2066

A SURVEY OF 1KM OF THE RIVER COLNE NEAR STANWELL MOOR (TQ 039749 - 034743)

A REPORT

FOR

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POND ACTION
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SUMMARY

This report gives the results of a survey of a 1 km length of the River Colne, undertaken in order to evaluate proposals to dredge the river as part of a flood alleviation scheme.

Three main types of survey were undertaken:

(i) a rapid "walk-through" survey of wetland plants.
(ii) a survey of aquatic macroinvertebrates.
(iii) a river substrate survey.

In order to identify changes in the R. Colne during the recent past, the results of the survey were compared with those of two earlier surveys: the first carried out by Nigel Holmes in 1984/5, and the second by Denise Exton in 1990.

WETLAND PLANTS

Updates to the 1990 Survey

It is unlikely that there have been any major changes in the plant community since 1990. However, two to three times more plant species were recorded in 1991. This is probably because of differences in the **recording technique** used. A summary map showing main additions to the 1990 list is given on page 8.

Comparison of the 1984/5 and 1990/1 Surveys

There are clear indications that wetland plants are currently both more **diverse** and more **abundant** than in 1984/5. This is most evident in:

(i) considerable increases in the **diversity** of submerged plants, including more uncommon species such as Oenanthe fluviatilis (river water-dropwort), Butomus umbellatus (flowering-rush), and Sagittaria sagittifolia (arrowhead).

(ii) Increases in the **abundance** of marginal species, such as Sparganium erectum (branched bur-reed) and Nasturtium officinale (water-cress).

Information provided by Alistair Driver (NRA, Thames) provides a likely explanation for this. When the flood relief scheme was first proposed in the 1970's/80's, routine dredging of the River Colne was halted in the areas likely to be affected by the scheme. It is probable that this has allowed time for plant colonisation (or recolonisation) aided by partial re-silting of the river.

MACROINVERTEBRATES

Water Quality

The BMWP score for the survey area was 248 (ASPT 5.4), indicating that a diverse community was present and that water quality was 'very good'.

Conservation Value of the Macroinvertebrate Community

64 species were recorded in the survey reach: a very good, though not exceptional, number of species. These included 6 local species and, possibly, one rare species (a riffle beetle, Oulimnius major). This beetle proved impossible to identify with any degree of certainty, since only one individual, a female, was caught. Males of this species are required for reliable identification.

The river supported a community which is of high to very high value to nature conservation (assessed using the provisional system devised by Pond Action).

SUBSTRATES

Information obtained from two augered cores and from the strata of an adjacent gravel pit indicated that the Colne runs over horizons of poorly-sorted, pebbly gravel 4-8m thick.

River Bed

In the northern half of the survey section (upstream of the Greenham works) the river bed substrate consisted of gravels with patches of finer sediments (mixtures of sands, silts and clays), becoming very silty towards the top of the reach. This river section suported a very diverse flora, with frequent stands of the more uncommon submerged species.

Adjacent to and downstream of the Greenham works, the river was shallow and the bed consisted of shallow banks of pebble gravels, which we were told had washed down from the works. This area supported plant species very similar to those recorded upstream, but the uncommon aquatic species were generally less abundant.

(Contd.)

Effects of Dredging on River Sediments and Plant and Animal Communities

The results of the 1991 survey (and comparison with the 1984/85 survey) suggest that the vegetation of the river is recovering from the effects of severe dredging during the late 1970's or early 80's. This suggests that a **single** dredging and deepening operation might not have a **permanent** effect on the vegetation of the river.

However, the **maintenance dredging** needed with a flood relief scheme could cause long-term damage since it would, in effect, permanently remove patches of fine sediments with which the uncommon plants are associated.

In addition, increased river depth and changes in flow regime could also have detrimental effects on the plant community.

Although an attempt was made to predict the impact of dredging on invertebrate communities by means of RIVPACS (River Invertebrate Prediction and Classification System), this proved impossible.

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1. INTRODUCTION AND AIMS

This report, commissioned by Nicholas Pearson Associates, gives the results of a survey of part of a 1km length of the R. Colne near Stanwell Moor (TQ 039749 - 034743). The survey was undertaken to provide information about the ecology and physical characteristics of the river in order to evaluate proposals to dredge it (to a depth of 750mm) as part of a flood aleviation scheme.

Three main surveys were undertaken for the report:

1.1 RIVER CORRIDOR SURVEY

(i) A brief check of changes in the river corridor subsequent to a survey undertaken in 1990 by Denise Exton for Nicholas Pearson Associates.

(ii) A report on significant changes or trends in the river corridor since 1984/5, when an earlier river corridor survey was undertaken by Nigel Holmes (incorrectly attributed to Angela Walker in D.Exton's 1990 report).

1.2 INVERTEBRATE SURVEY

(i) A survey of aquatic macroinvertebrates, undertaken in order to assess the conservation value of the river's invertebrate community.

(ii) A prediction of the effect of dredging on the invertebrate community using the River Invertebrate Prediction and Classification System (RIVPACS)

1.3 SUBSTRATE SURVEY

(i) Examination of river sediment and core material together with a review of any existing data on river substrates.

(ii) A brief report to provide a qualitative assessment of the effects of dredging to the proposed depth.

2. METHODS

2.1 RIVER CORRIDOR SURVEY METHODS

A 'walk through' check was made to identify any major changes to the river corridor subsequent to Denise Exton's 1990 survey.

During this check a list of wetland plant species was compiled. Particular attention was given to the distribution and abundance of local, rare and aquatic macrophyte species.

The plants recorded were those which appear on the Nature Conservancy Council wetland plant species list. Where possible macrophytes were identified to species level in the field. Critical species were taken back to the laboratory for identification.

2.2 MACROINVERTEBRATE SURVEY METHODS

Two types of macroinvertebrate surveys were undertaken:

i) An extensive 'bankside' survey of the the whole (1km) length of the Colne, which was undertaken to give as complete a species list as possible for the river. (See 2.2.1.)

ii) A timed survey undertaken in one 50m stretch to give specific information on:

   (a) water quality (using a BMWP score). (See 2.2.2.)

   (b) the potential effects of any dredging on invertebrate communities (using RIVPACS). (See 2.2.2.)

For both types of survey aquatic macroinvertebrates were collected by sweep netting in vegetation, kick-sampling gravelly substrata, and dredging the silty substrata using a standard pondnet (1mm square mesh).

2.2.1 Bankside sample and sort

To give information about invertebrates along the whole (1km) length of the survey section, the entire area was netted and searched for species at intermittent points over a period of 5hrs. Netted samples were sorted on the bankside and, if possible, species were identified in the field. Other species were returned to the laboratory for identification. Species recorded during the bankside sort, but not present in the timed sample (see below), are listed as "present" in the species list (see Appendix 2).

2.2.2 Timed sample (standard methodology for BMWP & RIVPACS analysis)

The timed sample was taken within a 50m stretch of the river. This was chosen to be as representative as possible of the whole (1km) survey section (see Figure 1.). The total sampling time (3 minutes) was divided up so that the amount of time spent sampling in any microhabitat was proportional to the area covered by that microhabitat.

In addition, a brief period (approximately 2 minutes) was spent searching the 50m stretch for invertebrates which might otherwise be missed using the 3 minute area-dependent method. The 3-minute sample, and any other animals found during the 2-minute search, were returned to the laboratory for sorting and identification.

In the laboratory, the sample was sorted in order to give a list of groups and species of invertebrate present. A subsample was sorted to give an indication of relative abundance. Species found during the 2-minute search were added to this list.

Information on the **families** of invertebrates present was used to obtain a BMWP (Biological Monitoring Working Party) score, which provides an estimate of water quality.

Physical and chemical data from the river was sent to the NRA Thames Region for analysis using RIVPACS (River Invertebrate Prediction and Classification System.

2.2.3 Assessment of the conservation value of the macroinvertebrate community in the River Colne

The conservation value of the aquatic macroinvertebrate communities was assessed using the criteria described in Table 2.

Note In this report the assessment of the conservation value of the macroinvertebrate communities has been made using data from a single season. Collecting in two or three different seasons of the year (ie spring, summer and autumn) usually results in the recording of 30-50% more species than are found in a single season. It is possible that, amongst these new species, further uncommon species could be recorded.

2.3 SUBSTRATE SURVEY METHODS

2.3.1 Channel sediments

A brief field examination of the river bed sediment was made throughout the survey length. To provide more detail, sediment transects were undertaken at four locations (see Figure 1). Along these transects, sediment samples were removed every 2m for laboratory analysis (see below).

