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AN ASSESSMENT OF RIVER WATER QUALITY IN THE RIVER KENN.

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AN ASSESSMENT OF RIVER WATER QUALITY IN THE RIVER KENN.

FWI/91/018

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EXETER

This investigation and report was undertaken by staff of the Freshwater Investigation Team and included contributions by staff of Pollution Control-East.

SUMMARY.

This study was undertaken to determine the causes of non-compliance with the designated River Quality Objective's (RQO) in the Kenn sub-catchment of the River Exe.

Aquatic macroinvertebrate samples were taken from 16 sites on the main River Kenn and its principle tributary, Splatford Brook, to locate areas of poor water quality in the Kenn catchment. The sources of pollution in these areas were traced by taking further samples and identifying indicator taxa in the field.

Chemical samples were collected during high river flows at the same main river sites sampled in the initial biological survey and at sites downstream of identified areas of poor water quality. Two continuous water quality monitors were installed in the catchment.

High Biochemical Oxygen Demand (BOD) concentrations and suspended solids concentrations were shown to occur in the majority of the Kenn catchment after heavy rainfall.

The aquatic macroinvertebrate survey revealed poor water quality, mostly due to organic enrichment, throughout the Kenn catchment with the exception of the headwaters and the extreme lower reaches.

Areas of poor water quality due to organic inputs were located in 4 areas in the catchment. It has been recommended that drainage arrangements from all the implicated sources in these areas be checked.

An unknown pollutant was traced to a surface water drain located downstream of Kenn on the main river. The origin and nature of the discharge from the surface water drain must be ascertained.

There was only a slight indication of organic enrichment downstream of Kenn and Kennford STW, although any impact from the discharges was likely to have been masked by poor water quality upstream. Therefore, it has been recommended that the impact of this STW is assessed once the water quality upstream has improved.

Discrepancies in the results from the chemical and biological surveys were discussed and it appears that an integration of biological and chemical methods provides the most comprehensive approach to investigating poor water quality.

Typical Land-use in the Upper Kenn Catchment 26.11.91.

River Kenn at Lower Brenton Farm during the high-flow chemical survey (4.4.91).

CONTENTS.

AN ASSESSMENT OF RIVER WATER QUALITY IN THE RIVER KENN.

1. INTRODUCTION.

A study was undertaken to determine the causes of non-compliance with the designated River Quality Objective's (RQO) in the Kenn sub-catchment of the Exe.

The Kenn sub-catchment was chosen for investigation as its poor water quality had been given a high priority rating in a FWIT report (FWI/90/024) (Ref. 1) and as it was also a small catchment suitable for reviewing.

Concern was later expressed over the river's water quality at a public meeting of the Kenn Parish Council on 31 July 1991. It was explained that an investigation into the cause of poor was currently being undertaken.

This report presents the results of the study and makes recommendations that could result in an improvement in water quality.

2. THE STUDY AREA.

The small Kenn sub-catchment lies to the West of Exeter in South-east Devon. The River Kenn rises in the common land of Haldon Forest, flows for 14.2km before draining directly into the Exe estuary. Brown earth soils overlie the upper and lower reaches of the catchment with an outcrop of brown sands in the middle reaches.

Dairy and arable farming are the predominate land-uses in the catchment, with forestry in the upper catchment and an area of free-range pig farming. The small settlements of Kenton, Kenn and Kennford are located in the mid-catchment and comprise the only settled areas in the catchment.

Three sewage treatment works discharge to the River Kenn (see Figure 1); the details of which are given below:

TABLE 1. Details of the 3 sewage treatment works that discharge to the River Kenn.

Sewage Treatment Works	Location NGR	Effluent Consent Conditions
Kenn and Kennford STW	SX 9275 8527	30mg/l BOD & 45mg/l Suspended Solids
Haldon View STW	SX 8965 8690	Descriptive Consent
Dunchideock STW	SX 8824 8787	Descriptive Consent

Constraint has been placed on any development requiring connection to the sewerage system in the area of Kenn and Kennford, because the stormwater overflow at Kenn and Kennford STW is considered to be polluting. The STW is near to capacity and infiltration water in the sewerage system causes premature operation of the stormwater overflow. This has lead to the placement of Kenn and Kennford STW on South West Water Services Limited Capital Improvement Programme.

2.1. River-Use.

The main river is divided for classification purposes into 2 reaches; upstream of the A38 bridge at Kennford (NGR SX 9132 8662) has a RQO of National Water Council (NWC) Class 1B whilst the downstream reach to the estuary has a RQO of NWC Class 1A. It is inappropriate that the lower reaches have a stricter RQO than the upper reaches.

The river has the following identified uses:

* Protection of Aesthetic Quality
* Protection of Salmonid Fish
* Protection of Other Aquatic Life and Dependent Organisms
* Protection for Livestock Watering
* Protection for Irrigation of Crops.

The River Kenn has been designated for the protection of salmonid fish from source to mouth under the European Council's (EC) Freshwater Fish Directive. Compliance with the Directive is monitored at the identified monitoring site at Powderham Castle (NGR SX 9660 8343).

3. BACKGROUND.

3.1. Review of Routine Water Quality Data.

There are 2 routine water quality monitoring sites within the catchment: at the A38 bridge Kennford (NGR SX 9132 8662) and at Powderham Castle (NGR SX 9660 8343) (see Figure 1). The 1990 classification of determinands monitored at each site using the National Water Council (NWC) river classification system are given in Table 2 (see Appendix I for the complete data).

TABLE 2. Classification of the non-complying determinands for the period 1988 to 1990 for the River Kenn.

	RQO	1990 Class	Dissolved Oxygen	BOD	Ammonia	Unionised Ammonia
A38 bridge Kennford	1B	3	1A	3	2	3
Powderham Castle	1A	2	1B	2	1A	1A

High suspended solids concentrations, mainly of inorganic origin, were recorded at both sites (eg. 28 January 1988 and 9 January 1991 - see Appendix I) during periods of heavy rain (13.1mm and 9.8mm) and are thought to arise from soil erosion.

High Biochemical Oxygen Demand (BOD) and total ammonia concentrations, ie.

greater than the standards for a NWC Class 1B river, at Kennford were associated with moderate rainfall events (0.7mm - 3.3mm), although high BOD concentrations at Powderham did not necessarily occur on the same day (see Appendix I).

Ammonia concentrations have not exceeded the standards for NWC Class quality 1A at Powderham Castle between 1987 and spring 1991.

The review of routine water quality data has shown local organic inputs associated with rainfall, possibly arising from farm drainage, to be responsible for the majority of the exceedance of the relevant RQO standards in the Kenn catchment. Water quality at the Powderham site in the lower reaches did not reflect this poor quality suggesting improvements occur between these two sites.

3.2. Review of Routine Invertebrate Data.

Routine macroinvertebrate samples are collected at 2 sites within the catchment:

(i) NRA060502 upstream of the A38 bridge, Kennford (NGR SX91178667)
(ii) NRA060503 upstream of the A379 bridge, Kenton (NGR SX95278463).

Locations are indicated in Figure 1 and data given in Appendix II.

The macroinvertebrate community upstream of the A38 bridge site was dominated by organic pollution tolerant taxa, described by low environmental quality indices (see Table 3).

Although organic pollution tolerant taxa were still abundant at the A379 bridge site, there was a large increase in the number of organic pollution sensitive taxa recorded. The macroinvertebrate community indicated a significant improvement in water quality at the lower site.

TABLE 3. Biotic indices for macroinvertebrate data collected in 1990 for the River Kenn. For an explanation of the indices see section 4.1.

Biotic Indices	NRA060502 A38 bridge, Kennford	NRA060503 A379 bridge, Kenton
3 seasons data (observed)		
BMWP Score	123	219
ASPT	5.10	6.40
Number of families	24	34
Environmental quality indices (observed/predicted)		
BMWP Score	0.59	1.04
ASPT	0.84	1.05
Number of families	0.70	0.99

4. METHODS.

4.1. Biological Investigation.

Initial Biological Survey - 26 to 28 February 1991.

Aquatic macroinvertebrate samples were taken from 16 sites on the main River Kenn and its principle tributary, Splatford Brook, to locate areas of poor water quality in the Kenn catchment (see Figure 1).

Aquatic macroinvertebrates were sampled in spring 1991, using a standard kick technique for 3 minutes in a riffle area of the river with a 1.0 mm mesh pond net plus a further 1 minute sampling of other habitats in the sample area. Details of substrate type, flow, width, depth, shade and flora were recorded on site. Samples were preserved on site with Industrial Methylated Spirit.

In the laboratory samples were sieved and placed in a shallow white tray to be sorted. Identification was to family level.

Biotic Scores were calculated using the Biological Monitoring Working Party (BMWP) score system which assigns a high score to organic pollution sensitive taxa (maximum of 10) and a low score to organic pollution tolerant taxa (minimum of 1). An average score per taxon (ASPT) was also calculated for each site. This value is considered to give a better indication of any pollution affects.

Using habitat characteristics, 'RIVPACS' was employed to predict taxa most likely to be present under ideal conditions (predicted fauna in Table 3). The predicted indices were compared to observed data from routine monitoring in order to provide an estimate of a decline in fauna attributed to pollution. 'RIVPACS' is a computer programme used to predict the macroinvertebrate fauna at flowing water sites employing various physical and chemical parameters (Ref. 2).

Follow up Biological Surveys - March 1991.

Areas of poor water quality identified by the initial survey were further investigated to trace sources of pollution (as indicated in Figure 2).

Aquatic macroinvertebrate samples were taken using a standard kick technique for one minute in a riffle area of the site with a 1.0 mm mesh pond net. In the field samples were placed in a white tray to be sorted. Identification was to family level.

In samples from polluted reaches indicator macroinvertebrate taxa identified by the initial survey were used to locate the source of pollution. Where tributaries were sampled entering the polluted reach all macroinvertebrate taxa were identified and recorded.

4.2. Chemical Survey.

Chemical samples were collected during high river flows from 3 to 4 April 1991 at the same main river sites sampled in the initial biological survey and at sites downstream of identified areas of poor water quality. Four samples were collected at each site during the high flow event.

The final effluent at Kenn and Kennford STW and the Kenton Brook downstream of a storm sewer overflow were also sampled.

Two continuous (pHOX 100DPM) water quality monitors were installed in the catchment; one system was placed at Lower Brenton Farm in the middle reaches (site B), and the other at Lower Horrels in the headwaters (site A) (see Figure 1). Ammonia concentrations were recorded at 15 minute intervals.

