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TN0025488

ASSESSMENT OF ROUND LICK CREEK
RECEIVING STREAM OF THE WATERTOWN STP
WILSON COUNTY, TENNESSEE
OCTOBER, 1992

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NASHVILLE, TN
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ABSTRACT

The city of Watertown, located in Wilson County, Tennessee, operates a sewage treatment plant which discharges into Round Lick Creek at river mile 19.2. This low flow stream (3Q20 = 0.0 cfs) is within the Cumberland River (Old Hickory Lake) watershed and drainage basin. The Division performed a survey of Round Lick Creek in 1987 and found a depressed macroinvertebrate community. Analysis of the physicochemical and biological data taken for this report in October of 1992 found Round Lick Creek to be slightly impacted below the outfall. The stream below the outfall was 72% comparable to the reference stream. The community structure was less than that found in the reference stream with no intolerant species found in Round Lick Creek below the outfall of Watertown STP. Sludge deposits were found in 1987 below the outfall. These sludge deposits were also present in 1992 indicating continued violations of permit limits.

Quarterly toxicity testing since April of 1992 to date showed acute and chronic toxicity of Watertown STP's effluent. There has been consistent bypassing of the system into Round Lick Creek upstream of the outfall (averaging 6/month since October, 1992). Within the last 16 months, many violations of permit limits of suspended solids (percent removable) have occurred. The most recent biannual testing found permit violations of cadmium, copper, nickel, silver, and mercury. From January to July, 1992, there was 110 excursions of effluent chlorine limits.

Due to the constant bypassing, Round Lick Creek is not fully supporting of its classification of recreation. The city of Watertown is requesting an increase in discharge to Round Lick Creek. Improvement of the sewage treatment must be insured in order to not further degrade the stream.

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INTRODUCTION

The Watertown sewage treatment plant located in Wilson County, TN, has one permitted discharge point into Round Lick Creek at river mile 19.2. Watertown's permit (TN0025488) allows for an average discharge of 0.2 MGD. Actual discharge is unknown since the discharge has not been measured for at least the last 14 months. Bypassing occurs on a regular basis (averaging 6/month). During this stream survey a lift station located approximately 2000 feet upstream of the STP was noted to have recently bypassed. Sludge deposits were found downstream of the lift station. The treatment plant discharge has been in violation of toxicity limits and monitoring requirements. Most recent metals testing found permit violations of cadmium, copper, nickel, silver, and mercury limits. During 1992 (January to July), there were 110 excursions of effluent chlorine limits. Within at least the last 16 months, suspended solids removal has been inadequate with many failures of the permit limits. These violations are evident within the stream where solids have built up within the pooled and quiet areas.

Considering the permit violations it is likely that Round Lick Creek is being adversely impacted by the Watertown STP's discharge. In 1987 a stream survey found a depressed macroinvertebrate community below the outfall. A macroinvertebrate and chemical stream survey was conducted in Round Lick Creek in order to determine the long-term effect of the plant's discharge to the receiving stream and to determine if impact to the stream has been lessened since 1987. The city of Watertown is proposing to increase its discharge from 0.2 MGD to 0.25 - 0.3 MGD. The condition of the stream prior to this proposed increase is ascertained in this study. Continued study of Round Lick Creek will determine the effects of this increased discharge.

SITE DESCRIPTIONS

Two sites were selected in Round Lick Creek for physicochemical sampling below the outfall (Site 01) and upstream of the outfall at Highway 70 bridge (Site 02). Site 01 downstream of the outfall was also sampled for macroinvertebrates. The sites upstream of the outfall were not conducive for sampling of macroinvertebrates. Approximately 2000 feet upstream of the outfall is located a lift station which frequently bypasses raw sewage. During the time of sampling, the lift station was checked and it appeared that raw sewage had been recently discharged. Round Lick Creek upstream of the lift station was not an

adequate comparison to the downstream site since habitat availability was not similar. Therefore, a comparable reference station was chosen, Spring Creek at river mile 21.2 (Site 03). RECEIVED JUN 24 93

Round Lick Creek and Spring Creek are 3rd order streams which drain to the Cumberland River at river mile 292 and river mile 252, respectively. The streams at their sampling points are found within the Lebanon limestone formation of the Ordovician system. The substrate was bedrock overlain with patches of cobble, gravel and sand. Therefore, macroinvertebrate habitat availability was substrate-limited. Habitat within the streams were found in the overhanging roots along the banks and patches of grass beds.

