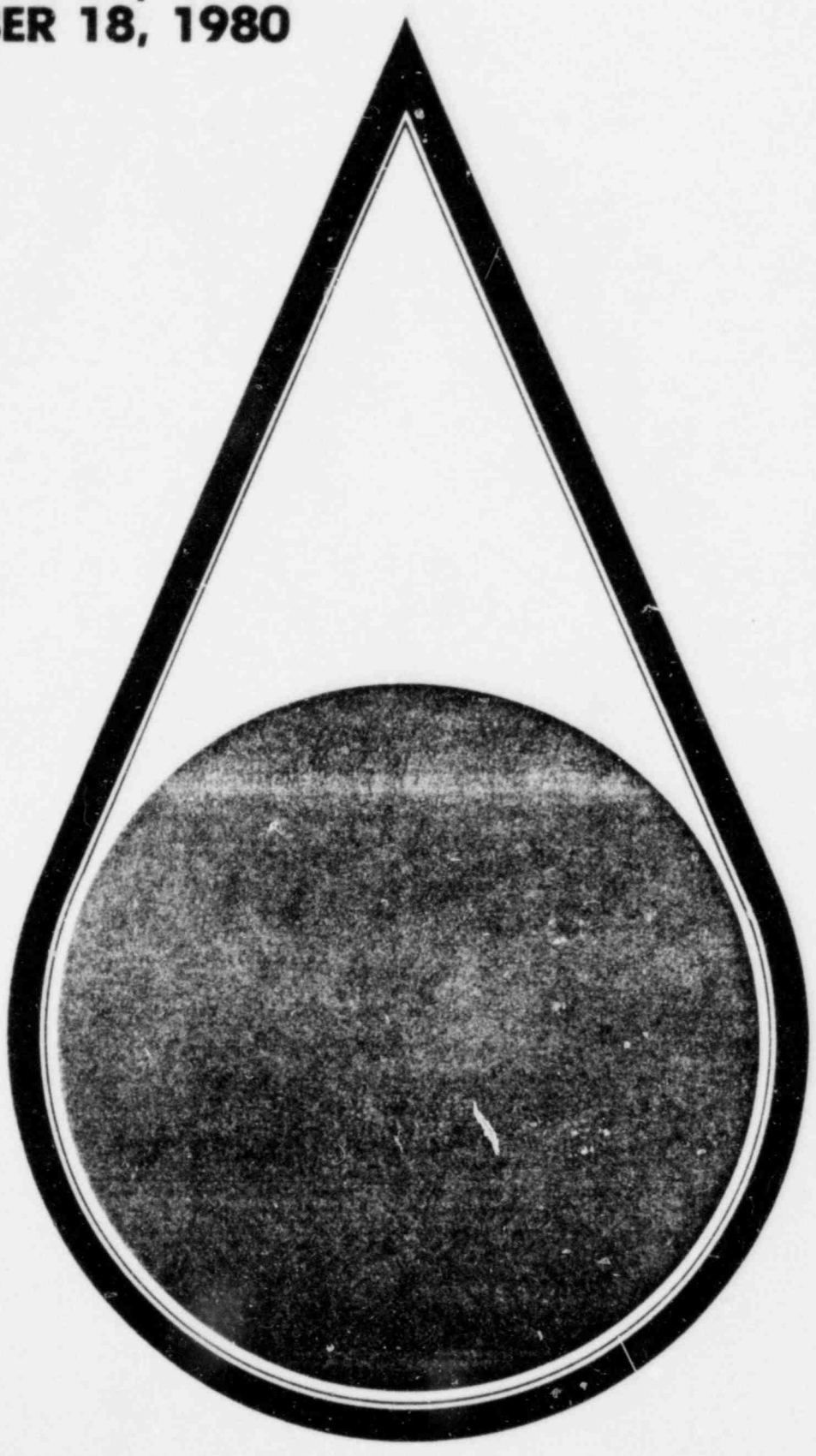
TECHNICAL REPORT SERIES

PHIPPS BEND NUCLEAR PLANT CONSTRUCTION EFFECTS MONITORING REPORT OCTOBER 19, 1979-OCTOBER 18, 1980

December 1980
Division of Water Resources
Office of Natural Resources
Tennessee Valley Authority



TENNESSEE VALLEY AUTHORITY

Office of Natural Resources
Division of Water Resources

PHIPPS BEND NUCLEAR PLANT

CONSTRUCTION EFFECTS MONITORING REPORT

OCTOBER 19, 1979-OCTOBER 18, 1980

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1: INTRODUCTION

The Tennessee Valley Authority (TVA) started construction of the Phipps Bend Nuclear Plant following the issuance of the Limited Work Authorization (LWA) by the Nuclear Regulatory Commission (NRC) on October 18, 1977. TVA has developed and implemented an erosion and sedimentation control plan and a construction effects aquatic monitoring plan as indicated in Part III, Sections G and I of the National Pollutant Discharge Elimination System (NPDES) Permit No. TN0029301.

The aquatic monitoring program consists of onsite monitoring of surface runoff, monitoring of point source discharges identified in the NPDES permit, and limited instream biological monitoring. The program is tied to a feedback mechanism for implementing corrective action before significant adverse impacts occur in the Holston River. Should the results of the runoff monitoring indicate conditions that may have potential for producing significant adverse effects on the aquatic environment, onsite project personnel will be notified to implement corrective action.

This report is to evaluate the aquatic monitoring program for the third year (October 19, 1979 through October 18, 1980) of construction as required by the NPDES permit, Part III, Section I. Included in this report are data from peripheral runoff monitoring, heavy rainfall sampling, instream aquatic macroinvertebrate monitoring, and aquatic macrophyte monitoring. The monitoring of point source discharges as identified in Part I of the NPDES permit have been reported separately in accordance with the requirements in Part I.C.2. Collection of ground water quality data was discontinued in August 1979. Therefore, no further mention of ground water quality will be made in this report.

2: SURFACE WATER RUNOFF

Introduction

Peripheral runoff monitoring was conducted monthly (Table 1) during the past year at five sampling stations PB 13-PB 17 as shown in Figure 1. Five additional sites PB 18, PB 19, and PB 30-PB 32 were added at various times during the year to meet the special needs for additional data. These extra five stations are also shown in Figure 1. The location and description of each sampling station are given in Table 2. Water samples from each site were analyzed for temperature, turbidity, pH, and suspended solids. Construction site inspections (Table 3) were also conducted on a monthly basis.

Precipitation for the past year was measured at the plant site and is presented in Table 4. When the rainfall intensity in the vicinity of the project exceeded 0.3 inches per hour, or 1.0 inches in 24 hours, additional "heavy rainfall" monitoring at selected sampling sites was conducted when deemed necessary by the Project Environmental Engineer. The dates of both routine and special monitoring surveys are given in Table 4.

At the start of the sampling period, five sampling stations existed. These stations were PB 13, PB 14, PB 15, PB 16, and PB 17 (Table 2). On April 3, 1980, a station, PB 30, was added at mile 0.9 of the unnamed tributary to Stony Point Creek. This station was to be a control station for the unnamed tributary and was located upstream of the Alladin Plastics Company discharge and the access railroad drainage area. Two more stations, PB 18 and PB 19, were added on June 10, 1980, for the purpose of sampling the runoff from borrow area "U." These stations were added after it was discovered that approximately one-half acre of disturbed area drains directly to the Holston River. The stations PB 31 and PB 32 were also added on June 10, 1980, to

determine the effects of a hog operation located near Stony Point Creek upstream of construction activities.

Results and Discussion

All monitoring data for the past year including both routine and heavy rainfall peripheral runoff are summarized in Table 5. The monitoring data for the most part were evaluated to detect differences in water quality in peripheral streams between sampling locations upstream of the construction site and those downstream of or on the construction site. In most cases the suspended solids concentration and turbidities for the downstream location for both routine and heavy rainfall were higher than at the upstream location and were statistically significant at high confidence levels. The effect of these parameters on the aquatic biota of Stony Point Creek could not be determined since no biological monitoring was conducted in the creek. The environmental significance with respect to the Holston River is discussed in Sections 3, 4, and 5, Aquatic Macrophyte Community, Aquatic Macroinvertebrate Community, and Conclusions, respectively.

Average suspended solids concentrations and turbidities for routine peripheral runoff monitoring at the downstream location (PB 15, Figure 1) on Stony Point Creek were both approximately 2.5 times greater than at the upstream location (PB 14, Figure 1). For the unnamed tributary, average suspended solids concentration was 2.4 times greater at the downstream location (PB 16, Figure 1) than at the upstream location (PB 30, Figure 1) while turbidity at the downstream location was 1.4 times greater than at the upstream location.

These routine monitoring data were analyzed for statistical significance using t-test for paired observations. This analysis showed that

the differences in suspended solids concentration between upstream and downstream sampling locations on Stony Point Creek and the unnamed tributary were statistically significant at high confidence levels (greater than 90 percent). This analysis indicated that construction activities increased suspended solids concentration and turbidity of the unnamed tributary and Stony Point Creek.

The pH of Stony Point Creek and the unnamed tributary varied little between upstream and downstream sample locations. Average values of 7.8 and 7.6 (upstream) and 7.6 and 7.5 (downstream) were observed in Stony Point Creek and the unnamed tributary, respectively.

Routine data collected upstream and downstream of the hog lot on Stony Point Creek were evaluated to determine if increases in turbidities and suspended solids concentrations resulted from the hog operation. Average turbidity at PB 32, downstream of the hog lot (Figure 1), was 2.6 times greater than average turbidity of PB 31, the upstream location. Average suspended solids concentrations at the downstream location was 4.8 times greater than average suspended solids concentration at the upstream stations. Therefore, the hog lot did account for increases in turbidity and suspended solids concentration noted during routine monitoring at the downstream sampling location on Stony Point Creek.

Routine monitoring data collected in the drainage area from borrow area U were evaluated to determine impact on water quality. Station PB 19 (Figure 1), located at the mouth of an unnamed tributary to the Holston River, collects drainage from borrow area U. Average suspended solids concentration and turbidity at this station were 34 mg/ℓ and 20 Nephelometric Turbidity Units (NTU), respectively. These values indicate the routine drainage from the construction activities in borrow area U have not caused significant

increases in turbidities and suspended solids concentrations in the Holston River since both values meet acceptable runoff criteria. Station PB 18 (Figure 1), located in the drainage ditch from borrow area U, had no flow during routine monitoring surveys and samples were collected only during heavy rainfall sampling.

The major erosion control problems during the recording period were encountered during heavy rainfall events. Greatest turbidities and suspended solids concentrations were recorded during these events. In the drainage area of borrow areas V and W at stations PB 17 and PB 16 on the unnamed tributary to Stony Point Creek, turbidities as high as 29,000 NTU and suspended solids concentrations as high as 31,000 mg/ℓ were recorded. Values of turbidity and suspended solids in Stony Point Creek downstream of the unnamed tributary were recorded as high as 12,000 NTU and 40,000 mg/ℓ.

In all cases suspended solids concentrations and turbidities for heavy rainfall peripheral runoff monitoring data were higher at the downstream location on each stream than at the upstream location. Average suspended solids concentration and turbidity in Stony Point Creek were 11 and 5 times greater, respectively, at the downstream location than the upstream location. Average suspended solids concentration and turbidity in the unnamed tributary was 15.7 and 8.0 times greater, respectively, at the downstream location than the upstream location. The pH values were similar at each location on both streams as observed during routine monitoring.

Heavy rainfall peripheral runoff data were analyzed for statistical significance using the t-test of paired observations and found statistically significant at high confidence levels (above 90 percent). This reinforces the previous indication that construction activities increased suspended solids concentrations and turbidities in Stony Point Creek and the unnamed tributary.

Heavy rainfall monitoring data upstream and downstream of the hog lot on Stony Point Creek yeilded an average suspended solids concentration 1.6 times greater at the downstream location than the upstream location. Average turbidity was 2.2 times greater at the downstream location than the upstream location. The increases can be partially linked to the hog operation as they were during routine monitoring surveys but are, in most cases, insignificant when compared to the increases caused by erosion. It should be noted that the heavy rainfall monitoring data also show contributions of turbidity and suspended solids to Stony Point Creek from runoff upstream of both construction activities and the hog farm, as high as 2,700 NTU and 3,600 mg/ℓ, respectively.

The heavy rainfall monitoring data for the drainage from borrow area U show significant increases in turbidities and suspended solids concentrations when compared to the data collected during the routine monitoring previously discussed. Average turbidity and suspended solids concentration at station PB 18 were 3,100 NTU and 1,300 mg/ℓ, respectively; while at station PB 19 corresponding values were 3,500 NTU and 3,000 mg/ℓ, respectively. Thus, runoff from rainfall associated with construction activities in borrow area U has contributed high levels of turbidity and suspended solids to the Holston River.

Conclusions

Peripheral runoff monitoring data compares closely to that of the previous reporting period (October 19, 1978, to October 19, 1979) in that the suspended solids concentrations and turbidities of Stony Point Creek and the unnamed tributary to Stony Point Creek were usually higher at the downstream location than at the upstream location for both routine and heavy rainfall samples. The operation of a hog lot upstream of the Phipps Bend Nuclear Plant partially contributed to the increased turbidities and suspended solids concentrations observed in Stony Point Creek at the downstream location. Highest turbidities and suspended solids concentrations were recorded during heavy rainfall sampling and the values were generally greater than those recorded during the previous reporting period referenced above. The major contributor to these high values was the unnamed tributary which receives silt from borrow areas V and W. Drainage from borrow area U also contributed turbidity and suspended solids to the Holston River during heavy rainfall events.

During this monitoring period corrective actions were taken to improve erosion control at the Phipps Bend Nuclear Plant. The potential environmental effects of high turbidities and suspended solids concentrations in the unnamed tributary (PB 16 and PB 17) to Stony Point Creek during heavy rainfalls were recognized and a corrective plan initiated. The plan consists of diverting the unnamed tirbutary to the yard holding pond and piping the Alladin Plastics Company wastes (which currently are conveyed to Stony Point Creek via the unnamed tributary) downstream of the diversion dike. This action will allow suspended solids to settle out in the holding pond and preclude their discharge to Stony Point Creek. To reduce the discharge of suspended solids from borrow area U straw filter dams have been

installed. If future monitoring shows that the new straw dams are inadequate, additional corrective measures will be implemented as soon as possible.

From the analyses of data obtained during the reporting period, it can be seen that construction activities have resulted in the discharge of suspended solids to Stony Point Creek and the Holston River. As indicated in the Results and Discussion section, the effect of the turbidity and suspended solids on Stony Point Creek is currently unknown since no instream biological monitoring has been conducted in the creek. The effect of the parameters on the Holston River is discussed in the following sections 3, 4, and 5.

3: AQUATIC MACROPHYTES

Introduction

The Holston River is a unique riverine system in the Tennessee Valley due to large numbers of aquatic macrophytes that inhabit the system. Young et al. (1980) reported the productivity of aquatic plants in the Holston River above Cherokee Reservoir was 16.6 mt/ha/yr, a rate much higher than reported for other rivers in temperate regions of North America.