Further information about river substrates was given by Mr Hunt, site manager of the Greenham works.

2.3.2 Cores

900mm cores were dug at the margin of the river at two locations using a 100mm diameter soil auger (see Figure 1). The material from each core was examined in the field and samples from the top, middle and bottom of the core were removed for laboratory analysis.

Information about near-surface geology in the area was taken from the relevant British Geological Survey map.

Local data was given by Greenham's site workers who provided information about the strata in a recently excavated gravel pit 70m west of the R.Colne.

2.3.3 Laboratory analysis

Qualitative analysis of sediments from the cores and the river bed were undertaken in the laboratory: sediment samples were spread out over a large white tray and the percentage of clasts in each of 5 size groups was assessed by eye with reference to a graphical chart of clast sizes. Clast size groups were based on the Wentworth Scale (1922), see Appendix A.

An assessment was also made of the degree of sediment 'sorting' in each sample (a sample containing clay, silt, sand and gravel would be poorly sorted; one containing only gravel would be well sorted). The maximum clast size and the average size of clasts in the coarse fraction were measured.

Approximately 25% of the sediment samples underwent a further analysis: each sample was shaken with water in a glass vessel and allowed to settle out through the water column under gravity. This ensured a slightly more accurate check of the percentage of the 'fines' (silt and clay) in the samples.

2.4 OTHER PHYSICAL AND CHEMICAL PARAMETERS MEASURED

A number of other physical parameters were measured to aid interpretation of the biological data and provide information required for RIVPACS analysis.

2.4.1 Water depth

Changes in water depth along the field survey length were assessed by taking 6 transects of the river (see Figure 1). Along each transect water depth was measured every metre. The results from each transect were averaged. Maximum and minimum depths were noted.

2.4.3 Chemistry

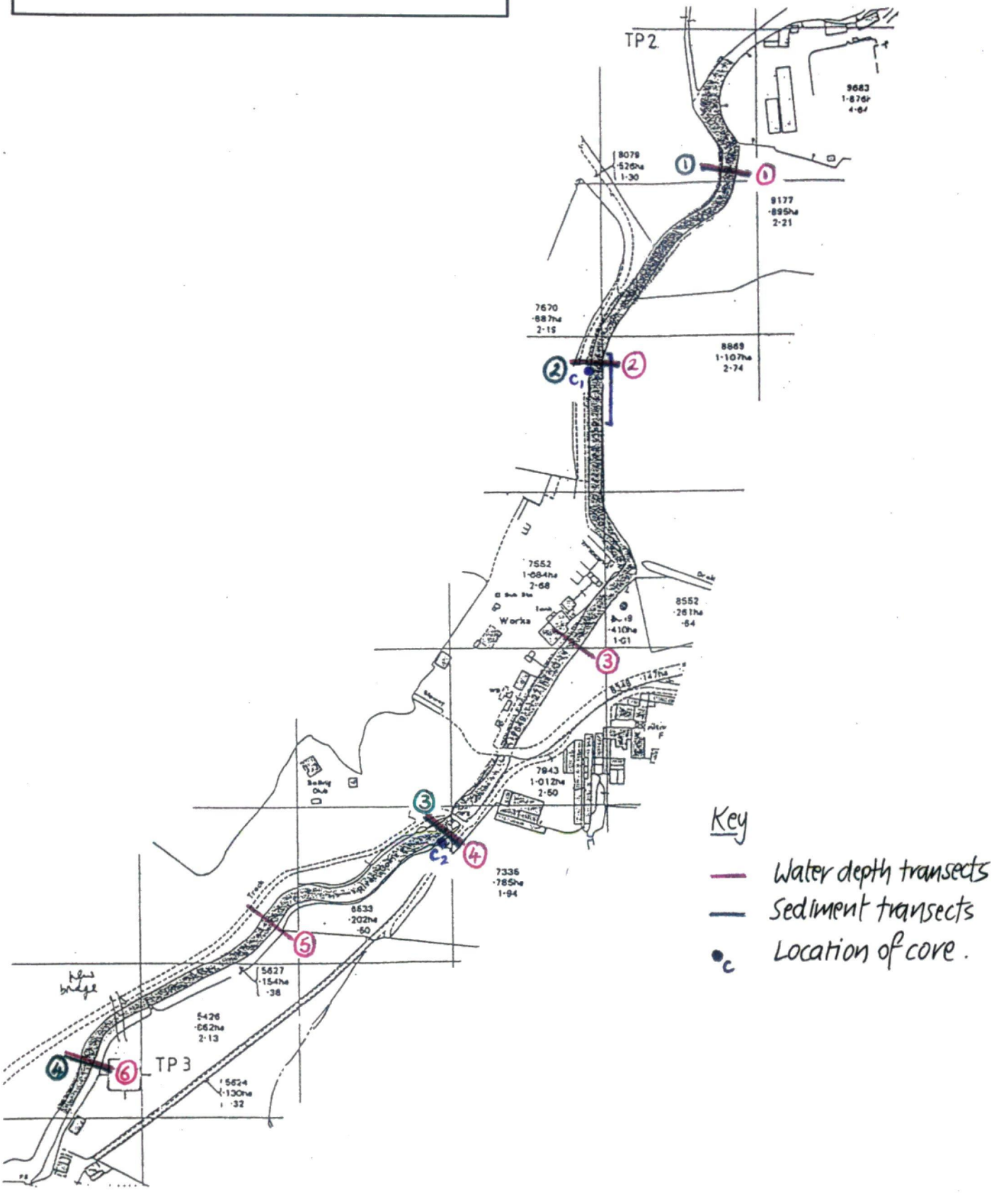
Alkalinity was determined using an Aquamerck 8048 Carbonate hardness measuring kit. On the advice of the Institute of Freshwater Ecology (IFE), nitrate and chloride concentrations are not being included in the RIVPACS prediction as the programme assumes that the environmental parameters are those of an undisturbed site (J. Wright, pers. comm.)

2.4.3 Others

Altitude, distance of the river from source, and slope were estimated from Ordnance Survey 1:10,000 scale maps (second series). Estimates of discharge category were provided by the National Rivers Authority.

Figure 1.

Location of transects, cores and BMWP sampling area.



3. RIVER CORRIDOR SURVEY

3.1. UPDATES TO THE 1990 SURVEY

Essentially there were few changes to the nature and vegetation of the bank and margins between the 1990 and 1991 surveys.

Although most of the differences identified related to the **number** and **abundance** of wetland plant species that were noted, the majority of these were likely to be due to differences in **recording technique** rather than to real changes or trends.

The main updates to the 1990 survey sections are outlined below and summarised in Figure 2. A compilation of the wetland plants recorded during each of the surveys (1991, 1990 and 1984/5) is given in Table 1. A total species list is given in Appendix 1.

3.1.1 Section 3 (74)* (TQ 038748-037745)

Banks: A number of additional marginal species were noted eg. Carex riparia (greater pond-sedge), Apium nodiflorum (fool's water-cress), Ranunculus sceleratus (celery-leaved buttercup) and Veronica beccabunga (brooklime) (see Table 1) but in general only small stands were present.

Channel: The 1990 report slightly underemphasised the diversity of submerged plants present. In addition to the four species noted, there were frequent submerged stands of Butomus umbellatus (flowering-rush) and Callitriche sp. (starwort). Fontinalis antipyretica (willow moss) and Elodea nuttallii (Nuttall's pondweed) were recorded occasionally and small stands of Nuphar lutea (yellow water-lily) were present in the more silty areas towards the north of the section.

3.1.2 Section 4 (75)* (TQ 037745-034742)

Banks: The bare eastern banks next to the Greenham yard, mentioned in Denise Exton's report, had become overgrown with wetland ruderals particularly Epilobium hirsutum (great willowherb) and Urtica dioica (common nettle). Conium maculatum (hemlock) was more extensive on the banks than indicated on the 1990 survey map.

*NOTE Section numbers refer to Denise Exton's 1990 river corridor survey. Numbers in parentheses refer to Nigel Holmes's 1984/5 survey.

