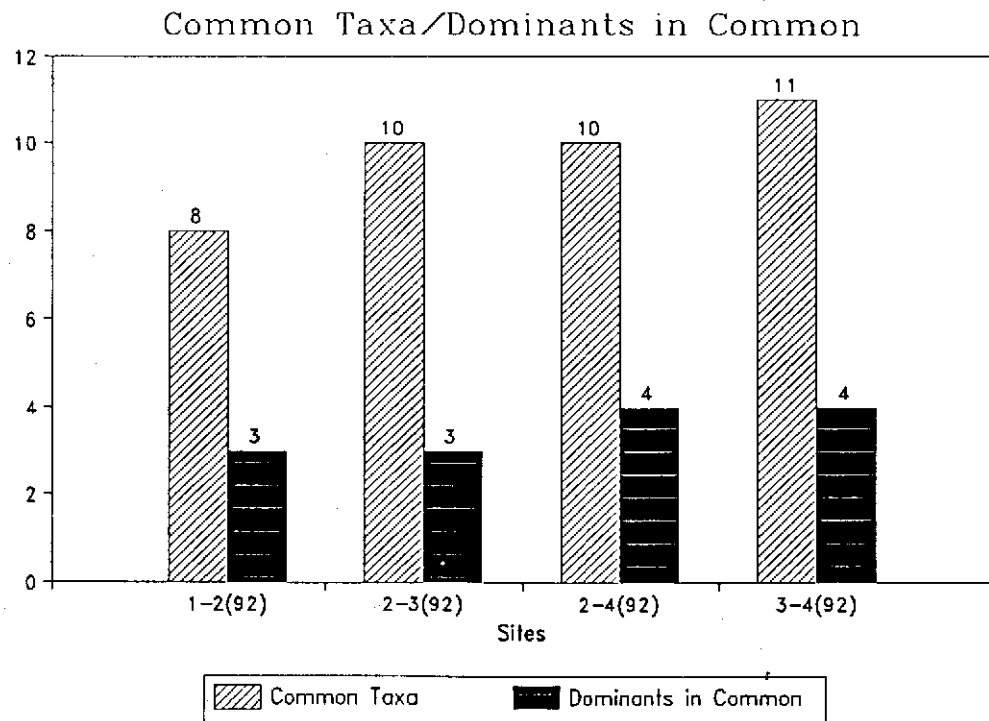
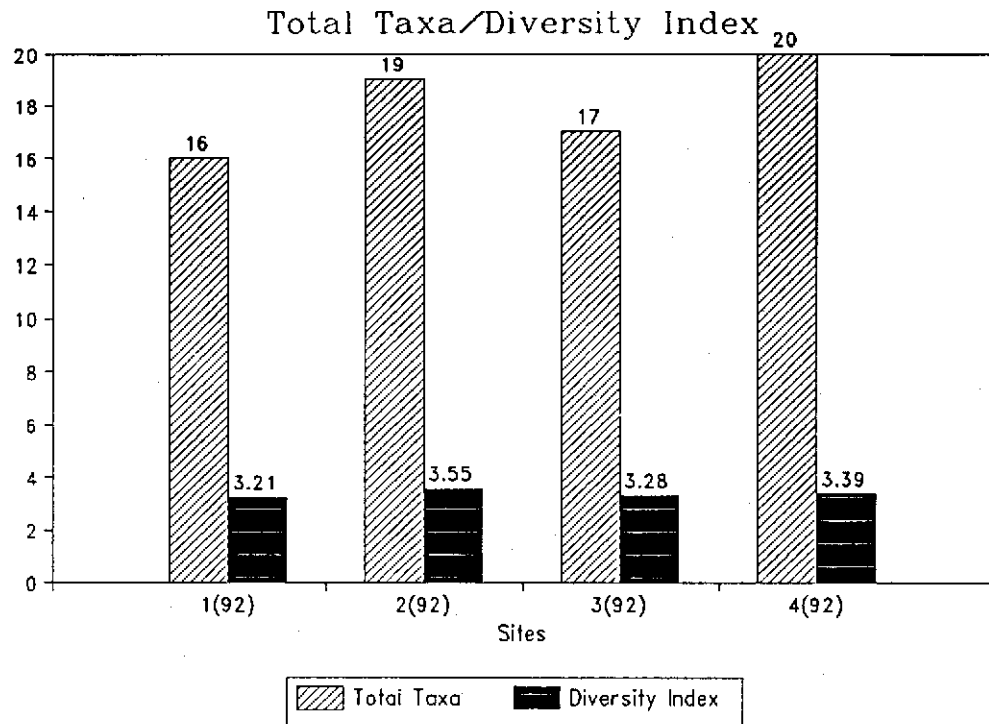
The extent of impairment of the benthic community below the wastewater discharge is determined by use of the biometric scoring system. This system, which assigns scores to various characteristics of the benthic community, can define relative change between communities upstream and downstream of a pollutant source. A mean biometric score is assigned to each community identifying its aquatic life use status, as determined by the extent of impairment ranging from none, minimal, substantial to excessive.

The biometrics evaluated from the 1992 survey data focus primarily on community diversity, and consist of Dominants in Common (DIC), Common Taxa Index (CTI), Quantitative Similarity Index (QSI) and Taxa Richness (Shackleford, 1988). Community comparisons were made between the Town Branch and upstream Holman Creek inhabitants (Stations 3 and 4A), upstream Holman Creek and Holman Creek at Highway 23 (Stations 4A and 5), upstream Holman Creek and Holman Creek below Smyrna Branch (Stations 4A and 6), and also between Station 5 and Station 6. Figure 2 identifies the sites where macroinvertebrate samples were collected. As might be expected, the Town Branch benthic community appears to be impacted more than the other three sites. This stream flow is consistently dominated by the municipal effluent, except possibly during rainfall events, so any type of deviations from the normal high quality effluent will be more visible at this site. A comparison of the benthic community from this site to that located at Station 4A--the background site on Holman Creek--revealed fewer taxa, a DIC value of 3, CTI of 0.42 and a QSI of 51. The DIC, CTI, and QSI values correspond to minimal impairment, substantial impairment, and substantial impairment, respectively. An evaluation of another metric--taxa richness--between these two sites indicates a difference of 15%, which is in the minimal impairment range.

Although rapid bioassessment metrics are designed to measure impacts above and below point source discharges (i.e. above and below Town Branch), some of the metrics evaluated for these two stations indicate a relatively healthy macroinvertebrate community existing in the "effluent stream". A benthic diversity index of 3.2 is also representative of a minimally impaired community. Further comparisons of Holman Creek benthic community structure above and below the confluence of Town Branch--the type situations that the RBA metrics are specifically designed to evaluate--are presented in Figures 11, 12 and 13. Metrics evaluated at these stations generally indicate minimal impairment, with a gradual improvement noted in the downstream direction. In these figures, stations 1-4 correspond to survey stations 3, 4A, 5, and 6. The