The aquatic macrophyte monitoring program consisted of two surveys along the Holston River in the vicinity of the Phipps Bend construction site on May 14, 1980, and August 22, 1980. Species frequency data were collected at HRM 119.8 and HRM 122.8 and standing crop estimates made at HRM 119.9 and HRM 125.6 (Figure 3). Standing crop estimates for aquatic macrophytes were obtained by removing all plants from ten 0.1 m^2 quadrats at approximate 2-meter intervals along a belt transect at two permanent stations. Samples were separated by species, ashed, and the mean standing crop expressed as g/m^2. Species frequency samples were obtained by making five throws of a drag chain with U-shaped hooks at 10 equidistant stations across each transect. The number of times that a given species occurred in the 50 samples was then expressed as a percent. In addition, an aerial overflight was conducted on July 19, 1980, to obtain color imagery for the assessment of construction effects on the aquatic macrophyte community in the vicinity of the Phipps Bend site.

In an effort to discern trends in standing crop, 95 percent confidence limits were calculated for each mean for the two stations

during the monitoring period. For comparative purposes, the samples were divided into those collected in the spring and those collected in late summer and early fall (Figures 4 and 5).

Results and Discussion

Surveys of the Holston River in the Phipps Bend area revealed a macrophyte flora composed primarily of sago pondweed (Potamogeton pectinatus L.), American pondweed (P. nodosus Poir.), curlyleaf pondweed (P. crispus L.), waterstargrass !Heteranthera dubia (Jacquin) MacM.1, tapegrass or eelgrass (Vallisneria americana Michx.), Canadian elodea (Elodea canadensis Michx.), and the aquatic mosses, Fissidens fontanus (B.-Pyl.) Steud. and Leptodictyum riparium (Hedw.) Warnst. Figure 6 is a generalized map of the aquatic macrophyte community in the vicinity of the Phipps Bend site. No significant changes were noted in the macrophyte community during this monitoring period that appeared related to construction activities, and no plants were observed that exhibited abnormalities in growth or form.

A standing crop of 84.6 g/m^2 of ash free dry weight was estimated at the upstream sampling station (HRM 125.6) in August 1980 compared to 74.5 g/m^2 in May 1980 (Table 7). The species having the greatest standing crop in May 1980 was sago pondweed with curlyleaf pondweed and waterstargrass comprising a substantial percentage of the total standing crop. Sago pondweed, waterstargrass, and curlyleaf pondweed were dominant species during August 1980 (Table 7). At the downstream station (HRM 119.9), standing crop estimates were 31.1 g/m^2 in May 1980 and 228.2 g/m^2 in

August 1980 (Figure 5). Sago pondweed and waterstargrass dominated in May and eelgrass, sago pondweed, and waterstargrass dominated in August (Table 7). Increased standing crop estimates from May to August at both were indicative of normal seasonal growth.

At the upstream station (HRM 125.5), the fluctuations in standing crop were within the range expected as a result of seasonal growth and cyclic fluctuations in macrophyte communities (Figures 4A and B). Although the April 1978 estimate was lower than any other sample periods, these data were collected earlier in the growing season. However, there was a decrease from 1979 standing crop estimates during both 1980 sample periods.

Standing crop estimates of macrophytes at the lower station (HRM 119.9) during the early growing season (e.g., April, May, June) were similar throughout the monitoring period (Figure 5A). The estimate of 11.4 g/m^2 for April 1978 was lower than previous years but again, data were collected much earlier in the growing season. Substantial increases in standing crops were noted in September 1979 and August 1980 compared to previous years (Figure 5B). However, the means of previous years (e.g., 1974, 1977, 1978) are within 95 percent confidence limits of the 1979 and 1980 estimates. Increases in the 1979 and 1980 estimates resulted from greater abundance of eelgrass, a species which inhabits rock crevices along much of the upper Holston River. Increased siltation could potentially create a more favorable habitat for eelgrass by forming soil pockets in depressions and crevices in the bedrock. Additionally, added nutrients to the system could result in increased growth of eelgrass. It is not known

whether the increase represented a natural cyclic phenomenon or could be attributed to site runoff and siltation resulting from construction activities at the Phipps Bend site or other ecological perturbations further upstream.

Additional data relating to biomass and productivity of aquatic macrophytes along the Holston River in the vicinity of the Phipps Bend site have been summarized by Young et al. (1980). Since two of their sampling stations (Stations 3 and 4) essentially correspond with those sampled as a part of the Phipps Bend Construction effects monitoring program, they provide baseline data for future monitoring programs.

In samples from HRM 122.8 sago pondweed and filamentous algae had the highest frequencies during the May sample period, while sago pondweed, American pondweed, and eelgrass had the highest frequencies in August samples (Table 8). At HRM 119.8 sago pondweed, filamentous algae, and aquatic mosses had highest frequencies in May (Table 8), while sago pondweed, eelgrass, the aquatic mosses were most frequenct during August. At both stations frequency of filamentous algae was substantially reduced from May to August. Frequency of eelgrass increased from May to August at both stations and it was one of the dominant species in August.

Conclusions

Field observations in 1980 did not reveal significant changes in the aquatic macrophyte community. Standing crop estimates at the upstream station (HRM 125.6) were within the expected range as were spring estimates at the downstream station (HRM 119.9). Increased

standing crop was noted in the fall sample at HRM 119.9. It is not known whether the increase is a natural phenomenon or related to construction at the Phipps Bend site. Variation in species frequency of aquatic macrophytes probably reflected normal seasonal growth and succession rather than a response to turbidity or other factors associated with construction activities.

Literature Cited

Young, R. C., W. M. Dennis, and N. E. Carriker. 1980. Quantification of Allochthonous Organic Input to Cherokee Reservoir: Implications to Hypolimnetic Oxygen Depletions. Paper presented at the International Symposium for Inland Waters and Lake Restorations, September 8-12, 1980 Portland, Maine.

4: AQUATIC MACROINVERTEBRATE COMMUNITY

Introduction

The aquatic macroinvertebrate community monitoring program and methods have been described in the October 1978 and October 1979, "Phipps Bend Nuclear Plant Construction Effects Monitoring Reports." The information in this report represents monthly sampling at four sites between October 1979 and January 1980. Macroinvertebrate sampling was terminated in January 1980, based on results from the report cited above, and was agreed to by NRC and EPA.

Results and Discussion

Macroinvertebrates colonizing artificial substrates were collected at stations identified in Table 9. During this period (October 1979 through January 1980), 51 taxa representing 4 phyla and 17 orders were collected (Table 10). Quantitative enumeration data (mean number/substrate) and associated statistics for each taxon by month and river mile are presented in Appendix A. Most abundant taxa collected were: Pleurocera sp., Hydropsyche sp., Chironomidae, Planariidae, Stenonema sp., and Baetis sp. The highest mean number of organisms (284.0/substrate) occurred at HRM 119.0 in November 1979 and the lowest (21.5/substrate) occurred at HRM 115.0 in October and December 1979.

Macroinvertebrate taxa collected from natural substrate samples, October 1979 through January 1980, are listed in Table 11. Twenty-nine taxa representing 4 phyla and 13 orders were collected.

Molluscan and nonmolluscan invertebrate biomass values recorded from the artificial substrates are given in Table 12. Mean molluscan biomass values

ranged from zero to 71,225 mg/substrate and nonmolluscan invertebrate biomass from 74 to 38,026 mg/substrate. A taxomonic presence/absence listing by month and station is presented in Table 13.

Diversity indices ($\overline{d}$) for the macroinvertebrates collected on artificial substrates at each station are presented in Table 14. Diversity values ranged from 0.35 (HRM 119.0, November 1979) to 3.68 (HRM 124.3, November 1979). Low diversity indices ($\overline{d}$) found at HRM 119.0 were attributed to high numbers of Pleurocera sp. and the loss of one out of two samples collected during both the October and November sample periods. These were the only sample periods with $\overline{d}$ values lower than 1.75 (Table 14).

Conclusions

Mean numbers of organisms and diversities found in this survey are generally slightly higher than for the same months in the previous survey. It is concluded that the macroinvertebrate community of the Holston River remains relatively diverse and has not been significantly altered by construction activities at Phipps Bend.

5: CONCLUSIONS

Turbidities and suspended solids concentrations in both Stony Point Creek and the unnamed tributary to Stony Point Creek were usually higher downstream than upstream. This was partially due to runoff not associated with TVA and operation of a hog farm upstream of the Phipps Bend construction site. However, most of the increased turbidities and suspended solids concentrations was due to construction activities. Runoff from borrow area U was also a source of high turbidities and suspended solids concentrations during the monitoring period. Corrective actions were initiated to minimize the environmental impacts of construction runoff. These included building and replacing straw dams, seeding and mulching of disturbed slopes, and implementation of a plan to divert the unnamed tributary into the yard holding pond.

Effects of increased turbidities and suspended solids on the aquatic environment of the Holston River were minimal. Taxonomic composition and biomass data recorded for the macrophyte and macroinvertebrate communities in the study area did not reveal effects that could be associated with construction activities at Phipps Bend Nuclear Plant.