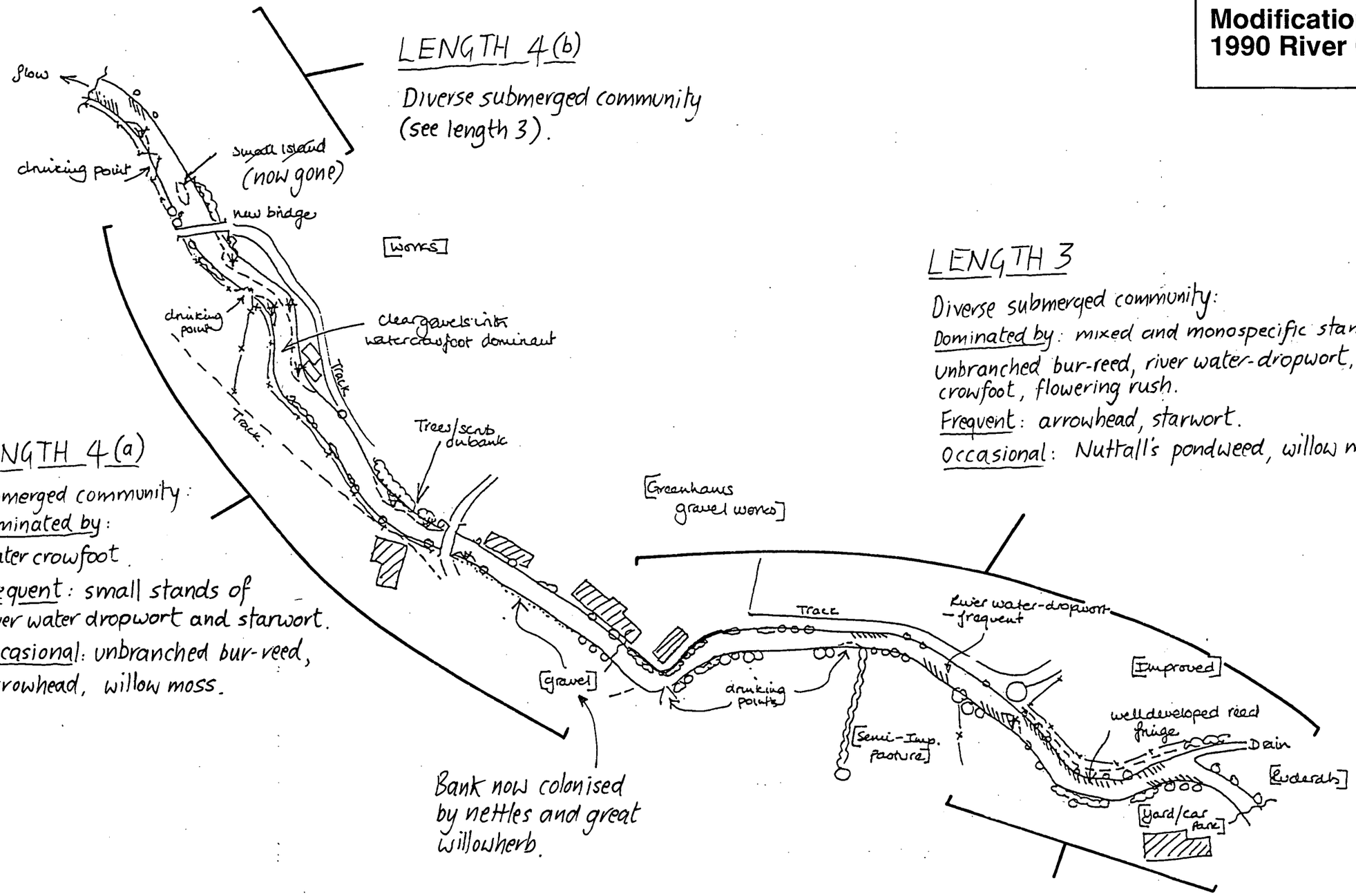
A number of additional species were noted (see Table 1), particularly Scutellaria galericulata (skullcap) which was locally frequent on lower banks near to the waters edge.

Channel: The area between the two Greenham bridges supported a more diverse flora than indicated: in addition to water crowfoot (Ranunculus penicillatus) which was noted in the 1990 survey as the dominant species, the river supported stands of 7 other submerged species. These included the frequent occurrence of small stands of Oenanthe fluviatilis (river water-dropwort) and Callitriche sp. (starwort) growing in both the faster-flowing parts of the channel and along the slower-flowing (?more silty) margins.

Butomus umbellatus (flowering-rush), Sparganium emersum (unbranched bur-reed) and Sagittaria sagittifolia (arrowhead) were also present, though much less abundant than in section 3. Fontinalis antipyretica (willow moss) was fairly common on hard substrates such as large stones or concrete blocks. Two stands of Potamogeton pectinatus (fennel pondweed) were also recorded, growing in mid channel amongst the stands of water crowfoot.

Figure 2.

Modifications to D . Exton's 1990 River Corridor Survey



LENGTH 3

Diverse submerged community:

Dominated by: mixed and monospecific stands of unbranched bur-reed, river water-dropwort, water crowfoot, flowering rush.

Frequent: arrowhead, starwort.

Occasional: Nuttall's pondweed, willow moss.

Modified from D. Exton 1990

Scale: 1:2500

3.2. COMPARISON OF 1990/1 AND 1984/5 SURVEYS

It is only possible to make very generalised comparisons between the recent (1990/91) surveys and Nigel Holmes's earlier 1984/5 survey because:

(i) No species lists were available for the 1984/5 survey, making it difficult to compare changes in the **number** of marginal and submerged species.

(ii) Some surveyors only record **dominant** or very abundant plant species on river corridor maps. It is therefore difficult to assess changes or trends in the **distribution** of most plant species.

3.2.1 OVERALL

Overall the **dominant marginal** species recorded in 1984/5 **seem** similar to those present in 1991, the only clear change being an increase in the number and extent of stands of Sparganium erectum (branched bur-reed) and Nasturtium officinale (water-cress). The **total number** of marginal species recorded **was** considerably less in 1984/5 than 1991, but again this **may** be largely due to different recording methods, so cannot be reliably interpreted as an increase in diversity (see 3.2.(ii) above).

In contrast there is a clear suggestion from the maps that **submerged** species are **more diverse** now than they were in 1984/5, with colonisation of the river channel by uncommon aquatic species such as Oenanthe fluviatilis (river water-dropwort), Butomus umbellatus (flowering-rush) and Sagittaria sagittifolia (arrowhead).

The overall impression from both the channel margin and the submerged flora is that the river was severely damaged or dredged prior to 1984/5 and is gradually being recolonised.

Information from Alistair Driver (NRA) provides a likely explanation: when the flood relief scheme was first mooted in the 1970s/80s, routine dredging of the River Colne was halted in the areas likely to be affected by the scheme.

The implication is that this period without dredging has allowed time for plant colonisation (probably recolonisation), aided by partial re-silting of the river.

More detailed differences between 1990/1 and 1984/5 records for the two survey sections are outlined below and summarised in Figure 3. Differences in the number of species of wetland plants recorded are shown in Table 1.

3.2.2 Section 3 (74), (TQ 038748-037745)

Bank vegetation. Comparison of the 1984/5 and 1990 maps suggests that the distribution of herbs, grasses and scrub on the banks has remained generally similar although a number of smaller (planted?) willows on the right bank may have died or been removed in the last 6 years.

Channel margin vegetation seems to have changed little in the **upstream** part of the section (although the 1984/5 survey does not record the present marginal stands of Butomus umbellatus flowering-rush).

In the **downstream** half of the section, recent surveys record approximately twice as many stands of both tall emergents (mainly Sparganium erectum, branched bur-reed with some Butomus umbellatus flowering rush) and low growing marginal plants (particulalry Nasturtium officinale (water-cress) and Myosotis scorpioides (water forget-me-not)).

The submerged flora seems very different: the 1984/5 survey suggests a channel only sparsely colonised by Ranunculus sp. (water crowfoot) and occasional Sparganium emersum (unbranched bur-reed) with areas of unvegetated channel between. The 1990 and 1991 surveys both record a much more diverse flora dominated by mixed stands of Oenanthe fluviatilis (river water-dropwort), Butomus umbellatus (flowering-rush), Sparganium emersum (unbranched bur-reed), Ranunculus penicillatus (water crowfoot), Sagittaria sagittifolia (arrowhead) and Callitriche sp (starwort).

3.2.3 Section 4 (75), (TQ 037745-034742)

Bank vegetation: Nigel Holmes's map gives little information about the **composition** of bank community but the **distribution** of herbs, grasses and scrub seems broadly similar to the recent surveys.