5. RESULTS.

5.1. Biological Investigation.

The macroinvertebrate communities of the upper reaches of the River Kenn (sites 1 and 3) were dominated by Heptageniidae, Plecoptera or Hydrobiidae (see Figure 3), with high BMWP and ASPT scores (see Figure 4). Erpobdellidae were recorded at site 3, Idestone Brook Cross.

Biotic scores in the middle reaches of the River Kenn, downstream of Hill Farm Brook to below Kenn (sites 8 and 13), had declined compared to those at the upstream sites (see Figure 4).

Seven areas of interest were identified by the initial biological survey (see Appendix III).

Area 1.

Downstream of Idestone Brook Cross, between sites 3 and 4 on the River Kenn the BMWP and ASPT scores declined markedly (see Figure 4). Heptageniidae and Plecoptera declined in relative abundance (see Figure 3). The macroinvertebrate community at site 4 was dominated by Hydrobiidae and Oligocheata.

Area 2.

A decrease in biotic scores was found between sites 5 and 6, up and downstream of Haldon Brook tributary on the main river (see Figure 4). Gammaridae were the major crustacean group at site 5 whereas Asellidae were the dominant crustacean group at site 6 (see Appendix III).

The BMWP scores at sites 5 and 6 were higher than at site 4 (see Figure 4), although the macroinvertebrate communities were still dominated by Hydrobiidae, Oligocheata and Chironomidae (see Figure 3).

Area 3.

A decline in biotic scores (see Figure 4) and increase in the relative abundance of Oligochaeta (see Figure 3) was recorded in the main river between sites 7 and 8, up and downstream of Hill Farm Brook.

Area 4.

Between sites 9 and 11 on the River Kenn, downstream of Kenn, there was a marked decline in the relative abundance of Baetidae and Crustacea.

Area 5.

Splatford Brook had low biotic scores and a scarcity of Ephemeroptera and Plecoptera (site 20).

Area 6.

The macroinvertebrate communities up and downstream of Kenn and Kennford STW (sites 12 and 13) were similar. Downstream of the STW there was an increase in the relative abundance of Oligochaeta.

BMWP and ASPT scores further downstream (sites 14 and 15) were higher than in the middle reaches (see Figure 4) and relative abundance of Oligocheata and Chironomidae had declined (see Figure 3).

Area 7.

In the lower reaches of the River Kenn in the vicinity of Powderham Castle at (sites 16 and 17) Hydrobiidae were dominant (see Figure 3) and BMWP and ASPT scores were lower than site 15.

5.2. Chemical Survey.

BOD and suspended solid concentrations at all the sites rose as the rainfall event progressed (see Table 4).

BOD concentrations exceeded the standards for a NWC Class 1B river (5mg/l) and the guideline value for a designated salmonid fishery at the majority (12 out of 14) of the main river sites and 2 of the 4 tributaries (see Figure 4). The lowest 2 main river sites had peak BOD concentrations within the NWC Class 1B RQO standards.

High suspended solids concentrations up to 350mg/l were recorded in the main river from sites 3 to 12. Samples from the upper site (2) and the lower 3 sites had lower suspended solid concentrations (see Table 4).

The ammonia concentrations in the manual spot samples were all remarkably low (see Table 4). Furthermore, the ammonia concentrations recorded on the continuous monitors were not similar to those in the spot samples (see Figure 5).

The peak ammonia concentrations recorded at both continuous monitoring sites (see Figure 1) exceed the NWC Class 1B standard (0.7mg/1N) and follow a similar pattern (see Figure 5).

There was no increase in any of the determinands measured downstream of Kenn and Kennford STW.

6. DISCUSSION.

Organic pollution arising from land runoff during heavy rainfall was demonstrated throughout the majority of the catchment in the high-flow chemical survey.

Soil erosion due to the steep valley and occurrence of exposed soil have resulted in very high suspended solids concentrations recorded throughout much of the River Kenn.

The aquatic macroinvertebrate survey revealed poor water quality, mostly due to organic enrichment, throughout the Kenn catchment with the exception of the headwaters and the extreme lower reaches.

Seven distinct areas of water quality were identified by changes in the invertebrate community. A total of 36 sites were sampled in the field to identify areas of poor water quality in the Kenn catchment (see Figure 2). As the findings of poor water quality were known they were passed to the Pollution Inspector for follow-up action.

Area 1 - Below Idestone Brook Cross.

Aquatic macroinvertebrate samples identified in the field between sites 3 and 4 (see Figure 2) traced the source of poor water quality to a river stretch below Idestone Brook Cross (NGR SX87818836), although the precise source of pollution was not found. An increase in BOD and suspended solids concentrations at site 4 compared to site 3 supported the biological findings.

Area 2 - The Haldon Brook.

Analysis of macroinvertebrate samples identified in the field within the Haldon Brook catchment (see Figure 2) indicated organic pollution from the Haldon House Brook. The lack of Ephemeroptera (organic pollution sensitive taxa) downstream of ponds at Haldon Grange traced the problem to the headwaters of the tributary. Farm drainage from Penhill Farm (NGR SX87608660) was the most likely cause of poor water quality.

Evidence of organic pollution was also detected downstream of Haldon Pond (NGR SX89108680). Macroinvertebrate communities in the feeder tributaries indicated good water quality upstream of the pond. The previous fishery at Haldon Pond may have lead to eutrophication and subsequent poor water quality downstream in the river.

Poor water quality was not identified in the Haldon Brook catchment during the chemical survey.

Area 3 - Farm Drainage at Hill Farm.

The source of organic pollution entering the River Kenn between sites 7 and 8 was traced to drainage entering Hill Farm Brook from Hill Farm (SX89718621), where sewage fungus cover up to 70% was recorded in the brook.

Higher BOD concentrations (>5.2 mg/l) were detected in Hill Farm Brook, although no impact was detected downstream of the tributary in the River Kenn during the chemical survey.

Area 4 - Surface Water Drain.

Macroinvertebrates samples identified in the field between sites 9 and 11 (see Figure 2) traced the absence of Baetidae and Crustacea to downstream of a surface water drain entering the River Kenn at NGR SX91888592. This decline resulted from an unknown pollutant in the surface water drain. However, samples collected from the surface water drain during the high flow event did not contain oils and greases.

Surface runoff from the A38 and A380 roads undoubtedly enters the River Kenn at Kenn and is likely to have an impact on river water quality, particularly following storm events. However, no evidence of any impact from surface runoff was detected in the biological survey downstream of the A38 and A380 roads, although it is likely that any effects would have been masked by the poor river water quality upstream.

Area 5 - Splatford Brook.

Extra samples taken from Splatford Brook could not trace the cause of poor water quality to any point discharge. Instead a gradual decline in Ephemeroptera was shown down the river. The absence of Plecoptera in all samples, including the upper site, could not be explained.

Area 6 - Kenn and Kennford STW.

The only indication of an increase in organic pollution downstream of the sewage effluent discharge from Kenn and Kennford STW final effluent was an increase in the relative abundance of Oligochaeta. However, any impact from the discharge was likely to have been masked by the organic pollution evident upstream of the discharge. No impact was detected downstream of the STW during the chemical survey.

Area 7 - The Lower reaches of the River Kenn.

The increase in biotic scores and the absence of Oligochaeta and Chironomidae at sites 14 and 15, in the lower reaches of the River Kenn, indicated an improvement in water quality.

The river at sites 16 and 17 was deep with a sandy substrate, a habitat favoured by Hydrobiidae and other organic pollution tolerant taxa. As organic pollution sensitive taxa were also present at these sites the lower biotic scores were not thought to indicate poor water quality in the lower reaches.

This improvement in water quality was supported by the chemical investigation in that the 2 lowest sites were the only ones in the main river to have peak BOD concentrations (4.0 and 3.0 mg/l) within the limits for a NWC Class 1B water.

Variations in the Chemical and Biological Data.

Inconsistences occurred in the patterns of poor water quality identified by the chemical and the biological surveys.

High ammonia and BOD concentrations collected during continuous monitoring at site A demonstrated exceedance with water quality standards (NWC Class 1B and EQS for salmonid fish) in the headwaters, where only a negligible impact was identified in the invertebrate community (site 1).

It is possible that aquatic macroinvertebrates can tolerate these short-lived pollution events. There is evidence that invertebrates migrate into the substrate on the river bed, where water quality may be better during episodic pollution (pers. comm. J. Murray-Bligh).

In contrast, the macroinvertebrate community indicated poor water quality in the Haldon sub-catchment, whereas no problem was detected with the high-flow chemical survey. Spot sampling may miss intermittent pollution even when sampling is targeted at a high-flow event, when pollution often occurs.

In addition, the high-flow chemical survey did not locate the distinct areas of poor water quality that the biological survey achieved.

Therefore, it appears that an integration of biological and chemical methods provides the most comprehensive approach to investigating poor water quality.

Problems with Chemical Results.

Due to the inconsistencies in the measurement of ammonia in spot samples and in continuous monitoring it has been assumed that ammonia degradation occurred in the spot samples (over at least 10 hours) prior to analysis at Countess Weir laboratories (cf. Figure 5 and Table 4).

Ammonia concentrations were unusually low in all the spot samples (<0.01 mg/lN) despite high BOD concentrations. The ammonia concentrations recorded with the continuous monitors were likely to have been correct as the monitors were validated with a hand held ammonium monitor (DMP Water Dipper) during the survey and as both sets of continuous readings were similar.

Samples analsyed by an analytical contractor resulted in a large number of BOD concentrations recorded with 'greater than' signs. This prevented identification of changes in water quality and most probably masked areas of poor water quality in the chemical survey.

7. CONCLUSIONS.

1. High BOD concentrations from surface runoff were shown to occur in the majority (mainly the middle section) of the Kenn catchment during heavy rainfall.

2. Soil erosion resulted in high suspended solid concentrations being recorded throughout the monitored watercourses of the Kenn catchment during heavy rainfall.

3. The aquatic macroinvertebrate survey revealed poor water quality in the middle reaches of the River Kenn.

4. River reaches of poor water quality due to organic inputs were located below Idestone Brook Cross in the River Kenn (area 1), in the Haldon Brook and downstream of this tributary in the main river (area 2), in Hill Farm Brook due to farm drainage (area 3) and in Splatford Brook (area 5).