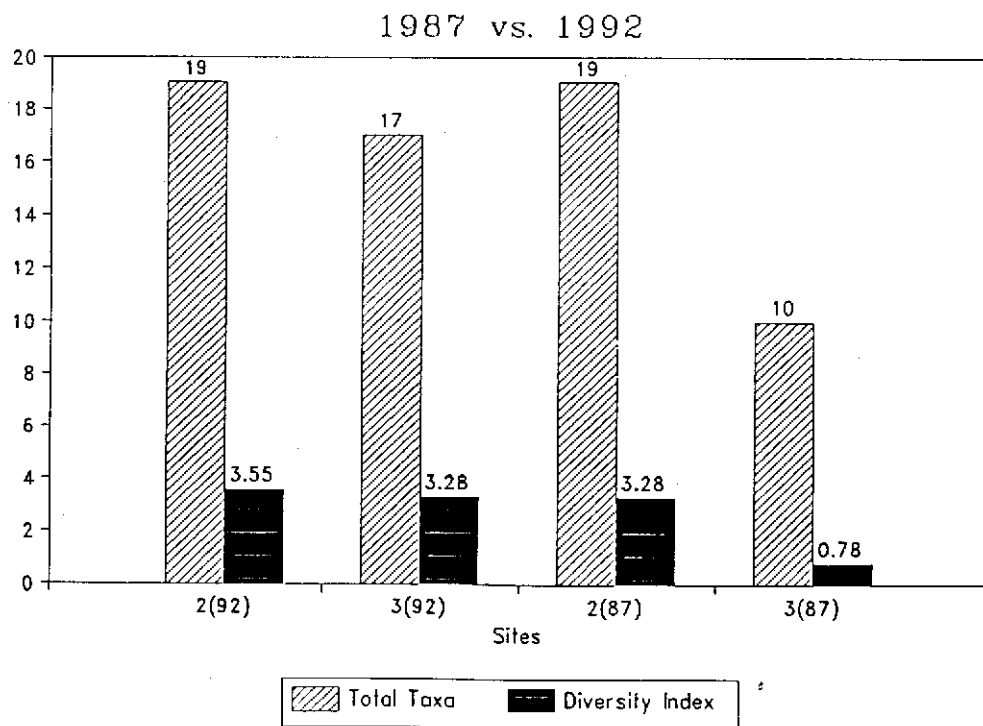
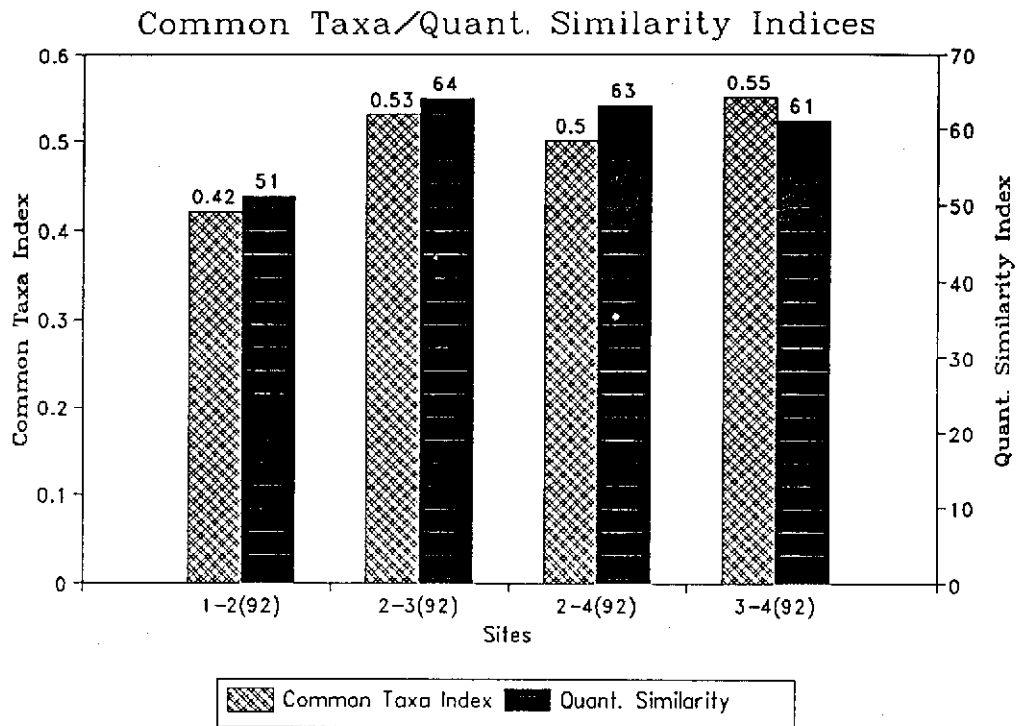
Macroinvertebrates

Figure 11



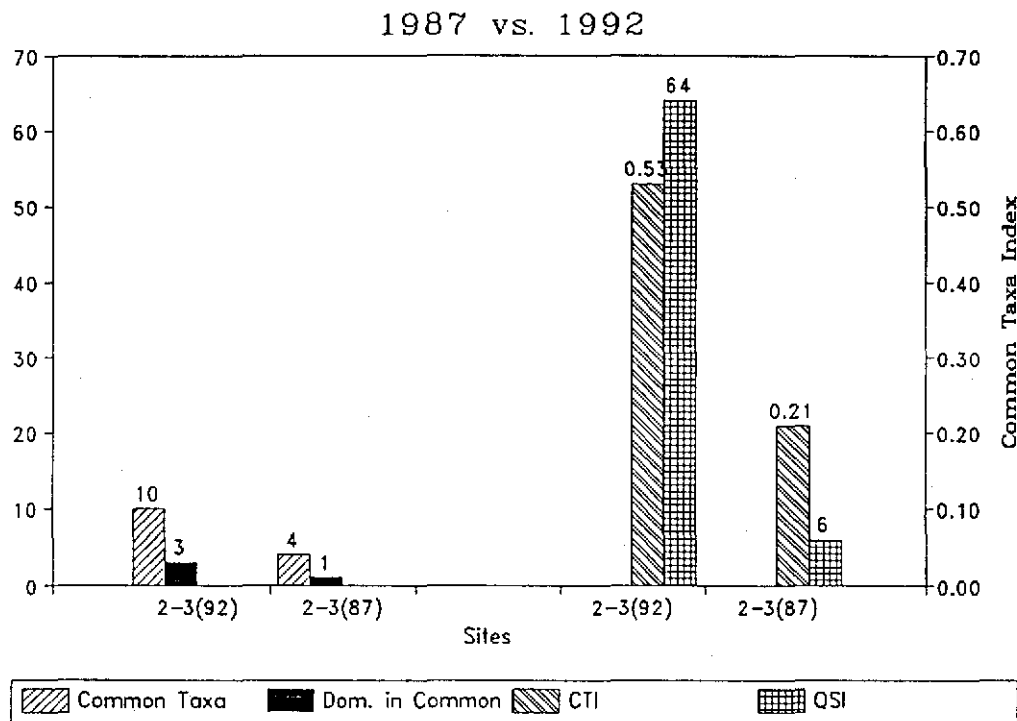
Macroinvertebrates

Figure 12



Macroinvertebrates

Figure 13



data displayed as 2-3 (87) on these figures are from a rapid bioassessment collection performed by ADPC&E ecologists during August of 1987. These sites were established on Holman Creek above and below Town Branch and correspond to Stations 4A and 5. Metrics evaluated for the benthic communities existing at that time indicated excessive impairment at the downstream site. A comparison of the 1987 community analyses with the 1992 analyses demonstrates a significant improvement in the downstream benthic assemblage in all the metrics evaluated. One of the more noticeable changes is in the Quantitative Similarity Index, which increased from 6 to 64, and also the Diversity Index, which rose from 0.78 to 3.28. The magnitude of the recovery of the benthic community at this site--from a severely impacted assemblage consisting of 90% bloodworms to one comprising a good diversity of pollution-intolerant organisms--indicates that if the sources of pollution are removed, or if an effective treatment of existing point sources is achieved, then streams can and do recover to a level supportive of growth and propagation of aquatic life. The benthic species lists and associated biometrics generated from this survey are included as Appendix B.

Fish Community

Fish communities were sampled at three locations in Holman Creek:

Site # 1--Holman Creek 100 yards above the confluence of Town Branch upstream for 1/4 mile.