Channel margin vegetation is almost certainly more extensive now than 6 years ago. This is particularly evident on the right bank downstream of the concrete bridge where the marginal fringe of Nasturtium officinale (water-cress) was thin and patchy in 1984/5 but is now semi-continous.

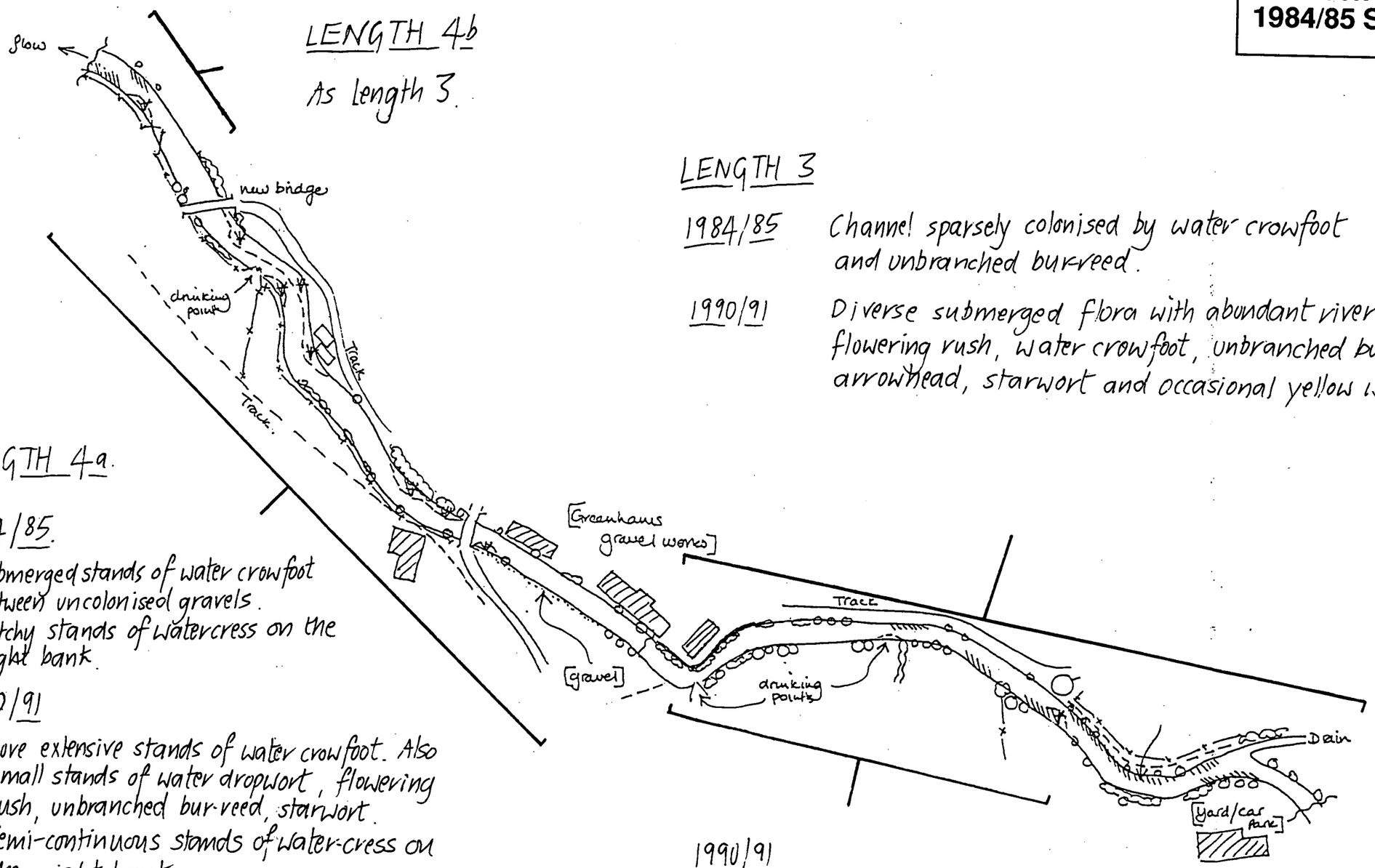
The current extent of **tall emergent** species (mainly Sparganium erectum: branched bur-reed) is similar to that shown in earlier surveys although the distribution has changed slightly; with two Sparganium stands which were formerly evident on the right bank of the river no longer present and two new stands now present upstream of the concrete bridge.

(Contd)

Submerged species: Upstream (north) of the new bridge all the surveys continue to show a submerged community dominated by Ranunculus penicillatus (river water-crowfoot). However, there is some indication that stands of Ranunculus **may** have been **less extensive** in 1984/5. There **may** also have been an increase in the diversity of other submerged species (eg Oenanthe, Saggitaria, Butomus) but these were were under-recorded in the 1990 survey, and might also have been in 1984/5.

Downstream of the new bridge the present plant community **clearly** shows an increase in diversity since the 1984/5 survey: the original dominance by water-crowfoot having given way to a diverse mixed community of aquatic species, very similar to those of section 3.

Figure 3.
Summary of the Differences Between the 1990/91 and 1984/85 Surveys.



LENGTH 4b

As length 3.

LENGTH 4a.

1984/85.

Submerged stands of water crowfoot between uncolonised gravels.
Patchy stands of watercress on the right bank.

1990/91

Move extensive stands of water crowfoot. Also small stands of water dropwort, flowering rush, unbranched bur-reed, starwort.
Semi-continuous stands of water-cress on the right bank.

LENGTH 3

1984/85 Channel sparsely colonised by water crowfoot and unbranched bur-reed.

1990/91 Diverse submerged flora with abundant river water-dropwort, flowering rush, water crowfoot, unbranched bur-reed, arrowhead, starwort and occasional yellow water-lily.

1990/91

Twice as many stands of tall emergents and marginals as in the 1984/85 survey.

Modified from D. Exton 1990

Scale: 1:2500

TABLE 1 WETLAND PLANT SPECIES RECORDED DURING THE THREE SURVEYS

91=1991 Pond Action 90=1990 Denise Exton 85/6=1985/6 Nigel Holmes

SPECIES	SECTION 3			SECTION 4		
	91	90	85/6	91	90	85/6
SUBMERGENT SPECIES						
Flowering-rush	+	+	+	+	+	-
Starwort	+	+	-	+	-	-
Nuttall's Pondweed	+	-	-	+	-	-
Willow moss	+	-	-	+	-	-
Yellow Water-lily	+	-	-	+	-	-
Floating-leaved water-dropwort	+	+	-	+	+	-
Fennel Pondweed	-	-	-	+	-	-
Stream water-crowfoot	+	+	+	+	+	+
Arrowhead	+	+	-	+	+	-
Unbranched Bur-reed (Strapweed)	+	+	-	+	-	-
TOTAL SUBMERGED SPECIES	9	6	2	10	4	1
EMERGENT SPECIES						
Creeping Bent	+	-	-	+	-	-
Water Plantain	+	+	-	+	-	-
Fool's Water-cress	+	-	-	+	-	-
Bur-marigold (prob. Trifid)	+	-	+	+	-	-
Greater Pond-sedge	+	-	-	-	-	-
Hemlock	-	-	-	+	+	-
Great Willowherb	+	+	+	+	-	+
Meadowsweet	-	-	-	-	-	+
Reed Sweet-grass	+	-	-	+	+	-
Indian Balsam	+	-	-	+	+	-
Gipsywort	+	-	-	+	-	-
Water Forget-me-not	+	+	+	+	+	-
Water Chickweed	-	-	-	+	-	-
Water-cress	+	+	-	+	+	+
Reed Canary-grass	+	+	+	-	-	-
Amphibious Bistort	+	-	-	+	-	-
Water Pepper	+	-	-	-	-	-
Celery-leaved Buttercup	+	-	-	+	-	-
Great Yellow-cress	+	+	-	+	-	+
Water Dock	-	-	-	+	-	-
Water Figwort	+	-	-	+	-	-
Skullcap	+	-	-	+	-	-
Bittersweet	+	-	-	+	+	+
Branched Bur-reed	+	+	+	+	+	+
Marsh Woundwort	+	-	+	-	-	+
Common Comfrey	+	+	-	+	-	-
Common Nettle	+	+	+	+	-	+
Brooklime	+	-	-	-	-	-
Blue Water-speedwell	+	-	-	-	-	-
TOTAL EMERGENT SPECIES	25	9	6	22	7	8
TOTAL SPECIES	**34**	**15**	**8**	**32**	**11**	**9**

4. MACROINVERTEBRATE SURVEY OF THE RIVER COLNE

4.1 Species Richness and composition of the fauna

A list of the invertebrate species recorded during this survey of the River Colne is given in Appendix 2.