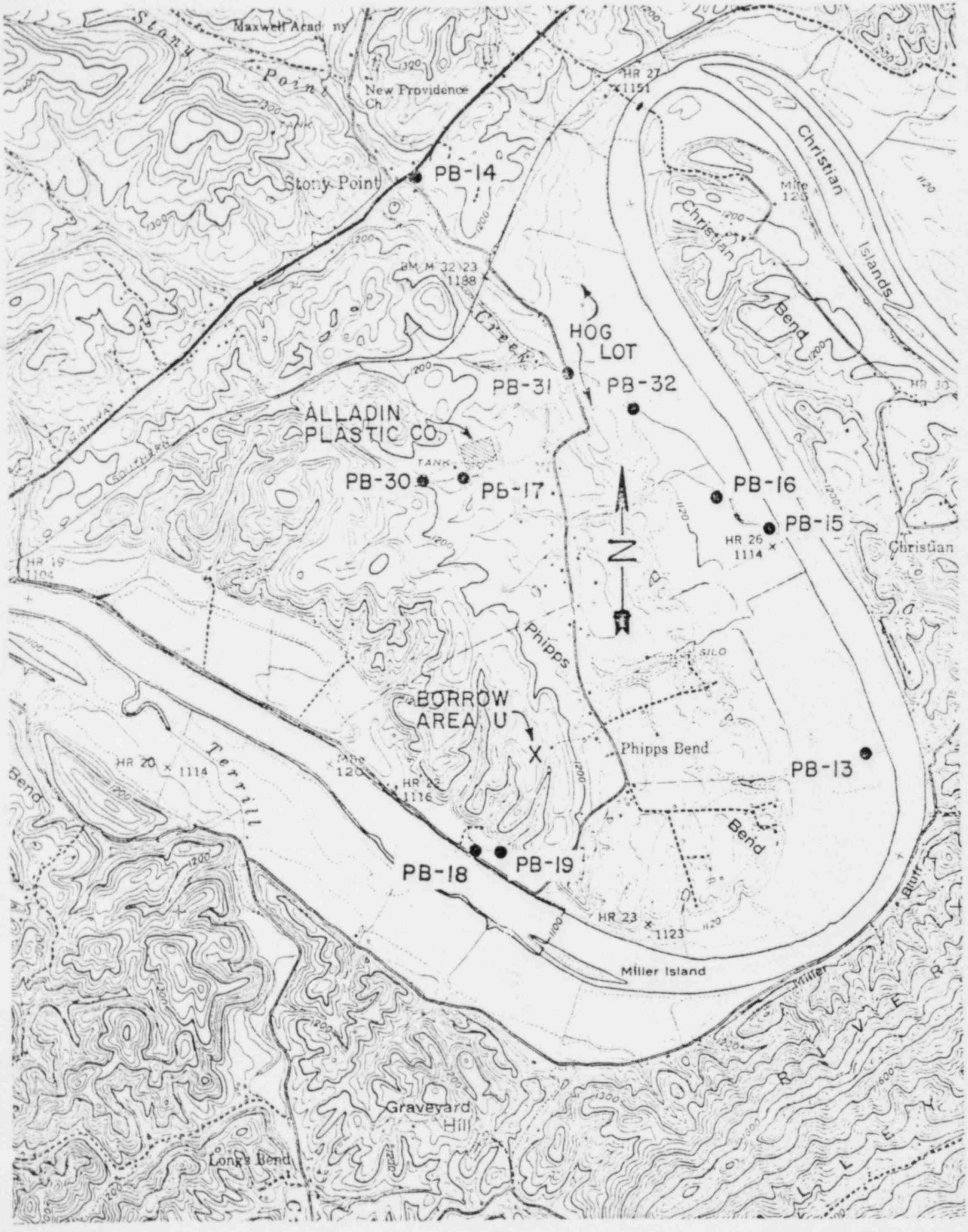

FIGURE: I

PHIPPS BEND CONSTRUCTION RUN-OFF SAMPLE SITES

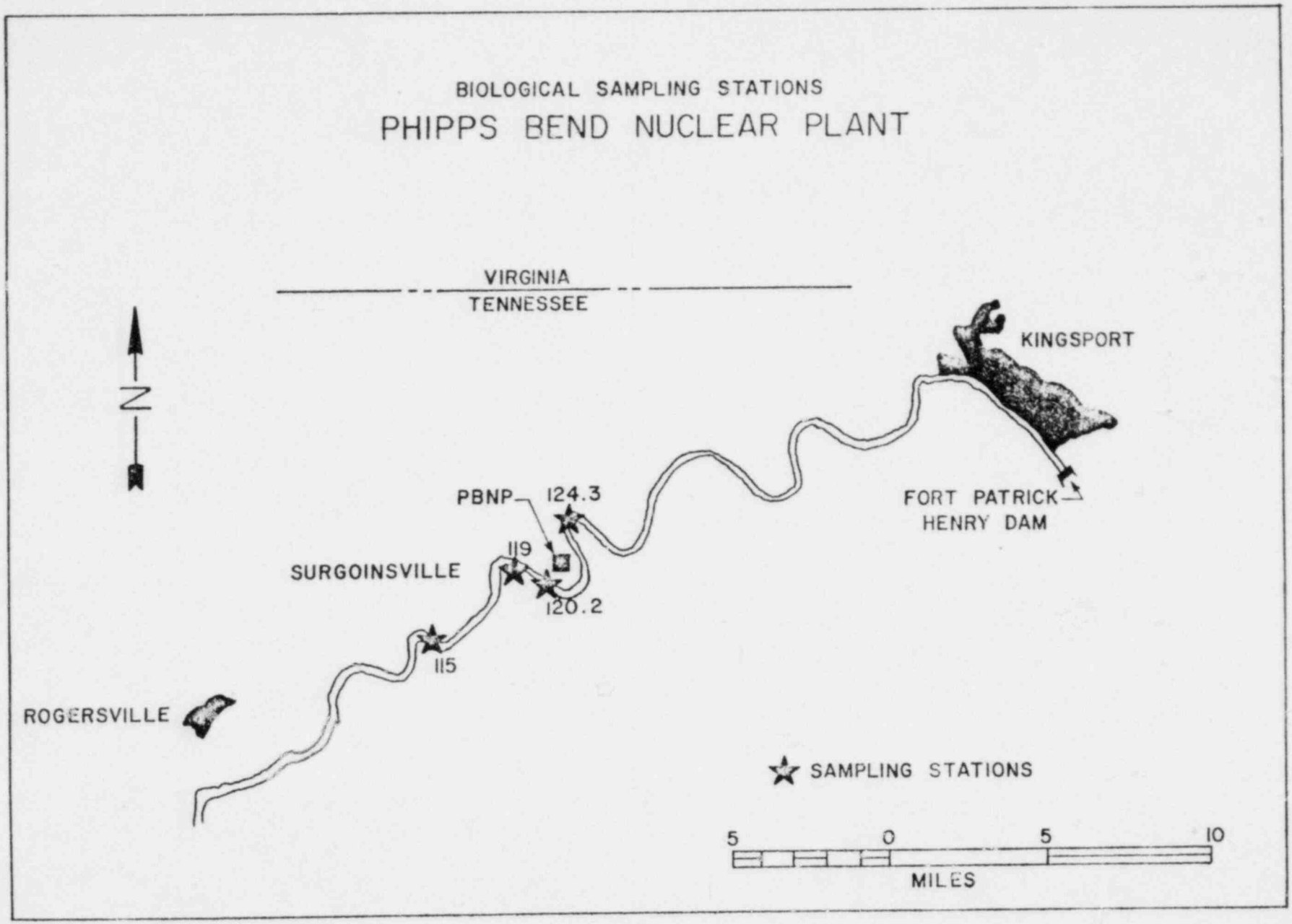
BIOLOGICAL SAMPLING STATIONS
PHIPPS BEND NUCLEAR PLANT
VIRGINIA
TENNESSEE
N
KINGSPORT
PBNP
124.3
FORT PATRICK
HENRY DAM
119
SURGOINSVILLE
120.2
115
ROGERSVILLE
SAMPLING STATIONS
5
0
5
10
MILES

FIGURE: 2

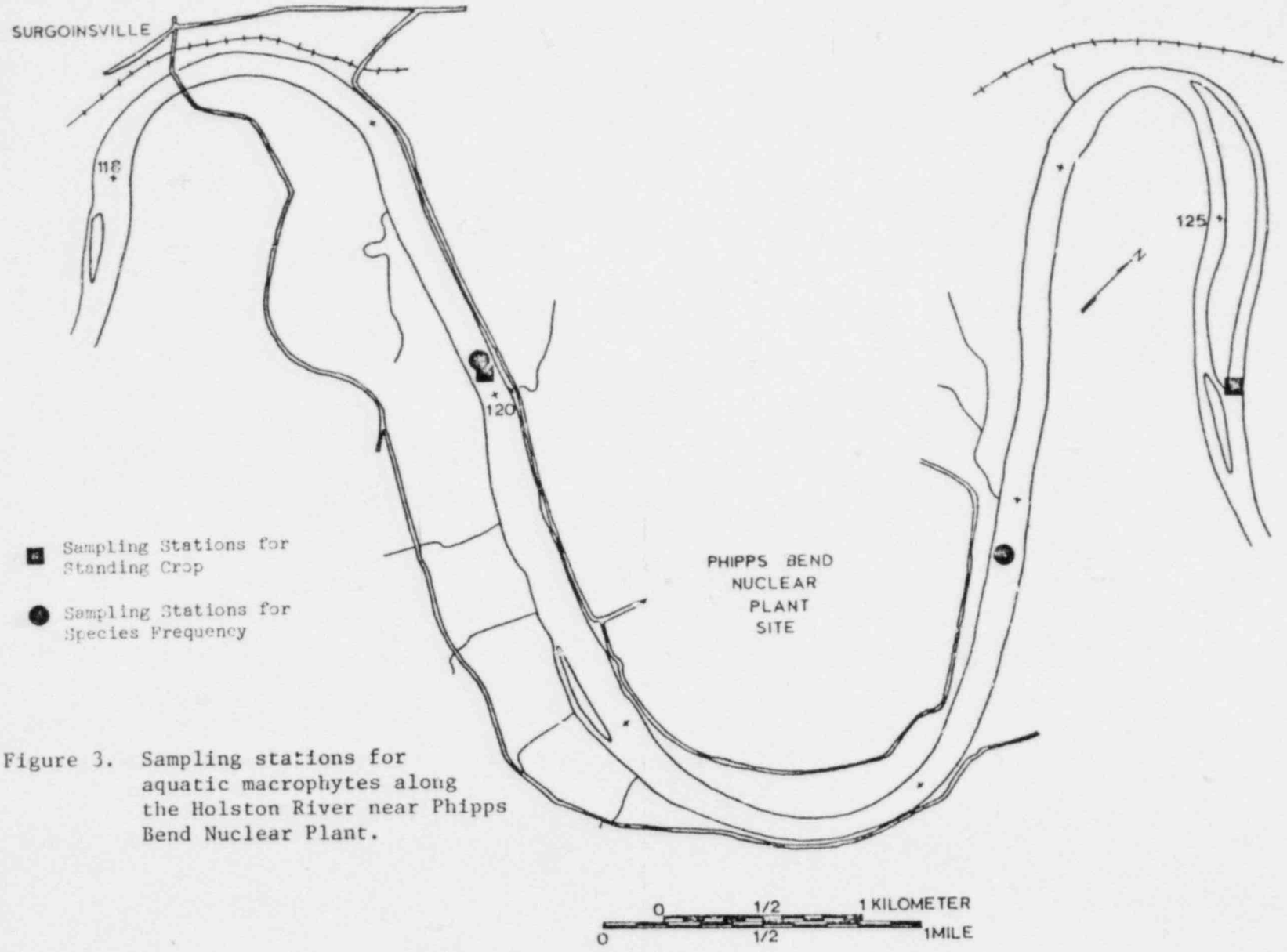

Figure 3. Sampling stations for aquatic macrophytes along the Holston River near Phipps Bend Nuclear Plant.

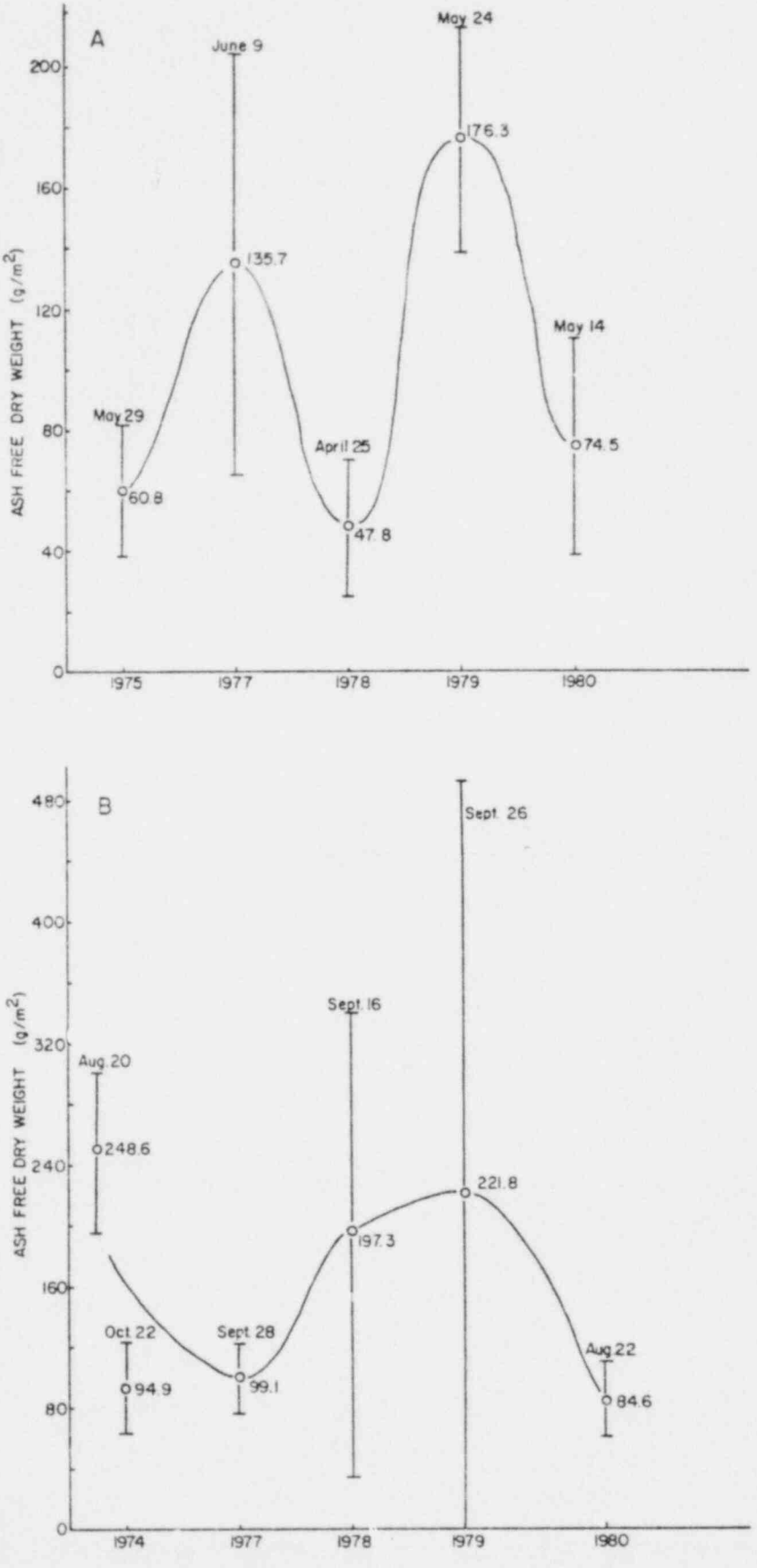

Figure 4. Mean standing crop and 95 percent confidence limits for Aquatic Macrophytes at HRM 125.6.

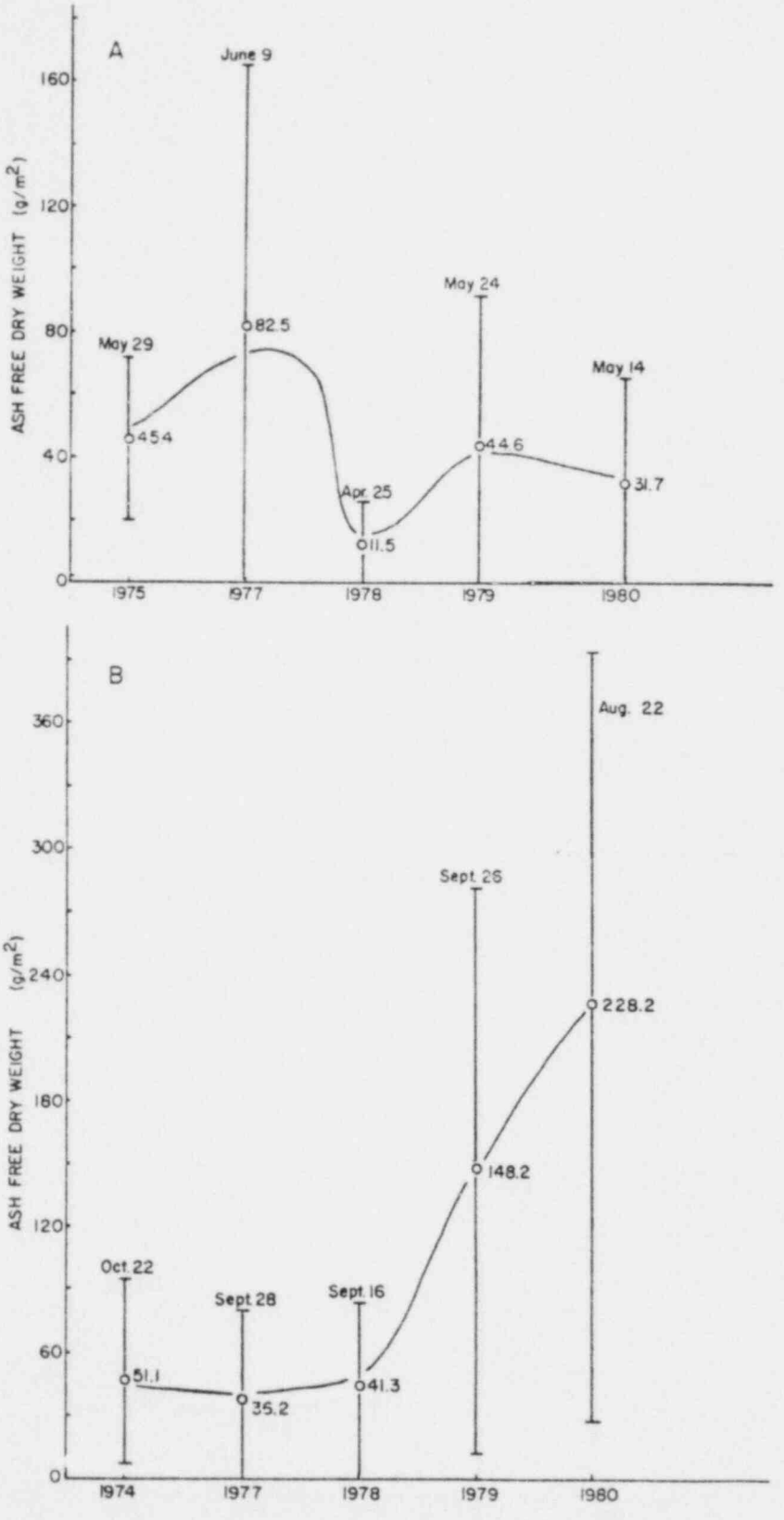

Figure 5. Mean standing crop and 95 percent confidence limits for Aquatic Macrophytes at HRM 119.9.