Site 01 (Figure 1) was located in Round Lick Creek, approximately 100 feet downstream of the Watertown STP's outfall at Latitude $36^{\circ}06'30''$, Longitude $86^{\circ}07'48''$ (U.S.G.S. Quad 318 SW, Watertown TN). The creek at this point was approximately 25 feet wide with an average depth of 10-15 inches within the riffles and 15 inches within the runs. Bank stability and canopy cover was good. The water velocity within the riffles was estimated as moderate (0.25-0.5m/sec). The bedrock substrate was covered in sediment and algae growth. Sludge deposits were found within the grass beds. The water flowing downstream of the outfall was covered in a sheen. The sheen originated at the outfall, but the exact cause was not determined.

Site 02 (Figure 1) in Round Lick Creek was located upstream of the outfall, downstream of Highway 70 bridge at Latitude $36^{\circ}05'54''$, Longitude $86^{\circ}07'50''$ (U.S.G.S. Quad 318 SW, Watertown TN). Only chemical samples were taken at this point since the stream appeared to be confined to a narrow channel during the summer months. Therefore, the macroinvertebrate population might be limited by habitat availability and not comparable to the lower sampling site.

Site 03 (Figure 2) was located in Spring Creek at Latitude $36^{\circ}14'20''$, Longitude $86^{\circ}14'20''$ (U.S.G.S. Quad 318 NW, Shop Springs, TN) downstream of the Greenwood Drive bridge. Spring Creek at the sampling point was 20 feet wide, with an average depth of 5 to 8 inches in the riffle and 14-18 inches in the run. The stream velocity in the riffles was estimated as moderate (0.25-0.5m/sec). The surrounding land use was field and pasture. The water was running clear at the time of sampling. The bedrock had some sediment deposits however algae growth was not as prolific as in Round Lick Creek below the outfall.

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METHODS

Chemical analysis. Chemical samples were taken of Round Lick Creek at Site 01 and Site 02. All grab samples were taken in properly prepared sample bottles, kept at 4°C, and returned to the state lab for analysis.

Macroinvertebrate sampling. At Site 01 and Site 03, qualitative macroinvertebrate samples were collected using EPA Protocol 3 (Plafkin 1989) and standard operating procedures. Due to the lack of an appropriate riffle, no semi-quantitative riffle samples were collected. All available habitats (riffle/pool rock, grass bed and overhanging root/bank) were sampled. Organisms were removed from debris on site, preserved and returned to the laboratory for identification. All invertebrates were identified to the lowest practical taxon, usually genus. Relative abundance was determined for each taxon.

Assessment of biological condition of Round Lick Creek. When compared to a reference stream which is similar in habitat, a determination of the biological condition and thus the water quality can be made by using biometric data analysis (Plafkin et al. 1989). These calculations employ eight metric criteria which are based on the percent comparability with the reference station score. The degree of comparability is assigned a number, 0, 2, 4, or 6. The 0 signifies very little comparability and the 6 signifies high comparability. The eight numbers are summed and compared to the total possible score which provides a final percentage in which a "Biological Condition Category" is assigned (Table I).

One of the eight macroinvertebrate data analysis techniques includes the biotic index calculation. Tolerance values are assigned to the taxa. A biotic index value for the stream community is determined through the calculation:

$$BI = \frac{\text{Sum } TV_i N_i}{\text{Total } N}$$

where TV_i is the tolerance value of the i th taxa, and N_i is the abundance of the i th taxa (Hilsenhoff 1987) (Appendix I). The percent comparability of the biotic index is then calculated between the reference stream and a score is assigned and tabulated with the other seven criteria. The mean of all eight criteria determines if impairment of the stream community exists.