5. An unknown pollutant was traced to a surface water drain located downstream of Kenn on the main river.

6. There was only a slight indication of organic enrichment downstream of Kenn and Kennford STW, although any impact from the discharges was likely to have been masked by poor water quality upstream.

7. An improvement in water quality was evident in the lower reaches of the main river.

8. Inconsistences in the results from the chemical and biological surveys were attributed to the intermittent nature of pollution in the catchment. Aquatic macroinvertebrates may tolerate short-lived pollution events detected by chemical surveys. In contrast, aquatic macroinvertebrates can demonstrate a previous water quality problem that spot sampling may miss.

9. Ammonia degradation appeared to have occurred in the spot samples prior to analysis in the laboratory when they were compared to concentrations recorded with the continuous monitor.

8. RECOMMENDATIONS.

1. The precise source and cause of the poor water quality below Idestone Brook Cross must be identified and resolved.

- Action by Catchment Scientist/Pollution Officer (East).

2. Farms in the catchment should be visited to check the drainage arrangements focusing on the problem areas identified by this study.

- Action by Pollution Officer (East).

3. The Kenn and Kennford STW must be revisited when water quality has improved upstream of the works to assess the performance of the works and the impact of the capital improvement work.

- Action by Catchment Scientist.

4. The origin of the surface water drain (NGR SX 9188 8592) must be located and the water quality of the discharge characterised.

- Action by Pollution Officer (East)/Quality Regulation Officer.

5. An inter-calibration experiment should be carried out to assess the different methods for recording ammonia concentrations within rivers.

- Action by Catchment Scientist/Laboratory Controller.

6. The RQO for the lower section of the River Kenn should be reviewed to NWC Class 1B to be consistent with the NWC Class 1B RQO in the upper catchment.

- Action by Freshwater Scientist.

7. The cause of the poor water quality in Splatford Brook should be investigated.

- Action by Catchment Scientist.

8. Soil conservation measures should be encouraged with land managers in the catchment.

- Action by Catchment Co-ordinator/Conservation Officer/Pollution Officer (East).

9. The potential impact of surface runoff from the A38 and A380 roads on the River Kenn should be assessed and an investigation undertaken if necessary.

- Action by Catchment Scientist.

9. REFERENCES.

1. Smith,R. (1990). Priority Rating of River Water Quality. FWI/90/024

2. Cox <u>et al.</u> (1991). RIVPACS II- A User Manual. Institute of Terrestrial Ecology, Monks Wood Experimental Station.

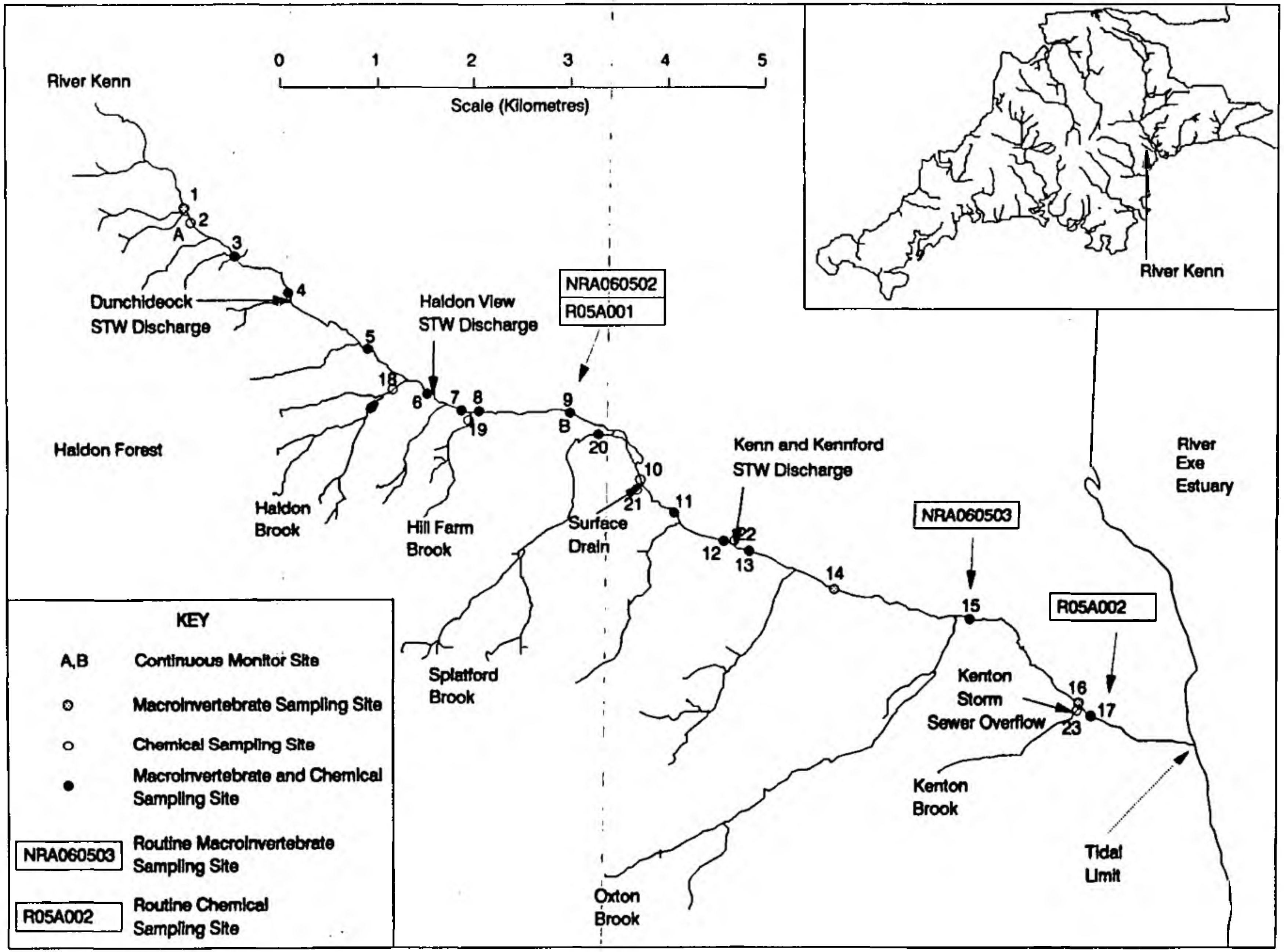

FIGURE 1. Macroinvertebrate & Chemical sampling sites in the River Kenn Catchment.

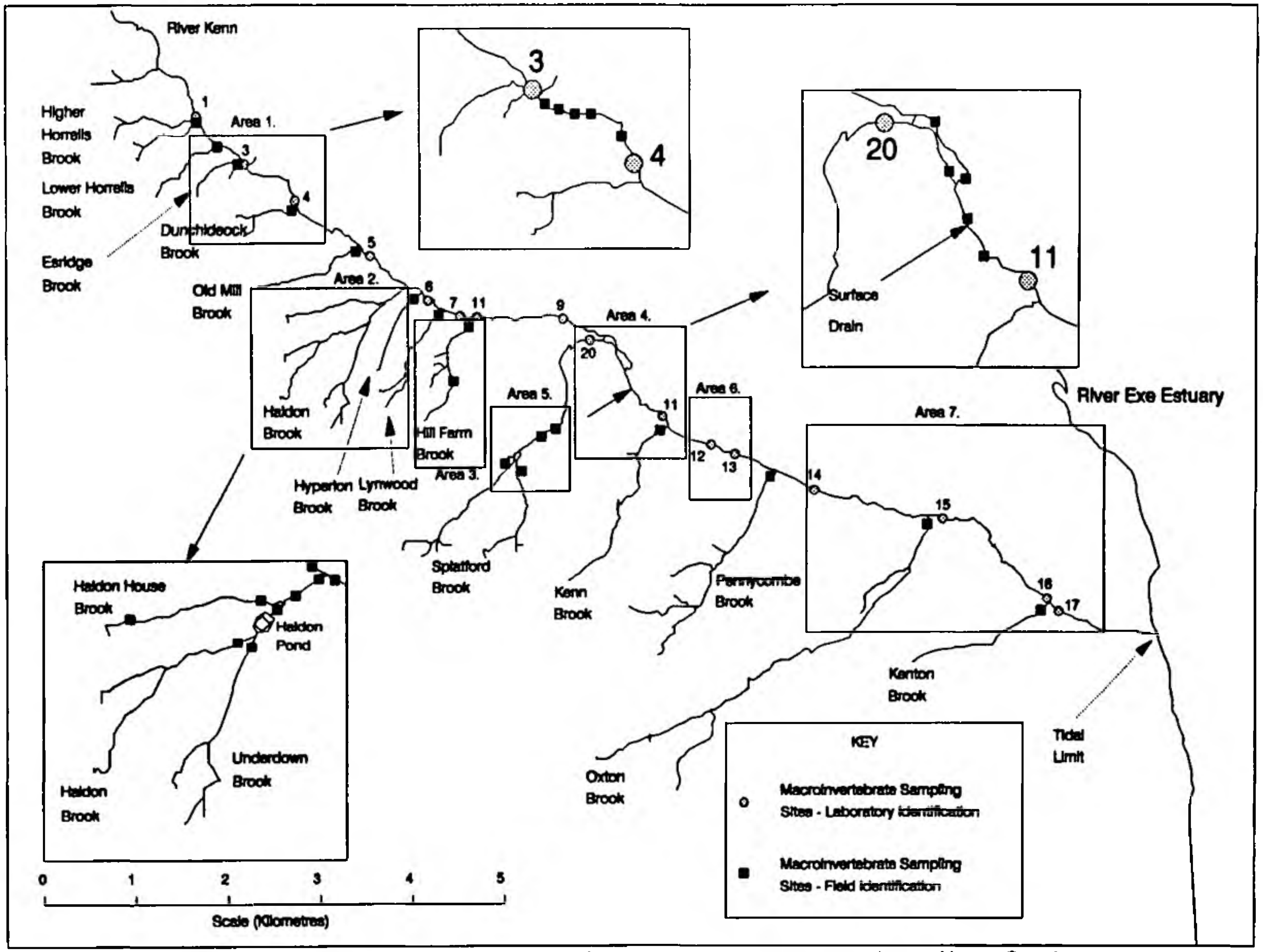

FIGURE 2. Macroinvertebrate sampling sites in the River Kenn Catchment.