A summary of major invertebrate groups, and the number of species in each group, recorded can be found in Appendices 3 and 4.

64 species of macroinvertebrate were recorded during this survey.

The macroinvertebrate community of the river was dominated numerically by crustacean, mayfly and snail species.

The water slater (or hog louse) Asellus aquaticus and the freshwater shrimp Gammarus pulex were both abundant: the former may be found in almost any permanent, base-rich body of water throughout Britain, but Gammarus pulex is known to be relatively intolerant of organic pollution. Both crustacean species together were so numerous as to outnumber all other macroinvertebrates present.

Caenis luctuosa (one of the family of mayflies known collectively as "Angler's Curse"), a species typical of running water, was the dominant mayfly; also present in slightly smaller numbers were Baetis rhodani (the Large Dark Olive Spinner) and Ephemerella ignita (the Blue Winged Olive Dun). These species are all common and widespread in clean flowing water conditions, and are an extremely important element in the diet of fish.

Snails were very well represented in the fauna, with 19 species present: almost 50% of the total number of British freshwater snails. The dominant snail species was Bithynia tentaculata, an an operculate snail which is characteristic of large ponds and lakes but is often found in smaller rivers.

Neither beetles nor bugs were well-represented in the the river fauna. Only 4 bug species were found (though nymphs of at least 2 others were present), and of these only 1 or 2 individuals of each were in evidence. Similarly, there were usually only single individuals of the 10 beetle species recorded.

The invertebrate fauna of the River Colne is broadly comprised of two community types: species which are typical of flowing water (found in the more fast-flowing gravelly parts of the river), and those which are more typical of still water (inhabiting the sluggish, silty, well vegetated margins).

For example, the leeches Erpobdella octoculata and Erpobdella testacea are both present. The former is very common in fast-flowing, base-rich streams and rivers, whereas the latter is particularly tolerant of low oxygen levels and is more typical of small eutrophic ponds. Similarly, Ancylus fluviatilis (the River Limpet), a species common on riverine stones and other hard substrata, and Acroloxus lacustris (the Lake Limpet), usually a still water species were both present.

It is worth noting that at least one sponge species, probably Ephydatia fluviatilis, was very abundant, growing profusely on almost every available surface. Sponges are known to be dependent upon clean water so that they are "often the first organisms to die when waters become polluted" (Fitter and Manuel, 1986).

4.2 RARE SPECIES

One potentially rare species was recorded as possibly present in the river: the riffle beetle Oulimnius major, which is listed in the Red Data Book as a **Category 3*** species, ie one that is "believed to be rare ....but too recently discovered or recognised to be certain of placing" (British Red Data Books 2. Insects: pp. 1 & 22). A further difficulty is that only one individual, a female, was recorded; while this specimen bore all known characteristics of Oulimnius major, males are required for reliable identification.

4.3 LOCAL SPECIES

A total of 6 local species were recorded during the survey.

Two local beetle species were recorded: Gyrinus urinator and Haliplus laminatus. Gyrinus urinator, a whirligig beetle typical of running water, is more commonly found in south-west England. Haliplus laminatus, a small beetle of the Haliplid family, is Nationally Notable B; it is locally common in south-east England and frequents lowland canals/rivers and silt ponds.

Bithynia leachi (Leach's Bithynia) is an operculate snail, locally common in south-east England, which is usually associated with slow-flowing and still water. Theodoxus fluviatilis (the Nerite) and Viviparus viviparus (the River Snail) are both found in calcareous rivers, the former preferring rapid flows. Both are common, but restricted in range to Southern England.

The leech Erpobdella testacea is restricted to England and Wales, where it is widespread but uncommon. It is, in general, more typical of ponds than flowing water.

4.4 CONSERVATION VALUE OF THE MACROINVERTEBRATE COMMUNITY OF THE RIVER COLNE

The provisional system outlined in Table 2 may be used to assess the nature conservation value of the invertebrate community.

The 1km section of the River Colne yielded a moderately high number of local species (6). In addition there is a probable record for the questionably rare species, Oulimnius major (see 4.2 above).

This section of the River Colne should be regarded as being of high to very high value to nature conservation.

4.5 WATER QUALITY ASSESSMENT USING BMWP AND ASPT SCORES

BMWP AND ASPT

The macroinvertebrate families recorded in the timed sample and the extra search within the sampling section were used to calculate the Biological Monitoring Working Party (BMWP) score and Average Score Per Taxon (ASPT).

The BMWP scoring system awards points to different families of macroinvertebrate which broadly reflect their tolerance of organic pollution and oxygen stress. Families which are intolerant of organic pollution and oxygen stress (usually families found in fast flowing rivers) score 10 points. Families which are more tolerant of organic pollution and oxygen stress score less points, down to 1 point. The BMWP score is the total of the scores of all the families in a sample. The higher the score, the less likely it is that the stream is polluted.

4.5.1 BMWP results for the R. Colne

The total BMWP score was 248, and the ASPT was 5.4: this indicates a **'very good'** water quality. A list of the invertebrate families used to calculate the BMWP score are given in Appendix 6.

4.6 Prediction and classification of the macroinvertebrate fauna using RIVPACS

The IFE (Institute of Freshwater Ecology) RIVPACS (River Invertebrate Prediction and Classification System) computer programme predicts BMWP and ASPT scores and fauna for unpolluted rivers with environmental parameters similar to those given. This is done by comparison with other rivers in the IFE database.

However, despite two runs by the NRA Thames Region the RIVPACS programme could not generate a satisfactory prediction of the invertebrate community. This may have been because the IFE database did not contain any unpolluted reference sites with physical features corresponding to those given for the R. Colne. Because of this, it was not possible to predict a target 'unpolluted' community for the Colne or to further predict the effects of dredging on the invertebrate community.

TABLE 2. SYSTEM USED FOR ASSESSING THE NATURE CONSERVATION VALUE OF AQUATIC MACROINVERTEBRATE COMMUNITIES

CONSERVATION VALUE	DESCRIPTION OF COMMUNITY
VERY HIGH	Supporting a rich community of macroinvertebrate species, including local species and/or rare (ie Red Data Book) species. Note that some sites with rare species may be relatively species-poor. Sites in this category are likely either to be Sites of Special Scientific Interest in their own right, or within larger SSSI's.
HIGH	Supporting a rich community of common macroinvertebrate species. A small number of local species present. No rare species. Could include sites on SSSI's or sites of local nature conservation value.
MODERATE/LOW	Supporting only common macroinvertebrate species. No rare or uncommon species.

5 SUBSTRATE, SEDIMENTS AND WATER DEPTHS

5.1 NEAR-SURFACE GEOLOGY

Study of the 1:50,000 geological map of the area indicates that the R. Colne runs directly over glacial gravels (part of the R.Thames terraces). These gravels, in turn, unconformably overlie the London Clay. Information from the strata of the Greenham gravel pit (which lies approx 70m west of the river) suggests that, in this area, the thickness of the gravel horizon varies between approximately 4 and 8m.

5.2 CORES

Two 900mm deep cores were dug to enable comparison between the gravel substratum and river bed sediments.

The cores were very uniform in composition, consisting throughout of poorly-sorted* pebbly gravels. The north core was slightly more sandy than the south (see Appendix 7).

5.3 RIVER BED AND SEDIMENT & WATER DEPTH TRANSECTS

The base of the river was fairly clearly divided into 3 main substrate types. Each was associated with different bedform characteristics, water depths and vegetation communities.

Four sediment transects were undertaken to typify changes in the nature of the river bed (see Appendix 8 and Figure 1).

A description of the river substrate types is given below and summarised in Figure 4. Associations between the river substrate type and vegetation communities are summarised in Figure 5.

5.3.1 River Substrate Type 1.

This river substrate type was characteristic of two areas:

(i) A stretch of approximately 250m immediately north of the Greenham works (TQ 03877480 - 03807453) (Transect 2)

(ii) A short 50m section at the southern end of the survey area below the new bridge (TQ 03477425 - 03457420) (Transect 4).

In these areas the bed of the river was very similar in character to material taken from the cores (ie poorly-sorted pebbly gravels) implying that the river was running directly over relatively unmodified glacial gravels.