FIGURE 6

PHIPPS BEND - HOLSTON RIVER

AQUATIC MACROPHYTE COMMUNITIES - 1980

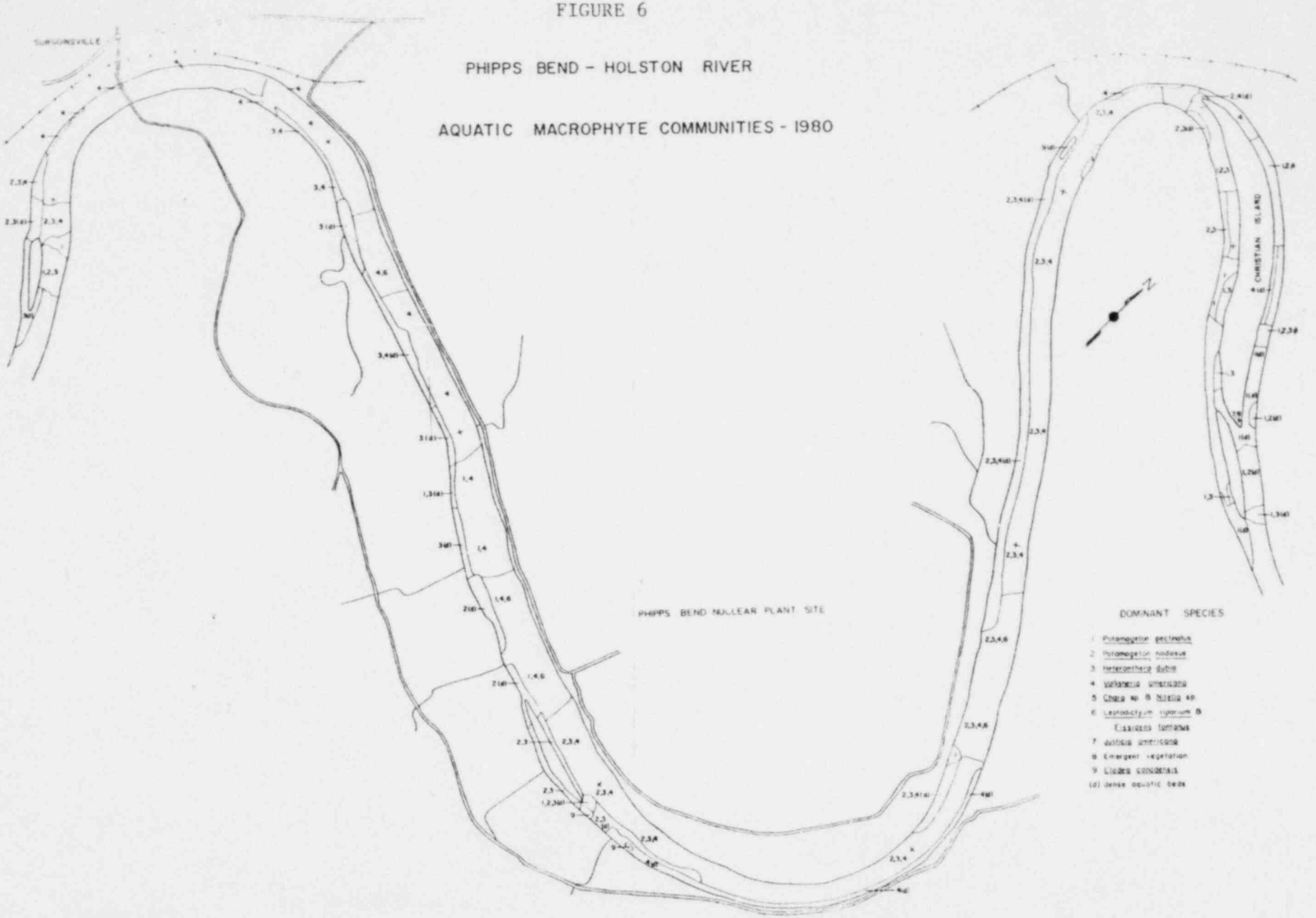

Table 1

PHIPPS BEND MONITORING SURVEY DATES

Scheduled Peripheral Runoff Monitoring	Heavy Rainfall Incidents Selected for Runoff Monitoring
11/13/79	11/11/79
12/4/79	1/22/80
1/8/80	3/17/80
2/5/80	7/11/80
3/11/80	8/1/80
4/3/80	9/25/80
5/7/80	
6/10/80	
7/8/80	
8/5/80	
9/5/80	
10/11/80	

Macroinvertebrate Monitoring	Macrophyte Monitoring
10/17/79	5/14/80
11/14/79	7/19/80 (aerial overflight)
12/3/80	8/22/80
1/7/80	

Table 2

DESCRIPTION OF SAMPLING STATIONS
FOR MONITORING SURFACE RUNOFF

Station	Location	Description
PB 13	Yard holding pond discharge	Overflow discharge structure
PB 14	Stony Point Creek Mile 1.7	Upper Stony Point Creek at Highway 11W Bridge
PB 15	Stony Point Creek Mile 0.1	Mouth of Stony Point Creek
PB 16	Unnamed Tributary Mile 0.1 to Stony Point Creek Mile 0.25	Mouth of Unnamed Tributary to Stony Point Creek
PB 17	Unnamed Tributary Mile 0.75 to Stony Point Creek Mile 0.25	Located near Alladin Plastic Company
PB 18	Unnamed Tributary Mile .01 to Holston River Mile 120.4	Small stream which collects runoff from Borrow Area U
PB 19	Drainage ditch mile .01 to Unnamed Tributary Mile 0.2 to Holston River Mile 120.4	Borrow Area U drainage ditch
PB 30	Unnamed Tributary Mile 0.9 to Stony Point Creek Mile 0.2	West of access railroad at Aladin Plastic Company
PB 31	Stony Point Creek Mile 0.85	Station above the hog lot
PB 32	Stony Point Creek Mile 0.60	Station below the hog lot

Table 3

PHIPPS BEND CONSTRUCTION SITE INSPECTION DATES

Routine Monthly Inspections	Special Inspections
11/6/79	Warehouse site 3/27/80
12/4/79	Borrow Area U 5/12/80
1/8/80	
2/5/80	
3/10/80	
4/3/80	
5/6/80	
6/10/80	
7/8/80	
8/5/80	
9/5/80	
10/10/80	

Table 4

PRECIPITATION RECORDS
PHIPPS BEND NUCLEAR PLANT CONSTRUCTION SITE
OCTOBER 19, 1979-OCTOBER 18, 1980
(inches of rainfall for 24-hour period)

Day of Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1	–	1.25	–	–	–	–	–	–	–	–	0.87[a]	–	–
2	–	–	–	–	–	0.66[b,c]	–	–	–	1.18[a]	–	–	0.16
3	–	–	–	–	–	–	0.57	–	–	0.65	–	–	–
4	–	–	–	T[d]	–	0.51	–	–	–	–	0.12	0.05	–
5	–	–	–	–	–	0.01	–	–	–	–	0.02	–	0.07
6	–	–	0.07	1.86[c]	1.25[b]	–	–	0.36	–	–	–	–	–
7	–	–	–	–	T[b,d]	–	–	0.15	–	–	–	–	–
8	–	0.02	–	–	–	–	0.43	–	–	0.30	–	–	–
9	–	0.97	–	0.02	–	0.82[c]	–	–	–	0.11	–	1.57[a]	–
10	–	–	–	–	0.41[b,c]	–	–	–	–	1.06[a]	–	–	–
11	–	1.21[c]	–	0.21	–	–	–	–	–	–	0.14	–	–
12	–	–	0.65	–	–	–	–	–	–	–	–	–	–
13	–	–	–	0.51[c]	–	–	0.94[c]	0.08	–	–	–	–	–
14	–	–	–	0.08	–	–	–	–	–	–	–	–	–
15	–	–	–	–	–	–	–	–	–	–	–	–	–
16	–	–	–	–	–	0.51[c]	–	0.91	0.25	–	–	–	–
17	–	–	–	0.86	0.87[c]	0.59[a]	–	–	0.04	–	–	0.45	–
18	–	–	–	0.22	–	–	–	–	–	–	0.08	–	–
19	–	–	0.01	–	–	–	–	0.36	–	–	0.64	–	–
20	–	–	–	–	0.69	1.72[a]	–	0.39	–	–	0.49	–	0.71
21	–	–	0.01	–	0.11	–	–	–	–	–	0.06	0.78	–
22	0.31	–	–	1.06[a]	–	–	–	0.05	–	0.10	–	0.04	–
23	–	–	–	–	–	–	–	0.11	0.16	–	–	–	–
24	–	–	0.14[a]	–	–	0.45	0.27	–	0.86	–	–	0.29	–
25	–	–	1.02[a]	–	T[d]	–	–	–	0.11	–	–	1.04[a]	–
26	–	–	0.12	–	–	–	–	–	–	–	–	0.45	–
27	–	–	–	–	–	–	1.11[c]	–	–	1.47[c]	–	–	–
28	–	–	–	–	–	0.73	0.19	–	–	–	–	–	–
29	–	–	–	–	–	–	0.15	0.02	0.02[c]	–	0.18	0.16	–
30	–	–	–	–	–	0.02[c]	–	–	–	–	–	–	–
31	–	–	–	–	–	–	–	0.16[c]	–	–	–	–	–

a. Heavy rainfall b. Melted snowfall c. Weekend precipitation d. Trace

Table 5

RESULTS OF ROUTINE AND HEAVY RAINFALL PERIPHERAL RUNOFF MONITORING
PHIPPS BEND NUCLEAR PLANT, CALENDAR YEAR 1980

STORET RETRIEVAL DATE 80/11/29

476212
36 29 23.0 082 49 15.0 2
HWY. 11 BRIDGE
47073 TENNESSEE
HOLSTON RIVER BASIN
SIDNEY POINT CREEK 1.7
13ITVAC 790505
0000 FEET DEPTH CLASS ..

STATION: PB 14
/TYPA/AMBNT/STREAM

DATE FROM TO	TIME OF DAY	DEPTH FEET	00002 HSAMPLOC % FROM RT BANK	00098 VSAMPLOC DEPTH METERS	00010 WATER TEMP CENT	00400 PH SU	00530 RESIDUE TOT NFLT MG/L	00070 TURB JKSN JTU
79/10/16	15 25	0001	50.0	0.30	18.0	6.90	3	1.3
79/11/12	11 00	0001	50.0	0.30		8.00	16	5.9
79/11/13	17 45	0001	50.0	0.30	11.0	7.80	24	7.2
79/12/04	12 49	0001	95.0	0.30	7.0	7.30	3	4.8
80/01/08	08 30	0001	95.0	0.30		7.10	17	14.0
80/01/23	10 00	0001	95.0	0.30		7.20	40	22.0
80/02/05	15 20	0001	50.0	0.30	6.0	7.70	4	2.0
80/03/11	09 50	0001	50.0	0.30	9.0	7.60	5	11.0
80/03/18	10 00	0001	50.0	0.30		7.60	25	28.0
80/04/03	11 10	0001	50.0	0.30	12.8	8.20	7	2.3
80/05/07	10 55	0001	50.0	0.30	10.3	8.60	10	1.7
80/06/10	10 35	0001	50.0	0.30	16.0	8.30	5	2.7
80/07/08	10 00	0001	50.0	0.30	17.0	7.80	14	7.1
80/07/11	16 00	0001	50.0	0.30		7.20	3600	2700.0
80/08/01	15 00	0001	50.0	0.30			250	150.0
80/08/05	14 47	0001	50.0	0.30	19.0	7.90	10	8.1
80/09/05	11 25	0001	50.0	0.30	20.0	7.60	9	5.2
80/09/25	14 30	0001	50.0	0.30		7.40	140	70.0
80/10/09	12 56	0001	50.0	0.30	16.0	8.20	2	3.1
80/11/06	12 10	0001	50.0	0.30	12.5	8.10	4	1.8
NUMBER			20	20	13	15	20	2.
MAXIMUM			95.0000	.300000	20.0000	8.60000	3600.00	2700.00
MINIMUM			50.0000	.300000	6.00000	6.90000	2.00000	1.30000
MEAN			56.7500	.299999	13.4308	7.71053	209.400	157.400

Table 5 (continued)

STORET RETRIEVAL DATE 80/11/24

476213
36 29 23.0 082 49 15.0 2
TRIBUTARY TO HOLSTON RIVER 123.0
47073 TENNESSEE HAWKINS
HOLSTON RIVER BASIN 040200
SIDNEY POINT CREEK 0.1
13ITVAC 79672E
0000 FEET DEPTH CLASS 00

STATION: PB 15
/TYPA/AMBNT/STREAM

DATE FROM TO	TIME OF DAY	DEPTH FEET	00002 HSAMPLOC % FROM RT BANK	00098 VSAMPLOC DEPTH METERS	00010 WATER TEMP CENT	00400 PH SU	00530 RESIDUE TOT NFLT MG/L	00070 TURB JKSN JTU
79/10/16	14 50	0001	50.0	0.30	16.5	6.30	6	3.0
79/11/12	11 00	0001	50.0	0.30		7.60	55	22.0
79/11/13	16 15	0001	50.0	0.30	13.0	7.70	15	9.0
79/12/04	11 45	0001	99.0	0.30	3.0	7.50	12	3.5
80/01/08	08 30	0001	95.0	0.30		7.00	22	20.0
80/01/23	10 00	0001	95.0	0.30		7.20	11	27.0
80/02/05	14 10	0001	50.0	0.30	3.8	7.60	34	8.8
80/03/11	10 20	0001	99.0	0.30	8.0	7.50	19	20.0
80/03/18	10 00	0001	99.0	0.30		7.60	39	50.0
80/04/03	11 15	0001	99.0	0.30	15.0	8.00	19	5.4
80/05/07	11 30	0001	50.0	0.30	10.8	8.00	72	30.0
80/06/10	11 50	0001	50.0	0.30	18.0	7.70	5	4.0
80/07/08	13 30	0001	50.0	0.30	20.0	7.70	32	36.0
80/07/11	15 00	0001	99.0	0.30		7.10	40000	12000.0
80/08/01	15 00	0001	90.0	0.30			19000	11000.0
80/08/05	11 21	0001	90.0	0.30	24.0	7.70	30	27.0
80/09/05	10 35	0001	50.0	0.30	22.0	7.60	17	18.0
80/09/25	14 30	0001	50.0	0.30		7.30	2700	1700.0
80/10/09	11 52	0001	50.0	0.30	16.5	7.90	12	16.0
80/11/06	12 20	0001	50.0	0.30	10.0	8.10	3	2.2
	NUMBER		20	20	[illegible]	19	20	20
	MAXIMUM		99.0000	.300000	24.0000	8.10000	40000.0	12000.0
	MINIMUM		50.0000	.300000	3.00000	6.30000	3.00000	2.20000
	MEAN		70.7500	.299999	13.8923	7.54210	3105.20	125[illegible]

Table 5 (continued)

STORET RETRIEVAL DATE 80/11/24

476219
36 28 35.0 082 46 15.0 2
TRIB. TO STONEY POINT CREEK 0.25
47073 TENNESSEE
HOLSTON RIVER BASIN
UNNAMED TRIBUTARY 0.1
1311VAC 790505
0000 FEET DEPTH CLASS 00

STATION: PB 16
/TYPA/AMBNT/STREAM

DATE FROM TO	TIME OF DAY	DEPTH FEET	00002 HSAMPLOC % FROM RT BANK	00098 VSAMPLOC DEPTH METERS	00010 WATER TEMP CENT	00400 PH SU	00530 RESIDUE TOT NFLT MG/L	00070 TURB JKSN JTU
79/10/16	15 10	0001	50.0	0.30	19.0	6.70	23	7.7
79/11/12	11 00	0001	50.0	0.30		7.60	11	10.0
79/11/13	17 15	0001	50.0	0.30	11.0	7.70	36	37.0
79/12/04	12 10	0001	99.0	0.30	4.0	7.60	6	4.4
80/01/08	08 30	0001	95.0	0.30		6.70	9	16.0
80/01/23	10 00	0001	95.0	0.30		7.00	30	34.0
80/02/05	14 50	0001	50.0	0.30	3.8	7.60	9	6.2
80/03/11	10 40	0001	99.0	0.30	8.0	7.30	59	80.0
80/03/18	10 00	0001	99.0	0.30		7.40	120	120.0
80/04/03	11 30	0001	99.0	0.30	17.0	7.90	47	20.0
80/05/17	11 45	0001	50.0	0.30	19.8	7.90	110	50.0
80/06/10	11 45	0001	50.0	0.30	18.0	8.00	15	12.0
80/07/08	13 20	0001	50.0	0.30	20.0	7.90	19	17.0
80/07/11	16 00	0001	99.0	0.30		7.20	31000	29000.0
*80/08/01	15 00	0001	50.0	0.30			7	15.0
*80/08/05	12 37	0001	50.0	0.30	23.0	7.70	17000	9300.0
80/09/05	10 43	0001	50.0	0.30	21.0	7.90	5	4.4
80/09/25	14 30	0001	50.0	0.30		7.40	3500	2300.0
80/10/09	12 09	0001	50.0	0.30	16.0	8.10	3	6.0
80/11/06	12 30	0001	50.0	0.30	11.0	7.60	[illegible]	2.2
	NUMBER		20	20	13	[illegible]	20	[illegible]
	MAXIMUM		99.0000	.300000	23.0000	8.10000	31000.0	29000.0
	MINIMUM		50.0000	.300000	3.80000	6.70000	3.00000	2.20000
	MEAN		66.7500	.299999	14.7385	7.53684	2000.70	2051.49

*Due to sample mishandling, data for 08/01/80 and 08/05/80 are assumed to be reversed.