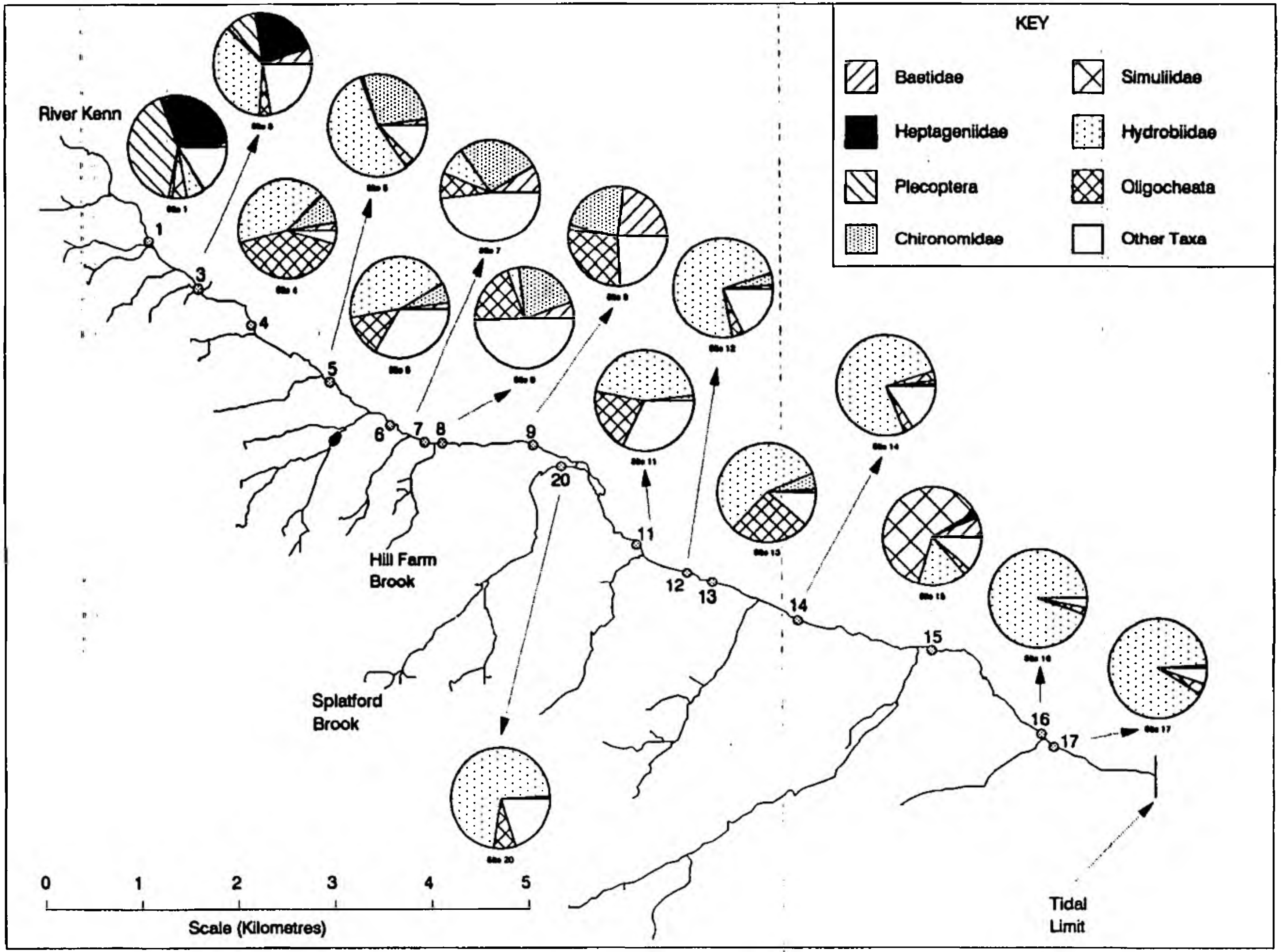

FIGURE 3. Relative abundance changes of Macroinvertebartes in the River Kenn Catchment 26-28 February 1991.

FIGURE 4 . Biotic Scores & BOD Concentrations in the River Kenn April 1991

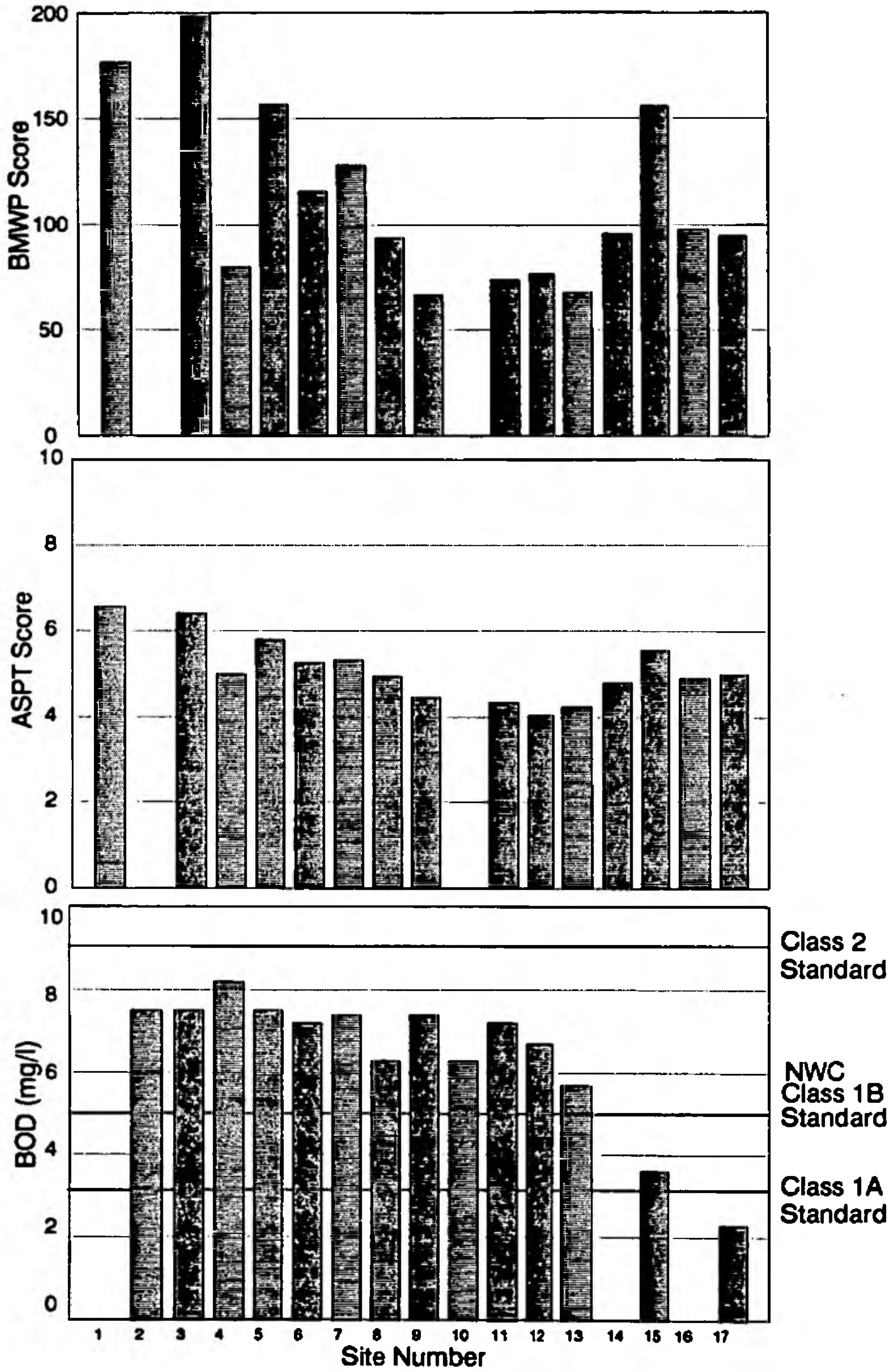

FIGURE 5. Ammonia Concentrations Collected in the River Kenn during April 1991.

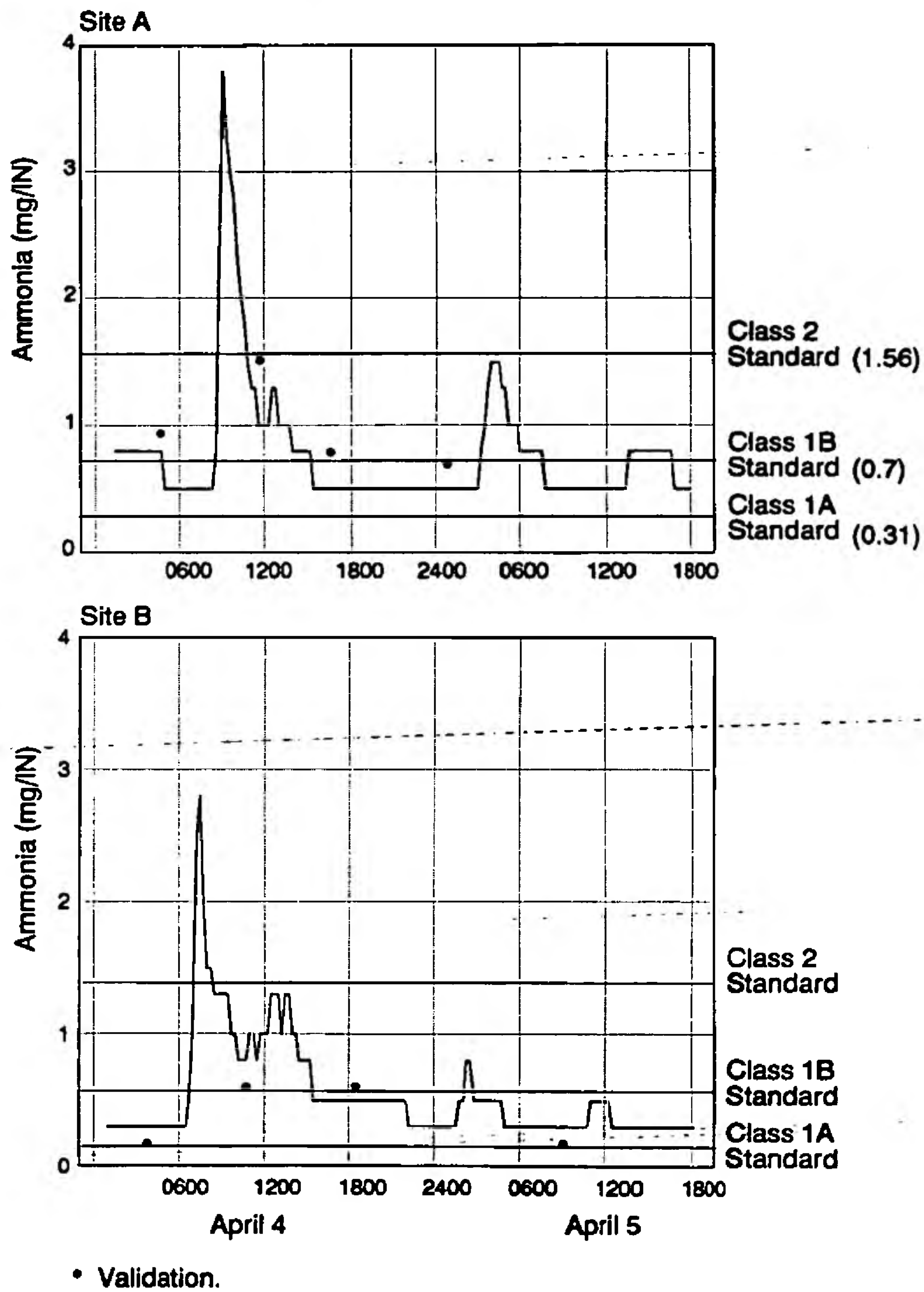

TABLE 4. High Flow Water Quality Survey of the Kenn Catchment 4 April 1991.