Site # 2--Holman Creek at Highway 23 upstream to a point approximately 200 yards downstream of the Town Branch confluence.

Site # 3--Holman Creek at Station # 6 upstream 3/8 mile, to a point 1/8 mile above the Smyrna Creek confluence.

The fish sampling sites are depicted in Figure 2. Each site was sampled for approximately two hours using a Smith-Root backpack electrofisher. Riffle areas were sampled by placing a seine below the riffle and driving the fish into the seine by shocking and substrate manipulation. The larger specimens collected were identified, recorded, and released. Smaller specimens were preserved and returned to the central laboratory for counting and identification. Relative Abundance Values (Keith, 1987) were assigned to each species. Appendix C lists the species collected at each site and the relative abundance for each species. The relative abundance value is based on the numerical abundance of the species relative to the habitat and the typical abundance of the species. A value from one to four is assigned to the adult and the sub-adult segment of each species population. The maximum relative abundance value for any species is eight.

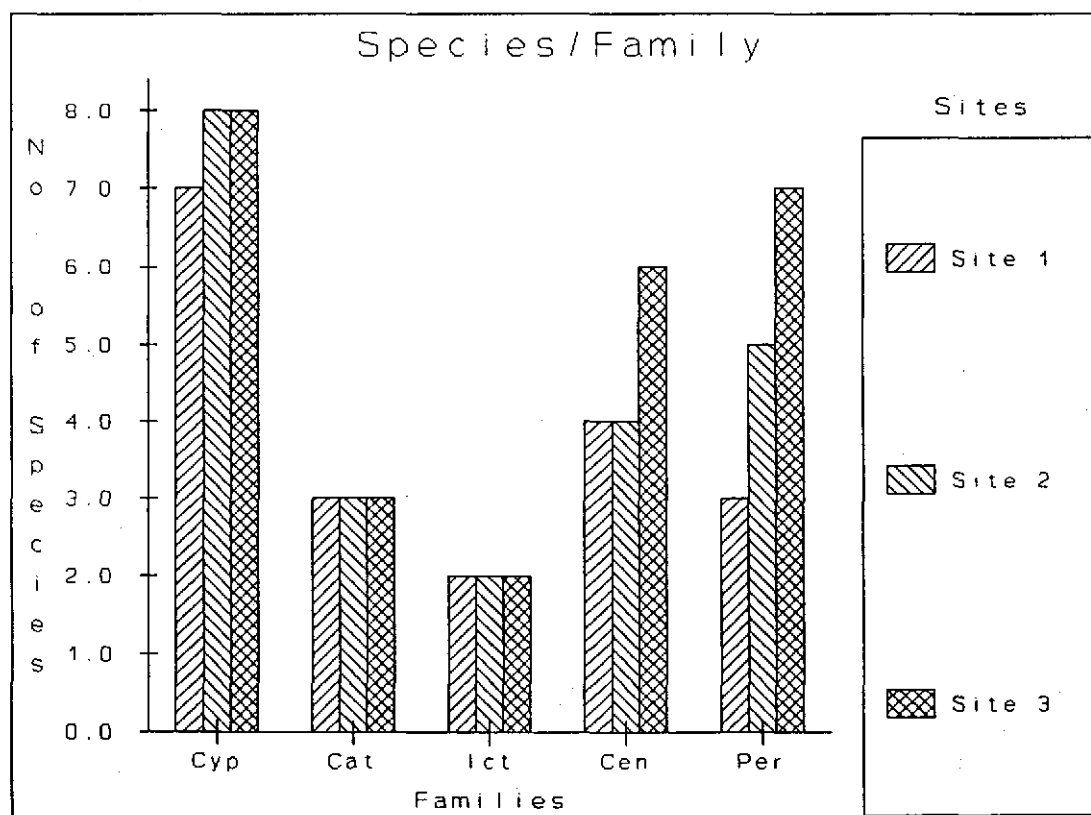
The fish community samples from Sites 1 and 2 contained 24 and 25 species, respectively, and had total RAV values of 96.5 and 98. The similarity index between these two communities is based on the number of common species and the similarity of the species relative abundance values. An index of 76% was recorded from these two communities. A value of 100% indicates identical communities. From these comparisons it can be assumed that the fish inhabitants in Holman Creek above and below Town Branch are similar. The few differing species collected at each site may be related to slight differences in the available habitat above and below the Town Branch confluence. One indication of the presence of a nutrient source may be attributed to the abundance of the Ozark Minnow at these two collection sites. This fish had a RAV of 6.0 above Town Branch where 57 specimens were collected, with a RAV of 8.0 being determined at the downstream site from the 141 specimens collected. This minnow is a primary feeder with a diet consisting of diatoms, planktonic and periphytic algae--a food source that generally increases in proportion to nutrient availability.

Another species with a significant population change was the Slender Madtom. Above Town Branch, this species had an RAV of 8.0 with 100 specimens collected. In contrast, the lower station

produced only 6 specimens and an RAV of only 2.0. The embedding of substrate due to sedimentation may be the cause of a reduction in numbers of this fish. An earlier discussion of periodic slug flows of untreated process water from the Swift poultry processor, with an associated elevated nutrient and total suspended solids contribution, may be the causative agent in habitat modification at the downstream Site # 2.

There were 27 species of fish collected at Site # 3, with a total RAV of 107 being recorded. This increase in both diversity and abundance may be due to an increase in stream flow and a reduction in temperature from the Smyrna Branch underground contribution. A change in habitat availability may also be a factor in the population increase. Irregardless of the reasons, this site is supporting a rich fish community when compared to other communities in the small watershed Ozark Highland streams. Figure 13 provides a species per family comparison at each of the three collection sites. This figure graphically depicts the fish community improvement noted at this downstream location.

FIGURE 14



CONCLUSIONS

A review of the water chemistry analyses in terms of permitted constituents in the Huntsville wastewater effluent discharge indicates an excellent removal efficiency for BOD, TSS, and NH_3N , with measured values of 1.1, 2.0, and 0.21 mg/l, respectively, at the outfall to Town Branch. A comparison of the effluent concentrations with those recorded at the upstream Town Branch site--having a BOD, TSS, and NH_3N of 0.4, 2.0, and 0.33 mg/l, respectively--verifies the presence of excellent treatment for the permitted parameters. If the review of the chemical analyses ended with these parameters, it would seem evident that there should be no adverse impacts on the receiving stream water quality from this wastewater discharge; however, a review of some of the non-permitted wastewater constituents--chlorides, nitrates, and phosphates--indicates that a change in water quality is occurring due to the wastewater influence. A seven-fold increase in chloride concentration, an eleven-fold increase in nitrate concentration, and a sixty-fold increase in phosphate concentration from the upstream Town Branch station to the first station below the STP effluent lends credence to the assumption that significantly elevated levels are occurring in this stream due to the STP effluent. Further comparisons of these three parameters in Holman Creek above and below the Town Branch confluence indicate minimal utilization and removal occurs in Town Branch. Nitrate nitrogen concentrations were 23 times higher, chlorides 9.4 times higher, and total phosphorus concentrations were 37 times greater at Station 4B than at Station 4A. Figures 7-10 depict the utilization/removal rates for nitrates and phosphorus in a downstream direction. Sufficient concentrations of these nutrients still exist at the lower Holman Creek stations to produce algae populations capable of causing large dissolved oxygen diurnal fluctuations, as noted in figure 4. If extended periods of hot, dry weather occur in this area, the nutrient contributions from the Huntsville STP effluent could result in substantial algae blooms and subsequent die-off. This cycle will stress the aquatic inhabitants and alter an apparently healthy macroinvertebrate and fish community currently inhabiting Town Branch and Holman Creek.