Table 5 (continued)

STORET RETRIEVAL DATE 80/11/24

476215
36 28 37.0 082 49 02.0 2
TRIB. TO STONEY PLINT CREEK 0.25
47073 TENNESSEE
HOLSTON RIVER BASIN
UNNAMED TRIBUTARY 0.75
131TVAC 790505
0000 FEET DEPTH CLASS 00

STATION: PB 17
/TYPA/AMBNT/STREAM

DATE FROM TO	TIME OF DAY	DEPTH FEET	00002 HSAMPLOC % FROM RT BANK	00098 VSAMPLOC DEPTH METERS	00010 WATER TEMP CENT	00400 PH SU	00530 RESIDUE TOT NFLT MG/L	00070 TURB JKSN JTU
79/10/16	14 20	0001	50.0	0.30	18.0	6.60	280	180.0
79/11/13	17 35	0001	50.0	0.30	11.0	7.70	12	14.0
79/12/04	12 34	0001	50.0	0.30	5.0	8.00	2	2.3
80/01/08	08 30	0001	95.0	0.30		6.70	44	32.0
80/01/23	10 00	0001	95.0	0.30		6.70	18	27.0
80/02/05	15 11	0001	50.0	0.30	4.5	7.40	5	3.5
80/03/11	09 58	0001	50.0	0.30	8.0	7.50	5	12.0
80/03/18	10 00	0001	50.0	0.30		7.40	27	70.0
80/04/03	12 30	0001	50.0	0.30	13.5	7.60	15	10.0
80/05/07	13 15	0001	50.0	0.30	22.0	7.90	8	4.2
80/06/10	11 00	0001	50.0	0.30	23.0	8.00	9	3.9
80/07/08	14 10	0001	50.0	0.30	33.0	7.80	3	5.9
80/07/11	16 00	0001	50.0	0.30		6.80	1700	2600.0
80/08/01	15 00	0001	50.0	0.30			13000	5400.0
80/08/05	13 21	0001	50.0	0.30	24.0	7.80	12	4.8
80/09/05	11 45	0001	50.0	0.30	21.0	7.60	5	4.1
80/09/25	14 30	0001	50.0	0.30		7.10	800	540.0
80/10/09	12 30	0001	50.0	0.30	20.5	7.80	3	7.7
80/11/06	13 01	0001	50.0	0.30	15.0	7.80	2	2.3
NUMBER			19	19	13	18	19	19
MAXIMUM			95.0000	.300000	33.0000	8.00000	13000.0	5400.00
MINIMUM			50.0000	.300000	4.50000	6.70000	2.00000	2.30000
MEAN			54.7368	.289589	16.8077	7.47777	839.474	469.667

Table 5 (continued)

.. ... DATE 80/11/24

476225
36 27 40.0 082 48 50.0 2
TRIB. TO HOLSTON R. 120.4
47073 TENNESSEE
HOLSTON RIVER BASIN
UNNAMED TRIBUTARY 0.01
131TVAC 79C9C1
0000 FEET DEPTH CLASS 00

STATION: PB 18
/TYPA/AMBNT/STREAM

DATE FROM TO	TIME OF DAY	DEPTH FEET	00002 HSAMPLOC % FROM RT BANK	00098 VSAMPLOC DEPTH METERS	00010 WATER TEMP CENT	00400 PH SU	00530 RESIDUE TOT NFLT MG/L	00070 TURB JKSN JTU
*80/01/08	09 30	0001	95.0	0.30		6.80	25	18.0
*80/01/23	10 00	0001	50.0	0.30		6.60	25	18.0
*80/03/18	10 00	0001	50.0	0.30		7.00	40	45.0
80/07/11	16 00	0001	50.0	0.30		7.50	3500	13000.0
80/08/01	15 00	0001	50.0	0.30			2200	1700.0
80/09/25	14 30	0001	50.0	0.30		7.20	710	540.0
NUMBER			6	6		5	6	6
MAXIMUM			95.0000	.300000		7.50000	3500.00	13000.0
MINIMUM			50.0000	.300000		6.80000	25.0000	18.0000
MEAN			57.5000	.300000		7.02000	1083.50	2553.50

*Preliminary data taken before permanent establishment of station.

:ble 5 (continued

STORET RETRIEVAL DATE 80/11/24

476220
36 27 38.0 082 48 49.0 2
TRIB. TO U.T. 0.2 TO HOLS 120.4
47073 TENNESSEE
HOLSTON RIVER BASIN
UNNAMED TRIBUTARY 0.01
131TVAC 790901
0000 FEET DEPTH CLASS 00

STATION: PI 19
/TYPA/AMBNT/STREAM

DATE FROM TO	TIME OF DAY	DEPTH FEET	00002 HSAMPLOC % FROM RT BANK	00098 VSAMPLOC DEPTH METERS	00010 WATER TEMP CENT	00400 PH SU	00530 RESIDUE TOT NFLT MG/L	00070 TURB JKSN JTU
*80/01/08	08 30	0001	95.0	0.30		6.40	130	55.0
*80/01/23	10 00	0001	50.0	0.30		6.80	64	31.0
*80/03/18	10 00	0001	50.0	0.30		6.90	98	60.0
80/06/10	13 00	0001	50.0	0.30		8.00	9	10.0
80/07/08	12 50	0001	50.0	0.30	20.0	7.60	13	8.1
80/07/11	16 00	0001	50.0	0.30		5.20	7200	9000.0
80/08/01	15 00	0001	50.0	0.30			4900	3200.0
80/08/05	11 35	0001	50.0	0.30	20.0	8.00	9	9.8
80/09/05	10 15	0001	50.0	0.30	23.0	7.50	9	16.0
80/09/25	14 30	0001	50.0	0.30		5.50	2700	1800.0
80/10/09	11 40	0001	50.0	0.30	14.0	7.60	5	13.0
80/11/06	12 08	0001	50.0	0.30	10.2	7.70	7	6.3
NUMBER			12	12	5	11	12	12
MAXIMUM			95.0000	.300000	23.0000	8.00000	7200.00	9000.00
MINIMUM			50.0000	.300000	10.2000	5.20000	5.00000	6.30000
MEAN			53.7500	.299999	17.4400	7.03636	1262.00	1184.10

*Preliminary data taken before permanent establishment of station.

Table 5 (continued)

STORET RETRIEVAL DATE 80/11/24

476255
36 28 36.0 082 48 55.0 2
TRIBUTARY TO SIDNEY POINT CREEK 0.2
47073 TENNESSEE HAWKINS
HOLSTON RIVER BASIN 060200
UNNAMED TRIBUTARY 0.90
1311VAC 80C503
0000 FEET DEPTH CLASS 00

STATION: PB 30
/TYPA/AMBNT/STREAM

DATE FROM TO	TIME OF DAY	DEPTH FEET	00002 HSAMPLOC % FROM RT BANK	00098 VSAMPLOC DEPTH METERS	00010 WATER TEMP CENT	00400 PH SU	00530 RESIDUE TOT NFLT MG/L	00070 TURB JKSN JTU
80/04/03	10	30 0001	50.0	0.30	13.5	7.40	6	10.0
80/05/07	13	15 0001	50.0	0.30	22.0	7.60	25	14.0
80/06/10	11	05 0001	50.0	0.30	19.0	7.60	6	8.9
80/07/08	14	05 0001	50.0	0.30	25.0	7.40	13	8.1
80/07/11	16	00 0001	50.0	0.30		6.30	2100	2800.0
80/08/01	15	00 0001	50.0	0.30			50	30.0
80/08/05	13	25 0001	50.0	0.30	24.0	7.70	2	3.6
80/09/25	14	30 0001	50.0	0.30		7.00	44	22.0
80/10/09	12	24 0001	50.0	0.30	19.0	7.20	9	4.2
80/11/06	13	10 0001	5.0	0.30	10.0	7.20	4	4.2
	NUMBER		10	10	7	9	10	10
	MAXIMUM		50.0000	.300000	25.0000	7.70000	2100.00	2800.00
	MINIMUM		5.00000	.300000	10.0000	6.30000	2.00000	3.60000
	MEAN		45.5000	.299999	18.9286	7.26666	225.900	290.520

Table 5 (continued)

STORET RETRIEVAL DATE 80/11/24

476265
36 29 14.0 082 49 05.0 2
TRIB. TO HOLSTON RIVER 123.0
47073 TENNESSEE HAWKINS
HOLSTON RIVER BASIN 040200
SIDNEY POINT CREEK 0.65
131TVAC 800621
3000 FEET LEFTH CLASS 00

STATION: PB 31
/TYPA/AMBNT/STREAM

DATE FROM TO	TIME OF DAY	DEPTH FEET	00002 HSAMPLOC % FROM RT BANK	00098 VSAMPLOC DEPTH METERS	00010 WATER TEMP CENT	00400 PH SU	00530 RESIDUE TOT NFLT MG/L	00070 TURB JKSN JTU
80/06/10	10 43	0001	50.0	0.30	16.0	8.30	4	2.6
80/07/08	13 10	0001	50.0	0.30	18.0	7.60	32	18.0
80/07/11	16 30	0001	50.0	0.30		7.30	2900	5500.0
80/08/01	15 30	0001	50.0	0.30			1200	660.0
80/08/05	13 14	0001	50.0	0.30	24.0	8.00	22	21.0
80/09/05	11 11	0001	50.0	0.30	21.0	7.80	4	4.4
80/09/25	14 30	0001	50.0	0.30		7.50	870	560.0
80/10/09	12 47	0001	50.0	0.30	16.5	8.60	2	3.2
80/11/06	12 40	0001	50.0	0.30	11.5	8.40	14	8.2
	NUMBER		9	9	6	8	9	9
	MAXIMUM		50.0000	.300000	24.0000	8.60000	2900.00	5500.00
	MINIMUM		50.0000	.300000	11.5000	7.30000	2.00000	2.60000
	MEAN		50.0000	.300000	17.8333	7.96249	560.889	753.044

Table 5 (continued)

STORET RETRIEVAL DATE 80/11/24

476265
36 29 06.0 082 48 57.0 2
TRIB. TO HOLSTON RIVER 123.0
47073 TENNESSEE HAWKINS
HOLSTON RIVER BASIN 060203
SIDNEY POINT CREEK 0.60
131IVAC P00621
0300 FEET DEPTH CLASS 00

STATION: PB 32
/TYPA/AMBNT/STREAM

DATE FROM TO	TIME OF DAY	DEPTH FEET	00002 HSAMPLOC % FROM RT BANK	00098 VSAMPLOC DEPTH METERS	00010 WATER TEMP CENT	00400 PH SU	00530 RESIDUE TOT NFLT MG/L	00070 TURB JKSN JTU
80/06/10	11 30	0001	50.0	0.30	19.0	8.10	3	3.4
80/07/08	10 20	0001	50.0	0.30	24.0	8.10	55	29.0
80/07/11	15 00	0001	50.0	0.30		7.10	980	5500.0
80/08/01	15 00	0001	50.0	0.30			6300	3800.0
80/08/05	12 58	0001	50.0	0.30	24.0	8.30	210	65.0
80/09/05	10 53	0001	50.0	0.30	22.0	7.90	27	34.0
80/09/25	14 30	0001	50.0	0.30		7.50	650	440.0
80/10/09	12 30	0001	50.0	0.30	16.5	8.40	9	8.7
80/11/06	12 46	0001	50.0	0.30	11.5	8.40	2	2.4
	NUMBER		9	9	8	8	9	9
	MAXIMUM		50.0000	.300000	24.0000	8.40000	6300.00	5500.00
	MINIMUM		50.0000	.300000	11.5000	7.10000	2.00000	2.40000
	MEAN		50.0000	.300000	19.5000	7.97499	916.889	1067.78

Table 6

WATER QUALITY OF DISCHARGES
FROM THE YARD HOLDING POND

Date	Location	pH	Turbidity, NTU	Suspended Solids, mg/ℓ
November 12, 1979	PB-13	7.3	3.6	9.0
April 3, 1980	PB-13	7.4	3.8	3.0

Table 7

STANDING CROP DETERMINATIONS FOR AQUATIC MACROPHYTES IN THE PHIPPS BEND VICINITY OF THE HOLSTON RIVER ALONG TWO TRANSECTS

Station Holston River Mile (HRM)	Aquatic Macrophyte	Ash Free Dry Weight (g/m^2) May 14, 1980	Ash Free Dry Weight (g/m^2) August 22, 1980
125.6	Sago Pondweed	41.25	46.07
	American Pondweed	0.00	0.00
	Curlyleaf Pondweed	19.45	14.04
	Canadian Elodea	0.01	1.59
	Waterstargrass	13.68	22.19
	Eelgrass	0.03	0.57
	Aquatic Mosses	0.09	0.14
	Total	74.51	84.60
119.9	Sago Pondweed	25.35	72.83
	American Pondweed	0.00	0.00
	Aquatic Mosses	0.12	1.25
	Curlyleaf Pondweed	0.00	0.00
	Canadian Elodea	0.00	0.80
	Eelgrass	0.00	137.68
	Waterstargrass	5.59	15.64
	Total	31.06	228.20