* ie with a very variable clast size (from clay to large pebbles)

The main difference between the material of the river bed and core were the local occurrence of patches of finer sediments (mixtures of sand, silt, clay and organics) deposited on top of the channel gravels. These finer sediments occurred in areas of low water velocity: particularly (i) within submerged vegetation stands in the channel (ii) at the river margins (iii) and within slacks in the river - often behind obstacles. The abundance of fines increased northwards grading into River Substrate Type 2 (see below).

This river substrate type showed moderate development of riffle and pool bedforms. The average water depth was approximately 580mm. The deepest water depth measured in the transects was 750mm; however pools with depths of 1m+ were fairly common.

5.3.2 River Substrate Type 2.

A short 80m length at the northern end of the survey section (TQ 03877487 - 03877480) (Transect 1).

Extensive areas of fine sediment (clay, silt and sand) were present overlying the gravel bed. The amount of fines increased northwards so that, at the very northern end of the survey section, the gravels were almost completely covered with beds of fines up to 400mm thick.

The channel was generally deeper than in other parts of the river with average depths of approximately 620mm (570mm water + 50mm silt). The maximum transect depth was 850mm but locally pools were over 1m deep.

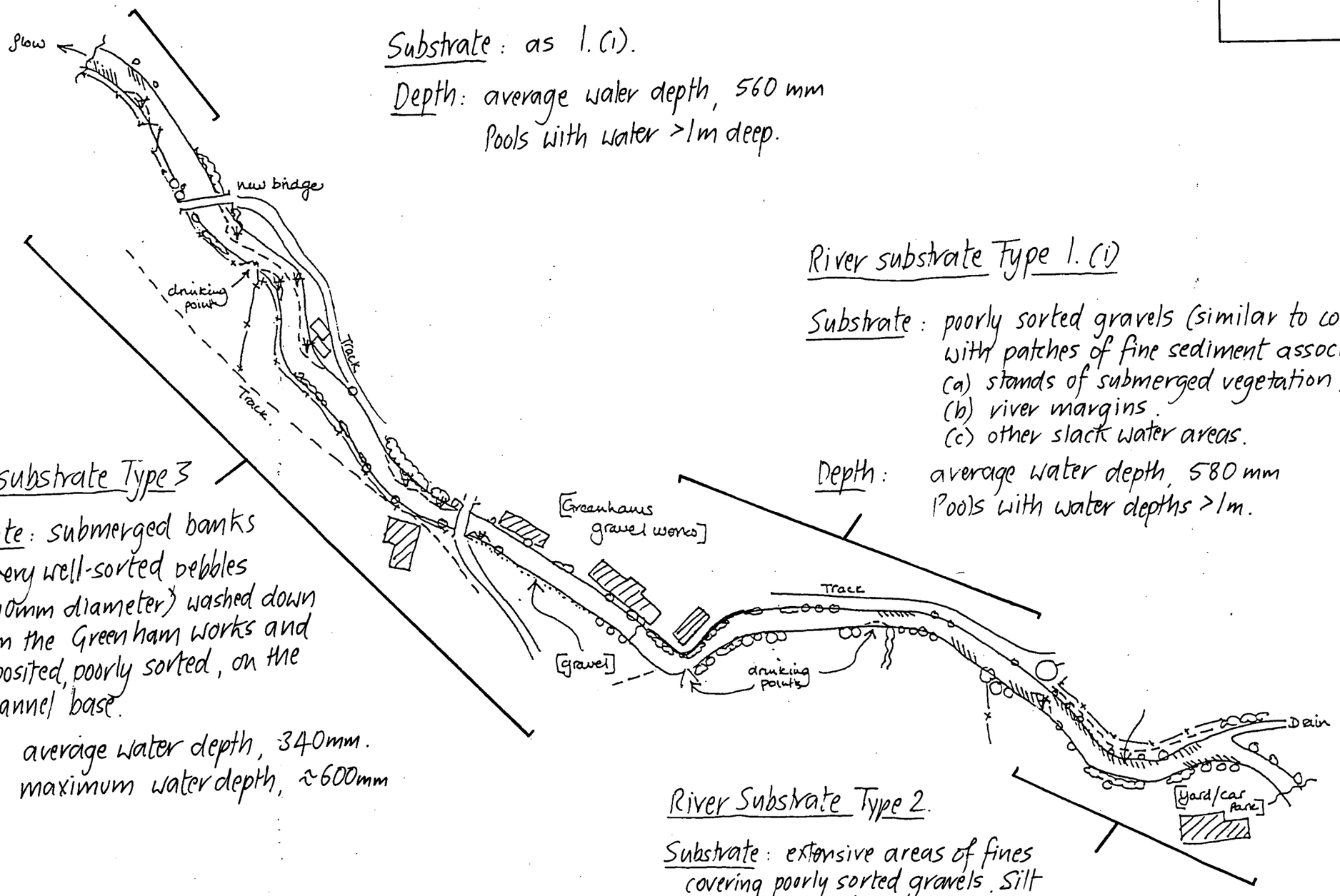
5.3.3 River Substrate Type 3.

A 500m section adjacent to, and south of, the Greenham works (TQ 03807453 - 03477425) (Transect 3).

This section of the river was much shallower than other areas with an average depth of only 340mm and maximum depths in the region of 600mm. The channel was dominated by submerged banks of very well sorted pebbles, 5-10mm in diameter, with patches of fine sediments deposited within vegetation stands and at the river edge. Only between the pebble banks were substrates more characteristic of the poorly-sorted gravel core material exposed.

During discussion with Mr Hunt, manager of the Greenham works, it was confirmed that these very even-sized pebbles were likely to have been derived from the Greenham works, washed into the river during spate from piles of sorted gravels close to the channel.

Figure 4.
River Bed Substrates



River substrate Type 3

Substrate: submerged banks of very well-sorted pebbles (5-10mm diameter) washed down from the Greenham works and deposited, poorly sorted, on the channel base.

Depth: average water depth, 340mm.
maximum water depth, ~600mm

River substrate Type 1. (i)

Substrate: poorly sorted gravels (similar to core material) with patches of fine sediment associated with:
(a) stands of submerged vegetation.
(b) river margins.
(c) other slack water areas.

Depth: average water depth, 580 mm
Pools with water depths >1m.

River Substrate Type 2.

Substrate: extensive areas of fines covering poorly sorted gravels. Silt becoming almost continuous upstream.

Depth: silt depths: 50mm average, 400mm max.
water depths: 570mm average, pools >1m deep.

Modified from D. Exton 1990

Scale: 1:2500

5.4 COMPARISON WITH SUBSTRATES RECORDED ON NIGEL HOLMES'S 1984/5 MAPS

Nigel Holmes's maps indicate a predominantly gravel-bottomed river, probably broadly similar to the present channel. In the area of River Substrate Type 3 the 1984/5 report locally describes the channel substrate as 'solid pebble gravel'. This suggests that the present banks of well-sorted pebbles (washed down from the Greenham works) may have also been present in the channel 6 years previously.

In the 1984/5 report no mention is made of the nature of the substrate at the very northern end of the survey section. It is therefore difficult to assess whether this section was always silty or whether silt has been washed down in more recent times from the more silty areas upstream.

5.5 THE EFFECT OF DREDGING ON THE CHARACTERISTICS OF BOTTOM SUBSTRATE

Comparison of core material with the nature of the present-day river bed suggests that, after dredging, the river substrate would be **broadly** similar to the present channel, although considerably more uniform in substrate type.

The most significant substrate changes would be likely to be:

(i) removal of fines from the northern end of the section

(ii) removal of the many heterogeneous patches of clays, silts, sand and organics from all parts of the channel and channel margins.

(iii) removal of the banks of well sorted gravels from below the Greenham works.

5.5.1 Additional information

The results of the 1991 survey (and comparison with the 1984/85 survey) suggest that the vegetation of the river is recovering from severe dredging during the late 1970's or early 80's. This suggests that a **single** dredging and deepening operation might not have a **permanent** effect on the vegetation of the river. Indeed the area of very uniform gravels washed down from the Greenham works might benefit from shallow dredging in order to provide a more varied substrate in this section.

However, the **maintenance dredging** needed with a flood relief scheme could cause long-term damage, since this would in effect, ensure the permanent removal of the patches of fine sediments with which high quality plant communities are associated.