RECOMMENDATIONS

It is recommended that the Huntsville Water Utilities continue the processes of developing and passing an ordinance requiring pretreatment of the Swift poultry processing plant wastewater, as well as directing them to provide sufficient holding capacity in the event of treatment system malfunction. The periodic slugs of untreated process water from this facility to the municipal treatment plant has proven to be deleterious to the treatment efficiency. For this facility to perform as designed, volume and concentration of incoming wastewater must be established. As noted

earlier, these untreated releases from Swift are having detrimental effects on the water quality and aquatic life of Town Branch and Holman Creek.

Additionally, investigations should be made to identify any treatment plant modifications required to achieve a more efficient removal of nitrate nitrogen and phosphorus, as well as establish requirements for better control of influent chlorides and sulfates. These last two parameters, in addition to total dissolved solids, were exceeding water quality standards established for Ozark Highland ecoregion streams.

Future permit limits for this facility should consider limitations on nitrate discharges to no more than the 10 mg/l MCL for drinking water supplies, since both streams are designated for drinking water uses. Additionally, most streams in this area of the state enter the groundwater which also may be used for drinking water supplies. Finally, phosphorus loadings frequently overload the stream assimilation capabilities and therefore should require limitations from the excessive "slug" effects.

APPENDIX A

CITY OF HUNTSVILLE
TOWN BRANCH--HOLMAN CREEK

DATE	SITE 1A	DO	PH	TOC	BOD	NH3-N	NO3-N	O-PHOS	T-PHOS	CL	TDS	SO4	HARD	TURB	TSS	CFS
92/07/21	PM	8.60	8.30	4.00	0.30	0.09	0.58	0.08	<0.03	8.85	148.00	16.80	120.00	1.80	1.00	0.82
92/07/22	AM	5.50	7.78	3.30	<0.2	0.08	0.83	0.10	0.05	9.56	173.00	16.80	142.00	1.80	1.00	0.80
92/09/15	AM	8.50	7.43	7.43	0.60	0.82	1.17	<0.03	<0.03	9.44	198.00	16.90	154.40	3.40	4.00	1.43
DATE	SITE E	DO	PH	TOC	BOD	NH3-N	NO3-N	O-PHOS	T-PHOS	CL	TDS	SO4	HARD	TURB	TSS	CFS
92/07/21	PM	8.20	8.06	10.70	1.30	0.22	13.70	5.84	6.42	140.00	589.00	27.70	190.00	1.60	2.00	0.16
92/07/22	AM	5.50	7.61	7.00	1.30	0.14	25.60	6.46	7.14	136.00	648.00	28.70	210.00	1.60	2.00	1.45
92/09/15	AM	7.20	9.75	9.75	0.70	0.28	18.30	6.59	6.94	126.00	545.00	33.60	204.80	1.60	2.00	1.09
DATE	SITE 1B	DO	PH	TOC	BOD	NH3-N	NO3-N	O-PHOS	T-PHOS	CL	TDS	SO4	HARD	TURB	TSS	CFS
92/07/21	PM	9.50	8.68	5.00	0.90	0.10	2.66	1.09	1.20	33.20	227.00	17.90	136.00	2.20	2.00	1.00
92/07/22	AM	5.10	7.67	5.80	0.90	0.11	19.20	4.90	5.19	105.16	506.00	24.90	192.00	2.00	2.00	2.25
92/09/15	AM	8.00	4.00	4.00	0.70	0.21	6.88	2.38	2.49	49.00	323.00	22.60	180.40	3.20	5.00	2.52
DATE	SITE 2	DO	PH	TOC	BOD	NH3-N	NO3-N	O-PHOS	T-PHOS	CL	TDS	SO4	HARD	TURB	TSS	CFS
92/07/21	PM	7.60	8.72	6.90	1.00	0.07	4.94	2.18	2.18	57.80	306.00	21.00	144.00	2.20	2.00	1.00
92/07/22	AM	5.20	7.82	5.80	0.70	0.07	16.30	4.58	4.88	102.22	495.00	24.90	192.00	1.60	2.00	2.25
92/09/15	AM	8.35	3.56	8.50	0.70	0.12	8.56	2.91	3.00	60.90	352.00	24.40	181.20	2.00	2.00	2.52
DATE	SITE 3	DO	PH	TOC	BOD	NH3-N	NO3-N	O-PHOS	T-PHOS	CL	TDS	SO4	HARD	TURB	TSS	CFS
92/07/21	PM	7.10	8.46	6.90	0.90	<0.05	6.22	2.70	2.85	83.80	378.00	23.00	160.00	2.00	2.00	1.00
92/07/22	AM	5.40	7.90	7.60	0.60	0.08	16.20	4.31	4.16	104.03	489.00	25.90	188.00	1.80	2.00	2.25
92/09/15	AM	8.30	8.50	8.50	0.70	<0.05	1.18	0.97	3.00	61.30	350.00	24.40	178.80	2.10	3.00	3.07
DATE	SITE 4A	DO	PH	TOC	BOD	NH3-N	NO3-N	O-PHOS	T-PHOS	CL	TDS	SO4	HARD	TURB	TSS	CFS
92/07/21	PM	6.70	7.74	1.90	0.90	0.05	0.28	0.07	0.06	5.51	131.00	14.60	108.00	7.20	6.00	0.70
92/07/22	AM	4.00	7.42	3.10	0.60	0.06	0.25	0.66	<0.03	5.79	133.00	14.60	110.00	7.60	8.00	0.70
92/09/15	AM	5.80	3.94	3.94	0.60	<0.05	0.23	<0.03	0.05	5.51	117.00	14.70	91.60	11.00	10.00	2.59
DATE	SITE 4B	DO	PH	TOC	BOD	NH3-N	NO3-N	O-PHOS	T-PHOS	CL	TDS	SO4	HARD	TURB	TSS	CFS
92/07/21	PM	8.30	8.67	3.50	0.60	0.06	2.86	1.22	1.37	49.60	262.00	19.00	136.00	2.80	2.00	1.70
92/07/22	AM	5.10	7.82	5.20	0.80	0.09	10.30	2.58	2.80	75.20	369.00	22.00	162.00	2.80	3.00	2.95
92/09/15	AM	8.80	6.75	6.75	0.50	<0.05	4.06	1.32	1.43	33.70	236.00	18.90	132.80	4.50	4.00	5.66
DATE	SITE 5	DO	PH	TOC	BOD	NH3-N	NO3-N	O-PHOS	T-PHOS	CL	TDS	SO4	HARD	TURB	TSS	CFS
92/07/21	PM	8.60	8.40	3.80	0.70	<0.05	2.76	1.29	1.37	47.80	265.00	19.00	134.00	3.40	2.00	1.70
92/07/22	AM	4.70	7.66	5.50	0.50	0.06	1.62	0.47	0.30	72.20	344.00	22.00	156.00	3.80	6.00	2.95
92/09/15	AM	8.20	6.31	6.31	0.80	<0.05	4.13	1.33	1.41	33.40	240.00	18.90	136.40	6.20	7.00	5.66
DATE	SITE 6	DO	PH	TOC	BOD	NH3-N	NO3-N	O-PHOS	T-PHOS	CL	TDS	SO4	HARD	TURB	TSS	CFS
92/07/21	PM	8.20	8.00	3.80	0.70	<0.05	2.53	0.67	0.71	36.70	242.00	13.40	150.00	2.60	2.00	3.30
92/07/22	AM	5.20	7.58	4.10	0.50	0.05	2.82	0.60	0.64	33.80	237.00	14.60	148.00	2.60	2.00	4.55