Table 8

FREQUENCY OF OCCURRENCE OF AQUATIC MACROPHYTES
ALONG PERMANENT TRANSECTS SAMPLED IN THE
PHIPPS BEND AREA OF THE HOLSTON RIVER

Station Holston River Mile (HRM)	Aquatic Macrophyte	Frequency (%) May 14, 1980	Frequency (%) August 22, 1980
122.8	Sago Pondweed	78	70
	Filamentous Algae	48	0
	Aquatic Mosses		
	Fissidens	24	16
	Leptodictyum	28	14
	American Pondweed	30	80
	Curlyleaf Pondweed	36	24
	Waterstargrass	18	36
	Eelgrass	4	46
	Canadian Elodea	20	12
119.8	Sago Pondweed	90	56
	Filamentous Algae	72	2
	Aquatic Mosses		
	Fissidens	74	38
	Leptodictyum	62	34
	American Pondweed	28	26
	Curlyleaf Pondweed	20	4
	Waterstargrass	4	12
	Eelgrass	10	44
	Canadian Elodea	12	6

TABLE 9

NUMBER OF ARTIFICAL SUBSTRATE SAMPLERS PLACED AND RECOVERED
PHIPPS BEND NUCLEAR PLANT

OCTOBER 1979 - JANUARY 1980

Date	HRM 115.0		HRM 119.0		HRM 120.2		HRM 124.3	
	Placed	Recovered	Placed	Recovered	Placed	Recovered	Placed	Recovered
October 16, 1979	2	2	2	1	2	2	2	2
November 14, 1979	2	2	2	1	2	2	2	2
December 3, 1979	2	1	2	2	2	2	2	2
January 7, 1980	2	2	2	2	2	1	2	2

TABLE 10

BENTHIC MACROINVERTEBRATE TAXA COLLECTED USING ARTIFICIAL SUBSTRATES IN THE HOLSTON RIVER

OCTOBER 1979 - JANUARY 1980

Platyhelminthes
- Turbellaria
  - Tricladida
    - Planariidae
      - *Cura foremanii*
      - *Dugesia tigrina*

Annelida
- Oligochaeta
  - Plesiopora
    - Lumbriculidae
    - Tubificidae
      - *Branchiura sowerbyi*
    - Naididae
- Hirudinea
  - Rhynchobdellida
    - Glossiphoniidae

Arthropoda
- Crustacea
  - Isopoda
    - *Lirceus* sp.
  - Amphipoda
    - *Crangonyx* sp.
  - Decapoda
    - *Cambarus* sp.
    - *Orconectes* sp.
- Insecta
  - Plecoptera
    - Taeniopterygidae
      - *Taeniopteryx* sp.
  - Ephemeroptera
    - Baetidae
      - *Baetis* sp.
      - *Pseudocloeon* sp.
    - Heptageniidae
      - *Stenacron* sp.
      - *Stenonema* sp.
    - Leptophlebiidae
      - *Leptophlebia* sp.
    - Tricorythidae
      - *Tricorythodes* sp.
    - Ephemerellidae
      - *Ephemerella* sp.

TABLE 10
(continued)

Odonata
  Aeschnidae
    Boyeria sp.
  Coenagrionidae
    Enallagma sp.
    Ischnura sp.
  Calopterygidae
    Hetaerina americana
    Calopteryx sp.
Megaloptera
  Corydalidae
    Corydalus cornutus
Trichoptera
  Hydropsychidae
    Cheumatopsyche sp.
    Hydropsyche sp.
  Leptoceridae
    Triaenodes sp.
  Psychomyiidae
    Polycentropus sp.
    Psychomyia sp.
  Hydroptilidae
    Hydroptila sp.
Lepidoptera
Diptera
  Chironomidae
    Chironominae
      Polypedilum sp.
    Pentaneuranii
      Ablabesmyia sp.
    Orthocladiinae
      Cricotopus sp.
      Eukiefferiella sp.
      Epoicocladius sp.
      Tribelos sp.
  Simuliidae
    Simulium vittatum
    Simulium sp.
  Muscidae
  Tipulidae
    Antocha sp.
    Tipula sp.
Coleoptera
  Elmidae
    Dubiraphia sp.
    Macronychus glabratus
    Oulimnius sp.

TABLE 10
(continued)

- Psephenidae
  - *Psephenus* sp.
- Mollusca
  - Gastropoda
    - Basommatophora
      - Ancylidae
        - *Ferrissia* sp.
      - Planorbidae
        - *Gyraulus parvus*
    - Mesogsatropoda
      - Pleuroceridae
        - *Pleurocera* sp.
      - Viviparidae
        - *Campeloma* sp.
  - Bivalvia
    - Cyrenidae
      - *Corbicula manilensis*

TABLE 11

BENTHIC MACROINVERTEBRATE TAXA COLLECTED
FROM NATURAL SUBSTRATES IN THE HOLSTON RIVER

OCTOBER 1979-JANUARY 1980

Platyhelminthes
  Turbellaria
    Tricladida
      Planariidae
        Dura foremanii
        Dugesia tigrina
Annelida
  Oligochaeta
    Plesiopora
      Lumbriculidae
      Tubificidae
Arthropoda
  Crustacea
    Isopoda
        Asellus sp.
    Amphipoda
        Crangonyx sp.
    Decapoda
        Cambarus sp.
        Orconectes sp.
  Insecta
    Ephemeroptera
      Baetidae
        Baetis sp.
        Pseudocloeon sp.
      Heptageniidae
        Stenonema sp.
      Tricorythidae
        Tricorythodes sp.
    Odonata
      Aeschnidae
        Boyeria sp.
        Baesiaeschna sp.
      Coenagrionidae
        Ischnura sp.
    Megaloptera
      Corydalidae
        Corydalus cornutus
      Corduliidae
        Epitheca sp.
    Trichoptera
      Hydropsychidae
        Hydropsyche sp.

TABLE 11
(continued)

Psychomyiidae
Psychomyia sp.
Hydroptilidae
Hydroptila sp.
Diptera
Chironomidae
Cricotopus sp.
Eukiefferiella sp.
Tanytarsini sp.
Simuliidae
Simul[illegible]atum
Tipulidae
Antocha sp.
Tipula sp.
Mollusca
Gastropoda
Basommatophora
Ancylidae
Ferrissia sp.
Mesogastropoda
Pleuroceridae
Pleurocera sp.
Bivalvia
Cyrenidae
Corbicula manilensis

TABLE 12

MEAN MOLLUSCAN AND NONMOLLUSCAN WET BIOMASS FOR BENTHIC MACROINVERTEBRATE FAUNA COLLECTED BY ARTIFICAL SUBSTR*TES FROM THE HOLSTON RIVER NEAR PHIPPS BEND NUCLEAR PLANT

OCTOBER 1979 - JANUARY 1980

Date	HRM 115.0		HRM 119.0		HRM 120.2		HRM 124.3	
	Molluscan	Nonmolluscan	Molluscan	Nonmolluscan	Molluscan	Nonmolluscan	Molluscan	Nonmolluscan
	(mg)		(mg)		(mg)		(mg)	
October 1979	549	934	16,518	8,181	24,977	74	5,396	764
November 1979	5,901	8,643	71,225	38,026	5,652	4,465	4,643	2,494
December 1979	0	139	6,601	5,227	2,446	15,836	15,812	2,025
January 1980	13,826	1,901	0	369	0	618	0	844

TABLE 13

TAXONOMIC PRESENCE/ABSENCE LISTING

TAXONOMIC PRESENCE/ABSENCE LISTING
PHIPPS BEND BENTHIC

October - December 1979

ABLABESMYIA SP.
ANTOCHA SP.
BAETIS SP.
BRYERIA SP.
BRANCHIURA SOWERBYI
CALOPTERYX SP.
CAMBARUS SP.
CAMPELOMA SP.
CHEUMATOPSYCHE SP.
CHIRONOMIDAE
CORBICULA MANILENSIS
CORYDALUS CORNUTUS
CORYDALUS SP.
CRANGONYX SP.
CRICOTOPUS SP.
CURA FOREMANII
DUBIRAPHIA SP.
DUGESIA TIGRINA
ENALLAGMA SP.
EPHEMERELLA SP.
EUKIEFFERIELLA SP.
FERRISSIA SP.
GLOSSIPHONIIDAE
GYRAULUS PARVUS
HETAERINA SP.
HYDROPSYCHE SP.
HYDROPTILA SP.
ISCHNURA SP.
LEPIDOPTERA
LEPTOPHLEBIA SP.
LIRCEUS SP.
LUMBRICULIDAE
MACRONYCHUS GLABRATUS
MUSCIDAE
NAIDIDAE
ORCONECTES SP.
OXLIMNIUS SP.
PLEUROCERA (SYN. OXYTREMA) SP.
POLYCENTROPUS SP.
PSEPHENUS SP.
PSEUDOCLOEON SP.
PSYCHOMYIA SP.
SIMULIUM SP.
SIMULIUM VITTATUM
STENACRON SP.
STENONEMA SP.
TAENIOPTERYX SP.
TRICORYTHODES SP.
TUBIFICIDAE

TABLE 13
(continued)

TAXONOMIC PRESENCE/ABSENCE LISTING BY MONTH
PHIPPS BEND BENTHIC

YEAR 79 RIVER MILE= 115.0 MONTH= 10

CORYDALUS CORNUTUS
DUGESIA TIGRINA
FERRISSIA SP.
HYDROPSYCHE SP.
PLEUROCERA (SYN. OXYTREMA) SP.
PSEPHENUS SP.
STENACRON SP.
STENONEMA SP.
TRICORYTHODES SP.

YEAR 79 RIVER MILE= 115.0 MONTH= 11

BOYERIA SP.
CAMBARUS SP..
CHIRONOMIDAE
CRANGONYX SP.
CURA FOREMANII
DUGESIA TIGRINA
EUKIEFFERIELLA SP.
HYDROPSYCHE SP.
HYDROPTILA SP.
ORCONECTES SP.
PLEUROCERA (SYN. OXYTREMA) SP.
PSYCHOMYIA SP.
SIMULIUM SP.
STENACRON SP.
STENONEMA SP.
TAENIOPTERYX SP.
TRICORYTHODES SP.

YEAR 79 RIVER MILE= 115.0 MONTH= 12

CHIRONOMIDAE
CRICOTOPUS SP.
CURA FOREMANII
DUGESIA TIGRINA
EUKIEFFERIELLA SP.
HYDROPSYCHE SP.
HYDROPTILA SP.
NAIDIDAE
STENACRON SP.
STENONEMA SP.

YEAR 79 RIVER MILE= 119.0 MONTH= 10

DUGESIA TIGRINA
METAERINA SP.

Table 13
(continued)

TAXONOMIC PRESENCE/ABSENCE LISTING BY MONTH
PHIPPS BEND BENTHIC

LUMBRICULIDAE
ORCONECTES SP.
PLEUROCERA (SYN. OXYTREMA) SP.
STENACRON SP.
TRICORYTHODES SP.

YEAR 79 RIVER MILE= 119.0 MONTH= 11

CAMBARUS SP..
CHIRONOMIDAE
CRANGONYX SP.
CURA FOREMANII
DUGESIA TIGRINA
GLOSSIPHONIIDAE
ORCONECTES SP.
PLEUROCERA (SYN. OXYTREMA) SP.
STENACRON SP.
STENONEMA SP.
TUBIFICIDAE

YEAR 79 RIVER MILE= 119.0 MONTH= 12

BAETIS SP.
CORBICULA MANILENSIS
CRANGONYX SP.
CRICOTOPUS SP.
CURA FOREMANII
DUGESIA TIGRINA
EUKIEFFERIELLA SP.
FERRISSIA SP.
HYDROPSYCHE SP.
LEPIDOPTERA
LIRCEUS SP.
MACRONYCHUS GLABRATUS
ORCONECTES SP.
OULIMNIUS SP.
PLEUROCERA (SYN. OXYTREMA) SP.
POLYCENTROPUS SP.
PSEUDOCLUEON SP.
SIMULIUM VITTATUM
STENACRON SP.
STENONEMA SP.
TUBIFICIDAE

YEAR 79 RIVER MILE= 120.2 MONTH= 10

ANTOCHA SP.
BAETIS SP.
CHEUMATOPSYCHE SP.
CHIRONOMIDAE
CORBICULA MANILENSIS
CRICOTOPUS SP.

TABLE 13
(continued)

TAXONOMIC PRESENCE/ABSENCE LISTING BY MONTH
PHIPPS BEND BENTHIC

EUKIEFFERIELLA SP.
FERRISSIA SP.
GLOSSIPHONIIDAE
GYRAULUS PARVUS
HYDROPSYCHE SP.
LEPIDOPTERA
LUMBRICULIDAE
PLEUROCERA (SYN. OXYTREMA) SP.
SIMULIUM VITTATUM
TRICORYTHODES SP.

YEAR 79 RIVER MILE= 120.2 MONTH= 11

ANTOCHA SP.
CALOPTERYX SP.
CAMBARUS SP..
CHEUMATOPSYCHE SP.
CHIRONOMIDAE
CORYDALUS SP.
CRANGONYX SP.
FERRISSIA SP.
HYDROPSYCHE SP.
HYDROPTILA SP.
LIRCEUS SP.
ORCONECTES SP.
PLEUROCERA (SYN. OXYTREMA) SP.
PSYCHOMYIA SP.
STENACRON SP.
STENONEMA SP.

YEAR 79 RIVER MILE= 120.2 MONTH= 12

ABLABESMYIA SP.
ANTOCHA SP.
BAETIS SP.
CAMBARUS SP..
CHIRONOMIDAE
CORBICULA MANILENSIS
CORYDALUS CORNUTUS
CRICOTOPUS SP.
CURA FOREMANII
DUGESIA TIGRINA
EPHEMERELLA SP.
EUKIEFFERIELLA SP.
FERRISSIA SP.
GLOSSIPHONIIDAE
HETAERINA SP.
HYDROPSYCHE SP.
HYDROPTILA SP.
LEPTOPHLEBIA SP.
ORCONECTES SP.
PLEUROCERA (SYN. OXYTREMA) SP.
PSYCHOMYIA SP.
SIMULIUM SP.