Chemical Sampling Sites	BOD				Ammonia (as N)				Suspended solids			
Sampling Runs	A	B	C	D	A	B	C	D	A	B	C	D
RIVER KENN												
2. Lower Horrells	3.7	7.5	2.7	2.6	0.05	0.01	0.01	0.01	8	74	12	10
3. Idestone Brook Cross	2.0	7.5	2.4	2.0	0.04	0.01	0.01	0.01	8	110	19	12
4. U/S Dunchideock STW Final Effluent	1.4	> 8.2	2.6	2.1	0.01	0.01	0.01	0.01	7	172	20	14
5. D/S Dunchideock STW Final Effluent	1.5	> 7.5	2.0	2.2	0.03	0.01	0.01	0.01	6	232	15	12
6. U/S Haldon View STW Final Effluent	1.1	> 7.2	2.1	1.7	0.03	0.01	0.01	0.01	8	232	15	12
7. D/S Haldon View STW Final Effluent	1.1	7.4	* 19	1.8	0.01	0.01	0.01	0.01	8	312	22	13
8. D/S Hill Farm Brook	1.2	6.3	* 19	1.9	0.03	0.02	0.01	0.01	8	350	27	14
9. U/S A38 Roadbridge	1.1	> 7.4	3	1.6	0.03	0.02	0.01	0.01	8	350	27	14
10. U/S Surface Water Drain	1.3	> 6.3	1.0	2.2	0.06	0.01	0.01	0.01	7	172	4.2	13
11. D/S Surface Water Drain	1.4	> 7.2	2.0	1.9	0.03	0.02	0.01	0.01	6	156	61	14
12. U/S Kenn & Kennford STW Final Effluent	1.7	> 6.7	3.0	2.3	0.03	0.28	0.39	0.01	16	200	54	15
13. D/S Kenn & Kennford STW Final Effluent	1.8	5.7	4.0	2.2	0.03	0.03	0.01	0.01	6	16	77	13
15. D/S Oxton Brook	1.0	3.6	4.0	2.3	0.01	0.01	0.01	0.01	7	16	98	20
17. D/S Kenton Brook	2.5	2.3	3.0	2.6	0.03	0.03	0.01	0.02	10	1.3	64	35
TRIBUTARIES												
18. Haldon Brook	0.8	1.0	1.1	1.5	0.08	0.01	0.01	0.01	11	26	11	11
19. Hill Farm Brook	2.6	> 5.2	3.1	3.0	0.03	0.01	0.01	0.01	23	222	32	25
20. Splatford Brook	0.5	5.1	1.3	1.5	0.02	0.01	0.01	0.01	4	138	2	7
DISCHARGES												
21. Surface Water Drain	0.8	3.6	0.8	0.8	0.02	0.01	0.02	0.01	1	58	5	4
22. Kenn & Kennford STW Final Effluent	-	-	13	15	-	-	0.01	2.78	19	91	43	23
23. D/S Kenton Storm Sewer Overflow	2.2	6.5	3.0	2.5	0.03	0.01	0.01	0.01	66	526	57	10

All Concentrations in mg/l
* Unusually high & not considered to be representative

Appendix I. Routine water quality monitoring data (1983–1990).

KENN AT A38 BRIDGE KENNFORD
R05A001

DATE	PH	TEMP	DO	BOD ATU	AMMON TOTAL	AMMON UNION	S.S. 105	COPPER	ZINC	ORTHOPHOS	NITRATE
	PH UNITS	CEL	% SATN		MG/L N	MG/L N	MG/L	MG/L Cu	MG/L Zn	MG/L P	MG/L N
16_03_83	8.1000	8.0000	93.0000	2.0000	0.1300	0.0100	4.0000			0.1300	5.5000
03_05_83	7.8000	10.0000	94.0000	1.7000	0.1100	0.0100	19.0000			0.0400	5.7800
11_07_83	7.8000	18.5000	75.0000	3.2000	0.2800	0.0100	4.0000			0.3000	5.7000
14_09_83	7.7000	14.0000	82.0000	1.4000	0.0900	0.0100	2.0000			0.2000	4.9000
10_11_83	7.2000	12.0000	78.0000	1.3000	0.0200	0.0100	4.0000	0.0050	0.0050	0.2500	10.8000
10_01_84	7.9000	9.0000	96.0000	1.8000	0.1900	0.0100	7.0000			0.1100	9.8000
14_03_84	8.1000	7.0000	113.0000	1.8000	0.0100		3.0000			0.0500	7.3000
01_05_84	8.3000			4.5000	0.1500		10.0000			0.2100	6.1000
11_07_84	7.8000	17.5000	74.0000	0.1000	0.2600	0.0100	5.0000			0.2500	3.7000
01_11_84	7.2000	13.0000	86.0000	2.6000	0.2400	0.0100	21.0000			0.1700	5.5000
18_02_85	7.7000	4.0000	101.0000	1.8000	0.0500	0.0100	5.0000			0.0800	9.7000
05_03_85	8.0000	7.0000	100.0000	3.4000	0.2400	0.0100	5.0000			0.1700	8.1000
20_03_85	7.9000	2.0000	98.0000	2.8000	0.1300	0.0100	6.0000			0.1200	6.8000
07_05_85	8.7000	14.0000	123.0000	2.5000	0.0100	0.0100	6.0000	0.0050	0.0050	0.1100	7.5000
10_07_85	7.8000	15.7500	87.0000	1.9000	0.1600	0.0100	4.0000			0.2300	4.5000
17_09_85	7.6000	16.5000	86.0000	1.1000	0.1300	0.0100	17.0000			0.2500	4.7000
13_11_85	7.6000	5.5000	92.0000	4.8000	0.5900	0.0100	8.0000			0.2300	5.3000
14_01_86	7.6000	7.0000	91.0000	3.7000	0.1800	0.0100	11.0000			0.1300	10.3000
12_03_86	8.0000	5.0000	97.0000	3.7000	0.1700	0.0100	7.0000			0.1100	7.9000
29_04_86	8.4000	10.0000	113.0000	1.8000	0.0400	0.0100	5.0000			0.1200	6.8000
08_07_86	7.9000	14.5000	85.0000	2.0000	0.1800	0.0100	14.0000			0.2200	5.0000
12_08_86	8.0000	14.0000	80.0000	2.6000	0.2100	0.0100	5.0000			0.3000	4.4000
20_10_86	7.6000	12.0000	77.0000	13.0000	0.9500	0.0100	39.0000			0.5400	5.1000
10_02_87	7.8000	5.5000	89.0000	5.4000	0.3300	0.0100	16.0000			0.1500	7.7000
09_03_87	7.9000	5.0000	96.0000	1.8000	0.1800	0.0100	11.0000			0.1200	6.5000
31_03_87	7.8000	9.0000	100.0000	1.4000	1.5800	0.0200	14.0000			0.5700	8.7000
20_05_87	8.3000	14.0000	111.0000	2.6000	0.0900	0.0100	7.0000			0.1500	7.4000
16_07_87	8.2000	16.0000	77.0000	2.0000	0.2600	0.0100	4.0000			0.2700	4.9000
24_08_87	8.1000	12.5000	74.0000	2.2000	0.0800	0.0100	2.0000			0.4300	5.9000
28_01_88	7.4000	7.0000	90.0000	3.0000	0.1400	0.0100	118.0000			0.1800	4.4000
02_03_88	7.9000	4.0000	93.0000	1.0000	0.2200	0.0100	5.0000			0.1300	8.6000
09_05_88	8.1000	13.5000	99.0000	7.1000	1.3500	0.0400	15.0000			0.2300	6.2000
03_08_88	8.0000	14.5000	96.0000	1.3000	0.0900	0.0100	6.0000			0.1900	4.9000
30_09_88	7.9000	12.0000	95.0000	1.6000	0.1400	0.0100	3.0000			0.2200	5.3000
16_11_88	7.9000	9.0000	97.0000	0.9000	0.0100	0.0100	2.0000			0.0700	4.8000
09_01_89	7.9000	10.0000	91.0000	1.9000	0.1200	0.0100	9.0000			0.2100	5.8000
06_03_89	7.7000	10.0000	92.0000	2.0000	0.1800	0.0100	10.0000			0.1100	10.0000
22_05_89	8.0000	15.0000	89.0000	4.2000	0.7800	0.0200	8.0000			0.1700	6.5000
11_07_89	7.9000	18.0000	96.0000	1.3000	0.0400	0.0100	3.0000			0.2700	5.0000
15_08_89	8.0000	15.0000	82.0000	3.1000	0.1100	0.0100	12.0000			0.2500	3.9000
04_09_89	8.2000	12.0000	110.0000	1.1000	0.0300	0.0100	6.0000			0.2400	5.5000
19_09_89	8.0000	15.0000	88.0000	1.1000	0.0300	0.0100	2.0000			0.3200	4.7000
12/01/90	7.8000	9.8000	90.0000	1.2000	0.0900	0.0100	7.0000			0.1000	12.0000
24/01/90	7.7000	8.0000	92.0000	4.5000	0.2100	0.0100	41.0000			0.1600	8.8000
23/04/90	8.3000	12.0000	103.0000	4.5000	0.3300	0.0100	8.0000			0.2900	7.1100
09/05/90	7.9000	13.0000	84.0000	1.9000	0.1100	0.0100	3.0000			0.1900	7.0600
05/06/90	7.8000	13.0000	81.0000	2.3000	0.1500	0.0100	4.0000			0.2400	6.0900
08/06/90	8.0000	15.0000	97.0000	1.1000	0.0100	0.0100	8.0000			0.0900	4.3000
10/07/90	8.1000	13.0000	93.0000	1.2000	0.0200	0.0100	3.0000			0.0900	4.0000