CITY OF HUNTSVILLE
TOWN BRANCH--HOLMAN CREEK

	SITE 1A	SITE E	SITE 1B	SITE 2	SITE 3	SITE 4A	SITE 4B	SITE 5	SITE 6
FLOW (cfs)									
AM	0.80	1.45	2.25	2.25	2.25	0.70	2.95	2.95	4.55
PM	0.82	0.16	1.00	1.00	1.00	0.70	1.70	1.70	3.30
D.O.									
AM	5.50	5.50	5.10	5.20	5.40	4.00	5.10	4.70	5.20
PM	8.60	8.20	9.50	7.60	7.10	6.70	8.30	8.60	8.20
pH									
AM	7.78	7.61	7.67	7.82	7.90	7.42	7.82	7.66	7.58
PM	8.30	8.06	8.68	8.72	8.46	7.74	8.67	8.40	8.00
TOC									
AM	3.30	7.00	5.80	5.80	7.60	3.10	5.20	5.50	4.10
PM	4.00	10.70	5.00	6.90	6.90	1.90	3.50	3.80	3.80
BOD									
AM	0.20	1.30	0.90	0.70	0.60	0.60	0.80	0.50	0.50
PM	0.30	1.30	0.90	1.00	0.90	0.90	0.60	0.70	0.70
TKN									
AM	0.24	0.87	0.68	0.64	0.56	0.21	0.53	0.56	0.29
PM	0.28	1.13	0.51	0.62	0.58	0.26	0.47	0.43	0.40
NH3-N									
AM(conc)	0.076	0.143	0.110	0.069	0.078	0.059	0.093	0.055	0.052
PM(conc)	0.088	0.221	0.102	0.069	0.050	0.053	0.059	0.050	0.050
AM(load)	0.328	1.117	1.333	0.836	0.946	0.223	1.478	0.874	1.275
PM(load)	0.389	0.191	0.550	0.372	0.269	0.200	0.540	0.458	0.889
NO3-N									
AM(conc)	0.832	25.600	19.200	16.300	16.200	0.249	10.300	1.620	2.820
PM(conc)	0.576	13.700	2.660	4.940	6.220	0.277	2.860	2.760	2.530
AM(load)	3.586	199.989	232.746	197.592	196.379	0.939	163.703	25.748	69.129
PM(load)	2.545	11.810	14.331	26.615	33.511	1.045	26.195	25.279	44.981
O-PHOS									
AM(conc)	0.101	6.460	4.900	4.580	4.310	0.066	2.580	0.472	0.600
PM(conc)	0.078	5.840	1.090	2.180	2.700	0.066	1.220	1.290	0.673
AM(load)	0.435	50.466	59.399	55.520	52.247	0.249	41.005	7.502	14.708
PM(load)	0.345	5.034	5.873	11.745	14.547	0.249	11.174	11.815	11.965
T-PHOS									
AM(conc)	0.047	7.140	5.190	4.880	4.160	0.030	2.800	0.304	0.642
PM(conc)	0.030	6.420	1.200	2.180	2.850	0.058	1.370	1.370	0.710
AM(load)	0.204	55.778	62.914	59.156	50.428	0.113	44.502	4.832	15.738
PM(load)	0.133	5.534	6.465	11.745	15.355	0.217	12.548	12.548	12.623
CL									
AM	9.56	136.00	105.00	102.00	104.00	5.79	75.20	72.20	33.80
PM	8.85	140.00	33.20	57.80	83.80	5.51	49.60	47.80	36.70
TDS									
AM	173	648	506	495	489	133	369	344	237
PM	148	589	227	306	378	131	262	265	242
SO4									
AM	16.80	28.70	24.90	24.90	25.90	14.60	22.00	22.00	14.60
PM	16.80	27.70	17.90	21.00	23.00	14.60	19.00	19.00	13.40
HARD									
AM	142	210	192	192	188	110	162	156	148
PM	120	190	136	144	160	108	136	134	150
TURB									
AM	1.8	1.6	2.0	1.6	1.8	7.6	2.8	3.8	2.6
PM	1.8	1.6	2.2	2.2	2.0	7.2	2.8	3.4	2.6
TSS									
AM	1	2	2	2	2	8	3	6	2
PM	1	2	2	2	2	6	2	2	2

APPENDIX B

Benthic Bioassessment

Page 1

Station # WHI0093

Town Branch Creek at mouth, above Holman Creek confluence

Eco Req. # 02HI

Segment # 4K

Sample Date 92-07-22

Sample Time 0930

Sampling technique employed 5MR

Printed on 10-DEC-1992

of Taxa = 16 # of organisms = 100 Biotic score = 0

% Annelida = 0.0

Ephemeroptera taxa = 5 % Ephemeroptera = 59.0

Trichoptera taxa = 2 % Trichoptera = 17.0

```
# Coleoptera      taxa = 0  % Coleoptera      = 0.0
```

Diversity index = 3.2071440

Group summary

SH= 2 SC= 27 PR= 21 GC= 35 FC= 15

SH%= 2 SC%= 27 PR%= 21 GC%= 35 FC%= 15

Bio #	Name		Gr	Count	%
18020508002	MAYFLY NYMPH	Baetis	GC	29	29.0
18020510007	MAYFLY NYMPH	Stenonema	SC	19	19.0
18020704002	CADDISFLY LARVA	Cheumatops	FC	15	15.0
18020510011005	MAYFLY NYMPH	Stenacron interpunct	SC	7	7.0
18021115002	BLOODWORM	Ablabesmyi	PR	5	5.0
18020802001001	HELLGRAMMITE	Corydalis cornutus	PR	4	4.0
18020408003	DAMSELFLY NAIAD	Argia	PR	3	3.0
18020503002	MAYFLY NYMPH	Caenis	GC	3	3.0
8021215020	RIFFLE BEETLE, ADULT	Stenelmis adult	GC	3	3.0
18010302004	CRAYFISH	Cambarellu	SH	2	2.0
18021120001	DANCEFLY LARVA	Hemerodrom	PR	2	2.0
18021110002	CRANEFLY LARVA	Hexatoma	PR	2	2.0
18020718006003	CADDISFLY LARVA	Polycentro cinereus	PR	2	2.0
09010101001	FLATWORM	Dugesia	PR	2	2.0
18020510005	MAYFLY NYMPH	Heptagenia	SC	1	1.0
18021118001	HORSEFLY LARVA	Tabanus	PR	1	1.0

Page 1

# of Taxa = 20	# of organisms = 100	Biotic score = 0
	% Annelida = 5.0	
# Ephemeroptera taxa = 5	% Ephemeroptera = 58.0	
# Trichoptera taxa = 2	% Trichoptera = 15.0	
# Coleoptera taxa = 3	% Coleoptera = 6.0	
# Chironomidae taxa = 1	% Chironomidae = 2.0	

					Group summary				
SH=	2	SC=	20	PR=	7	GC=	35	FC=	36
SH%	2	SC%	20	PR%	7	GC%	35	FC%	36

Bio #	Name		Gr	Count	%
18020508002	MAYFLY NYMPH	Baetis	GC	27	27.0
18020511005	MAYFLY NYMPH	Isonychia	FC	17	17.0
18020704002	CADDISFLY LARVA	Cheumatops	FC	14	14.0
18020510007	MAYFLY NYMPH	Stenonema	SC	11	11.0
18021101003	BLACK FLY LARVA	Simulium	FC	5	5.0
18021215020	BEETLE, ELMID, LARVA	Stenelmis	SC	4	4.0
17010202	AQUATIC EARTHWORM	Lumbriculi	GC	3	3.0
18020802001001	HELLGRAMMITE	Corydalus cornutus	PR	2	2.0
18010302003	CRAYFISH	Orconectes	SH	2	2.0
18021115002	BLOODWORM	Ablabesmyi	PR	2	2.0
18020510011005	MAYFLY NYMPH	Stenacron interpunct	SC	2	2.0
17010102	AQUATIC EARTHWORM	Naididae	GC	2	2.0
8021215020	RIFFLE BEETLE, ADULT	Stenelmis adult	GC	2	2.0
19031003003	LIMPET	Ferrissia	SC	1	1.0
18021217004001	WATER PENNY LARVA	Psephenus herricki	SC	1	1.0
18020502002	MAYFLY NYMPH	Tricorytho	GC	1	1.0
1802121400200002	BEETLE, DRYOPID	Helichus	SC	1	1.0
18021120001	DANCEFLY LARVA	Hemerodrom	PR	1	1.0
18021110002	CRANEFLY LARVA	Hexatoma	PR	1	1.0
18020718006003	CADDISFLY LARVA	Polycentro cinereus	PR	1	1.0