TABLE 13
(continued)

TAXONOMIC PRESENCE/ABSENCE LISTING BY MONTH
PHIPPS BEND BENTHIC

STENACRON SP.
STENONEMA SP.
TAENIOPTERYX SP.
TUBIFICIDAE

YEAR 79 RIVER MILE= 124.3 MONTH= 10

ANTOCHA SP.
BAETIS SP.
CAMPELOMA SP.
CHIRONOMIDAE
DUGESIA TIGRINA
ENALLAGMA SP.
FERRISSIA SP.
HYDROPTILA SP.
ISCHNURA SP.
MUSCIDAE
ORCONECTES SP.
PLEUROCERA (SYN. CAYTREMA) SP.
PSYCHOMYIA SP.
TUBIFICIDAE

YEAR 79 RIVER MILE= 124.3 MONTH= 11

ABLABESMYIA SP.
ANTOCHA SP.
CALOPTERYX SP.
CAMBARUS SP..
CHIRONOMIDAE
CORBICULA MANILENSIS
CRANGONYX SP.
CURA FOREMANII
DUGESIA TIGRINA
HYDROPSYCHE SP.
HYDROPTILA SP.
LIRCEUS SP.
LUMBRICULIDAE
NAIDIDAE
ORCONECTES SP.
PLEUROCERA (SYN. CAYTREMA) SP.
PSYCHOMYIA SP.
STENACRON SP.
STENONEMA SP.
TUBIFICIDAE

YEAR 79 RIVER MILE= 124.3 MONTH= 12

ANTOCHA SP.
BRANCHIURA SOWERBYI
CAMBARUS SP..
CORBICULA MANILENSIS
CRANGONYX SP.

TABLE 13
(continued)

TAXONOMIC PRESENCE/ABSENCE LISTING BY MONTH
PHIPPS BEND BENTHIC

CRICOTOPUS SP.
CURA FOREMANII
DUBIRAPHIA SP.
DUGESIA TIGRINA
EUKIEFFERIELLA SP.
GLOSSIPHONIIDAE
HETAERINA SP.
HYDROPSYCHE SP.
HYDROPTILA SP.
LUMBRICULIDAE
NAIDIDAE
ORCONECTES SP.
PLEUROCERA (SYN. OXYTREMA) SP.
POLYCENTROPUS SP.
PSYCHOMYIA SP.
STENACRON SP.
TUBIFICIDAE

TABLE 13
(continued)

TAXONOMIC PRESENCE/ABSENCE LISTING BY MONTH
PHIPPS BEND BENTHIC

January 1980

ABLABESMYIA SP.
ANTOCHA SP.
CALOPTERYX SP.
CHIRONOMIDAE
CURA FOREMANII
DUGESIA TIGRINA
EPOICOCLADIUS SP.
EURIEFFERIELLA SP.
HETAERINA AMERICANA
HYDROPSYCHE SP.
NAIDIDAE
POLYCENTROPUS SP.
POLYPEDILUM SP.
PSYCHOMYIA SP.
SIMULIUM SP.
STENACRON SP.
STENONEMA SP.

TABLE 13
(continued)

TAXONOMIC PRESENCE/ABSENCE LISTING BY MONTH
PHIPPS BEND BENTHIC

YEAR 80 RIVER MILE= 115.0 MONTH= 01

BRANCHIURA SOWERBYI
CHIRONOMIDAE
CORBICULA MANILENSIS
CRANGONYX SP.
CURA FOREMANII
DUGESIA TIGRINA
EUKIEFFERIELLA SP.
HYDROPSYCHE SP.
HYDROPTILA SP.
LUMBRICULIDAE
NAIDIDAE
ORCONECTES SP.
PLEUROCERA (SYN. OXYTREMA) SP.
SIMULIUM VITTATUM
STENACRON SP.
STENONEMA SP.
TAENIOPTERYX SP.
TUBIFICIDAE

YEAR 80 RIVER MILE= 119.0 MONTH= 01

BRANCHIURA SOWERBYI
CHIRONOMIDAE
CRANGONYX SP.
CURA FOREMANII
DUGESIA TIGRINA
EUKIEFFERIELLA SP.
HETAERINA AMERICANA
HYDROPSYCHE SP.
STENACRON SP.
STENONEMA SP.
TIPULA SP.
TRIAENODES SP.
TRIBELOS SP.
TUBIFICIDAE

YEAR 80 RIVER MILE= 120.2 MONTH= 01

ANTOCHA SP.
CHIRONOMIDAE
EUKIEFFERIELLA SP.
HYDROPSYCHE SP.
NAIDIDAE
SIMULIUM VITTATUM
STENONEMA SP.

YEAR 80 RIVER MILE= 124.3 MONTH= 01

TABLE 13
(continued)

TAXONOMIC PRESENCE/ABSENCE LISTING
PHIPPS BEND BENTHIC

ABLABESMYIA SP.
ANTOCHA SP.
BRANCHIURA SOWERBYI
CALOPTERYX SP.
CHIRONOMIDAE
CORBICULA MANILENSIS
CRANGONYX SP.
CURA FOREMANII
DUGESIA TIGRINA
EPICOCLADIUS SP.
EUKIEFFERIELLA SP.
HETAERINA AMERICANA
HYDROPSYCHE SP.
HYDROPTILA SP.
LUMBRICULIDAE
NAIDIDAE
ORCONECTES SP.
PLEUROCERA (SYN. OXYTREMA) SP.
POLYCENTROPUS SP.
POLYPEDILUM SP.
PSYCHOMYIA SP.
SIMULIUM SP.
SIMULIUM VITTATUM
STENACRON SP.
STENONEMA SP.
TAENIOPTERYX SP.
TIPULA SP.
TRIAENODES SP.
TRIBELOS SP.
TUBIFICIDAE

TABLE 14

DIVERSITY INDICES ($\bar{d}$) FOR THE BENTHIC MACROINVERTEBRATE FAUNA COLLECTED BY ARTIFICIAL SUBSTRATES FROM THE HOLSTON RIVER

OCTOBER 1979 - JANUARY 1980

Date	Holston River Mile			
	115.0	119.0	120.2	124.3
October 1979	2.34	0.815	2.43	2.67
November 1979	3.11	0.348	2.63	3.68
December 1979	2.94	2.64	1.78	3.21
January 1980	3.21	2.51	2.19	2.54

APPENDIX A

PHIPPS BEND MACROBENTHIC CALCULATIONS - TOTAL ORGANISMS

YEAR=79 RM=115.0 HABITAT=CHANBORK

MN	N	MEAN	STD	MIN	MAX	STDERR	SUM	VAR	CV
10	2	21.5	28.9914	1	42	20.5	43	840.5	134.844
11	2	71.5	0.7071	71	72	0.5	143	0.5	0.989
12	2	21.5	30.4056	0	43	21.5	43	924.5	141.421

N=3

PHIPPS BEND MACROBENTHIC CALCULATIONS - TOTAL ORGANISMS

YEAR=79 RM=1;9.0 HABITAT=CHANBORK

MY	N	MEAN	STD	MIN	MAX	STDERR	SUM	VAR	CV
10	2	33.5	47.376	0	67	33.5	67	2245	141.421
11	2	284.0	401.637	0	568	284.0	568	161312	141.421
12	2	182.5	19.092	169	196	13.5	365	365	10.461

N=3

PHIPPS BEND MACROBENTHIC CALCULATIONS - TOTAL ORGANISMS

YEAR=79 RM=120.2 HABITAT=CHANBORK

MN	N	MEAN	STD	MIN	MAX	STDERR	SUM	VAR	CV
10	2	81.5	99.702	11	152	70.5	163	9940.5	122.334
11	2	41.0	19.799	27	55	14.0	82	392.0	48.290
12	2	270.0	239.002	101	439	169.0	540	57122.0	88.519

N=3

PHIPPS BEND MACROBENTHIC CALCULATIONS - TOTAL ORGANISMS

YEAR=79 RM=124.3 HABITAT=CHANBORK

RP	N	MEAN	STD	MIN	MAX	STDERR	SUM	VAR	CV
10	2	34.0	12.728	25	43	9.0	68	162.0	37.4351
11	2	39.5	16.263	28	51	11.5	79	264.5	41.1733
12	2	142.0	134.350	47	237	95.0	284	18050.0	94.6129

N=3

YEAR=79 R=115.0 MN=10 HABITAT=CHANNDRK

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
CORYDALUS CORNUTUS	2	0.5	0.7071	0	1	0.5	0.5	141.421
DUGESIA TIGRINA	2	1.0	1.4142	0	2	1.0	2.0	141.421
FERRISSIA SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421
HYDROPSYCHE SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421
PLEURUCERA (SYN. OXYTREMA) SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
PSEPHENUS SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
STENACRON SP.	2	2.5	3.5355	0	5	2.5	12.5	141.421
STENONEMA SP.	2	4.5	6.3640	0	9	4.5	40.5	141.421
TRICORYTHODES SP.	2	10.0	14.1421	0	20	10.0	200.0	141.421

N=9

YEAR=79 RM=115.0 MN=11 HABITAT=CHANNEL

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
BOYERIA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
CAMBARUS SP..	2	0.5	0.7071	0	1	0.5	0.5	141.421
CHIRONOMIDAE	2	3.5	3.5355	1	6	2.5	12.5	101.015
CRANGONYX SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
CURA FOREMANII	2	2.5	0.7071	2	3	0.5	0.5	28.284
DUGESIA TIGRINA	2	2.5	0.7071	2	3	0.5	0.5	28.284
EUKIEFFERIELLA SP.	2	9.5	3.5355	7	12	2.5	12.5	37.216
HYDROPSYCHE SP.	2	19.5	19.0919	6	33	13.5	364.5	97.907
HYDROPTILA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
ORCONECTES SP.	2	1.5	2.1213	0	3	1.5	4.5	141.421
PLEUROCERA (SYN. OXYTREMA) SP.	2	14.0	1.4142	13	15	1.0	2.0	10.102
PSYCHOMYIA SP.	2	2.0	2.8284	0	4	2.0	8.0	141.421
SIMULIUM SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
STENACRON SP.	2	2.0	2.8284	0	4	2.0	8.0	141.421
STENONEMA SP.	2	10.5	4.9497	7	14	3.5	24.5	47.140
TAENIOPTERYX SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
TRICORYTHODES SP.	2	1.0	0.0000	1	1	0.0	0.0	0.000

N=17

PHIPPS BEND MACROBENTHIC CALCULATIONS - SPECIES LIST - BY MONTH

YEAR=79 RM=115.0 M=12 HABITAT=CHANNDRK

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
CHIRONOMIDAE	2	2.0	2.82843	0	4	2.0	8.0	141.421
CRICOTOPUS SP.	2	1.5	2.12132	0	3	1.5	4.5	141.421
CURA FOREMANII	2	1.5	2.12132	0	3	1.5	4.5	141.421
DUGESIA TIGRINA	2	1.0	1.41421	0	2	1.0	2.0	141.421
EUKIEFFERIELLA SP.	2	5.0	7.07107	0	10	5.0	50.0	141.421
HYDROPSYCHE SP.	2	5.5	7.77817	0	11	5.5	60.5	141.421
HYDROPTILA SP.	2	0.5	0.70711	0	1	0.5	0.5	141.421
NAIDIDAE	2	2.0	2.82843	0	4	2.0	8.0	141.421
STENACRON SP.	2	0.5	0.70711	0	1	0.5	0.5	141.421
STENONEMA SP.	2	2.0	2.82843	0	4	2.0	8.0	141.421

N=10

PHIPPS BEND MACROBENTHIC CALCULATIONS - SPECIES LIST - BY MONTH

YEAR=75 PR=119.0 MN=10 HABITAT=CHANBORK

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
DUGESIA TIGRINA	2	0.5	0.7071	0	1	0.5	0.5	141.421
HETAERINA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
LUMBRICULIDAE	2	0.5	0.7071	0	1	0.5	0.5	141.421
ORCONECTES SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
PLEURDCERA (SYN, OXYTREMA) SP.	2	29.5	41.7193	0	59	29.5	1740.5	141.421
STENACRON SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
TRICORYTHODES SP.	2	1.5	2.1213	0	3	1.5	4.5	141.421

N=7

PHIPPS BEND MACROBENTHIC CALCULATIONS - SPECIES LIST - BY MONTH

YEAR=79 RM=119.0 MN=11 HABITAT=CHANNDRW

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
CAMBARUS SP..	2	0.5	0.707	0	1	0.5	1	141.421
CHIRONOMIDAE	2	0.5	0.707	0	1	0.5	1	141.421
CRANGONYX SP.	2	0.5	0.707	0	1	0.5	1	141.421
CURA FOREMANII	2	4.0	5.657	0	8	4.0	32	141.421
DUGESIA TIGRINA	2	1.5	2.121	0	3	1.5	5	141.421
GLOSSIPHONIIDAE	2	0.5	0.707	0	1	0.5	1	141.421
ORCONECTES SP.	2	1.0	1.414	0	2	1.0	2	141.421
PLEUROCERA (SYN. OXYTREMA) SP.	2	273.0	386.080	0	546	273.0	149058	141.421
STENACRON SP.	2	0.5	0.707	0	1	0.5	1	141.421
STENONEMA SP.	2	1.0	1.414	0	2	1.0	2	141.421
TUBIFICIDAE	2	1.0	1.414	0	2	1.0	2	141.421

N=11

YEAR=79 RN=119.0 MN=12 HABITAT=CHANNOK

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
BAETIS SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
CORBICULA MANILENSIS	2	1.0	0.0000	1	1	0.0	0.0	0.000
CRANGONYX SP.	2	7.5	3.5355	5	10	2.5	12.5	47.140
CRICOTOPUS SP.	2	3.0	0.0000	3	3	0.0	0.0	0.000
CURA FOREMANII	2	43.0	15.5563	32	54	11.0	242.0	36.178
DUGESIA TIGRINA	2	4.0	1.4142	3	5	1.0	2.0	35.355
EUKIEFFERIELLA SP.	2	8.5	3.5355	6	11	2.5	12.5	41.595
FERRISSIA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
HYDROPSYCHE SP.	2	77.5	34.6482	53	102	24.5	1200.5	44.707
LEPIDOPTERA	2	1.0	0.0000	1	1	0.0	0.0	0.000
LIRCEUS SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
MACRONYCHUS GLABRATUS	2	0.5	0.7071	0	1	0.5	0.5	141.421
ORCONECTES SP.	2	1.0	0.0000	1	1	0.0	0.0	0.000
OULIMNIUS SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421
PLEUROCERA (SYN. OXYTREMA) SP.	2	18.5	26.1630	0	37	18.5	684.5	141.421
POLYCENTROPUS SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
PSEUDOCLOEON SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
SIMULIUM VITTATUM	2	1.5	0.7071	1	2	0.5	0.5	47.140
STENACRON SP.	2	1.5	2.1213	0	3	1.5	4.5	141.421
STENONEMA SP.	2	10.0	14.1421	0	20	10.0	200.0	141.421
TUBIFICIDAE	2	0.5	0.7071	0	1	0.5	0.5	141.421