30/08/90	7.9000	15.0000	76.0000	4.7000	0.0500	0.0100	12.0000			0.4700	3.9000
25/09/90	8.1000	10.0000	84.0000	1.1000	0.0200	0.0100	1.0000	0.0050	0.0050	0.2300	4.8000
23/10/90	7.9000	12.0000	72.0000	1.6000	0.0400	0.0100	3.0000			0.3400	3.7000
07/11/90	7.8000	7.0000	82.0000	2.4000	0.1300	0.0100	7.0000			0.2500	4.9000
13/11/90	7.6000	12.0000	56.0000	16.0000	1.4200	0.0100	171.0000			1.2300	3.4500

KENN AT POWDERHAM CASTLE
R05A002

DATE	PH	TEMP	DO	BOD ATU	AMMON TOTAL	AMMON UNION	S.S. 105	COPPER	ZINC	ORTHOPHOS	NITRATE
	PH UNITS	CEL	% SATN		MG/L N	MG/L N	MG/L	MG/L Cu	MG/L Zn	MG/L P	MG/L N
16_03_83	7.9000	8.0000	101.0000	1.0000	0.0200	0.0100	5.0000	0.0020	0.0060	0.1100	6.3000
03_05_83	7.7000	10.0000	97.0000	1.2000	0.0200	0.0100	14.0000	0.0030	0.0060	0.0900	5.9000
11_07_83	7.7000	18.5000	103.0000	2.6000	0.0400	0.0100	6.0000	0.0030	0.0040	0.1700	6.3000
14_09_83	7.3000	14.0000	88.0000	2.1000	0.1600	0.0100	6.0000	0.0030	0.0070	0.2200	6.6000
10_11_83	7.5000	13.0000	105.0000	0.8000	0.0200	0.0100	4.0000	0.0050	0.0050	0.1900	6.3000
10_01_84	7.8000	9.5000	96.0000	1.2000	0.0900	0.0100	9.0000	0.0050	0.0050	0.1300	8.4000
14_03_84	7.7000	7.0000	108.0000	1.6000	0.0200	0.0100	9.0000			0.0800	7.5000
01_05_84	8.5000	16.0000	141.0000	2.8000	0.0200	0.0100	10.0000	0.0050	0.0050	0.1200	6.2000
11_07_84	7.6000	15.0000	89.0000	0.5000	0.0500	0.0100	5.0000	0.0050	0.0060	0.1500	6.5000
01_11_84	7.0000	13.0000	81.0000	1.2000	0.0100		2.0000	0.0050	0.0050	0.1500	6.4000
18_02_85	7.8000	5.5000	101.0000	2.2000	0.0600	0.0100	11.0000	0.0050	0.0060	0.1000	8.4000
05_03_85	7.9000	8.0000	120.0000	1.7000	0.0200	0.0100	6.0000	0.0050	0.0070	0.1200	7.7000
20_03_85	7.4000	3.0000	97.0000	1.5000	0.0400	0.0100	5.0000	0.0050	0.0050	0.1000	7.0000
07_05_85	7.6000	9.7500	109.0000	1.9000	0.0100	0.0100	7.0000			0.0800	7.0000
10_07_85	7.5000	14.0000	92.0000	1.2000	0.0300	0.0100	6.0000	0.0050	0.0050	0.1900	6.7000
17_09_85	7.4000	16.0000	94.0000	0.8000	0.0200	0.0100	3.0000	0.0050	0.0050	0.1900	6.7000
13_11_85	7.3000	3.2500	87.0000	1.2000	0.0200	0.0100	4.0000	0.0050	0.0050	0.1900	7.5000
14_01_86	7.6000	7.0000	92.0000	1.1000	0.0500	0.0100	14.0000	0.0050	0.0050	0.1000	9.9000
12_03_86	7.6000	5.5000	95.0000	2.0000	0.0200	0.0100	7.0000	0.0050	0.0050	0.1000	7.8000
29_04_86	8.3000	10.0000	121.0000	2.7000	0.0300	0.0100	5.0000	0.0050	0.0050	0.1200	6.4000
08_07_86	7.7000	15.0000	91.0000	0.7000	0.0200	0.0100	4.0000	0.0050	0.0050	0.1800	6.1000
12_08_86	7.7000	14.0000	94.0000	1.9000	0.0400	0.0100	5.0000	0.0050	0.0050	0.1900	5.8000
20_10_86	7.5000	11.5000	74.0000	1.9000	0.0700	0.0100	2.0000	0.0050	0.0050	0.2700	6.7000
10_02_87	7.6000	7.5000	93.0000	1.6000	0.1400	0.0100	6.0000	0.0050	0.0050	0.1400	7.6000
09_03_87	7.7000	5.0000	96.0000	1.7000	0.1300	0.0100	12.0000	0.0050	0.0050	0.1400	6.5000
31_03_87	7.7000	9.0000	98.0000	1.1000	0.0900	0.0100	15.0000	0.0050	0.0050	0.1100	6.8000
20_05_87	7.9000	11.0000	103.0000	1.6000	0.0200	0.0100	333.0000	0.0050	0.0050	0.1000	7.5000
16_07_87	7.7000	13.0000	83.0000	1.5000	0.0700	0.0100	12.0000	0.0050	0.0050	0.2000	6.5000
24_08_87	7.6000	13.5000	73.0000	0.9000	0.0800	0.0100	4.0000	0.0050	0.0050	0.1800	2.2000
28_01_88	7.4000	7.0000	87.0000	1.7000	0.0600	0.0100	50.0000	0.0050	0.0100	0.1300	5.2000
02_03_88	7.6000	3.0000	94.0000	1.2000	0.0400	0.0100	8.0000	0.0050	0.0050	0.1100	7.7000
09_05_88	7.9000	13.5000	103.0000	1.9000	0.0300	0.0100	6.0000	0.0050	0.0050	0.1100	6.8000
03_08_88	7.5000	14.5000	79.0000	10.0000	0.1600	0.0100	13.0000	0.0050	0.0050	0.3400	6.6000
30_09_88	7.4000	11.5000	94.0000	1.1000	0.0100	0.0100	1.0000	0.0050	0.0050	0.1800	6.5000
16_11_88	7.2000	9.0000	77.0000	0.9000	0.1100	0.0100	8.0000	0.0050	0.0050	0.1000	12.6000
09_01_89	7.5000	10.0000	92.0000	1.5000	0.0400	0.0100	20.0000	0.0050	0.0050	0.1800	7.2000
06_03_89	7.7000	11.0000	97.0000	1.4000	0.0500	0.0100	20.0000	0.0060	0.0100	0.1200	8.7000
22_05_89	7.8000	16.0000	105.0000	1.8000	0.0700	0.0100	4.0000	0.0050	0.0050	0.1700	7.1000
11_07_89	7.5000	17.0000	88.0000	1.2000	0.0400	0.0100	6.0000	0.0050	0.0050	0.2600	6.2000
15_08_89	7.6000	15.5000	65.0000	3.9000	0.1100	0.0100	15.0000	0.0080	0.0090	0.3400	4.4000
04_09_89	7.5000	16.0000	78.0000	1.9000	0.1200	0.0100	30.0000	0.0050	0.0070	0.2300	8.3000
14_09_89	7.4000	12.0000	72.0000	1.1000	0.0300	0.0100	7.0000	0.0050	0.0050	0.2000	6.6000
19_09_89	7.6000	15.5000	83.0000	1.0000	0.0200	0.0100	7.0000	0.0050	0.0270	0.2600	6.4000
28_09_89	7.8000	13.0000	113.0000	1.1000	0.0100		4.0000	0.0050	0.0050	0.2500	6.6000
09_10_89	7.6000	12.4000	82.0000	1.1000	0.0200	0.0100	6.0000	0.0050	0.0050	0.2400	7.5000
12_10_89	7.6000	14.0000	106.0000	0.9000	0.0200	0.0100	12.0000	0.0140	0.0120	0.2200	6.7000
16_10_89	7.5000	13.0000	92.0000	0.7000	0.0200	0.0100	5.0000	0.0050	0.0050	0.2400	7.4000
19_10_89	7.4000	12.3000	79.0000	1.0000	0.0100	0.0100	4.0000	0.0050	0.0050	0.2200	7.6000
12/01/90	7.7000	10.0000	90.0000	0.8000	0.0900	0.0100	9.0000	0.0050	0.0050	0.1200	10.7000

23/04/90	8.0000	14.0000	134.0000	1.7000	0.0200	0.0100	5.0000	0.0050	0.0080	0.1100	8.1100
09/05/90	7.5000	13.0000	91.0000	1.8000	0.0300	0.0100	14.0000	0.0050	0.0050	0.1500	8.1500
05/06/90	7.4000	14.0000	99.0000	1.7000	0.0200	0.0100	5.0000	0.0050	0.0050	0.1900	7.2000
08/06/90	7.6000	15.0000	102.0000	1.1000	0.0400	0.0100	6.0000	0.0050	0.0050	0.1500	8.3000
10/07/90	7.5000	14.0000	93.0000	1.2000	0.0300	0.0100	3.0000	0.0050	0.0060	0.1900	7.7000
30/08/90	7.3000	15.0000	76.0000	1.8000	0.0500	0.0100	5.0000	0.0050	0.0060	0.2300	6.0000
25/09/90	7.6000	11.0000	87.0000	0.9000	0.0200	0.0100	1.0000	0.0050	0.0050	0.1700	8.5000
23/10/90	7.5000	12.0000	75.0000	1.1000	0.0300	0.0100	4.0000	0.0050	0.0050	0.2000	8.3000
07/11/90	7.5000	8.0000	84.0000	1.4000	0.0100	0.0100	3.0000	0.0050	0.0060	0.1900	8.1000
13/11/90	7.5000	12.0000	74.0000	1.7000	0.0400	0.0100	13.0000	0.0050	0.0070	0.3200	6.6300

Appendix II. Routine Biological Monitoring data from the 1990 Survey.