Page 1

Holman Cr BL Huntsville AR

Segment # 4K

Sample Time 1200

Printed on 2-FEB-1989

Chironomidae taxa = 1 % Chironomidae = 90.0

Group summary

SH%= 1 CO%= 90 SC%= 1 PR%= 4 GC%= 4

Gr	Count	%
----	-------	---

180211115	BLOODWORM	Chironomid	CO	90	90.0
18020508002	MAYFLY NYMPH	Baetis	GC	2	2.0
18010302	CRAYFISH	Cambarinae	SH	1	1.0
18020802001001	HELLGRAMMITE	Corydalis cornutus	PR	1	1.0
18020603	BUG, WATERBOATMAN	Corixidae	PR	1	1.0
18010101001	AQUATIC SOWBUG	Asellus sp.	GC	1	1.0
18021114002	BITING MIDGE LARVA	Palpomyia	PR	1	1.0
18021209033	BEETLE, WATER SCAVEN	Tropistern	PR	1	1.0
17010101002004	SLUDGEWORM	Tubifex tubifex	GC	1	1.0
19030201004	SNAIL	Viviparus	SC	1	1.0

Page 1

Eco Req.# OZHI

Sample Date 87-08-26

Sample Time 1000

Sampling technique employed 5MR

Printed on 2-FEB-1989

Diversity index = 3.2804689

Group summary

SH= 3 CO= 2 SC= 65 PR= 7 GC= 10 FC= 12

SH%= 3 CO%= 2 SC%= 65 PR%= 7 GC%= 10 FC%= 12

Bio #	Name		Gr	Count	%
18021217004001	WATER PENNY LARVA	Psephenus herricki	SC	33	33.3
18020510007	MAYFLY NYMPH	Stenonema	SC	17	17.2
1802121400200002	BEETLE, DRYOPID	Helichus	SC	11	11.1
18020508002	MAYFLY NYMPH	Baetis	GC	5	5.1
18020702001001	CADDISFLY LARVA	Chimarra obscura	FC	5	5.1
18020511005	MAYFLY NYMPH	Isonychia	FC	5	5.1
18020503002	MAYFLY NYMPH	Caenis	GC	4	4.0
18020712001001	CADDISFLY LARVA	Helicopsyc borealis	SC	3	3.0
18010302	CRAYFISH	Cambarinae	SH	2	2.0
18020614001	BUG, WATER TREADER	Mesovelia	PR	2	2.0
18021114002	BITING MIDGE LARVA	Palpomyia	PR	2	2.0
18020611001	BUG, BR SHD WATERSTR	Rhagovelia	PR	2	2.0
18021115	BLOODWORM	Chironomid	CO	2	2.0
18020408003	DAMSELFLY NAIAD	Argia	PR	1	1.0
18020704002	CADDISFLY LARVA	Cheumatops	FC	1	1.0
18010202001	SIDESWIMMER	Gammarus	GC	1	1.0
18020704013002	CADDISFLY LARVA	Symphitops bifida	FC	1	1.0
18021215020	BEETLE, ELMID, LARVA	Stenelmis	SC	1	1.0
18021110004	[ACRANEFLY LARVA	Tipula	SH	1	1.0

Benthic Community Comparision

Stations: WHI0070A Holman Cr AB Huntsville AR
 Sample Date 87-08-26
 Sample Time 1000
 Sampling technique employed 5MR
 WHI0070
 Sample Date 87-08-26
 Sample Time 1200
 Sampling technique employed 5MR

Printed on 9-FEB-1989

Qual. Similarity Index = 6.
 Dominants in Common = 1
 Taxa in Common = 4
 Common Taxa Index = 0.21
 Pro. Judgement Score = 4

	WHI0070A	WHI0070
# of Taxa =	19	10
# of organisms =	99	100
# Ephemeroptera taxa =	4	1
# Trichoptera taxa =	4	0
# Coleoptera taxa =	3	1
# Chironomidae taxa =	1	1
Annelida cnt/% =	0/ 0.0	1/ 1.0
Ephemeroptera cnt/% =	31/ 31.3	2/ 2.0
Trichoptera cnt/% =	10/ 10.1	0/ 0.0
Coleoptera cnt/% =	45/ 45.5	1/ 1.0
Chironomidae cnt/% =	2/ 2.0	90/ 90.0
Biotic score =	0	0

Taxa @ WHI007 but not @ WHI007

WATER PENNY LARVA	Psephenus	herricki	33	33.3
MAYFLY NYMPH	Stenonema		17	17.2
BEETLE, DRYOPID	Helichus		11	11.1
MAYFLY NYMPH	Isonychia		5	5.1
CADDISFLY LARVA	Chimarra	obscura	5	5.1
MAYFLY NYMPH	Caenis		4	4.0
CADDISFLY LARVA	Helicopsyche	borealis	3	3.0
BUG, WATER TREADER	Mesovelia		2	2.0
BUG, BR SHD WATERSTR	Rhagovelia		2	2.0
CADDISFLY LARVA	Cheumatopsyche		1	1.0
CADDISFLY LARVA	Symphitopsyche	bifida	1	1.0
SIDESWIMMER	Gammarus		1	1.0
DAMSELFLY NAIAD	Argia		1	1.0
BEETLE, ELMID, LARVA	Stenelmis		1	1.0
[ACRANEFLY LARVA	Tipula		1	1.0

Taxa @ WHI007 but not @ WHI007

SNAIL	Viviparus		1	1.0
AQUATIC SOWBUG	Asellus	sp.	1	1.0
HELLGRAMMITE	Corydalus	cornutus	1	1.0
BUG, WATERBOATMAN	Corixidae		1	1.0
SLUDGEWORM	Tubifex	tubifex	1	1.0
BEETLE, WATER SCAVEN	Tropisternus		1	1.0

Benthic Community Comparison

Stations: WHI0093 Town Branch Creek at mouth, above Holman
 Sample Date 92-07-22
 Sample Time 0930
 Sampling technique employed SMR
 WHI0094 Holman Creek above confluence of Town Br
 Sample Date 92-07-22
 Sample Time 1015
 Sampling technique employed SMR

Printed on 23-OCT-1992

Qual. Similarity Index = 51.
 Dominants in Common = 3
 Taxa in Common = 8
 Common Taxa Index = 0.42
 Pro. Judgement Score = 0

		WHI0093	WHI0094
# of Taxa	=	16	19
# of organisms	=	100	100
# Ephemeroptera taxa	=	5	5
# Trichoptera taxa	=	2	3
# Coleoptera taxa	=	0	2
# Chironomidae taxa	=	1	3
Annelida cnt/%	=	0/ 0.0	2/ 2.0
Ephemeroptera cnt/%	=	59/ 59.0	55/ 55.0
Trichoptera cnt/%	=	17/ 17.0	24/ 24.0
Coleoptera cnt/%	=	0/ 0.0	2/ 2.0
Chironomidae cnt/%	=	5/ 5.0	6/ 6.0
Biotic score	=	0	0