L=21

YEAR=79 RM=120.2 MM=10 HABITAT=CHANBORX

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
ANTOCHA SP.	2	3.5	4.9497	0	7	3.5	24.5	141.421
BAETIS SP.	2	11.0	15.5563	0	22	11.0	242.0	141.421
CHEUMATOPSYCHE SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
CHIRONOMIDAE	2	1.5	2.1213	0	3	1.5	4.5	141.421
CORBICULA MANILENSIS	2	2.5	3.5355	0	5	2.5	12.5	141.421
CRICOTOPUS SP.	2	1.5	2.1213	0	3	1.5	4.5	141.421
EUKIEFFERIELLA SP.	2	1.5	2.1213	0	3	1.5	4.5	141.421
FERPISSIA SP.	2	5.0	7.0711	0	10	5.0	50.0	141.421
GLOSSIPHONIIDAE	2	1.0	1.4142	0	2	1.0	2.0	141.421
GYRAULUS PARVUS	2	0.5	0.7071	0	1	0.5	0.5	141.421
HYDROPSYCHE SP.	2	4.0	1.4142	3	5	1.0	2.0	35.355
LEPIDOPTERA	2	1.0	1.4142	0	2	1.0	2.0	141.421
LUMBRICULIDAE	2	0.5	0.7071	0	1	0.5	0.5	141.421
PLEUROCERA (SYN. OXYTREMA) SP.	2	45.5	55.8614	6	85	39.5	3120.5	122.772
SIMULIUM VITTATUM	2	1.5	2.1213	0	3	1.5	4.5	141.421
TRICORYTHODES SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421

N=16

P-IPPS BEND MACROBENTHIC CALCULATIONS - SPECIES LIST - BY MONTH

YEAR=79 RM=120.2 PT=1. HABITAT=CHANNEL

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
ANTOCHA SP.	2	1.0	0.0000	1	1	0.0	0.0	0.000
CALOPTERYX SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
CAMBARUS SP.,	2	1.0	1.4142	0	2	1.0	2.0	141.421
CHEUMATOPSYCHE SP.	2	7.0	9.8995	0	14	7.0	98.0	141.421
CHIRONOMIDAE	2	0.5	0.7071	0	1	0.5	0.5	141.421
CORYDALUS SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
CRANGONYX SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
FERRISSIA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
HYDROPSYCHE SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421
HYDROPTILA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
LIRCEUS SP.	2	3.5	0.7071	3	4	0.5	0.5	20.203
ORCONECTES SP.	2	1.0	0.0000	1	1	0.0	0.0	0.000
PLEUROCERA (SYN, OXYTREMA) SP.	2	20.0	28.2843	0	40	20.0	800.0	141.421
PSYCHOMYIA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
STENACRON SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
STENONEMA SP.	2	2.5	2.1213	1	4	1.5	4.5	84.853

N=16

YEAR=79 RM=120.2 MN=12 HABITAT=CHANNDRK

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
ABLABESMYIA SP.	2	0.5	0.707	0	1	0.5	0.5	141.421
ANATOCHA SP.	2	9.5	6.364	5	14	4.5	40.5	66.989
BAETIS SP.	2	2.5	2.121	1	4	1.5	4.5	84.853
CAMBARUS SP..	2	1.5	2.121	0	3	1.5	4.5	141.421
CHIRONOMIDAE	2	0.5	0.707	0	1	0.5	0.5	141.421
CORBICULA MANILENSIS	2	0.5	0.707	0	1	0.5	0.5	141.421
CORYDALUS CORNUTUS	2	6.0	8.485	0	12	6.0	72.0	141.421
CRICOTOPUS SP.	2	5.0	0.000	5	5	0.0	0.0	0.000
CURA FOREMANII	2	3.0	1.414	2	4	1.0	2.0	47.140
DUGESIA TIGRINA	2	2.5	0.707	2	3	0.5	0.5	28.284
EPHEMERELLA SP.	2	1.5	0.707	1	2	0.5	0.5	47.140
EUKIEFFERIELLA SP.	2	5.5	6.364	1	10	4.5	40.5	115.708
FERRISSIA SP.	2	0.5	0.707	0	1	0.5	0.5	141.421
GLOSSIPHONIIDAE	2	0.5	0.707	0	1	0.5	0.5	141.421
HETAERINA SP.	2	1.5	2.121	0	3	1.5	4.5	141.421
HYDROPSYCHE SP.	2	204.0	210.718	55	353	149.0	44402.0	103.293
HYDROPTILA SP.	2	1.5	2.121	0	3	1.5	4.5	141.421
LEPTOPHLEBIA SP.	2	0.5	0.707	0	1	0.5	0.5	141.421
ORCONECTES SP.	2	0.5	0.707	0	1	0.5	0.5	141.421
PLEURDCERA (SYN. OXYTREMA) SP.	2	7.0	2.828	5	9	2.0	8.0	40.406
PSYCHOMYIA SP.	2	1.0	1.414	0	2	1.0	2.0	141.421
SIMULIUM SP.	2	1.5	2.121	0	3	1.5	4.5	141.421
STENACRON SP.	2	2.5	0.707	2	3	0.5	0.5	28.284
STENONEMA SP.	2	9.0	4.243	6	12	3.0	18.0	47.140
TAENIOPTERYX SP.	2	0.5	0.707	0	1	0.5	0.5	141.421
TUBIFICIDAE	2	1.0	1.414	0	2	1.0	2.0	141.421

N=20

YEAR=79 RM=124.3 MN=10 HABITAT=CHANBORK

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
ANTOCHA SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421
TAETIS SP.	2	12.5	17.6777	0	25	12.5	312.5	141.421
CAMPELOMA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
CHIRONOMIDAE	2	1.0	1.4142	0	2	1.0	2.0	141.421
DUGESIA TIGRINA	2	1.0	1.4142	0	2	1.0	2.0	141.421
ENALLAGMA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
FERRISSIA SP.	2	3.5	4.9497	0	7	3.5	24.5	141.421
HYDROPTILA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
ISCHNURA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
MUSCIDAE	2	1.0	1.4142	0	2	1.0	2.0	141.421
NAIS SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
PLEUROCERA (SYN. OXYTREMA) SP.	2	10.0	14.1421	0	20	10.0	200.0	141.421
PSYCHOMYIA SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421
TUBIFICIDAE	2	0.5	0.7071	0	1	0.5	0.5	141.421

N=14

YEAR=79 RM=124.3 MN=11 HABITAT=CHAMBORK

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
ABLABESMYIA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
ANTOCHA SP.	2	2.0	0.0000	2	2	0.0	0.0	0.000
CALOPTERYX SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
CAMBARUS SP..	2	1.0	1.4142	0	2	1.0	2.0	141.421
CHIRONOMIDAE	2	4.0	4.2426	1	7	3.0	18.0	106.066
CORBICULA MANILENSIS	2	0.5	0.7071	0	1	0.5	0.5	141.421
CRANGONYX SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421
CURA FOREMANII	2	2.0	2.8284	0	4	2.0	8.0	141.421
DUGESIA TIGRINA	2	8.5	12.0208	0	17	8.5	144.5	141.421
HYDROPSYCHE SP.	2	7.0	9.8995	0	14	7.0	98.0	141.421
HYDROPTILA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
LIRCEUS SP.	2	2.0	1.4142	1	3	1.0	2.0	70.711
LUMBRICULIDAE	2	1.0	1.4142	0	2	1.0	2.0	141.421
NAIDIDAE	2	1.0	1.4142	0	2	1.0	2.0	141.421
ORCONECTES SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
PLEUROCERA (SYN. OXYTREMA) SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
PSYCHOMYIA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
SYNAGROA SP.	2	1.5	0.7071	1	2	0.5	0.5	47.140
STAGNICOLA SP.	2	2.0	2.8284	0	4	2.0	8.0	141.421
TUBIFICIDAE	2	3.0	4.2426	0	6	3.0	18.0	141.421

N=20

PHIPPS BEND MACROBENTHIC CALCULATIONS - SPECIES LIST - BY MONTH

YEAR=79 RM=124.3 MO=12 HABITAT=CHANNEL

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
ANTECHA SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421
BRANCHIURA SOWERBYI	2	1.0	1.4142	0	2	1.0	2.0	141.421
CAMBARUS SP.	2	2.0	1.4142	1	3	1.0	2.0	70.711
CORBICULA MANILENSIS	2	3.0	4.2426	0	6	3.0	8.0	141.421
CRANGONYX SP.	2	14.0	18.3848	1	27	13.0	338.0	131.320
CRICOTOPUS SP.	2	1.5	0.7071	1	2	0.5	0.5	47.140
CURA FOREMANII	2	33.0	36.7696	7	59	26.0	1352.0	111.423
DUBIRAPHIA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
DUGESIA TIGRINA	2	3.5	2.1213	2	5	1.5	4.5	60.609
EUKIEFFERIELLA SP.	2	3.0	1.4142	2	4	1.0	2.0	47.140
GLOSSIPHONIIDAE	2	0.5	0.7071	0	1	0.5	0.5	141.421
HETAERINA SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421
HYDROPSYCHE SP.	2	2.0	0.0000	2	2	0.0	0.0	0.000
HYDROPTILA SP.	2	5.5	3.5355	3	8	2.5	12.5	64.282
LUMBRICULIDAE	2	4.0	5.6569	0	8	4.0	32.0	141.421
NAIDIDAE	2	0.5	0.7071	0	1	0.5	0.5	141.421
ORCONECTES SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
PLEURDCERA (SYN. OXYTREMA) SP.	2	42.5	43.1335	12	73	30.5	1860.5	101.491
POLYCENTROPUS SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
PSYCHOMYIA SP.	2	3.5	0.7071	3	4	0.5	0.5	20.203
STENACRON SP.	2	13.5	4.9497	10	17	3.5	24.5	36.663
TUBIFICIDAE	2	5.5	7.7782	0	11	5.5	60.5	141.421

N=22

YEAR=80 RM=115.0 MN=01 HABITAT=CHANBDRK

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
BRANCHIURA SOWERBYI	2	3.5	4.9497	0	7	3.5	24.5	141.421
CHIRONOMIDAE	2	18.5	12.0208	10	27	8.5	144.5	64.977
CORBICULA MANILENSIS	2	0.5	0.7071	0	1	0.5	0.5	141.421
CRANGONYX SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421
CURA FOREMANII	2	1.5	0.7071	1	2	0.5	0.5	47.140
DUGESIA TIGRINA	2	3.0	2.8284	1	5	2.0	8.0	94.281
FUKIEFFERIELLA SP.	2	28.0	4.2426	25	31	3.0	18.0	15.152
HYDROPSYCHE SP.	2	6.5	7.7782	1	12	5.5	60.5	119.664
HYDROPTILA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
LUMBRICULIDAE	2	0.5	0.7071	0	1	0.5	0.5	141.421
NAIDIDAE	2	4.5	4.9497	1	8	3.5	24.5	109.994
ORCONECTES SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
PLEUROCERA (SYN. OXYTREMA) SP.	2	14.5	20.5061	0	29	14.5	420.5	141.421
SIMULIUM VITTATUM	2	1.5	2.1213	0	3	1.5	4.5	141.421
STENACRON SP.	2	3.5	0.7071	3	4	0.5	0.5	20.203
STENONEMA SP.	2	5.0	2.8284	3	7	2.0	8.0	56.569
TAENIOPTERYX SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
TUBIFICIDAE	2	4.5	3.5355	2	7	2.5	12.5	78.567

N=14

PIPPS BE... MACROBENTHIC CALCULATIONS - SPECIES LIST - BY MONTH

YEAR=83 RU=119.0 MI=01 HABITAT=CHANBORK

TAXON	N	MEAN	STD	MIN	MAX	STDERR	VAR	CV
BRANCHIURA SOWERBYI	2	0.5	0.7071	0	1	0.5	0.5	141.421
CHIRONOMIDAE	2	2.5	2.1213	1	4	1.5	4.5	84.853
CRANGONYX SP.	2	3.0	2.8284	1	5	2.0	8.0	94.281
CURA FOREMANII	2	22.5	30.4056	1	44	21.5	924.5	135.136
DUGESIA TIGRINA	2	9.0	11.3137	1	17	8.0	128.0	125.708
EUKIEFFERIELLA SP.	2	1.5	0.7071	1	2	0.5	0.5	47.140
HETAERINA AMERICANA	2	0.5	0.7071	0	1	0.5	0.5	141.421
HYDROPSYCHE SP.	2	1.5	0.7071	1	2	0.5	0.5	47.140
STENACRON SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
STENONEMA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
TIPULA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
TRIAENODES SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
TRIBELOS SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
TUBIFICIDAE	2	3.0	1.4142	2	4	1.0	2.0	47.140

N=14

YEAR=80 RM=120.2 MO=01 HABITAT=CHANBORM

TAXON	.	MEAN	STD	MIN	MAX	STDERR	VAR	CV
ANTOCHA SP.	1	1	.	1	1	.	.	.
CHIRONOMIDAE	1	32	.	32	32	.	.	.
EUKIEFFERIELLA SP.	1	27	.	27	27	.	.	.
HYDROPSYCHE SP.	1	22	.	22	22	.	.	.
NAIDIDAE	1	3	.	3	3	.	.	.
SIMULIUM VITTATUM	1	13	.	13	13	.	.	.
STENONEMA SP.	1	1	.	1	1	.	.	.

N=7

YEAR=80 RM=24.3 N=51 HABITAT=CHANNEL

TAXON	N	MEAN	ST.	MIN	MAX	STDERR	VAR	CV
ABLABESMYIA SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
ANTOCHA SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421
CALOPTERYX SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
CHIRONOMIDAE	2	39.0	24.0416	22	56	17.0	578.0	61.645
CURA FOREMANII	2	1.5	2.1213	0	3	1.5	4.5	141.421
DUGESIA TIGRINA	2	0.5	0.7071	0	1	0.5	0.5	141.421
EPOICOCLADIUS SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
EUKIEFFERIELLA SP.	2	31.5	33.2340	8	55	23.5	1104.5	105.505
HETAERINA AMERICANA	2	0.5	0.7071	0	1	0.5	0.5	141.421
HYDROPSYCHE SP.	2	31.5	43.1335	1	62	30.5	1860.5	136.932
NAIDIDAE	2	1.5	2.1213	0	3	1.5	4.5	141.421
POLYCENTROPUS SP.	2	0.5	0.7071	0	1	0.5	0.5	141.421
POLYPEDILUM SP.	2	2.5	0.7071	2	3	0.5	0.5	28.284
PSYCHOMYIA SP.	2	2.5	2.1213	1	4	1.5	4.5	84.853
SIMULIUM SP.	2	9.5	13.4350	0	19	9.5	180.5	141.421
STENACRON SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421
STENONEMA SP.	2	1.0	1.4142	0	2	1.0	2.0	141.421

N=17

PHIPPS REID MACROBENTHIC CALCULATIONS - TOTAL ORGANISMS

YEAR=83 PS=115.0 HABITAT=CHANNORR

VAR	N	MEAN	STD	MIN	MAX	STDERR	SUM	VAR	CV
G1	2	98	1.41421	97	99	1	196	2	1.44308

N=1

PHIPPS HEAD : AGROGEOMIC CALCULATIONS - TOTAL ORGANISMS

YEARS: [illegible] HABITAT: CHATSWORK

		MEAN	STD	MIN	MAX	STDERR	SUM	VAR	CV
1	2	46.5	37.4767	21	73	26.5	93	1404.5	80.595

1