NATIONAL RIVERS AUTHORITY
RIVER QUALITY SURVEY - 1990
BIOLOGY

SOUTH WEST (06)

SAMPLE DATA

Thames use only Sample Reference 0690 ______ 0690 ______ 0690 ______

SAMPLE	SPRING	SUMMER	AUTUMN
Status	01	01	01
Sample Date	11/04/1990	13/07/1990	09/10/1990
Sample Time	14:15	14:25	11:20
Survey	901	902	903

Site Reference NRA06 0502
Watercourse KENN
Location A38 BR. KENNFORD. 50m U/S F. BR BRENTON FM
Grid Reference SX9117 8667

	SPRING	SUMMER	AUTUMN
Width	2 m	2 m	1 m
Average Depth	14 cm	12 cm	12 cm
Boulders/Cobbles	35 %	30 %	60 %
Pebbles/Gravel	55 %	55 %	35 %
Sand	5 %	10 %	5 %
Silt/Clay	5 %	5 %	0 %
Sampling Method	03	03	03
Sampler Initials	LB	JS	AA

TAXA DETAILS (see over)

SCORE RESULTS AND PREDICTIONS			
Scoring Families	16	21	16
BMWP Score	78	103	66
BMWP ASPT	4.88	4.90	4.12
Predicted BMWP			
Predicted ASPT	.	.	.
No of Predicted Taxa			
IFE/FBA Group			
Method Of Prediction			
Suitable for Prediction ?	Y/N	Y/N	Y/N

WATER CHEMISTRY

Chemical Class __
Chloride ____ mg/l
Alkalinity ____ mg $CaCO_3$/l

Alternatives to Alkalinity
Hardness ____ mg/l $CaCO_3$
Calcium ____ mg/l
Conductivity ____ uS/cm

COMMENTS

SMALL BROWN TROUT - RETURNED

Signed J.B. Stoneman (summer) J.B. Stoneman (spring)
Date 13.12.90 (summer) 7th November 1990 (Spring)
J.B Stoneman. 23.1.91 - Aut.

Please return to: *NRA Thames Region*
Biology 1990 Survey
Fobney Mead
Rose Kiln Lane
READING
Berks RG2 0SF

TAXA LIST

Site Reference NRA 06 : 0502

GROUP 1 TAXA (10)

	Spring	Summer	Autumn
Siphlonuridae			
Heptogeniidae			
Leptophlebiidae			
Ephemerellidae	B	A	
Potamanthidae			
Ephemeridae			
Taeniopterygidae			
Leuctridae		A	
Capniidae			
Perlodidae			
Perlidae			
Chloroperlidae	B		
Aphelocheiridae			
Phryganeidae			
Molannidae			
Beraeidae			
Odontoceridae			
Leptoceridae			
Goeridae			
Lepidostomatidae			
Brachycentridae		A	
Sericostomatidae			
SUB-TOTAL TAXA	02	03	00

GROUP 2 TAXA (8)

	Spring	Summer	Autumn
Astacidae			
Lestidae			
Agriidae			
Gomphidae			
Cordulegasteridae			
Aeshnidae			
Corduliidae			
Libellulidae			
Psychomyiidae (Ecnomidae)			
Philopotamidae			
SUB-TOTAL TAXA			

GROUP 3 TAXA (7)

	Spring	Summer	Autumn
Caenidae			
Nemouridae			
Rhyacophilidae (Glossosomatidae)			
Polycentropodidae			
Limnephilidae	B	A	B
SUB-TOTAL TAXA	01	01	01

GROUP 4 TAXA (6)

	Spring	Summer	Autumn
Neritidae			
Viviparidae			
Ancylidae (Acroloxidae)	A	B	B
Hydroptilidae			
Unionidae			
Corophiidae			
Gammaridae (Crangonyctidae)	A	B	C
Platycnemidae			
Coenagriidae			
SUB-TOTAL TAXA	02	02	02

GROUP 5 TAXA (5)

	Spring	Summer	Autumn
Mesoveliidae			
Hydrometridae			
Gerridae			
Nepidae			
Naucoridae			
Notonectidae			
Pleidae			
Corixidae			
Haliplidae		A	
Hygrobiidae			
Dytiscidae (Noteridae)			A
Gyrinidae			
Hydrophilidae (Hydraenidae)	B	A	B
Clambidae			
Scirtidae			
Dryopidae			
Elmidae	B	A	A
Chrysomelidae			
Curculionidae			
Hydropsychidae	B		A
Tipulidae		A	
Simuliidae	A	B	C
Planariidae (Dugesiidae)			
Dendrocoelidae			
SUB-TOTAL TAXA	04	05	05

GROUP 6 TAXA (4)

	Spring	Summer	Autumn
Baetidae	B	B	A
Sialidae		A	
Piscicolidae			
SUB-TOTAL TAXA	01	02	01

GROUP 7 TAXA (3)

	Spring	Summer	Autumn
Valvatidae			
Hydrobiidae (Bithyniidae)	C	B	A
Lymnaeidae		A	
Physidae			
Planorbidae		A	A
Sphaeriidae			
Glossiphoniidae	B	B	B
Hirudinidae			
Erpobdellidae	A	A	A
Asellidae	A	B	A
SUB-TOTAL TAXA	04	06	05

GROUP 8 TAXA (2)

	Spring	Summer	Autumn
Chironomidae	B	B	B
SUB-TOTAL TAXA	01	01	01

GROUP 9 TAXA (1)

	Spring	Summer	Autumn
Oligochaeta	B	B	B
SUB-TOTAL TAXA	01	01	01

	Spring	Summer	Autumn
TOTAL TAXA	16	21	16
BMWP SCORE	78	103	66

Other Taxa

Ceratopogonidae - A
Empididae - A

HYDRACARINA - A
PSYCHODIDAE - A
MUSCIDAE PUPAE - A

AUTUMN
MUSCIDAE - B
ACARI - A
CERATOPOGONIDAE - A
EMPIDIDAE - A
PSYCHODIDAE - A
OSTRACODA - A

	No of Individuals
Abundance	A – 1–9
	B – 10–99
	C – 100–999
	D – 1000–9999
	E – 10000+

NATIONAL RIVERS AUTHORITY
RIVER QUALITY SURVEY - 1990
BIOLOGY

SOUTH WEST (06)

SAMPLE DATA

Thames use only *Sample Reference* | 0690 | 0690 | 0690

SAMPLE	SPRING	SUMMER	AUTUMN
Status	01	01	01
Sample Date	19/04/1990	13/07/1990	09/10/1990
Sample Time	13:05	15:10	15:00
Survey	901	902	903

Site Reference NRA06 0503
Watercourse KENN
Location 20m. u/s. A379. br. u/s. KENTON
Grid Reference SX 9627 8463

	SPRING	SUMMER	AUTUMN
Width	5 m	6 m	5 m
Average Depth	10 cm	8 cm	13 cm
Boulders/Cobbles	30 %	25 %	30 %
Pebbles/Gravel	55 %	60 %	50 %
Sand	0 %	5 %	10 %
Silt/Clay	15 %	10 %	10 %
Sampling Method	03	03	03
Sampler Initials	LB	JBS	AA

TAXA DETAILS (see over)

SCORE RESULTS AND PREDICTIONS

	SPRING	SUMMER	AUTUMN
Scoring Families	24	21	26
BMWP Score	157	114	151
BMWP ASPT	6.54	05.43	5.81
Predicted BMWP			
Predicted ASPT	.	.	.
No of Predicted Taxa			
IFE/FBA Group			
Method Of Prediction			
Suitable for Prediction ?	Y/N	Y/N	Y/N

WATER CHEMISTRY

Chemical Class
Chloride mg/l
Alkalinity mg $CaCO_3$ /l

Alternatives to Alkalinity
Hardness mg/l $CaCO_3$
Calcium mg/l
Conductivity uS/cm

COMMENTS

THREE BULLHEADS, THREE STONELOACH AND ONE EEL RETURNED
LEPIDOSTOMATIDAE - IN SEVERAL PARTS - DAMAGED DURING EXAMINATION

Signed J.B. Staneman (summer) J.B. Staneman (spring)
Date 13th December (Summer) 7th November 1990 (Spring)
J.B. Staneman 24.1.91. Aut.

Please return to: *NRA Thames Region*
Biology 1990 Survey
Fobney Mead
Rose Kiln Lane
READING
Berks RG2 0SF

TAXA LIST

Site Reference NRA 06: 0523

Columns: SPRING, SUMMER, AUTUMN

GROUP 1 TAXA (10)

Taxon	Spring	Summer	Autumn
Siphlonuridae			
Heptageniidae	A	B	
Leptophlebiidae	A		B
Ephemerellidae	C	B	A
Potamanthidae			
Ephemeridae	A		A
Taeniopterygidae			
Leuctridae		B	
Capniidae			
Perlodidae	A	B	
Perlidae			
Chloroperlidae	A		
Aphelocheiridae			
Phryganeidae			
Molannidae			
Beraeidae			
Odontoceridae			
Leptoceridae	A		A
Goeridae			A
Lepidostomatidae	A		A
Brachycentridae			
Sericostomatidae	A		A
SUB-TOTAL TAXA	09	04	07

GROUP 2 TAXA (8)

Taxon	Spring	Summer	Autumn
Astacidae			
Lestidae			
Agriidae	A		
Gomphidae			
Cordulegasteridae			
Aeshnidae			
Corduliidae			
Libellulidae			
Psychomyiidae (Ecnomidae)		B	
Philopotamidae			
SUB-TOTAL TAXA	01	01	00

GROUP 3 TAXA (7)

Taxon	Spring	Summer	Autumn
Caenidae	A		B
Nemouridae			
Rhyacophilidae (Glossosomatidae)		B	B
Polycentropodidae			
Limnephilidae	A		
SUB-TOTAL TAXA	02	01	02

GROUP 4 TAXA (6)

Taxon	Spring	Summer	Autumn
Neritidae			
Viviparidae			
Ancylidae (Acroloxidae)		B	B
Hydroptilidae			
Unionidae			
Corophiidae			
Gammaridae (Crangonyctidae)	B	B	B
Platycnemididae			
Coenagriidae			
SUB-TOTAL TAXA	01	02	02

GROUP 5 TAXA (5)