Taxa @ WHI0093 but not @ WHI0094

MAYFLY NYMPH	Stenacron	interpunctatum	7	7.0
DAMSELFLY NAIAD	Argia		3	3.0
CRANEFLY LARVA	Hexatoma		2	2.0
FLATWORM	Dugesia		2	2.0
CADDISFLY LARVA	Polycentropus	cinereus	2	2.0
DANCEFLY LARVA	Hemerodromia		2	2.0
MAYFLY NYMPH	Heptagenia		1	1.0
HORSEFLY LARVA	Tabanus		1	1.0

Taxa @ WHI0094 but not @ WHI0093

MAYFLY NYMPH	Isonychia		14	14.0
MAYFLY NYMPH	Tricorythodes		11	11.0
BLOODWORM	Pseudochironomus		3	3.0
BLACK FLY LARVA	Simulium		3	3.0
CADDISFLY LARVA	Chimarra		3	3.0
AQUATIC EARTHWORM	Lumbriculidae		2	2.0
BLOODWORM	Polypedilum		2	2.0
BEETLE, RIFFLE-ADULT	Elmidae-adult		1	1.0
BEETLE, AQUATIC	Amphizoa		1	1.0
CADDISFLY LARVA	Helicopsyche	borealis	1	1.0
DRAGONFLY NAIAD	Boyeria	vinosa	1	1.0

Benthic Community Comparision

Stations: WHI0094 Holman Creek above confluence of Town Br
 Sample Date 92-07-22
 Sample Time 1015
 Sampling technique employed SMR
 WHI0095 Holman Creek at Hwy 23 Bridge nr. Huntsv
 Sample Date 92-07-21
 Sample Time 0930
 Sampling technique employed SMR

Printed on 23-OCT-1992

Qual. Similarity Index = 64.
 Dominants in Common = 3
 Taxa in Common = 10
 Common Taxa Index = 0.53
 Pro. Judgement Score = 0

	WHI0094	WHI0095
# of Taxa	19	17
# of organisms	100	100
# Ephemeroptera taxa	5	5
# Trichoptera taxa	3	2
# Coleoptera taxa	2	2
# Chironomidae taxa	3	0
Annelida cnt/%	2/ 2.0	2/ 2.0
Ephemeroptera cnt/%	55/ 55.0	41/ 41.0
Trichoptera cnt/%	24/ 24.0	30/ 30.0
Coleoptera cnt/%	2/ 2.0	3/ 3.0
Chironomidae cnt/%	6/ 6.0	0/ 0.0
Biotic score	0	0

Taxa @ WHI0094 but not @ WHI0095

HELLGRAMMITE	Corydalis	cornutus	4	4.0
BLOODWORM	Pseudochironomus		3	3.0
BLOODWORM	Polypedilum		2	2.0
AQUATIC EARTHWORM	Lumbriculidae		2	2.0
BLOODWORM	Ablabesmyia		1	1.0
BEETLE, RIFFLE-ADULT	Elmidae-adult		1	1.0
DRAGONFLY NAIAD	Boyeria	vinosa	1	1.0
BEETLE, AQUATIC	Amphizoa		1	1.0
CADDISFLY LARVA	Helicopsyche	borealis	1	1.0

Taxa @ WHI0095 but not @ WHI0094

BEETLE, DRYOPID	Helichus		2	2.0
FLATWORM	Dugesia		2	2.0
LEECH	Piscicola	milneri	2	2.0
CRANEFLY LARVA	Hexatoma		1	1.0
LIMPET	Ferrissia		1	1.0
WHIRLIGIG BEETLE LAR	Dineutus	larvae	1	1.0
DANCEFLY LARVA	Hemerodromia		1	1.0

Benthic Community Comparision

Stations: WHI0095 Holman Creek at Hwy 23 Bridge nr. Huntsv
 Sample Date 92-07-21
 Sample Time 0930
 Sampling technique employed SMR
 WHI0096 Holman Creek below Smyrna Cr. confluence
 Sample Date 92-07-22
 Sample Time 1315
 Sampling technique employed SMR

Printed on 23-OCT-1992

Qual. Similarity Index = 61.
 Dominants in Common = 4
 Taxa in Common = 11
 Common Taxa Index = 0.55
 Pro. Judgement Score = 0

		WHI0095	WHI0096
# of Taxa	=	17	20
# of organisms	=	100	100
# Ephemeroptera taxa	=	5	5
# Trichoptera taxa	=	2	2
# Coleoptera taxa	=	2	3
# Chironomidae taxa	=	0	1
Annelida cnt/%	=	2/ 2.0	5/ 5.0
Ephemeroptera cnt/%	=	41/ 41.0	58/ 58.0
Trichoptera cnt/%	=	30/ 30.0	15/ 15.0
Coleoptera cnt/%	=	3/ 3.0	6/ 6.0
Chironomidae cnt/%	=	0/ 0.0	2/ 2.0
Biotic score	=	0	0

Taxa @ WHI0095 but not @ WHI0096

CADDISFLY LARVA	Chimarra		6	6.0
CRAYFISH	Cambarellus		2	2.0
LEECH	Piscicola	milneri	2	2.0
FLATWORM	Dugesia		2	2.0
MAYFLY NYMPH	Caenis		2	2.0
WHIRLIGIG BEETLE LAR	Dineutus	larvae	1	1.0

Taxa @ WHI0096 but not @ WHI0095

BEETLE, ELMID, LARVA	Stenelmis		4	4.0
AQUATIC EARTHWORM	Lumbriculidae		3	3.0
HELLGRAMMITE	Corydalus	cornutus	2	2.0
MAYFLY NYMPH	Stenacron	interpunctatum	2	2.0
AQUATIC EARTHWORM	Naididae		2	2.0
BLOODWORM	Ablabesmyia		2	2.0
CRAYFISH	Orconectes		2	2.0
WATER PENNY LARVA	Psephenus	herricki	1	1.0
CADDISFLY LARVA	Polycentropus	cinereus	1	1.0

Benthic Community Comparison

Stations: WHI0094 Holman Creek above confluence of Town Br
 Sample Date 92-07-22
 Sample Time 1015
 Sampling technique employed SMR
 WHI0096 Holman Creek below Smyrna Cr. confluence
 Sample Date 92-07-22
 Sample Time 1315
 Sampling technique employed SMR

Printed on 23-OCT-1992

Qual. Similarity Index = 63.
 Dominants in Common = 4
 Taxa in Common = 10
 Common Taxa Index = 0.50
 Pro. Judgement Score = 0

	WHI0094	WHI0096
# of Taxa =	19	20
# of organisms =	100	100
# Ephemeroptera taxa =	5	5
# Trichoptera taxa =	3	2
# Coleoptera taxa =	2	3
# Chironomidae taxa =	3	1
Annelida cnt/% =	2/ 2.0	5/ 5.0
Ephemeroptera cnt/% =	55/ 55.0	58/ 58.0
Trichoptera cnt/% =	24/ 24.0	15/ 15.0
Coleoptera cnt/% =	2/ 2.0	6/ 6.0
Chironomidae cnt/% =	6/ 6.0	2/ 2.0
Biotic score =	0	0

Taxa @ WHI0094 but not @ WHI0096

MAYFLY NYMPH	Caenis		5	5.0
CADDISFLY LARVA	Chimarra		3	3.0
BLOODWORM	Pseudochironomus		3	3.0
BLOODWORM	Polypedilum		2	2.0
CRAYFISH	Cambarellus		2	2.0
BEETLE, RIFFLE-ADULT	Elmidae-adult		1	1.0
DRAGONFLY NAIAD	Boyeria	vinosa	1	1.0
BEETLE, AQUATIC	Amphizoa		1	1.0
CADDISFLY LARVA	Helicopsyche	borealis	1	1.0