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TABLE I
BIOASSESSMENT

% COMPARABLE TO REFERENCE STATION	BIOLOGICAL CONDITION	ATTRIBUTES
>83%	Nonimpaired	Comparable to the best situation to be expected within an ecoregion. Balanced trophic structure. Optimum community structure (composition and dominance) for stream size and habitat quality.
54-79%	Slightly Impaired	Community structure less than expected. Composition (species richness) lower than expected due to loss of some intolerant forms. Percent contribution of tolerant forms increases.
21-50%	Moderately Impaired	Fewer species due to loss of most intolerant forms. Reduction in EPT index.
<17%	Severely Impaired	Few species present. If high densities of organisms, then dominated by one or two taxa.

RESULTS AND DISCUSSION

Chemical data results. Table II summarizes the water quality measurements collected on October 7, 1992. All chemical parameter measurements were within Tennessee's Water Quality Criteria chronic limits (1991) except for lead which measured 10 ug/l both upstream and downstream of the STP. The water quality chronic freshwater criteria for lead is 3 ug/l (hardness adjusted). Although the copper measurement of 3 ug/l at Site 02 and 4 ug/l at Site 01 was not above the chronic criteria of 6 ug/l (hardness adjusted), these levels are worthy of noting.

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TABLE II
CHEMICAL DATA
WATERTOWN STP, WILSON COUNTY
UPSTREAM AND DOWNSTREAM
OCTOBER 8, 1993

MEASUREMENT	UPSTREAM STP	DOWNSTREAM STP
pH (s.u.)	8.1	8.1
Temperature (°C)	19.5	17.6
Hardness (mg/L)	252	249
Ammonia Nitrogen (mg/L)	0.02	0.02
Nitrogen (mg/L)	0.4	1.5
Chromium (ug/L)	<1	1
Copper (ug/L)	3	4
Lead (ug/L)	10	10
Mercury (ug/L)	<0.2	<0.2
Nickel (ug/L)	3	(14)
Silver (ug/L)	<2	<2
Zinc (ug/L)	<6	<6

Macroinvertebrate data results. The macroinvertebrate taxa list is found in Appendix I. Because of the substrate-limited stream found in these bedrock bottom streams, the EPT group (Ephemeroptera, Plecoptera, Trichoptera) would not be as well represented as would be found in a cobble substrate stream. The reference stream provides information needed to assess the types of taxa that would be found in this type stream.

The number of taxa found within Round Lick Creek was 40 compared to 39 found within Spring Creek. Of those 40 taxa within Round Lick Creek, 100% were facultative or tolerant, no intolerant taxa were present. Only one genus of Trichoptera was represented compared to three in Spring Creek. The order, Ephemeroptera was taxonomically fewer in abundance with only two genera found in Round Lick Creek compared to four in Spring Creek.

Biometric data analysis found Round Lick Creek to be 72% comparable to Spring Creek which indicates slight impairment (Table I and Table III). The impairment could be contributed to the untreated sewage discharge which is occurring on a routine basis upstream of the outfall. The invertebrates which would be normally found there to provide colonizers for the downstream site below the outfall are possibly being effected by the bypassing. If an upstream site above the bypassing point had been available, a comparison to the area below the bypass could have verified this theory.