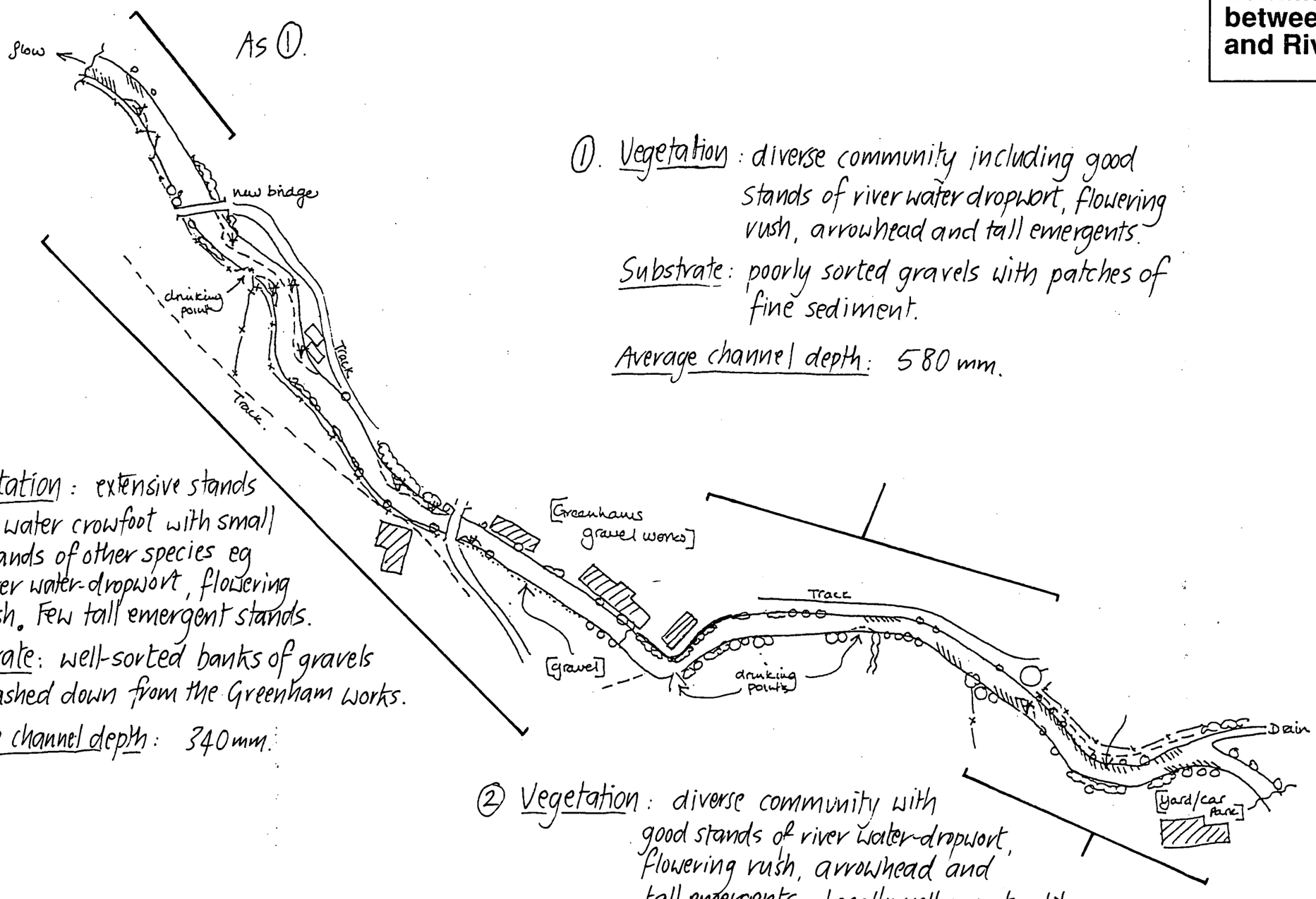
(Contd.)

In addition other effects of dredging the flood relief channel, particularly the increases in average depth (probably at least doubling it in some areas), as well as changes in the section's hydrological regime both have the **potential** to **permanently damage** the existing plant and invertebrate communities.

More information would be needed to accurately predict the effect of depth/flow regime changes on the plant communities. However limited empirical evidence from the survey section itself shows that deeper pools (900+mm) in the most floristically diverse areas were very poorly colonized by aquatic plants.

Figure 5.

Summary of Associations between River Vegetation and River Substrates



① Vegetation: diverse community including good stands of river water dropwort, flowering rush, arrowhead and tall emergents.

Substrate: poorly sorted gravels with patches of fine sediment.

Average channel depth: 580 mm.

③ Vegetation: extensive stands of water crowfoot with small stands of other species eg river water-dropwort, flowering rush. Few tall emergent stands.

Substrate: well-sorted banks of gravels washed down from the Greenham works.

Average channel depth: 340 mm.

② Vegetation: diverse community with good stands of river water-dropwort, flowering rush, arrowhead and tall emergents. Locally yellow water-lily.

Substrate: extensive area of silt over poorly sorted gravels.

Average channel depth: (water + silt) 620 mm.

Modified from D. Exton 1990

Scale: 1:2500

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APPENDIX 1. WETLAND SPECIES RECORDED

SPECIES NAME	COMMON NAME
Agrostis stolonifera	Creeping Bent
Apium nodiflorum	Fool's Water-cress
Butomus umbellatus	Flowering-rush
*Callitriche sp.	Starwort
Carex riparia	Greater Pond-sedge
Conium maculatum	Hemlock
Elodea nuttallii	Nuttall's Pondweed
Epilobium hirsutum	Great Willowherb
Filipendula ulmaria	Meadowsweet
Fontinalis antipyretica	Willow moss
Glyceria maxima	Reed Sweet-grass
Impatiens glandulifera	Indian Balsam
Lycopus europaeus	Gipsywort
Myosotis scorpioides	Water Forget-me-not
Myosoton aquaticum	Water Chickweed
Nasturtium officinale (previously Rorippa nasturtium-aquaticum)	Green Water-cress
Nuphar lutea	Yellow Water-lily
Oenanthe fluviatilis	River Water-dropwort
Phalaris arundinacea	Reed Canary-grass
Polygonum amphibium	Amphibious Bistort
Polygonum hydropiper	Water Pepper
Potamogeton pectinatus	Fennel Pondweed
Ranunculus penicillatus ssp. pseudofluitans var. pseudofluitans	Stream Water-crowfoot
Ranunculus sceleratus	Celery-leaved Buttercup
Rorippa amphibia	Great Yellow-cress
Rumex hydrolapathum	Water Dock
Sagittaria sagittifolia	Arrowhead
Scrophularia auriculata	Water Figwort
Scutellaria galericulata	Skullcap
Solanum dulcamara	Bittersweet
Sparganium emersum	Unbranched Bur-reed (Strapweed)
Sparganium erectum	Branched Bur-reed
Stachys palustris	Marsh Woundwort
Symphytum officinale	Common Comfrey
Urtica dioica	Common Nettle
Veronica beccabunga	Brooklime
Veronica anagalis-aquatica	Blue Water-speedwell

* Callitriche sp. were not identified to species level because suitable flowering material was not available at the time of the survey.

Latin and English equivalents from Dony et.al. (1986) The English names of wild flowers. BSBI. 2nd edition.

APPENDIX 2. AQUATIC MACROINVERTEBRATES RECORDED FROM THE RIVER COLNE

Abundance codes: 1-10 = A; 11-100 = B; 101-500 = C; 501-1,000+ = D.
Other: + = Present, but not found in sampling section.

SPECIES	
TRICLADIDA (flatworms)	
Polycelis tenuis	+
HIRUDINEA (leeches)	
Erpobdella octoculata	A
Erpobdella testacea	+
Glossiphonia complanata	A
Glossiphonia heteroclita	+
Helobdella stagnalis	A
Piscicola geometra	A
GASTROPODA (snails)	
Acroloxus lacustris	A
Ancylus fluviatilis	B
Anisus vortex	B
Armiger crista	A
Bathyomphalus contortus	A
Bithynia leachi	B
Bithynia tentaculata	C
Gyraulus albus	B
Lymnaea auricularia	A
Lymnaea palustris	A
Lymnaea peregra	B
Lymnaea stagnalis	A
Physa fontinalis	B
Planorbis carinatus	A
Planorbis planorbis	+
Potamopyrgus jenkinsi	B
Theodoxus fluviatilis	B
Valvata piscinalis	B
Viviparus viviparus	A

Contd.

AQUATIC MACROINVERTEBRATES RECORDED FROM THE RIVER COLNE (Contd.)