Taxa @ WHI0096 but not @ WHI0094

BEETLE, ELMID, LARVA	Stenelmis		4	4.0
CRAYFISH	Orconectes		2	2.0
AQUATIC EARTHWORM	Naididae		2	2.0
MAYFLY NYMPH	Stenacron	interpunctatum	2	2.0
DANCEFLY LARVA	Hemerodromia		1	1.0
CADDISFLY LARVA	Polycentropus	cinereus	1	1.0
BEETLE, DRYOPID	Helichus		1	1.0
WATER PENNY LARVA	Psephenus	herricki	1	1.0
CRANEFLY LARVA	Hexatoma		1	1.0
LIMPET	Ferrissia		1	1.0

APPENDIX C

HUNTSVILLE FISH COMMUNITY SURVEY

Town Branch--Holman Creek (1992)

FISH FAMILY & SPECIES		SITE 1	SITE 2	SITE 3
<hr/>		<hr/>		
Cyprinidae	Minnows			
Campostoma anomalum	Stoneroller	8.0	8.0	8.0
*Cyprinella whipplei	Steelcolor shiner			2.0
Cyprinus carpio	Carp	1.0	3.5	1.0
Luxilus chrysocephalus	Striped shiner	4.5	1.5	4.0
*Luxilus pilsbryi	Duskystripe shiner	8.0	6.0	6.0
*Notropis boops	Bigeye shiner	2.0	2.0	
Notropis nubilus	Ozark minnow	6.0	8.0	8.0
Notropis rubellus	Rosyface shiner			1.0
Pimephales notatus	Bluntnose minnow	2.0	2.0	1.0
*Semotilus atromaculatus	Creek chub		2.0	
<hr/>		<hr/>		
Catostomidae	Suckers			
*Hypentelium nigricans	Northern hogsucker	4.0	4.0	7.0
*Moxostoma duquesnei	Black redhorse	3.0	2.0	5.0
Moxostoma erythrurum	Golden redhorse	1.0	6.0	7.0
<hr/>		<hr/>		
Ictaluridae	Freshwater catfishes			
Ictalurus natalis	Yellow bullhead	3.0	5.0	4.0
*Noturus exilis	Slender madtom	8.0	2.0	3.5
<hr/>		<hr/>		
Cyprinodontidae	Killifishes			
*Fundulus catenatus	Northern studfish	2.0		
Fundulus olivaceus	Blackspotted topminnow	3.0	2.0	
<hr/>		<hr/>		
Poeciliidae	Livebearers			
Gambusia affinis	Mosquitofish	1.0	2.0	
<hr/>		<hr/>		
Atherinidae	Silversides			
Labidesthes sicculus	Brook silversides	1.0		
<hr/>		<hr/>		
Centrarchidae	Sunfishes			
Lepomis cyanellus	Green sunfish	3.0	5.0	1.5
Lepomis macrochirus	Bluegill	3.0	4.5	1.5
Lepomis megalotis	Longear	7.0	6.0	8.0
*Micropterus dolomieu	Smallmouth bass			1.0
Micropterus punctulatus	Spotted bass			2.0
Micropterus salmoides	Largemouth bass	5.0	4.5	3.0
<hr/>		<hr/>		
Percidae	Perches			
*Etheostoma blennioides	Greenside darter			5.0
*Etheostoma caeruleum	Rainbow darter	8.0	8.0	8.0
*Etheostoma punctulatum	Stippled darter	1.0		1.5
Etheostoma spectabile	Orangethroat darter	6.0	4.0	2.0
*Etheostoma stigmaeum	Speckled darter		1.0	1.0
*Etheostoma zonale	Banded darter		1.0	2.0
Percina caprodes	Logperch		2.0	5.0
<hr/>		<hr/>		
Cottidae	Sculpins			
*Cottus carolinae	Banded sculpin	6.0	6.0	8.0
<hr/>		<hr/>		
TOTAL SPECIES		24.0	25.0	27.0
TOTAL "RAV" VALUES		96.5	98.0	107.0
<hr/>		<hr/>		
SIMILARITY INDICES		1--2	2--3	1--3
		76.0	72.6	73.7

SITE #1 -- Holman Creek 100 yds above confluence of Town Branch
upstream 1/4 mile (Sec 2, T17N, R26W)

SITE #2 -- Holman Creek @ St. Hwy #27 bridge to 200 yds downstream of
Town Branch Creek (Sec 22, T17N, R26W)

SITE #3 -- Holman Creek 1/4 mi. below and 1/8 mi. above Smyrna Creek
(Secs 14, 15, 22, 23, T17N, R26W)

APPENDIX C
HUNTSVILLE FISH COMMUNITY SURVEY
Town Branch--Homan Creek (1992)

FISH FAMILY & SPECIES		SITE 1	SITE 2	SITE 3
<hr/>		<hr/>		
Cyprinidae	Minnows			
Campostoma anomalum	Stoneroller	269+	184+	327+
*Cyprinella whipplei	Steelcolor shiner			2
Cyprinus carpio	Carp	2	12	1
Luxilus chrysocephalus	Striped shiner	15	2	9
*Luxilus pilsbryi	Duskystripe shiner	174	84	87
*Notropis boops	Bigeye shiner	6	10	
Notropis nubilus	Ozark minnow	57	141	144
Pimephales notatus	Bluntnose minnow	7	4	2
*Semotilus atromaculatus	Creek chub		3	
Catostomidae	Suckers			
*Hypentelium nigricans	Northern hogsucker	6	7	12
*Moxostoma duquesnei	Black redhorse	6	2	7
Moxostoma erythrurum	Golden redhorse	1	13	11
Ictaluridae	Freshwater catfishes			
Ameiurus natalis	Yellow bullhead	8	12	7
*Noturus exilis	Slender madtom	100	6	10
Cyprinodontidae	Killifishes			
*Fundulus catenatus	Northern studfish	2		
Fundulus olivaceus	Blackspotted topminno	4	4	
Poeciliidae	Livebearers			
Gambusia affinis	Mosquitofish	1	3	
Atherinidae	Silversides			
Labidesthes sicculus	Brook silversides	1		
Centrarchidae	Sunfishes			
Lepomis cyanellus	Green sunfish	10	16	5
Lepomis macrochirus	Bluegill	7	23	5
Lepomis megalotis	Longear	35+	49	55
*Micropterus dolomieu	Smallmouth bass			1
Micropterus punctulatus	Spotted bass			3
Micropterus salmoides	Largemouth bass	17	13	3
Percidae	Perches			
*Etheostoma blennioides	Greenside darter			14
*Etheostoma caeruleum	Rainbow darter	160	84	156
*Etheostoma punctulatum	Stippled darter	2		2
Etheostoma spectabile	Orangethroat darter	82	29	4
*Etheostoma stigmaeum	Speckled darter		1	1
*Etheostoma zonale	Banded darter		1	3
Percina caprodes	Logperch		2	17
Cottidae	Sculpins			
*Cottus carolinae	Banded sculpin	33	34	166
<hr/>		<hr/>		
TOTAL SPECIES		24	25	26

SITE #1 -- Holman Creek 100 yds above confluence of Town Branch
upstream 1/4 mile (Sec 2, T17N, R26W)

SITE #2 -- Holman Creek @ St. Hwy #27 bridge to 200 yds downstream of
Town Branch Creek (Sec 22, T17N, R26W)

SITE #3 -- Holman Creek 1/4 mi. below and 1/8 mi. above Smyrna Creek
(Secs 14, 15, 22, 23, T17N, R26W)