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TABLE III

BIOMETRICS	BIOASSESSMENT SCORE
TAXA RICHNESS	6
BIOTIC INDEX	6
RATIO OF SCRAPER TO FILTER COLLECTOR	6
RATIO OF EPT/CHIRONOMID	2
% CONTRIBUTION OF DOMINANT TAXA	NA
EPT INDEX	0
COMMUNITY SIMILARITY	6
RATIO OF SHREDDERS/TOTAL	NA
TOTAL	26/36 = 72%

SUMMARY

Round Lick Creek is not fully supporting its use classifications downstream of the Watertown STP's outfall because of the routine bypassing. Chemical sampling found lead levels exceeding the chronic water quality criteria both upstream and downstream of the outfall. The source of this contamination was not determined. The macroinvertebrate sampling found 72% comparability to the reference station. This places Round Lick Creek in the slightly impaired category. This stream impairment may be a result of the less than adequate treatment within the treatment plant and the discharge of untreated sewage upstream of the outfall. Sludge deposits found within the stream at the bypass point and below the outfall indicate violations of their permit limits.

In summary, Round Lick Creek is being adversely impacted and measures should be taken to alleviate these violations. The proposed increase of effluent to Round Lick Creek may cause further impact to the stream if treatment is not improved. Further study will determine the effects to the stream if discharge is increased.

LITERATURE CITED

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Hilsenhoff, W. L. 1987. An improved biotic index of organic stream pollution. Great Lakes Entomologist 20: 1-39.

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, R. M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers. EPA/444/4-89-001. Washington D.C.

State of Tennessee Water Quality Standards. 1991. Department of Environment and Conservation, Bureau of Environment, Division of Water Pollution Control.

APPENDIX I
BENTHIC MACROINVERTEBRATE DATA
SPRING CREEK/ROUND LICK CREEK
WILSON COUNTY, TN
OCTOBER 1992

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TAXA:
PHYLUM

Class

Order

Family

Genus species

SPRING CREEK
REL ABUNDANCE
(SC REL ABUND)

ROUND LICK CR.
REL ABUNDANCE
(RLC REL ABUND)

BIOTIC
INDEX
(BI)

BI *
SC REL ABUND.

BI *
RLC REL ABUND

TAXA	SC REL ABUND	RLC REL ABUND	BI	BI * SC REL ABUND	BI * RLC REL ABUND
PLATYHELMINTHES					
Turbellarian					
<i>Phagocata sp.</i>	1	3	3	3	9
ANNELIDA					
Oligochaeta					
Lumbriculidae					
<i>Undet. genus</i>	1		3.7	3.7	
Naididae					
<i>Undet. genus</i>		1	3.4		3.4
Tubificidae					
<i>Undet. genus</i>	1	3	3.3	3.3	9.9
ARTHROPODA					
Crustacea					
Amphipoda					
Gammaridae					
<i>Crangonyx sp.</i>		1	3		3
Decapoda					
Cambaridae					
<i>Undet. genus immatures</i>	1	1	*		
Isopoda					
Asellidae					
<i>Lirceus fontinalis</i>	12	21	4.1	49.2	86.1
Arachnoidea					
Hydracarina	3	1	2.7	8.1	2.7
Insecta					
Ephemeroptera					
Baetidae					
<i>Baetis sp.</i>	1	6	3.5	3.5	21
Caenidae					
<i>Caenis sp.</i>	13	30	3.4	44.2	102
Ephemeridae					
<i>Hexagenia poss. atrocaudata</i>	1		2.2	2.2	
Heptageniidae					
<i>Stenonema sp.</i>	7		3	21	
Odonata					
Anisoptera					
Calopterygidae					
<i>Calopteryx maculata</i>		4	4.3		17.2
Coenagrionidae					
<i>Argia sp.</i>	1	12	4.3	4.3	51.6
<i>Enallagma sp.</i>	33	13	4.4	145.2	57.2
Zygoptera					
Gomphidae					
<i>Dromogomphus spinosus</i>		1	2		2
<i>Gomphus sp.</i>	1		3	3	
Macromiidae					
<i>Didymops transversa</i>	10	1	2.3	23	2.3
Hemiptera					
Corixidae					
<i>Undet. genus</i>	1		*		
Hydrometridae					
<i>Hydrometra martini</i>		3	3		9
Megaloptera					
Sialidae					
<i>Sialis vagans</i>	1		3.7	3.7	
<i>Sialis not vagans</i>	1		3.7	3.7	