BIVALVIA (Bivalves)	
Anodonta anatina	A
Anodonta cygnaea	A
Sphaerium corneum	+
MALACOSTRACA (shrimps and slaters)	
Asellus aquaticus	D
Gammarus pulex	D
EPHEMEROPTERA (mayflies)	
Baetis rhodani	B
Caenis luctuosa	C
Ephemerella ignita	B
ODONATA (dragonflies)	
Coenagrion puella/pulchellum	+
Ischnura elegans	A
Calopteryx splendens	A
MEGALOPTERA (alderflies)	
Sialis lutaria	B
HETEROPTERA (bugs)	
Hydrometra stagnorum	A
Sigara dorsalis	A
Sigara falleni	+
Velia caprai	A

Contd.

AQUATIC MACROINVERTEBRATES RECORDED FROM THE RIVER COLNE (Contd.)

TRICHOPTERA (caddis flies)

Athripsodes cinereus	A
Ceraclea dissimilis	A
Hydropsyche angustipennis	B
Hydropsyche contubernalis	B
Hydropsyche pellucidula	B
Hydropsyche siltalai	A
Limnephilus lunatus	A
Molanna angustata	B
Mystacides azurea	B
Phryganea bipunctata	A
Polycentropus flavomaculatus	A
Rhyacophila dorsalis	A
Tinodes waeneri	A

COLEOPTERA (beetles)

Elmis aenea	A
Gyrinus urinator	A
Haliplus laminatus	A
Helophorus brevipalpis	A
Hydrobius fuscipes	A
Hyphydrus ovatus	+
Laccobius striatulus	A
Laccophilus hyalinus	A
*Oulimnius ?major	A
Potamonectes depressus elegans	A

*NOTE: This riffle beetle was tentatively identified as a female of the species Oulimnius major, but certain identification requires males. (See 4.2 above.)

APPENDIX 3. GROUPS OF MACROINVERTEBRATES RECORDED IN THE RIVER COLNE

GROUPS IDENTIFIED TO SPECIES LEVEL

Tricladida	(Flatworms)
Hirudinea	(Leeches)
Gastropoda	(Snails and limpets)
Bivalvia (excluding Pisidium spp.)	(Bivalves)
Malacostraca	(Shrimps and slaters)
Ephemeroptera	(Mayflies)
Odonata	(Dragonflies and damselflies)
Megaloptera	(Alderflies)
Heteroptera**	(Water bugs)
Trichoptera**	(Caddis-flies)
Coleoptera*	(Water beetles)

GROUPS NOT IDENTIFIED TO SPECIES LEVEL BUT INCLUDED IN THE BMWP SCORE

Diptera***	(True-flies)
Oligochaeta	(Segmented worms)

*Adults from the following families of Coleoptera were recorded: Gyrinidae, Haliplidae, Dytiscidae, Elmidae, Hydrophilidae.

**The families Notonectidae and Gerridae (Heteroptera) and Hydroptilidae and Goeridae (Trichoptera) were included in the BMWP scoring, but were not identified to species level since only larvae (at present unidentifiable) were found.

***Only Chironomidae, Tipulidae, and Simuliidae feature in the BMWP system.

APPENDIX 4. NUMBERS OF AQUATIC MACROINVERTEBRATE SPECIES IN MAJOR GROUPS RECORDED FROM THE RIVER COLNE

GROUP	
TRICLADIDA	1
HIRUDINEA	6
GASTROPODA	19
BIVALVIA	3
MALACOSTRACA	2
EPHEMEROPTERA	3
PLECOPTERA	0
ODONATA	3
MEGALOPTERA	1
HETEROPTERA	4
TRICHOPTERA	13
COLEOPTERA	10
TOTAL SPECIES	**64**

APPENDIX 5. BMWP SCORING FAMILIES RECORDED FROM THE RIVER COLNE

Group 1 (10 points)

Ephemerellidae
Phryganeidae
Leptoceridae
Molannidae
Goeridae

Group 2 (8 points)

Agriidae
Psychomyidae

Group 3 (7 points)

Caenidae
Rhyacophilidae
Polycentropodidae
Limnephilidae

Group 4 (6 points)

Neritidae
Viviparidae
Ancylidae
Hydroptilidae
Unionidae
Gammaridae
Coenagrionidae

Group 5 (5 points)

Veliidae
Hydrometridae
Gerridae
Notonectidae
Corixidae
Haliplidae
Dytiscidae
Gyrinidae
Hydrophilidae
Elmidae
Circulionidae
Hydropsychidae
Tipulidae
Simuliidae

Group 6 (4 points)

Baetidae
Piscicolidae
Sialidae

Group 7 (3 points)

Valvatidae
Hydrobiidae
Lymnaeidae
Physidae
Planorbidae
Sphaeriidae
Glossiphoniidae
Erpobdellidae
Asellidae

Group 8 (2 points)

Chironomidae

Group 9 (1 point)

Oligochaeta (whole class)

TOTAL NUMBER OF FAMILIES	46
BMWP SCORE	248
ASPT	5.4

Approximate estimates of water quality associated with BMWP values

Score	Water Quality
0 - 15	Very poor
16 - 50	Poor
51 - 100	Fair
101 - 150	Good
151 +	Very good

APPENDIX 6. ENVIRONMENTAL PARAMETERS OF THE RIVER COLNE: JULY 9TH 1991

GRID REFERENCE (top of section)	TQ 039749
GRID REFERENCE (bottom of section)	TQ 034743
GRID REFERENCE (sampling section)	TQ 038746
LONGITUDE	51.47
LATITUDE	-0.48
ALKALINITY (m.eq/l)	4.5
SUBSTRATUM %	
Silt/clay	8
Sand	12
Gravel and pebbles	80
WIDTH (m)	7
DEPTH (cm)	56
ALTITUDE (m)	20
SLOPE (m/km) (approx)	0.6

APPENDIX 7. COMPOSITION OF CORES

SPL NO.	DEPTH (mm)	%CLAY/ SILT	% SAND	% GRAVEL	% PEBBLE	SAMPLE SORTING	GRAVEL SORTING	MAX SIZE PEBBLES (mm)
CORE 1								
1	10	5	15	15	65	Poor	Poor	60
2	50	5	15	25	55	Poor	Poor	55
3	1000	5	15	30	50	Poor	Poor	50
CORE 2								
1	10	5	5	20	70	Poor	Poor	20
2	50	5	10	5	80	Poor	Poor	45
3	1000	2	8	5	85	Poor	Poor	55

SEDIMENT SIZE CATEGORIES:

Clay and silt	0.004 - 0.062mm
Sand	0.062 - 2mm
Gravel	2 - 16mm
Pebbles	16 - 64mm

APPENDIX 8. COMPOSITION OF TRANSECTS

SPL NO.	%CLAY/ SILT	% SAND	% GRAVEL	% PEBBLE	SAMPLE SORTING	GRAVEL SORTING	MAX SIZE PEBBLES (mm)	COMMENTS
TRANSECT 1								
1	20	10	10	60	Poor	Poor	30	Very silty
2	5	10	5	80	Poor	Poor	45	-
3	10	10	5	75	Poor	Poor	35	Silty
4	15	15	10	60	Poor	Poor	25	Very silty
TRANSECT 2								
1	2	8	10	80	Poor	Poor	40	-
2	10	15	10	65	Poor	Poor	25	Aquatic plant stand
3	1	4	10	85	Poor	Poor	35	-
4	20	35	20	25	Poor	Poor	20	Aquatic plant stand
TRANSECT 3								
1	2	6	12	80	Mod/Poor	Good	20	-
2	2	8	5	85	Mod/Poor	Good	45	-
3	8	12	5	75	Mod/Poor	Mod/Good	60	Aquatic plant stand
4	2	8	5	85	Poor	Poor	55	-
TRANSECT 4								
1	0	5	15	80	Poor	Poor	50	-
2	0	5	10	85	Poor	Poor	40	-
3	40	15	10	20	Poor	Poor	25	Aquatic plant stand
4	20	10	10	60	Poor	Poor	35	Some aquatic plants

APPENDIX 9. WATER DEPTHS

The average, maximum and minimum water depths recorded from 6 transects of the River Colne. (Transect locations are shown in Figure 1.)

TRANSECT NUMBER	AVERAGE WATER DEPTH (mm)	MAXIMUM WATER DEPTH (mm)	MINIMUM WATER DEPTH (mm)
1	600	850	300
2	560	750	300
3	310	400	200
4	310	450	300
5	410	500	300
6	600	750	500