Taxon	Spring	Summer	Autumn
Mesoveliidae			
Hydrometridae			
Gerridae			
Nepidae			
Naucoridae			
Notonectidae			
Pleidae			
Corixidae			
Haliplidae			A
Hygrobiidae			
Dytiscidae (Noteridae)			
Gyrinidae			B
Hydrophilidae (Hydraenidae)	B	B	B
Clambidae			
Scirtidae			
Dryopidae			
Elmidae	B	B	B
Chrysomelidae			
Curculionidae			
Hydropsychidae	B	B	B
Tipulidae		A	
Simuliidae	C	B	B
Planariidae (Dugesiidae)			
Dendrocoelidae			
SUB-TOTAL TAXA	04	05	06

Abundance	No of individuals
A	1–9
B	10–99
C	100–999
D	1000–9999
E	10000+

GROUP 6 TAXA (4)

Taxon	Spring	Summer	Autumn
Baetidae	C	B	B
Sialidae			
Piscicolidae			
SUB-TOTAL TAXA	01	01	01

GROUP 7 TAXA (3)

Taxon	Spring	Summer	Autumn
Valvatidae			
Hydrobiidae (Bithyniidae)	C	C	B
Lymnaeidae	A	B	A
Physidae			
Planorbidae		B	B
Sphaeriidae			
Glossiphoniidae	A	A	A
Hirudinidae			
Erpobdellidae			A
Asellidae	A	B	B
SUB-TOTAL TAXA	04	05	06

GROUP 8 TAXA (2)

Taxon	Spring	Summer	Autumn
Chironomidae	B	A	A
SUB-TOTAL TAXA	01	01	01

GROUP 9 TAXA (1)

Taxon	Spring	Summer	Autumn
Oligochaeta	B	B	A
SUB-TOTAL TAXA	01	01	01

	Spring	Summer	Autumn
TOTAL TAXA	24	21	26
BMWP SCORE	157	114	151

Other Taxa

SPRING

Ceratopogonidae A

Hydracarina A

SUMMER

Empididae - A

Muscidae pupae - A.

AUTUMN

MUSCIDAE - A

STRATIOMYIDAE - A

Appendix III. **The occurrence and abundance of macroinvertebrate taxa in the initial survey of the Kenn catchment (26–28 February 1991).**

OCCURRENCE AND ABUNDANCE OF MACROINVERTEBRATE TAXA IN THE RIVER KENN CATCHMENT

SITE NUMBER (SEE MAP)	1	3	4	5	6	7	8	9	20	11	12	13	14	15	16	17
EPHEMEROPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	11	95	38	57	52	111	61	251	4	1	24	11	14	150	-	1
CAENIDAE	-	-	-	3	-	2	1	-	-	-	-	-	1	6	-	3
EPHEMERELLIDAE	-	6	-	-	1	1	-	-	2	-	-	-	-	1	-	-
EPHEMERIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	2	7	6
HEPTAGENIIDAE	350	426	-	1	-	3	-	-	-	-	-	-	2	19	1	-
LEPTOPHLEBIIDAE	2	1	-	3	3	15	-	-	6	1	-	2	-	-	-	-
ODONATA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COENAGRIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHLOROPERLIDAE	41	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-
LEUCTRIDAE	180	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEMOURIDAE	176	6	1	3	1	1	-	-	-	-	-	-	-	-	-	-
PERLODIDAE	49	125	3	1	-	-	-	-	-	-	-	-	-	3	-	-
TAENIOPTERYGIDAE	34	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HEMIPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CORIXIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRICHOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GLOSSOSOMATIDAE	4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GOERIDAE	6	5	-	-	-	-	-	-	-	-	-	-	-	2	-	-
HYDROPSYCHIDAE	5	49	1	6	162	26	27	20	66	386	194	8	80	41	-	1
LEPIDOSTOMATIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
LEPTOCERIDAE	-	-	-	13	2	-	1	-	-	-	-	-	-	-	-	-
LIMNEPHILIDAE	120	60	-	1	2	3	-	-	10	-	-	-	1	4	-	-
ODONTOCERIDAE	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PHILOPOTAMIDAE	5	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-
POLYCENTROPODIDAE	-	4	-	4	-	-	-	-	-	-	-	-	-	-	-	-
PSYCHOMIIDAE	-	-	-	2	-	-	1	2	-	6	10	1	-	-	-	-
RHYACOPHILIDAE	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
SERICOSTOMATIDAE	3	25	-	1	1	2	3	1	2	-	-	-	1	9	-	2
DIPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ANISOPODIDAE	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CERATOPOGONIDAE	-	2	1	7	24	116	53	60	-	19	46	27	16	1	4	-
CHIRONOMIDAE	13	27	153	891	153	356	234	250	15	42	87	66	23	18	1	4
DIXIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EMPIDIDAE	-	6	1	10	14	9	10	2	1	5	5	-	1	-	-	-
EPHYDRIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

OCCURRENCE AND ABUNDANCE OF MACROINVERTEBRATE TAXA IN THE RIVER KENN CATCHMENT

SITE NUMBER (SEE MAP)	1	3	4	5	6	7	8	9	20	11	12	13	14	15	16	17
MUSCIDAE	-	-	-	15	1	-	-	-	2	-	2	-	1	4	-	-
PSYCHODIDAE	-	-	1	9	15	7	6	2	2	4	2	2	3	1	1	-
PTYCHOPTERIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCATOPSIDAE	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
SIMULIIDAE	56	7	9	28	5	4	2	-	-	-	-	-	62	1396	1	-
STRATIOMYIDAE	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
SYRPHIDAE	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TABANIDAE	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
TIPULIDAE	7	31	1	3	4	4	-	-	5	-	1	1	3	16	8	9
TRICHOCERIDAE	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
COLEOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DYTISCIDAE	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
ELMIDAE	2	41	13	204	237	258	140	11	334	93	58	6	19	67	-	1
GYRINIDAE	2	6	-	-	-	-	-	-	-	-	-	-	-	1	-	-
HALIPLIDAE	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
HYDRAENIDAE	5	4	-	5	17	1	6	1	-	-	-	-	-	-	-	-
HYDROPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCIRTIDAE	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CRUSTACEA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	-	1	-	2	132	52	149	12	11	-	7	-	6	14	-	-
GAMMARIDAE	14	149	4	39	102	95	13	12	1	1	7	1	6	16	-	-
OSTRACODA	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CHELICERATA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HYDRACARINA	-	1	-	-	-	-	2	-	-	-	-	-	-	-	-	-
MOLLUSCA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ANCYLIDAE	2	1	24	23	24	1	2	30	20	211	40	-	95	36	3	-
BITHYNIIDAE	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
HYDROBIIDAE	70	676	680	1728	1104	121	42	16	1765	1060	1726	600	1580	360	850	500
LYMNAEIDAE	1	-	-	-	-	2	-	-	11	-	2	-	-	1	-	-
PHYSIDAE	-	-	-	-	-	-	-	-	-	1	2	-	-	1	-	-
PLANORBIDAE	-	-	-	-	6	2	-	3	1	2	-	5	25	6	-	2
SPHAERIIDAE	1	-	-	1	3	-	1	-	-	6	13	37	18	6	1	1
SUCCINEIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
VALVATIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ZONITOIDAE	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
OLIGOCHEATA	5	75	657	101	353	106	216	312	177	492	86	277	85	81	21	19
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

OCCURRENCE AND ABUNDANCE OF MACROINVERTEBRATE TAXA IN THE RIVER KENN CATCHMENT

SITE NUMBER (SEE MAP)	1	3	4	5	6	7	8	9	20	11	12	13	14	15	16	17
ERPOBDELLIDAE	-	8	25	14	39	30	37	31	9	16	23	10	30	3	-	-
GLOSSIPHONIIDAE	-	-	8	6	42	15	66	47	6	7	9	16	26	13	1	-
PISCICOLIDAE	-	-	-	-	-	-	-	-	-	1	1	1	-	2	1	-
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLANARIIDAE	-	3	1	4	-	-	1	-	5	-	1	-	2	-	-	-

OCCURRENCE AND ABUNDANCE OF MACROINVERTEBRATE TAXA IN THE RIVER KENN CATCHMENT

SITE NUMBER (SEE MAP)	1	3	4	5	6	7	8	9	20	11	12	13	14	15	16	17
BIOTIC SCORES																
TOTAL NUMBER OF TAXA	28	36	20	32	27	26	25	18	24	23	24	20	25	33	23	20
NUMBER OF INDIVIDUALS	1170	1887	1623	3169	2496	1349	1098	1091	2477	2356	2351	1063	2053	2254	900	553
NUMBER OF BMWP TAXA	27	31	16	27	22	24	19	15	21	17	19	16	20	28	20	19
BMWP SCORE	177	199	80	157	116	128	94	67	104	74	77	68	98	156	98	95
ASPT SCORE	6.6	6.4	5.00	5.8	5.3	5.3	5	4.5	5	4.4	4.1	4.3	4.80	5.6	4.90	5.00
PHYSICAL PARAMETERS																
WIDTH (METRES)	0.9	1.9	1.90	2.3	3	1.9	2.2	2.9	1.7	2.4	3.3	3.7	3.4	3.7	4.20	4.6
MEAN DEPTH (METRES)	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.20	0.3	0.3	0.2	0.3	0.5	0.4
FLOW (METRES/SECOND)	0.5	0.6	0.5	0.8	0.9	0.8	0.5	0.7	0.70	0.9	0.8	0.6	0.9	1.00	0.6	0.6
SHADE (%)	70	90	75	10	75	50	30	40	40	50	40	0	0	0	0	0
SUBSTRATE (%)																
ROCK PAVEMENT	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOULDERS (>256mm)	-	-	-	-	-	5	-	-	5	2	5	-	-	-	-	-
COBBLES (64-256mm)	15	20	20	20	20	5	10	10	20	18	30	3	2	6	-	-
PEBBLES (16-64mm)	65	60	60	50	60	50	60	60	40	50	35	57	58	50	6	1
GRAVEL (2-16mm)	10	10	10	10	10	10	10	10	15	10	10	25	20	20	60	60
SAND	5	10	10	20	10	30	20	20	20	20	20	20	20	25	35	49
SILT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FLORA																
MACROPHYTE COVER (%)	-	-	-	-	2	2	3	-	2	-	-	5	20	25	2	2
BRYOPHYTE COVER (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ALGAE COVER (%)	-	-	75	90	50	60	50	70	40	60	60	70	5	-	-	-
SEWAGE FUNGUS (%)	-	-	?	-	-	?	?	?	?	?	?	5	-	-	-	-