APPENDIX I
BENTHIC MACROINVERTEBRATE DATA
SPRING CREEK/ROUND LICK CREEK
WILSON COUNTY, TN
OCTOBER 1992

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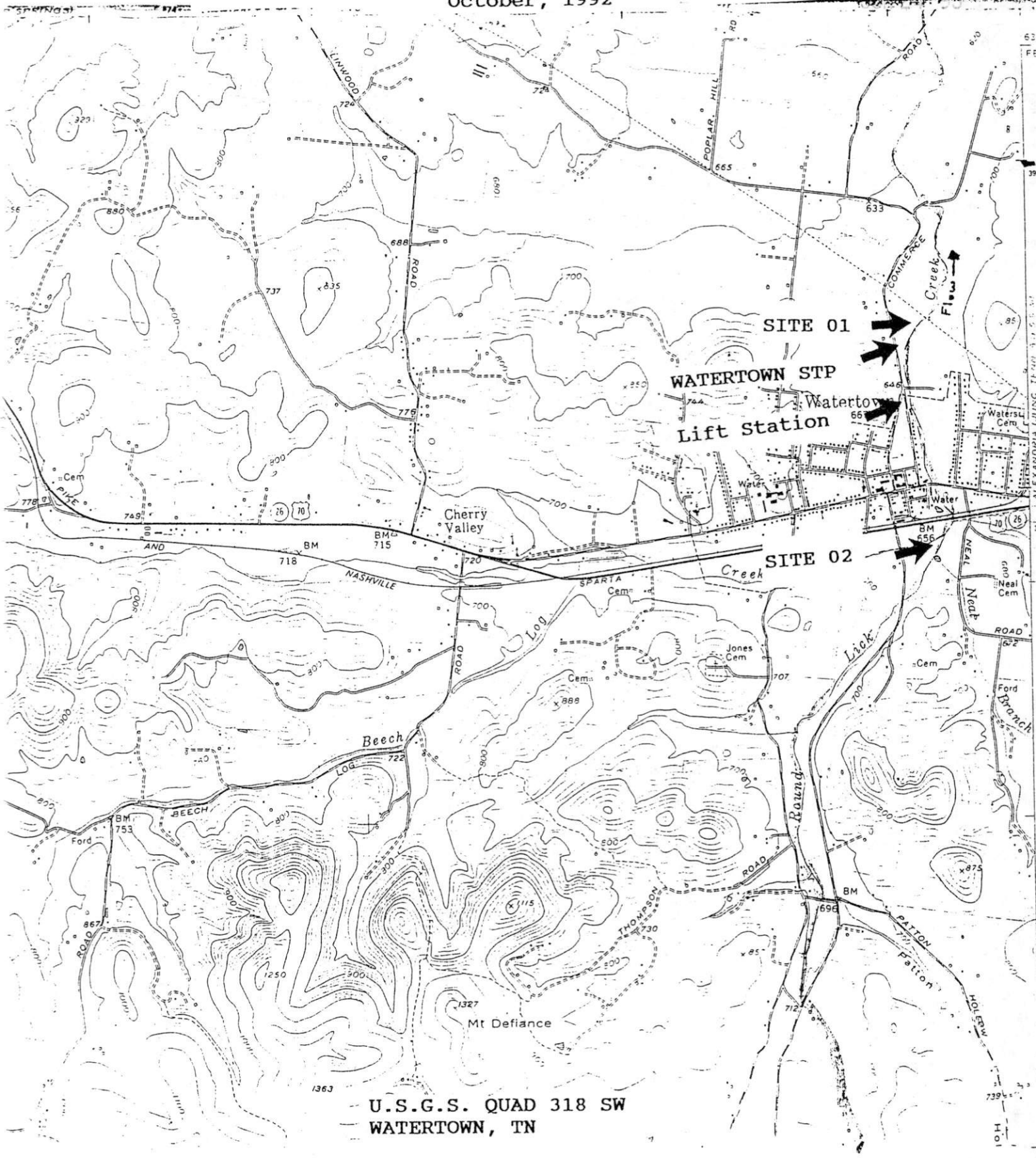
TAXA	SC REL ABUND	RLC REL ABUND	BI	BI * SC REL ABUND	BI * RLC REL ABUND
Coleoptera					
Elmidae					
<i>Dubiraphia vittata</i>	1		3.1	3.1	
<i>Stenelmis sexlineata (adult)</i>	13	4	2.8	36.4	11.2
<i>Stenelmis sexlineata (larvae)</i>	10	2	2.8	28	5.6
Haliplidae					
<i>Peltodytes duodecimpunctatus</i>	1	3	2	2	6
Hydrophilidae					
<i>Berosus sp.</i>	1	6	4.4	4.4	26.4
<i>Enochorus sp. (adult)</i>		1	4.3		4.3
<i>Enochorus sp. (larvae)</i>		1	4.3		4.3
Trichoptera					
Brachycentridae					
<i>Triaenodes sp.</i>	1		0.9	0.9	
Helicopsychidae					
<i>Helicopsyche sp.</i>	3		0		
Hydropsychidae					
<i>Cheumatopsyche sp.</i>	11	6	3.1	34.1	18.6
Diptera					
Ceratopogonidae					
<i>Allaudomyia sp.</i>		3	2		6
<i>Bezzia sp.</i>	1		3	3	
Chironomidae					
pupae undet genus	1	2	*		
Chironominae					
<i>Einfeldia sp.</i>		1	2.8		2.8
<i>Chironomus sp.</i>	3	1	4.8		4.8
<i>Paratendipes sp.</i>		3	1.2	0	
<i>Polypedilum sp.</i>	2	16	*		
<i>Tanytarsus sp.</i>	2	6	*		
Orthoclaadiinae					
<i>Crictopus bicinctus</i>	1		*		
<i>Eukiefferiella sp.</i>		1	2.1		2.1
<i>Orthocladus sp.</i>	1	1	*		
<i>Parametriocnemus sp.</i>		1	*		
Tanyodinae					
<i>Ablabesmyia sp.</i>	1		4.8	4.8	
<i>Clinotanypus sp.</i>		1	4.3		4.3
<i>Larsia sp.</i>		1	3.7		3.7
<i>Procladius sp.</i>		1	4.5		4.5
<i>Rheopelopia sp.</i>	1		1	1	
Simuliidae					
<i>Simulium sp.</i>	2	3	2.4	4.8	7.2
Tipuliidae					
<i>Tipula sp.</i>	1	3	3.9	3.9	11.7
MOLLUSCA					
Gastropoda					
Lymnaidae					
<i>Undet genus</i>	1		*		
Physidae					
<i>Physella sp.</i>	3	1	4.5		
Pleuroceridae					
<i>Undet genus</i>		6	*		
Pelecypoda					
Sphaeriidae					
<i>Undet genus</i>	7	1	*		

TOTAL ABUNDANCE	157	176	BI * ABUNDANCE =	447.5	499.9
ABUNDANCE - * =	140	143			
* = NO BI AVAILABLE			BIOTIC INDEX =	3.196429	3.495804

TOTAL TAXA =	39	40
% INTOLERANT TAXA =	10	0
% FACULTATIVE TAXA	63	62
% TOLERANT TAXA =	27	38

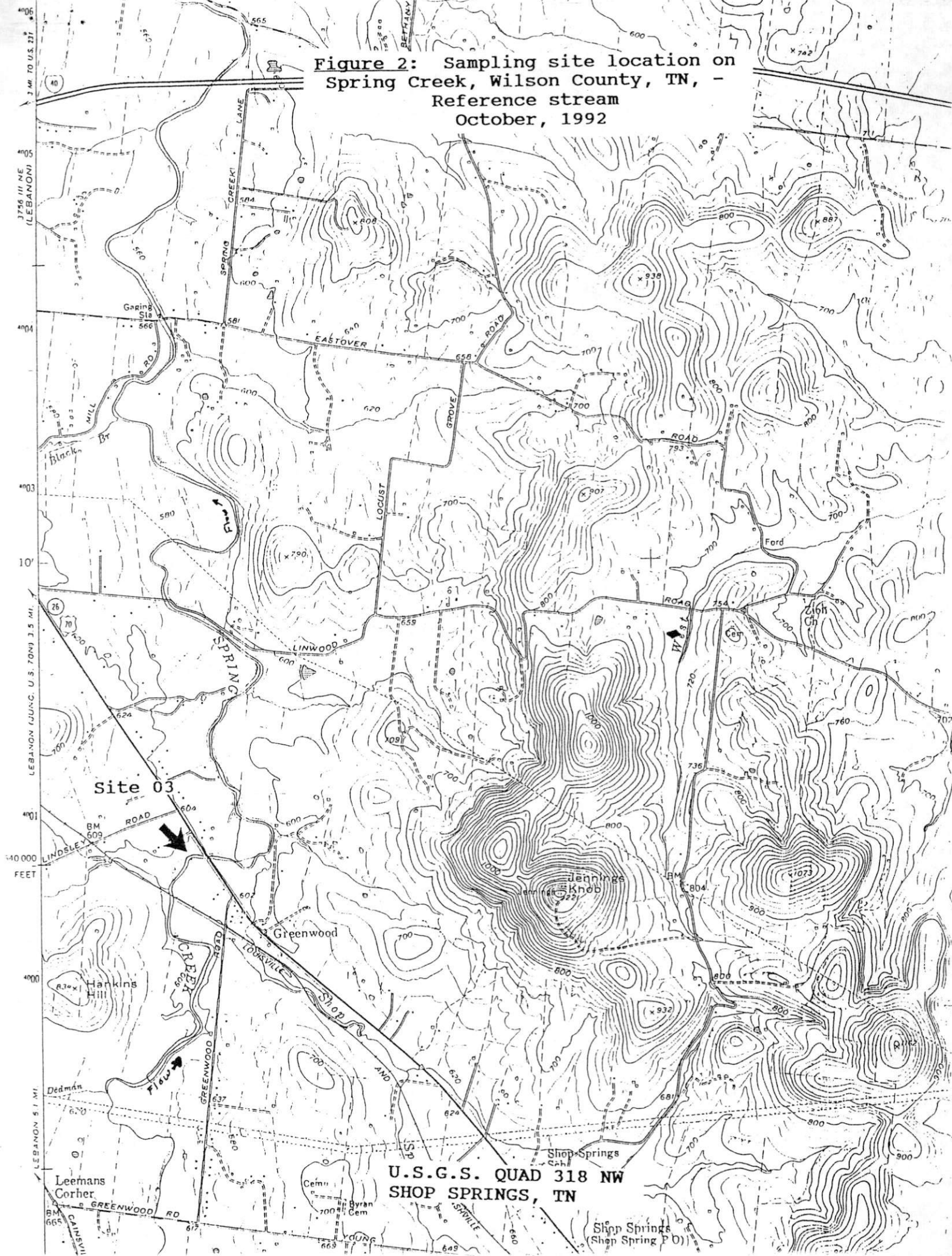
**Figure 1: Sampling site locations on Round Lick Creek, Wilson County, TN, -
upstream and downstream of Watertown STP
October, 1992**

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U.S.G.S. QUAD 318 SW
WATERTOWN, TN

Figure 2: Sampling site location on Spring Creek, Wilson County, TN, - Reference stream October, 1992



Site 03

U.S.G.S. QUAD 318 NW
SHOP SPRINGS, TN

Shop Springs
(Shop Spring P.O.)